LAND TITLE GUARANTEE COMPANY

Date: October 28, 2021

Subject: Attached Title Policy DILLON COMPANIES, LLC, A KANSAS LIMITED LIABILITY COMPANY for 2900 ARAPAHOE, ERIE, CO 80516

Enclosed please find the Owner's Title Insurance Policy for your purchase of the property listed above.

This title policy is the final step in your real estate transaction, and we want to take a moment to remind you of its importance. Please review all information in this document carefully and be sure to safeguard this policy along with your other legal documents.

Your owner's policy insures you as long as you own the property and requires no additional premium payments.

Please feel free to contact any member of our staff if you have questions or concerns regarding your policy, or you may contact Land Title Policy Team at (303) 850-4158 or finals@ltgc.com

As a Colorado-owned and operated title company for over 50 years, with offices throughout the state, we take pride in serving our customers one transaction at a time. We sincerely appreciate your business and welcome the opportunity to assist you with any future real estate needs. Not only will Land Title be able to provide you with the title services quickly and professionally, but you may also be entitled to a discount on title premiums if you sell or refinance the property described in the enclosed policy.

Thank you for giving us the opportunity to work with you on this transaction. We look forward to serving you again in the future.

Sincerely,

Land Title Guarantee Company

OWNER'S POLICY OF TITLE INSURANCE

ANY NOTICE OF CLAIM AND ANY OTHER NOTICE OR STATEMENT IN WRITING REQUIRED TO BE GIVEN TO THE COMPANY UNDER THIS POLICY MUST BE GIVEN TO THE COMPANY AT THE ADDRESS SHOWN IN SECTION 18 OF THE CONDITIONS.

COVERED RISKS

SUBJECT TO THE EXCLUSIONS FROM COVERAGE, THE EXCEPTIONS FROM COVERAGE CONTAINED IN SCHEDULE B AND THE CONDITIONS,OLD REPUBLIC NATIONAL TITLE INSURANCE COMPANY, a Minnesota corporation, (the "Company"), insures, as of Date of Policy and, to the extent stated in Covered Risks 9 and 10, after Date of Policy, against loss or damage, not exceeding the Amount of Insurance, sustained or incurred by the Insured by reason of:

1. Title being vested other than as stated in Schedule A.
2. Any defect in or lien or encumbrance on the title; This covered Risk includes but is not limited to insurance against loss from
    a. A defect in the Title caused by
        (i) forgery, fraud, undue influence, duress, incompetency, incapacity, or impersonation;
        (ii) failure of any person or Entity to have authorized a transfer or conveyance;
        (iii) a document affecting Title not properly created, executed, witnessed, sealed, acknowledged, notarized, or delivered;
        (iv) failure to perform those acts necessary to create a document by electronic means authorized by law;
        (v) a document executed under a falsified, expired, or otherwise invalid power of attorney;
        (vi) a document not properly filed, recorded, or indexed in the Public Records including failure to perform those acts by electronic means authorized by law; or
        (vii) a defective judicial or administrative proceeding.
    b. The lien of real estate taxes or assessments imposed on the Title by a governmental authority due or payable, but unpaid.
    c. Any encroachment, encumbrance, violation, variation, or adverse circumstance affecting the Title that would be disclosed by an accurate and complete land survey of the Land. The term "encroachment" includes encroachments of existing improvements located on the Land onto adjoining land, and encroachments onto the Land of existing improvements located on adjoining land.
3. Unmarketable Title.
4. No right of access to and from the Land.
5. The violation or enforcement of any law, ordinance, permit, or governmental regulation (including those relating to building and zoning) restricting, regulating, prohibiting, or relating to
    (a) the occupancy, use or enjoyment of the Land;
    (b) the character, dimensions, or location of any improvement erected on the Land;
    (c) the subdivision of land; or
    (d) environmental protection

    if a notice, describing any part of the Land, is recorded in the Public Records setting forth the violation or intention to enforce, but only to the extent of the violation or enforcement referred to in that notice.
6. An enforcement action based on the exercise of a governmental police power not covered by Covered Risk 5 if a notice of the enforcement action, describing any part of the Land, is recorded in the Public Records, but only to the extent of the enforcement referred to in that notice.
7. The exercise of the rights of eminent domain if a notice of the exercise, describing any part of the Land, is recorded in the Public Records.
8. Any taking by a governmental body that has occurred and is binding on the rights of a purchaser for value without Knowledge.
9. Title being vested other than as stated in Schedule A or being defective
    (a) as a result of the avoidance in whole or in part, or from a court order providing an alternative remedy, of a transfer of all or any part of the title to or any interest in the Land occurring prior to the transaction vesting Title as shown in Schedule A because that prior transfer constituted a fraudulent or preferential transfer under federal bankruptcy, state insolvency, or similar creditors' rights laws; or
    (b) because the instrument of transfer vesting Title as shown in Schedule A constitutes a preferential transfer under federal bankruptcy, state insolvency, or similar creditors' rights laws by reason of the failure of its recording in the Public Records
        (i) to be timely, or
        (ii) to impart notice of its existence to a purchaser for value or to a judgment or lien creditor.
10. Any defect in or lien or encumbrance on the Title or other matter included in Covered Risks 1 through 9 that has been created or attached or has been filed or recorded in the Public Records subsequent to Date of Policy and prior to the recording of the deed or other instrument of transfer in the Public Records that vests Title as shown in Schedule A. The Company will also pay the costs, attorneys' fees, and expenses incurred in defense of any matter insured against by this Policy, but only to the extent provided in the Conditions.

Issued by:
Land Title Guarantee Company
3033 East First Avenue Suite 600
Denver, Colorado 80206
303-321-1880

Craig B. Rants, Senior Vice President

OLD REPUBLIC NATIONAL TITLE INSURANCE COMPANY
A Stock Company
400 Second Avenue South, Minneapolis, Minnesota 55401
(612) 371-1111

By _____ President
Attest _____ Secretary

AMERICAN LAND TITLE ASSOCIATION

AMERICAN LAND TITLE ASSOCIATION OWNER'S POLICY Adopted 6-17-06

EXCLUSIONS FROM COVERAGE

The following matters are expressly excluded from the coverage of this policy, and the Company will not pay loss or damage, costs, attorneys' fees, or expenses that arise by reason of:

(1)(a) Any law, ordinance, permit, or governmental regulation (including those relating to building and zoning) restricting, regulating, prohibiting or relating to
- (i) the occupancy, use, or enjoyment of the Land;
- (ii) the character, dimensions, or location of any improvement erected on the Land;
- (iii) the subdivision of land; or
- (iv) environmental protection; or the effect of any violation of these laws, ordinances, or governmental regulations. This Exclusion 1(a) does not modify or limit the coverage provided under Covered Risk 5. (b) Any governmental police power. This Exclusion 1(b) does not modify or limit the coverage provided under Covered Risk 6.

(2) Rights of eminent domain. This Exclusion does not modify or limit the coverage provided under Covered Risk 7 or 8.

(3) Defects, liens, encumbrances, adverse claims, or other matters
- (a) created, suffered, assumed, or agreed to by the Insured Claimant;
- (b) not Known to the Company, not recorded in the Public Records at Date of Policy, but Known to the Insured Claimant and not disclosed in writing to the Company by the Insured Claimant prior to the date the Insured Claimant became an Insured under this policy;
- (c) resulting in no loss or damage to the Insured Claimant;
- (d) attaching or created subsequent to Date of Policy (however, this does not modify or limit the coverage provided under Covered Risk 9 and 10); or
- (e) resulting in loss or damage that would not have been sustained if the Insured Claimant had paid value for the Title.

(4) Any claim, by reason of the operation of federal bankruptcy, state insolvency, or similar creditors' rights laws, that the transaction vesting the Title as shown in Schedule A, is
- (a) a fraudulent conveyance or fraudulent transfer; or
- (b) a preferential transfer for any reason not stated in Covered Risk 9 of this policy.

(5) Any lien on the Title for real estate taxes or assessments imposed by governmental authority and created or attaching between Date of Policy and the date of recording of the deed or other instrument of transfer in the Public Records that vests Title as shown in Schedule A.

CONDITIONS

1. DEFINITION OF TERMS

The following terms when used in this policy mean:

(a) "Amount of Insurance": The amount stated in Schedule A, as may be increased or decreased by endorsement to this policy, increased by Section 8(b) or decreased by Sections 10 and 11 of these Conditions.

(b) "Date of Policy": The date designated as "Date of Policy" in Schedule A.

(c) "Entity": A corporation, partnership, trust, limited liability company, or other similar legal entity.

(d) "Insured": The Insured named in Schedule A.
- (i) The term "Insured" also includes
  - (A) successors to the Title of the Insured by operation of law as distinguished from purchase, including heirs, devisees, survivors, personal representatives, or next of kin;
  - (B) successors to an Insured by dissolution, merger, consolidation, distribution, or reorganization;
  - (C) successors to an Insured by its conversion to another kind of Entity;
  - (D) a grantee of an Insured under a deed delivered without payment of actual valuable consideration conveying the Title
  - (1) if the stock, shares, memberships, or other equity interests of the grantee are wholly-owned by the named Insured.
  - (2) if the grantee wholly owns the named Insured,
  - (3) if the grantee is wholly-owned by an affiliated Entity of the named Insured, provided the affiliated Entity and the named Insured are both wholly-owned by the same person or Entity, or
  - (4) if the grantee is a trustee or beneficiary of a trust created by a written instrument established by the Insured named in Schedule A for estate planning purposes
- (ii) With regard to (A), (B), (C), and (D) reserving, however, all rights and defensed as to any successor that the Company would have had against any predecessor Insured.

(e) "Insured Claimant": An Insured claiming loss or damage.

(f) "Knowledge" or "Known": Actual knowledge, not constructive knowledge or notice that may be imputed to an Insured by reason of the Public Records or any other records that impart constructive notice of matters affecting the Title.

(g) "Land": The land described in Schedule A, and affixed improvements that by law constitute real property. The term "Land" does not include any property beyond the lines of the area described in Schedule A, nor any right, title, interest, estate, or easement in abutting streets, roads, avenue, alleys, lanes, ways, or waterways, but this does not modify or limit the extent that a right of access to and from the Land is insured by this policy.

(h) "Mortgage": Mortgage, deed of trust, trust deed, or other security instrument, including one evidenced by electronic means authorized by law.

(i) "Public Records": Records established under state statutes at Date of Policy for the purpose of imparting constructive notice of matters relating to real property to purchasers for value and without Knowledge. With respect to Covered Risk 5(d), "Public Records" shall also include environmental protection liens filed in the records of the clerk of the United States District Court for the district where the Land is located.

(j) "Title": The estate or interest described in Schedule A. "Unmarketable Title": Title affected by an alleged or apparent matter that would permit a prospective purchaser or lessee of the Title or lender on the Title to be released from the obligation to purchase, lease, or lend if there is a contractual condition requiring the delivery of marketable title.

2. CONTINUATION OF INSURANCE

The coverage of this policy shall continue in force as of Date of Policy in favor of an Insured, but only so long as the Insured retains an estate or interest in the Land, or holds an obligation secured by a purchase money Mortgage given by a purchaser from the Insured, or only so long as the Insured shall have liability by reason of warranties in any transfer or conveyance of the Title. This policy shall not continue in force in favor of any purchaser from the Insured of either (i) an estate or interest in the Land, or (ii) an obligation secured by a purchase money Mortgage given to the Insured.

3. NOTICE OF CLAIM TO BE GIVEN BY INSURED CLAIMANT

The Insured shall notify the Company promptly in writing (i) in case of any litigation as set forth in Section 5(a) of these Conditions, (ii) in case Knowledge shall come to an Insured hereunder of any claim of title or interest that is adverse to the Title, as insured, and that might cause loss or damage for which the Company may be

liable by virtue of this policy, or (iii) if the Title, as insured, is rejected as Unmarketable Title. If the Company is prejudiced by the failure of the Insured Claimant to provide prompt notice, the Company's liability to the Insured Claimant under the policy shall be reduced to the extent of the prejudice.

4. PROOF OF LOSS

In the event the Company is unable to determine the amount of loss or damage, the Company may, at its option, require as a condition of payment that the Insured Claimant furnish a signed proof of loss. The proof of loss must describe the defect, lien, encumbrance, or other matter insured against by this policy that constitutes the basis of loss or damage and shall state, to the extent possible, the basis of calculating the amount of the loss or damage.

5. DEFENSE AND PROSECUTION OF ACTIONS

(a) Upon written request by the Insured, and subject to the options contained in Section 7 of these Conditions, the Company, at its own cost and without unreasonable delay, shall provide for the defense of an Insured in litigation in which any third party asserts a claim covered by this policy adverse to the Insured. This obligation is limited to only those stated causes of action alleging matters insured against by this policy. The Company shall have the right to select counsel of its choice (subject to the right of the Insured to object for reasonable cause) to represent the Insured as to those stated causes of action. It shall not be liable for and will not pay the fees of any other counsel. The Company will not pay any fees, costs, or expenses incurred by the Insured in the defense of those causes of action that allege matters not insured against by this policy.

(b) The Company shall have the right, in addition to the options contained in Section 7 of these Conditions, at its own cost, to institute and prosecute any action or proceeding or to do any other act that in its opinion may be necessary or desirable to establish the Title, as insured, or to prevent or reduce loss or damage to the Insured. The Company may take any appropriate action under the terms of this policy, whether or not it shall be liable to the Insured. The exercise of these rights shall not be an admission of liability or waiver of any provision of this policy. If the Company exercises its rights under this subsection, it must do so diligently.

(c) Whenever the Company brings an action or asserts a defense as required or permitted by this policy, the Company may pursue the litigation to a final determination by a court of competent jurisdiction, and it expressly reserves the right, in its sole discretion, to appeal any adverse judgment or order.

6. DUTY OF INSURED CLAIMANT TO COOPERATE

(a) In all cases where this policy permits or requires the Company to prosecute or provide for the defense of any action or proceeding and any appeals, the Insured shall secure to the Company the right to so prosecute or provide defense in the action or proceeding, including the right to use, at its option, the name of the Insured for this purpose. Whenever requested by the Company, the Insured, at the Company's expense, shall give the Company all reasonable aid (i) in securing evidence, obtaining witnesses, prosecuting or defending the action or proceeding, or effecting settlement, and (ii) in any other lawful act that in the opinion of the Company may be necessary or desirable to establish the Title or any other matter as insured. If the Company is prejudiced by the failure of the Insured to furnish the required cooperation, the Company's obligation to the Insured under the policy shall terminate, including any liability or obligation to defend, prosecute, or continue any litigation, with regard to the matter or matters requiring such cooperation.

(b) The Company may reasonably require the Insured Claimant to submit to examination under oath by any authorized representative of the Company and to produce for examination, inspection, and copying, at such reasonable times and places as may be designated by the authorized representative of the Company, all records, in whatever medium maintained, including books, ledgers, checks, memoranda, correspondence, reports, e-mails, disks, tapes, and videos whether bearing a date before or after Date of Policy, that reasonably pertain to the loss or damage. Further, if requested by any authorized representative of the Company, the Insured Claimant shall grant its permission, in writing, for any authorized representative of the Company to examine, inspect, and copy all of these records in the custody or control of a third party that reasonably pertain to the loss or damage. All information designated as confidential by the Insured Claimant provided to the Company pursuant to this Section shall not be disclosed to others unless, in the reasonable judgment of the Company, it is necessary in the administration of the claim. Failure of the Insured Claimant to submit for examination under oath produce any reasonably requested information, or grant permission to secure reasonably necessary information from third parties as required in this subsection, unless prohibited by law or governmental regulation, shall terminate any liability of the Company under this policy as to that claim.

7. OPTIONS TO PAY OR OTHERWISE SETTLE CLAIMS; TERMINATION OF LIABILITY

In case of a claim under this policy, the Company shall have the following additional options:

(a) To Pay or Tender Payment of the Amount of Insurance. To pay or tender payment of the Amount of Insurance under this policy together with any costs, attorneys' fees, and expenses incurred by the Insured Claimant that were authorized by the Company up to the time of payment or tender of payment and that the Company is obligated to pay. Upon the exercise by the Company of this option, all liability and obligations of the Company to the Insured under this policy, other than to make the payment required in the subsection, shall terminate, including any liability or obligation to defend, prosecute, or continue any litigation.

(b) To Pay or Otherwise Settle With Parties Other Than the Insured or With the Insured Claimant.

(i) To pay or otherwise settle with other parties for or in the name of an Insured Claimant any claim insured against under this policy. In addition, the Company will pay any costs, attorneys' fees, and expenses incurred by the Insured Claimant that were authorized by the Company up to the time of payment and that the Company is obligated to pay; or

(ii) To pay or otherwise settle with the Insured Claimant the loss or damage provided for under this policy, together with any costs, attorneys' fees, and expensed incurred by the Insured Claimant that were authorized by the Company up to the time of payment and that the Company is obligated to pay. Upon the exercise by the Company of either of the options provided for in subsections (b)(i) or (ii), the Company's obligations to the Insured under this policy for the claimed loss or damage, other than the payments required to be made, shall terminate, including any liability or obligation to defend, prosecute, or continue any litigation.

8. DETERMINATION AND EXTENT OF LIABILITY

This policy is a contract of indemnity against actual monetary loss or damage sustained or incurred by the Insured Claimant who has suffered loss or damage by reason of matters insured against by this policy.

(a) The extent of liability of the Company for loss or damage under this policy shall not exceed the lesser of

(i) the Amount of Insurance; or

(ii) the difference between the value of the Title as insured and the value of the Title subject to the risk insured against by this policy.

(b) If the Company pursues its rights under Section 5 of these Conditions and is unsuccessful in establishing the Title, as insured,

(i) the Amount of Insurance shall be increased by 10%, and
(ii) the Insured Claimant shall have the right to have the loss or damage determined either as of the date the claim was made by the Insured Claimant or as of the date it is settled and paid.

(c) In addition to the extent of liability under (a) and (b), the Company will also pay those costs, attorneys' fees, and expenses incurred in accordance with Sections 5 and 7 of these Conditions.

9. LIMITATION OF LIABILITY

(a) If the Company establishes the Title, or removes the alleged defect, lien, or encumbrance, or cures the lack of a right of access to or from the Land, or cures the claim of Unmarketable Title, all as insured, in a reasonably diligent manner by any method, including litigation and the completion of any appeals, it shall have fully performed its obligations with respect to that matter and shall not be liable for any loss or damage caused to the Insured.

(b) In the event of any litigation, including litigation by the Company or with the Company's consent, the Company shall have no liability for loss or damage until there has been a final determination by a court of competent jurisdiction, and disposition of all appeals, adverse to the Title, as insured.

(c) The Company shall not be liable for loss or damage to the Insured for liability voluntarily assumed by the Insured in settling any claim or suit without the prior written consent of the Company.

10. REDUCTION OF INSURANCE; REDUCTION OR TERMINATION OF LIABILITY

All payments under this policy, except payments made for costs, attorneys' fees, and expenses, shall reduce the Amount of Insurance by the amount of the payment.

11. LIABILITY NONCUMULATIVE

The Amount of Insurance shall be reduced by any amount the Company pays under any policy insuring a Mortgage to which exception is taken in Schedule B or to which the Insured has agreed, assumed, or taken subject, or which is executed by an Insured after Date of Policy and which is a charge or lien on the Title, and the amount so paid shall be deemed a payment to the Insured under this policy.

12. PAYMENT OF LOSS

When liability and the extent of loss or damage have been definitely fixed in accordance with these Conditions, the payment shall be made within 30 days.

13. RIGHTS OF RECOVERY UPON PAYMENT OR SETTLEMENT

(a) Whenever the Company shall have settled and paid a claim under this policy, it shall be subrogated and entitled to the rights of the Insured Claimant in the Title and all other rights and remedies in respect to the claim that the Insured Claimant has against any person or property, to the extent of the amount of any loss, costs, attorneys' fees, and expenses paid by the Company. If requested by the Company, the Insured Claimant shall execute documents to evidence the transfer to the Company of these rights and remedies. The Insured Claimant shall permit the Company to sue, compromise, or settle in the name of the Insured Claimant and to use the name of the Insured Claimant in any transaction or litigation involving these rights and remedies. If a payment on account of a claim does not fully cover the loss of the Insured Claimant, the Company shall defer the exercise of its right to recover until after the Insured Claimant shall have recovered its loss.

(b) The Company's right of subrogation includes the rights of the Insured to indemnities, guaranties, other policies of insurance, or bonds, notwithstanding any terms or conditions contained in those instruments that address subrogation rights.

14. ARBITRATION

Either the Company or the Insured may demand that the claim or controversy shall be submitted to arbitration pursuant to the Title Insurance Arbitration Rules of the American Land Title Association ("Rules"). Except as provided in the Rules, there shall be no joinder or consolidation with claims or controversies of other persons, Arbitrable matters may include, but are not limited to, any controversy or claim between the Company and the Insured arising out of or relating to this policy, any service in connection with its issuance or the breach of a policy provision, or to any other controversy or claim arising out of the transaction giving rise to this policy. All arbitrable matters when the Amount of Insurance is $2,000,000 or less shall be arbitrated at the option of either the Company or the Insured. All arbitrable matters when the Amount of Insurance is in excess of $2,000,000 shall be arbitrated only when agreed to by both the Company and the Insured. Arbitration pursuant to this policy and under the Rules shall be binding upon the parties. Judgment upon the award rendered by the Arbitrator(s) may be entered in any court of competent jurisdiction.

15. LIABILITY LIMITED TO THIS POLICY; POLICY ENTIRE CONTRACT

(a) This policy together with all endorsements, if any, attached to it by the Company is the entire policy and contract between the Insured and the Company. In interpreting any provision of this policy, this policy shall be construed as a whole.

(b) Any claim or loss or damage that arises out of the status of the Title or by any action asserting such claim shall be restricted to this policy.

(c) Any amendment of or endorsement to this policy must be in writing and authenticated by an authorized person, or expressly incorporated by Schedule A of this policy.

(d) Each endorsement to this policy issued at any time is made a part of this policy and is subject to all of its terms and provisions. Except as the endorsement expressly states, it does not (i) modify any of the terms and provisions of the policy, (ii) modify any prior endorsement, (iii) extend the Date of Policy, or (iv) increase the Amount of Insurance.

16. SEVERABILITY

In the event any provision of this policy, in whole or in part, is held invalid or unenforceable under applicable law, the policy shall be deemed not to include that provision or such part held to be invalid, but all other provisions shall remain in full force and effect.

17. CHOICE OF LAW; FORUM

(a) Choice of Law; The Insured acknowledges the Company has underwritten the risks covered by this policy and determined the premium charged therefor in reliance upon the law affecting interests in real property and applicable to the interpretation, rights, remedies, or enforcement of policies of title insurance of the jurisdiction where the Land is located. Therefore, the court or an arbitrator shall apply the law of the jurisdiction where the Land is located to determine the validity of claims against the Title that are adverse to the Insured and to interpret and enforce the terms of this policy. In neither case shall the court or arbitrator apply its conflicts of law principles to determine the applicable law.

(b) Choice of Forum; Any litigation or other proceeding brought by the Insured against the Company must be filed only in a state or federal court within the United States of America or its territories having appropriate jurisdiction.

18. NOTICES, WHERE SENT

Any notice of claim and any other notice or statement in writing required to be given to the Company under this policy must be given to the Company at: 400 Second Avenue South, Minneapolis, Minnesota 55401 (612)371-1111.

ANTI-FRAUD STATEMENT: Pursuant to CRS 10-1-128(6)(a), it is unlawful to knowingly provide false, incomplete, or misleading facts or information to an insurance company for the purpose of defrauding or attempting to defraud the company. Penalties may include imprisonment, fines, denial of insurance and civil damages. Any insurance company or agent of an insurance company who knowingly provides false, incomplete, or misleading facts or information to a policyholder or claimant for the purpose of defrauding or attempting to defraud the policyholder or claimant with regard to a settlement or award payable from insurance proceeds shall be reported to the Colorado division of insurance within the department of regulatory agencies.

This anti-fraud statement is affixed to and made a part of this policy.

Old Republic National Title Insurance Company

Schedule A

Order Number: ABZ70707001 **Policy No.:** OX70707001.8489806

Amount of Insurance: $3,162,815.50

Property Address:

2900 ARAPAHOE, ERIE, CO 80516

1. Policy Date:

October 18, 2021 at 5:00 P.M.

2. Name of Insured:

DILLON COMPANIES, LLC, A KANSAS LIMITED LIABILITY COMPANY

3. The estate or interest in the Land described in this Schedule and which is covered by this policy is:

A Fee Simple as to Parcel I; An Easement Interest as to Parcel II

4. Title to the estate or interest covered by this policy at the date is vested in:

DILLON COMPANIES, LLC, A KANSAS LIMITED LIABILITY COMPANY

5. The Land referred to in this Policy is described as follows:

PARCEL I:

LOT 10,
NINE MILE CORNER AMENDMENT NO. 1, THE PLAT OF WHICH WAS RECORDED FEBRUARY 25, 2021 UNDER RECEPTION NO. **03862483**, COUNTY OF BOULDER, STATE OF COLORADO.

PARCEL II:

THOSE BENEFICIAL EASEMENTS SET FORTH AND CREATED IN INSTRUMENT ENTITLED EASEMENTS COVENANTS, CONDITIONS AND RESTRICTIONS RECORDED OCTOBER 1, 2020 AT RECEPTION NO. **03820570**, AS AMENDED AND RESTATED IN INSTRUMENT RECORDED OCTOBER 18, 2021 UNDER RECEPTION NO. **03921451**, IN THE RECORDS OF THE COUNTY OF BOULDER, STATE OF COLORADO

AMERICAN LAND TITLE ASSOCIATION

Old Republic National Title Insurance Company

(Schedule B)

Order Number: ABZ70707001 **Policy No.:** OX70707001.8489806

This policy does not insure against loss or damage by reason of the following:

1. **Any facts, rights, interests, or claims thereof, not shown by the Public Records but that could be ascertained by an inspection of the Land or that may be asserted by persons in possession of the Land.**
2. **Easements, liens or encumbrances, or claims thereof, not shown by the Public Records.**
3. **Any encroachment, encumbrance, violation, variation, or adverse circumstance affecting the Title that would be disclosed by an accurate and complete land survey of the Land and not shown by the Public Records.**
4. **Any lien, or right to a lien, for services, labor or material heretofore or hereafter furnished, imposed by law and not shown by the Public Records.**
5. **(a) Unpatented mining claims; (b) reservations or exceptions in patents or in Acts authorizing the issuance thereof; (c) water rights, claims or title to water.**

   *** ITEM NOS. 1 THROUGH 3 AND 5(A) AND 5(B) OF THE ABOVE STANDARD EXCEPTIONS ARE HEREBY DELETED.

   *** ITEM NO. 4 OF THE STANDARD EXCEPTIONS IS DELETED AS TO ANY LIENS OR FUTURE LIENS RESULTING FROM WORK OR MATERIAL CONTRACTED FOR OR FURNISHED AT THE SPECIFIC, DIRECT REQUEST, AND WITH THE ACTUAL KNOWLEDGE OF EVERGREEN-287 & ARAPAHOE, L.L.C., AN ARIZONA LIMITED LIABILITY COMPANY..
   OLD REPUBLIC NATIONAL TITLE INSURANCE COMPANY SHALL HAVE NO LIABILITY FOR ANY LIENS ARISING FROM WORK OR MATERIAL FURNISHED AT THE SPECIFIC, DIRECT REQUEST, AND WITH THE ACTUAL KNOWLEDGE OF DILLON COMPANIES, LLC, A KANSAS LIMITED LIABILITY COMPANY.

6. TAXES AND ASSESSMENTS FOR THE YEAR 2021 AND SUBSEQUENT YEARS, A LIEN NOT YET DUE AND PAYABLE.
7. ALL COAL THAT MAY BE UNDERNEATH THE SURFACE OF THE LAND, AND THE EXCLUSIVE RIGHT TO PROSPECT, SINK SHAFT OR SHAFTS AND MINE FOR THE SAME; ALSO RESERVING SUCH RIGHT OF WAY AND OTHER GROUNDS AS MAY BE NECESSARY FOR THE PROPER WORKING OF ANY COAL MINE THAT MAY BE DEVELOPED UPON SAID PREMISES AND FOR THE TRANSPORTATION OF COAL FROM THE SAME, AS RESERVED UNTO THE COLORADO MORTGAGE AND INVESTMENT CO., LTD., A CORPORATION ORGANIZED AND EXISTING UNDER THE LAWS OF GREAT BRITAIN AND IRELAND; ANDREW WHITTON; JAMES GUTHRIE; AND ALEXANDER GOURLAY IN THE DEED RECORDED OCTOBER 18, 1901 IN BOOK 249 AT PAGE **209**, AND ANY AND ALL ASSIGNMENTS THEREOF OR INTERESTS THEREIN.

   NOTE: MINERAL DEED RECORDED FEBRUARY 27, 1907 IN BOOK 296 AT PAGE **299**.

   NOTE: MINERAL DEED RECORDED SEPTEMBER 11, 1929 IN BOOK 566 AT PAGE **360**.

   (AFFECTS PORTION OF SECTION 34)

8. ALL COAL OR OTHER MINERALS THAT MAY BE UNDERNEATH THE SURFACE OF THE LAND; AND THE EXCLUSIVE RIGHT TO PROSPECT, SINK SHAFT OR SHAFTS, AND MINE FOR THE SAME, AS RESERVED UNTO THE COLORADO MORTGAGE & INVESTMENT COMPANY, LIMITED, A CORPORATION ORGANIZED AND EXISTING UNDER THE LAWS OF GREAT BRITAIN AND IRELAND; ANDREW WHITTON; JAMES GUTHRIE; AND ALEXANDER GOURLEY IN THE DEED RECORDED JANUARY 21, 1904 IN BOOK 251 AT PAGE **460**, AND ANY AND ALL ASSIGNMENTS THEREOF OR INTERESTS THEREIN.

   (AFFECTS PORTION OF SECTION 34)

Old Republic National Title Insurance Company

(Schedule B)

Order Number: ABZ70707001 **Policy No.:** OX70707001.8489806

9. AN UNDIVIDED ONE-HALF INTEREST IN THE COAL AND OTHER MINERALS LYING UNDERNEATH THE SURFACE OF THE LAND AS CONVEYED TO GEORGE MURRAY, EDWARD E. HOLMES AND ALFRED N. GOSSETT BY THE DEED RECORDED FEBRUARY 27, 1907 IN BOOK 296 AT PAGE **299**.

   (AFFECTS PORTION OF SECTION 34)

10. ALL COAL AND OTHER MINERALS UNDERNEATH THE SURFACE OF THE LAND, AND THE EXCLUSIVE RIGHT TO PROSPECT, SINK SHAFT OR SHAFTS, AND MINE FOR THE SAME; ALSO RESERVING SUCH RIGHT OF WAY AND OTHER GROUNDS AS MAY BE NECESSARY FOR THE PROPER WORKING OF ANY COAL OR OTHER MINE OR MINES THAT MAY BE DEVELOPED UPON SAID PREMISES AND FOR THE TRANSPORTATION OF THE PRODUCTS THEREFROM, AND FOR SUCH SURFACE AREA SO REQUIRED, AS RESERVED UNTO THE COLORADO MORTGAGE AND INVESTMENT COMPANY, LIMITED, A CORPORATION ORGANIZED AND EXISTING UNDER THE LAWS OF GREAT BRITAIN AND IRELAND; ANDREW WHITTON; JAMES GUTHRIE; AND ALEXANDER GOURLAY IN THE DEED RECORDED JANUARY 15, 1910 IN BOOK 340 AT PAGE **259**, AND ANY AND ALL ASSIGNMENTS THEREOF OR INTERESTS THEREIN.

    (AFFECTS PORTION OF SECTION 34)

11. AN UNDIVIDED 2½% INTEREST IN AND TO ALL THE OIL AND GAS IN AND UNDER AND THAT MAY BE PRODUCED FROM THE LAND, AS CONVEYED TO ROY R. CARPENTER BY THE DEED RECORDED JULY 22, 1924 IN BOOK 511 AT PAGE **168**, AND ANY AND ALL ASSIGNMENTS THEREOF OR INTERESTS THEREIN.

    (AFFECTS SECTIONS 34 AND 27)

12. OIL AND GAS LEASE BETWEEN ROY N. AUSTIN, LESSOR, AND O.D. PRESLEY, LESSEE, RECORDED MAY 06, 1985 UNDER RECEPTION NO. **686626**, AND ANY AND ALL ASSIGNMENTS THEREOF, OR INTEREST THEREIN.

    NOTE: AFFIDAVIT OF PRODUCTION RECORDED JULY 30, 1985 UNDER RECEPTION NO. **702639**. REVISED AFFIDAVIT OF PRODUCTION RECORDED APRIL 21, 1986 UNDER RECEPTION NO. **754068** AND RECORDED JUNE 12, 1986 UNDER RECEPTION NO. **766082**.

13. OIL AND GAS LEASE BETWEEN JANE KUEHNER, MARY F. DEHAAN, MICHAEL R. SHELTON, MARK L. SHELTON, BRUCE D. CARPENTER, JEAN K. CARPENTER, GLENN C. CARPENTER AND SARAH A. CARPENTER, LESSORS, AND O.D. PRESLEY, LESSEE, RECORDED AUGUST 06, 1985 UNDER RECEPTION NO. **703693**, AND ANY AND ALL ASSIGNMENTS THEREOF, OR INTEREST THEREIN.

    NOTE: REVISED AFFIDAVIT OF PRODUCTION RECORDED APRIL 21, 1986 UNDER RECEPTION NO. **754068** AND RECORDED JUNE 12, 1986 UNDER RECEPTION NO. **766082**.

    NOTE: RATIFICATIONS OF OIL AND GAS LEASE RECORDED JUNE 12, 1986 UNDER RECEPTION NOS. **766084**, **766085** AND **766086**.

14. OIL AND GAS LEASE BETWEEN CLAUDE JONES AND ALINE JONES, LESSORS, AND O.D. PRESLEY, LESSEE, RECORDED AUGUST 06, 1985 UNDER RECEPTION NO. **703694**, AND ANY AND ALL ASSIGNMENTS THEREOF, OR INTEREST THEREIN.

    NOTE: REVISED AFFIDAVIT OF PRODUCTION RECORDED APRIL 21, 1986 UNDER RECEPTION NO. **754068** AND RECORDED JUNE 12, 1986 UNDER RECEPTION NO. **766082**.

15. OIL AND GAS LEASE BETWEEN WINNIFRED H. EWALT, LESSOR, AND O.D. PRESLEY, LESSEE, RECORDED OCTOBER 08, 1985 UNDER RECEPTION NO. **717948**, AND ANY AND ALL ASSIGNMENTS THEREOF, OR INTEREST THEREIN.

Old Republic National Title Insurance Company

(Schedule B)

Order Number: ABZ70707001 **Policy No.:** OX70707001.8489806

NOTE: REVISED AFFIDAVIT OF PRODUCTION RECORDED APRIL 21, 1986 UNDER RECEPTION NO. 754068 AND RECORDED JUNE 12, 1986 UNDER RECEPTION NO. 766082.

NOTE: RATIFICATION OF OIL AND GAS LEASE RECORDED JUNE 12, 1986 UNDER RECEPTION NO. 766083.

16. OIL AND GAS LEASE BETWEEN JAY P. WALKER, LESSOR, AND O.D. PRESLEY, LESSEE, RECORDED JULY 09, 1986 UNDER RECEPTION NO. 772253, AND ANY AND ALL ASSIGNMENTS THEREOF, OR INTEREST THEREIN.

17. MINERAL DEED RECORDED MARCH 5, 1992 UNDER RECEPTION NO. 1165768.

18. OIL AND GAS LEASE BETWEEN PAUL K. LASNIK, LESSOR, AND MARTIN EXPLORATION MANAGEMENT COMPANY, LESSEE, RECORDED MARCH 17, 1992 UNDER RECEPTION NO. 1168168, AND ANY AND ALL ASSIGNMENTS THEREOF, OR INTEREST THEREIN.

19. OIL AND GAS LEASE BETWEEN HELEN M. MASTRIONA AND FRANK M. MASTRIONA, LESSORS, AND MARTIN EXPLORATION MANAGEMENT COMPANY, LESSEE, RECORDED MARCH 24, 1992 UNDER RECEPTION NO. 1169721, AND ANY AND ALL ASSIGNMENTS THEREOF, OR INTEREST THEREIN.

20. OIL AND GAS LEASE BETWEEN DOROTHY J. BLACKBURN AND JOSEPH BLACKBURN, LESSORS, AND MARTIN EXPLORATION MANAGEMENT COMPANY, LESSEE, RECORDED MARCH 24, 1992 UNDER RECEPTION NO. 1169722, AND ANY AND ALL ASSIGNMENTS THEREOF, OR INTEREST THEREIN.

21. OIL AND GAS LEASE BETWEEN DOLORES T. FORBIS AND DERL D. FORBIS, LESSORS, AND MARTIN EXPLORATION MANAGEMENT COMPANY, LESSEE, RECORDED MARCH 30, 1992 UNDER RECEPTION NO. 1171195, AND ANY AND ALL ASSIGNMENTS THEREOF, OR INTEREST THEREIN.

22. OIL AND GAS LEASE BETWEEN MARTIN EXPLORATION MANAGEMENT COMPANY, LESSOR, AND BASIN EXPLORATION INCORPORATED, LESSEE, RECORDED NOVEMBER 08, 1993 UNDER RECEPTION NO. 1358710, AND ANY AND ALL ASSIGNMENTS THEREOF, OR INTEREST THEREIN.

    NOTE: NOTICE OF OIL AND GAS INTERESTS AND SURFACE USE IN CONNECTION WITH THE ABOVE LEASE RECORDED JANUARY 23, 2001 UNDER RECEPTION NO. 2112332.

23. RESOLUTION #94-25, PERTAINING TO ANNEXATION, RECORDED NOVEMBER 9, 1994 UNDER RECEPTION NO. 1477392 AND MAP IN CONNECTION THEREWITH RECORDED NOVEMBER 9, 1994 UNDER RECEPTION NO. 1477393.

24. RESOLUTION #05-2015, PERTAINING TO ANNEXATION, RECORDED APRIL 21, 2015 UNDER RECEPTION NO. 3440934 AND MAP IN CONNECTION THEREWITH RECORDED APRIL 21, 2015 UNDER RECEPTION NO. 3440932.

25. TERMS, CONDITIONS, PROVISIONS, BURDENS AND OBLIGATIONS AS SET FORTH IN APPROVED NINE MILE CORNER PD-DEVELOPMENT PLAN RECORDED SEPTEMBER 26, 2017 UNDER RECEPTION NO. 03616633, AND ORDINANCE NO. 16-2017 IN CONNECTION THEREWITH RECORDED SEPTEMBER 26, 2017 UNDER RECEPTION NO. 03616632,
    AND NINE MILE CORNER PD-DP AMENDMENT NO. 1 RECORDED MAY 4, 2020 UNDER RECEPTION NO. 03781994.

26. ANY TAX, LIEN, FEE, OR ASSESSMENT BY REASON OF INCLUSION OF SUBJECT PROPERTY IN THE NINE MILE METROPOLITAN DISTRICT, AS EVIDENCED IN ORDER OF ORGANIZATION OF NINE MILE METROPOLITAN DISTRICT RECORDED FEBRUARY 4, 2020 UNDER RECEPTION NO. 03764280 AND IN SPECIAL DISTRICT PUBLIC DISCLOSURE DOCUMENT RECORDED FEBRUARY 04, 2020, UNDER RECEPTION NO. 03764281.

Old Republic National Title Insurance Company

(Schedule B)

Order Number: ABZ70707001 **Policy No.:** OX70707001.8489806

27. TERMS, CONDITIONS, PROVISIONS, BURDENS AND OBLIGATIONS AS SET FORTH IN DITCH EASEMENT RELOCATION AGREEMENT RECORDED MARCH 10, 2020 UNDER RECEPTION NO. **03771070** AND FIRST AMENDMENT THERETO RECORDED MARCH 10, 2020 UNDER RECEPTION NO. **03771071**.

    NOTE FOR CHAIN OF TITLE PURPOSES:
    EASEMENT DEED IN CONNECTION THEREWITH RECORDED MARCH 30, 2020 UNDER RECEPTION NO. **03774838**.
    TERMINATION OF PRESCRIPTIVE EASEMENT WAS RECORDED APRIL 15, 2020 UNDER RECEPTION NO. **03777748**.
    EASEMENT AND QUIT CLAIM DEED REGARDING STARR PROPERTY WAS RECORDED APRIL 15, 2020 UNDER RECEPTION NOS. **03777746** AND **03777747**.

28. TERMS, CONDITIONS AND PROVISIONS OF REQLINQUISHMENT AND QUIT CLAIM OF SURFACE RIGHTS RECORDED OCTOBER 01, 2020 UNDER RECEPTION NO. **03820447**.

29. TERMS, CONDITIONS, PROVISIONS, BURDENS AND OBLIGATIONS AS SET FORTH IN DEVELOPMENT AGREEMENT RECORDED OCTOBER 01, 2020 UNDER RECEPTION NO. **03820448**.

30. TERMS, CONDITIONS, PROVISIONS, BURDENS, OBLIGATIONS AND EASEMENTS AS SET FORTH AND GRANTED IN TEMPORARY CONSTRUCTION EASEMENT (LOT 10) RECORDED OCTOBER 01, 2020 UNDER RECEPTION NO. **03820449**.

    NOTE: THE ABOVE ITEM WILL BE DELETED UPON RECORDING OF A TERMINATION THEREOF OR UPON RECORDING OF A FINAL ACCEPTANCE BY THE TOWN OF ERIE OF ALL PUBLIC IMPROVEMENTS REQUIRED UNDER THE DEVELOPMENT AGREEMENT.

31. RESTRICTIVE COVENANTS, WHICH DO NOT CONTAIN A FORFEITURE OR REVERTER CLAUSE, BUT OMITTING ANY COVENANTS OR RESTRICTIONS, IF ANY, BASED UPON RACE, COLOR, RELIGION, SEX, SEXUAL ORIENTATION, FAMILIAL STATUS, MARITAL STATUS, DISABILITY, HANDICAP, NATIONAL ORIGIN, ANCESTRY, OR SOURCE OF INCOME, AS SET FORTH IN APPLICABLE STATE OR FEDERAL LAWS, EXCEPT TO THE EXTENT THAT SAID COVENANT OR RESTRICTION IS PERMITTED BY APPLICABLE LAW, AS CONTAINED IN EASEMENT COVENANTS, CONDITIONS AND RESTRICTIONS RECORDED OCTOBER 01, 2020, UNDER RECEPTION NO. **03820570**.

    NOTICE STATEMENT IN CONNECTION THEREWITH WAS RECORDED MAY 24, 2021 UNDER RECEPTION NO. **03887375**, AND RECORDED AUGUST 2, 2021 UNDER RECEPTION NO. **03903720**.

    AS AMENDED AND RESTATED IN INSTRUMENT RECORDED OCTOBER 18, 2021 UNDER RECEPTION NO. **03921451**.

32. TERMS, CONDITIONS, PROVISIONS, BURDENS, OBLIGATIONS AND EASEMENTS AS SET FORTH AND GRANTED IN USE RESTRICTION AND EASEMENT AGREEMENT RECORDED OCTOBER 01, 2020 UNDER RECEPTION NO. **03820638**.

    AS AMENDED AND RESTATED IN INSTRUMENT RECORDED OCTOBER 19, 2021 UNDER RECEPTION NO. **03921718**.

33. EASEMENTS, CONDITIONS, COVENANTS, RESTRICTIONS, RESERVATIONS AND NOTES ON THE RECORDED PLAT OF NINE MILE CORNER AMENDMENT NO. 1 RECORDED FEBRUARY 25, 2021 UNDER RECEPTION NO. **03862483**.

34. ANY FACTS, RIGHTS, INTERESTS OR CLAIMS WHICH MAY EXIST OR ARISE BY REASON OF THE FOLLOWING FACTS SHOWN ON ALTA/NSPS LAND TITLE SURVEY DATED OCTOBER 4, 2021 PREPARED BY GALLOWAY & COMPANY, INC., JOB # KSS000138.10

    SAID DOCUMENT STORED AS OUR IMAGE **39794354**

Old Republic National Title Insurance Company

(Schedule B)

Order Number: ABZ70707001 **Policy No.:** OX70707001.8489806

A. DIRT ROAD ON SITE LIES OUTSIDE OF CURRENT, GRANTED ACCESS EASEMENTS.

Endorsement 17.1-06 Indirect Access and Entry

American Land Title Association **Adopted 06-17-06**

Endorsement

Attached to Policy No. OX70707001.8489806

Our Order No. 70707001

Issued By Old Republic National Title Insurance Company

The Company insures against loss or damage sustained by the Insured if, at Date of Policy (i) the easement identified as PARCEL II in Schedule A (the "Easement") does not provide that portion of the Land identified as PARCEL I in Schedule A both actual vehicular and pedestrian access to and from Arapahoe Road and Highway 287 (aka North 107th Street) (the "Street"), (ii) the Street is not physically open and publicly maintained, or (iii) the Insured has no right to use existing curb cuts or entries along that portion of the Street abutting the Easement.

This endorsement is issued as part of the Policy. Except as it expressly states, it does not (i) modify any of the terms and provisions of the Policy, (ii) modify any prior endorsements, (iii) extend the Date of Policy, or (iv) increase the Amount of Insurance. To the extent a provision of the Policy or a previous endorsement is inconsistent with an express provision of this endorsement, this endorsement controls. Otherwise, this endorsement is subject to all of the terms and provisions of the Policy and of any prior endorsements.

Old Republic National Title Insurance Company

By: LAND TITLE GUARANTEE COMPANY

By: CB Rants

Craig B. Rants, Senior Vice President

AMERICAN LAND TITLE ASSOCIATION

Endorsement 25-06 Same as Survey
American Land Title Association **Adopted 10-16-08**

Endorsement
Attached to Policy No. OX70707001.8489806
Our Order No. 70707001
Issued By Old Republic National Title Insurance Company

The Company insures against loss or damage sustained by the Insured by reason of the failure of the Land as described in Schedule A to be the same as that identified on the survey made by Galloway & Company, Inc. dated OCTOBER 4, 2021 and as designated Job No. KSS000138.10.

This endorsement is issued as part of the Policy. Except as it expressly states, it does not (i) modify any of the terms and provisions of the Policy, (ii) modify any prior endorsements, (iii) extend the Date of Policy, or (iv) increase the Amount of Insurance. To the extent a provision of the Policy or a previous endorsement is inconsistent with an express provision of this endorsement, this endorsement controls. Otherwise, this endorsement is subject to all of the terms and provisions of the Policy and of any prior endorsements.

Old Republic National Title Insurance Company

By: LAND TITLE GUARANTEE COMPANY

By: 
Craig B. Rants, Senior Vice President

American Land Title Association

Endorsement 18.1-06 Multiple Tax Parcel
Adopted 6-17-06

Endorsement
Attached to Policy No. OX70707001.8489806
Our Order No. 70707001
Issued By Old Republic National Title Insurance Company

The Company insures against loss or damage sustained by the Insured by reason of:

1. those portions of the Land identified below not being assessed for real estate taxes under the listed tax identification numbers or those tax identification numbers including any additional land:

   Portion of Lot 10 - R0612902
   Portion of Lot 10 - R0612903

2. the easements, if any, described in Schedule A being cut off or disturbed by the nonpayment of real estate taxes, assessments or other charges imposed on the servient estate by a governmental authority.

This endorsement is issued as part of the Policy. Except as it expressly states, it does not (i) modify any of the terms and provisions of the Policy, (ii) modify any prior endorsements, (iii) extend the Date of Policy, or (iv) increase the Amount of Insurance. To the extent a provision of the Policy or a previous endorsement is inconsistent with an express provision of this endorsement, this endorsement controls. Otherwise, this endorsement is subject to all of the terms and provisions of the Policy and of any prior endorsements.

Old Republic National Title Insurance Company

By: LAND TITLE GUARANTEE COMPANY

By: 
Craig B. Rants, Senior Vice President

American Land Title Association

Endorsement 26-06 Subdivision
Adopted 10-16-08

Endorsement
Attached to Policy No. OX70707001.8489806
Our Order No. 70707001
Issued By Old Republic National Title Insurance Company

The Company insures against loss or damage sustained by the Insured by reason of the failure of the Land to constitute a lawfully created parcel according to the subdivision statutes and local subdivision ordinances applicable to the Land.

This endorsement is issued as part of the Policy. Except as it expressly states, it does not (i) modify any of the terms and provisions of the Policy, (ii) modify any prior endorsements, (iii) extend the Date of Policy, or (iv) increase the Amount of Insurance. To the extent a provision of the Policy or a previous endorsement is inconsistent with an express provision of this endorsement, this endorsement controls. Otherwise, this endorsement is subject to all of the terms and provisions of the Policy and of any prior endorsements.

Old Republic National Title Insurance Company

By: LAND TITLE GUARANTEE COMPANY

By: 
Craig B. Rants, Senior Vice President

American Land Title Association

Endorsement 19-06 Contiguity Multiple Parcels - Adopted 6-17-06

Endorsement

Attached to Policy No. OX70707001.8489806

Our Order No. 70707001

Issued By Old Republic National Title Insurance Company

The Company insures against loss or damage sustained by the Insured by reason of:

1. the failure of Parcel I of the Land to be contiguous to Parcel II of the Land
2. the presence of any gaps, strips, or gores separating any of the contiguous boundary lines described above.

This endorsement is issued as part of the Policy. Except as it expressly states, it does not (i) modify any of the terms and provisions of the Policy, (ii) modify any prior endorsements, (iii) extend the Date of Policy, or (iv) increase the Amount of Insurance. To the extent a provision of the Policy or a previous endorsement is inconsistent with an express provision of this endorsement, this endorsement controls. Otherwise, this endorsement is subject to all of the terms and provisions of the Policy and of any prior endorsements.

Old Republic National Title Insurance Company

By: LAND TITLE GUARANTEE COMPANY

By: 

Craig B. Rants, Senior Vice President

Endorsement 17.2-06 utility Access
American Land Title Association **Adopted 10-16-08**

Endorsement
Attached to Policy No. OX70707001.8489806
Our Order No. 70707001
Issued By Old Republic National Title Insurance Company

The Company insures against loss or damage sustained by the Insured by reason of the lack of a right of access to the following utilities or services:

X Water Service

X Natural Gas Service

X Telephone Service

X Sanitary Sewer

X Storm Water Drainage

X Electrical Power Service

either over, under or upon rights-of-way or easements for the benefit of the Land because of:
1. a gap or gore between the boundaries of the Land and the rights-of-way or easements;
2. a gap between the boundaries of the rights-of-way or easements; or
3. a termination by a grantor, or its successor, of the rights-of-way or easements.

This endorsement is issued as part of the Policy. Except as it expressly states, it does not (i) modify any of the terms and provisions of the Policy, (ii) modify any prior endorsements, (iii) extend the Date of Policy, or (iv) increase the Amount of Insurance. To the extent a provision of the Policy or a previous endorsement is inconsistent with an express provision of this endorsement, this endorsement controls. Otherwise, this endorsement is subject to all of the terms and provisions of the Policy and of any prior endorsements.

Old Republic National Title Insurance Company

By: LAND TITLE GUARANTEE COMPANY

By: 
Craig B. Rants, Senior Vice President

American Land Title Association

Endorsement 22-06 Location
Adopted 6-17-06

Endorsement
Attached to Policy No. OX70707001.8489806
Our Order No. 70707001
Issued By Old Republic National Title Insurance Company

The Company insures against loss or damage sustained by the Insured by reason of the failure of a vacant lot , known as 2900 Arapahoe, Erie, Colorado , to be located on the Land at Date of Policy.

This endorsement is issued as part of the Policy. Except as it expressly states, it does not (i) modify any of the terms and provisions of the Policy, (ii) modify any prior endorsements, (iii) extend the Date of Policy, or (iv) increase the Amount of Insurance. To the extent a provision of the Policy or a previous endorsement is inconsistent with an express provision of this endorsement, this endorsement controls. Otherwise, this endorsement is subject to all of the terms and provisions of the Policy and of any prior endorsements.

Old Republic National Title Insurance Company

By: LAND TITLE GUARANTEE COMPANY

By: CB Rants
Craig B. Rants, Senior Vice President

AMERICAN LAND TITLE ASSOCIATION

Endorsement
Attached to Policy No. OX70707001.8489806
Our Order No. 70707001
Issued By Old Republic National Title Insurance Company

The provisions of said Policy are hereby modified and amended as of the date hereof as to the following matters and none other: The Company agrees that if application is made by the Insured to the Company for a policy to be issued Insuring a mortgage, grantee, mortgagee of any grantee or lessee of the Insured, the Company will issue such policy insuring the title as the interest may then exist in the proposed insureds designated by the Insured in and to the Land. In the case of an owner's policy or policies, said policy shall be issued in an amount not less than the value of the Land, including its appreciation and any improvements thereon on the date of the application. The Company will not take exception for matters not excepted from coverage in this policy; provided however that the Company may issue its policy:

Subject to liens, defects, encumbrances first created or attaching subsequent to Date of Policy. The Company will also issue, to the extent applicable, the ALTA 35.3-06 endorsement, as attached to this policy, or equivalent ALTA 35 series endorsement form that is applicable at the time.

The Company shall not be obligated to issue additional insurance which would violate any law or regulation existing at the time application is made, or would exceed the amount of Insurance customarily retained by the Company unreinsured, if, after the exercise of its best efforts, it is unable to obtain reinsurance. The Company's obligations under this endorsement are subject to receipt by if of a written application and payment of the Company's usual charge for insurance in the amount applied for based upon its then existing rates.

The Policy or policies to be issued will be on the Company's title insurance form then in use by it to insure titles or interests of a nature similar to that for which application is made.

The Company shall not be obligated to issue its policy or policies if at the time the application is made the Insured has Knowledge of a claim against the Company under the policy, whether or not notice of the claim has been filed with the Company.

This endorsement is issued as part of the Policy. Except as it expressly states, it does not (i) modify any of the terms and provisions of the Policy, (ii) modify any prior endorsements, (iii) extend the Date of Policy, or (iv) increase the Amount of Insurance. To the extent a provision of the Policy or a previous endorsement is inconsistent with an express provision of this endorsement, this endorsement controls. Otherwise, this endorsement is subject to all of the terms and provisions of the Policy and of any prior endorsements.

Old Republic National Title Insurance Company

By: LAND TITLE GUARANTEE COMPANY

By: 

Craig B. Rants, Senior Vice President

Galloway
6162 S. Willow Drive, Suite 320
Greenwood Village, CO 80111
303.770.8884 • GallowayUS.com

August 31, 2021

Tyler Burhenn
Town of Erie - Engineering Division
645 Holbrook Street
Erie, Colorado 80516

RE: Lot 10A (King Soopers) – Nine Mile Corner – Drainage Conformance Letter

Dear Mr. Burhenn,

This drainage conformance letter has been prepared for the King Soopers #138 development on Lot 10A, Block 1, Nine Mile Subdivision Filing No. 1, Amendment No. 2, in Erie, Colorado. The objective of this letter is to show that the proposed drainage for the site conforms to the current Town of Erie *Standards and Specifications, Section 800 – Storm Drainage Facilities*, the current Urban Drainage and Flood Control District *Urban Storm Drainage Criteria Manual, Volumes 1, 2, & 3*, and the *Phase III Drainage Report for Nine Mile Corner at Nine Mile Subdivision Filing No. 1* prepared by Galloway & Company, Inc. accepted by the Town of Erie, March 2020.

Lot 10A is 341,926 square feet (7.85 acres). The existing site is overlot graded, sloping from south to north, with an existing storm sewer provided from the north. The proposed improvements will include a 103,000 S.F. King Soopers building with parking areas, drive aisles, and associated landscaping and sidewalks on Lot 10A. Runoff from the building roofs will be collected in roof drains and routed via underground PVC storm sewer. Surface runoff will be collected by an on-site storm sewer system which will connect to the provided storm sewer stubs on the north end of the lot. Drainage for Lot 10A is consistent with the Phase III Drainage Report.

All stormwater elements on Lot 10A are private and will be maintained by the property owner.

Regional water quality and stormwater detention is provided with the overall infrastructure development and neither on-site water quality nor stormwater detention are required to be constructed for this site.

In the Phase III Drainage Report Lot 10A was included in basins 130, 132, and 202 with an overall imperviousness of 66%. The 5-year coefficient was anticipated to be 0.54, with a runoff of 21.1 cfs. The 100-year coefficient was anticipated to be 0.73, with a runoff of 69.1 cfs. Excerpts from the Phase III Drainage Report are included in Attachment E of this letter.

The proposed Lot 10A development is further subdivided into 21 sub-basins in this drainage letter. The proposed sub-basins are depicted in the attached Drainage Map (Attachment B) with descriptions provided below.

<u>Lot 10A Sub-Basin Descriptions:</u>

Basin 130A (2.93 acres) consists of paved roadways/parking areas, sidewalk, and landscaped area. Drainage from Basin 130A will be collected by a curb inlet (Design Point 1) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 36.6% with 3.5 cfs and 13.7 cfs in the 5- and 100-year storm events, respectively.

Basin 130B (0.34 acres) consists of paved roadways/parking areas, sidewalk, and landscaped area. Drainage from Basin 130B will be collected by a curb inlet (Design Point 2) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 87.9% with 1.3 cfs and 2.7 cfs in the 5- and 100-year storm events, respectively.

Basin 130C (0.49 acres) consists of paved roadways/parking areas, sidewalk, and landscaped area. Drainage from Basin 130C will be collected by a curb inlet (Design Point 3) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 96.5% with 2.0 cfs and 4.0 cfs in the 5- and 100-year storm events, respectively.

Basin 130D (0.48 acres) consists of paved roadways/parking areas, sidewalk, and landscaped area. Drainage from Basin 130D will be collected by a curb inlet (Design Point 4) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 96.8% with 2.0 cfs and 4.0 cfs in the 5- and 100-year storm events, respectively.

Basin 130E (0.29 acres) consists of paved roadways/parking areas, sidewalk, and landscaped area. Drainage from Basin 130E will be collected by a curb inlet (Design Point 5) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 89.2% with 1.1 cfs and 2.4 cfs in the 5- and 100-year storm events, respectively.

Basin 130F (0.31 acres) consists of paved roadways/parking areas, sidewalk, and landscaped area. Drainage from Basin 130F will be collected by a curb inlet (Design Point 6) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 95.7% with 1.3 cfs and 2.6 cfs in the 5- and 100-year storm events, respectively.

Basin 130G (0.51 acres) consists of paved roadways/parking areas, sidewalk, and landscaped area. Drainage from Basin 130G will be collected by a curb inlet (Design Point 7) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 96.2% with 2.1 cfs and 4.3 cfs in the 5- and 100-year storm events, respectively.

Basin 130H (0.51 acres) consists of paved roadways/parking areas, sidewalk, and landscaped area. Drainage from Basin 130H will be collected by a curb inlet (Design Point 8) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 92.8% with 2.0 cfs and 4.2 cfs in the 5- and 100-year storm events, respectively.

Basin 132A (0.20 acres) consists of paved roadways area. Drainage from Basin 132A will sheet flow into Basin 130B where it will be collected by a curb inlet (Design Point 2) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 98.3% with 0.9 cfs and 1.7 cfs in the 5- and 100-year storm events, respectively.

Basin 132B (0.04 acres) consists of paved roadways area. Drainage from Basin 132B will sheet flow into Basin 130C where it will be collected by a curb inlet (Design Point 3) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 100% with 0.2 cfs and 0.4 cfs in the 5- and 100-year storm events, respectively.

Basin 132C (0.05 acres) consists of paved roadways area. Drainage from Basin 132C will sheet flow into Basin 130D where it will be collected by a curb inlet (Design Point 4) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 100% with 0.2 cfs and 0.4 cfs in the 5- and 100-year storm events, respectively.

Basin 132D (0.05 acres) consists of paved roadways area. Drainage from Basin 132D will sheet flow into Basin 130F where it will be collected by a curb inlet (Design Point 6) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 100% with 0.2 cfs and 0.5 cfs in the 5- and 100-year storm events, respectively.

Basin 132E (0.10 acres) consists of paved roadways area and a portion of the Lot 7 development which drains off-site per the Lot 7 Drainage Conformance Letter. Drainage from Basin 132E will sheet flow into Basin 130G where it will be collected by a curb inlet (Design Point 7) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 61.1% with 0.3 cfs and 0.7 cfs in the 5- and 100-year storm events, respectively.

Basin 132F (0.56 acres) consists of paved roadways area and a portion of the Lot 7 development which drains off-site per the Lot 7 Drainage Conformance Letter. Drainage from Basin 132F will sheet flow into Basin 130H where it will be collected by a curb inlet (Design Point 8) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 93.5% with 2.3 cfs and 4.6 cfs in the 5- and 100-year storm events, respectively.

Basin 202A (1.11 acres) consists of roof area. Drainage from Basin 202A will be collected by roof drains which will connect to the proposed storm drain system where it will continue to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 90% with 4.3 cfs and 8.9 cfs in the 5- and 100-year storm events, respectively.

Basin 202B1 (1.53 acres) consists of paved roadways/parking areas, sidewalk, and landscaped area. Drainage from Basin 202B1 will be collected by a curb inlet (Design Point 17a) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 29.2% with 1.5 cfs and 6.9 cfs in the 5- and 100-year storm events, respectively.

Basin 202B2 (0.24 acres) consists of paved roadways, and landscaped area. Drainage from Basin 202B2 will be collected by a curb inlet (Design Point 17b) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 81.7% with 0.8 cfs and 1.8 cfs in the 5- and 100-year storm events, respectively.

Basin 202C (0.15 acres) consists of truck dock area. Drainage from Basin 202C will be collected an area inlet (Design Point 18) which will connect to the proposed storm drain system where it will continue to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 100% with 0.7 cfs and 1.2 cfs in the 5- and 100-year storm events, respectively.

Basin 202D (1.26 acres) consists of roof area. Drainage from Basin 202D will be collected by roof drains which will connect to the proposed storm drain system where it will continue to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 90% with 4.9 cfs and 10.2 cfs in the 5- and 100-year storm events, respectively.

Basin 202E (0.29 acres) consists of paved roadways and landscaped area. Drainage from Basin 202E will be collected by a curb inlet (Design Point 20) and routed via storm drain to the existing storm sewer stub at the northern side of the site. From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 76.2% with 0.9 cfs and 2.1 cfs in the 5- and 100-year storm events, respectively.

Basin 202F (0.32 acres) consists of paved roadways/parking areas, sidewalk, and landscaped area. Drainage from Basin 202F will sheet flow into Basin 204 of the Master report and will be collected by an existing curb inlet (Design Point 41). From there it will ultimately discharge to the extended detention basin proposed with the Phase III Drainage Report. The overall composite imperviousness of this basin is 91.8% with 1.3 cfs and 2.6 cfs in the 5- and 100-year storm events, respectively.

Conclusions:

The anticipated composite 100-year runoff coefficient for Basins 130, 132, and 202 was 0.73, as calculated in the Phase III Drainage Report. The developed 100-year runoff coefficient for the site has been determined to be 0.75 with the construction of the King Soopers store, parking lot, and landscape areas. Both the anticipated and developed runoff coefficients are summarized in the table below.

Runoff Coefficients

	5-Year Coefficient	100-Year Coefficient	5-Year Runoff (cfs)	100-Year Runoff (cfs)
Anticipated Condition	0.54	0.73	21.1	69.1
Developed Condition	0.58	0.75	28.2	68.7

Since the developed 100-yr runoff is less than the anticipated 100-yr runoff, the proposed King Soopers development conforms to the Phase III Drainage Report and will not cause any adverse effects to the downstream stormwater system.

I affirm that the proposed drainage design of Lot 10A, Block 1, Nine Mile Subdivision Filing No. 1, Amendment No. 2, in Erie, Colorado is in conformance with existing site grading and drainage conditions, the Town of Erie *Standards and Specifications, Section 800 – Storm Drainage Facilities*, and the *Phase III Drainage Report for Nine Mile Corner at Nine Mile Subdivision Filing No. 1* prepared by Galloway & Company, Inc. currently in review with the Town of Erie.

Sincerely,
GALLOWAY

Jenny Romano, PE
jennyromano@gallowayus.com

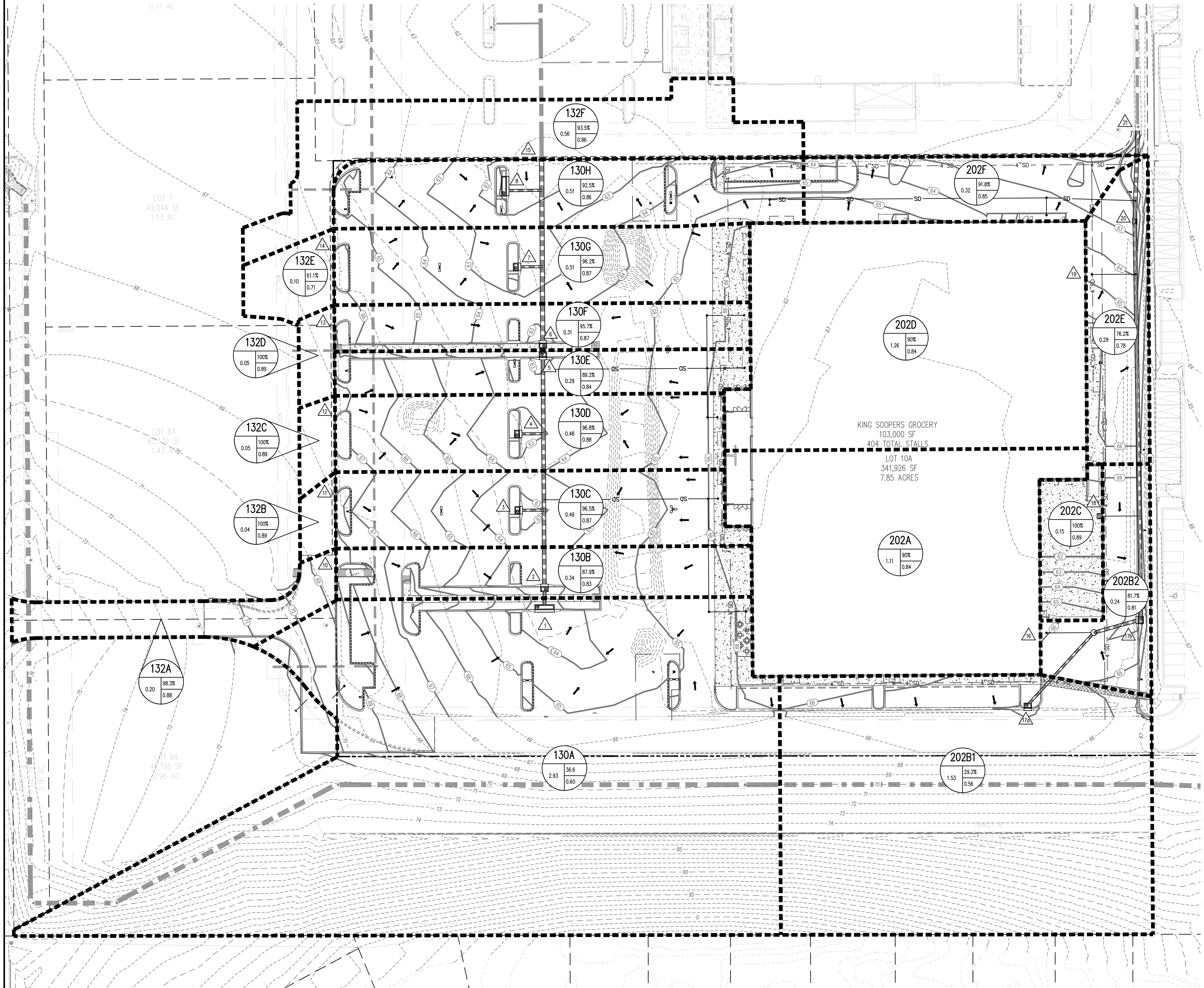
Attachments
Vicinity Map (Attachment A)
Drainage Map (Attachment B)
Hydrology Calculations (Attachment C)
Hydraulic Calculations (Attachment D)
Excerpts from Phase III Drainage Report (Attachment E)

Attachment A
Vicinity Map

VICINITY MAP

NOT TO SCALE

Attachment B
Drainage Map



VICINITY MAP
NOT TO SCALE

GRADING LEGEND

- PROPERTY LINE
- ADJACENT PROPERTY BOUNDARY LINE
- EXISTING EASEMENT BOUNDARY LINE
- EASEMENT BOUNDARY LINE
- 70 — PROPOSED MAJOR CONTOUR
- 71 — PROPOSED MINOR CONTOUR
- 4970 — EXISTING MAJOR CONTOUR
- 4971 — EXISTING MINOR CONTOUR
- SD — EXISTING STORM SEWER (LESS THAN 12")
- SD — EXISTING STORM SEWER (12" AND GREATER)
- X"SD — PROPOSED STORM SEWER (12" AND GREATER)
- X"SD — PROPOSED STORM SEWER (LESS THAN 12")
- 1 — DESIGN POINT
- FLOW ARROW
- DRAINAGE BASIN BOUNDARY
- 000 — BASIN DESIGNATION
- 0.00 — COMPOSITE PERCENT IMPERVIOUS
- 0.00 — 100-YEAR RUNOFF COEFFICIENT
- 0.00 — BASIN AREA IN ACRES

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KING Soopers

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SITE IMPROVEMENT CONSTRUCTION PLANS
KING SOOPERS #138
NINE MILE CORNER

ARAPAHOE ROAD & 107th STREET
ERIE, COLORADO

#	Date	Issue / Description	Init.

Project No:	KSS000138
Drawn By:	RDG
Checked By:	ACJ
Date:	05/21/21

PROPOSED DRAINAGE MAP

DR1

Attachment C
Hydrologic Calculations

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Nine Mile Corner
Location: CO, Erie

Project Name: Kings Soopers #138 (Lot 10)
Project No.: KSS000138
Calculated By: R. Gordon
Checked By: J. Romano
Date: 8/31/21

Basin ID	Total Area (sf)	Paved Roads			Lawns			Sidewalks			Roofs			Basins Total Weighted % Imp.
		% Imp.	Area (sf)	Weighted % Imp.	% Imp.	Area (sf)	Weighted % Imp.	% Imp.	Area (sf)	Weighted % Imp.	% Imp.	Area (sf)	Weighted % Imp.	
130A	127572	100	42336	33.2	2	82209	1.3	90	3027	2.1	90	0	0.00	36.6
130B	14890	100	11122	74.7	2	1618	0.2	90	2150	13.0	90	0	0.00	87.9
130C	21226	100	19623	92.5	2	665	0.1	90	938	4.0	90	0	0.00	96.5
130D	20866	100	19863	95.2	2	665	0.1	90	338	1.5	90	0	0.00	96.8
130E	12820	100	10428	81.3	2	1301	0.2	90	1091	7.7	90	0	0.00	89.2
130F	13590	100	10742	79.0	2	338	0.0	90	2510	16.6	90	0	0.00	95.7
130G	22372	100	19652	87.8	2	665	0.1	90	2054	8.3	90	0	0.00	96.2
130H	22135	100	19773	89.3	2	1616	0.1	90	747	3.0	90	0	0.00	92.5
TOTAL 130 BASINS	255472	100	153538	60.1	2	89079	0.7	90	12855	4.5	90	0	0.00	65.3
132A	8879	100	8724	98.3	2	155	0.0	90	0	0.0	90	0	0.00	98.3
132B	1763	100	1763	100.0	2	0	0.0	90	0	0.0	90	0	0.00	100.0
132C	2103	100	2103	100.0	2	0	0.0	90	0	0.0	90	0	0.00	100.0
132D	2249	100	2249	100.0	2	0	0.0	90	0	0.0	90	0	0.00	100.0
132E	4428	100	1920	43.4	2	1674	0.8	90	834	17.0	90	0	0.00	61.1
132F	24482	100	21999	89.9	2	1525	0.1	90	958	3.5	90	0	0.00	93.5
TOTAL 132 BASINS	43904	100	38758	88.3	2	3353	0.2	90	1,792	3.7	90	0	0.00	92.2
202A	48230	100	0	0.0	2	0	0.0	90	0	0.0	90	48,230	90.00	90.0
202B1	66834	100	16392	24.5	2	48037	1.4	90	2,405	3.2	90	0	0.00	29.2
202B2	10282	100	8354	81.3	2	1928	0.4	90	0	0.0	90	0	0.00	81.7
202C	6387	100	6387	100.0	2	0	0.0	90	0	0.0	90	0	0.00	100.0
202D	54744	100	0	0.0	2	0	0.0	90	0	0.0	90	54,744	90.00	90.0
202E	12470	100	7784	62.4	2	2849	0.5	90	1,837	13.3	90	0	0.00	76.2
202F	14019	100	12149	86.7	2	1107	0.2	90	763	4.9	90	0	0.00	91.8
TOTAL 202 BASINS	212966	100	51066	24.0	2	53921	0.5	90	5,005	2.1	90	102,974	43.50	70.1
TOTAL ALL BASINS	512341	100	243362	47.5	2	146353	0.6	90	19,652	3.5	90	102,974	18.10	69.7

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Nine Mile Corner
Location: CO, Erie

Project Name: Kings Soopers #138 (Lot 10)
Project No.: KSS000138
Calculated By: R. Gordon
Checked By: J. Romano
Date: 8/31/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)	FINAL
BASIN ID	D.A. (AC)	Hydrologic Soils Group	Impervious (%)	C_{100}	C_5	L (FT)	S (%)	T_i (MIN)	L (FT)	S (%)	Cv	VEL. (FPS)	T_t (MIN)	Urbanized T_c (MIN)	T_c (MIN)
130A	2.93	B	36.6	0.60	0.29	84	17.0%	5.3	685	2.0%	20.0	2.8	4.0	25.5	9.3
130B	0.34	B	87.9	0.83	0.74										5.0
130C	0.49	B	96.5	0.87	0.82										5.0
130D	0.48	B	96.8	0.88	0.83										5.0
130E	0.29	B	89.2	0.84	0.76										5.0
130F	0.31	B	95.7	0.87	0.82										5.0
130G	0.51	B	96.2	0.87	0.82										5.0
130H	0.51	B	92.5	0.86	0.79										5.0
TOTAL 130 BASINS	5.86	B	65.3	0.73	0.54										
132A	0.20	B	98.3	0.88	0.84										5.0
132B	0.04	B	100.0	0.89	0.86										5.0
132C	0.05	B	100.0	0.89	0.86										5.0
132D	0.05	B	100.0	0.89	0.86										5.0
132E	0.10	B	61.1	0.71	0.50										5.0
132F	0.56	B	93.5	0.86	0.80										5.0
TOTAL 132 BASINS	1.01	B	92.2	0.85	0.78										
202A	1.11	B	90.0	0.84	0.76										5.0
202B1	1.53	B	29.2	0.56	0.22	84	17.0%	5.7	478	2.0%	20.0	2.8	2.8	25.3	8.5
202B2	0.24	B	81.7	0.81	0.69	30	2.0%	3.2	130	1.0%	20.0	2.0	1.1	13.2	5.0
202C	0.15	B	100.0	0.89	0.86										5.0
202D	1.26	B	90.0	0.84	0.76										5.0
202E	0.29	B	76.2	0.78	0.64										5.0
202F	0.32	B	91.8	0.85	0.78										5.0
TOTAL 202 BASINS	4.89	B	70.1	0.75	0.58										
TOTAL ALL BASINS	11.76	B	69.7	0.75	0.58										

NOTES:

T_i = (0.395*(1.1 - C_5)*(L)^0.5)/((S)^0.33), S in ft/ft

T_t=L/60V (Velocity From Fig. 501)

Velocity V=Cv*S^0.5, S in ft/ft

Tc Check = (26-17i)+Lt/(60(14i+9)sqrt(St)) (MHFD Vol. 1, Equation 6-5)

For Urbanized basins a minimum T_c of 5.0 minutes is required.

For non-urbanized basins a minimum T_c of 10.0 minutes is required

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Nine Mile Corner
Location: CO, Erie
Design Storm: 5-Year

Project Name: Kings Soopers #138 (Lot 10)
Project No.: KSS000138
Calculated By: R. Gordon
Checked By: J. Romano
Date: 8/31/21

	DIRECT RUNOFF							TOTAL RUNOFF				
Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	REMARKS
1	130A	2.93	0.29	9.3	0.85	4.13	3.5					
2	130B	0.34	0.74	5.0	0.25	5.08	1.3					
3	130C	0.49	0.82	5.0	0.40	5.08	2.0					
4	130D	0.48	0.83	5.0	0.40	5.08	2.0					
5	130E	0.29	0.76	5.0	0.22	5.08	1.1					
6	130F	0.31	0.82	5.0	0.26	5.08	1.3					
7	130G	0.51	0.82	5.0	0.42	5.08	2.1					
8	130H	0.51	0.79	5.0	0.40	5.08	2.0					
	TOTAL 130 BASINS	5.86	0.54					9.3	3.20	4.13	13.2	130 BASINS
10	132A	0.20	0.84	5.0	0.17	5.08	0.9	5.0	0.42	5.08	2.1	BASINS 130B + 132A
11	132B	0.04	0.86	5.0	0.03	5.08	0.2	5.0	0.43	5.08	2.2	BASINS 130C + 132B
12	132C	0.05	0.86	5.0	0.04	5.08	0.2	5.0	0.44	5.08	2.2	BASINS 130D + 132C
13	132D	0.05	0.86	5.0	0.04	5.08	0.2	5.0	0.30	5.08	1.5	BASINS 130F + 132D
14	132E	0.10	0.50	5.0	0.05	5.08	0.3	5.0	0.47	5.08	2.4	BASINS 130G + 132E
15	132F	0.56	0.80	5.0	0.45	5.08	2.3	5.0	0.85	5.08	4.3	BASINS 130H + 132F
	TOTAL 132 BASINS	1.01	0.78					5.0	0.78	5.08	4.0	132 BASINS
16	202A	1.11	0.76	5.0	0.84	5.08	4.3					
17a	202B1	1.53	0.22	8.5	0.34	4.27	1.5					
17b	202B2	0.24	0.69	5.0	0.16	5.08	0.8					
18	202C	0.15	0.86	5.0	0.13	5.08	0.7					
19	202D	1.26	0.76	5.0	0.96	5.08	4.9					
20	202E	0.29	0.64	5.0	0.18	5.08	0.9					
21	202F	0.32	0.78	5.0	0.25	5.08	1.3					
	TOTAL 202 BASINS	4.89	0.58					8.5	2.86	4.27	12.2	202 BASINS
	TOTAL ALL BASINS	11.76	0.58					9.3	6.84	4.13	28.2	130, 132, & 202 BASINS

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Nine Mile Corner
Location: CO, Erie
Design Storm: 100-Year

Project Name: Kings Soopers #138 (Lot 10)
Project No.: KSS000138
Calculated By: R. Gordon
Checked By: J. Romano
Date: 8/31/21

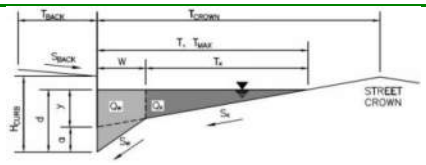
	DIRECT RUNOFF							TOTAL RUNOFF				
Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	REMARKS
1	130A	2.93	0.60	9.3	1.76	7.80	13.7					
2	130B	0.34	0.83	5.0	0.28	9.60	2.7					
3	130C	0.49	0.87	5.0	0.42	9.60	4.0					
4	130D	0.48	0.88	5.0	0.42	9.60	4.0					
5	130E	0.29	0.84	5.0	0.25	9.60	2.4					
6	130F	0.31	0.87	5.0	0.27	9.60	2.6					
7	130G	0.51	0.87	5.0	0.45	9.60	4.3					
8	130H	0.51	0.86	5.0	0.44	9.60	4.2					
	TOTAL 130 BASINS	5.86	0.73					9.3	4.29	7.80	33.5	130 BASINS
10	132A	0.20	0.88	5.0	0.18	9.60	1.7	5.0	0.46	9.60	4.4	BASINS 130B + 132A
11	132B	0.04	0.89	5.0	0.04	9.60	0.4	5.0	0.46	9.60	4.4	BASINS 130C + 132B
12	132C	0.05	0.89	5.0	0.04	9.60	0.4	5.0	0.46	9.60	4.4	BASINS 130D + 132C
13	132D	0.05	0.89	5.0	0.05	9.60	0.5	5.0	0.32	9.60	3.1	BASINS 130F + 132D
14	132E	0.10	0.71	5.0	0.07	9.60	0.7	5.0	0.52	9.60	5.0	BASINS 130G + 132E
15	132F	0.56	0.86	5.0	0.48	9.60	4.6	5.0	0.92	9.60	8.8	BASINS 130H + 132F
	TOTAL 132 BASINS	1.01	0.85					5.0	0.86	9.60	8.3	132 BASINS
16	202A	1.11	0.84	5.0	0.93	9.60	8.9					
17a	202B1	1.53	0.56	8.5	0.86	8.06	6.9					
17b	202B2	0.24	0.81	5.0	0.19	9.60	1.8					
18	202C	0.15	0.89	5.0	0.13	9.60	1.2					
19	202D	1.26	0.84	5.0	1.06	9.60	10.2					
20	202E	0.29	0.78	5.0	0.22	9.60	2.1					
21	202F	0.32	0.85	5.0	0.27	9.60	2.6					
	TOTAL 202 BASINS	4.89	0.75					8.5	3.66	8.06	29.5	202 BASINS
	TOTAL ALL BASINS	11.76	0.75					9.3	8.81	7.80	68.7	130, 132, & 202 BASINS

Attachment D
Hydraulic Calculations

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 1**



Gutter Geometry:

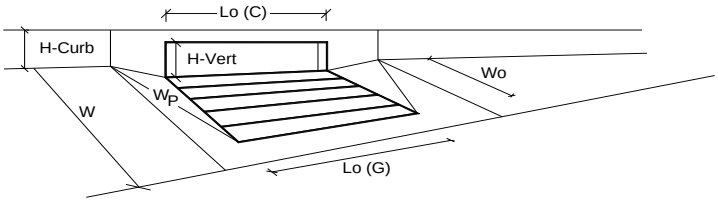
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.1	6.1	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

	Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion			
MAJOR STORM Allowable Capacity is based on Depth Criterion			
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

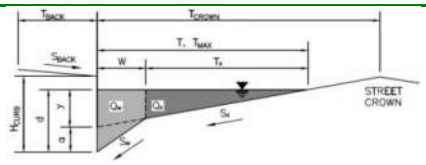


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.1	6.1	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.34	0.34	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.58	0.58	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	0.79	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**14.1**	**14.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.5	13.7	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 2**



Gutter Geometry:

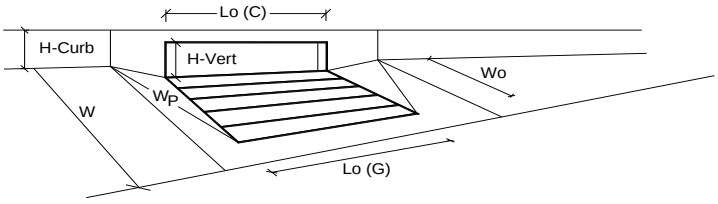
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

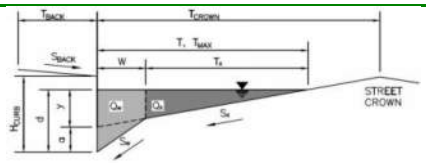


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.3	2.7	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 3**



Gutter Geometry:

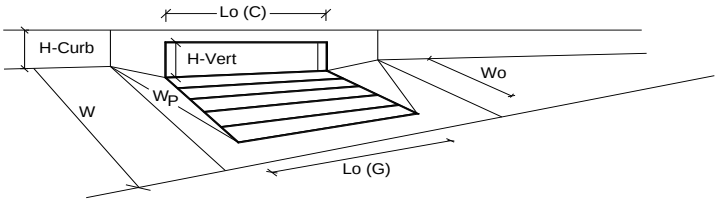
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

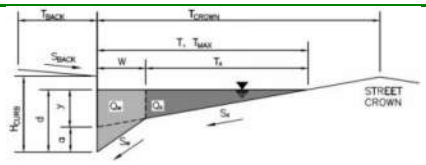


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.0	4.0	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 4**



Gutter Geometry:

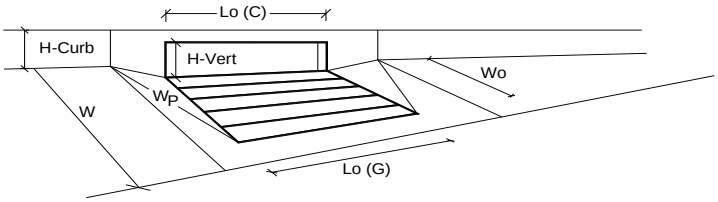
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

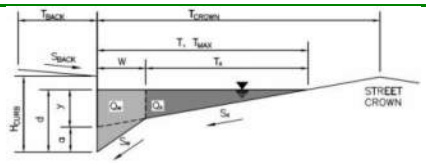


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.0	4.0	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 5**



Gutter Geometry:

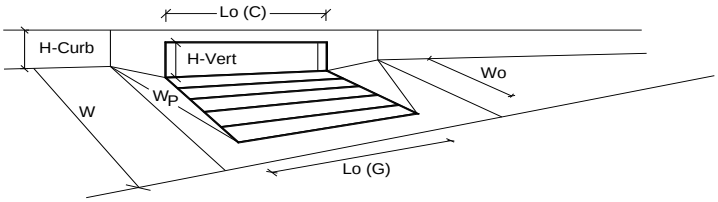
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

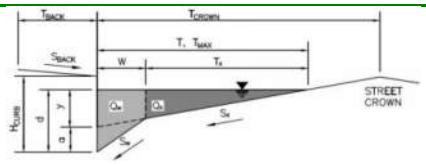


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.1	2.4	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 6**



Gutter Geometry:

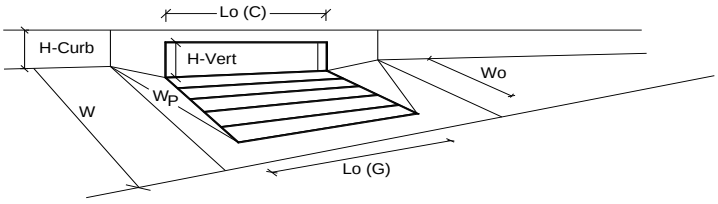
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

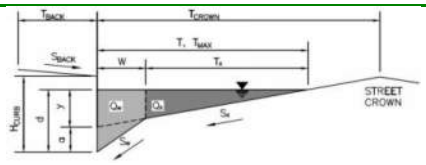


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.3	2.6	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 7**



Gutter Geometry:

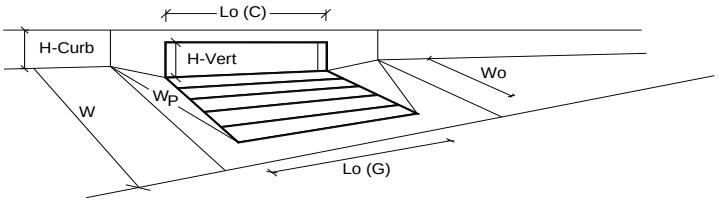
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.025	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

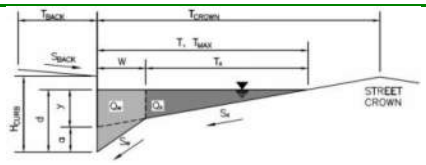


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.9	5.9	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.76	0.76	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.2**	**5.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.4	5.0	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 8**



Gutter Geometry:

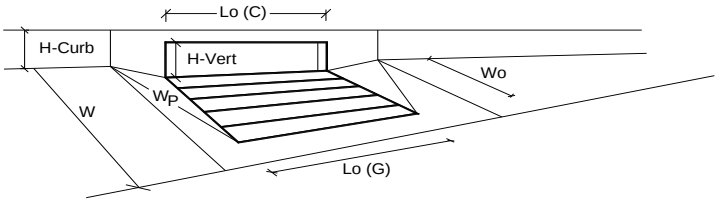
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.019	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

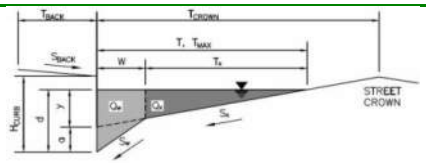


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.0	5.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.25	0.25	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.47	0.47	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.72	0.72	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**10.5**	**10.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.3	8.8	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 17a**



Gutter Geometry:

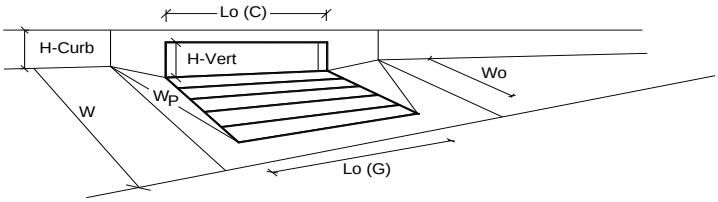
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.250	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.025	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.8	6.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

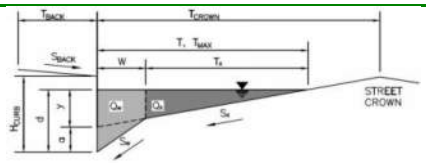


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.8	6.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.40	0.40	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.87	0.87	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**7.1**	**7.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.5	6.9	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 17b**



Gutter Geometry:

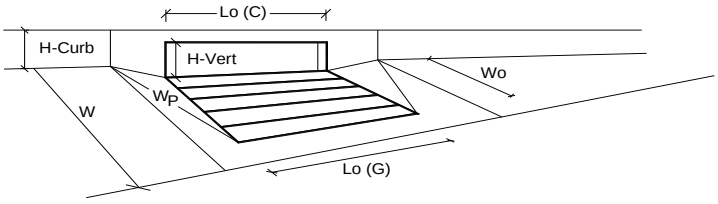
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.250	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.025	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

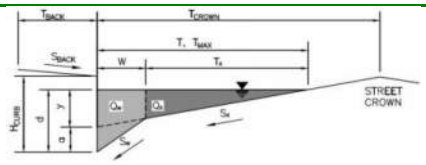


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.9	5.9	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.76	0.76	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.2**	**5.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.8	1.8	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 18**



Gutter Geometry:

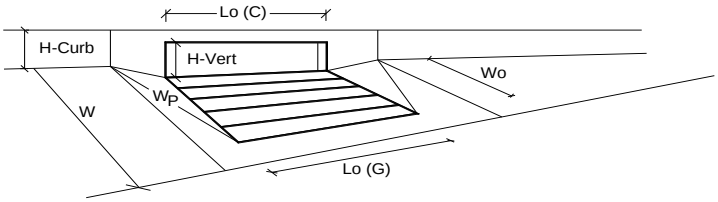
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.019	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

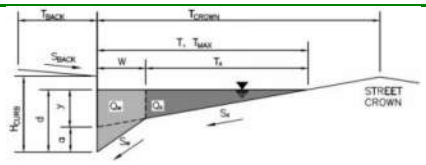


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.0	5.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.440	0.440	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.25	0.25	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.78	0.78	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.78	0.78	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.2**	**2.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.7	1.2	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 20**



Gutter Geometry:

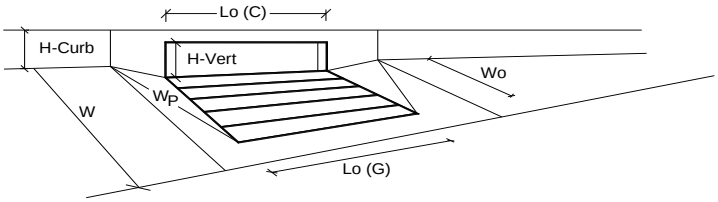
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

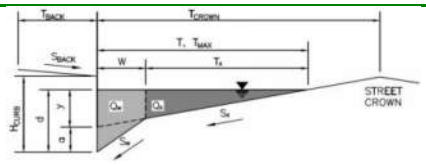


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.523	0.523	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.94	0.94	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.94	0.94	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.6**	**3.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.9	2.1	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Kings Soopers #138 (Lot 10)**
Inlet ID: **Design Point 21**



Gutter Geometry:

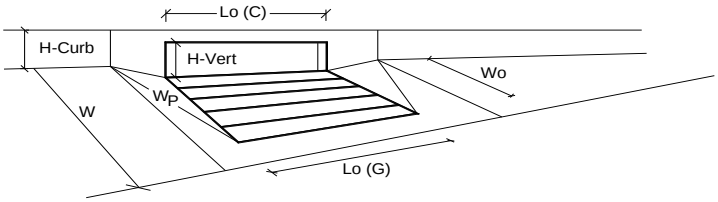
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.250	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

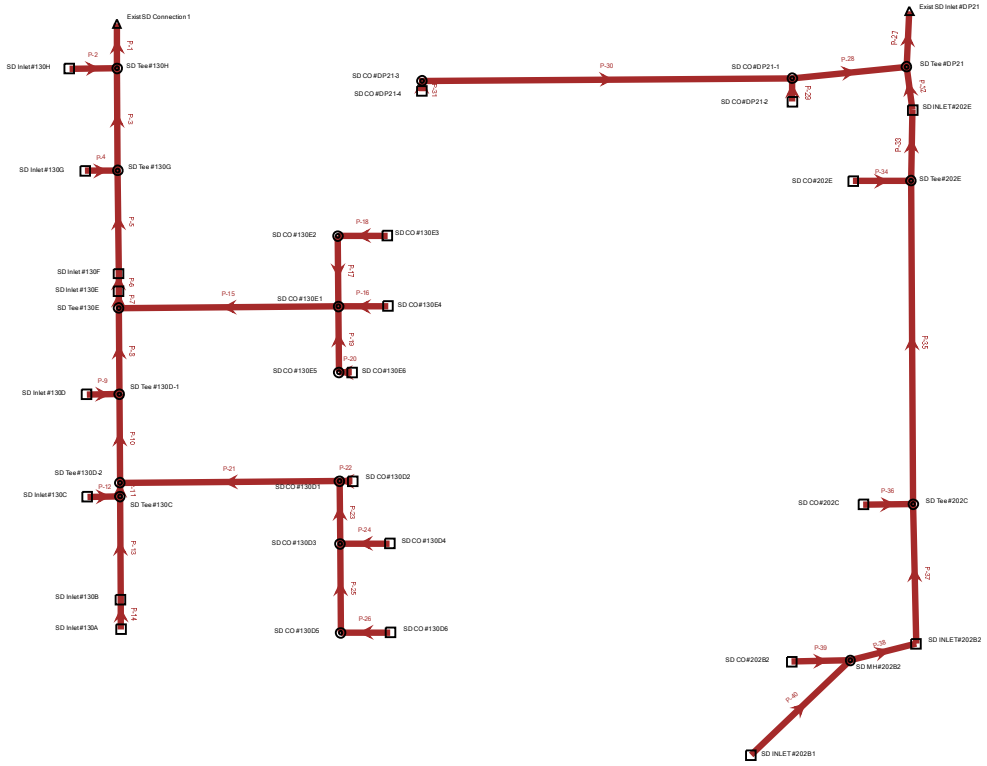
INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	5.1	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.26	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.66	0.66	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.7**	**3.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.3	2.8	cfs

Scenario: 100 Year

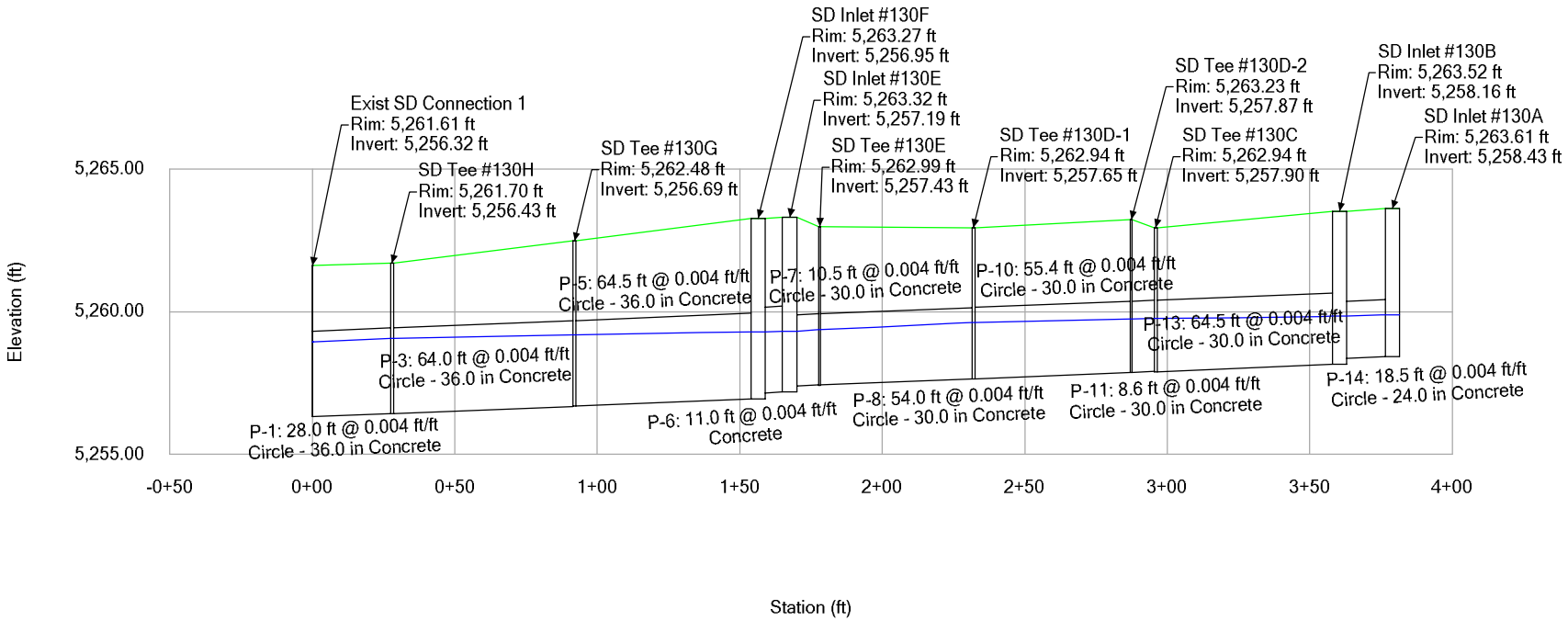


Scenario: 100 Year
Current Time Step: 0.000Hr
FlexTable: Conduit Table

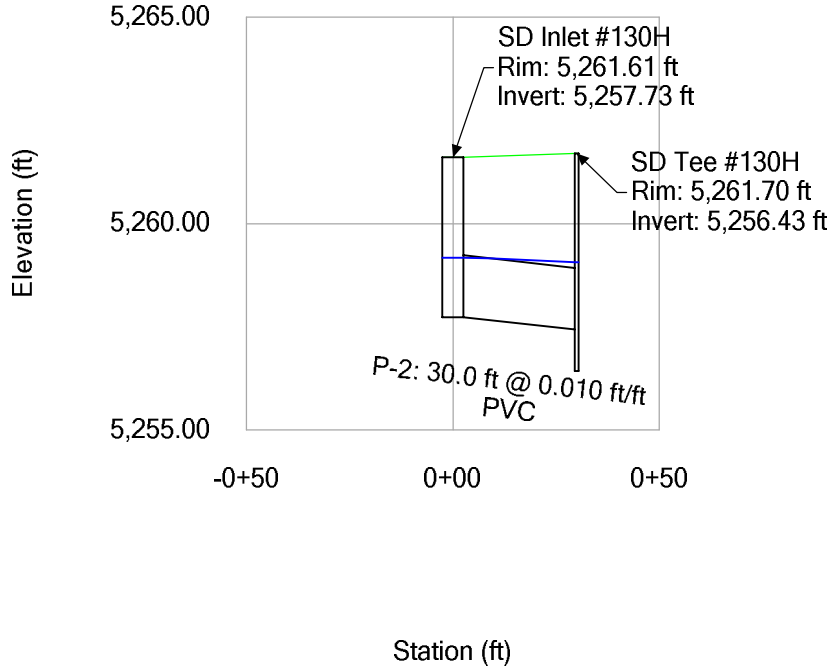
Label	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Length (User Defined) (ft)	Start Node	Stop Node	Flow (cfs)	Slope (Calculated) (ft/ft)	Diameter (in)	Invert (Start) (ft)	Invert (Stop) (ft)	Headloss (ft)
P-01	5,259.06	5,258.94	28	SD Tee #130H	Exist SD Connection 1	45.2	0.004	36	5,256.43	5,256.32	0.12
P-02	5,259.17	5,259.06	30	SD Inlet #130H	SD Tee #130H	8.8	0.01	18	5,257.73	5,257.43	0.11
P-03	5,259.20	5,259.06	64	SD Tee #130G	SD Tee #130H	36.4	0.004	36	5,256.69	5,256.43	0.14
P-04	5,259.21	5,259.20	20.5	SD Inlet #130G	SD Tee #130G	5	0.01	18	5,257.90	5,257.69	0
P-05	5,259.30	5,259.20	64.5	SD Inlet #130F	SD Tee #130G	31.4	0.004	36	5,256.95	5,256.69	0.1
P-06	5,259.31	5,259.30	11	SD Inlet #130E	SD Inlet #130F	28.3	0.004	36	5,257.19	5,257.15	0.01
P-07	5,259.37	5,259.31	10.5	SD Tee #130E	SD Inlet #130E	25.9	0.004	30	5,257.43	5,257.39	0.06
P-08	5,259.62	5,259.37	54	SD Tee #130D-1	SD Tee #130E	25.6	0.004	30	5,257.65	5,257.43	0.25
P-09	5,259.56	5,259.62	20.5	SD Inlet #130D	SD Tee #130D-1	4.4	0.01	18	5,258.61	5,258.40	-0.06
P-10	5,259.75	5,259.62	55.4	SD Tee #130D-2	SD Tee #130D-1	21.2	0.004	30	5,257.87	5,257.65	0.13
P-11	5,259.77	5,259.75	8.6	SD Tee #130C	SD Tee #130D-2	20.9	0.004	30	5,257.91	5,257.87	0.02
P-12	5,259.67	5,259.77	20.5	SD Inlet #130C	SD Tee #130C	4.5	0.01	18	5,258.86	5,258.65	-0.1
P-13	5,259.84	5,259.77	64.5	SD Inlet #130B	SD Tee #130C	16.4	0.004	30	5,258.16	5,257.90	0.08
P-14	5,259.90	5,259.84	18.5	SD Inlet #130A	SD Inlet #130B	11.9	0.004	24	5,258.43	5,258.36	0.05
P-15	5,260.23	5,259.37	137.5	SD CO #130E1	SD Tee #130E	0.3	0.01	8	5,259.97	5,258.60	0.86
P-16	5,260.43	5,260.23	31.1	SD CO #130E4	SD CO #130E1	0.1	0.01	8	5,260.28	5,259.97	0.2
P-17	5,260.56	5,260.23	44.2	SD CO #130E2	SD CO #130E1	0.1	0.01	8	5,260.41	5,259.97	0.33
P-18	5,260.87	5,260.56	31.1	SD CO #130E3	SD CO #130E2	0.1	0.01	8	5,260.72	5,260.41	0.31
P-19	5,260.53	5,260.23	41.2	SD CO #130E5	SD CO #130E1	0.1	0.01	8	5,260.38	5,259.97	0.3
P-20	5,260.61	5,260.53	8.2	SD CO #130E6	SD CO #130E5	0.1	0.01	8	5,260.46	5,260.38	0.08
P-21	5,260.67	5,259.75	137.6	SD CO #130D1	SD Tee #130D-2	0.3	0.01	8	5,260.41	5,259.04	0.92
P-22	5,260.64	5,260.67	8.2	SD CO #130D2	SD CO #130D1	0.1	0.01	8	5,260.49	5,260.41	-0.03
P-23	5,261.01	5,260.67	39.2	SD CO #130D3	SD CO #130D1	0.2	0.01	8	5,260.80	5,260.41	0.34
P-24	5,261.26	5,261.01	31.1	SD CO #130D4	SD CO #130D3	0.1	0.01	8	5,261.11	5,260.80	0.25
P-25	5,261.50	5,261.01	55.7	SD CO #130D5	SD CO #130D3	0.1	0.01	8	5,261.36	5,260.80	0.5
P-26	5,261.81	5,261.50	31.1	SD CO #130D6	SD CO #130D5	0.1	0.01	8	5,261.67	5,261.36	0.31
P-27	5,261.23	5,260.92	58.7	SD Tee #DP21	Exist SD Inlet #DP21	29.8	0.003	30	5,255.50	5,255.32	0.31
P-28	5,261.24	5,261.23	71.9	SD CO #DP21-1	SD Tee #DP21	0.2	0.01	8	5,257.19	5,256.47	0.01
P-29	5,261.24	5,261.24	14.6	SD CO #DP21-2	SD CO #DP21-1	0.1	0.01	8	5,257.33	5,257.19	0
P-30	5,261.25	5,261.24	231.8	SD CO #DP21-3	SD CO #DP21-1	0.1	0.01	8	5,259.50	5,257.19	0.01
P-31	5,261.25	5,261.25	4.3	SD CO #DP21-4	SD CO #DP21-3	0.1	0.01	8	5,259.55	5,259.50	0
P-32	5,261.31	5,261.23	15.6	SD INLET #202E	SD Tee #DP21	29.6	0.003	30	5,255.55	5,255.50	0.08
P-33	5,261.50	5,261.31	42.6	SD Tee #202E	SD INLET #202E	27.4	0.005	30	5,256.33	5,256.12	0.19
P-34	5,263.26	5,261.50	36.3	SD CO #202E	SD Tee #202E	10.2	0.01	12	5,257.37	5,257.01	1.76
P-35	5,261.86	5,261.50	202.6	SD Tee #202C	SD Tee #202E	17.2	0.005	30	5,257.34	5,256.33	0.36
P-36	5,261.88	5,261.86	31.3	SD CO #202C	SD Tee #202C	1.2	0.01	12	5,258.33	5,258.02	0.02
P-37	5,261.99	5,261.86	86.8	SD INLET #202B2	SD Tee #202C	16	0.005	30	5,257.77	5,257.34	0.13
P-38	5,262.15	5,261.99	40.9	SD MH #202B2	SD INLET #202B2	14.2	0.005	24	5,258.18	5,257.97	0.16
P-39	5,263.60	5,262.15	39.2	SD CO #202B2	SD MH #202B2	8.9	0.01	12	5,261.40	5,261.00	1.45
P-40	5,262.36	5,262.15	82.1	SD INLET #202B1	SD MH #202B2	5.3	0.005	18	5,258.79	5,258.38	0.21

Profile Report

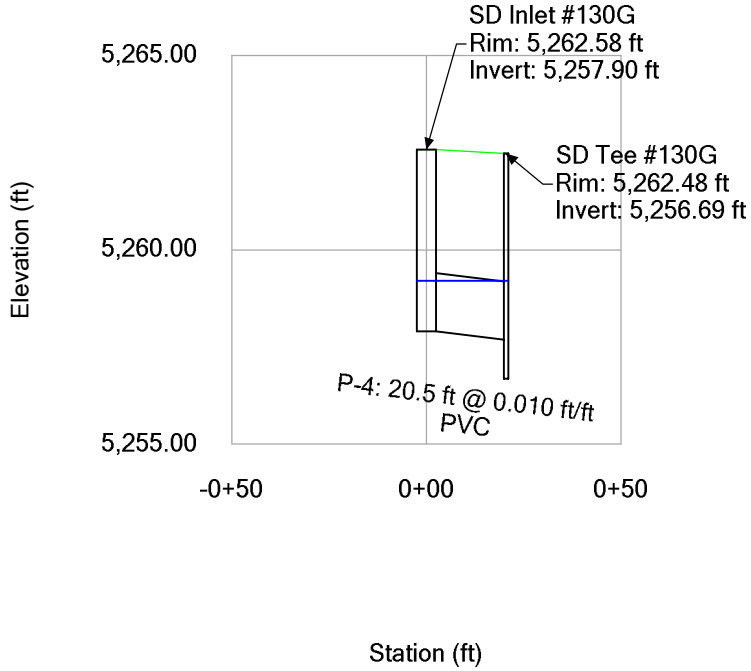
Engineering Profile - Ex SD Connection 1 to Inlet 130A (KSS138-Storm CAD.stsw)



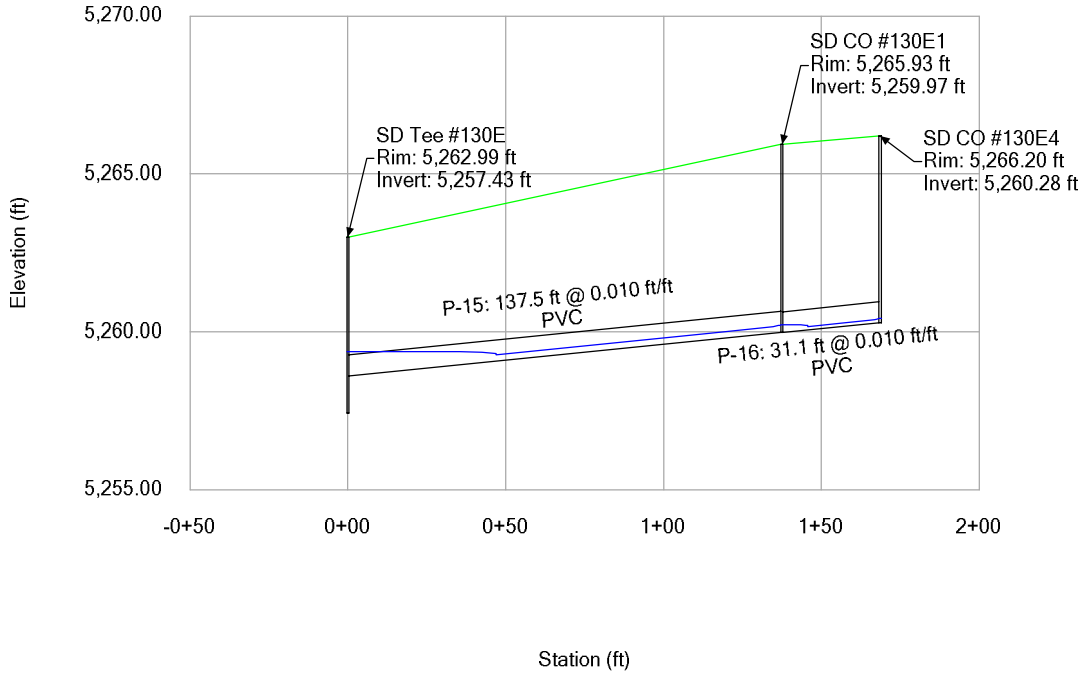
Profile Report
Engineering Profile - Tee 130H to Inlet 130H (KSS138-Storm CAD.stsw)



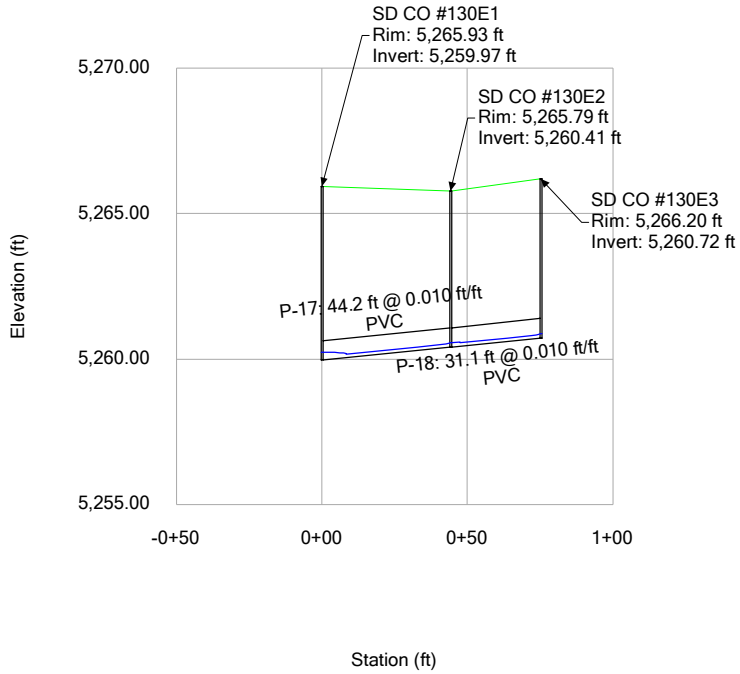
Profile Report
Engineering Profile - Tee 130G to Inlet 130G (KSS138-Storm CAD.stsw)



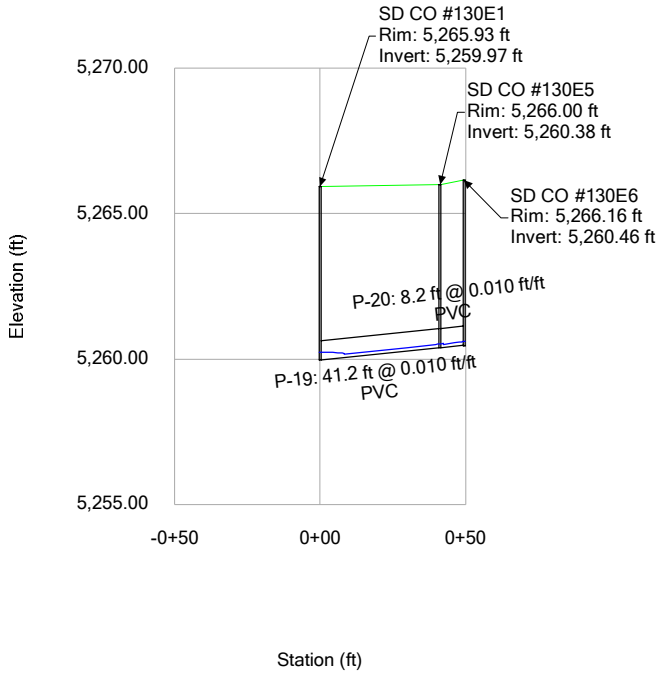
Profile Report
Engineering Profile - Tee 130E to CO 130E4 (KSS138-Storm CAD.stsw)



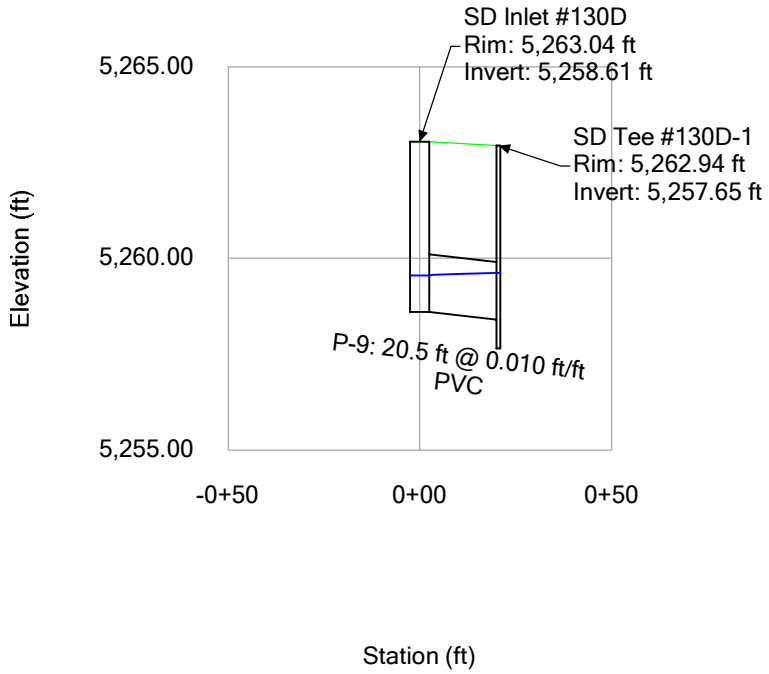
Profile Report
Engineering Profile - CO 130E1 to CO-130E3 (KSS138-Storm CAD.stsw)



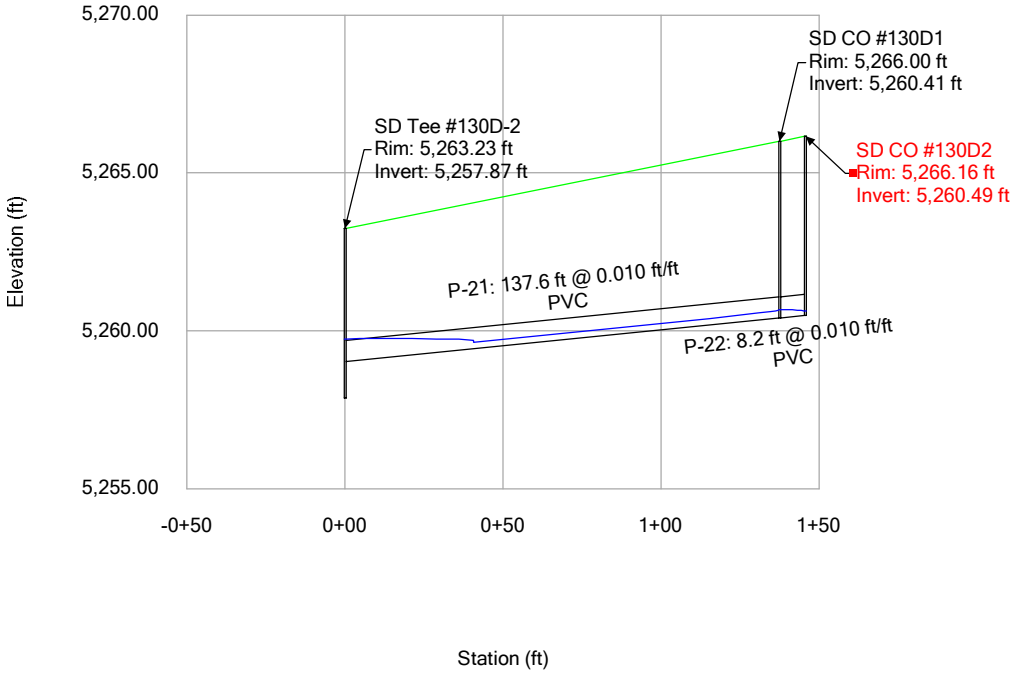
Profile Report
Engineering Profile - CO 130E1 to CO 130E6 (KSS138-Storm CAD.stsw)



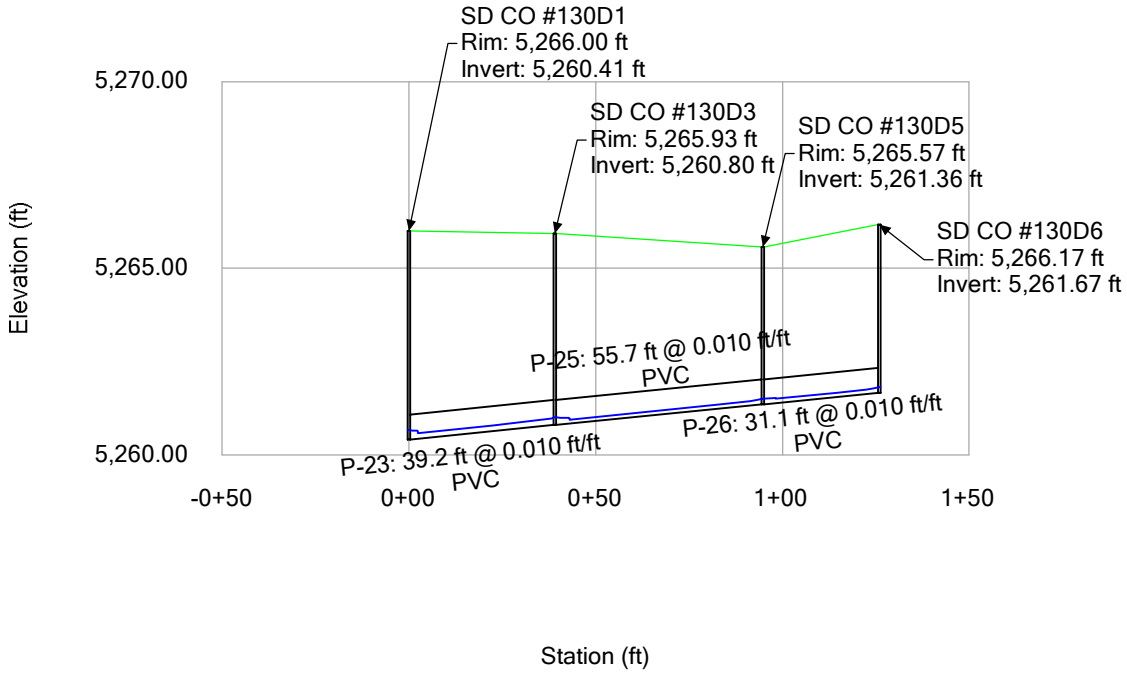
Profile Report
Engineering Profile - Tee 130D1 to Inlet 130D (KSS138-Storm CAD.stsw)



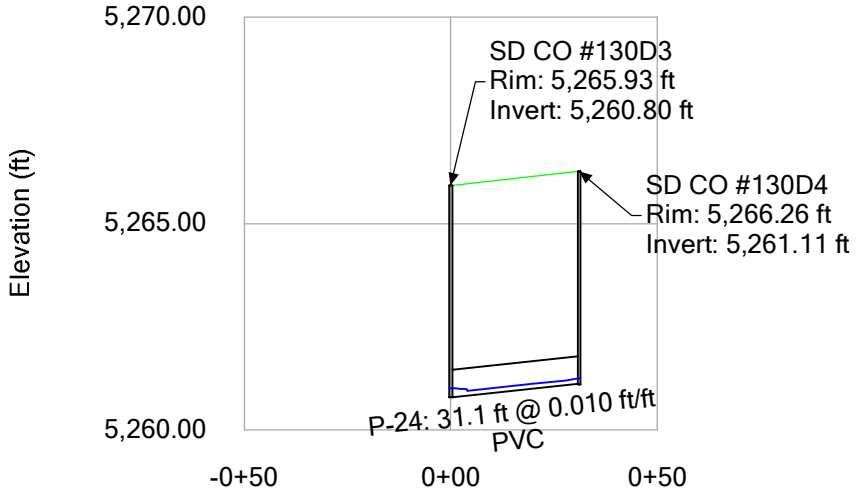
Profile Report
Engineering Profile - Tee 130D2 to CO 130D2 (KSS138-Storm CAD.stsw)



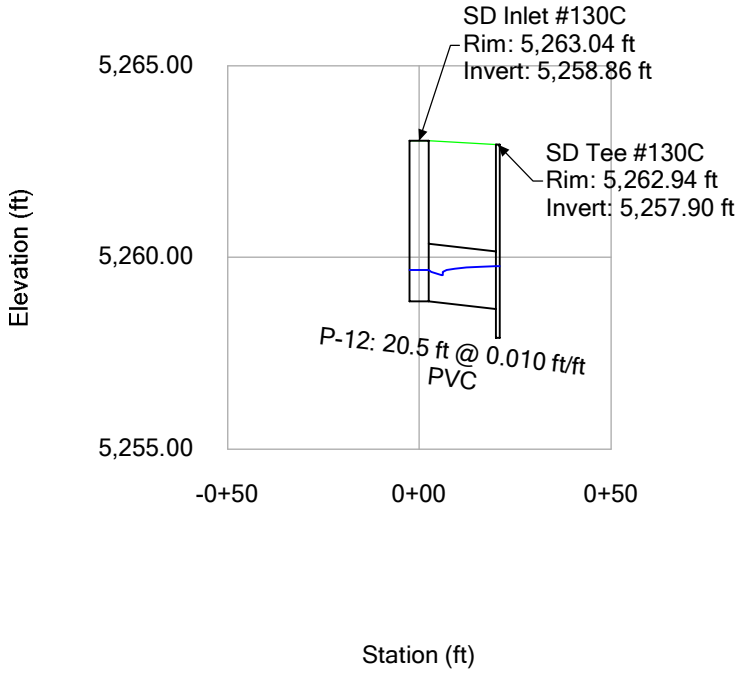
Profile Report
Engineering Profile - CO 130D1 to CO 130D6 (KSS138-Storm CAD.stsw)



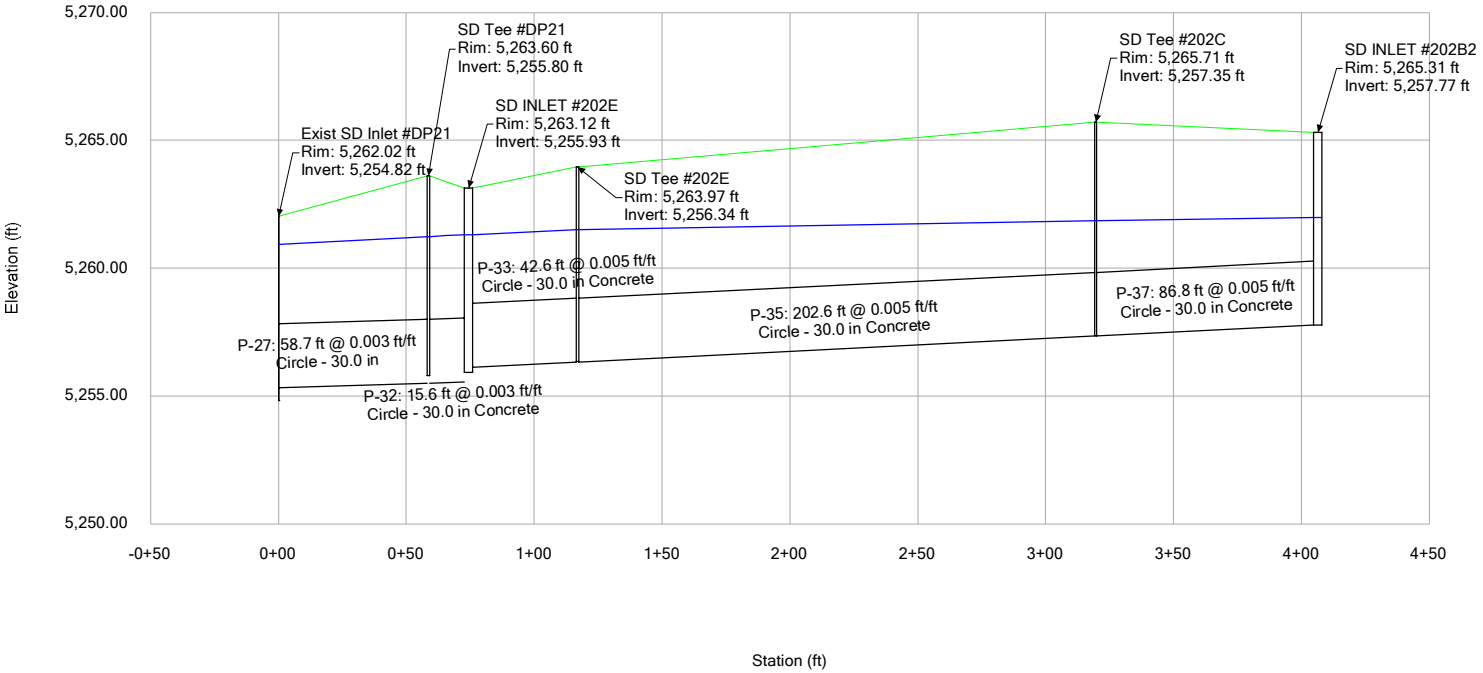
Profile Report
Engineering Profile - CO 130D3 to CO 130D4 (KSS138-Storm CAD.stsw)



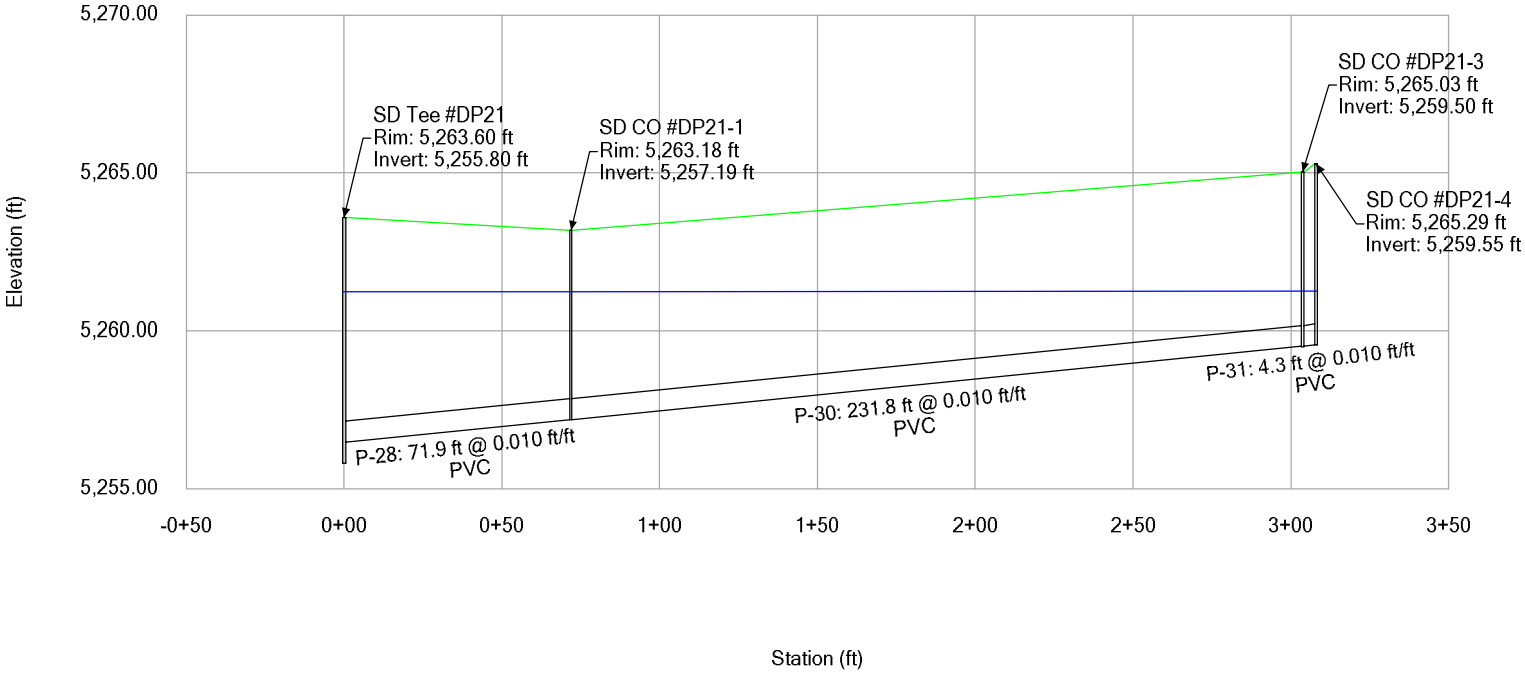
Profile Report
Engineering Profile - Tee 130C to Inlet 130C (KSS138-Storm CAD.stsw)



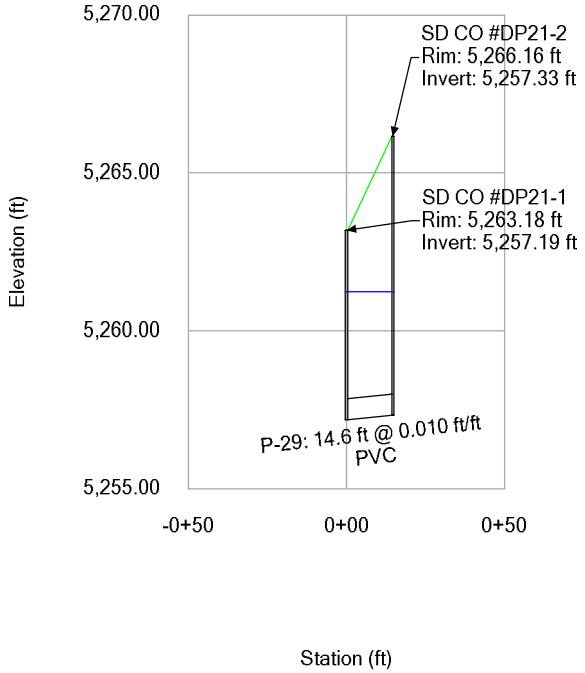
Profile Report
Engineering Profile - Ex Inlet DP21 to Inlet 202B2 (KSS138-Storm CAD.stsw)



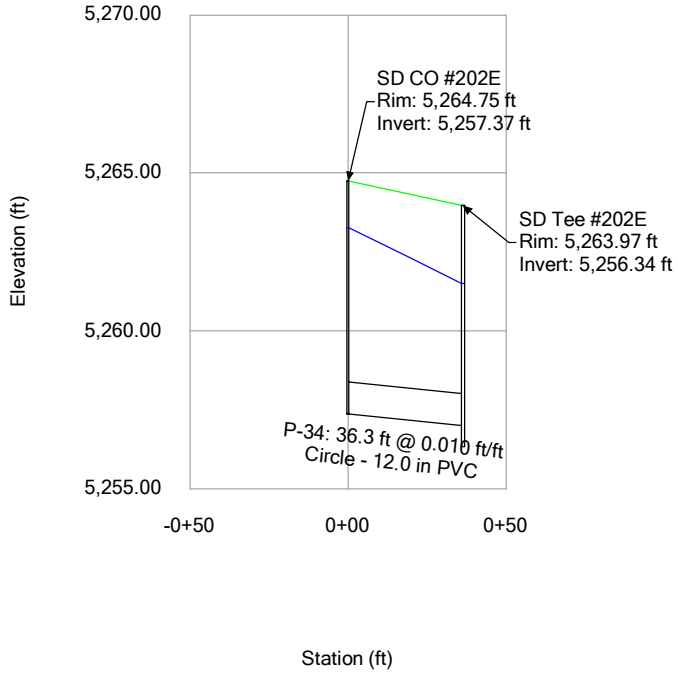
Profile Report
Engineering Profile - Tee DP21 to CO DP21-4 (KSS138-Storm CAD.stsw)



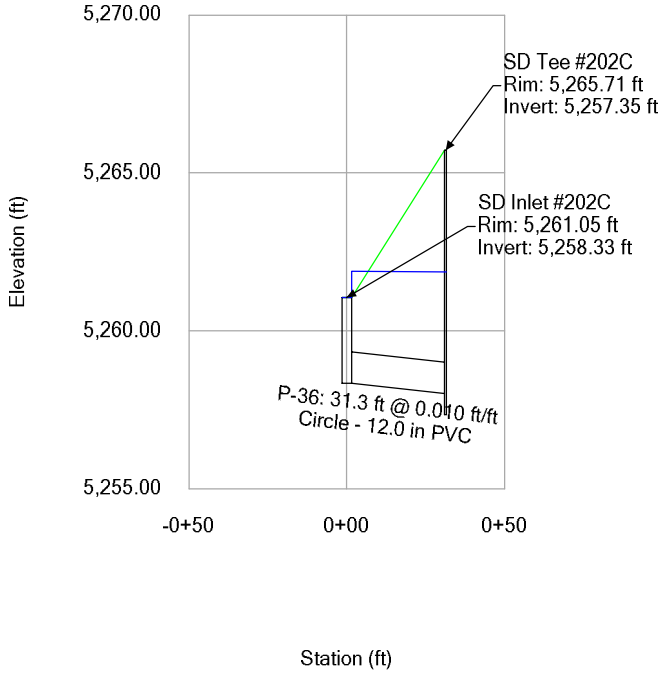
Profile Report
Engineering Profile - CO DP21-1 to CO DP21-2 (KSS138-Storm CAD.stsw)



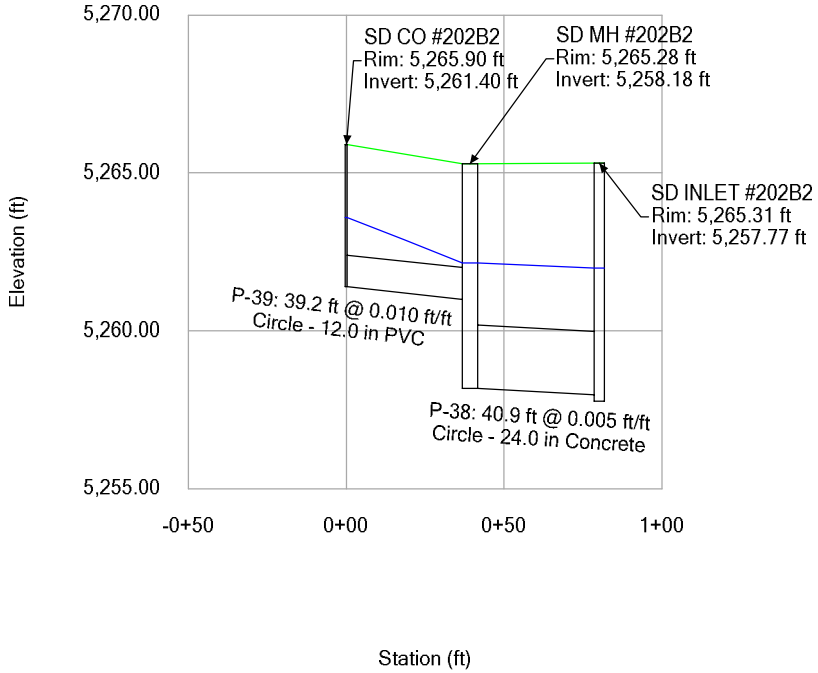
Profile Report
Engineering Profile - Tee 202E to CO-202E (KSS138-Storm CAD.stsw)



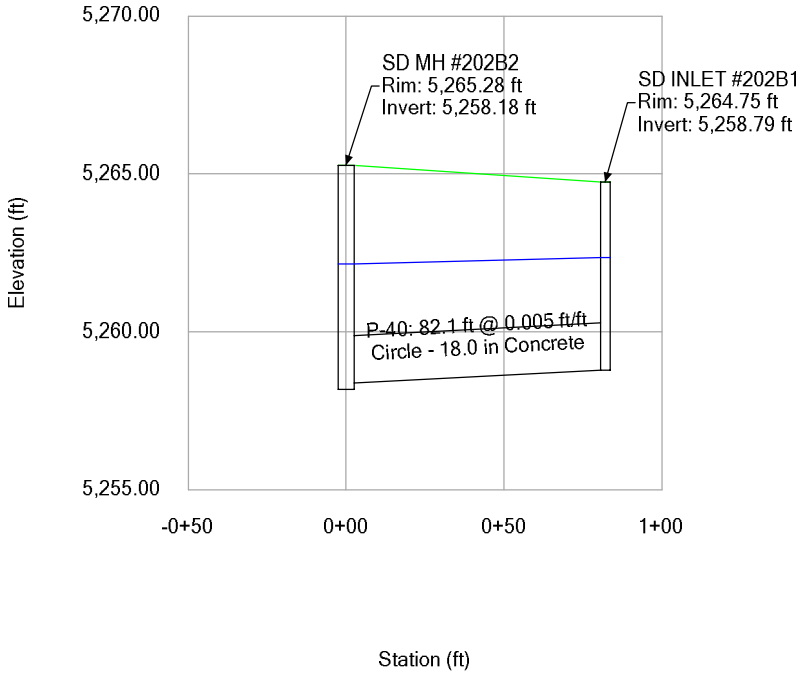
Profile Report
Engineering Profile - Tee 202C to Inlet 202C (KSS138-Storm CAD.stsw)



Profile Report
Engineering Profile - Inlet 202B2 to Co 202B2 (KSS138-Storm CAD.stsw)



Profile Report
Engineering Profile - MH 202B2 to Inlet 202B1 (KSS138-Storm CAD.stsw)



Attachment E
Excerpts from Phase III Drainage Report

Galloway & Company, Inc.
6162 S. Willow Dr., Ste. 320
Greenwood Village, CO 80111
Ph: (303) 770-8884

Job Name: Lowe's at Nine Mile
Job Number: EDI18.20
Date: 1/24/20
By: J. Greenough

Enter Value User Input Cell

Lowe's at Nine Mile Corner

Composite Runoff Coefficient Calculations

Location: Erie
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: B

Basin Design Data									I (%)	Runoff Coefficients			
Basin Name	I (%) =	100%	90%	90%	30%	2%							
	Design Point	$A_{Asphalt}$ (sf)	$A_{Sidewalks}$ (sf)	$A_{Roof\ Area}$ (sf)	$A_{SFHomes}$ (sf)	A_{Lscape} (sf)	A_{Total} (sf)	A_{Total} (ac)	Imp (%)	C_2	C_5	C_{10}	C_{100}
102	1	39,700	0	0	0	4,673	44,373	1.02	90%	0.74	0.76	0.78	0.85
104	3	50,115	0	0	0	5,893	56,008	1.29	90%	0.74	0.76	0.78	0.85
106	5	27,275	0	0	0	3,210	30,485	0.70	90%	0.74	0.76	0.78	0.85
108	7	47,125	0	0	0	5,542	52,667	1.21	90%	0.74	0.76	0.78	0.85
110	9	30,365	0	0	0	3,572	33,937	0.78	90%	0.74	0.76	0.78	0.85
112	11	20,722	0	0	0	740	21,462	0.49	97%	0.81	0.83	0.84	0.88
114	12	33,420	0	0	0	3,936	37,356	0.86	90%	0.74	0.76	0.78	0.85
116	13	0	0	10,023	0	0	10,023	0.23	90%	0.74	0.77	0.79	0.85
118	14	24,156	11,412	0	0	10,899	46,467	1.07	75%	0.60	0.62	0.66	0.78
120	15	0	0	8,033	0	0	8,033	0.18	90%	0.74	0.77	0.79	0.85
122	16	18,531	1,747	0	0	2,152	22,430	0.51	90%	0.74	0.77	0.78	0.85
124	17	2,129	0	0	0	250	2,379	0.05	90%	0.74	0.76	0.78	0.85
126	18	3,415	0	0	0	643	4,058	0.09	84%	0.69	0.72	0.74	0.82
128	20	27,167	0	0	0	3,087	30,254	0.69	90%	0.74	0.77	0.79	0.85
130-Final	21	159,083	15,091	40,070	0	111,868	326,112	7.49	65%	0.50	0.54	0.58	0.73
132	22	38,105	117	0	0	729	38,951	0.89	98%	0.82	0.84	0.85	0.89
134	23	30,274	750	0	0	1,173	32,197	0.74	96%	0.80	0.82	0.84	0.88
136	25	18,446	1,104	0	0	688	20,238	0.46	96%	0.80	0.82	0.84	0.88
138	27	10,568	215	0	0	150	10,933	0.25	98%	0.82	0.85	0.85	0.89
140	28	11,903	1,872	0	0	3,290	17,065	0.39	80%	0.65	0.67	0.71	0.80
142	29	20,499	0	0	0	740	21,239	0.49	97%	0.81	0.83	0.84	0.88
144	32	19,891	1,258	0	0	740	21,889	0.50	96%	0.80	0.82	0.84	0.88
146	34	7,769	299	0	0	385	8,453	0.19	95%	0.79	0.82	0.83	0.87
148	35	15,864	2,704	0	0	1,578	20,146	0.46	91%	0.75	0.78	0.79	0.85
150	36	0	0	27,594	0	0	27,594	0.63	90%	0.74	0.77	0.79	0.85
152	38	12,071	1,222	0	0	0	13,293	0.31	99%	0.83	0.85	0.86	0.89
154	39	0	0	0	0	60,307	60,307	1.38	2%	0.01	0.01	0.07	0.44
156	39	0	0	0	0	24,672	24,672	0.57	2%	0.01	0.01	0.07	0.44
202-Final	40	39,616	8,834	34,082	0	59,798	142,330	3.27	56%	0.42	0.46	0.51	0.69
204	41	24,934	0	0	0	0	24,934	0.57	100%	0.84	0.86	0.87	0.90
206	42	0	0	47,766	0	0	47,766	1.10	90%	0.74	0.77	0.79	0.85

Galloway & Company, Inc.
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Job Name: Lowe's at Nine Mile Corner
Job Number: EDI18.20
Date: 1/24/20
By: J. Greenough

Lowe's at Nine Mile Corner

Developed Storm Runoff Calculations

Design Storm : **5 Year**

Point Hour Rainfall (P_1) : **1.11**

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time				
Basin Name	Design Point	Area (ac)	Runoff Coeff	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Total t_c (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Description / Struture / Inlet Type	Q intercepted	Q carryover	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Approx. Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)	Travel Time (min)	Total Time (min)	Notes
102	1	1.02	0.76	5.0	0.78	3.76	2.9					Stub to future lot												
104	3	1.29	0.76	5.0	0.98	3.76	3.7					Stub to future lot												
106	5	0.70	0.76	5.0	0.53	3.76	2.0					Stub to future lot												
108	7	1.21	0.76	5.0	0.92	3.76	3.5					Stub to future lot												
110	9	0.78	0.76	5.0	0.60	3.76	2.2					Stub to future lot												
112	11	0.49	0.83	5.0	0.41	3.76	1.5					Type R inlet												
114	12	0.86	0.76	5.0	0.66	3.76	2.5					Stub to future lot												
116	13	0.23	0.77	5.0	0.18	3.76	0.7					Roof drain lateral												
118	14	1.07	0.62	5.0	0.67	3.76	2.5					Type R inlet												
120	15	0.18	0.77	5.0	0.14	3.76	0.5					Roof drain lateral												
122	16	0.51	0.77	5.0	0.39	3.76	1.5					Type R Inlet												
124	17	0.05	0.76	5.0	0.04	3.76	0.2					Type 13 combination inlet												
126	18	0.09	0.72	5.0	0.07	3.76	0.3					Type 13 combination inlet												
128	20	0.69	0.77	5.0	0.53	3.76	2.0					Stub to future lot												
130-Final	21	7.49	0.54	7.3	4.01	3.37	13.5					Stub to future lot												
132	22	0.89	0.84	6.1	0.75	3.56	2.7					Type R inlet												
134	23	0.74	0.82	5.0	0.61	3.76	2.3					Type R inlet												
136	25	0.46	0.82	5.0	0.38	3.76	1.4					Type R inlet												
138	27	0.25	0.85	5.0	0.21	3.76	0.8					Type R inlet												
140	28	0.39	0.67	5.0	0.26	3.76	1.0					Type R inlet												
142	29	0.49	0.83	5.0	0.40	3.76	1.5					Type R inlet												
144	32	0.50	0.82	5.0	0.41	3.76	1.6					Type R inlet												
146	34	0.19	0.82	5.0	0.16	3.76	0.6					Type R inlet												
148	35	0.46	0.78	5.0	0.36	3.76	1.4					Type R inlet												
150	36	0.63	0.77	5.0	0.49	3.76	1.8					Area drains for garden center												
152	38	0.31	0.85	5.0	0.26	3.76	1.0					Type R inlet												
154	39	1.38	0.01	5.0	0.02	3.76	0.1					E. Detention Pond												
156	39	0.57	0.01	5.0	0.01	3.76	0.0					W. Detention Pond												
202-Final	40	3.27	0.46	7.8	1.49	3.29	4.9					Stub to future lot												
204	41	0.57	0.86	5.0	0.49	3.76	1.9					Type R inlet												
206	42	1.10	0.77	5.0	0.84	3.76	3.2					Roof drain lateral												
208	43	0.16	0.86	5.0	0.14	3.76	0.5					Type R inlet												
210	44	1.58	0.77	5.0	1.21	3.76	4.6					Roof drain lateral												
212	45	0.23	0.86	5.0	0.19	3.76	0.7					Type R inlet												
213	46	0.10	0.86	5.0	0.08	3.76	0.3					Area drain for truck dock												
214	48	0.31	0.86	5.0	0.26	3.76	1.0					Type R inlet												

Q Minor

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Ph: (303) 770-8884

Job Name: Lowe's at Nine Mile Corner
Job Number: EDI18.20
Date: 1/24/20
By: J. Greenough

Lowe's at Nine Mile Corner

Developed Storm Runoff Calculations

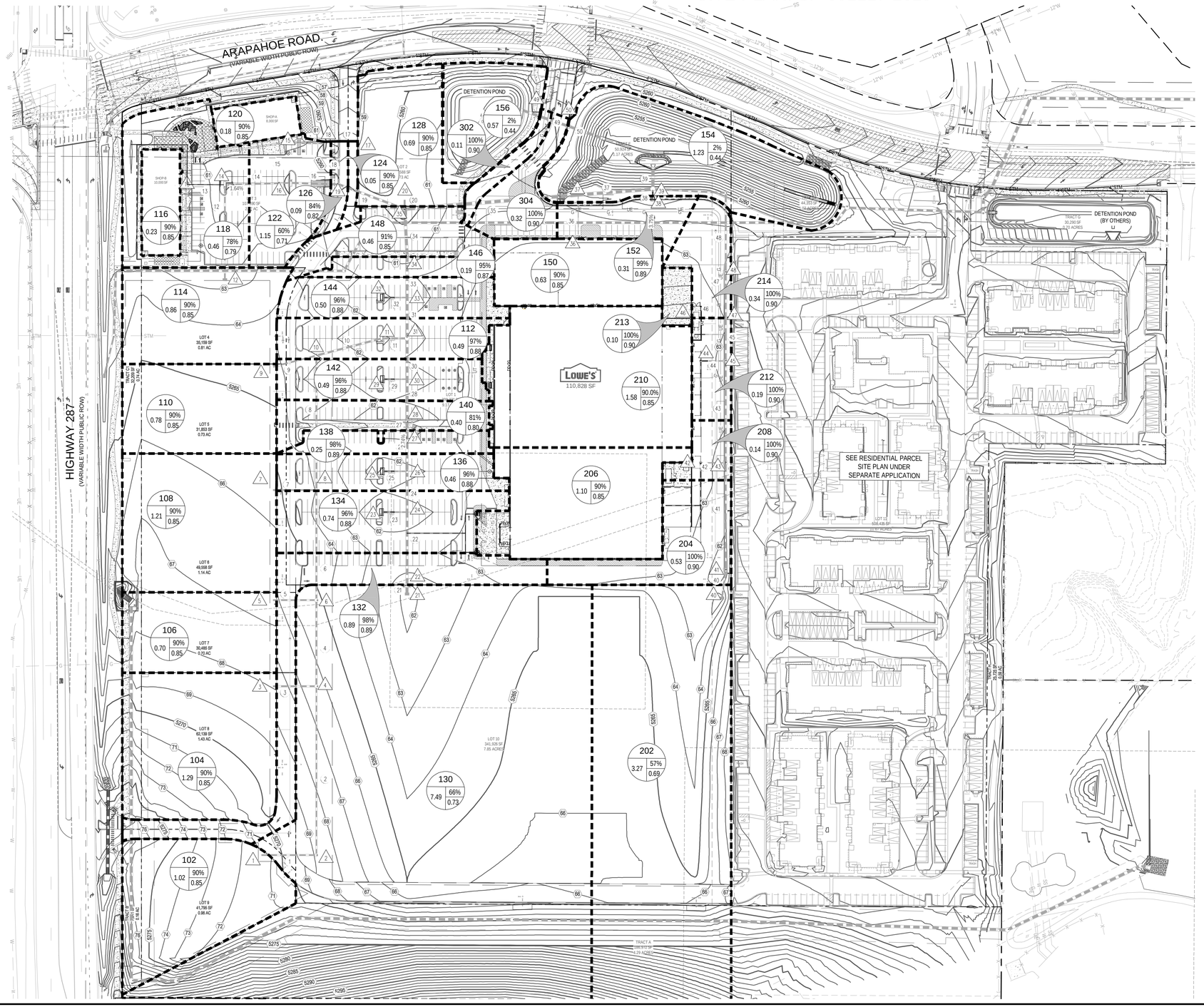
Design Storm : **100 Year**

Point Hour Rainfall (P_1) : **2.68**

	Direct Runoff							Total Runoff				Inlets			Pipe					Pipe/Swale Travel Time				
Basin Name	Design Point	Area (ac)	Runoff Coeff	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Total tc (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Description / Struture / Inlet Type	Q intercepted	Q carryover	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Approx. Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)	Travel Time (min)	Total Time (min)	Notes
102	1	1.02	0.85	5.0	0.86	9.09	7.8					Stub to future lot												
104	3	1.29	0.85	5.0	1.09	9.09	9.9					Stub to future lot												
106	5	0.70	0.85	5.0	0.59	9.09	5.4					Stub to future lot												
108	7	1.21	0.85	5.0	1.02	9.09	9.3					Stub to future lot												
110	9	0.78	0.85	5.0	0.66	9.09	6.0					Stub to future lot												
112	11	0.49	0.88	5.0	0.43	9.09	3.9					Type R inlet												
114	12	0.86	0.85	5.0	0.73	9.09	6.6					Stub to future lot												
116	13	0.23	0.85	5.0	0.20	9.09	1.8					Roof drain lateral												
118	14	1.07	0.78	5.0	0.83	9.09	7.5					Type R inlet												
120	15	0.18	0.85	5.0	0.16	9.09	1.4					Roof drain lateral												
122	16	0.51	0.85	5.0	0.44	9.09	4.0					Type R Inlet												
124	17	0.05	0.85	5.0	0.05	9.09	0.4					Type 13 combination inlet												
126	18	0.09	0.82	5.0	0.08	9.09	0.7					Type 13 combination inlet												
128	20	0.69	0.85	5.0	0.59	9.09	5.4					Stub to future lot												
130-Final	21	7.49	0.73	7.3	5.47	8.13	44.4					Stub to future lot												
132	22	0.89	0.89	6.1	0.79	8.60	6.8					Type R inlet												
134	23	0.74	0.88	5.0	0.65	9.09	5.9					Type R inlet												
136	25	0.46	0.88	5.0	0.41	9.09	3.7					Type R inlet												
138	27	0.25	0.89	5.0	0.22	9.09	2.0					Type R inlet												
140	28	0.39	0.80	5.0	0.31	9.09	2.9					Type R inlet												
142	29	0.49	0.88	5.0	0.43	9.09	3.9					Type R inlet												
144	32	0.50	0.88	5.0	0.44	9.09	4.0					Type R inlet												
146	34	0.19	0.87	5.0	0.17	9.09	1.5					Type R inlet												
148	35	0.46	0.85	5.0	0.39	9.09	3.6					Type R inlet												
150	36	0.63	0.85	5.0	0.54	9.09	4.9					Area drains for garden center												
152	38	0.31	0.89	5.0	0.27	9.09	2.5					Type R inlet												
154	39	1.38	0.44	5.0	0.60	9.09	5.5					E. Detention Pond												
156	39	0.57	0.44	5.0	0.25	9.09	2.2					W. Detention Pond												
202-Final	40	3.27	0.69	7.8	2.25	7.95	17.9					Stub to future lot												
204	41	0.57	0.90	5.0	0.51	9.09	4.7					Type R inlet												
206	42	1.10	0.85	5.0	0.93	9.09	8.5					Roof drain lateral												
208	43	0.16	0.90	5.0	0.14	9.09	1.3					Type R inlet												
210	44	1.58	0.85	5.0	1.34	9.09	12.2					Roof drain lateral												
212	45	0.23	0.90	5.0	0.20	9.09	1.8					Type R inlet												
213	46	0.10	0.90	5.0	0.09	9.09	0.8					Area drain for truck dock												
214	48	0.31	0.90	5.0	0.27	9.09	2.5					Type R inlet												

NINE MILE CORNER - SITE PLAN CONSTRUCTION DOCUMENTS

A PORTION OF NE 1/4 OF SECTION 34, TOWNSHIP 1 NORTH, RANGE 69 WEST AND THE
SOUTHEAST QUARTER OF SECTION 27, TOWNSHIP 1 NORTH, RANGE 69 WEST OF THE 6TH
PRINCIPLE MERIDIAN, TOWN OF ERIE, COUNTY OF BOULDER, COLORADO
SITE PLAN: SP-001117-2019



DRAINAGE LEGEND

- 5575 — EXISTING MAJOR CONTOUR
- 5574 — EXISTING MINOR CONTOUR
- 75 — PROPOSED MAJOR CONTOUR
- 74 — PROPOSED MINOR CONTOUR
- STS — EXISTING STORM SEWER
- PROPOSED STORM SEWER
- MAJOR BASIN BOUNDARY LINE
- FLOW ARROW
- DESIGN POINT
- 1 — PIPE LABEL
- 102 — BASIN DESIGNATION
- 0.00% — COMPOSITE PERCENT IMPERVIOUS
- 0.00 — PEAK 100-YEAR RUNOFF COEFFICIENT
- 0.00 — BASIN AREA IN ACRES

BASIN SUMMARY TABLE

Tributary Sub-Basin	Area (acres)	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)	100-Yr Routed Design Point	100-Yr Routed Flow (cfs)
102	1.02	0.76	0.85	5	2.9	7.8	1	7.8
							2	7.8
104	1.29	0.76	0.85	5	3.7	9.9	3	9.9
							4	16.3
106	0.70	0.76	0.85	5	2.0	5.4	5	5.4
							6	20.6
108	1.21	0.76	0.85	5	3.5	9.3	7	9.3
							8	27.9
110	0.78	0.76	0.85	5	2.2	6.0	9	6.0
							10	32.1
112	0.49	0.83	0.88	5	1.5	3.9	11	34.9
114	0.86	0.76	0.85	5	2.5	6.6	12	6.6
116	0.23	0.77	0.85	5	0.7	1.8	13	1.8
118	1.07	0.62	0.78	5	2.5	7.5	14	18.5
120	0.18	0.77	0.85	5	0.5	1.4	15	1.4
122	0.51	0.77	0.85	5	1.5	4.0	16	31.7
124	0.05	0.76	0.85	5	0.2	0.4	17	0.4
126	0.09	0.72	0.82	5	0.3	0.7	18	0.7
							19	23.4
128	0.69	0.77	0.85	5	2.0	5.4	20	5.4
130-Final	7.49	0.54	0.73	12.9	13.5	44.4	21	44.4
132	0.89	0.84	0.89	6.1	2.7	6.8	22	52.0
134	0.74	0.82	0.88	5	2.3	5.9	23	5.9
							24	56.7
136	0.46	0.82	0.88	5	1.4	3.7	25	3.7
							26	59.6
138	0.25	0.85	0.89	5	0.8	2.0	27	61.0
140	0.39	0.67	0.80	5	1.0	2.9	28	63.5
142	0.49	0.83	0.88	5	1.5	3.9	29	3.9
							30	66.6
							31	96.3
144	0.50	0.82	0.88	5	1.6	4.0	32	4.0
							33	98.9
146	0.19	0.82	0.87	5	0.6	1.5	34	99.4
148	0.46	0.78	0.85	5	1.4	3.6	35	111.5
150	0.63	0.77	0.85	5	1.8	4.9	36	4.9
							37	113.2
152	0.31	0.85	0.89	5	1.0	2.5	38	2.5
154	1.38	0.01	0.44	5	0.1	5.5		5.5
156	0.57	0.01	0.44	5	0.0	2.2		2.2
							39	148.2
202-Final	3.27	0.46	0.69	12.7	4.9	17.9	40	17.9
204	0.57	0.86	0.90	5	1.9	4.7	41	22.1
206	1.10	0.77	0.85	5	3.2	8.5	42	8.5
208	0.16	0.86	0.90	5	0.5	1.3	43	29.9
210	1.58	0.77	0.85	5	4.6	12.2	44	12.2
212	0.23	0.86	0.90	5	0.7	1.8	45	40.9
213	0.10	0.86	0.90	5	0.3	0.8	46	0.8
							47	41.3
214	0.31	0.86	0.90	5	1.0	2.5	48	43.4
302	0.11	0.86	0.90	5	0.4	0.9	49	0.9
304	0.32	0.86	0.90	5	1.0	2.6	50	2.6

REVISIONS

◇ PRE-BID SET ISSUE DATE △ POST BID SET ISSUE DATE

DATE	DESCRIPTION
11/25/19	1ST SITE CD SUB.
01/29/20	2ND SITE CD SUB.

Evergreen Development | Services | Investments
Galloway
6162 S. Willow Drive, Suite 320
Greenwood Village, CO 80111
303.770.8884
gallowayus.com

LOWE'S HOME CENTERS, LLC
1000 Lowes Boulevard
Mooresville, NC 28117

704.758.1000 (V)

LOWE'S

SITE PLAN CONSTRUCTION DOCUMENTS
DRAINAGE PLAN

LOWE'S OF:
ERIE, COLORADO

PROJECT No: EDV000018.20 | DRAWN BY: | CHECKED BY:

CRITERIA
ISSUE DATE: 11.21.19

PERMIT SET
ISSUE DATE:

CONSTRUCTION SET
ISSUE DATE:

DRAWING NUMBER:
DR02

Galloway
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Greenwood Village, CO 80111
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May 14, 2021

Tyler Burhenn
Town of Erie - Engineering Division
645 Holbrook Street
Erie, Colorado 80516

RE: Lot 10 (King Soopers #138) – Nine Mile Corner – Utility Conformance Letter

Dear Mr. Burhenn,

This utility conformance letter has been prepared for the King Soopers development at Lot 10, Block 1, Nine Mile Subdivision Filing No. 1 in Erie, Colorado. The objective of this letter is to show that the proposed utility design for the site conforms to the current Town of Erie *Standards and Specifications, Section 600 – Water Supply Facilities*, *Section 700 – Sanitary Sewer Facilities,* and the *Final Utility Report for Nine Mile Corner at Nine Mile Subdivision Filing No. 1* prepared by Galloway & Company, Inc. accepted by the Town of Erie, January 24, 2020.

Lot 10 is 341,926 square feet (7.85 acres) and will contain a King Soopers grocery store that is 103,000 square feet. Additional site improvements include wet and dry utility mains and service lines, paved parking areas and drive aisles, and landscaping. All proposed water and sanitary sewer mains will be publicly owned, maintained, and dedicated to the Town of Erie. Service lines that connect to mains will be privately owned and maintained by King Soopers.

Calculated Water Demands:

Maximum Daily Demand (MDD) for the site was calculated per the Town of Erie *Standards and Specifications, Section 600 – Water Supply Facilities* being 3,000 gpd/acre for commercial areas. The Peak Hour Demand (PHD) was calculated by multiplying the MDD by the Peak Hour Demand Factor of 2. For the King Soopers site the water system MDD was calculated as 23,550 gdp and the PHD was calculated as 49.06 gpm. Maximum Daily and Peak Hour Demands for the site are presented in the table below.

Water Demand Table						
Lot	Land Use	Area (acres)	Max Day Demand (gpd/acre)	Calculated MDD (gpd)	PHD Factor	PHD (gpm)
10	Commercial	7.85	3,000	23,550	2.0	49.06

Fire flow demands were calculated based on 2018 International Fire Code flow rates. The King Soopers building will be construction type VB. Based on Table B 105.1, a minimum fire flow demand of 8,000 gpm was derived. An automatic commercial sprinkler system is to be installed within the building allowing for the required fire flow to be 25% of the derived fire flow demand, resulting in a final required fire flow of 2,000 gpm for a 2-hour duration. An excerpt of Table B 105.1 is attached for reference.

Water System:

An existing 12” stub and 8” stub is provided along the north side of the site. Connections being made to the existing 8” water main that runs along the south side of the site will require tees to be cut into the existing main. An 8” water main running N-S is proposed at the front of the King Soopers store to service fire hydrants. Another 8” water main running N-S is proposed at the back of the store to provide water service to the building.

Bentley WaterCAD was used to model the water hydraulics for the site in relation to the overall development. Per the Town of Erie minimum design standards, the following hydraulic scenarios have been analyzed:

- Max Daily Demand
- Peak Hour Demand
- Peak Hour Demand plus Fire Flow

The Town of Erie minimum design standards requires that water distribution pipes have a maximum velocity of 10 feet per second. Per the WaterCAD hydraulic analysis, this criterion is being met for the site during the highest demand scenario of PHD plus Fire Flow (refer to Attachment C).

A fire flow analysis was conducted to model the fire flow demands for the King Soopers sprinkler system, fire line, and proposed fire hydrants. The fire flow for the sprinkler system is assumed to be 800 gpm. Based on IFC Table B 105.1, a hydrant flow of 2,000 gpm spread out between 2 fire hydrants is also required. The hydraulic modeling provided with Attachment C shows the required fire flow for the site can be supplied while maintaining a residual pressure of at least 20 psi. A fire pump will not be required to satisfy the sprinkler design requirements at adequate pressures and pipe velocities.

Calculated Wastewater Flows:

Maximum Daily Flows (MDF) for wastewater were calculated per the Town of Erie *Standards and Specifications Section 700 – Sanitary Sewer Facilities*, being 1,000 gallons/acre/day for commercial areas. Peak Design Flows (PDF) were determined by multiplying the Maximum Daily Flow by the Peaking Factor (PF). The Peaking Factor is calculated using the following equation:

$$PF = 2.6 * Q_{Max\ Day}{}^{-0.16}$$

The Peaking Factor shall not be less than 2.0 or greater than 4.0 per Town of Erie criteria.

The Peak Design Flow rate for the King Soopers site was calculated to be 31,400 gpd or 0.05 cfs. All sanitary flow calculations are shown below.

Commercial Area =	7.85 acres
Commercial MDF required =	1,000 gal/acre/day
Calculated MDF =	7,850 gal/day
Peaking Factor =	4
Peak Design Flow Rate =	31,400 gal/day
	0.05 cfs

Wastewater System:

An existing 8” sanitary sewer stub is provided at the northeast corner of the site. The 8” sanitary sewer main will be extended south behind the King Soopers building to provide service laterals to the northeast corner and south side of the building. A grease interceptor is also proposed along the south side of the building.

Conclusions:

No changes are proposed from the design and calculations presented in the *Final Utility Report for Nine Mile Corner at Nine Mile Subdivision Filing No. 1*. Therefore, the proposed King Soopers site will not have an adverse impact on the existing utility infrastructure.

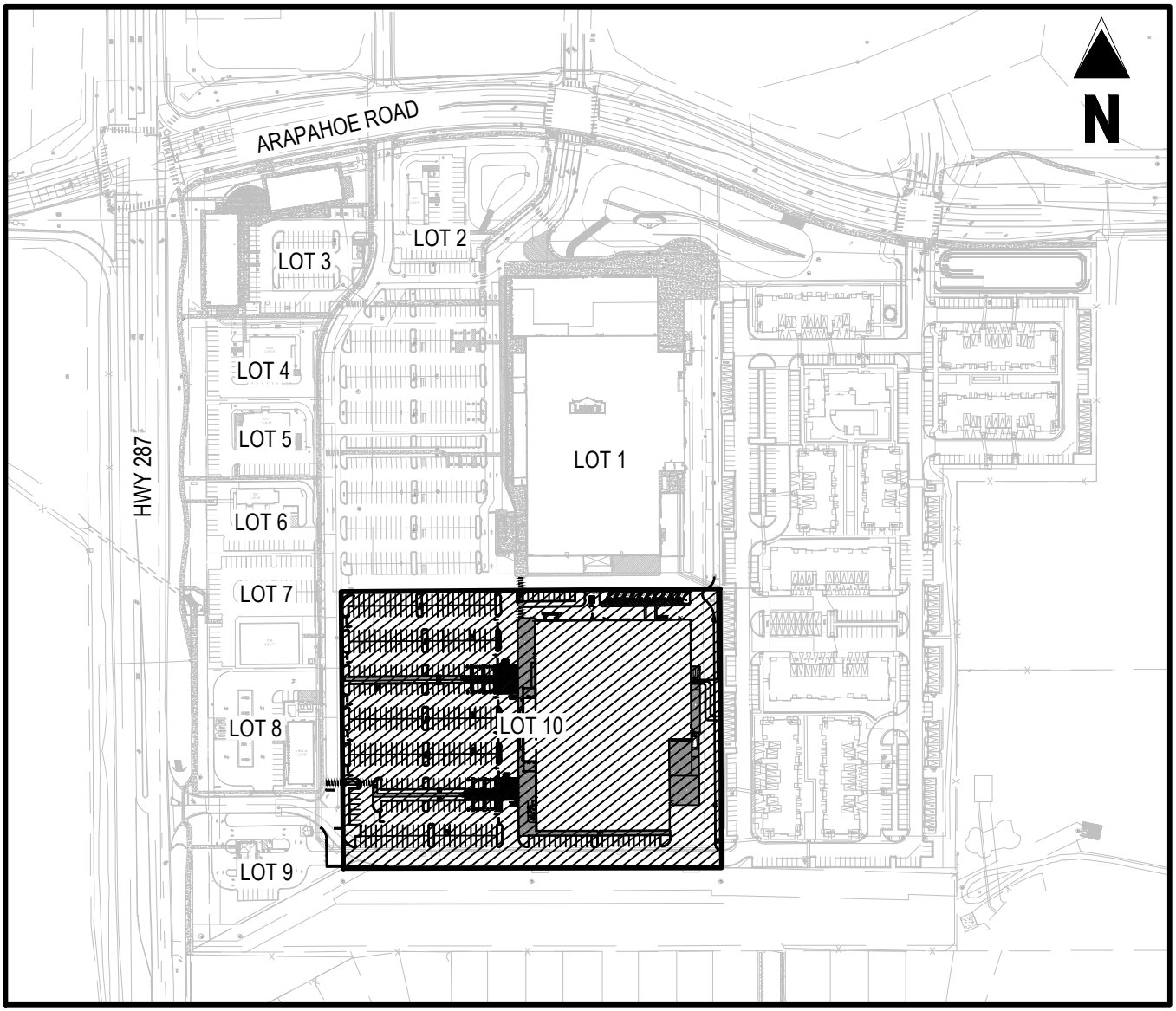
I affirm that the proposed water and sanitary design for Lot 10, Nine Mile Subdivision Filing No. 1 in Erie, Colorado is in conformance with the Town of Erie *Standards and Specifications, Section 600 – Water Supply Facilities*, *Section 700 – Sanitary Sewer Facilities,* and the *Final Utility Report for Nine Mile Corner at Nine Mile Subdivision Filing No. 1* prepared by Galloway & Company, Inc. accepted by the Town of Erie, January 24, 2020.

Sincerely,
GALLOWAY

Aaron Johnston, PE
aaronjohnston@gallowayus.com

Attachments
Vicinity Map (Attachment A)
Fire Flow Calculations (Attachment B)
WaterCAD Calculations (Attachment C)

Attachment A
Vicinity Map



SCALE: 1" = 300'

KING SOOPERS #138 (LOT 10)

-

ERIE NINE MILE CORNER

-

VICINITY MAP

Project No:	EDI000068
Drawn By:	RDG
Checked By:	ACJ
Date:	05/04/2021

Galloway

6162 S. Willow Drive, Suite 320
Greenwood Village, CO 80111
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Attachment B
Fire Flow Calculations

APPENDIX B

FIRE-FLOW REQUIREMENTS FOR BUILDINGS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance or legislation of the jurisdiction.

User note:

About this appendix: *Appendix B provides a tool for the use of jurisdictions in establishing a policy for determining fire-flow requirements in accordance with Section 507.3. The determination of required fire flow is not an exact science, but having some level of information provides a consistent way of choosing the appropriate fire flow for buildings throughout a jurisdiction. The primary tool used in this appendix is a table that presents fire flow based on construction type and building area based on the correlation of the Insurance Services Office (ISO) method and the construction types used in the* International Building Code®.

SECTION B101
GENERAL

B101.1 Scope. The procedure for determining fire-flow requirements for buildings or portions of buildings hereafter constructed shall be in accordance with this appendix. This appendix does not apply to structures other than buildings.

SECTION B102
DEFINITIONS

B102.1 Definitions. For the purpose of this appendix, certain terms are defined as follows:

FIRE FLOW. The flow rate of a water supply, measured at 20 pounds per square inch (psi) (138 kPa) residual pressure, that is available for fire fighting.

FIRE-FLOW CALCULATION AREA. The floor area, in square feet (m^2), used to determine the required fire flow.

SECTION B103
MODIFICATIONS

B103.1 Decreases. The *fire code official* is authorized to reduce the *fire-flow* requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full *fire-flow* requirements is impractical.

B103.2 Increases. The *fire code official* is authorized to increase the *fire-flow* requirements where conditions indicate an unusual susceptibility to group fires or conflagrations. An increase shall be not more than twice that required for the building under consideration.

B103.3 Areas without water supply systems. For information regarding water supplies for fire-fighting purposes in rural and suburban areas in which adequate and reliable water supply systems do not exist, the *fire code official* is authorized to utilize NFPA 1142 or the *International Wildland-Urban Interface Code*.

SECTION B104
FIRE-FLOW CALCULATION AREA

B104.1 General. The *fire-flow calculation area* shall be the total floor area of all floor levels within the *exterior walls*, and under the horizontal projections of the roof of a building, except as modified in Section B104.3.

B104.2 Area separation. Portions of buildings that are separated by *fire walls* without openings, constructed in accordance with the *International Building Code*, are allowed to be considered as separate *fire-flow calculation areas*.

B104.3 Type IA and Type IB construction. The *fire-flow calculation area* of buildings constructed of Type IA and Type IB construction shall be the area of the three largest successive floors.

Exception: *Fire-flow calculation area* for open parking garages shall be determined by the area of the largest floor.

SECTION B105
FIRE-FLOW REQUIREMENTS FOR BUILDINGS

B105.1 One- and two-family dwellings, Group R-3 and R-4 buildings and townhouses. The minimum *fire-flow* and flow duration requirements for one- and two-family *dwellings*, Group R-3 and R-4 buildings and *townhouses* shall be as specified in Tables B105.1(1) and B105.1(2).

B105.2 Buildings other than one- and two-family dwellings, Group R-3 and R-4 buildings and townhouses. The minimum *fire-flow* and flow duration for buildings other than one- and two-family *dwellings*, Group R-3 and R-4 buildings and *townhouses* shall be as specified in Tables B105.2 and B105.1(2).

B105.3 Water supply for buildings equipped with an automatic sprinkler system. For buildings equipped with an *approved automatic sprinkler system*, the water supply shall be capable of providing the greater of:

1. The *automatic sprinkler system* demand, including hose stream allowance.
2. The required *fire flow*.

TABLE B105.1(1)
REQUIRED FIRE FLOW FOR ONE- AND TWO-FAMILY DWELLINGS, GROUP R-3 AND R-4 BUILDINGS AND TOWNHOUSES

FIRE-FLOW CALCULATION AREA (square feet)	AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE FLOW (gallons per minute)	FLOW DURATION (hours)
0–3,600	No automatic sprinkler system	1,000	1
3,601 and greater	No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2) at the required fire-flow rate
0–3,600	Section 903.3.1.3 of the *International Fire Code* or Section P2904 of the *International Residential Code*	500	$^1/_2$
3,601 and greater	Section 903.3.1.3 of the *International Fire Code* or Section P2904 of the *International Residential Code*	$^1/_2$ value in Table B105.1(2)	1

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m.

TABLE B105.1(2)
REFERENCE TABLE FOR TABLES B105.1(1) AND B105.2

FIRE-FLOW CALCULATION AREA (square feet)					FIRE FLOW (gallons per minute)[b]	FLOW DURATION (hours)
Type IA and IB[a]	Type IIA and IIIA[a]	Type IV and V-A[a]	Type IIB and IIIB[a]	Type V-B[a]		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	2
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	3
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	4
—	—	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
—	—	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
—	—	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
—	—	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
—	—	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
—	—	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
—	—	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
—	—	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

reduction for sprinklered building

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.

a. Types of construction are based on the *International Building Code*.

b. Measured at 20 psi residual pressure.

TABLE B105.2
REQUIRED FIRE FLOW FOR BUILDINGS OTHER THAN ONE- AND TWO-FAMILY DWELLINGS, GROUP R-3 AND R-4 BUILDINGS AND TOWNHOUSES

AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE FLOW (gallons per minute)	FLOW DURATION (hours)
No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2)
Section 903.3.1.1 of the *International Fire Code*	25% of the value in Table B105.1(2)[a]	Duration in Table B105.1(2) at the reduced flow rate
Section 903.3.1.2 of the *International Fire Code*	25% of the value in Table B105.1(2)[b]	Duration in Table B105.1(2) at the reduced flow rate

For SI: 1 gallon per minute = 3.785 L/m.

a. The reduced fire flow shall be not less than 1,000 gallons per minute.

b. The reduced fire flow shall be not less than 1,500 gallons per minute.

SECTION B106
REFERENCED STANDARDS

ICC	IBC—18	International Building Code	B104.2
ICC	IWUIC—18	International Wildland-Urban Interface Code	B103.3
ICC	IRC—18	International Residential Code	Table B105.1(1)
NFPA	1142—17	Standard on Water Supplies for Suburban and Rural Fire Fighting	B103.3

APPENDIX C
FIRE HYDRANT LOCATIONS AND DISTRIBUTION

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance or legislation of the jurisdiction.

User note:

About this appendix: *Appendix C focuses on the location and spacing of fire hydrants, which is important to the success of fire-fighting operations. The difficulty with determining the spacing of fire hydrants is that every situation is unique and has unique challenges. Finding one methodology for determining hydrant spacing is difficult. This particular appendix gives one methodology based on the required fire flow that fire departments can work with to set a policy for hydrant distribution around new buildings and facilities in conjunction with Section 507.5.*

SECTION C101
GENERAL

C101.1 Scope. In addition to the requirements of Section 507.5.1, fire hydrants shall be provided in accordance with this appendix for the protection of buildings, or portions of buildings, hereafter constructed or moved into the jurisdiction.

SECTION C102
NUMBER OF FIRE HYDRANTS

C102.1 Minimum number of fire hydrants for a building. The number of fire hydrants available to a building shall be not less than the minimum specified in Table C102.1.

TABLE C102.1
REQUIRED NUMBER AND SPACING OF FIRE HYDRANTS[h]

FIRE-FLOW REQUIREMENT (gpm)	MINIMUM NUMBER OF HYDRANTS	AVERAGE SPACING BETWEEN HYDRANTS[a,b,c,f,g] (feet)	MAXIMUM DISTANCE FROM ANY POINT ON STREET OR ROAD FRONTAGE TO A HYDRANT[d,f,g]
1,750 or less	1	500	250
1,751–2,250	2	450	225
2,251–2,750	3	450	225
2,751–3,250	3	400	225
3,251–4,000	4	350	210
4,001–5,000	5	300	180
5,001–5,500	6	300	180
5,501–6,000	6	250	150
6,001–7,000	7	250	150
7,001 or more	8 or more[e]	200	120

For SI: 1 foot = 304.8 mm, 1 gallon per minute = 3.785 L/m.

a. Reduce by 100 feet for dead-end streets or roads.

b. Where streets are provided with median dividers that cannot be crossed by fire fighters pulling hose lines, or where arterial streets are provided with four or more traffic lanes and have a traffic count of more than 30,000 vehicles per day, hydrant spacing shall average 500 feet on each side of the street and be arranged on an alternating basis.

c. Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 1,000 feet to provide for transportation hazards.

d. Reduce by 50 feet for dead-end streets or roads.

e. One hydrant for each 1,000 gallons per minute or fraction thereof.

f. A 50-percent spacing increase shall be permitted where the building is equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1 of the *International Fire Code*.

g. A 25-percent spacing increase shall be permitted where the building is equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.2 or 903.3.1.3 of the *International Fire Code* or Section P2904 of the *International Residential Code*.

h. The fire code official is authorized to modify the location, number and distribution of fire hydrants based on site-specific constraints and hazards.

SECTION C103
FIRE HYDRANT SPACING

C103.1 Hydrant spacing. Fire apparatus access roads and public streets providing required access to buildings in accordance with Section 503 shall be provided with one or more fire hydrants, as determined by Section C102.1. Where more than one fire hydrant is required, the distance between required fire hydrants shall be in accordance with Sections C103.2 and C103.3.

C103.2 Average spacing. The average spacing between fire hydrants shall be in accordance with Table C102.1.

> **Exception:** The average spacing shall be permitted to be increased by 10 percent where existing fire hydrants provide all or a portion of the required number of fire hydrants.

C103.3 Maximum spacing. The maximum spacing between fire hydrants shall be in accordance with Table C102.1.

SECTION C104
CONSIDERATION OF EXISTING FIRE HYDRANTS

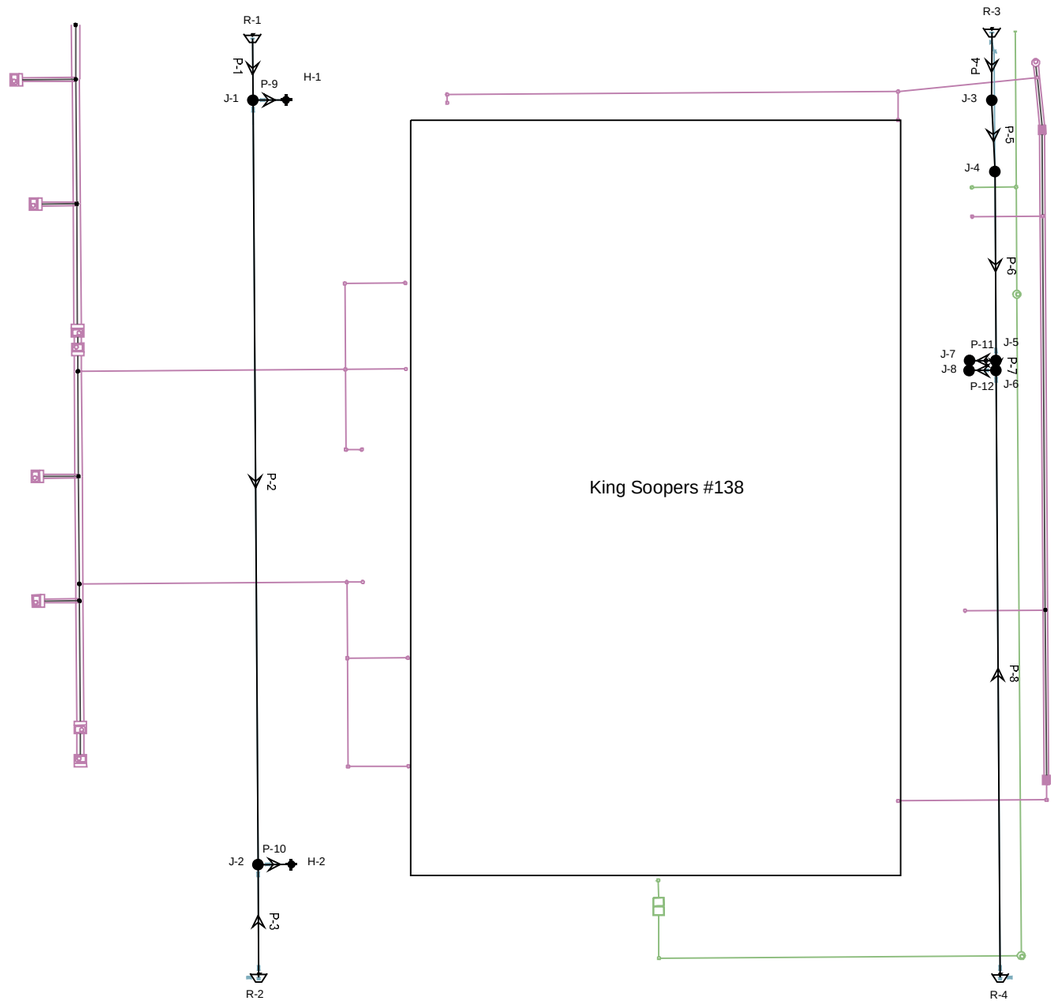
C104.1 Existing fire hydrants. Existing fire hydrants on public streets are allowed to be considered as available to meet the requirements of Sections C102 and C103. Existing fire hydrants on adjacent properties are allowed to be considered as available to meet the requirements of Sections C102 and C103 provided that a fire apparatus access road extends between properties and that an easement is established to prevent obstruction of such roads.

SECTION C105
REFERENCED STANDARD

ICC	IBC—18	International Residential Code	Table C102.1

Attachment C
WaterCAD Calculations

Scenario: PHD + Fire Flow



Scenario: PHD + Fire Flow
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	32	R-1	J-1	12.0	PVC	150.0	1,295	3.67	0.003
P-2	393	J-1	J-2	12.0	PVC	150.0	295	0.84	0.000
P-3	58	J-2	R-2	12.0	PVC	150.0	-705	2.00	0.001
P-4	35	R-3	J-3	8.0	PVC	150.0	495	3.16	0.004
P-5	37	J-3	J-4	8.0	PVC	150.0	495	3.16	0.004
P-6	97	J-4	J-5	8.0	PVC	150.0	495	3.16	0.004
P-7	5	J-5	J-6	8.0	PVC	150.0	446	2.85	0.003
P-8	312	J-6	R-4	8.0	PVC	150.0	-354	2.26	0.002
P-9	17	J-1	H-1	6.0	Ductile Iron	130.0	1,000	11.35	0.074
P-10	17	J-2	H-2	6.0	Ductile Iron	130.0	1,000	11.35	0.074
P-11	14	J-5	J-7	3.0	PVC	150.0	49	2.23	0.006
P-12	14	J-6	J-8	8.0	Ductile Iron	130.0	800	5.11	0.012

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Scenario: PHD + Fire Flow
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	5,257.88	0	5,419.00	70
J-2	5,259.12	0	5,418.92	69
J-3	5,257.11	0	5,418.85	70
J-4	5,257.98	0	5,418.71	70
J-5	5,260.10	0	5,418.34	68
J-6	5,260.10	0	5,418.32	68
J-7	5,260.48	49	5,418.25	68
J-8	5,260.27	800	5,418.15	68

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Scenario: PHD + Fire Flow
Current Time Step: 0.000Hr
FlexTable: Hydrant Table

Label	Hydrant Status	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
H-1	Open	5,264.70	1,000	5,417.73	66
H-2	Open	5,265.60	1,000	5,417.65	66

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Galloway
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Memorandum

To: Shannon Moeller, AICP
Town of Erie – Planning & Development

From: Brian Horan, PE

Date: May 18, 2021

Re: Nine Mile – Lot 10
King Soopers Conformance

INTRODUCTION

This memorandum provides the results of a traffic conformance analysis performed in support of an approximately 7.85 Acre site in the Town of Erie, Colorado. Specifically, the site is identified as Lot 10, of the larger Nine Mile mixed-used development. The Nine Mile development is located in the southeast corner of the Arapahoe Road and US-287 intersection and is currently undeveloped. The site location is shown on Figure 1.

Figure 1 – Site Location

The subject site is part of the larger Nine Mile mixed-use development (Nine Mile) which was supported by a Traffic Impact Study (TIS) completed by Kimley Horn dated November 2019. The TIS analyzed Nine Mile with the following mix of uses:

- 4,300 SF bank
- 2,200 SF coffee shop with drive-thru
- 8,000 SF fast-food restaurant with drive-thru

- 16 fueling pump gas station with convenience store
- 77,654 SF home improvement superstore
- 290 dwelling units of mid-rise multifamily housing
- 93,000 SF shopping center
- 7,300 SF sit down restaurant

Excerpts from the Nine Mile TIS are included as Attachment I.

The Applicant, King Soopers, is proposing to develop Lot 10 of Nine Mile with a 103,000 SF grocery store. A full-sized copy of the site plan is provided as Attachment II. The following memorandum has been prepared for the Town of Erie as requested. The purpose is to evaluate the traffic generated by the currently proposed grocery store use in comparison to the previously studied assumptions as well as to the overall Nine Mile development and the associated roadway improvements.

NINE MILE TIS TRIP GENERATION AND RECOMMENDATIONS

As mentioned previously, the Nine Mile TIS is dated November 2019 and contemplates a mix of residential and commercial uses. The TIS analyzed the project in one build out phase to be complete in 2021. The site is laid out with commercial uses oriented to the west of the site and utilizing access primarily off of HWY 287 and Arapahoe Road and the residential to the east.

The subject site is proposed to occupy Lot 10 and is annotated within Attachment I. The approved TIS forecasted trip generation estimates for the above development program based on rates/equations published in the Institute of Transportation Engineers (ITE) *Trip Generation Manual*, 10th Edition and industry standard methodologies for pass-by and internal capture reductions.

The approved TIS concluded that in order to accommodate the 2021 and 2040 forecasted volumes a number of roadway improvements would need to be provided. These improvements were shown on the provided site plan included in the approved TIS and included herein as Attachment I. It is assumed that those proposed improvements will be provided per the recommendations of the TIS.

However, since the original TIS was published, changes to the site have been proposed. The Nine Mile site is now expected to consist of:

- 4,400 SF bank
- 8,400 SF fast-food restaurant with drive-thru
- 10 fueling pump gas station with convenience store
- 113,990 SF home improvement store (Lowe's)
- 18,000 SF shopping center
- 103,000 SF supermarket (King Soopers)
- 2,000 SF auto parts and service center
- 8,000 SF medical office building
- 287 dwelling units of mid-rise multifamily housing

PROPOSED DEVELOPMENT AND TRIP GENERATION COMPARISON

As shown in the Attachment I excerpt, the subject site is Lot 10 of the larger Nine Mile development. The Applicant proposes to develop Lot 10 with a 103,000 SF grocery store. Lot 10 was contemplated as shopping center use in the approved Nine Mile TIS. A trip generation analysis comparison is provided on Table 1 of the approved versus currently proposed uses. The comparison table includes pass by,

internal captures, and total site generated trips for the AM and PM peak hours. As shown in Table 1 the proposed uses represent 114 more AM peak hour trips after reductions and pass-by and 320 more PM peak hour trips after reductions and pass-by.

In order to understand the potential impact of the difference in trips, the net additional trips were assigned to the site entrances consistent with the approved TIS. These net additional trips are presented on Figure 2. As shown on Figure 2, due to the number of available access locations, additional trips would be distributed across all available points of ingress/egress. As such, turning movements that may experience high delay or queues, such as unsignalized left turns, would experience only minor increases in forecasted trips. With this in mind the proposed increase in trips would represent no significant impact to the results and conclusions of the approved TIS.

Table 1
Erie - King Soopers
Trip Distribution

Land Use	Land Use Code	Amount	Units	AM Peak Hour In	AM Peak Hour Out	AM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out	PM Peak Hour Total
Approved									
Bank	912	4,300	SF	24	17	41	44	44	88
Coffee Shop w/ drive-thru	937	2,200	SF	100	96	196	48	47	95
Fast-Food Restaurant w/ drive-thru	934	8,000	SF	164	158	322	136	125	261
Gas Station w/ Convenience Market	945	16	FP	102	98	200	114	110	224
Home Improvement Superstore	862	77,654	SF	70	52	122	89	92	181
Mid-Rise Multifamily Housing	221	290	DU	25	72	97	75	48	123
Shopping Center	820	93,000	SF	54	33	87	170	184	354
Sit Down Restaurant	932	7,300	SF	40	33	73	44	27	71
		Total Site Generated Trips		579	559	1,138	720	677	1,397
		Pass by trips		138	138	267	202	194	396
		Internal Capture Trips		71	118	189	223	196	419
		Total Trips after Internal Capture		508	441	949	497	481	978
		Total NEW trips (after internal and pass-by)		370	312	682	295	287	582
Proposed									
Bank (BANK)	912	4,400	SF	24	18	42	45	45	90
Fast-Food Restaurant w/ drive-thru (QSR)	934	8,400	SF	172	166	338	142	132	274
Gas Station w/ Convenience Market (C STORE)	945	10	FP	64	61	125	71	69	140
Home Improvement Superstore (LOWE'S)	862	113,990	SF	102	77	179	130	136	266
Shopping Center (SHOP A+B)	820	18,000	SF	11	6	17	33	36	69
Supermarket (KING SOOPERS)	850	103,000	SF	236	157	393	486	466	952
Auto Parts and Service Center (AUTO)	942	2,000	SF	3	1	4	2	3	5
Medical Office Building (MOB)	720	8,000	SF	19	5	24	8	21	29
Mid-Rise Multifamily Housing	221	287	DU	27	76	103	77	49	126
		Total Site Generated Trips		658	567	1,225	994	957	1,951
		Pass by trips		133	127	260	368	357	725
		Internal Capture Trips		81	88	169	165	159	324
		Total Trips after Internal Caputure		577	479	1,056	829	798	1,627
		Total NEW trips (after internal and pass-by)		444	352	796	461	441	902
		Site Generated Trips Difference (Proposed - Approved)		79	8	87	274	280	554
		Total Trips after Internal Capture & Pass By Difference (Proposed - Approved)		74	40	114	166	154	320

Note(s):
(1) Trip generation based on the Institute of Transportation Engineers' Trip Generation Manual, 10th Edition
(2) Internal Trip Capture based on NCHRP 8-51 Internal Trip Capture Estimation Tool

FIGURE 2
New Trips Distribution

King Soopers – Nine Mile
Erie, CO

0000/0000 (AM PEAK HOUR/PM PEAK HOUR)

MOVEMENT

SIGNALIZED INTERSECTION

STOP SIGN

YIELD SIGN

CONCLUSIONS

The conclusions of this comparative analysis are as follows:

1. The subject site was part of the Nine Mile mixed use development in the Town of Erie, Colorado.

2. According to the approved traffic impact study (Nine Mile TIS) prepared by Kimley Horn dated November 2019, the TIS analyzed Nine Mile with the following mix of uses:

   - 290 apartment units
   - 93,000 square feet (SF) of retail
   - 77,654 SF home improvement store
   - 4,300 SF drive-in bank
   - 7,300 SF high turnover sit down restaurant
   - 8,000 SF grocery store (two buildings)
   - 2,200 SF coffee shop with drive-thru

   The approved Nine Mile TIS identified road improvements to mitigate impacts associated with the overall proposed development which were provided for on the approved Nine Mile Site Plan.

3. The site is currently being proposed with the following mix of uses:

   - 4,400 SF bank
   - 8,400 SF fast-food restaurant with drive-thru
   - 10 fueling pump gas station with convenience store
   - 113,990 SF home improvement store (Lowe's)
   - 18,000 SF shopping center
   - 103,000 SF supermarket (King Soopers)
   - 2,000 SF auto parts and service center
   - 8,000 SF medical office building
   - 287 dwelling units of mid-rise multifamily housing

4. A comparison of trip generation between the approved and proposed use suggests that the proposed use would generate 114 more weekday AM peak hour, and 320 more weekday PM peak hour than the approved use.

5. Based on the trip generation comparison contained herein, the proposed grocery store development would not significantly impact the conclusions of the approved Nine Mile TIS. The traffic impacts associated with the proposed use would be adequately accommodated by the constructed/proposed road network without the need for additional improvements.

We trust that the information contained herein satisfy the request of the Town of Erie. If you have any questions or need further information, please contact Brian Horan at BrianHoran@gallowayus.com or 303-770-8884.

Attachment I
Nine Mile Mixed Use Traffic Impact Study
Kimley Horn dated November 2019 excerpts

Traffic Impact Study

Nine Mile
Erie, Colorado

Prepared for:

Evergreen Devco, Inc.

Kimley»Horn

T R A F F I C I M P A C T S T U D Y

Nine Mile

Erie, Colorado

Prepared for
Evergreen Devco, Inc.
2390 East Camelback Road
Suite 410
Phoenix, Arizona 85016

Prepared by
Kimley-Horn and Associates, Inc.
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Denver, Colorado 80237
(303) 228-2300

November 2019

1.0 EXECUTIVE SUMMARY

Nine Mile, a residential and commercial development, is proposed to be located on the southeast corner of the Arapahoe Road and US-287 intersection in Erie, Colorado. The project includes approximately 290 apartment units, approximately 93,000 square feet of retail, a 77,654 square foot home improvement store, a 4,300 square foot drive-in bank, a 7,300-square foot high turnover sit down restaurant, two fast food restaurants with drive-through window (8,000 square feet total), a 2,200 square foot coffee shop with drive-through window, and a 16 fueling position gasoline/service station. It is expected that project construction will be completed by 2021; therefore, analysis was conducted for the 2021 short term build out horizon as well as the 2040 long-term horizon per the Town of Erie and State of Colorado Department of Transportation (CDOT) requirements.

The purpose of this study is to identify project traffic generation characteristics, to identify potential project traffic related impacts on the local street system, and to develop mitigation measures required for identified impacts. The originally approved *Nine Mile Traffic Impact Study* completed by Kimley-Horn and Associates, Inc. dated August 14, 2019 has been readministered due the desire to preserve historical structures on the west leg of the Arapahoe Road and US-287 intersection which limits the improvements at this intersection in the short-term 2021 horizon. The following intersections were incorporated into this traffic study based on the Town of Erie and CDOT requirements:

- Arapahoe Road and US-287
- Arapahoe Road Full Movement Access (Safeway)
- Arapahoe Road and Beasley Drive
- Lucerne Drive and US-287

The proposed project access intersections along Arapahoe Road and US-287 were also studied. In addition, a traffic signal progression analysis was conducted along the approximate 2,750-foot long segment of Arapahoe Road from US-287 to the west and 111th Street to the east due to the proposal to add two traffic signals for this project along this roadway segment. Therefore, the intersection of Arapahoe Road and 111th Street was included for signal progression purposes only.

Regional access to the project site is expected from Baseline Road, Arapahoe Road, and US-287. Primary access to the project will be provided by Arapahoe Road and US-287. With the completion of the project, direct access is proposed from a right-in/right-out and two full movement access intersections along Arapahoe Road and three-quarter movement access intersection along US-287. The two full movement access intersections along Arapahoe Road are proposed to align with the Safeway full movement and Beasley Drive intersections. The right-in/right-out access along Arapahoe Road is proposed approximately half way between US-287 and the existing Safeway access. The three-quarter movement access along US-287 is proposed approximately one-quarter mile (1,320 feet), measured center to center, south of Arapahoe Road and will restrict eastbound and westbound left turn and through movements.

Full build out of Nine Mile residential/commercial development on the southeast corner of the Arapahoe Road and US-287 intersection is expected to generate approximately 13,330 daily weekday driveway trips. Of these, 949 driveway trips are expected to occur during the morning peak hour, while 978 driveway trips are expected during the afternoon peak hour. Since the project is a commercial development, pass-by trips are expected. These pass-by trips are vehicles already on the street network that will be attracted to the bank, adjacent commercial developments, and gas station. With pass-by, expected net new trips to the surrounding street network results in an anticipated 9,370 weekday daily trips, of which 682 and 582 trips are anticipated to be new (non pass-by) during the weekday morning and afternoon peak hours, respectively.

Distribution of site traffic on the street system was based on the area street characteristics, existing traffic patterns, demographic information, anticipated surrounding development areas, and the proposed access system for the project. Assignment of project traffic was based upon the trip generation described previously and the distributions developed. The traffic assignment was added to the background traffic volumes to determine future traffic with the project.

Based on the analysis presented in this report, Kimley-Horn believes the traffic anticipated from the proposed Nine Mile project on the southeast corner of the Arapahoe Road and US-287 intersection will be incorporated into the existing and future roadway network. Analysis of the existing street network, the proposed project development, and expected traffic volumes resulted in the following recommendations:

2021 Horizon Recommendations

With development of the Nine Mile development on the southeast corner of the Arapahoe Road and US-287 intersection, several improvements are recommended to improve traffic operations. The improvements recommended are those that are believed to be feasible to construct with the development of the project.

- It is recommended that Arapahoe Road be widened to include two eastbound and westbound through lanes adjacent to the project.
- It is recommended that the Arapahoe Road/US-287 signalized intersection include dual left turn lanes on the northbound, southbound, and westbound approaches. The eastbound approach of this intersection will maintain a single left turn lane in the short-term horizon due to the Town of Erie having a desire to preserve historical structures on the west leg of this intersection. The widening of Arapahoe Road along the south side of the roadway adjacent to the project will allow for the westbound dual left turn lanes along with the two eastbound and westbound through lanes. The northbound and southbound dual left turn lanes can be designated within the existing striped out area along US-287. A traffic signal modification will be needed at the intersection to accommodate these additional turn lanes.
- The proposed right-in/right-out access along Arapahoe Road is recommended to operate with stop control on the new northbound exiting access approach with the installation of a R1-1 “STOP” sign. A separate right turn lane is not anticipated to be needed on the eastbound approach. To provide signage for the proposed right-in/right-out restricted access along Arapahoe Road, it is recommended that a R6-1(R) “ONE WAY” sign be installed within the raised median in alignment of exiting traffic from the proposed access.
- It is recommended that the northbound right turn movement at the Arapahoe Road right-in/right-out intersection provide a minimum throat depth of 25 feet (1 vehicle).
- The full movement access proposed along Arapahoe Road to align with the existing full movement access for Safeway is recommended to be signalized. The new northbound approach to the intersection is recommended to include separate left turn and shared through/right turn lanes. The southbound approach should also be designated with this configuration if possible to provide the most efficient signal operations. Northbound and southbound left turn lanes of 100 feet with 50-foot tapers is recommended. A westbound left turn lane of 150 feet with 100-foot taper is recommended along Arapahoe

Road for the new access. Separate right turn lanes are not anticipated to be needed on any approaches.

- A new south leg is recommended to be constructed at the Arapahoe Road and Beasley Drive intersection to provide access to the project. With this new access, it is recommended that this intersection be signalized. It is recommended that a westbound left turn lane of 150 feet in length plus 100-foot taper be designated along Arapahoe Road. The new northbound approach is recommended to include separate left turn and through/right turn lanes. A northbound left turn lane of 100 feet with 50-foot taper is recommended. The southbound approach of Beasley Drive to the intersection is recommended to also be striped to include a separate left turn lane and shared through/right turn lane as well to provide for more efficient signal operations. Separate right turn lanes are not anticipated to be needed for any approach to this intersection.
- A new three-quarter movement access is recommended along US-287, approximately a quarter-mile south of the Arapahoe Road intersection. This access intersection is recommended to operate with stop control with a R1-1 "STOP" sign installed on the westbound approach. To provide signage for the proposed three-quarter access with restricted right-out only turning movements onto US-287, it is recommended that a R3-2 No Left Turn sign be installed underneath the STOP sign at the proposed access for exiting traffic.
- Based on the available approximate 1,030-foot spacing along US-287 between Arapahoe Road and the proposed three-quarter access, it is recommended that the southbound left turn lane at the access along US-287 provide 330 feet of length plus a 300-foot taper so that the existing northbound left lane length of 400 feet can remain unmodified when converted to dual left turn lanes. Therefore, a Variance Waiver from CDOT will likely be needed for this southbound left turn lane. It should be noted that a speed limit of 60 miles per hour will likely not be maintained as the surrounding area is developed. With a potential lower speed limit in the future, the turn lane length requirements would decrease.
- A northbound right turn deceleration lane is recommended to be designated for the three-quarter movement access along US-287. Adequate pavement width exists for this turn lane today. Therefore, it is recommended that northbound US-287 be restriped to account for this recommended northbound right turn deceleration lane back to the Lucerne Drive intersection located approximately 350 feet to the south.

- A northbound acceleration lane from the westbound right turn is recommended to be designated for the three-quarter movement access along US-287. A continuous acceleration/deceleration lane currently exists along northbound US-287. It is recommended that this acceleration lane along northbound US-287 be a continuous acceleration/deceleration lane between this access and US-287/Arapahoe Road intersection.
- It is recommended that the westbound right turn movement at the US-287 three-quarter access intersection provide a minimum throat depth of 50 feet (2 vehicles).
- A traffic signal progression analysis was conducted along the approximate 2,750-foot long segment of Arapahoe Road from US-287 to the west and 111th Street to the east. A traffic signal is proposed at the Safeway full movement access along Arapahoe Road located approximately 800 feet east of US-287. A traffic signal is also proposed at the intersection of Arapahoe Road and Beasley Drive which is located approximately 660 feet east of the Safeway full access intersection and 1,290 feet west of the Arapahoe Road and 111th Street intersection. A goal platoon efficiency for an arterial roadway should be 20 percent or higher, or does not degrade the existing signal progression, which has been achieved in both 2021 and 2040 for both directions of travel. Therefore, it is believed that two proposed signalized intersections along Arapahoe Road would maintain an acceptable platoon efficiency along the Arapahoe Road corridor if coordinated with the adjacent traffic signals.

2040 Horizon Recommendations

Based on the annual traffic volume growth rate, several capacity improvements may be needed in the future to accommodate traffic within the area. The following provides recommendations that will likely be needed to accommodate 2040 future traffic volumes:

- If future projected traffic volume growth is realized, US-287 may need to provide three through lanes in each direction, northbound and southbound. It is recommended that CDOT continue to monitor traffic volumes in the future to determine if and when the highway may need to include capacity improvements for possible increased through lane capacity in each direction.
- By 2040, it is anticipated that the development west of US-287 will be complete and that the US-287 three-quarter access intersection will be a four-leg intersection. It is recommended that the eastbound and westbound restricted approaches of the intersection consist a single right turn lane and be stop controlled. Separate left turn

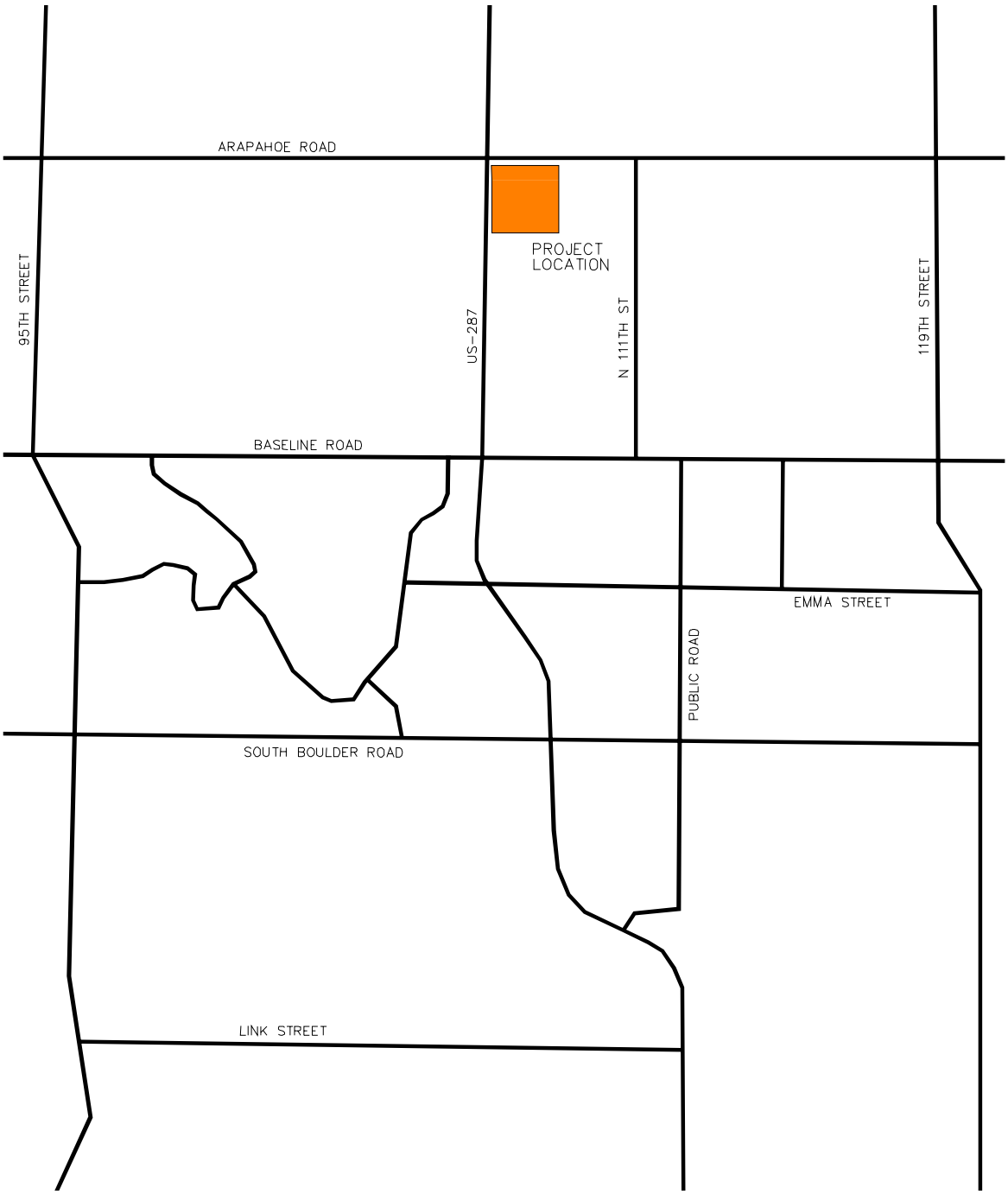
lanes and three through lanes of travel with the outside lane being a shared through/right turn lane are recommended on the northbound and southbound approaches.

- By 2040, the intersection of Arapahoe Road/US-287 may need to be fully built out in order to operate acceptably. This includes eastbound dual left turn lanes, and three through lanes with separate right turn lanes northbound and southbound along US-287.

General Recommendation

- All on-site and off-site roadway improvements should be incorporated into the Civil Drawings and conform to standards of the Town of Erie, CDOT (as appropriate), American Association of State Highway and Transportation Officials (AASHTO) Geometric Design of Highways and Streets, Institute of Transportation Engineers (ITE), and the Manual on Uniform Traffic Control Devices (MUTCD) – 2009 Edition.

Kimley»Horn
NORTH
NTS 096266012



NINE MILE
ERIE, COLORADO
VICINITY MAP

FIGURE 1

Kimley»Horn

Kimley»Horn
NORTH
NTS 096266012

NINE MILE
ERIE, COLORADO
SITE AREA

FIGURE 2

Kimley»Horn

4.0 PROJECT TRAFFIC CHARACTERISTICS

4.1 Trip Generation

Site-generated traffic estimates are determined through a process known as trip generation. Rates and equations are applied to the proposed land uses to estimate traffic generated by the development during a specific time interval. The acknowledged source for trip generation rates is the *Trip Generation*[1] report published by the Institute of Transportation Engineers (ITE). ITE has established trip rates in nationwide studies of similar land uses. The Nine Mile project includes approximately 290 apartment units, approximately 93,000 square feet of retail, a 77,654 square foot home improvement store, a 4,300 square foot drive-in bank, a 7,300-square foot high turnover sit down restaurant, two fast food restaurants with drive-through window (8,000 square feet total), a 2,200 square foot coffee shop with drive through window, and a 16 fueling position gasoline/service station. It is expected that project construction will be completed by 2021; therefore, analysis was conducted for the 2021 short term build out horizon as well as the 2040 long-term horizon.

The ITE Trip Generation fitted curve and average trip rates that apply to Mid-Rise Multifamily Housing (ITE Code 221), Shopping Center (820), Home Improvement Superstore (862), Drive-In Bank (912) High Turnover Sit-Down Restaurant (932), Fast Food Restaurant with Drive-Through Window (934), Coffee Shop with Drive-Through Window (937) and Gasoline Service Station with Convenience Market (945) were used to estimate traffic generated by the proposed development.

Since a mix of uses including bank, retail, restaurants, and gas station are all proposed within the same development, it is anticipated that traffic will be shared between the uses. Therefore, the ITE internal capture procedure was used to determine the amount of traffic that may be shared, which thereby determines the number of external trips. The internal capture methodology and procedure as well as the pass-by percentages for each use were obtained from the ITE *"Trip Generation Manual, Tenth Edition, Users Guide and Handbook" 2017.*

Based on this, the full build out of Nine Mile residential and commercial development on the southeast corner of the Arapahoe Road and US-287 intersection in 2021 is expected to

[1] Institute of Transportation Engineers, *Trip Generation Manual*, Tenth Edition, Washington DC, 2017.

generate approximately 17,592 daily weekday driveway trips. Of these, 1,138 driveway trips are expected to occur during the morning peak hour, while 1,397 driveway trips are expected during the afternoon peak hour. Since the project includes a commercial development, pass-by trips are expected. These pass-by trips are vehicles already on the street network that will be attracted to the bank, adjacent retail, and gas station. With pass-by, expected net new trips to the surrounding street network results in an anticipated 9,370 weekday daily trips, of which 682 and 582 trips are anticipated to be new (non pass-by) during the weekday morning and afternoon peak hours, respectively.

The pass-by percentages for each use were obtained from the ITE *"Trip Generation Manual, Tenth Edition, Users Guide and Handbook" 2017.* Of note, the afternoon peak hour pass-by rates were applied to the morning peak hour and daily if data wasn't available as these rates are anticipated to be similar throughout the day. **Table 1** summarizes the estimated traffic generation for the proposed development. Trip generation worksheets are included in **Appendix C**. These calculations illustrate the equations used and directional distribution of trips based on the published ITE Trip Generation Report.

Table 1 – Nine Mile Project Trip Generation

Land Use	Quantity	Units	Vehicle Trips						
			Daily	Weekday AM Peak Hour			Weekday PM Peak Hour		
				In	Out	Total	In	Out	Total
Mid-Rise Multifamily Housing (ITE 221)	290	Units	1,580	25	72	97	75	48	123
Shopping Center (ITE 820)	93,000	Square Feet	3,512	54	33	87	170	184	354
Home Improvement Superstore (ITE 862)	77,654	Square Feet	2,388	70	52	122	89	92	181
Bank (ITE 912)	4,300	Square Feet	432	24	17	41	44	44	88
Sit Down Restaurant (ITE 932)	7,300	Square Feet	820	40	33	73	44	27	71
Fast-Food Restaurant w/ DT (ITE 934)	8,000	Square Feet	3,768	164	158	322	136	125	261
Coffee Shop w/ DT (ITE 937)	2,200	Square Feet	1,806	100	96	196	48	47	95
Gas Station w/ Convenience Market (ITE 945)	16	Fuel Positions	3,286	102	98	200	114	110	224
Total Site Generated Trips			**17,592**	**579**	**559**	**1,138**	**720**	**677**	**1,397**
Total Trips after Internal Capture			**13,330**	**508**	**441**	**949**	**497**	**481**	**978**
Total Trips after Internal Capture & Pass By (Non Pass-By Trips)			**9,370**	**370**	**312**	**682**	**295**	**287**	**582**
Pass By Trips			**3,960**	**138**	**129**	**267**	**202**	**194**	**396**

Lot 10

4.2 Trip Distribution

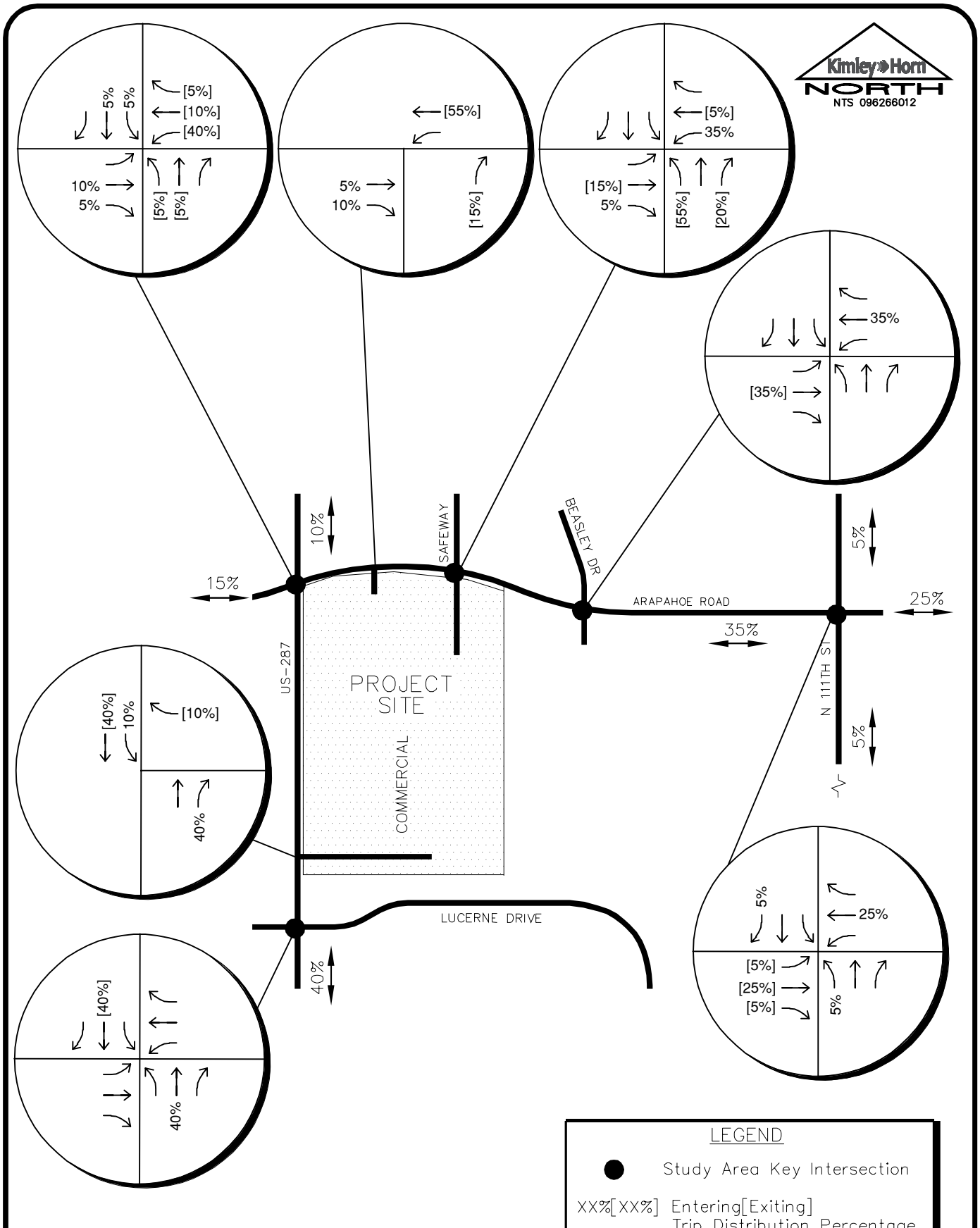
Distribution of site traffic was based on the area street system characteristics, existing traffic patterns and volumes, existing demographic information, and the proposed access system for the project. The directional distribution of traffic is a means to quantify the percentage of site-generated traffic that approaches the site from a given direction and departs the site back to the original source. Since the travel patterns are anticipated to be different for the commercial retail development and residential development, separate distributions were developed to account for these differences. **Figure 7** illustrates the expected trip distribution for the commercial retail portion of the project, while **Figure 8** illustrates the expected trip distribution for the residential portion of the project.

Since Nine Mile is a commercial development, a certain amount of traffic attracted to the project will be passing by the site. This pass-by distribution is a means to quantify the amount of traffic arriving to the site from a given direction and then leaving the site in the same original direction of travel, continuing the driver's trip. The expected weekday morning and afternoon peak hour pass-by trip distributions were calculated based on actual traffic volumes. Directional differences in the morning and afternoon peak hours were accounted for in the pass-by distributions as shown in **Figure 9** and **Figure 10**, respectively.

4.3 Traffic Assignment and Total (Background Plus Project) Traffic

Traffic assignment was obtained by applying the project trip distribution to the estimated traffic generation of the development shown in **Table 1**. The total project traffic assignment for the Nine Mile development project for the non-pass-by conditions during the peak hours studied for the Nine Mile Development is shown in **Figure 11**. The total project traffic assignment for the Nine Mile Development project for the pass-by conditions during the peak hours studied is shown in **Figure 12**.

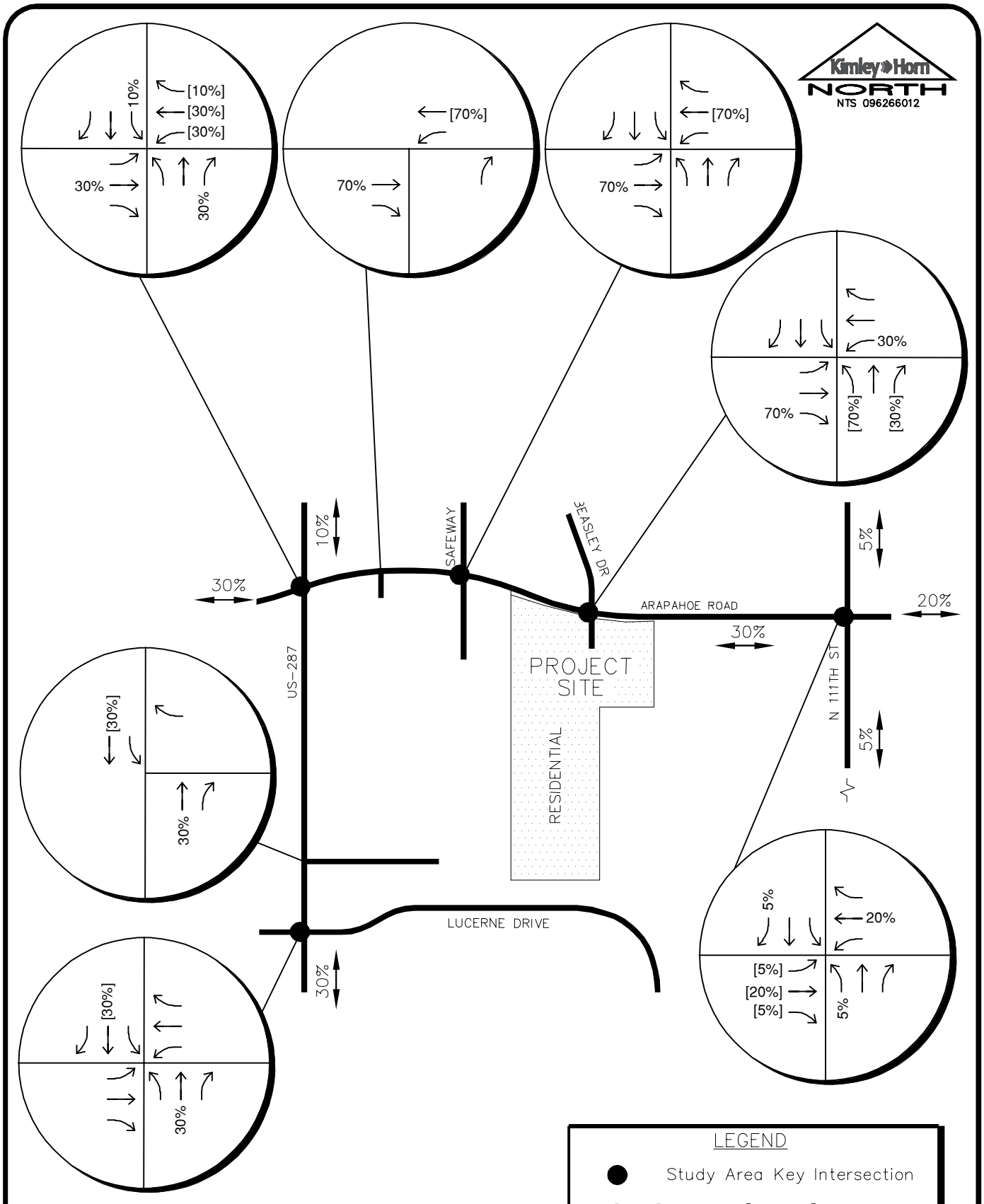
Project traffic volumes were added to the background volumes to represent estimated traffic conditions for the short term 2021 horizon as well as the long term 2040 horizon. These background plus project (total) traffic volumes for the project are illustrated for the 2021 project buildout year and the 2040 horizon year in **Figure 13** and **Figure 14**, respectively.



NINE MILE
ERIE, COLORADO
RETAIL TRIP DISTRIBUTION

FIGURE 7

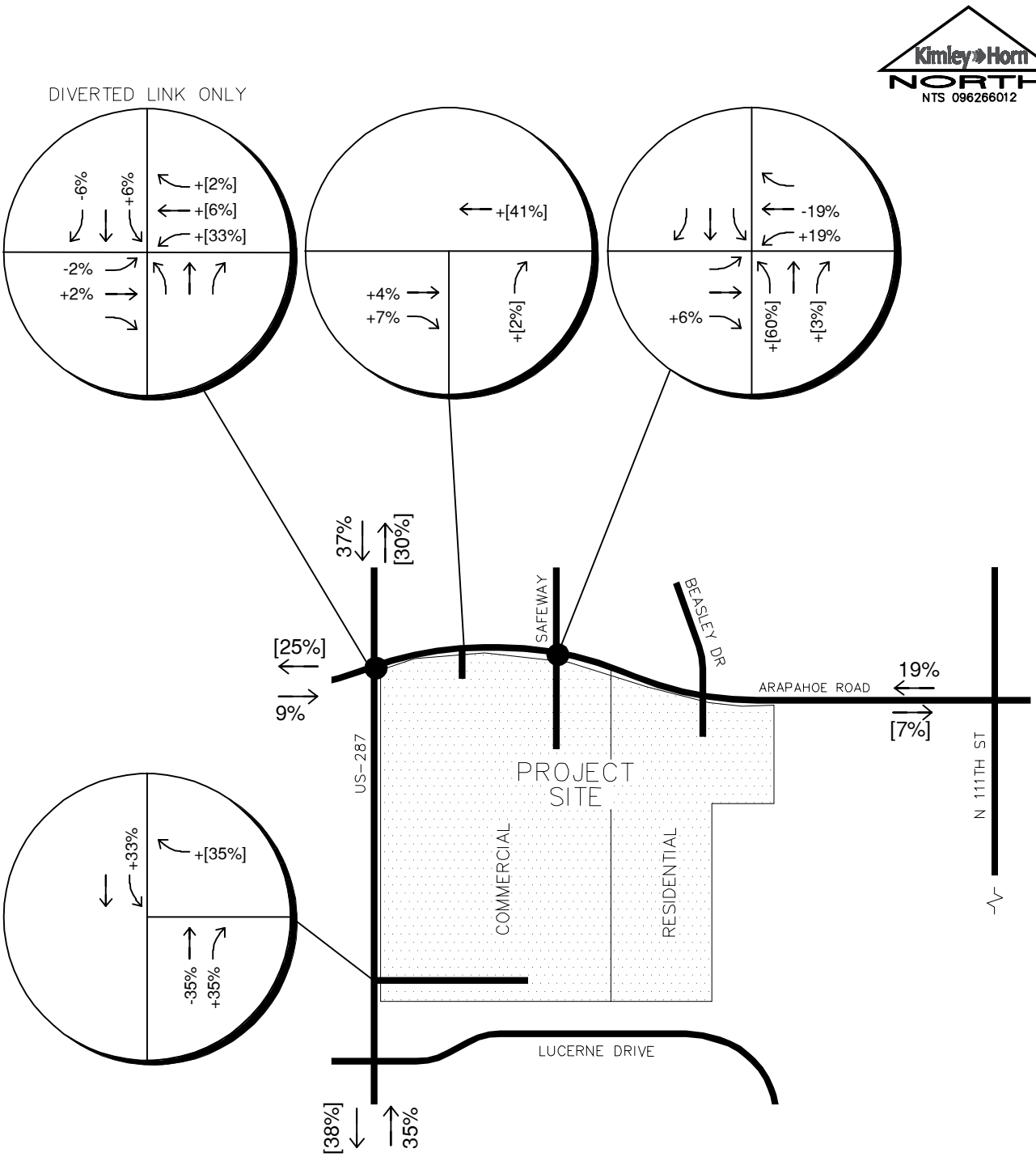
Kimley»Horn



NINE MILE
ERIE, COLORADO
RESIDENTIAL TRIP DISTRIBUTION

FIGURE 8

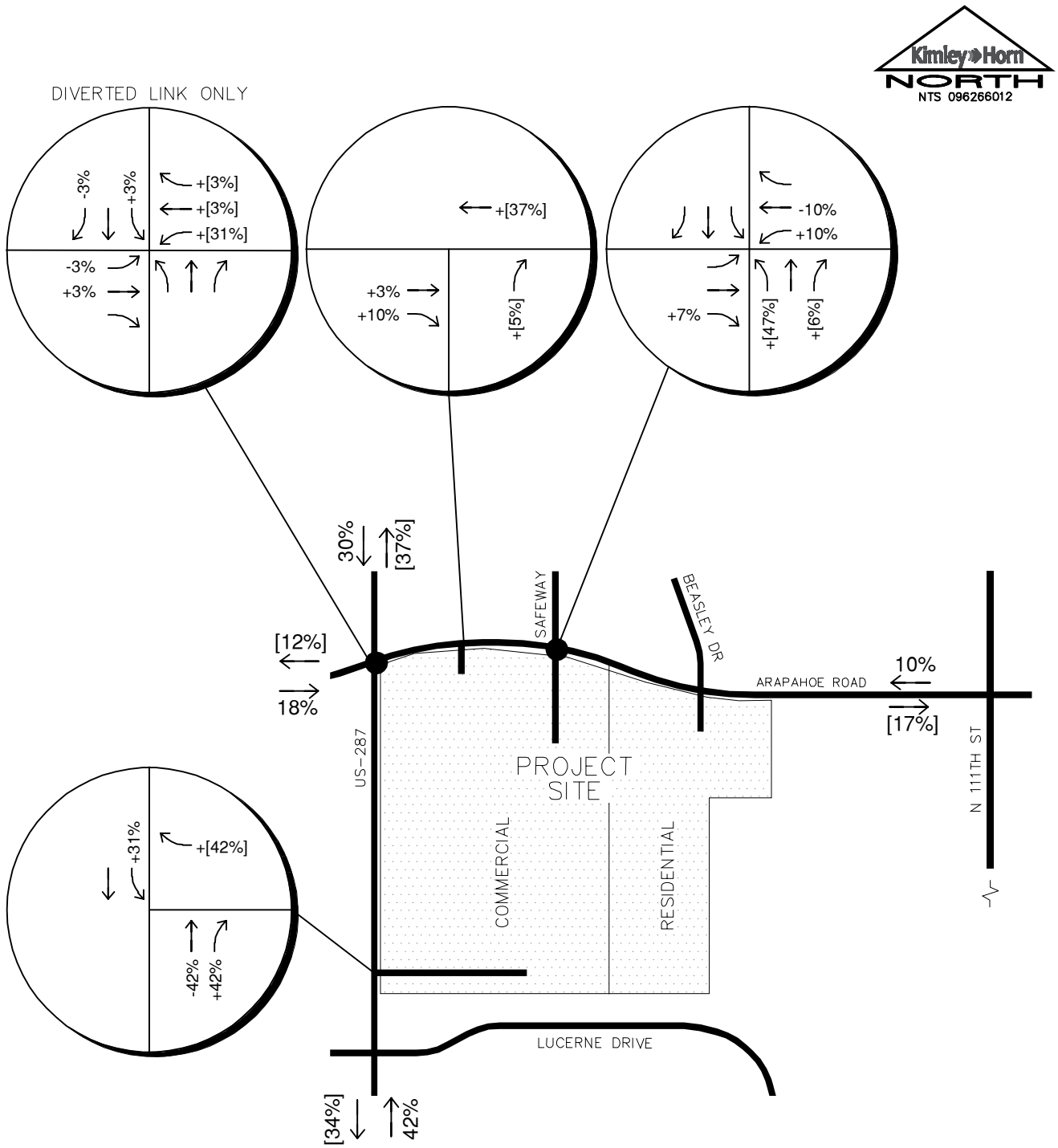
Kimley»Horn



NINE MILE
ERIE, COLORADO
AM PEAK PASS-BY TRIP DISTRIBUTION

FIGURE 9

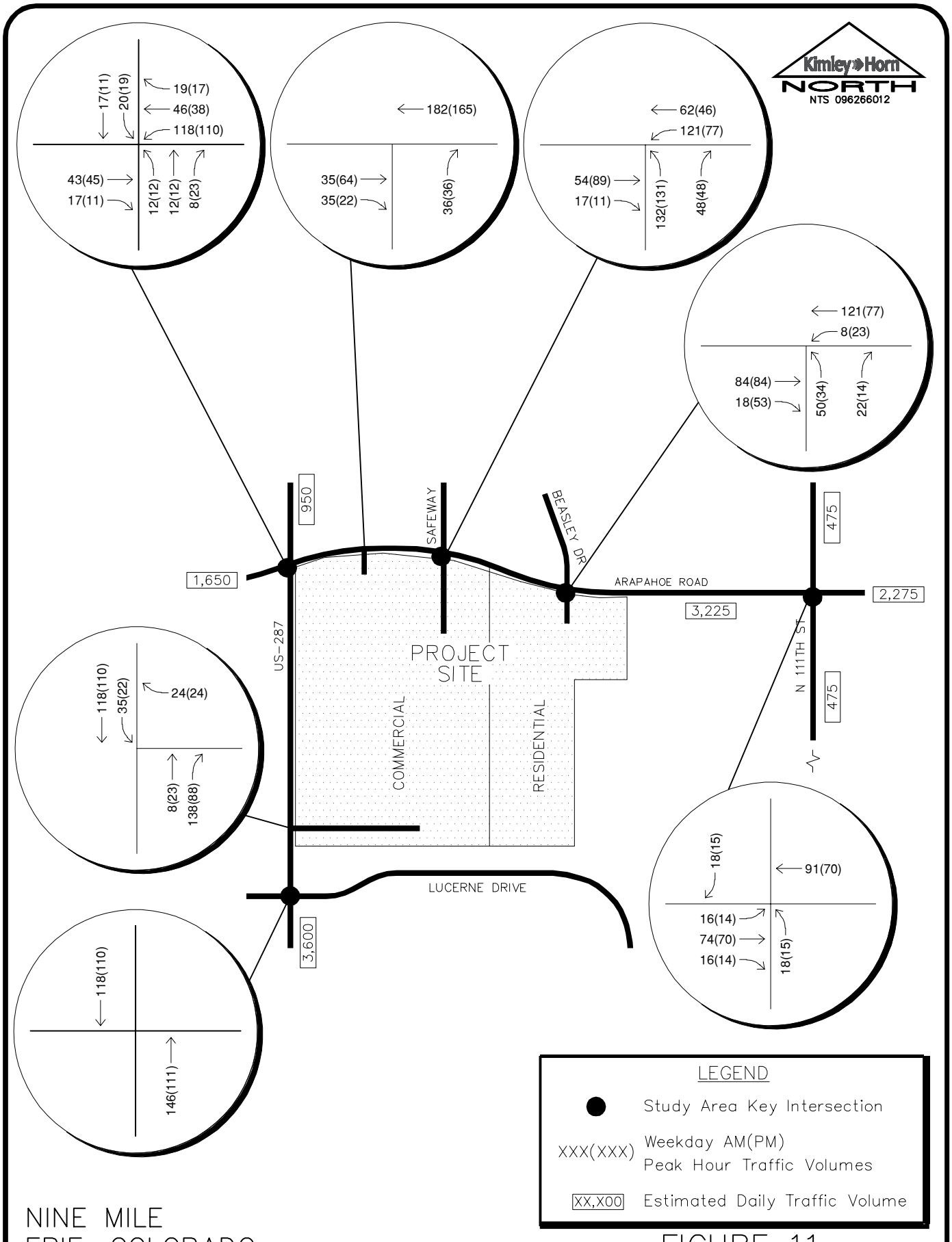
Kimley»Horn



NINE MILE
ERIE, COLORADO
PM PEAK PASS-BY TRIP DISTRIBUTION

FIGURE 10

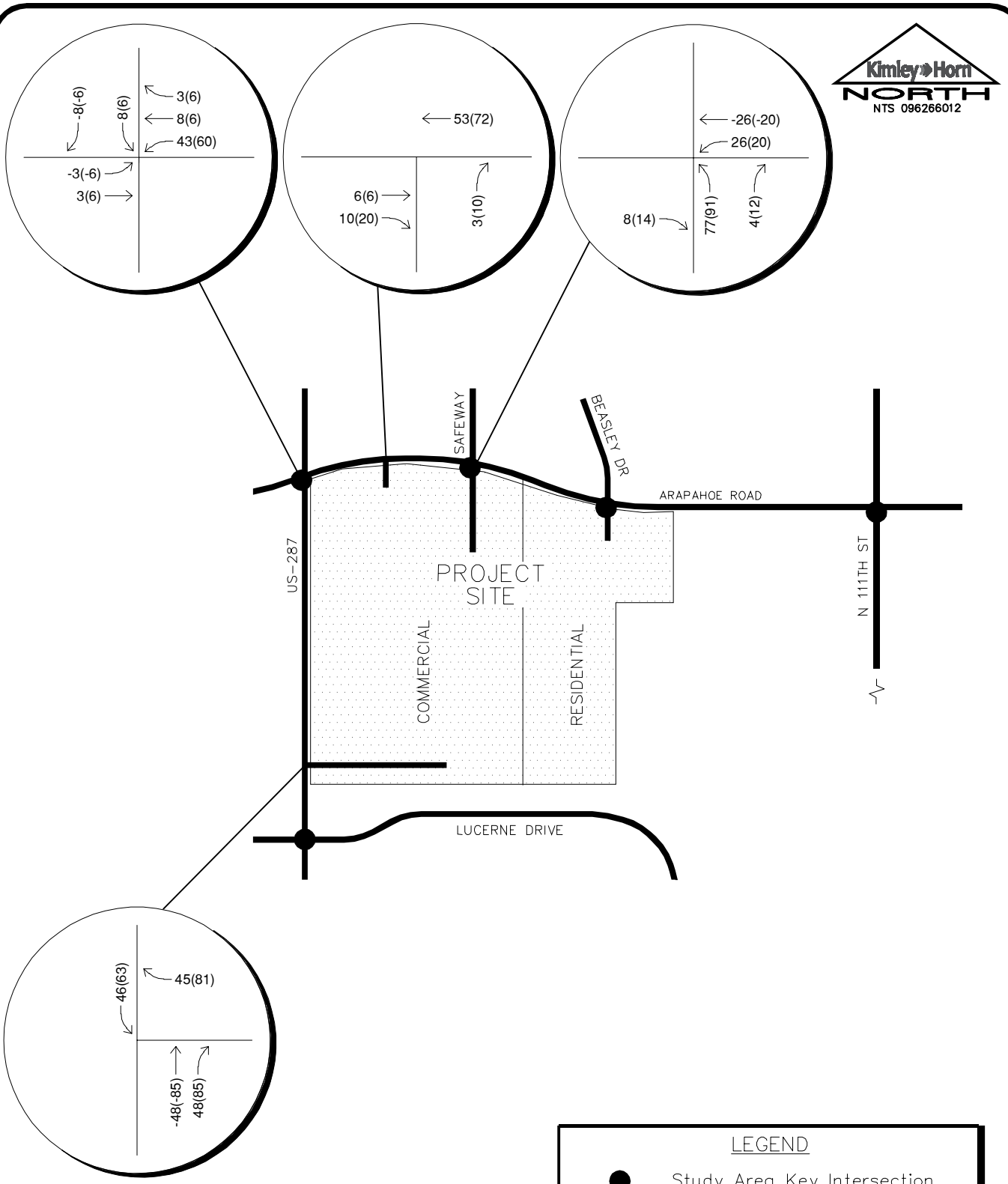
Kimley»Horn



NINE MILE
ERIE, COLORADO
NON PASS-BY TRAFFIC ASSIGNMENT

FIGURE 11

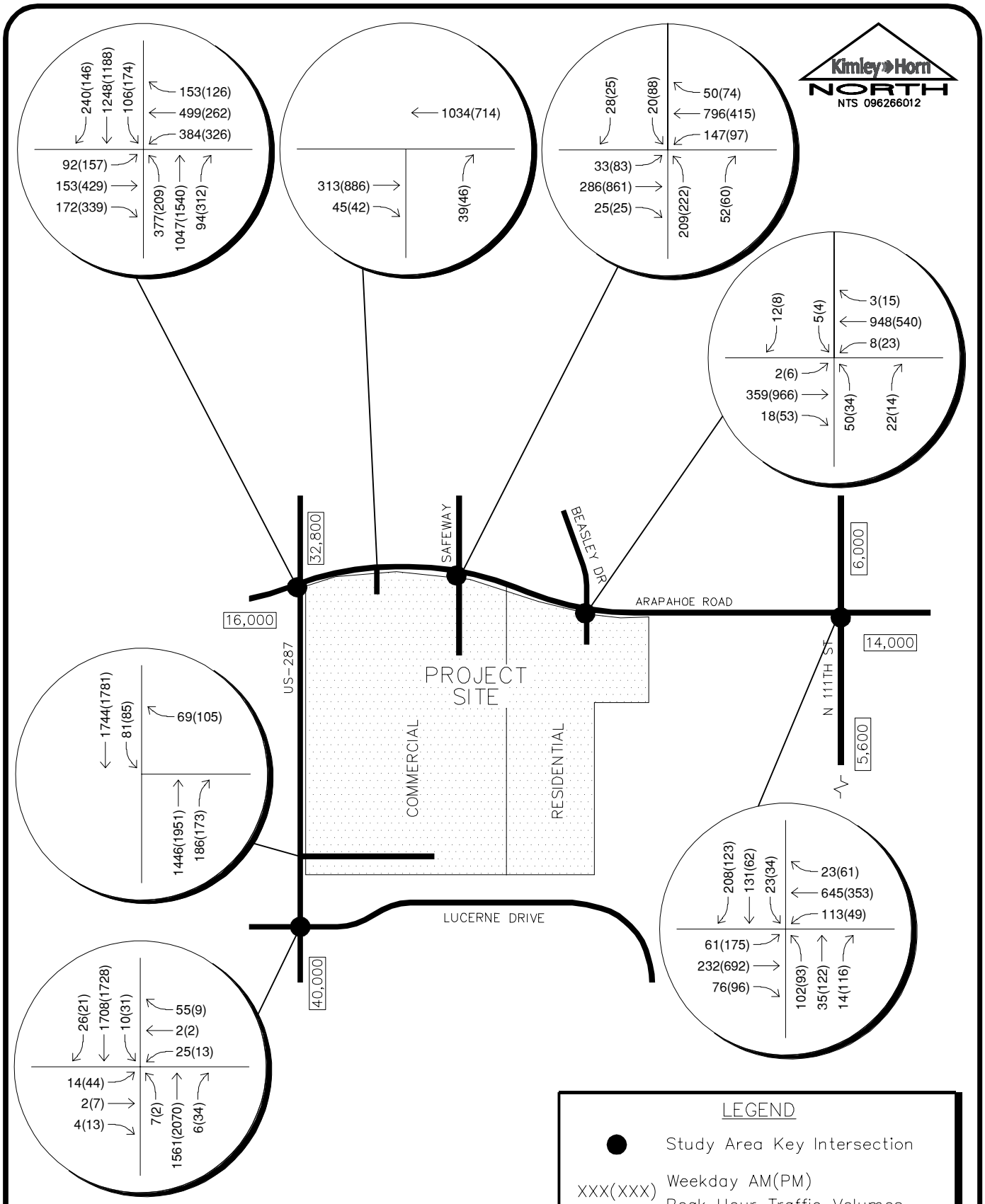
Kimley»Horn



NINE MILE
ERIE, COLORADO
TOTAL PASS-BY
TRAFFIC ASSIGNMENT

FIGURE 12

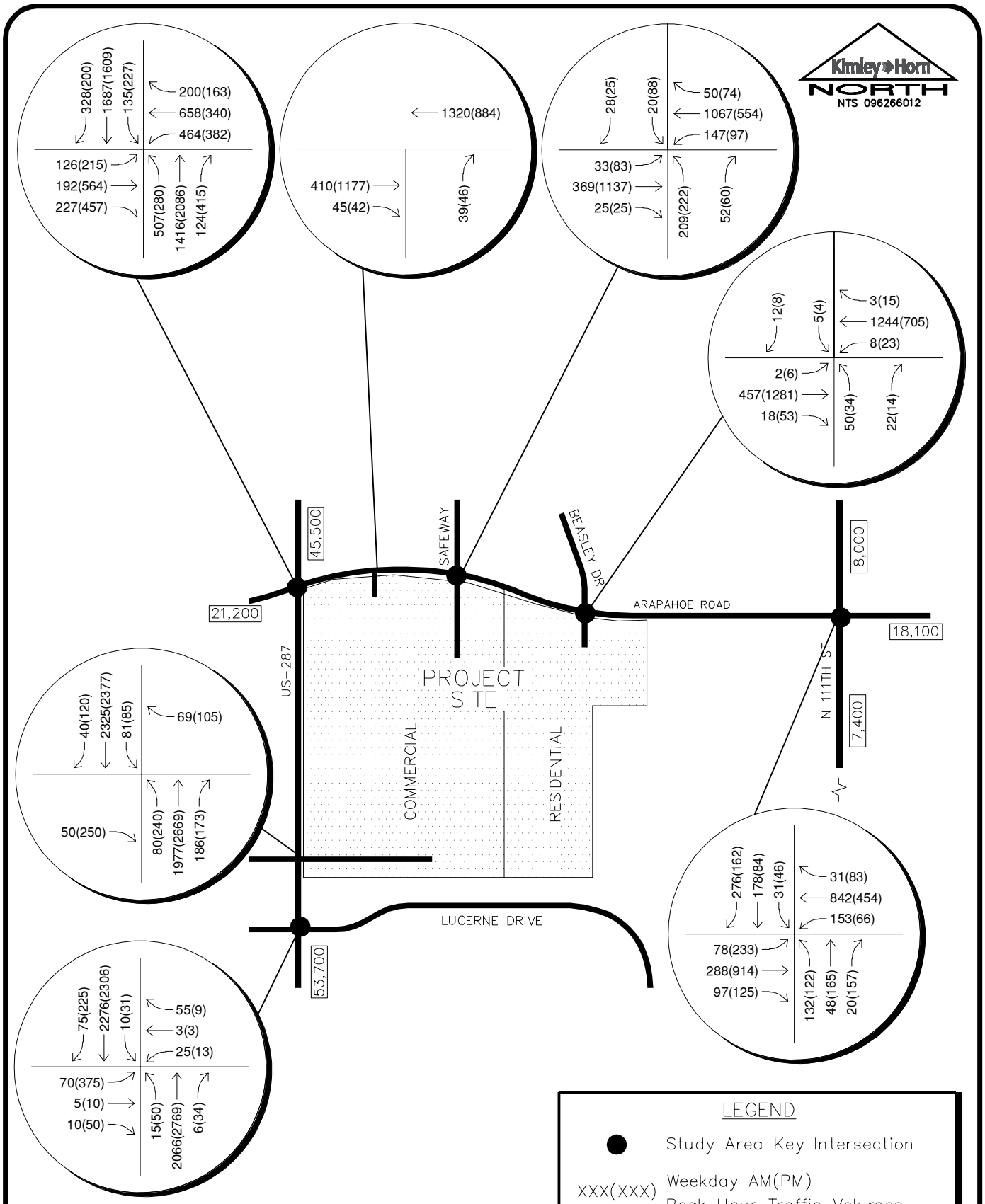
Kimley»Horn



NINE MILE
ERIE, COLORADO
2021 BACKGROUND PLUS
PROJECT TRAFFIC VOLUMES

FIGURE 13

Kimley»Horn



NINE MILE
ERIE, COLORADO
2040 BACKGROUND PLUS PROJECT TRAFFIC VOLUMES

FIGURE 14

Kimley»Horn

5.0 TRAFFIC OPERATIONS ANALYSIS

Kimley-Horn's analysis of traffic operations in the site vicinity was conducted to determine potential capacity deficiencies in the 2021 and 2040 development horizons at the identified key intersections. The acknowledged source for determining overall capacity is the current edition *Highway Capacity Manual*[2] (HCM).

5.1 Analysis Methodology

Capacity analysis results are listed in terms of Level of Service (LOS). LOS is a qualitative term describing operating conditions a driver will experience while traveling on a particular street or highway during a specific time interval. It ranges from A (very little delay) to F (long delays and congestion). For intersections and roadways in this study area, standard traffic engineering procedure recommends intersection LOS D as the minimum threshold for acceptable operations for signalized intersections and LOS E for movements or approaches of unsignalized intersections. **Table 2** shows the definition of level of service for signalized and unsignalized intersections.

Table 2 – Level of Service Definitions

Level of Service	Signalized Intersection Average Total Delay (sec/veh)	Unsignalized Intersection Average Total Delay (sec/veh)
A	≤ 10	≤ 10
B	> 10 and ≤ 20	> 10 and ≤ 15
C	> 20 and ≤ 35	> 15 and ≤ 25
D	> 35 and ≤ 55	> 25 and ≤ 35
E	> 55 and ≤ 80	> 35 and ≤ 50
F	> 80	> 50

Definitions provided from the Highway Capacity Manual, Special Report 209, Transportation Research Board, 2010.

Study area intersections were analyzed based on average total delay analysis for signalized and unsignalized intersections. Under the unsignalized analysis, the level of service (LOS) for a two-way stop-controlled intersection is determined by the computed or measured control delay and is defined for each minor movement. Level of service for a two-way stop-controlled intersection is not defined for the intersection as a whole. Level of service for a signalized and all-way stop controlled intersection is defined for each approach and for the overall intersection.

[2] Transportation Research Board, *Highway Capacity Manual*, Special Report 209, Washington DC, 2010.

5.2 Key Intersection Operational Analysis

Calculations for the level of service at the key intersections and project access driveways for the study area are provided in **Appendix D**. The signalized intersection analysis utilizes the observed cycle lengths for the morning and afternoon peak hours with existing phasing and timing splits. The existing year analysis is based on the lane geometry and intersection control shown in **Figure 2.** The existing peak hour factors are also used in the 2019 existing and 2021 short term horizon analysis. The recommended HCM urban area peak hour factor of 0.92 was used for the 2040 horizon analysis. LOS for the intersections was calculated using Synchro software presenting the HCM results.

Arapahoe Road and US-287

The existing intersection of Arapahoe Road and US-287 is signalized and operates with protected left turn phasing on the northbound and southbound approaches and protected-permitted left turn phasing on the eastbound and westbound approaches. With the existing configuration and control, the intersection operates with LOS E during the morning peak hour and LOS D during the afternoon peak hour. It is understood that with the construction of the Nine Mile project in 2021, Arapahoe Road will be improved to include two through lanes of travel in each direction, eastbound and westbound, from US-287 to Beasley Drive. It is recommended that with buildout of this project, this intersection be improved to include dual left turn lanes on the northbound, southbound, and westbound approaches. The eastbound approach of this intersection will maintain a single left turn lane in the short-term horizon due to the Town of Erie having a desire to preserve historical structures on the west leg of this intersection. With these improvements, the intersection is anticipated to operate with improved LOS D during the morning and afternoon peak hours.

By 2040, the intersection may need to be fully built out including dual left turn lanes, two through lanes, and right turn lanes eastbound and westbound, as well as dual left turn lanes, three through lanes, and right turn lanes northbound and southbound. With these improvements, the intersection would continue to operate with LOS D during both the morning and afternoon peak hours. It is anticipated that US-287 will be improved to provide three through lanes in each direction, northbound and southbound, by the year 2040. This has been found to be needed for acceptable operations at this intersection and was therefore included in this analysis. **Table 3** provides the results of the level of service analysis at this intersection.

Table 3 – Arapahoe Road and US-287 LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2019 Existing	57.2	E	49.5	D
2021 Background	61.0	E	52.1	D
2021 Background Plus Project #	47.0	D	45.5	D
2040 Background ##	42.3	D	40.7	D
2040 Background Plus Project ##	45.6	D	49.7	D

= Dual Left Turn Lanes on NB, SB, and WB Approaches; Two Eastbound & Westbound Through Lanes.

= Three Through Lanes & Separate Right Turn Lanes NB & SB

Arapahoe Road Full Movement Access (Safeway)

The existing Arapahoe Road and Safeway access is a "T"-intersection with stop control on the southbound approach. With the existing configuration, all movements at this intersection operate with LOS C or better during the morning peak hour and with long delays and LOS F during the afternoon peak hour. Upon construction of the Nine Mile project in 2021, a new south leg will be constructed at this intersection. With completion of the project in 2021, it is anticipated that the intersection will need and warrant signalization. The new northbound approach to the intersection is recommended to include separate left turn and shared through/right turn lanes. The southbound approach should also be designated with this configuration if possible to provide the most efficient signal operations. Designated northbound, southbound, and westbound left turn lanes are recommended. Separate right turn lanes are not anticipated to be needed on any approaches. With these improvements and the addition of project traffic in 2021, the intersection is anticipated to operate with LOS B or better during the morning and afternoon peak hours. This intersection is anticipated to continue to operate acceptably at LOS B during both the morning and afternoon peak hours throughout the 2040 horizon. **Table 4** provides the results of the level of service analysis at this intersection.

Table 4 – Arapahoe Road Full Movement Access (Safeway) LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2019 Existing				
Eastbound Left	10.6	B	8.8	A
Southbound Approach	15.6	C	62.2	F
2021 Background				
Eastbound Left	10.9	B	8.8	A
Southbound Approach	16.8	C	78.2	F
2021 Background Plus Project #				
Northbound Left	492.7	F	1566.7	F
Northbound Right	8.9	A	10.5	B
Eastbound Left	8.4	A	8.2	A
Westbound Left	8.0	A	8.7	A
Southbound Left	80.9	F	251.7	F
Southbound Right	10.0	B	9.0	A
2021 Background Plus Project # ##	9.1	A	12.4	B
2040 Background # ##	7.5	A	8.3	A
2040 Background Plus Project # ##	10.9	B	14.4	B

= South Leg & Associated Movements

= Signalized; EB & WB Two Through Lanes

Arapahoe Road and Beasley Drive

The existing Arapahoe Road and Beasley Drive intersection is a "T"-intersection with stop control on the southbound approach. With the existing configuration, all movements at this intersection operate with LOS C or better during both the morning and afternoon peak hours. Upon construction of the Nine Mile project in 2021, a new south leg will be constructed at this intersection. With this construction, it is recommended that this Arapahoe Road and Beasley Drive intersection be signalized. It is recommended that a westbound left turn lane be designated along Arapahoe Road. The new northbound approach is recommended to include separate left turn and through/right turn lanes. The southbound approach of Beasley Drive to the intersection is recommended to also be striped to include a separate left turn lane and shared through/right turn lane as well to provide for more efficient signal operations. When Arapahoe is improved to include two through lanes in each direction with the outside lane being a shared through/right turn lane. With these improvements and the addition of project traffic throughout 2040, the intersection is anticipated to operate acceptably at LOS A during the morning and afternoon peak hours. **Table 5** provides the results of the level of service analysis at this intersection.

Table 5 – Arapahoe Road and Beasley Drive LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2019 Existing				
Eastbound Left	11.2	B	8.3	A
Southbound Approach	15.7	C	14.1	B
2021 Background				
Eastbound Left	11.2	B	8.5	A
Southbound Approach	15.7	C	14.7	B
2021 Background				
Northbound Left	29.3	D	65.2	F
Northbound Through/Right	8.9	A	10.4	B
Eastbound Left	8.6	A	7.8	A
Westbound Left	7.6	A	8.6	A
Southbound Left	36.6	E	31.7	D
Southbound Through/Right	10.5	B	9.2	A
2021 Background Plus Project #	5.7	A	1.8	A
2040 Background ##	1.5	A	1.0	A
2040 Background Plus Project ##	2.5	A	2.2	A

= South Leg & Associated Movements

= Signalized; NB & SB Left Turn & Shared Through/Right Lanes; EB & WB Two Through Lanes

Lucerne Drive and US-287

The existing intersection of Lucerne Drive and US-287 is signalized and operates with permitted-only left turn phasing on the eastbound and westbound approaches and protected-permitted left turn phasing on the northbound and southbound approach. With the existing conditions, this intersection is anticipated to continue operating acceptably with or without project traffic in 2021 project buildout year as well as throughout the long term 2040 horizon. **Table 6** provides the results of the level of service analysis at this intersection.

Table 6 – Lucerne Drive and US-287 LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2019 Existing	6.0	A	7.4	A
2021 Background	6.1	A	7.8	A
2021 Background Plus Project	7.0	A	8.9	A
2040 Background	7.1	A	20.9	C
2040 Background Plus Project	7.6	A	23.5	C

Arapahoe Road Right-In/Right-Out Access

With development of the commercial portion of the project in 2021, a right-in/right-out access is proposed along Arapahoe Road approximately half way between US-287 and the existing Safeway access. As previously mentioned, it is understood that Arapahoe Road will be improved to provide two through lanes in each direction, eastbound and westbound. The westbound approach is recommended to improve two through lanes with the outside lane being a shared/through right turn lane. It is recommended that the northbound approach of the access include a single right turn lane and operate with stop control with the installation of an R1-1 "STOP" sign. To provide signage for the proposed right-in/right-out restricted access along Arapahoe Road, it is recommended that a R6-1(R) "ONE WAY" sign be installed within the raised median in alignment of exiting traffic from the proposed access. It is recommended that the northbound right turn movement for exiting vehicles provide a minimum throat depth of 25 feet (1 vehicle). With this configuration, all movements at the unsignalized access are anticipated to operate acceptably throughout the 2040 horizon. **Table 7** provides the results of the level of service at this intersection.

Table 7 – Arapahoe Road Right-In/Right-Out Access LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec)	LOS	Delay (sec)	LOS
2021 Background Plus Project Northbound Right	8.9	A	10.3	B
2040 Background Plus Project Northbound Right	9.1	A	11.8	B

US-287 Three-Quarter Access

A three-quarter movement project access along US-287 is proposed approximately one-quarter mile (1,320 feet), measured center to center, south of Arapahoe Road and will restrict westbound left turn and through movements. With the completion of the project in 2021, the westbound approach at this intersection is anticipated to include a single right turn lane and operate with stop control with the installation of an R1-1 "STOP" sign. To provide signage for the proposed three-quarter access with restricted right-out only turning movements onto US-287, it is recommended that a R3-2 No Left Turn sign be installed underneath the STOP sign at the proposed access for exiting traffic. It is also recommended that a southbound left turn lane and northbound right turn lane be designated with buildout of the project in 2021. It is recommended that the westbound right turn movement for exiting vehicles provide a minimum throat depth of 50 feet (2 vehicles).

By 2040, it is anticipated that the development west of US-287 will be complete and that the intersection will be a four-leg intersection. By this time, it is anticipated that US-287 will be a six-lane roadway. It is recommended that the eastbound and westbound restricted approaches of the intersection consist a single right turn lane and are stop controlled. Separate left turn lanes and three through lanes of travel with the outside lane being a shared through/right turn lane are recommended on the northbound and southbound approaches. With this configuration, the intersection is anticipated to operate with LOS C or better during the morning peak hour and LOS E or better during the afternoon peak hour. **Table 8** provides the results of the level of service at this intersection.

Table 8 – US-287 Three Quarter Access LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec)	LOS	Delay (sec)	LOS
2021 Background Plus Project				
Westbound Right	13.6	B	29.9	D
Southbound Left	10.5	B	17.4	C
2040 Background Plus Project #				
Northbound Left	14.6	B	24.7	C
Eastbound Right	16.5	C	44.3	E
Westbound Right	14.4	B	26.1	D
Southbound Left	14.2	B	18.7	C

= West Leg & Associated Movements; Three Through Lanes NB

5.3 Turn Bay Length Analysis

It is recommended that auxiliary turn lanes along US-287 be constructed in accordance with the current CDOT State Highway Access Code (SHAC). The State Highway Access Category Schedule categorizes the segment of US-287 through the study intersection as NR-A: Non-Rural Principal Highway. According to the State Highway Access Code for category NR-A roadways, the following thresholds apply:

- A left turn deceleration lane and taper with storage length is required for any access with a projected peak hour ingress turning volume greater than 10 vehicles per hour (vph).
- A right turn deceleration lane and taper is required for any access with a projected peak hour ingress turning volume greater than 25 vehicles per hour (vph).
- A right turn acceleration lane and taper is required for any access with a projected peak hour right turning volume greater than 50 vehicles per hour (vph) when the posted aped on the highway is greater than 40 miles per hour.

Based on traffic projections, the auxiliary turn lane requirements were calculated per the Colorado State Highway Access Code for the proposed three-quarter movement access intersection along US-287. Through this intersection, US-287 provides two lanes of travel each direction, northbound and southbound, with a 60 mile per hour posted speed limit. US-287 also contains a continuous acceleration/deceleration lane along northbound US-287 adjacent to the project. As such, turn lane requirements are as follows:

US-287 Three-Quarter Movement Access

- A southbound left turn lane **is warranted** at the proposed US-287 three-quarter movement access based on the projected 2021 and 2040 traffic volumes with 85 left turn vehicles per hour and the threshold being 10 vehicles per hour (vph). Since it has a category of NR-A with a 60 mile per hour speed limit, the turn lane requirement is deceleration length plus storage with the taper length being included within the required deceleration length. The required deceleration length is 700 feet (including 25 to 1 taper) with 85 feet of storage based on the projected 2021 and 2040 traffic volume. This lane would need to be designated with a left turn lane length of 485 feet plus 300-foot taper. Based on the available approximate 1,030-foot spacing along US-287 between Arapahoe Road and the proposed three-quarter access, it is recommended that the southbound left turn lane at the access along US-287 provide 330 feet of length plus a

300-foot taper so that the existing northbound left lane length of 400 feet can remain unmodified when converted to dual left turn lanes. Therefore, a Variance Waiver from CDOT will likely be needed for this left turn lane. It should be noted that a speed limit of 60 miles per hour will likely not be maintained as the surrounding area is developed. With a potential lower speed limit in the future, the turn lane length requirements would decrease.

- A northbound right turn deceleration lane **is warranted** at the proposed US-287 three-quarter movement access intersection based on the projected 2021 and 2040 traffic volumes with 186 right turn vehicles and the threshold being 25 vehicles per hour (vph). Since it has a category of NR-A with a 60 mile per hour speed limit, the turn lane requirement is deceleration length only with the taper length being included within the required deceleration length. The required deceleration length is 700 feet. The taper is identified as 25 to 1 based on the 60 mile per hour speed limit. Assuming a 12-foot wide right turn lane, the taper length is 300 feet. Therefore, it is recommended that a northbound right turn lane be provided at this intersection with the completion of the project with 400 feet of storage and 300-foot taper. A continuous acceleration/deceleration lane currently exists along northbound US-287 and will remain south of this proposed access. There is approximately 375 feet between the proposed full moment access and Lucerne Drive. Since an acceleration lane is not warranted from the Lucerne Drive intersection, this lane could be designated as a right turn deceleration lane, although a CDOT waiver may be needed for the design.

- A westbound right turn acceleration lane **is warranted** at the US-287 three-quarter movement access based on the projected 2021 and 2040 traffic volumes with 105 right turn vehicles and the threshold being 50 vehicles per hour (vph). The turn lane requirement is acceleration length with the taper being included. The required acceleration length is 1170 feet with the same 25 to 1 taper based on the 60 mile per hour speed limit. A continuous acceleration/deceleration lane currently exists along northbound US-287. It is recommended that this acceleration lane along northbound US-287 be a continuous acceleration/deceleration lane between this access and US-287/Arapahoe Road intersection. There is approximately 1,320 feet, measured center to center, between Arapahoe Road and proposed three-quarter access intersection.

5.4 Queueing Analysis

A queuing analysis was conducted for the study area intersections and proposed accesses along Arapahoe Road and US-287. Turn lanes are recommended to be constructed/designated to Town of Erie and CDOT standards providing the recommended storage length based on the queuing analysis. Results were obtained from the 95th percentile queue lengths obtained from the Synchro analysis. Results are shown in the following **Table 9** with calculations provided within the level of service operational sheets of **Appendix D** for the unsignalized intersections and **Appendix E** for signalized intersections.

Table 9 – Queue Length Analysis Results

Intersection Turn Lane	Existing Turn Lane Length (feet)	2021 Calculated Queue Length (feet)	2021 Recommended Turn Lane Length (feet)	2040 Calculated Queue Length (feet)	2040 Recommended Turn Lane Length (feet)
Arapahoe/US 287					
Eastbound Left	150’	186’	**200’**	157’ DL	200’ DL
Westbound Left	375’	285’ DL	375’ **DL**	329’ DL	375’ DL
Northbound Left	400’	380’ DL	400’ **DL**	396’ DL	400’ DL
Northbound Right	C	129’	C	163’	C
Southbound Left	425’	180’ DL	425’ **DL**	214’ DL	425’ DL
Southbound Right	C	98’	C	211’	C
Arapahoe/Safeway					
Eastbound Left	150’	44’	150’	43’	150’
Westbound Left	DNE	103’	**150’**	146’	150’
Northbound Left	DNE	140’	**150’**	140’	150’
Southbound Left	DNE	74’	**100’**	74’	100’
Arapahoe/Beasley					
Eastbound Left	275’	25’	275’	25’	275’
Westbound Left	DNE	25’	**150’**	25’	150’
Northbound Left	DNE	52’	**100’**	52’	100’
Northbound Th/Rt	DNE	25’	**100’**	25’	100’
Southbound Left	DNE	25’	**100’**	25’	100’
Southbound Th/Rt	DNE	25’	**100’**	25’	100’
Lucerne/US 287					
Eastbound Left	175’	26’	175’	145’	175’
Eastbound Right	100’	25’	100’	25’	100’
Westbound Left	100’	33’	100’	32’	100’
Northbound Left	625’	25’	625’	25’	625’
Northbound Right	375’	25’	375’	25’	375’
Southbound Left	250’	25’	250’	25’	250’
Southbound Right	C	25’	C	25’	C
Arapahoe RIRO					
Northbound Right	DNE	25’	**25’**	25’	25’
US 287 3/4 Access					
Westbound Right	DNE	50’	**50’**	50’	50’
Southbound Left	DNE	25’	**330’ D + 300’ T**	25’	330’ D + 300’ T

DNE = Does Not Exist; C = Continuous; DL = Dual Left Turn Lanes

As shown in the table representing the queuing results in 2021, all anticipated queues are accommodated or managed within existing turn bay lengths. Of note, these calculations include the planned roadway improvements at the intersection of Arapahoe Road and US-287. The planned turn lane improvements at the intersection of Arapahoe Road and US-287 include providing dual left turn lanes on the northbound, southbound, and westbound approaches, and extending the eastbound left turn lane from 150 feet to 200 feet of the length.

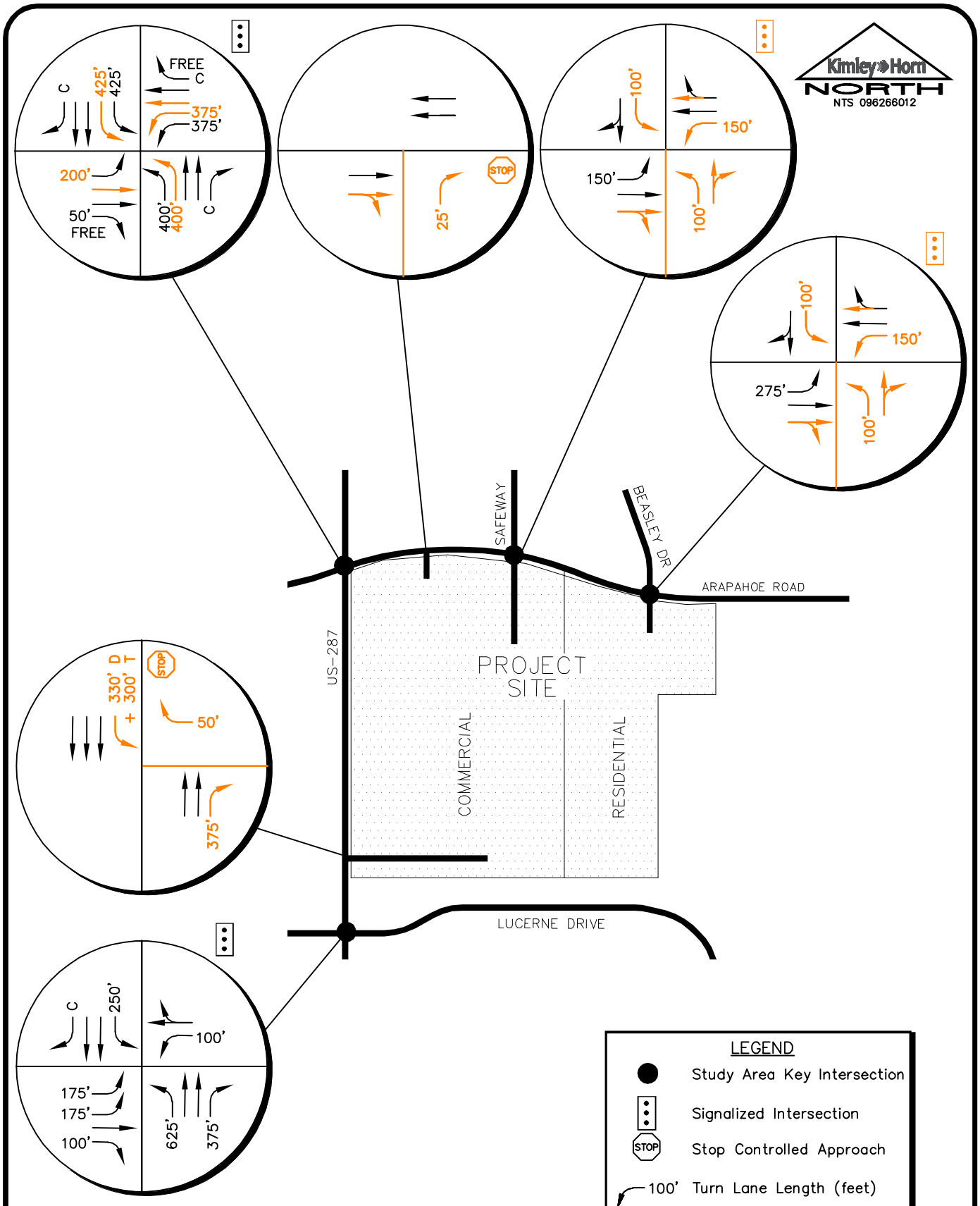
At the Arapahoe Road Safeway access, the westbound left, northbound left, and southbound left turn lanes should provide storage of 150 feet, 150 feet, and 100 feet, respectively.

At the Arapahoe Road and Beasley Drive intersection, it is recommended that the westbound left turn provide storage of 150 feet. It is recommended that the northbound and southbound approaches at the Arapahoe Road and Beasley Drive intersection consist of separate left turn lanes. It is recommended that the northbound and southbound left turn lanes accommodate a queue of 100 feet.

Based on the available approximate 1,030-foot spacing along US-287 between Arapahoe Road and the proposed three-quarter access, it is recommended that the southbound left turn lane at the access along US-287 provide 330 feet of length plus a 300-foot taper so that the existing northbound left turn lane length of 400 feet can remain unmodified when converted to dual left turn lanes.

It is recommended that the exiting driveway throat at the Arapahoe Road right-in/right-out access provide a minimum length of 25 feet (one vehicle) while the exit throat at the proposed three-quarter access along US-287 provide a minimum length of 50 feet (two vehicles). All proposed turn lanes should provide the lengths recommended in **Table 10**.

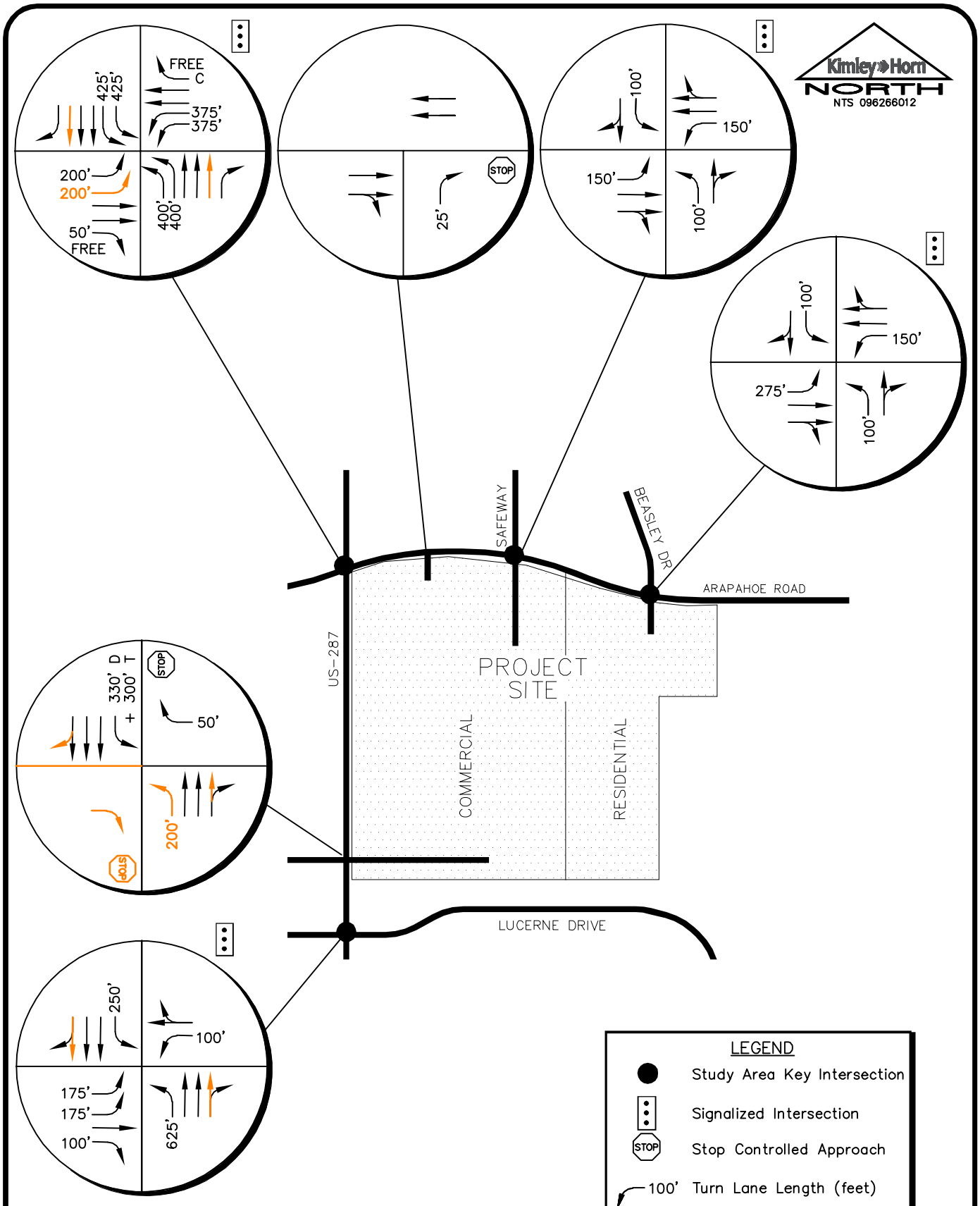
Based on the results of the operational and queuing analysis, the recommended intersection improvements are illustrated in **Figure 15** for the 2021 horizon year and **Figure 16** for the 2040 horizon year.



NINE MILE
ERIE, COLORADO
2021 RECOMMENDED LANE CONFIGURATION AND CONTROL

FIGURE 15

Kimley»Horn



NINE MILE
ERIE, COLORADO
2040 RECOMMENDED LANE CONFIGURATION AND CONTROL

FIGURE 16

Kimley»Horn

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis presented in this report, Kimley-Horn believes the traffic anticipated from the proposed Nine Mile project on the southeast corner of the Arapahoe Road and US-287 intersection will be incorporated into the existing and future roadway network. Analysis of the existing street network, the proposed project development, and expected traffic volumes resulted in the following recommendations:

2021 Horizon Recommendations

With development of the Nine Mile development on the southeast corner of the Arapahoe Road and US-287 intersection, several improvements are recommended to improve traffic operations. The improvements recommended are those that are believed to be feasible to construct with the development of the project.

- It is recommended that Arapahoe Road be widened to include two eastbound and westbound through lanes adjacent to the project.
- It is recommended that the Arapahoe Road/US-287 signalized intersection include dual left turn lanes on the northbound, southbound, and westbound approaches. The eastbound approach of this intersection will maintain a single left turn lane in the short-term horizon due to the Town of Erie having a desire to preserve historical structures on the west leg of this intersection. The widening of Arapahoe Road along the south side of the roadway adjacent to the project will allow for the westbound dual left turn lanes along with the two eastbound and westbound through lanes. The northbound and southbound dual left turn lanes can be designated within the existing striped out area along US-287. A traffic signal modification will be needed at the intersection to accommodate these additional turn lanes.
- The proposed right-in/right-out access along Arapahoe Road is recommended to operate with stop control on the new northbound exiting access approach with the installation of a R1-1 “STOP” sign. A separate right turn lane is not anticipated to be needed on the eastbound approach. To provide signage for the proposed right-in/right-out restricted access along Arapahoe Road, it is recommended that a R6-1(R) “ONE WAY” sign be installed within the raised median in alignment of exiting traffic from the proposed access.
- It is recommended that the northbound right turn movement at the Arapahoe Road right-in/right-out intersection provide a minimum throat depth of 25 feet (1 vehicle).

- The full movement access proposed along Arapahoe Road to align with the existing full movement access for Safeway is recommended to be signalized. The new northbound approach to the intersection is recommended to include separate left turn and shared through/right turn lanes. The southbound approach should also be designated with this configuration if possible to provide the most efficient signal operations. Northbound and southbound left turn lanes of 100 feet with 50-foot tapers is recommended. A westbound left turn lane of 150 feet with 100-foot taper is recommended along Arapahoe Road for the new access. Separate right turn lanes are not anticipated to be needed on any approaches.
- A new south leg is recommended to be constructed at the Arapahoe Road and Beasley Drive intersection to provide access to the project. With this new access, it is recommended that this intersection be signalized. It is recommended that a westbound left turn lane of 150 feet in length plus 100-foot taper be designated along Arapahoe Road. The new northbound approach is recommended to include separate left turn and through/right turn lanes. A northbound left turn lane of 100 feet with 50-foot taper is recommended. The southbound approach of Beasley Drive to the intersection is recommended to also be striped to include a separate left turn lane and shared through/right turn lane as well to provide for more efficient signal operations. Separate right turn lanes are not anticipated to be needed for any approach to this intersection.
- A new three-quarter movement access is recommended along US-287, approximately a quarter-mile south of the Arapahoe Road intersection. This access intersection is recommended to operate with stop control with a R1-1 “STOP” sign installed on the westbound approach. To provide signage for the proposed three-quarter access with restricted right-out only turning movements onto US-287, it is recommended that a R3-2 No Left Turn sign be installed underneath the STOP sign at the proposed access for exiting traffic.
- Based on the available approximate 1,030-foot spacing along US-287 between Arapahoe Road and the proposed three-quarter access, it is recommended that the southbound left turn lane at the access along US-287 provide 330 feet of length plus a 300-foot taper so that the existing northbound left lane length of 400 feet can remain unmodified when converted to dual left turn lanes. Therefore, a Variance Waiver from CDOT will likely be needed for this southbound left turn lane. It should be noted that a speed limit of 60 miles per hour will likely not be maintained as the surrounding area is

developed. With a potential lower speed limit in the future, the turn lane length requirements would decrease.

- A northbound right turn deceleration lane is recommended to be designated for the three-quarter movement access along US-287. Adequate pavement width exists for this turn lane today. Therefore, it is recommended that northbound US-287 be restriped to account for this recommended northbound right turn deceleration lane back to the Lucerne Drive intersection located approximately 350 feet to the south.
- A northbound acceleration lane from the westbound right turn is recommended to be designated for the three-quarter movement access along US-287. A continuous acceleration/deceleration lane currently exists along northbound US-287. It is recommended that this acceleration lane along northbound US-287 be a continuous acceleration/deceleration lane between this access and US-287/Arapahoe Road intersection.
- It is recommended that the westbound right turn movement at the US-287 three-quarter access intersection provide a minimum throat depth of 50 feet (2 vehicles).
- A traffic signal progression analysis was conducted along the approximate 2,750-foot long segment of Arapahoe Road from US-287 to the west and 111th Street to the east. A traffic signal is proposed at the Safeway full movement access along Arapahoe Road located approximately 800 feet east of US-287. A traffic signal is also proposed at the intersection of Arapahoe Road and Beasley Drive which is located approximately 660 feet east of the Safeway full access intersection and 1,290 feet west of the Arapahoe Road and 111th Street intersection. A goal platoon efficiency for an arterial roadway should be 20 percent or higher, or does not degrade the existing signal progression, which has been achieved in both 2021 and 2040 for both directions of travel. Therefore, it is believed that two proposed signalized intersections along Arapahoe Road would maintain an acceptable platoon efficiency along the Arapahoe Road corridor if coordinated with the adjacent traffic signals.

2040 Horizon Recommendations

Based on the annual traffic volume growth rate, several capacity improvements may be needed in the future to accommodate traffic within the area. The following provides recommendations that will likely be needed to accommodate 2040 future traffic volumes:

- If future projected traffic volume growth is realized, US-287 may need to provide three through lanes in each direction, northbound and southbound. It is

recommended that CDOT continue to monitor traffic volumes in the future to determine if and when the highway may need to include capacity improvements for possible increased through lane capacity in each direction.

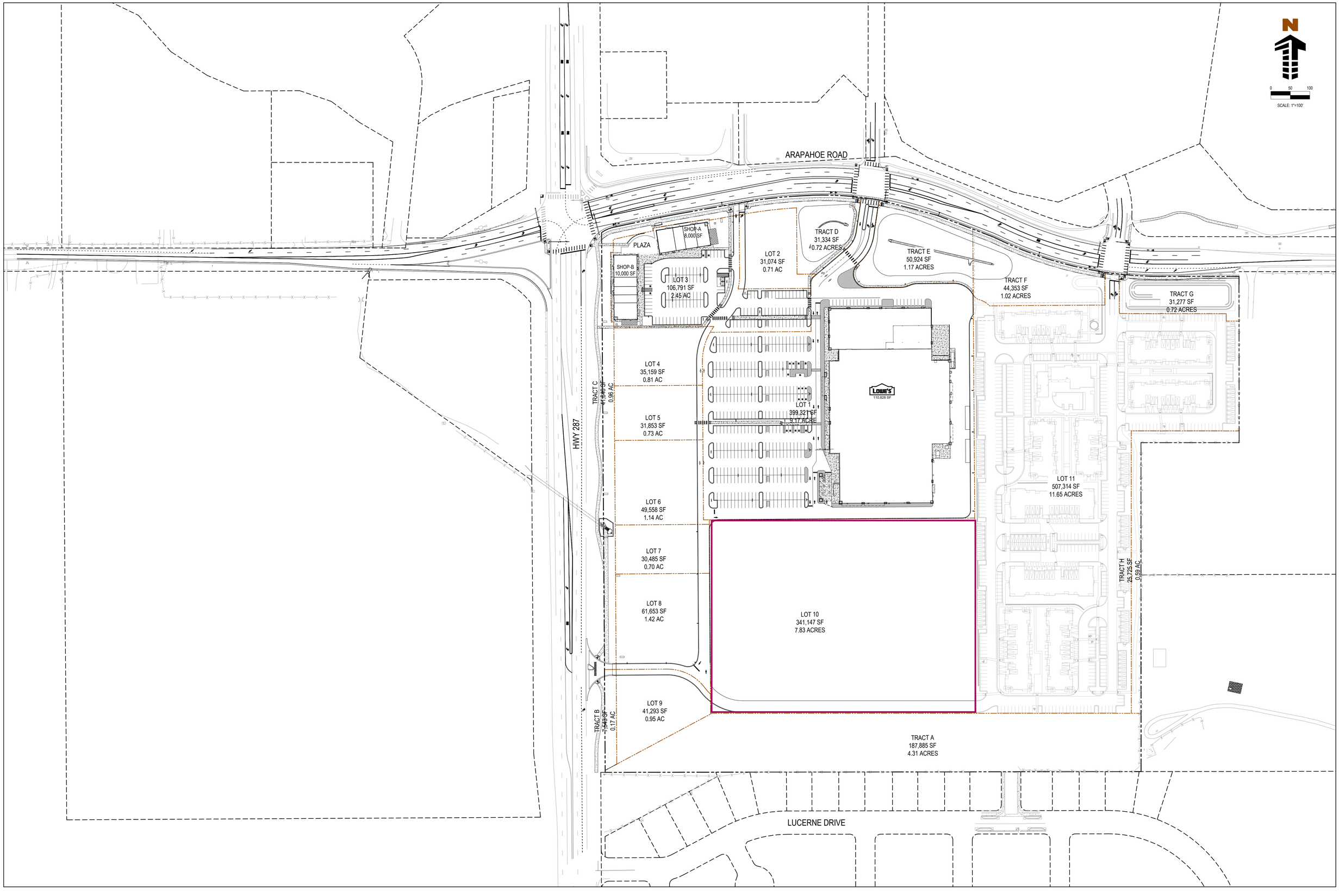
- By 2040, it is anticipated that the development west of US-287 will be complete and that the US-287 three-quarter access intersection will be a four-leg intersection. It is recommended that the eastbound and westbound restricted approaches of the intersection consist a single right turn lane and be stop controlled. Separate left turn lanes and three through lanes of travel with the outside lane being a shared through/right turn lane are recommended on the northbound and southbound approaches.
- By 2040, the intersection of Arapahoe Road/US-287 may need to be fully built out in order to operate acceptably. This includes eastbound dual left turn lanes, and three through lanes with separate right turn lanes northbound and southbound along US-287.

General Recommendation

- All on-site and off-site roadway improvements should be incorporated into the Civil Drawings and conform to standards of the Town of Erie, CDOT (as appropriate), American Association of State Highway and Transportation Officials (AASHTO) Geometric Design of Highways and Streets, Institute of Transportation Engineers (ITE), and the Manual on Uniform Traffic Control Devices (MUTCD) – 2009 Edition.

APPENDIX G

Conceptual Site Plan


N
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SCALE: 1"=100'
ARAPAHOE ROAD
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SHOP-B
10,000 SF
LOT 3
106,791 SF
2.45 AC
LOT 2
31,074 SF
0.71 AC
TRACT D
31,334 SF
0.72 ACRES
TRACT E
50,924 SF
1.17 ACRES
TRACT F
44,353 SF
1.02 ACRES
TRACT G
31,277 SF
0.72 ACRES
LOT 4
35,159 SF
0.81 AC
LOT 5
31,853 SF
0.73 AC
TRACT C
41,846 SF
0.96 AC
LOWE'S
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LOT 1
399,321 SF
9.17 ACRE
LOT 11
507,314 SF
11.65 ACRES
LOT 6
49,558 SF
1.14 AC
LOT 7
30,485 SF
0.70 AC
LOT 8
61,653 SF
1.42 AC
LOT 10
341,147 SF
7.83 ACRES
TRACT H
25,725 SF
0.59 AC
LOT 9
41,293 SF
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TRACT A
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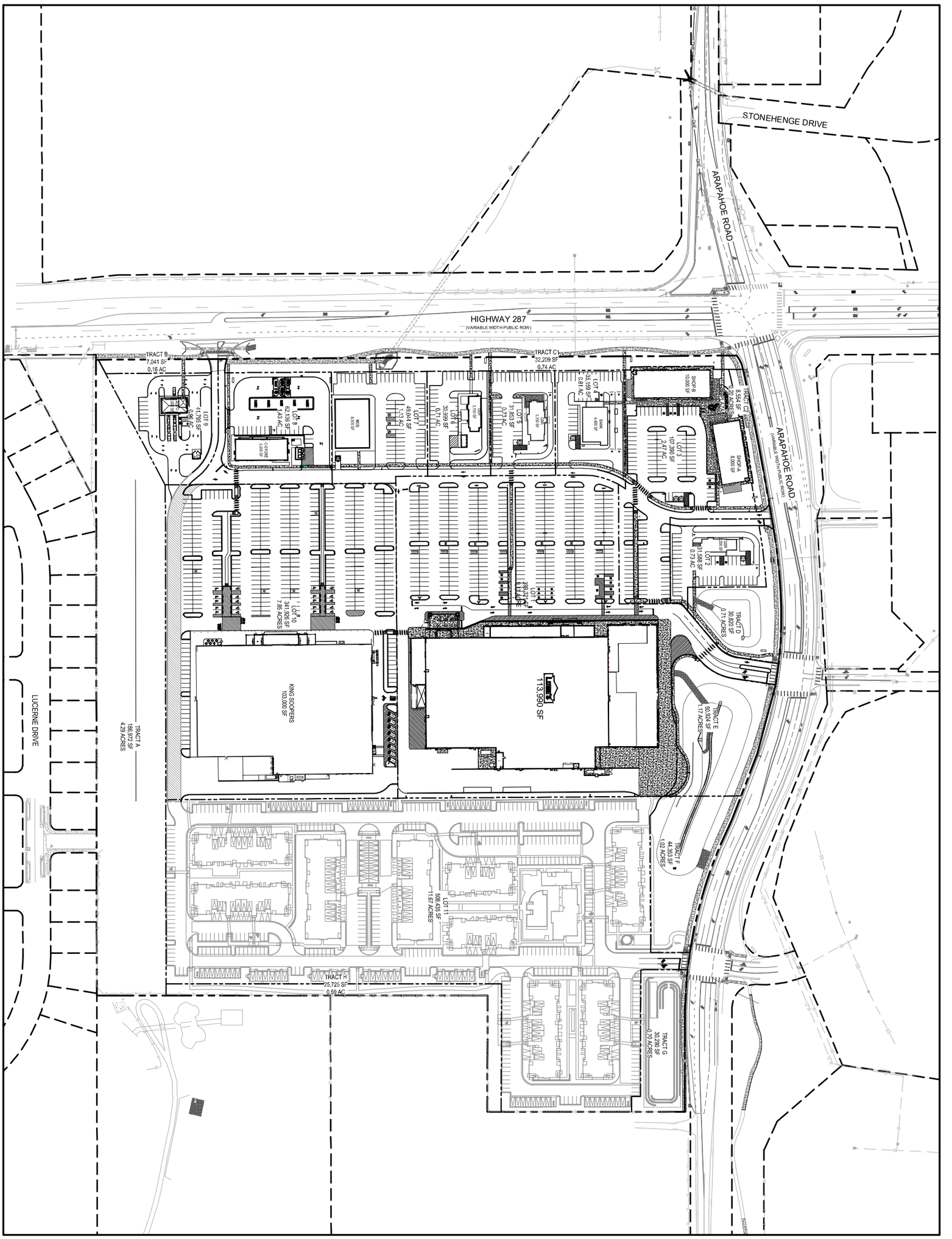
LUCERNE DRIVE

Attachment II
Site Plan



ADDRESS EXHIBIT

HIGHWAY 287 AND ARAPAHOE ROAD
ERIE, COLORADO

Project No:	EDI000018
Drawn By:	ACJ
Checked By:	BSM
Date:	3/12/2021

Galloway
6162 S. Willow Drive, Suite 320
Greenwood Village, CO 80111
303.770.8884 • GallowayUS.com

CTL | THOMPSON INCORPORATED

PRELIMINARY GEOTECHNICAL INVESTIGATION
NINE MILE CORNER – COMMERCIAL AREA
SOUTHEAST OF HIGHWAY 287 AND
ARAPAHOE ROAD
ERIE, COLORADO

Prepared For:

EVERGREEN DEVELOPMENT
1873 South Bellaire Street, #1106
Denver, Colorado 80222

Attention: Ron Wolford

Project No. DN48,647-125-R1

November 21, 2019
Revised March 4, 2020

1971 West 12th Avenue | Denver, Colorado 80204 | Phone: 303-825-0777 | Fax: 303-825-4252

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SCOPE

This report presents a revised Preliminary Geotechnical Investigation for the commercial area at Nine Mile Corner, southeast of Highway 287 and Arapahoe Road in Erie, Colorado (Fig. 1). We performed a Geotechnical Investigation for apartments planned on the east side of the parcel and presented results under separate cover. The purpose of our investigation was to evaluate the subsurface conditions to assist in planning of site development and commercial construction. The report includes descriptions of soil and bedrock strata and groundwater levels encountered in our exploratory borings, and discussions of site development and construction as influenced by geotechnical considerations. The scope was described in a Proposal (DN 16-0532R) dated December 6, 2016. Evaluation of the property for the possible presence of potentially hazardous materials (Environmental Site Assessment) was not included in our scope. We have revised the November 21, 2019 version of the report to include results of additional testing and discussion regarding foundations, floor systems and pavements for the north anchor building, Lowe's.

This report is based on subsurface conditions disclosed by exploratory drilling and sampling, results of field and laboratory tests, engineering analysis of field and laboratory data, and our experience. It contains descriptions of the soil and bedrock conditions and groundwater levels found in exploratory borings drilled in 2016 and 2017, recommendations for site development, and preliminary discussion of foundations, floor systems, pavements, and surface drainage. The discussions of foundation and floor system alternatives are intended for preliminary design. Additional, building-specific investigations will be necessary to design structures and improvements. A brief summary of our conclusions and recommendations follows, with more detailed discussion in the report.

SUMMARY OF FINDINGS AND CONCLUSIONS

1. The primary geotechnical concerns are expansive soil and bedrock, potentially shallow groundwater and deep fill. We believe these concerns can be mitigated with proper investigation, planning, engineering, design and construction. We believe there are no geotechnical constraints at this site that preclude development.

2. Strata found in our borings consisted of nil to 11.5 feet of fill over natural clay, sand, and/or interlayered clay/sand underlain in most borings by weathered to comparatively unweathered claystone and interbedded claystone/sandstone bedrock. Bedrock was not encountered in four borings. Testing indicates the fill is predominately low swelling and the natural clay and claystone have variable swell potential. We judge the sand is non-expansive.

3. Groundwater was encountered during drilling in fourteen borings at depths of about 3.5 to 28 feet below existing grades. When the holes were checked after drilling, water levels were measured in twenty-one borings at depths of 1.5 to 37.5 feet. Groundwater may impact sub-excavation of the south building anchor pad, the retaining walls at the south site limits, and utility installation. Temporary construction dewatering may be necessary. Groundwater may fluctuate seasonally and rise in response to precipitation and landscape irrigation.

4. Expansive soils and bedrock are present. We estimated potential heave of about 1.7 to 8.1 inches at the ground surface based on a depth of wetting of 20 feet below proposed grades. The majority of the heave estimates were 2 inches or less. We anticipate shallow foundations can be used for the north anchor building and building pads along the west side and northwest corner of the site. The southern portion of the north anchor pad should be sub-excavated to match existing grades on the northern portion. This will create a relatively uniform fill depth across the building pad and reduce the risk of differential movement. We recommend monitoring of the north pad to confirm settlement has virtually ceased prior to foundation construction. Existing fill should be removed below the northwest building pads.

   Highly expansive claystone and natural clay are present below the south anchor building and southwest building pad. Sub-excavation of the south anchor building and southwest building pad appears merited to potentially allow use of footing-type foundations and enhance performance of slab-on-grade floors.

5. We judge there is relatively low risk of excessive floor movements caused by expansive soils for the north anchor and building pads along the west side and northwest corner of the site. Sub-excavation of the south anchor and southwest building pad should reduce potential floor movements.

6. Pavement subgrade soils are likely to be derived of clay and claystone, which are poor subgrade material. Imported materials will also support pavements. Based on Lowe's criteria, we anticipate a full depth asphalt section of 7 inches for light duty parking lots and parking access drives, and 10 inches for heavy duty fire/truck lanes and loading dock areas. Concrete and composite sections (asphalt and base course) are provided in the report. In areas of highly expansive claystone and/or natural clay (south anchor and southwest building pad parking areas), sub-excavation to a depth of at least 3 feet below pavement subgrade can be selected to enhance pavement performance. A design-level subgrade investigation should be done prior to paving.

7. Control of surface and subsurface drainage will be critical to the performance of foundations, slabs-on-grade and pavements. Overall surface drainage should be designed to provide rapid run-off of surface water away from structures and off pavements and flatwork. Water should not be allowed to pond near the crests of slopes, near structures or on pavements and flatwork.

SITE CONDITIONS

The commercial area is planned on the western side of the proposed Nine Mile Corner development (Fig. 1 and Photo 1). The site is bordered by Arapahoe Road on the north, Highway 287 to the west, and existing single-family residences to the south and east. The ground surface is covered with grass, weeds, bushes and trees. The site generally slopes from south to north, with overall relief of about 50 feet. The northwest portion of the site was previously occupied by Prince Lake No. 1, which was used as a water storage reservoir. Based on Google Earth aerial photos, the reservoir appears to have been constructed in 2003 and remained in use until about 2015 when it was drained and partially filled. An existing ditch traverses the middle portion of the property from west-to-east.

PROPOSED CONSTRUCTION

Plans provided show construction will include two anchor buildings, oriented north-south across the center of the site, and eight smaller building pads along the western edge of the parcel. Surface parking and access drives will occupy the area between the anchors and western building pads. Based on site topography and grading

plans, up to about 21 feet of fill and 30 feet of cut will be necessary to reach final construction grades (Fig. 5). The majority of fill will be located north of the existing ditch, with the deepest fills occurring in the previous reservoir area. A cut slope and mechanically stabilized earth retaining wall will be constructed along the south property line to accommodate grade change, with cuts of about 10 to 22 feet occurring north of the wall. Two detention ponds are planned along the north side of the site and the existing ditch will be piped across the site.

Photo 1 – Google Earth© Aerial Site Photo, May 2018

GEOLOGIC HAZARDS

Colorado is a challenging location to practice geotechnical engineering. The climate is relatively dry and the near-surface soils are typically dry and comparatively stiff. These soils and related sedimentary bedrock formations react to changes in moisture conditions. Some of the soils swell as they increase in moisture and are referred to as expansive soils. Other soils can compress significantly upon wetting and are identi-

fied as compressible soils. Most of the land available for development east of the Front Range is underlain by expansive clay or claystone bedrock near the surface. The soils that exhibit compressible behavior are more likely west of the Continental Divide; however, both types of soils occur throughout the state.

Covering the ground with buildings, streets, pavements, sidewalks, etc., coupled with landscape irrigation and changing drainage patterns, leads to an increase in subsurface moisture conditions. As a result, some soil movement due to heave or settlement is inevitable. Expansive soil and bedrock are present at this site, which constitutes a geologic hazard. Soft soils are also present which will compress under the proposed fill. There is risk that foundations and slab-on-grade floors will experience heave or settlement and damage. It is critical that precautions are taken to increase the chances that the foundations and slabs-on-grade will perform satisfactorily. Engineered design of grading, pavements, foundations, slabs-on-grade, and drainage can mitigate, but not eliminate, the effects of expansive soil and bedrock and potential settlement. Subexcavation is a means to reduce potential heave and potentially allow use of shallow foundations and slab-on-grade floors. Shallow groundwater is also considered a geologic hazard and should be considered in design.

INVESTIGATION

We investigated subsurface conditions by drilling and sampling 22 exploratory borings in the commercial area at the approximate locations shown on Fig. 1. Prior to drilling, we contacted the Utility Notification Center of Colorado and local sewer and water districts to identify locations of buried utilities. Boring locations were staked and elevations provided by Galloway & Company Inc. prior to drilling. The borings were drilled to depths of 20 to 50 feet below existing grades using 4-inch diameter, continuous-flight solid-stem auger and truck-mounted drill rigs. Samples were obtained at 5 to 10 feet intervals using 2.5-inch diameter (O.D.) modified California samplers driven by blows of an automatic 140-pound hammer falling 30 inches. Bulk samples were also obtained from auger cuttings. Our field representative was present to observe drilling,

log the strata encountered and obtain samples. Upon completion of drilling, hand-slotted PVC pipe was inserted in some holes to allow delayed groundwater level measurements. Graphical logs of the borings are presented in Appendix A.

Samples were returned to our laboratory for examination and testing. Laboratory tests included moisture content, dry density, percent silt and clay-sized particles (passing No. 200 sieve), Atterberg limits, swell-consolidation, time consolidation, soil suction, standard Proctor, California Bearing Ratio (CBR), and water-soluble sulfate concentration. Swell-consolidation tests were performed by wetting samples under approximate anticipated overburden pressure (the pressure exerted by overlying soils) based on grading plans provided in 2016. Load back analysis was performed on select samples to estimate swelling pressure Laboratory test results are presented in Appendix B and summarized in Table B-I.

SUBSURFACE CONDITIONS

Strata found in the borings consisted of nil to 11.5 feet of fill over natural clay, sand, and/or interlayered clay/sand, underlain in most borings by weathered to comparatively unweathered claystone and interbedded claystone/sandstone bedrock. Bedrock was not encountered in four borings. Pertinent engineering characteristics of the soil and bedrock are described in the following paragraphs.

Fill

About 5 to 11.5 feet of clayey sand to sandy clay fill was encountered from the ground surface in nine borings. We understand the fill was placed during partial backfill of Prince Lake No. 1 in 2015. We were provided compaction test records from Midwest Testing. These records indicate the fill was placed in a controlled manner, and compaction met project specifications at locations tested. The records provided indicate dewatering was necessary, some soft materials were removed, and some fill was placed to bridge soft areas before compaction was achieved. We obtained topographic data

from Galloway for prior to 2015 and current conditions and used the data to estimate the depth of existing fill (Fig. 4). The datum for the two sets of data appears to be inconsistent, which results in estimates of cut or fill in areas where no grading has occurred. The data suggests a maximum of about 10 to 11 feet of fill was placed in the reservoir which is consistent with conditions found in borings TH-1, TH-21 and TH-22.

The fill was medium stiff to very stiff or loose to medium dense based on results of field penetration resistance tests. One fill sample compressed 0.3 percent and six swelled 0.1 to 3.5 percent when wetted. Three samples contained 48 to 78 percent silt and clay sized particles, with one showing moderate plasticity. A bulk sample of the fill had a standard Proctor maximum dry density of 113 pcf and optimum moisture content of 15.5 percent. A remolded sample of the same material compacted at 2 percent over optimum moisture content swelled 0.9 percent when wetted under a confining pressure of 1,000 psf.

Natural Clay and Sand

Natural clay, sand, and/or interlayered clay/sand was encountered below the fill or from the ground surface in seventeen borings. The clay was soft to very stiff and the sand very loose to medium dense. The softer clay and sand generally coincided with the presence of groundwater. One clay sample compressed 0.1 percent, two did not swell, and three swelled 0.9 to 4.8 percent when wetted. One bulk sample of clay obtained in the south portion of the site (TH-9) contained 88 percent silt and clay-sized particles and showed high plasticity. The same bulk sample had a standard Proctor maximum density of 106 pcf and optimum moisture content of 18.5 percent. A remolded sample of the clay compacted at 2 percent over optimum moisture content swelled 1.0 percent when wetted under a confining pressure of 1,000 psf. One sand sample contained 25 percent silt and clay sized particles. One interlayered clay/sand sample compressed 0.1 percent and two did not swell when wetted. Two interlayered clay/sand samples contained 23 and 29 percent silt and clay sized particles.

Bedrock

Weathered and comparatively unweathered claystone and interbedded claystone/sandstone bedrock was encountered below the fill and natural soils in eighteen borings at depths of about 3 to 24 feet. Estimated bedrock surface elevations are shown on Fig. 2. Claystone was predominant. The bedrock was weathered to very hard. Three claystone samples compressed 0.1 to 0.5 percent and forty swelled 0.1 to 8.7 percent when wetted. The average swell of the claystone was 3.5 percent. Four claystone samples contained 69 to 100 percent silt and clay sized particles, with two exhibiting high plasticity. Eighteen claystone samples had soil suction values of 3.68 to 4.65 pF. Laboratory testing indicates the majority of the claystone is moderate to highly expansive.

Groundwater

Groundwater was encountered during drilling in fourteen borings at depths of about 3.5 to 28 feet below existing grades. When the holes were checked after drilling on January 9, 2017, water levels were measured in twenty-one borings at depths of about 1.5 to 37.5 feet. Measured depths to groundwater and corresponding surface elevations are presented on Fig. 3. Groundwater will likely influence sub-excavation, the south retaining wall, and possibly utility installation. Groundwater control will likely be necessary during construction, and may be necessary after construction.

We understand the existing ditch will be piped across the site which may lower groundwater levels. Groundwater may fluctuate seasonally and rise in response to precipitation and landscape irrigation.

ESTIMATED POTENTIAL SETTLEMENT AND HEAVE

We estimate 1.7 to 8.1 inches of potential ground heave based on depth of wetting of 20 feet below proposed grades. The majority of the site borings have heave

estimates of 2 inches or less. We estimated up to about 4 inches of potential settlement in the previous reservoir area after grading. Additional settlement will occur as the fill is placed. We anticipate settlement will occur fairly rapidly after grading, likely within a few months or less. We recommend installing survey benchmarks to monitor the potential settlement after grading as shown on Fig. 8. The points should be surveyed on a weekly basis by a professional surveyor to monitor ongoing settlement of the fill. Construction of the north anchor foundation should be delayed until survey measurements confirm settlement has substantially ceased (settlement less than 0.02 feet over one month)Surcharging the north anchor pad can be considered to potentially expedite settlement.

SITE DEVELOPMENT

The primary geotechnical concerns are expansive soil and bedrock, deep fill and potential shallow groundwater. These concerns can be mitigated with proper investigation, planning, engineering, design, and construction. We believe there are no geotechnical constraints at this site that could preclude development.

Excavation and Utility Installation

We believe the soils and bedrock penetrated by our exploratory borings can be excavated with typical heavy-duty equipment. Contractors should be familiar with applicable local, state and federal safety regulations, including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards. Based on our investigation and OSHA standards, we anticipate the clay and sand will classify as Type B and C soil, respectively, and the bedrock as Type B. Type B and C soils require maximum slope inclinations of 1:1 and 1½:1 (horizontal:vertical), respectively, for temporary excavations in dry conditions. Excavations will require flatter slopes below groundwater and where seepage is present. Excavation side slopes specified by OSHA are dependent upon soil types and groundwater or seepage conditions encountered. The contractor's "competent person" is required to identify the soils encountered

in the excavations and refer to OSHA standards to determine appropriate slopes. Stockpiles of soils and equipment should not be placed within a horizontal distance equal to one-half the excavation depth, from the edge of an excavation. A professional engineer should design excavations deeper than 20 feet.

Site Grading

Substantial site grading will be required to achieve proposed construction grades. The on-site soils are generally suitable for reuse as new fill provided they are substantially free of debris, vegetation/organics and other deleterious materials. Significant import fill will also be necessary, which may be obtained from the residential portion of Nine Mile Corner. The ground surface in areas to be filled should be stripped of debris, vegetation/organics and other deleterious materials, scarified and moisture conditioned to the specifications outlined in the table below. To control settlement after grading, we recommend a higher degree of compaction in deep fill.

RECOMMENDED FILL/BACKFILL COMPACTION CRITERIA

Soil Type	Depth of Fill* (feet)	Moisture Content From Optimum	Minimum Compaction (ASTM D698)
Clay and Claystone	0 to 18	0 to +3	95 %
	>18	-1 to +2	100 %
Sand	0 to 18	-2 to +2	95
	>18	-2 to +2	100 %

* Depth below proposed grade

The properties of fill will affect the performance of foundations, slabs-on-grade, utilities, pavements, flatwork and other improvements. Fill should be placed in thin loose lifts, moisture-conditioned and compacted prior to placement of the next lift. The placement and compaction of fill should be observed and density tested by our representative during construction. Guideline grading specifications are presented in Appendix C.

Bulking/Shrinkage

The on-site soils consist primarily of sandy clay and claystone bedrock. We estimate relatively minor shrinkage of the clay and bulking of the claystone on the order of 5 to 10 percent. Many variables will affect the actual bulking/shrinkage factors. These variables include sample disturbance that will affect the densities used in the estimate, actual percent compaction of the fill, subsoil profiles, compression of the native soils below the fill, compression of deeper fill, rebound of soil and bedrock during cuts, stripping of topsoil, stabilization of soft soils, limitation of survey accuracy, and others. The effects of these variables on the bulkage/shrinkage factor are difficult to quantify.

Sub-Excavation

We have estimated potential ground heave of up to about 8 inches for an assumed depth of wetting of 20 feet. Settlement can also occur in areas where soft, compressible soils are present and where deep fill is necessary. Long and heavily-reinforced drilled piers and structurally supported floors are normally recommended for sites with significant potential heave. The south anchor building and southwest building pad (TH-13) are underlain at proposed grade by highly expansive claystone and/or natural clay, while other building pads along the west and northwestern portion of the site will be underlain by fill and lower swelling materials. Sub-excavation of the south anchor building and southwest building pad appears merited to reduce potential heave. Sub-excavation of the south portion of the north anchor pad is also recommended.

Sub-excavation is a ground improvement method used to reduce the potential swell or compression and mitigate impacts of expansive/compressible soils. In order to use footing foundations and enhance floor performance for the south anchor building and southwest building pad, we anticipate sub-excavation to at least 10 feet below foundations and 14 feet below floors, whichever is deeper. Sub-excavation should extend at least 5 feet laterally outside foundations. The southern portion of the north anchor building pad should also be sub-excavated to nearly match existing grades on

the northern portion. This will create a relatively uniform fill depth across the building pad and should reduce differential movement. Existing fill should be removed below the northwest building pads. Figure 6 shows the anticipated sub-excavation depths and elevations.

Sub-excavation has been used in the Denver area with satisfactory performance for the large majority of the sites where this ground modification method has been completed. We have seen isolated instances where settlement of sub-excavation fill has led to damage to buildings supported on footings. In most cases, the settlement was caused by wetting associated with poor surface drainage or seepage, and/or poorly compacted fill placed at the horizontal limits of excavation. Wetting of the fill may cause softening and settlement. If groundwater is encountered during sub-excavation an interceptor drain may be necessary. Interceptor drains should consist of Mirafi G200N drain board or a similar product with two-sided drainage capacity connected to 4-inch diameter perforated PVC pipe or approved equivalent. The drain board should extend up the excavation slope at least 3 feet above groundwater. A typical detail is provided on Fig. 7. Drains should slope to a gravity outfall or to a wet well where water can be removed with a pump.

The excavation contractor should be chosen carefully to assure they have experience with fill placement at over-optimum moisture and have the necessary compaction equipment. The contractor should provide a construction disc to break down fill materials and anticipate use of push-pull scraper operations and dozer assistance. The operation will be relatively slow. In order for the procedure to be performed properly, close contractor control of fill placement to specifications is required. Sub-excavation fill should be moisture-conditioned between optimum and 3 percent above optimum moisture content with an average test moisture content each day of at least 1 percent above optimum. Fill should be moisture conditioned and compacted as recommended in Site Grading.

Special precautions should be taken for compaction of fill at corners, access ramps, and along the perimeters of the sub-excavated areas as large compaction equipment cannot easily reach these areas. Our representative should observe placement procedures and test compaction of the fill on a nearly full-time basis. The swell of the moisture-conditioned fill should be tested during and after the fill placement.

Sub-excavation and replacement with moisture conditioned fill will likely allow use of footing foundations and enhance performance of slab-on-grade floors. Sub-excavation can also enhance performance of concrete flatwork and pavements, potentially reducing maintenance costs. We recommend a surveyor document the actual limits of the treatment, and create "as-built" plans. These plans should be provided to the civil/surveyor so that they can verify that each building is over the treated area. The "treated area" stops at the toe of the deep sub-excavation slope. It would be prudent to show the horizontal limits and bottom elevation of treatment on plans. Guideline sub-excavation specifications are presented in Appendix D.

Slopes

We recommend permanent cut and fill slopes be designed with a maximum grade of 3:1 (horizontal to vertical). If site constraints (property boundaries and streets) do not permit construction with recommended slopes, we should be contacted. Concentrated surface drainage should not be allowed to sheet flow across slopes or pond near the crest of slopes. All cut and fill slopes should be re-vegetated as soon as possible after grading to reduce potential for erosion problems.

Stabilization and Dewatering

Based on current water levels, it is possible that sub-excavation of the south anchor, excavation for the south retaining wall, and (potentially) utility excavations will penetrate groundwater in various parts of the site, particularly at the south side. Soft, very moist soils may be encountered in excavations and should be removed or stabi-

lized. Soft excavation bottoms can be stabilized by crowding crushed rock into the soils until firm. Acceptable rock materials include, but are not limited to, No. 2 and No. 57 rock. Crushed rock on a layer of geosynthetic grid or geotextile can also be used, which should reduce the amount of aggregate needed to stabilize the subgrade.

Temporary construction dewatering systems may be needed. We anticipate excavations can be dewatered using sumps, where the water is pumped down through the soils before being discharged. The Town of Erie and/or the Colorado Department of Public Health and Environment may require dewatering permits. Our experience indicates periodic environmental testing is usually required with these permits, with reporting. Permitting requirements may also influence the construction schedule. We recommend researching these requirements and permit processing times well before dewatering begins.

Pavements

Pavement subgrade soils are likely to be derived of clay and claystone, which are considered poor subgrade material. We obtained additional bulk samples during recent re-alignment of the existing ditch which we believe will be representative of the majority of the pavement subgrade after site grading. The samples were tested to classify the anticipated subgrade and evaluate index properties that will influence pavement design. The samples contained 78 and 99 percent silt and clay-sized particles, exhibited moderate and high plasticity, and had CBR's of 1.5 and 2, respectively. We used the AASHTO design methodology based on the Town of Erie's requirements and Lowe's criteria to evaluate the anticipated pavement sections. Anticipated pavement sections based on our additional testing are provided in the table below. In areas of highly expansive claystone and/or natural clay (south anchor and southwest building pad parking areas), sub-excavation to a depth of at least 3 feet below pavements should be considered to reduce potential heave. Further investigation should be done after grading to confirm whether the design assumptions remain appropriate.

ANTICIPATED PAVEMENT SECTIONS (Lowe's Criteria)

Anticipated Subgrade Soil	Anticipated Traffic Type	Hot-Mix Asphalt (HMA)	Hot-Mix Asphalt + Aggregate Base Course (HMA + ABC)	Portland Cement Concrete (PCC)
Clay and Claystone	Parking Areas	7" HMA	4" HMA + 10" ABC	5" PCC
	Access Drives/Fire Lanes	10" HMA	6" HMA + 13" ABC	7" PCC

BUILDING CONSTRUCTION CONSIDERATIONS

The following discussions are preliminary and are intended for preliminary design. After grading is completed design-level investigations should be performed.

Foundations

Site soils include expansive soils and bedrock at depths likely to affect foundation performance. Drilled piers bottomed in bedrock are typically used where relatively high swelling soil and bedrock are encountered. We believe sub-excavation could allow use of footing foundations for the south anchor building and southwest building pad, where more expansive materials are present.

Building pads along the western and northwestern edges of the property will be underlain by fill and lower swelling materials. We anticipate shallow foundations (footings) will be suitable for those pads without sub-excavation. Footing-type foundations should also be suitable for the north anchor provided partial sub-excavation of the pad is performed and survey monitoring confirms settlement has dissipated. Anticipated foundation design criteria for the north anchor pad are provided below. We should drill additional borings and perform a design-level investigation after sub-excavation and site grading to confirm whether the recommendations remain appropriate.

Footings with Minimum Deadload (North Anchor)

1. Footings should be constructed on moisture-conditioned, well compacted fill. If loose or soft soils are exposed during footing excavation, these soils should be removed and re-compacted.

2. Footings should be designed for a maximum allowable soil pressure of 3,000 psf and a minimum deadload pressure of 1000 psf. Lateral earth pressures can be calculated based on equivalent fluid density of at least 55 pcf for moisture-conditioned and compacted fill. Footing translation can be resisted using an equivalent fluid density of 300 pcf for the passive case, providing backfill is similar to the site soils, is well compacted and remains in-place. The coefficient of friction for sliding may be taken as 0.3. These values have not been factored. The structural engineer should apply appropriate factors of safety in design.

3. If use of void-forming materials is necessary to maintain deadload for footings below foundation walls, a minimum 4-inch void should be used.

4. Strip footings should have a minimum width of 18 inches. Pads for isolated columns should have minimum dimensions of 20 inches by 20 inches. Larger sizes may be required depending upon the loads and structural system used.

5. Grade beams should be well-reinforced. We recommend reinforcement sufficient to span an unsupported distance of at least 10 feet. Reinforcement should be designed by the structural engineer considering lateral earth pressure on wall performance.

6. Exterior footings must be protected from frost action. Normally, 3 feet of frost cover is assumed in the area.

7. The completed foundation excavation(s) should be observed by a representative of our firm to confirm subsurface conditions are as anticipated from our borings.

8. Excessive wetting of foundation soils during and after construction can cause softening and settlement of foundation soils and result in footing and slab movements. Proper surface drainage around the building is critical to control wetting.

Slab-On-Grade Construction

The south anchor building and southwest building pad appear to have high risk of poor slab performance unless sub-excavation is performed. We believe performance of slab-on-grade will be good for the north and northwest building pads provided recommendations in this report are followed. We have considered the criteria for slab performance provided by Lowe's.

Sub-excavation may be used to reduce the influence of expansive soil and bedrock on floors. Our experience suggests risk of poor slab performance can be reduced to low if the fill is moisture conditioned and compacted properly. Lowe's minimum floor criteria include 5 inches of 4000 psi concrete over 4 inches of compacted stone base. We recommend placement of at least 4 feet of imported, granular fill below the stone base to enhance floor performance for the Lowe's pad. Imported granular fill should consist of silty to clayey sand with 10 to 45 percent fines (particles passing the No. 200 sieve), with a liquid limit less than 30 and plasticity index less than 15. We anticipate differential floor settlement should be reduced to less than ½-inch when measured across a horizontal distance of 50 feet provided survey monitoring has confirmed settlement of the north anchor building pad has substantially ceased. The performance of pavements, sidewalks, and other surface flatwork installed outside sub-excavated areas in the south and southwest portion of the site will likely be erratic. Shallower sub-excavation of 3 feet can be considered in these areas to enhance performance.

The following precautions will be required to reduce the potential for damage due to movement of slabs-on-grade placed at this site:

1. Isolation of conventional slabs from foundation walls, columns or other slab penetrations;

2. Voiding of interior partition walls to allow slab movement without transferring movement to the structures;

3. Use of flexible water and gas connections to allow slab movement. A flexible duct above slab-supported furnaces (if any) will also be required; and

4. Proper surface grading to reduce water availability to sub-slab and foundation soils.

Structurally supported floors are recommended for areas of high risk, such as the south anchor building and southwest building pad. A structurally supported floor should also be used where a building owner cannot tolerate the potential movement described previously.

Concrete

Concrete in contact with soil can be subject to sulfate attack. We measured water-soluble sulfate concentrations of less than 0.01 to 0.19 percent in four samples from this study. For the highest level of sulfate concentration, ACI indicates concrete shall be made with ASTM C150 Type II cement, or an ASTM C595 or C1157 hydraulic cement meeting moderate sulfate-resistant hydraulic cement (MS) designation. In our experience, superficial damage may occur to the exposed faces of highly permeable concrete. To control this risk and to resist freeze-thaw deterioration, the water-to-cementitious material ratio should not exceed 0.5 for concrete in contact with soils that are likely to stay moist. Foundation concrete should have a total air content of 6 percent ± 1.5 percent. Additional testing is recommended during building specific investigations.

Surface Drainage

The performance of foundations, floors, pavements and other improvements is affected by moisture changes within the soil and bedrock. This is largely influenced by surface drainage. When developing an overall drainage scheme, consideration should be given to drainage around each structure. The ground surface around the buildings should be sloped to provide positive drainage away from the foundation. We recommend a slope of at least 5 percent for the first 10 feet in landscaped areas surrounding each building. Roof downspouts and other water collection systems should discharge

well beyond the limits of all backfill around structures. Roof drainage should not be directed below floors.

Proper control of surface runoff is also important to control wetting. Concentrated sheet flow should not be directed over unprotected slopes. Water should not be allowed to pond at the crest of slopes. Permanent slopes should be prepared to reduce erosion.

Attention should be paid to compaction of the soils behind curb and gutter adjacent to streets and in utility trenches during the construction and development. If surface drainage between preliminary development and construction phases is neglected, performance of the pavements, flatwork and foundations may be poor.

RETAINING WALLS

A mechanically stabilized earth retaining wall is planned along the southern edge of the property. The maximum exposed height of the wall will be about 8 feet. Retaining walls should be designed to resist lateral earth pressures. The lateral earth pressure will depend on the height of the wall, retained soil, type of backfill, slope of backfill surface, surcharge loads and allowable horizontal movement at the top of the wall. Where multiple walls are closely spaced (if any), the lower wall design should consider surcharge from upper walls. Internal and global stability of the walls should be considered.

Some movement of MSE walls must occur to mobilize the shear strength of the soil. We assume retained soil and backfill above the reinforced zone will be on-site soils or similar soils. The on-site soil should not be used in the reinforced zone. We recommend the reinforced zone of the MSE Walls be constructed with imported sand and gravel meeting CDOT Class 5 or 6 Aggregate Road Base Specification or CDOT Class 1 structural fill. Angular gravel meeting AASHTO No. 57 or 67 Specification may be used for the reinforced soil (if desired) and is recommended for the leveling pad and drainage material.

Most MSE block retaining wall design programs require input of soil parameters for foundation soil, leveling pad, reinforced soil and retained soil. We recommend the parameters presented below be used for the design of the wall.

MSE SOIL INPUT PARAMETERS

Material use	Material Description & Classification	Cohesion (psf)	Internal Friction Angle* (degrees)	Unit Weight (pcf)
Foundation Soil	Sandy Clay/Claystone	200	23	130
Leveling Pad	Gravel (imported) AASHTO #57 or 67 Coarse Concrete Aggregate	0	34	140
Reinforced Soil (import recommended)	Sand, Gravelly, Silty, CDOT Class 6 Road Base or Class I Structure Fill	0	34	140
Retained Soil	Sandy Clay/Claystone	200	23	130

*The friction angle for leveling pad and reinforced soil can be increased in testing demonstrates higher values.

Free draining granular backfill should be used adjacent to the wall. We recommend a free-draining sand and gravel material with less than 5 percent fines (passing No. 200 sieve) within at least 1-foot behind the wall. Imported backfill should be tested and approved by our firm prior to importing. The upper 2 feet of wall backfill should be derived from the on-site clay. Fill should be placed and compacted to the criteria provided in Fill and Backfill. Special precautions should be taken to avoid over-stressing the wall during compaction. We recommend small, hand-operated compactors be used.

RECOMMENDED FUTURE INVESTIGATIONS

We recommend the following investigations and services:

1. Construction testing and observation during site development, sub-excavation, and pavement construction;
2. Survey monitoring in deep fill areas;
3. Subgrade investigation and pavement design after grading;
4. Design-level geotechnical investigation(s) after grading; and

5. Construction observations during foundation construction.

LIMITATIONS

Our borings were widely spaced to provide a general picture of subsurface conditions for preliminary planning of development and construction. We believe this investigation was conducted in a manner consistent with the level of care and skill ordinarily used by geotechnical engineers practicing in this area at this time. No warranty, express or implied, is made. If we can be of further service in discussing the contents of this report or analysis of the influence of subsurface conditions on the project, please call.

CTL | THOMPSON, INC.

Chris Fitzsimmons, E.I.T.
Staff Engineer

Reviewed by:

Ronald M. McOmber, P.E.
Chairman, Senior Principal

CF:RMM/nn

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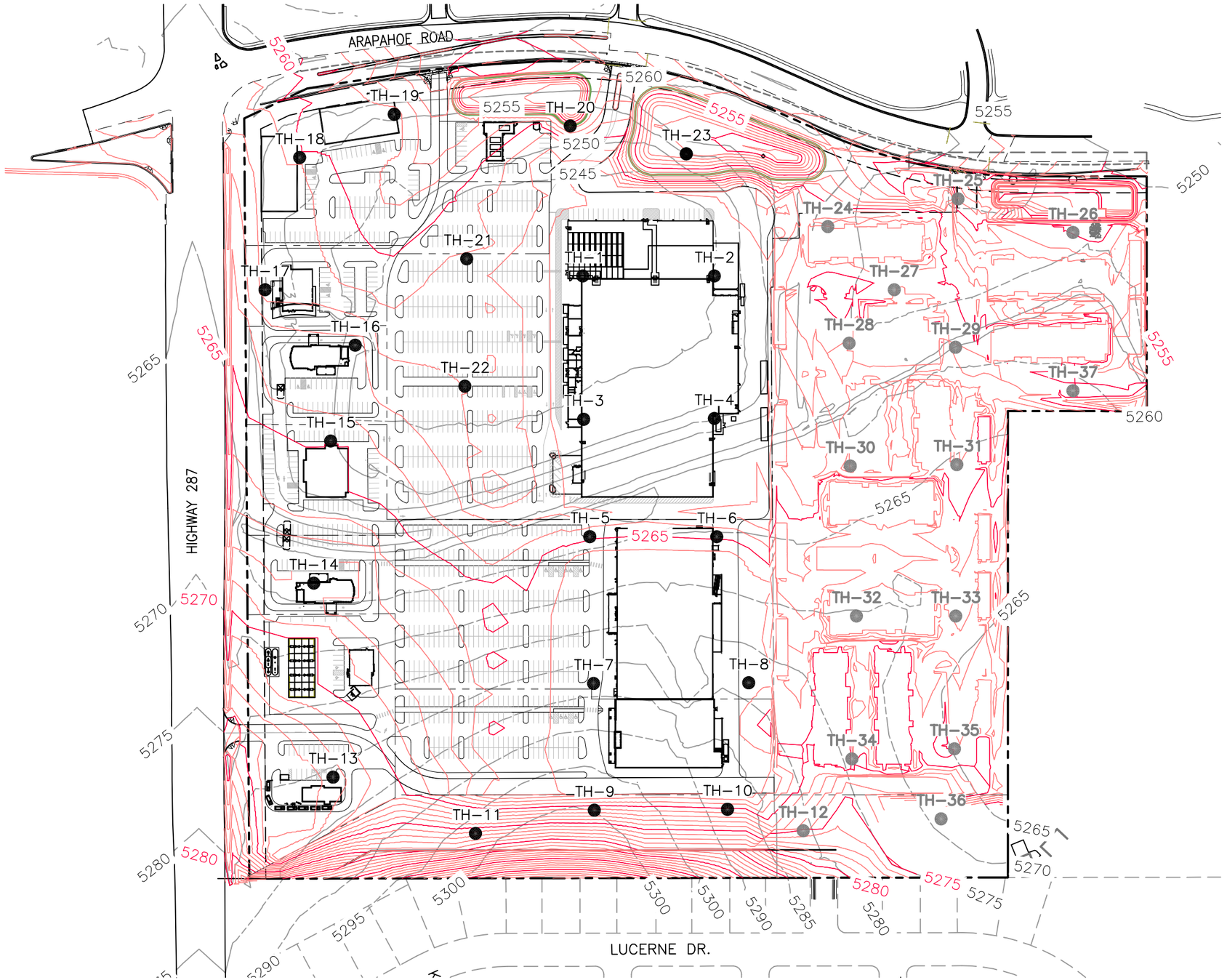

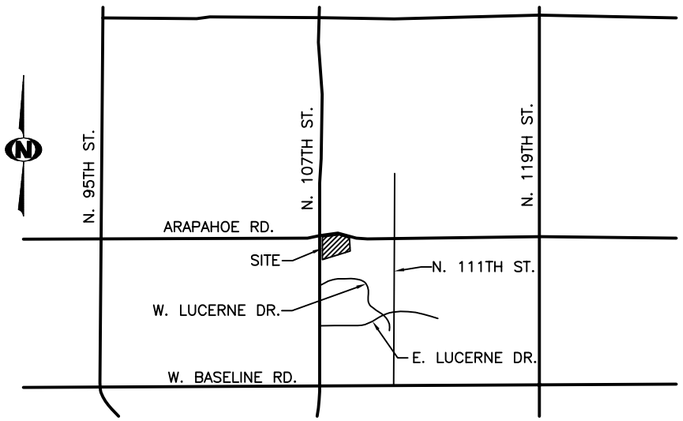

VICINITY MAP
NOT TO SCALE

LEGEND:

- TH–1 ● APPROXIMATE LOCATION OF EXPLORATORY BORING
- TH–12 ● APPROXIMATE LOCATION OF EXPLORATORY BORING INCLUDED IN SEPARATE INVESTIGATION
- 5260 – – – – INDICATES EXISTING GROUND SURFACE ELEVATION (FEET)
- 5300 ——— INDICATES PROPOSED GROUND SURFACE ELEVATION (FEET)

N

0 100 200
SCALE: 1" = 200'

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
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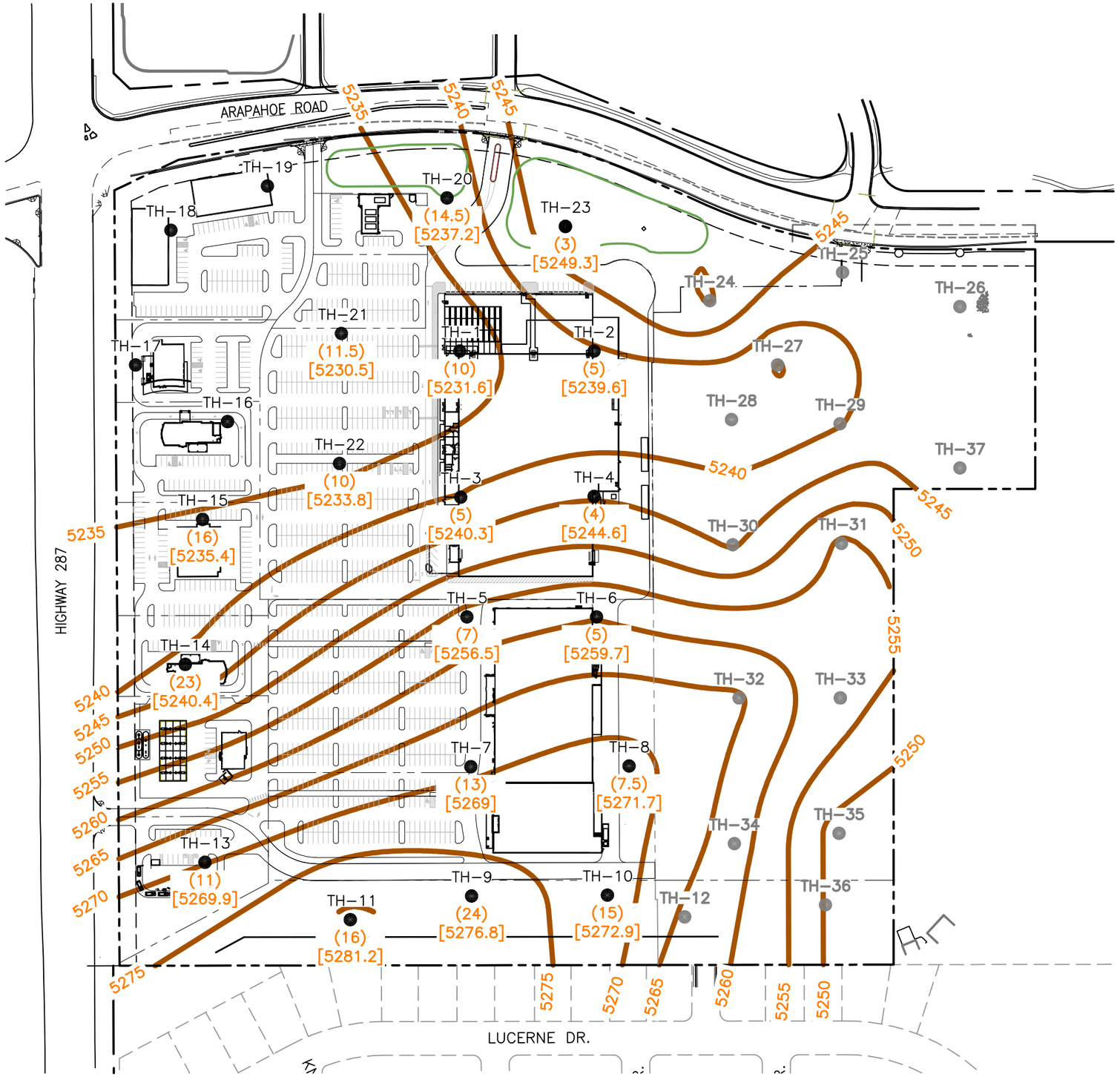
Locations of Exploratory Borings

Fig. 1



LEGEND:

TH–1 ●	APPROXIMATE LOCATION OF EXPLORATORY BORING
TH–12 ●	APPROXIMATE LOCATION OF EXPLORATORY BORING INCLUDED IN SEPARATE INVESTIGATION
(11)	INDICATES DEPTH TO BEDROCK AT BORING LOCATION (FEET)
[5269.9]	INDICATES BEDROCK ELEVATION AT BORING LOCATION (FEET)
5250	INDICATES ESTIMATED BEDROCK SURFACE ELEVATION (FEET)

NOTE: THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF DRILL HOLE DATA AND MAY NOT REFLECT LOCAL VARIATIONS.

N

0 100 200

SCALE: 1" = 200'

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
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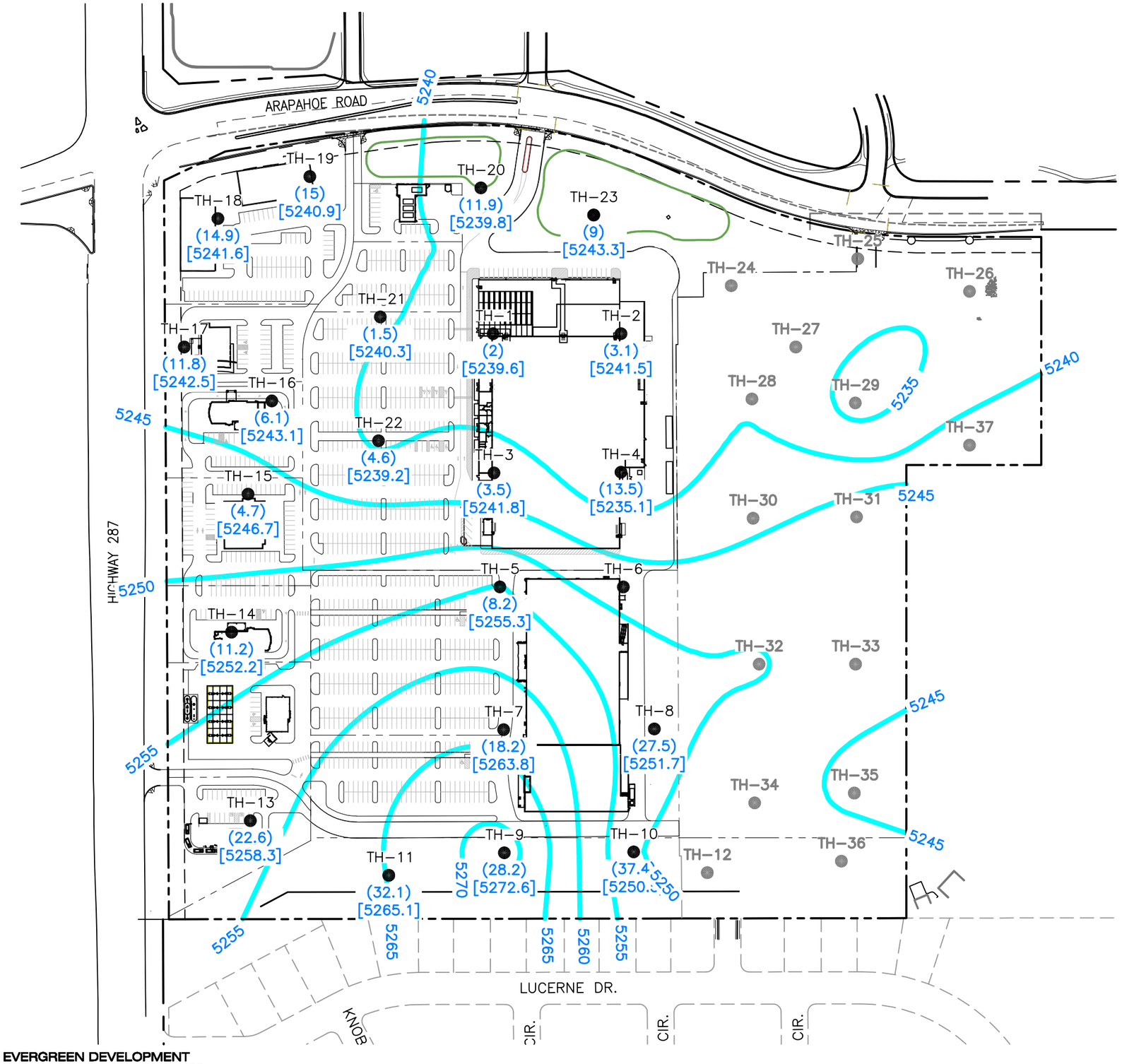
Estimated Bedrock Surface Elevations

Fig. 2



LEGEND:

TH–1 ●	APPROXIMATE LOCATION OF EXPLORATORY BORING
TH–12 ●	APPROXIMATE LOCATION OF EXPLORATORY BORING INCLUDED IN SEPARATE INVESTIGATION
(22.6)	INDICATES MEASURED DEPTH TO GROUNDWATER AT BORING LOCATION (FEET)
[5258.3]	INDICATES GROUNDWATER ELEVATION AT BORING (FEET)
5245	INDICATES ESTIMATED GROUNDWATER SURFACE ELEVATION (FEET)

NOTE: THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF DRILL HOLE DATA AND MAY NOT REFLECT LOCAL VARIATIONS AND SEASONAL FLUCTUATIONS.

0 100 200

SCALE: 1" = 200'

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
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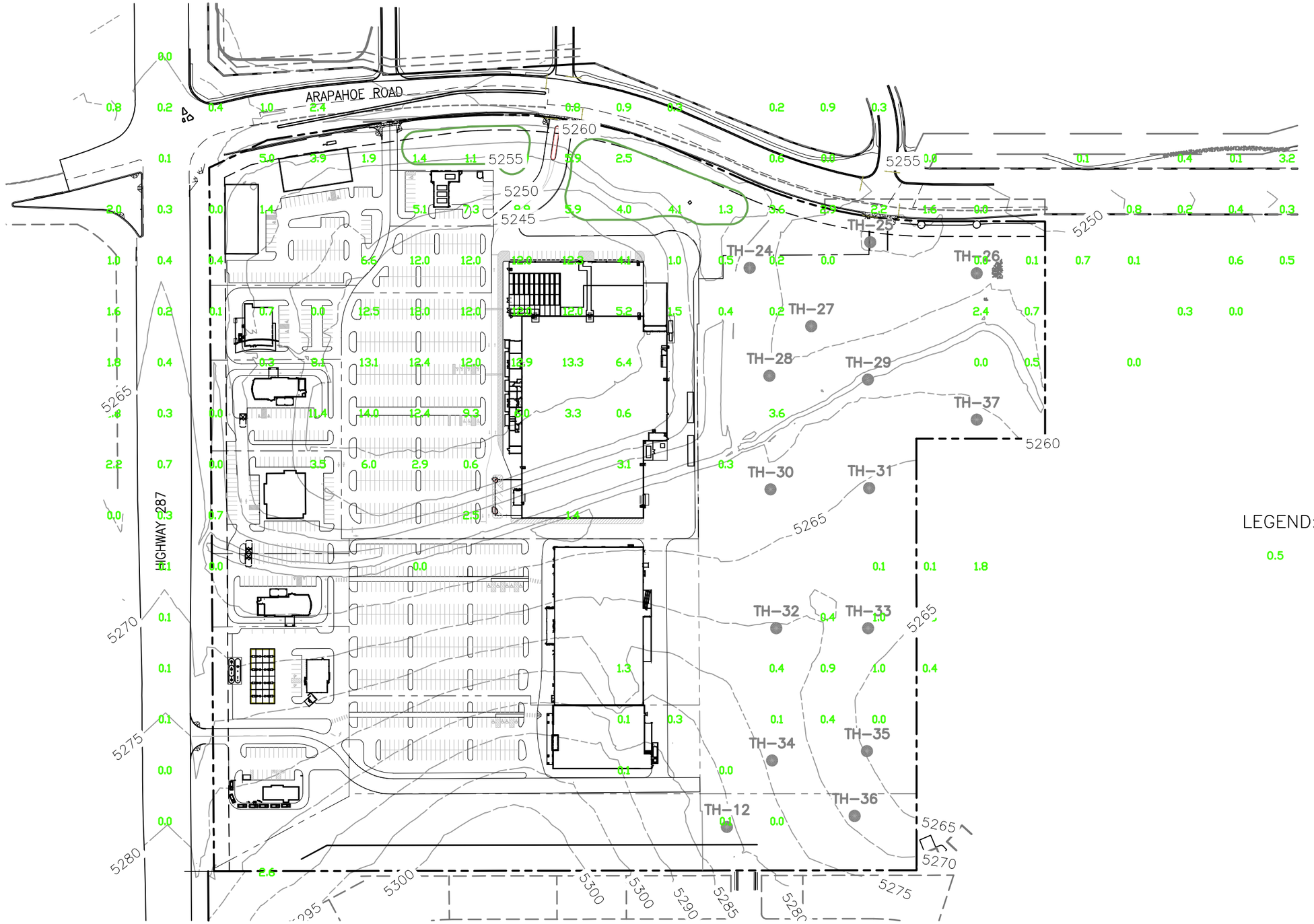
Estimated Groundwater Surface Elevations

Fig. 3



LEGEND:

0.5 INDICATES APPROXIMATE DEPTH OF EXISTING FILL (FEET)

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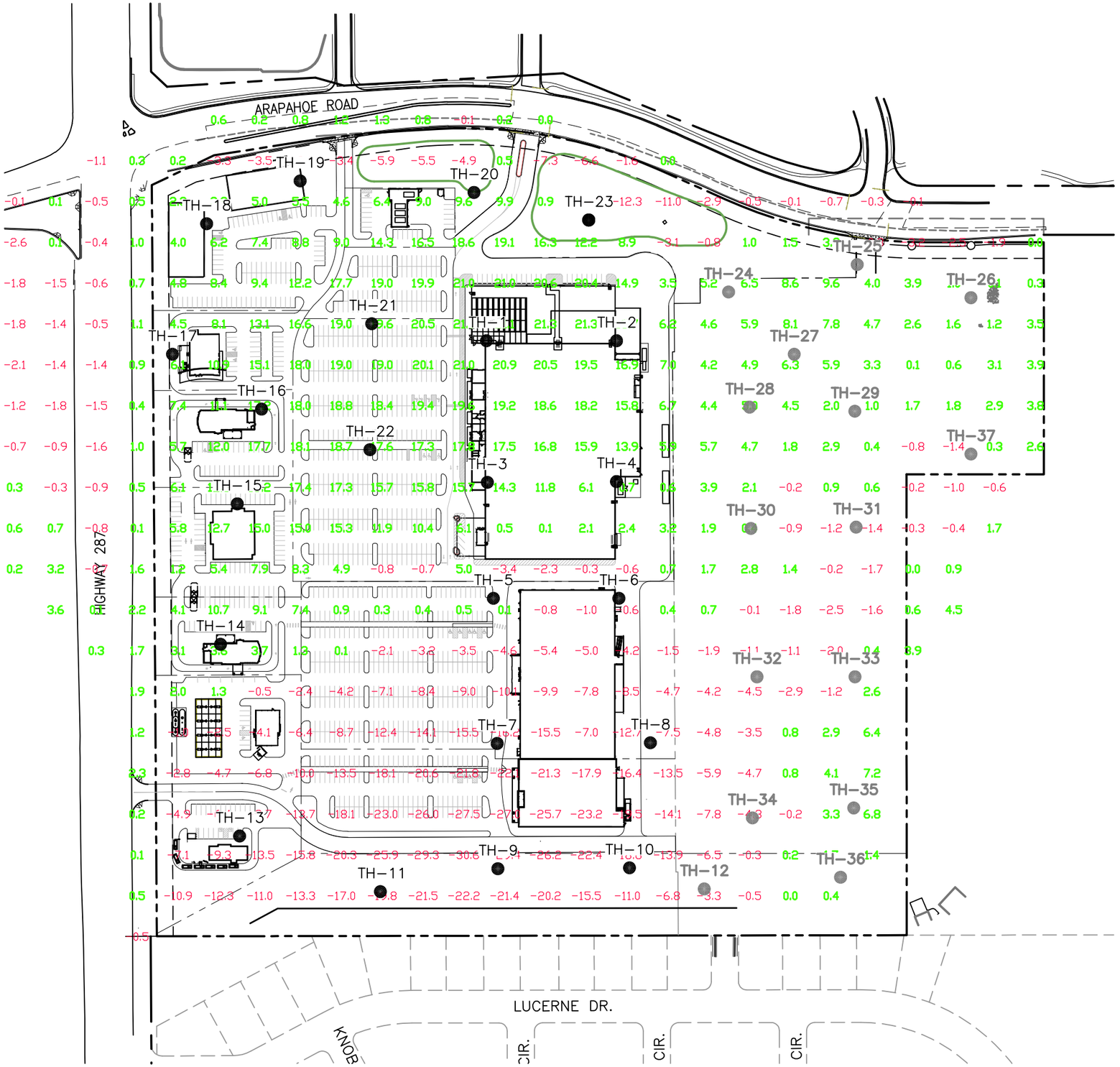
Estimated Depth of Existing Fill Fig. 4



0 100 200

SCALE: 1" = 200'

LEGEND:

TH-1 APPROXIMATE LOCATION OF EXPLORATORY BORING

TH-12 APPROXIMATE LOCATION OF EXPLORATORY BORING INCLUDED IN SEPARATE INVESTIGATION

21.1 INDICATES PROPOSED FILL DEPTH (FEET)

-12.2 INDICATES PROPOSED CUT DEPTH (FEET)

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NINE MILE CORNER - COMMERCIAL AREA
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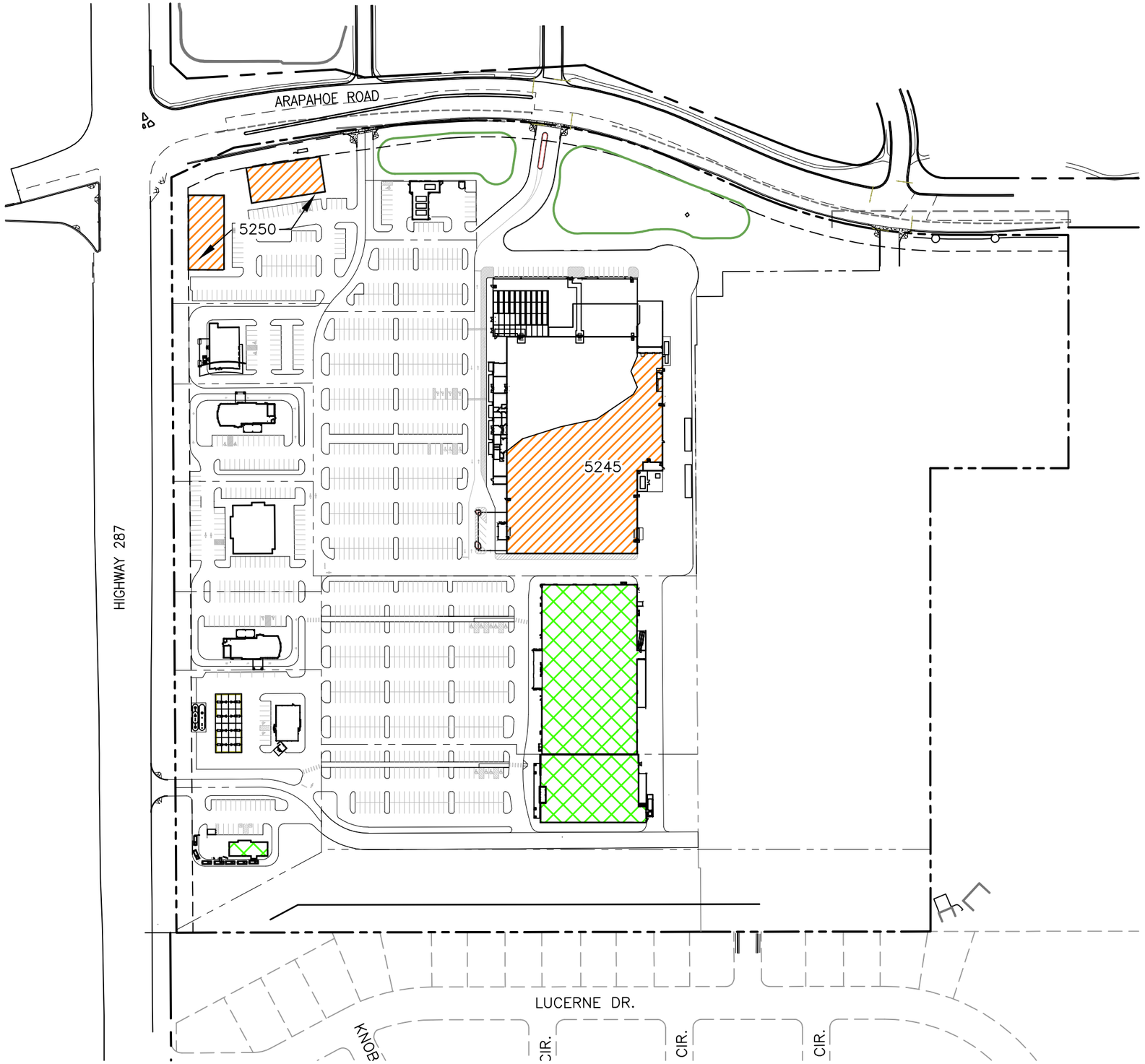
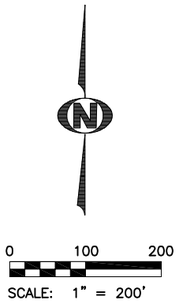
Proposed Depth of Cut/Fill

Fig. 5





LEGEND:

5245 — SUB–EXCAVATE TO ELEVATION 5245

SUB–EXCAVATE TO 10 FEET BELOW FOOTING FOUNDATIONS AND 14 FEET BELOW FLOOR (WHICHEVER IS DEEPER)

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NINE MILE CORNER - COMMERCIAL AREA
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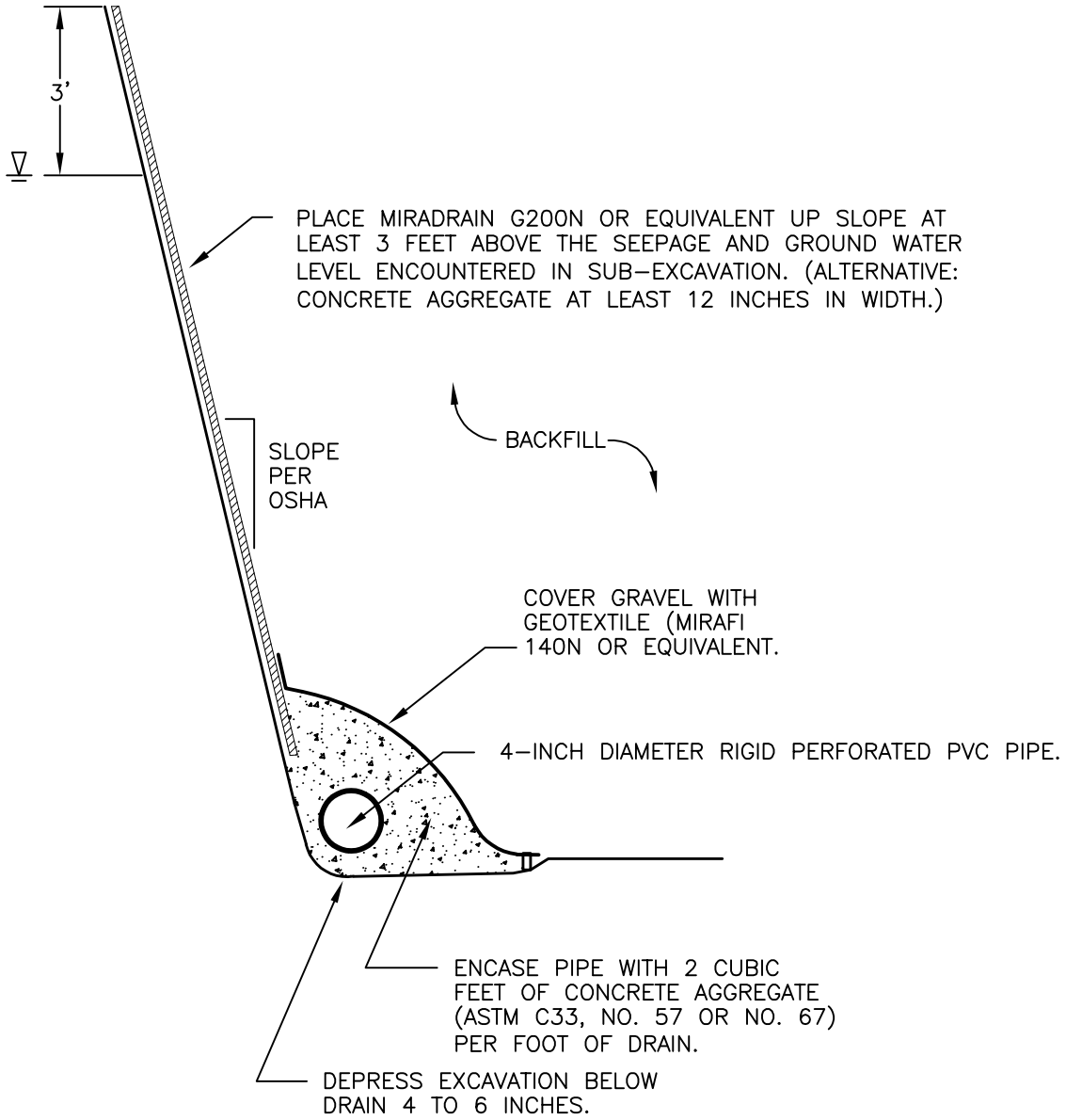
Anticipated Sub-Excavation Recommendations

Fig. 6

20-INTERCEPTOR_08



NOTE:
THE BOTTOM OF THE DRAIN SHOULD SLOPE TO A POSITIVE GRAVITY OUTLET WITH A MINIMUM SLOPE OF 0.5 PERCENT.

Sub-Excavation Interceptor Drain

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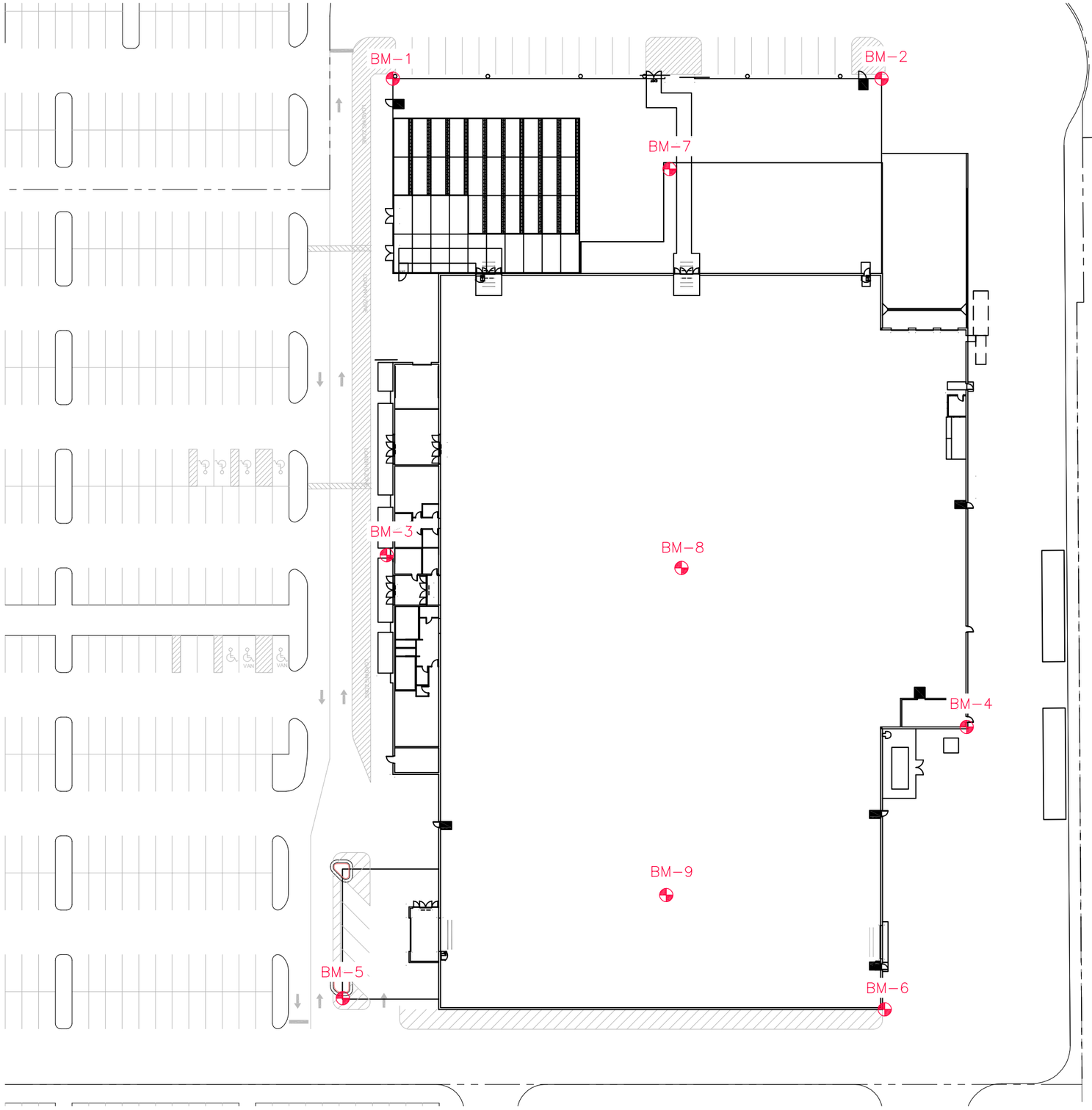
Fig. 7



LEGEND:

BM-1 SUGGESTED SETTLEMENT MONITORING BENCHMARK LOCATION

0 30 60

SCALE: 1" = 60'

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
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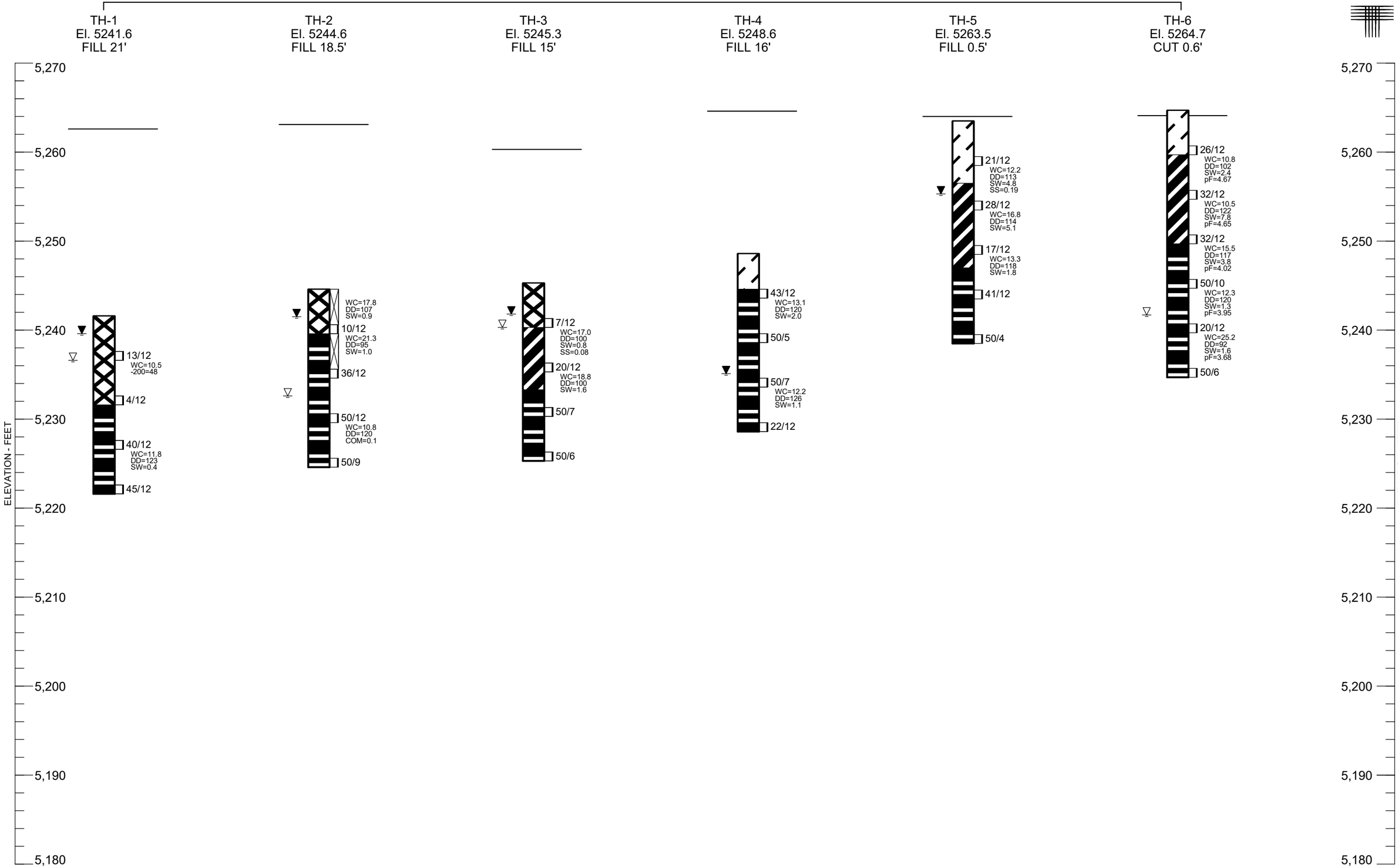
Recommended Settlement Monitoring Locations - North Anchor

Fig. 8

APPENDIX A

SUMMARY LOGS OF EXPLORATORY BORINGS

NORTH ANCHOR BUILDING



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NINE MILE CORNER - COMMERICAL AREA
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SUMMARY LOGS OF EXPLORATORY BORINGS

FIG. A- 1

SOUTH ANCHOR BUILDING

TH-5
El. 5263.5
FILL 0.5'

TH-6
El. 5264.7
CUT 0.6'

TH-7
El. 5282.0
CUT 16.2'

TH-8
El. 5279.2
CUT 13.0'

TH-9
El. 5300.8
CUT 29.4'

TH-10
El. 5287.9
CUT 18.6'

ELEVATION - FEET

5,310
5,300
5,290
5,280
5,270
5,260
5,250
5,240
5,230
5,220

21/12
WC=12.2
DD=113
SW=4.8
SS=0.19

28/12
WC=16.8
DD=114
SW=5.1

17/12
WC=13.3
DD=118
SW=1.8

41/12

50/4

26/12
WC=10.8
DD=102
SW=2.4
pF=4.67

32/12
WC=10.5
DD=122
SW=7.8
pF=4.65

32/12
WC=15.5
DD=117
SW=3.8
pF=4.02

50/10
WC=12.3
DD=120
SW=1.3
pF=3.95

20/12
WC=25.2
DD=92
SW=1.6
pF=3.68

50/6

32/12

50/11
WC=16.8
DD=113
SW=8.7

24/12
WC=25.9
DD=98
SW=4.6

50/5
WC=14.8
DD=116
SW=0.7

50/4

27/12
WC=17.1
DD=114
SW=8.2

50/10
WC=15.5
DD=116
SW=4.3

35/12
WC=16.5
DD=116
SW=3.8

50/9
WC=16.6
DD=112
SW=2.9

50/5

LL=55 PI=34
-200=88

50/5
WC=11.7
DD=119
SW=5.1
pF=4.07

50/9
WC=13.8 DD=118
SW=3.7 pF=4.21

31/12
WC=21.3
DD=109
SW=4.9
pF=4.10

34/12
WC=23.3
DD=104
SW=4.1
pF=4.22

N/R

50/10

50/7
WC=9.0
DD=125
SW=1.6

35/12
WC=14.3
DD=113
SW=6.7

21/12
WC=22.6
DD=97
SW=4.7
-200=100

50/8

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EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERICAL AREA
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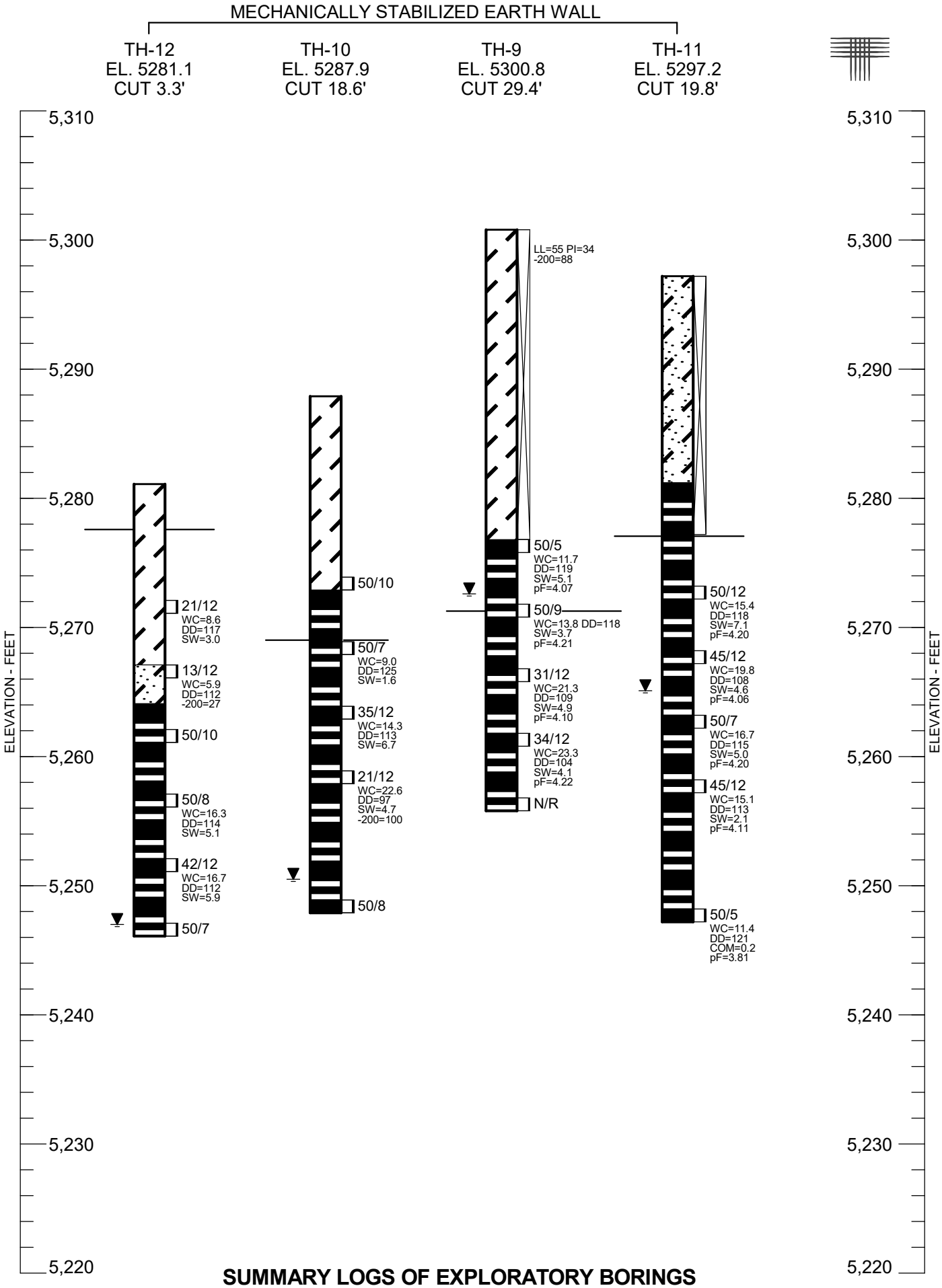
SUMMARY LOGS OF EXPLORATORY BORINGS

FIG. A- 2



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SUMMARY LOGS OF EXPLORATORY BORINGS

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERICAL AREA
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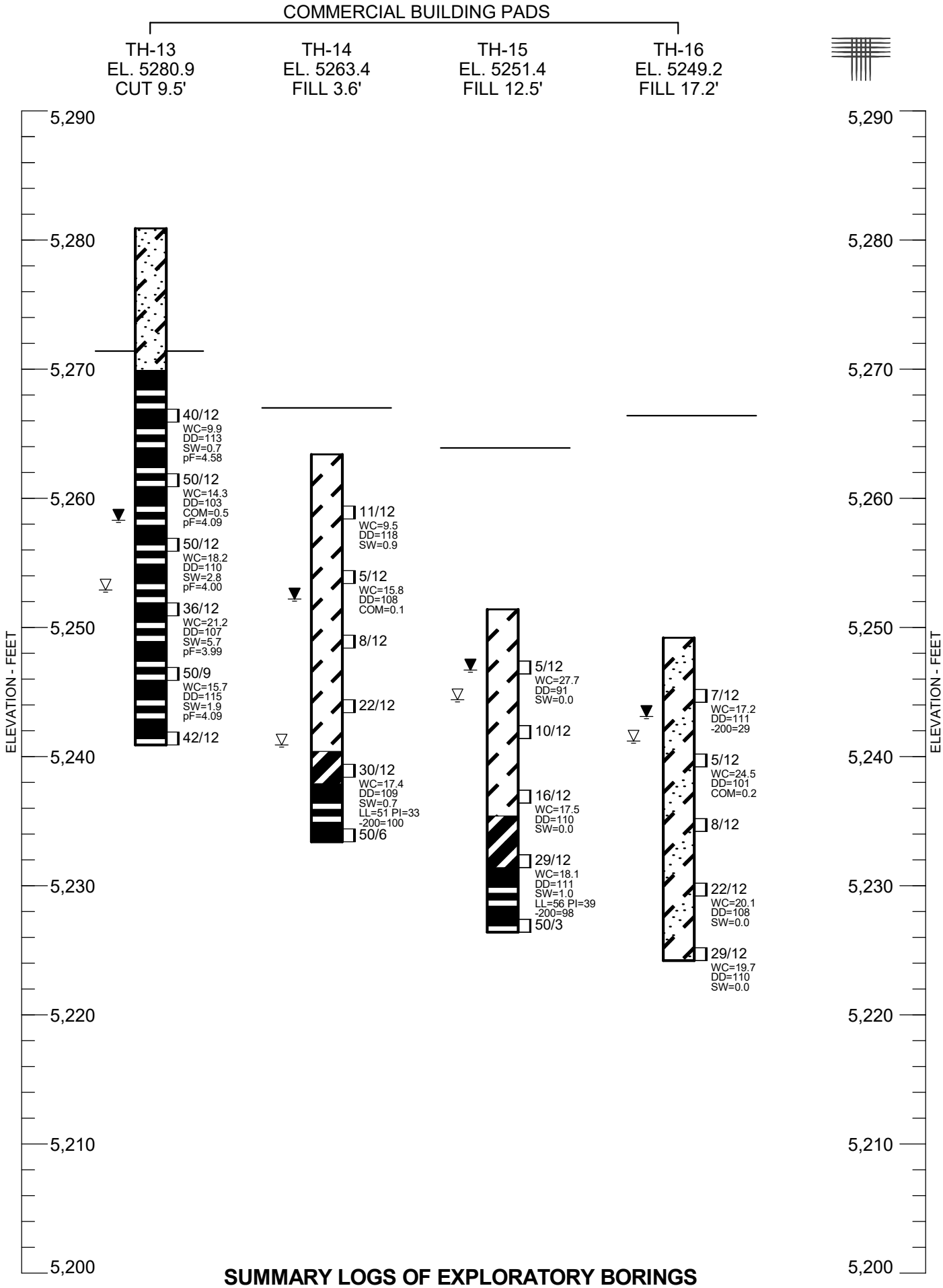
FIG. A- 3



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SUMMARY LOGS OF EXPLORATORY BORINGS

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERICAL AREA
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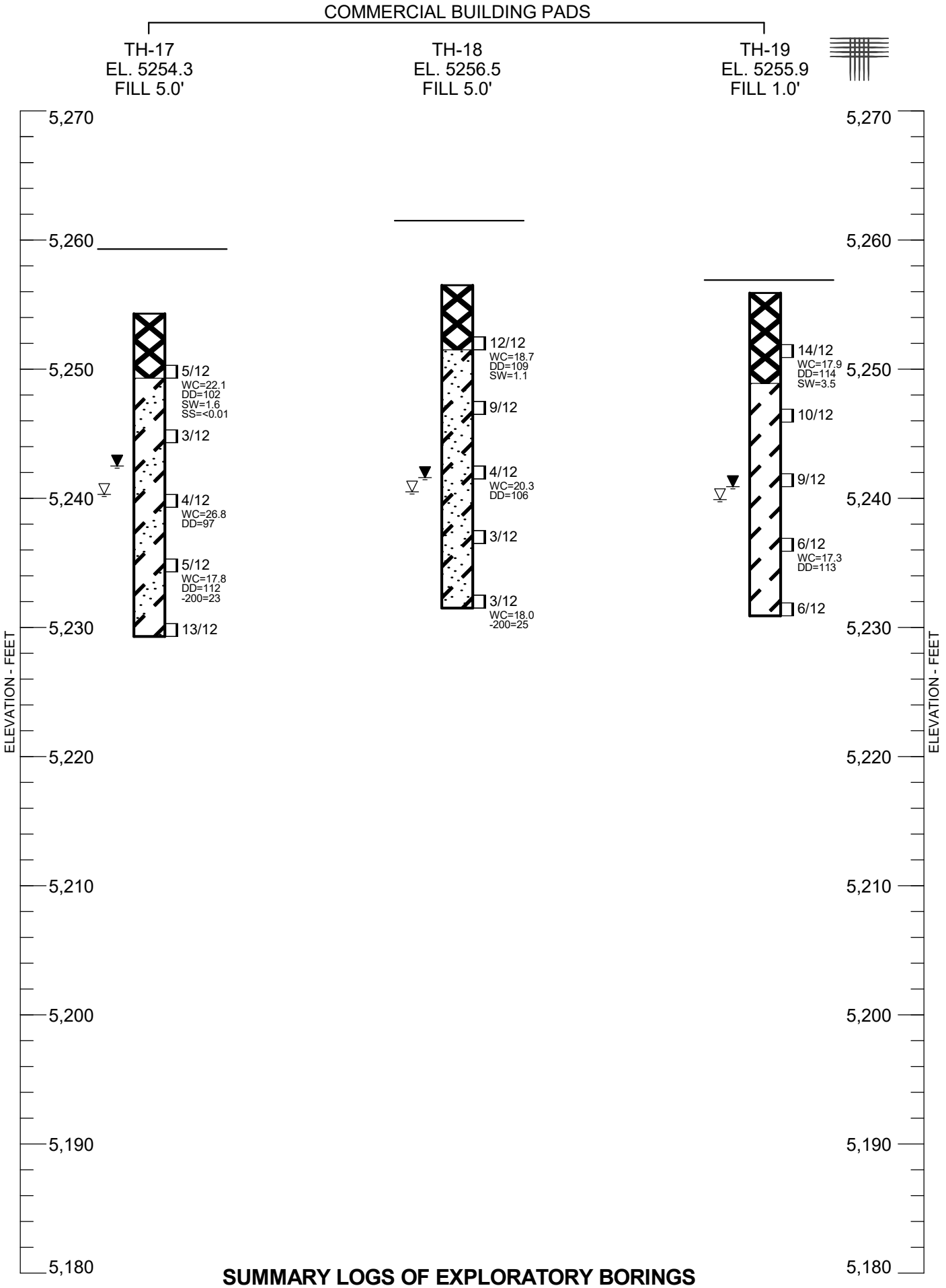
FIG. A- 4



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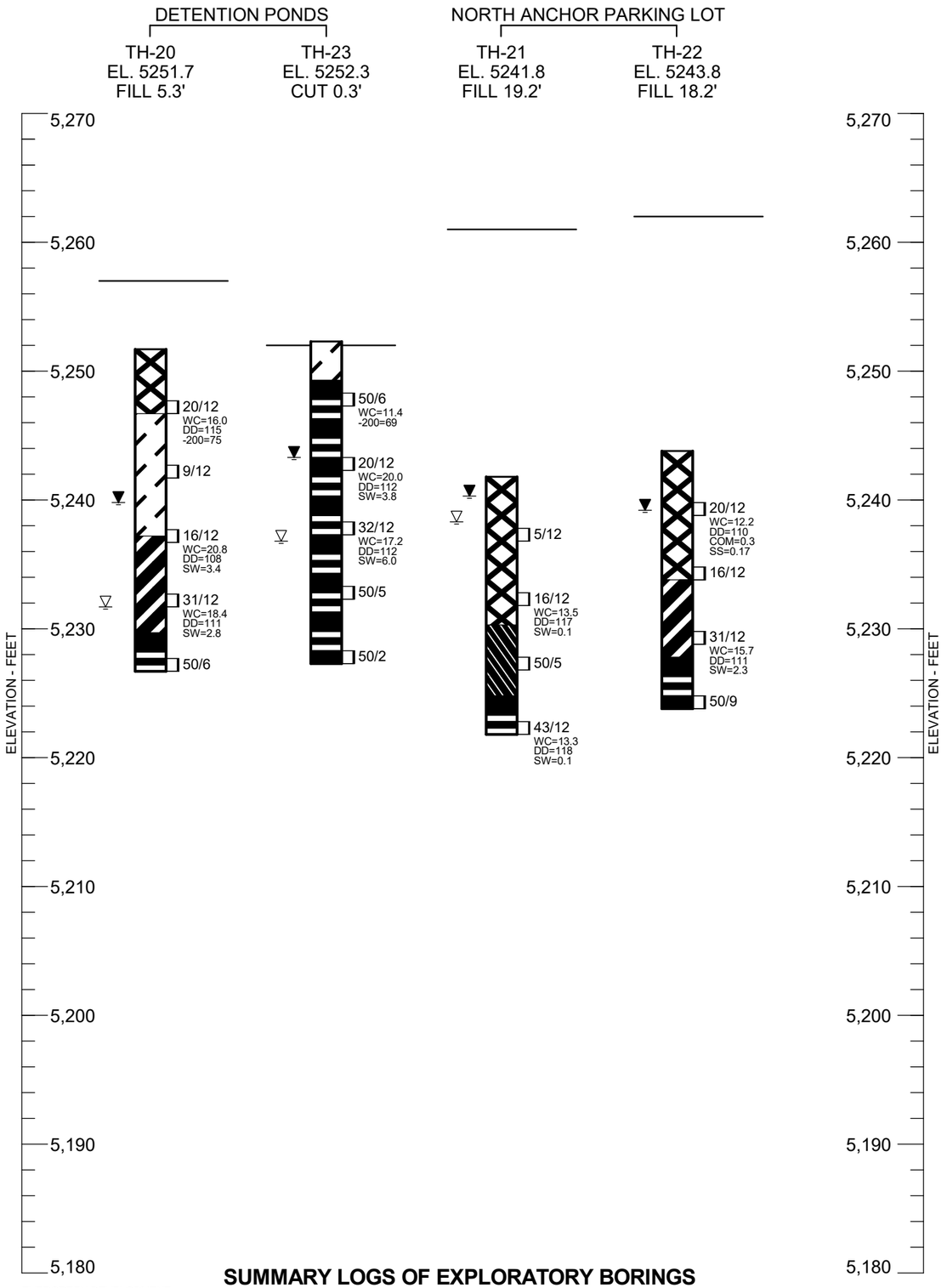
SUMMARY LOGS OF EXPLORATORY BORINGS

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERICAL AREA
CTL|T PROJECT NO. DN48,647-125-R1

FIG. A- 5



SUMMARY LOGS OF EXPLORATORY BORINGS

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERICAL AREA
CTL|T PROJECT NO. DN48,647-125-R1

LEGEND:

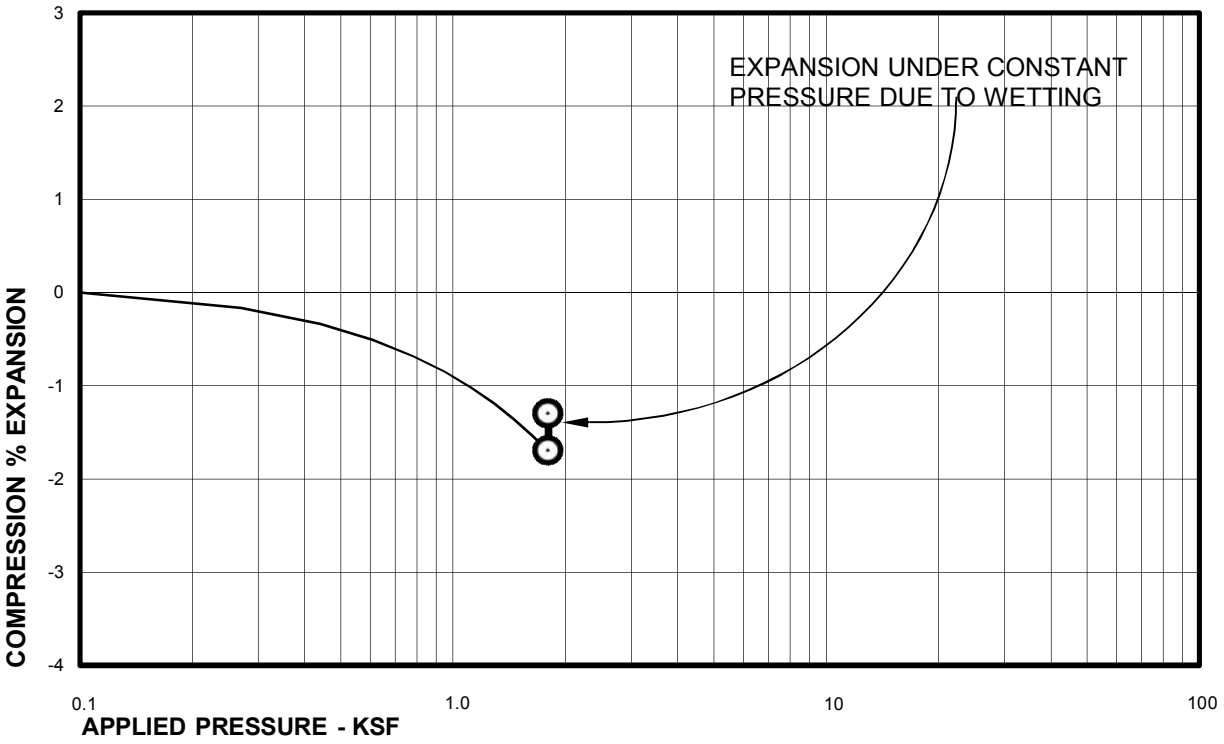
- FILL, CLAY, SANDY OR SAND, CLAYEY, GRAVELLY, MEDIUM STIFF TO VERY STIFF OR LOOSE TO MEDIUM DENSE, SLIGHTLY MOIST TO VERY MOIST, BROWN, GRAY, RUST, TAN.
- CLAY, SANDY, MEDIUM STIFF TO VERY STIFF, DRY TO MOIST, BROWN, GRAY, TAN (CL).
- SAND, CLAYEY, GRAVELLY, DRY, BROWN.
- INTERLAYERED CLAY/SAND, SOFT TO VERY STIFF OR VERY LOOSE TO MEDIUM DENSE, SLIGHTLY MOIST TO WET, BROWN, LIGHT BROWN, RUST, TAN, WHITE (SM, SC, CL).
- WEATHERED CLAYSTONE, DRY TO MOIST, BROWN, LIGHT BROWN, GRAY, TAN, RUST.
- BEDROCK, INTERBEDDED CLAYSTONE/SANDSTONE, VERY HARD, MOIST, TAN.
- BEDROCK, CLAYSTONE, OCCASIONAL LIGNITE SEAMS, MEDIUM HARD TO VERY HARD, DRY TO SLIGHTLY MOIST, BROWN, GRAY, LIGHT GRAY, TAN, RUST.
- DRIVE SAMPLE. THE SYMBOL 12/12 INDICATES 12 BLOWS OF AN AUTOMATIC 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.
- BULK SAMPLE COLLECTED FROM AUGER CUTTINGS.
- WATER LEVEL MEASURED AT TIME OF DRILLING.
- WATER LEVEL MEASURED AFTER DRILLING ON JANUARY 9, 2017.
- INDICATES PROPOSED GRADE.

NOTES:

1. THE BORINGS WERE DRILLED ON DECEMBER 30, 2016 THROUGH JANUARY 4, 2017 USING 4-INCH DIAMETER, CONTINUOUS-FLIGHT SOLID-STEM AUGER AND A TRUCK-MOUNTED CME-45 OR CME-55 DRILL RIG.
2. BORING LOCATIONS AND ELEVATIONS WERE SURVEDY BY GALLOWAY & COMPANY, INC.
3. WC - INDICATES MOISTURE CONTENT (%).
   DD - INDICATES DRY DENSITY (PCF).
   SW - INDICATES SWELL WHEN WETTED UNDER APPLIED PRESSURE (%).
   COM- INDICATES COMPRESSION WHEN WETTED UNDER APPLIED PRESSURE (%).
   LL - INDICATES LIQUID LIMIT.
   PI - INDICATES PLASTICITY INDEX.
   -200 - INDICATES PASSING NO. 200 SIEVE (%).
   SS - INDICATES WATER-SOLUBLE SULFATE CONTENT (%).
   pF - INDICATES SOIL SUCTION VALUE (pF).
4. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS AND CONCLUSIONS CONTAINED IN THIS REPORT.

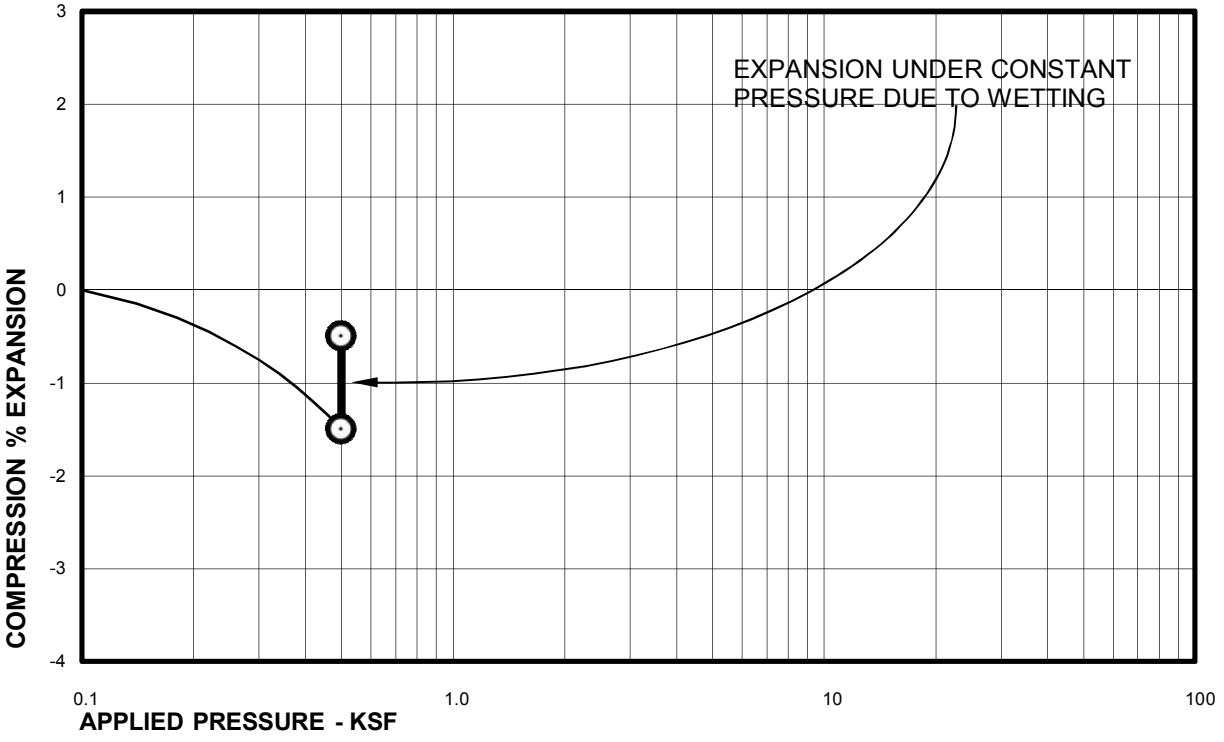
FIG. A- 6

APPENDIX B
LABORATORY TEST RESULTS



Sample of CLAYSTONE
From TH-1 AT 14 FEET

DRY UNIT WEIGHT= 123 PCF
MOISTURE CONTENT= 11.8 %



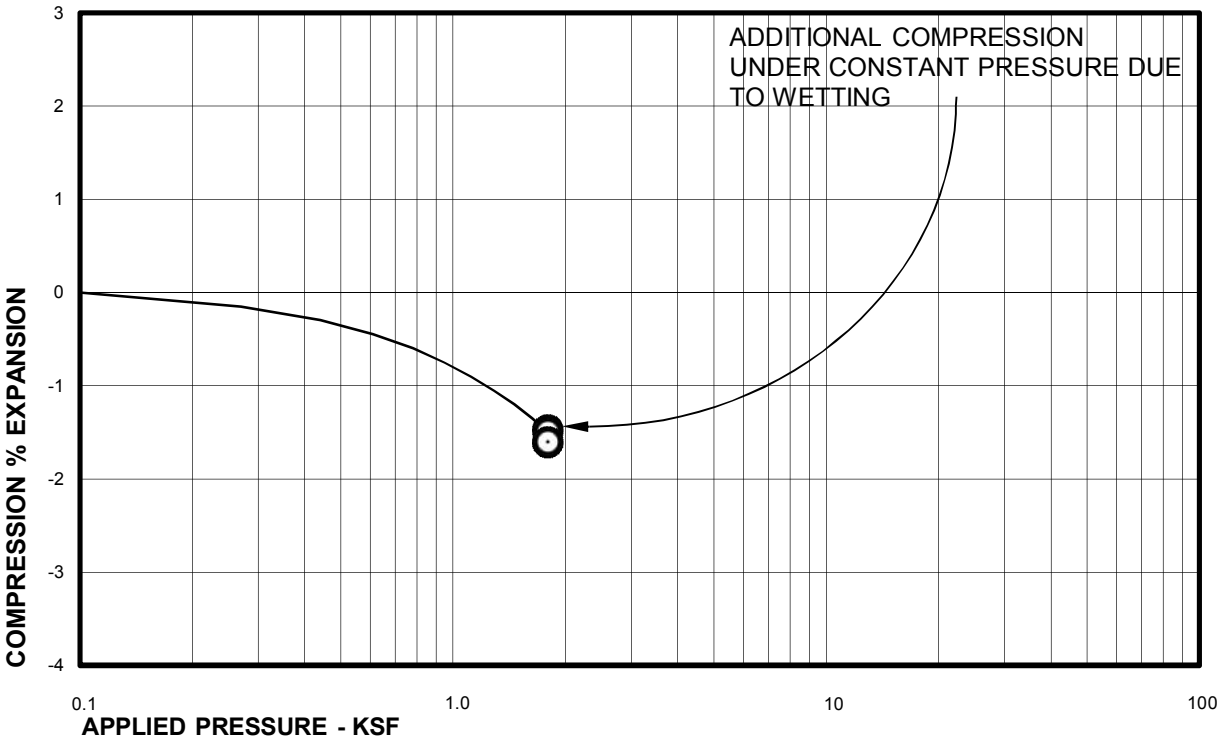
Sample of FILL, CLAY, SANDY
From TH-2 AT 4 FEET

DRY UNIT WEIGHT= 95 PCF
MOISTURE CONTENT= 21.3 %

Swell Consolidation Test Results

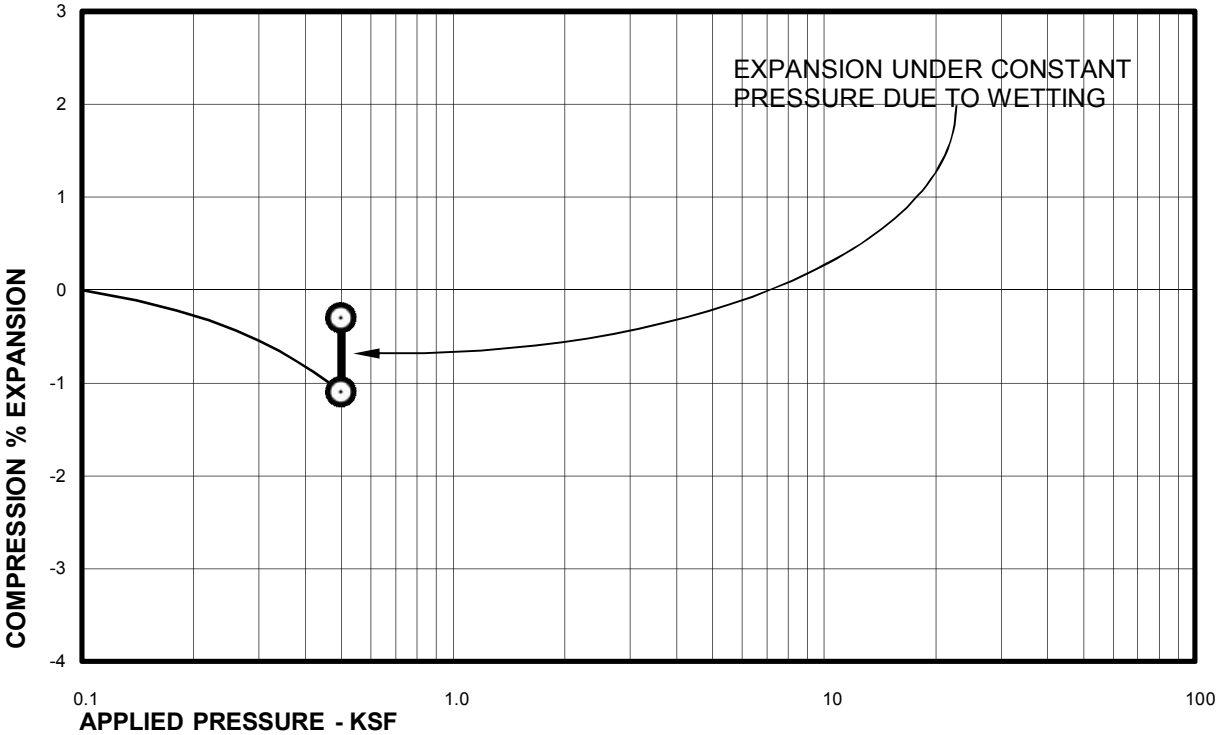
FIG. B-1

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of CLAYSTONE
From TH-2 AT 14 FEET

DRY UNIT WEIGHT= 120 PCF
MOISTURE CONTENT= 10.8 %



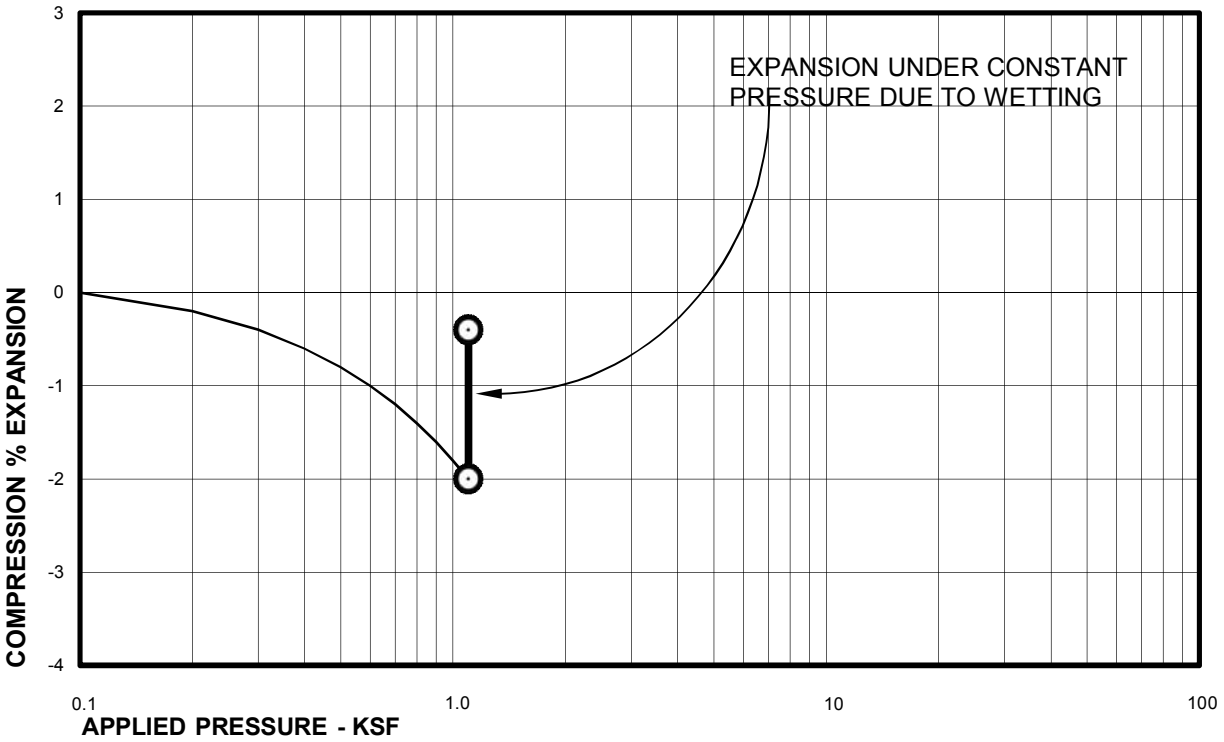
Sample of FILL, CLAY, SANDY
From TH-3 AT 4 FEET

DRY UNIT WEIGHT= 100 PCF
MOISTURE CONTENT= 17.0 %

Swell Consolidation Test Results

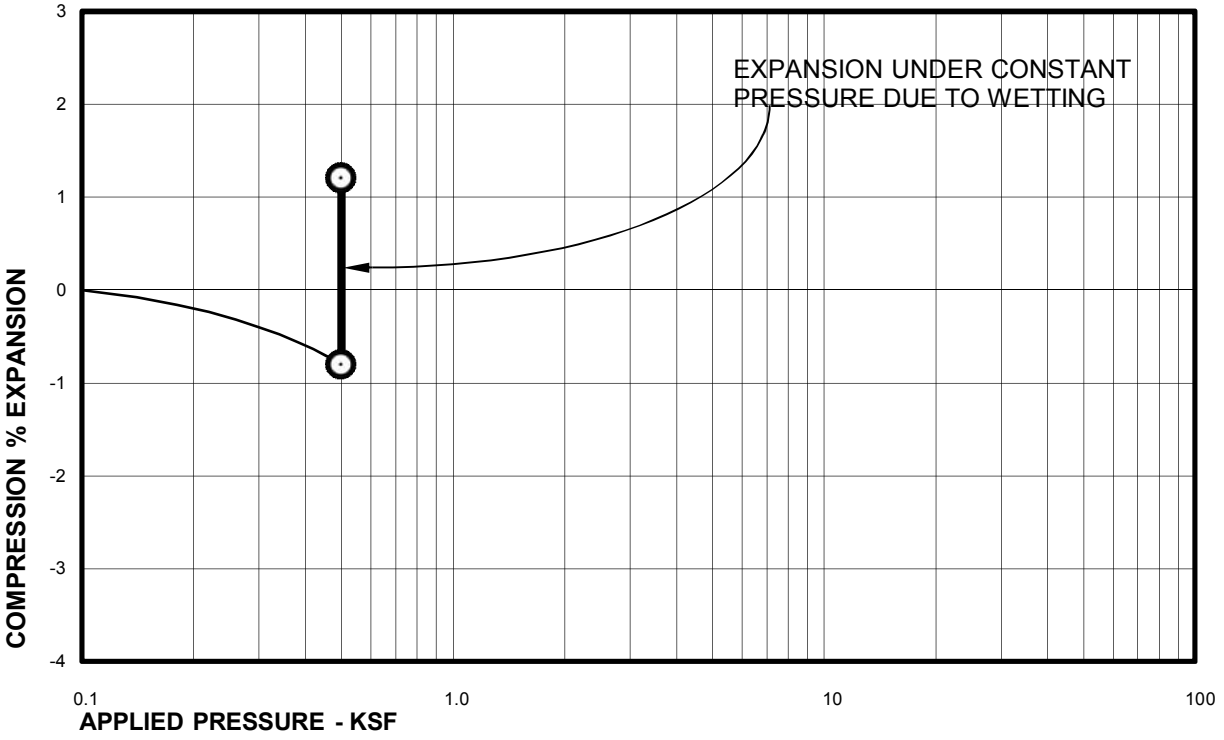
FIG. B-2

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of CLAYSTONE
From TH-3 AT 9 FEET

DRY UNIT WEIGHT= 100 PCF
MOISTURE CONTENT= 18.8 %



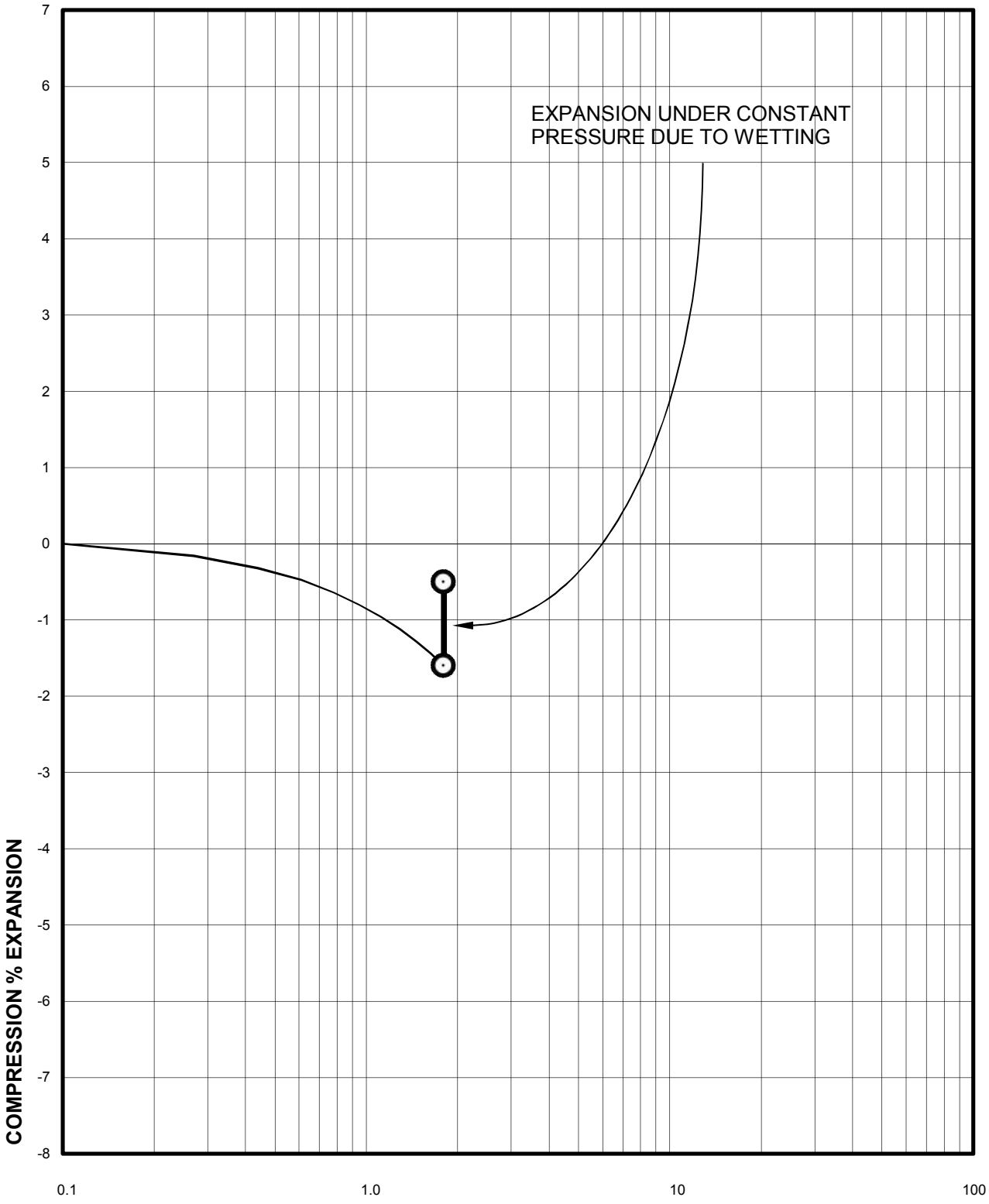
Sample of CLAYSTONE
From TH-4 AT 4 FEET

DRY UNIT WEIGHT= 120 PCF
MOISTURE CONTENT= 13.1 %

Swell Consolidation Test Results

FIG. B-3

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



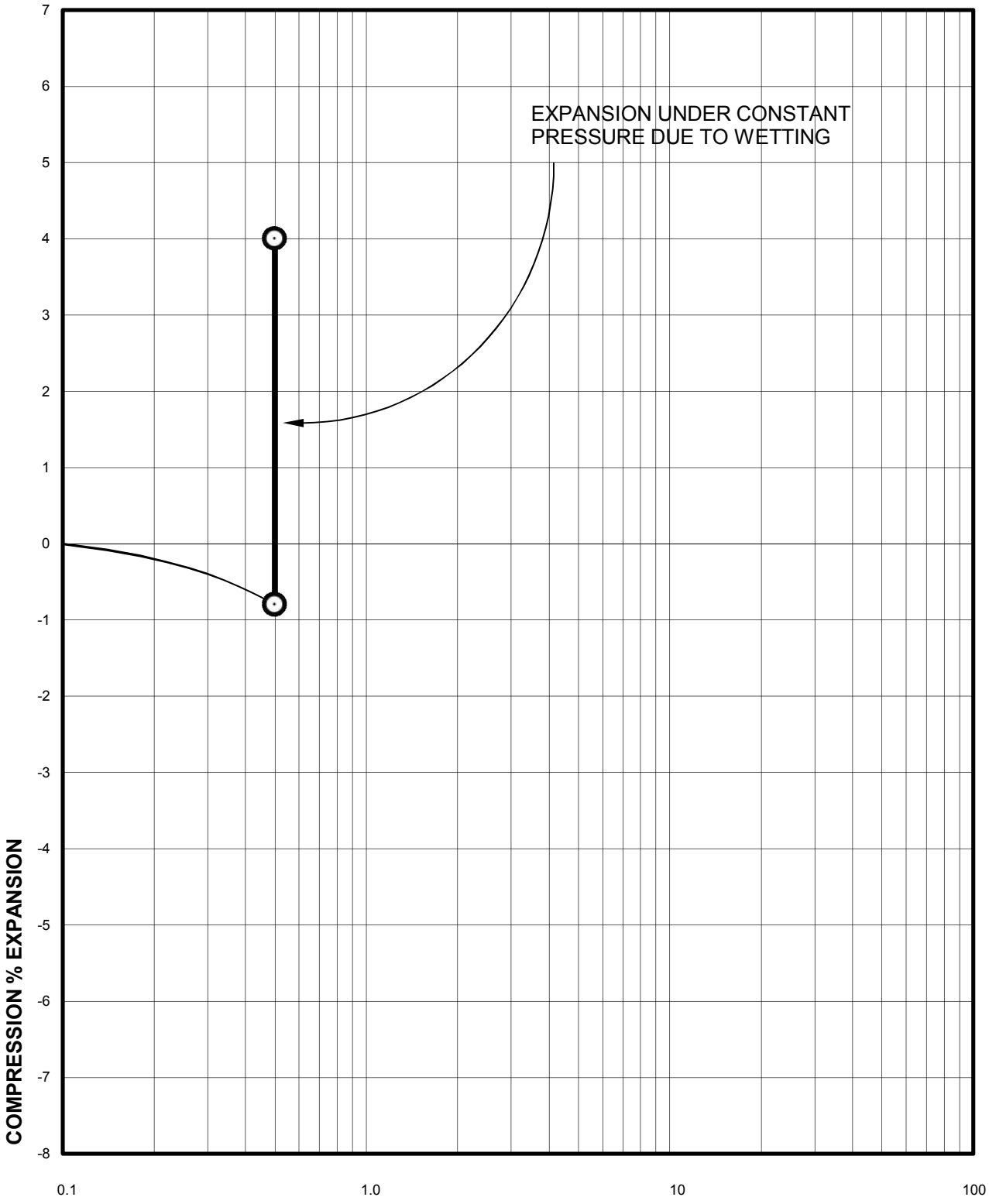
Sample of CLAYSTONE
From TH-4 AT 14 FEET

DRY UNIT WEIGHT= 126 PCF
MOISTURE CONTENT= 12.2 %

Swell Consolidation Test Results

FIG. B-4

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



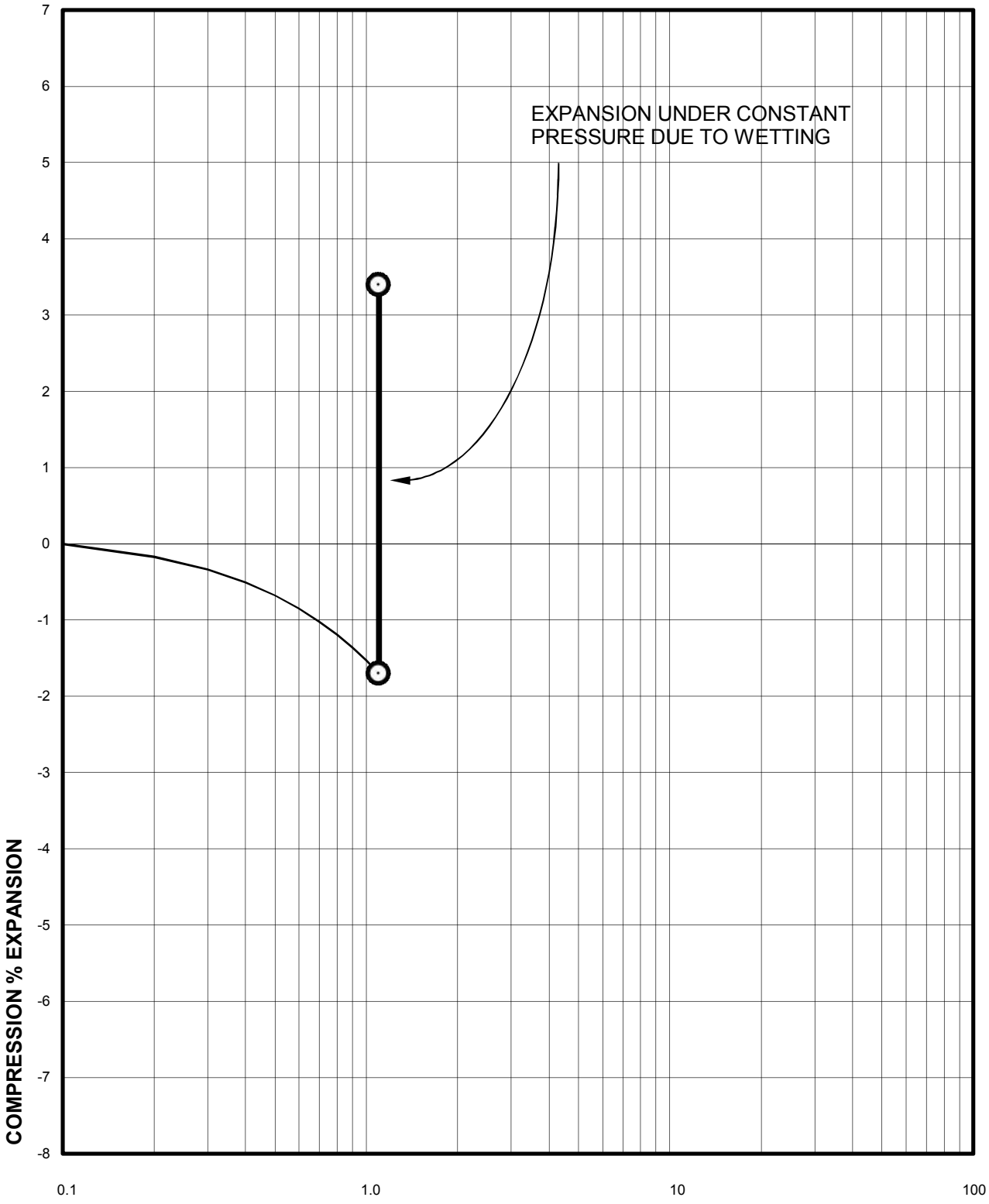
Sample of CLAY, SANDY (CL)
From TH-5 AT 4 FEET

DRY UNIT WEIGHT= 113 PCF
MOISTURE CONTENT= 12.2 %

Swell Consolidation Test Results

FIG. B-5

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



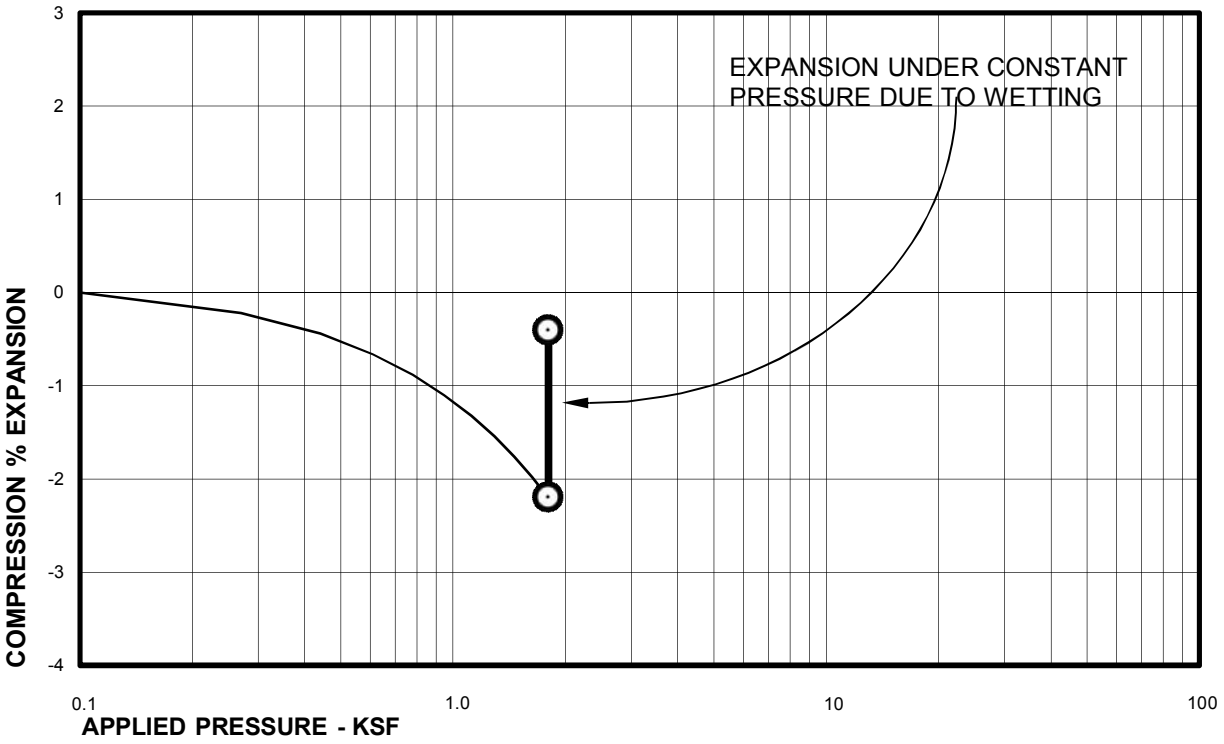
Sample of WEATHERED CLAYSTONE
From TH-5 AT 9 FEET

DRY UNIT WEIGHT= 114 PCF
MOISTURE CONTENT= 16.8 %

Swell Consolidation Test Results

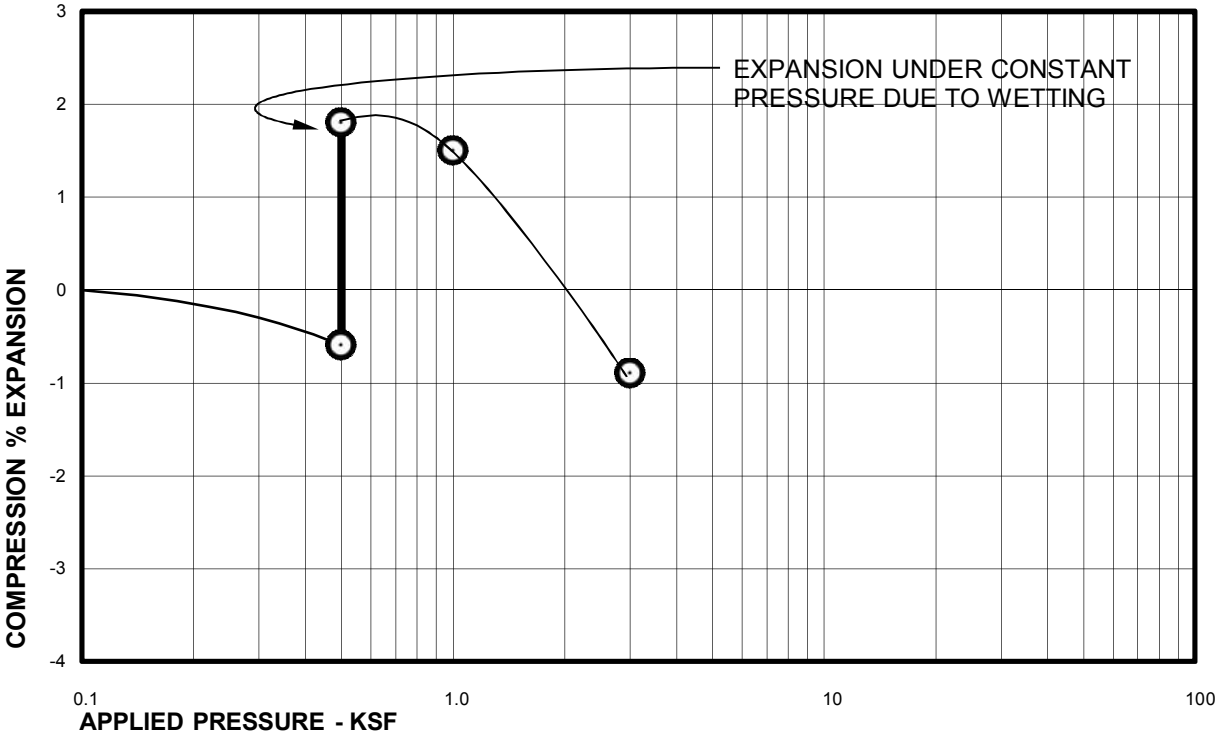
FIG. B-6

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of WEATHERED CLAYSTONE
From TH-5 AT 14 FEET

DRY UNIT WEIGHT= 118 PCF
MOISTURE CONTENT= 13.3 %



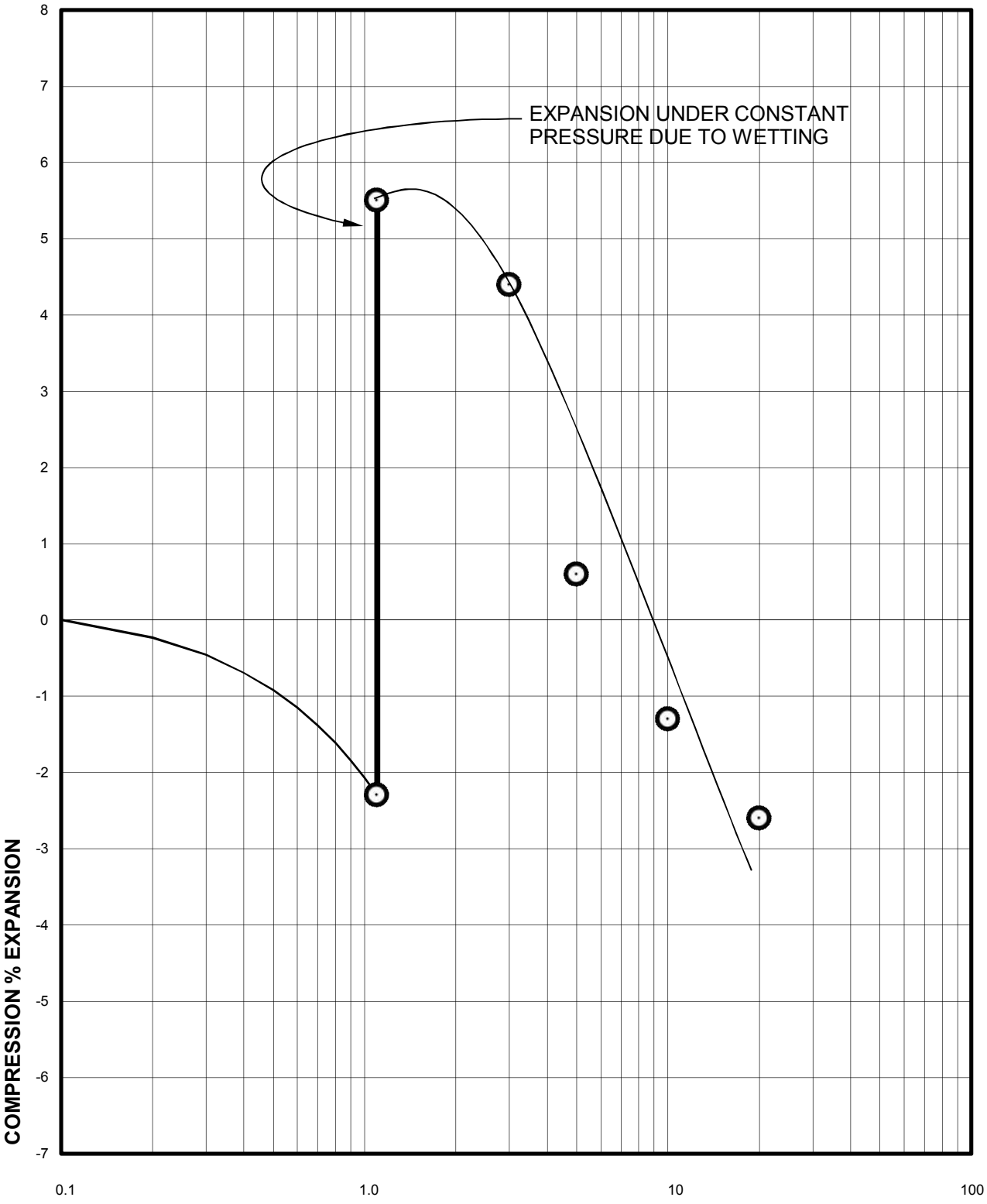
Sample of CLAY, SANDY (CL)
From TH-6 AT 4 FEET

DRY UNIT WEIGHT= 102 PCF
MOISTURE CONTENT= 10.8 %

Swell Consolidation Test Results

FIG. B-7

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



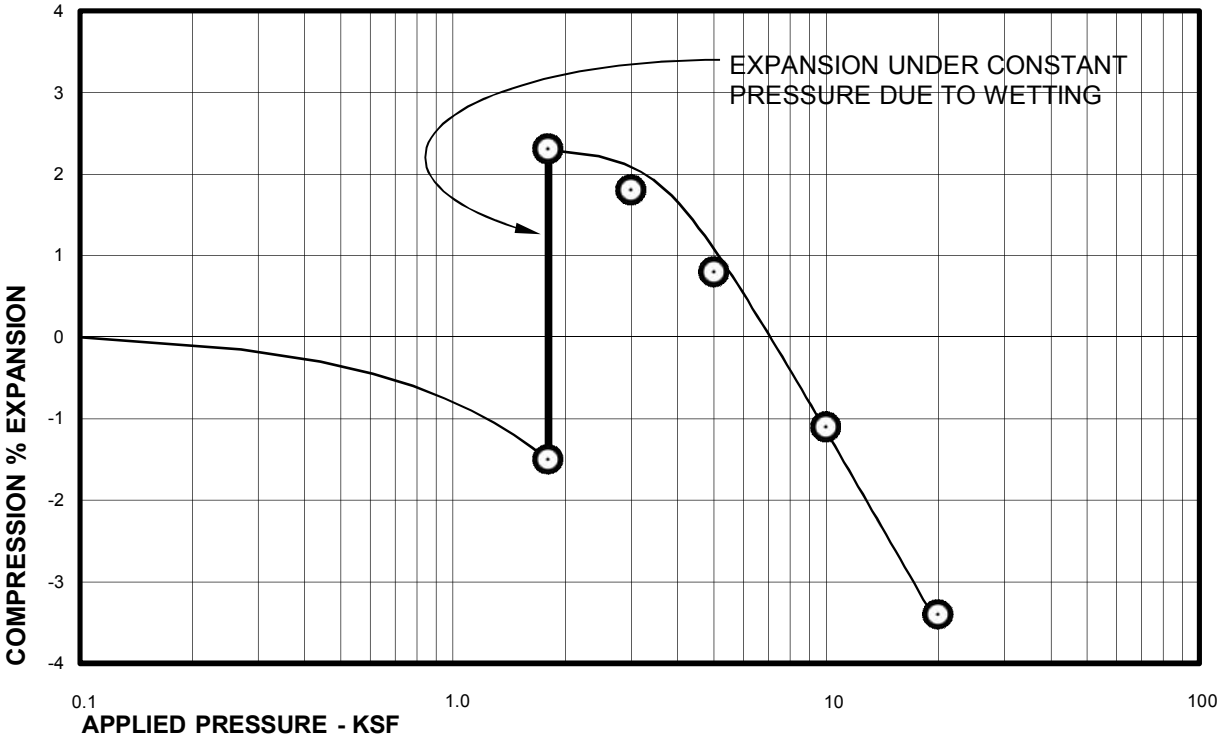
Sample of WEATHERED CLAYSTONE
From TH-6 AT 9 FEET

DRY UNIT WEIGHT= 122 PCF
MOISTURE CONTENT= 10.5 %

Swell Consolidation Test Results

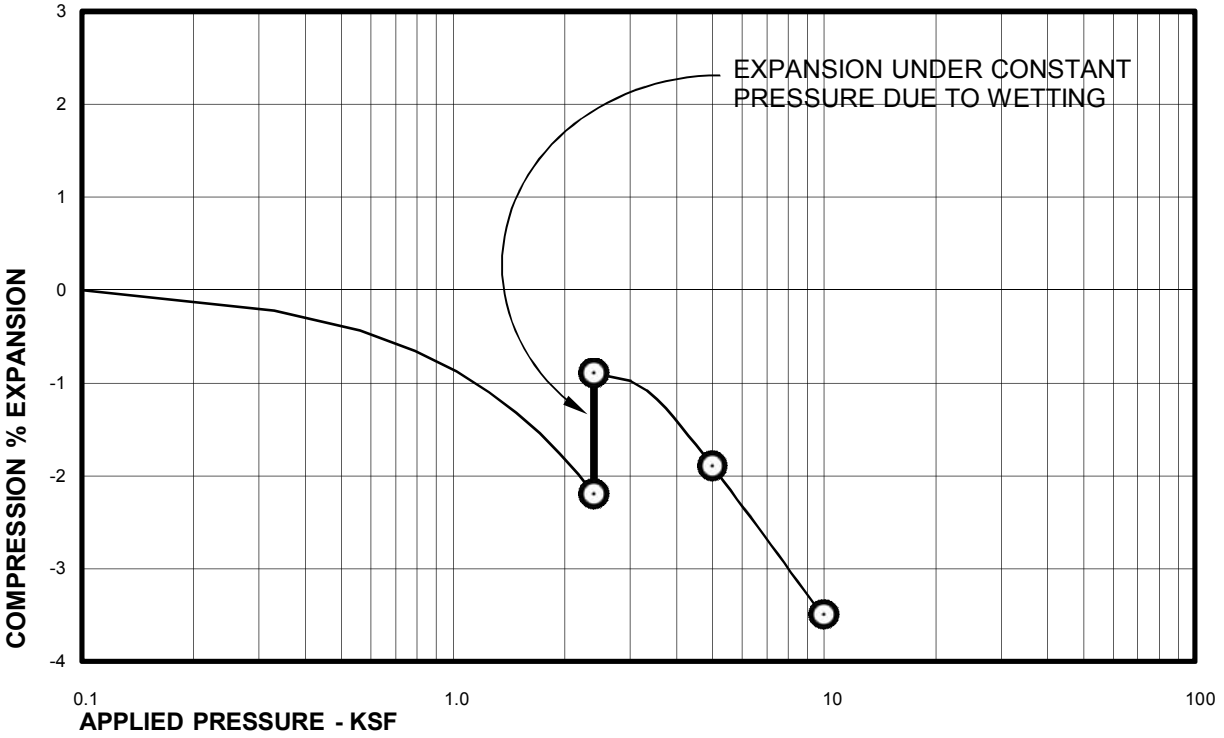
FIG. B-8

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of WEATHERED CLAYSTONE
From TH-6 AT 14 FEET

DRY UNIT WEIGHT= 117 PCF
MOISTURE CONTENT= 15.5 %



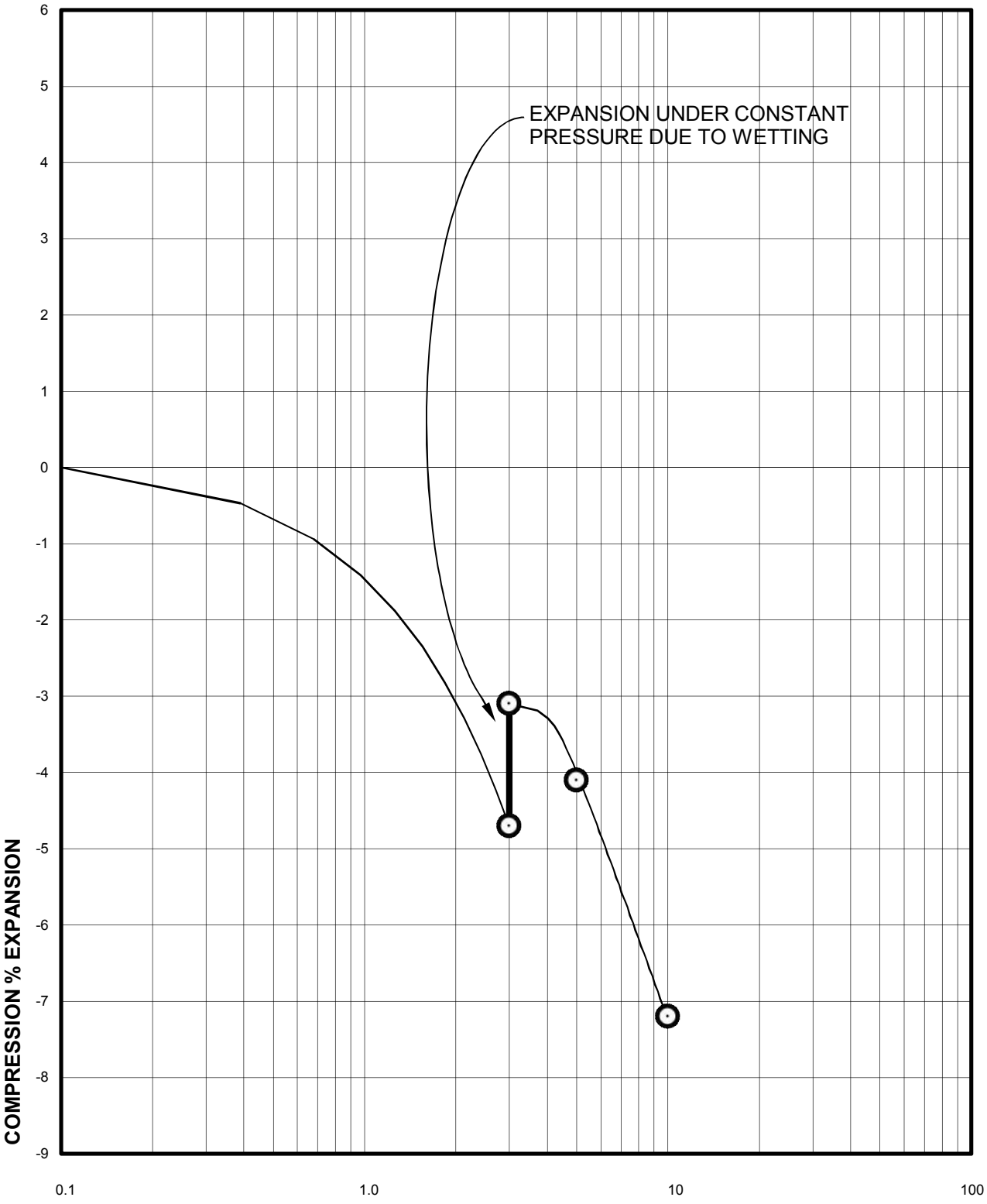
Sample of CLAYSTONE
From TH-6 AT 19 FEET

DRY UNIT WEIGHT= 120 PCF
MOISTURE CONTENT= 12.3 %

Swell Consolidation Test Results

FIG. B-9

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



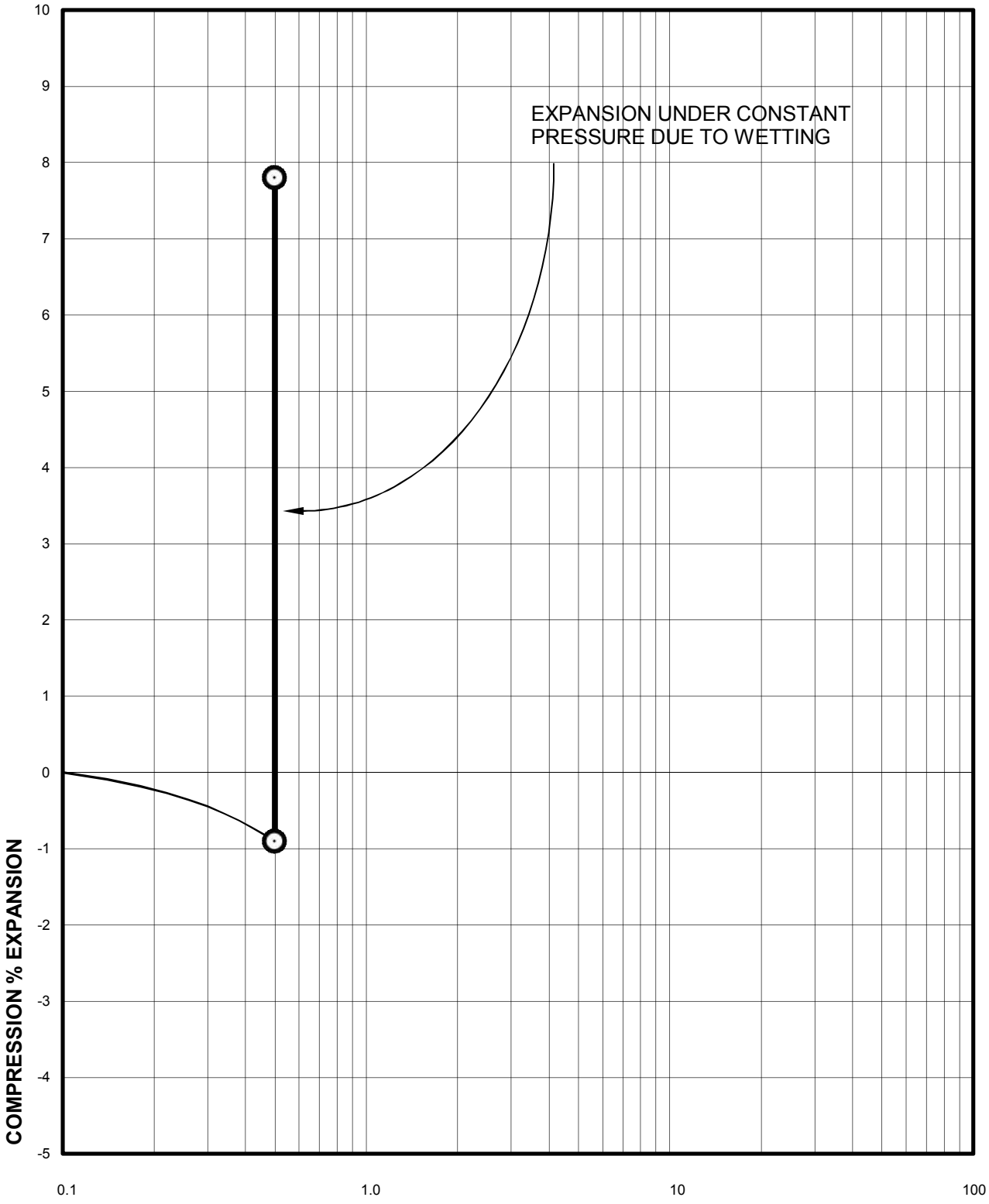
Sample of CLAYSTONE
From TH-6 AT 24 FEET

DRY UNIT WEIGHT= 92 PCF
MOISTURE CONTENT= 25.2 %

Swell Consolidation Test Results

FIG. B-10

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



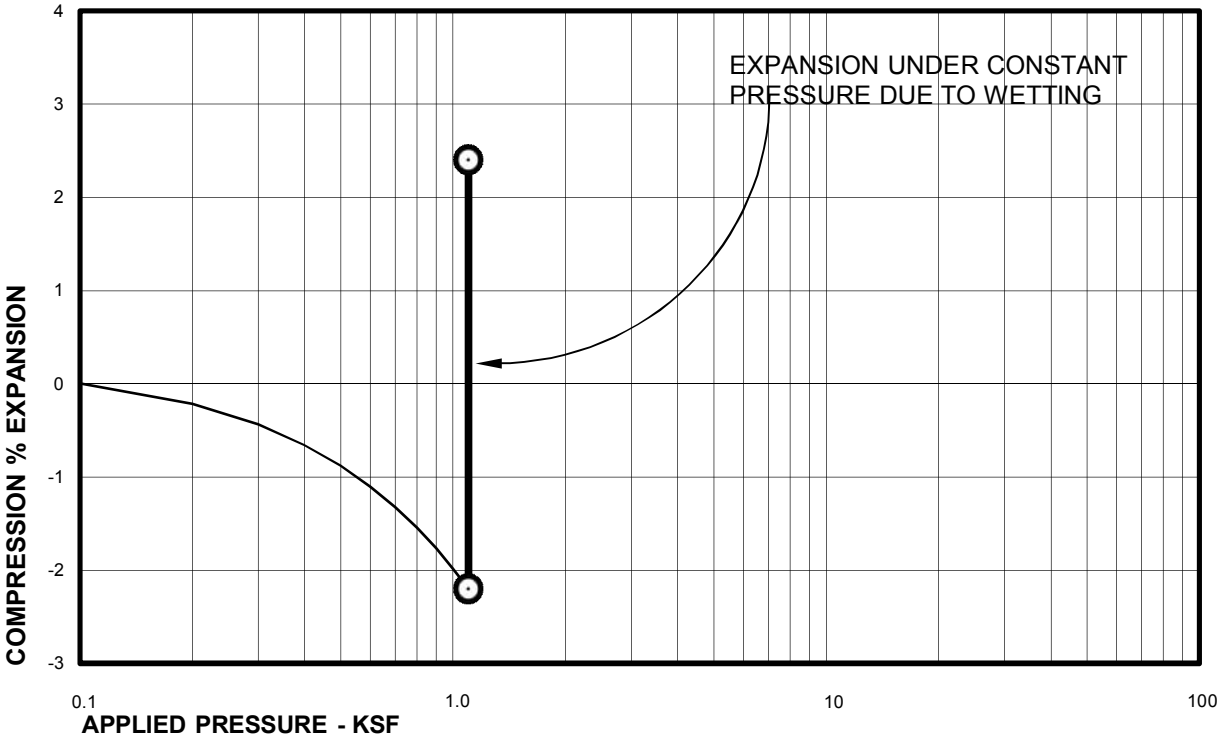
Sample of CLAYSTONE
From TH-7 AT 19 FEET

DRY UNIT WEIGHT= 113 PCF
MOISTURE CONTENT= 16.8 %

Swell Consolidation Test Results

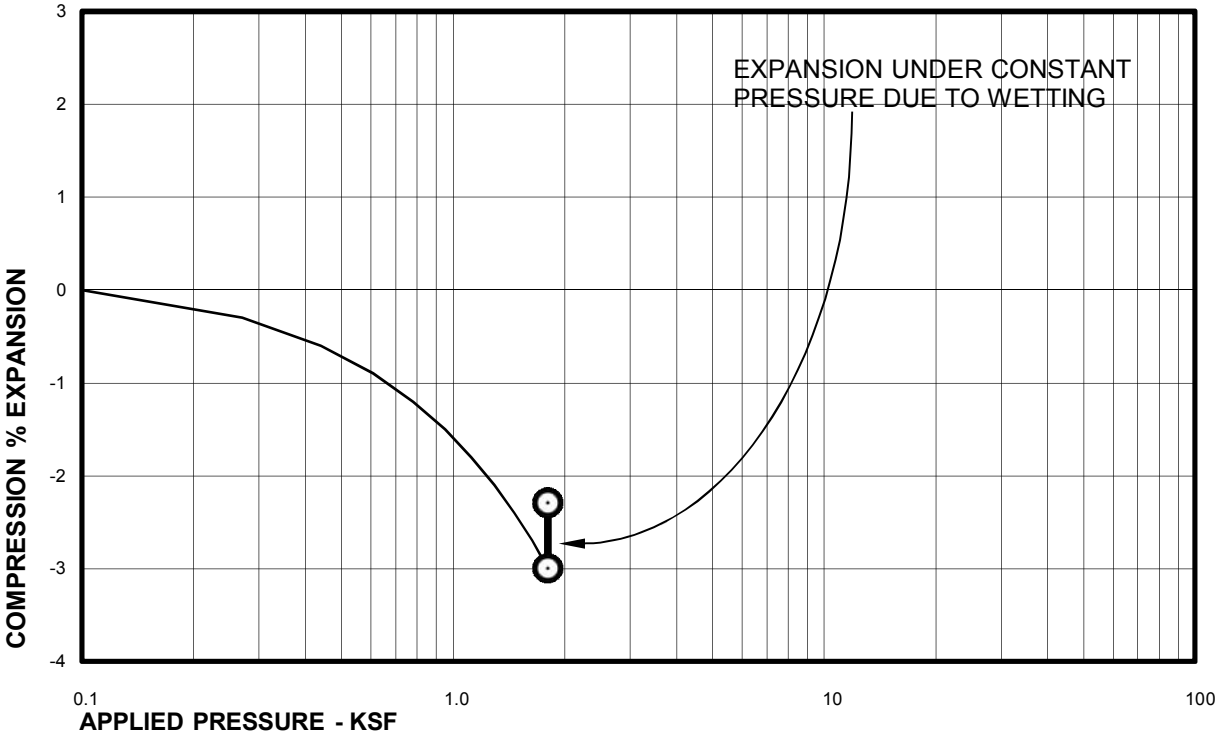
FIG. B-11

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of CLAYSTONE
From TH-7 AT 24 FEET

DRY UNIT WEIGHT= 98 PCF
MOISTURE CONTENT= 25.9 %



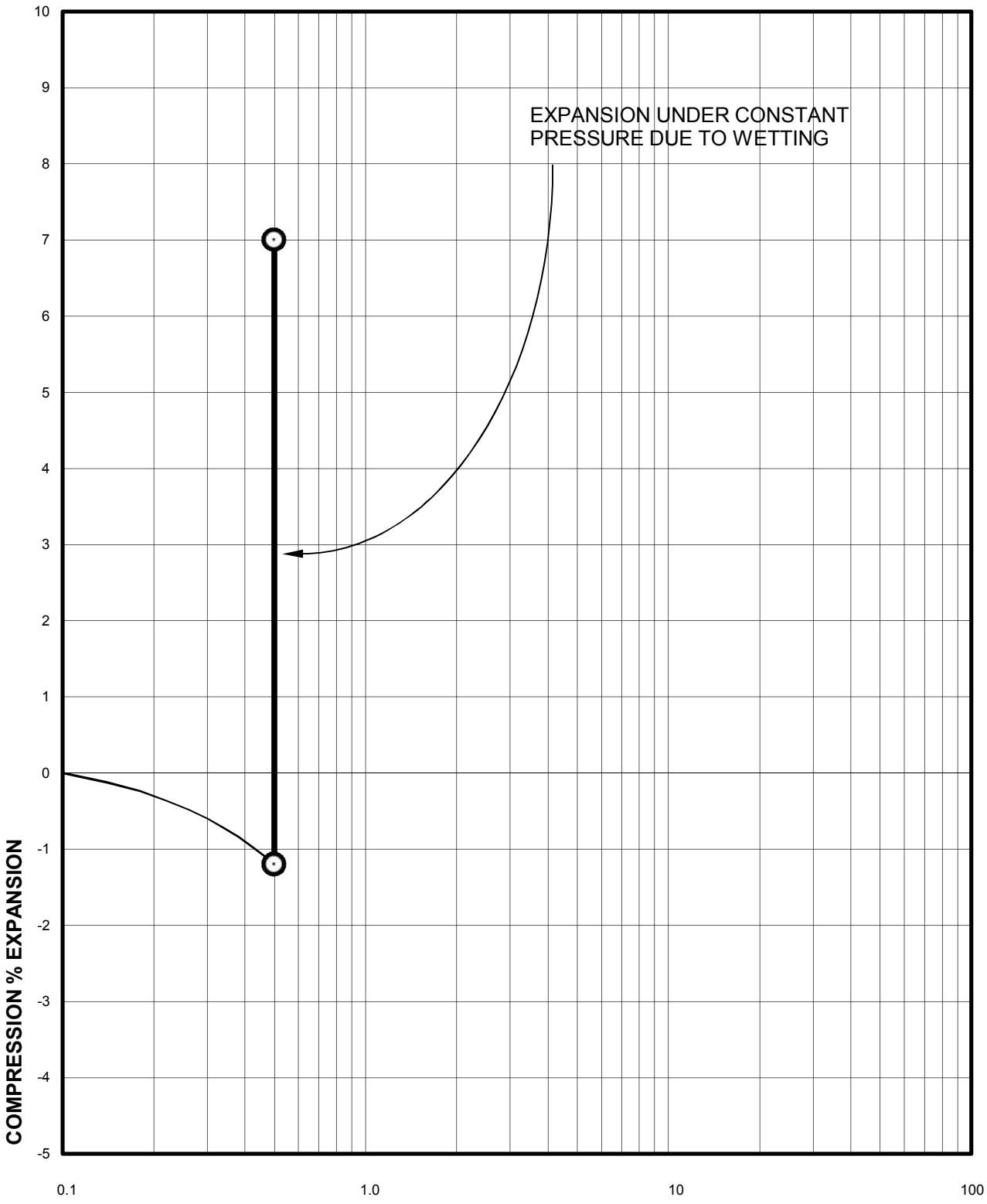
Sample of CLAYSTONE
From TH-7 AT 29 FEET

DRY UNIT WEIGHT= 116 PCF
MOISTURE CONTENT= 14.8 %

Swell Consolidation Test Results

FIG. B-12

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



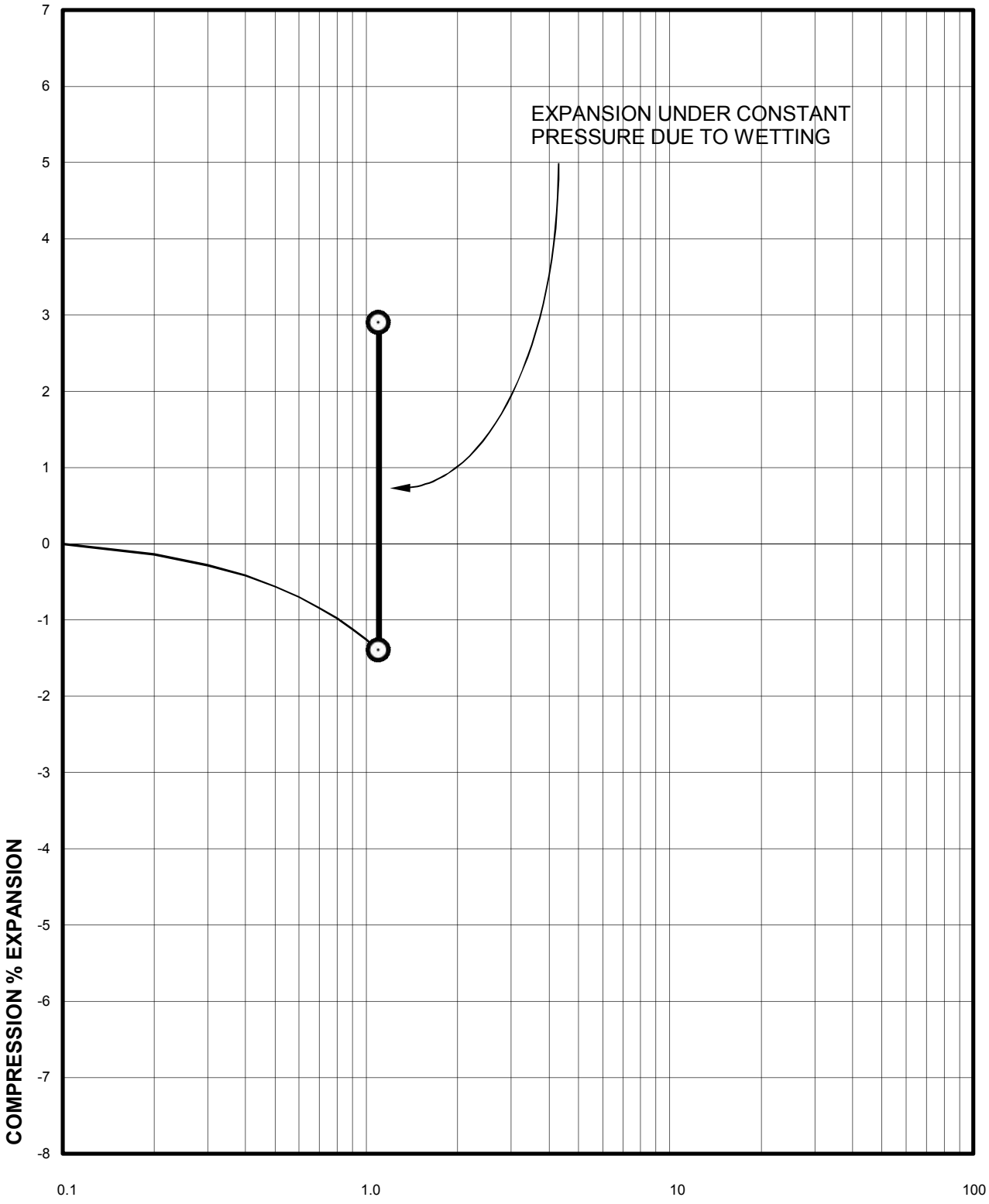
Sample of CLAYSTONE
From TH-8 AT 14 FEET

DRY UNIT WEIGHT= 114 PCF
MOISTURE CONTENT= 17.1 %

Swell Consolidation Test Results

FIG. B-13

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



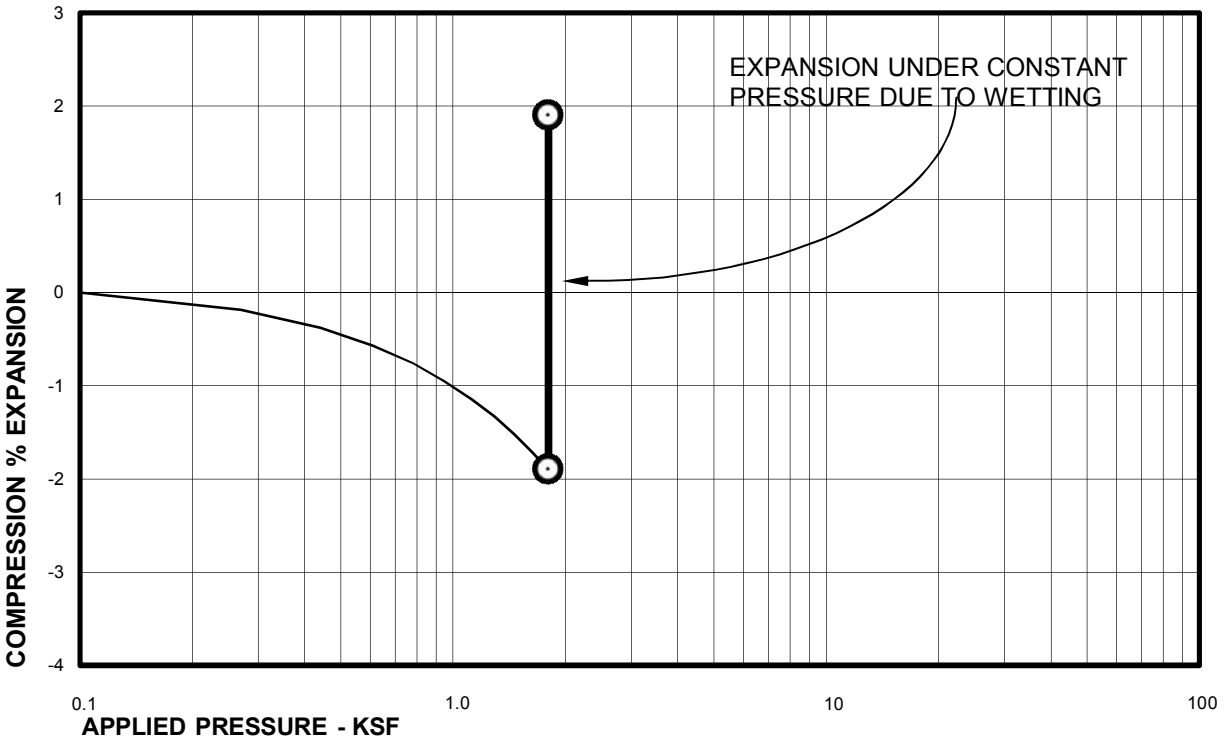
Sample of CLAYSTONE
From TH-8 AT 19 FEET

DRY UNIT WEIGHT= 116 PCF
MOISTURE CONTENT= 15.5 %

Swell Consolidation Test Results

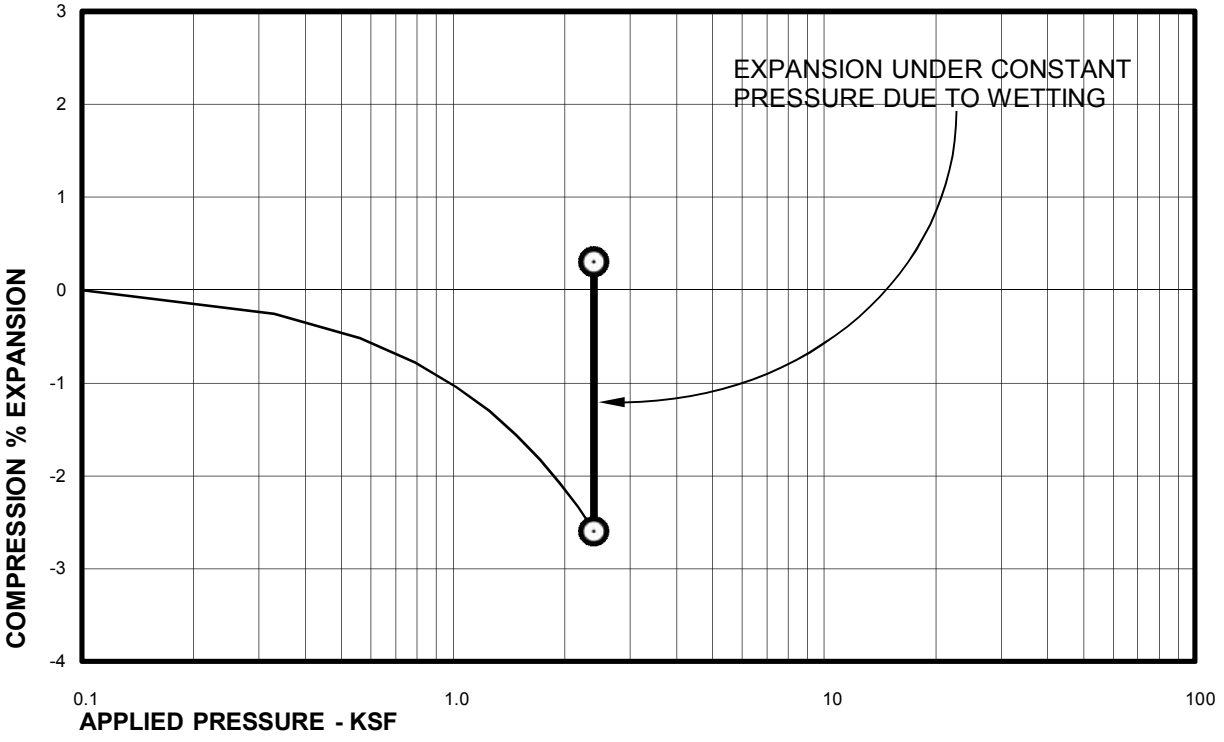
FIG. B-14

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of CLAYSTONE
From TH-8 AT 24 FEET

DRY UNIT WEIGHT= 116 PCF
MOISTURE CONTENT= 16.5 %



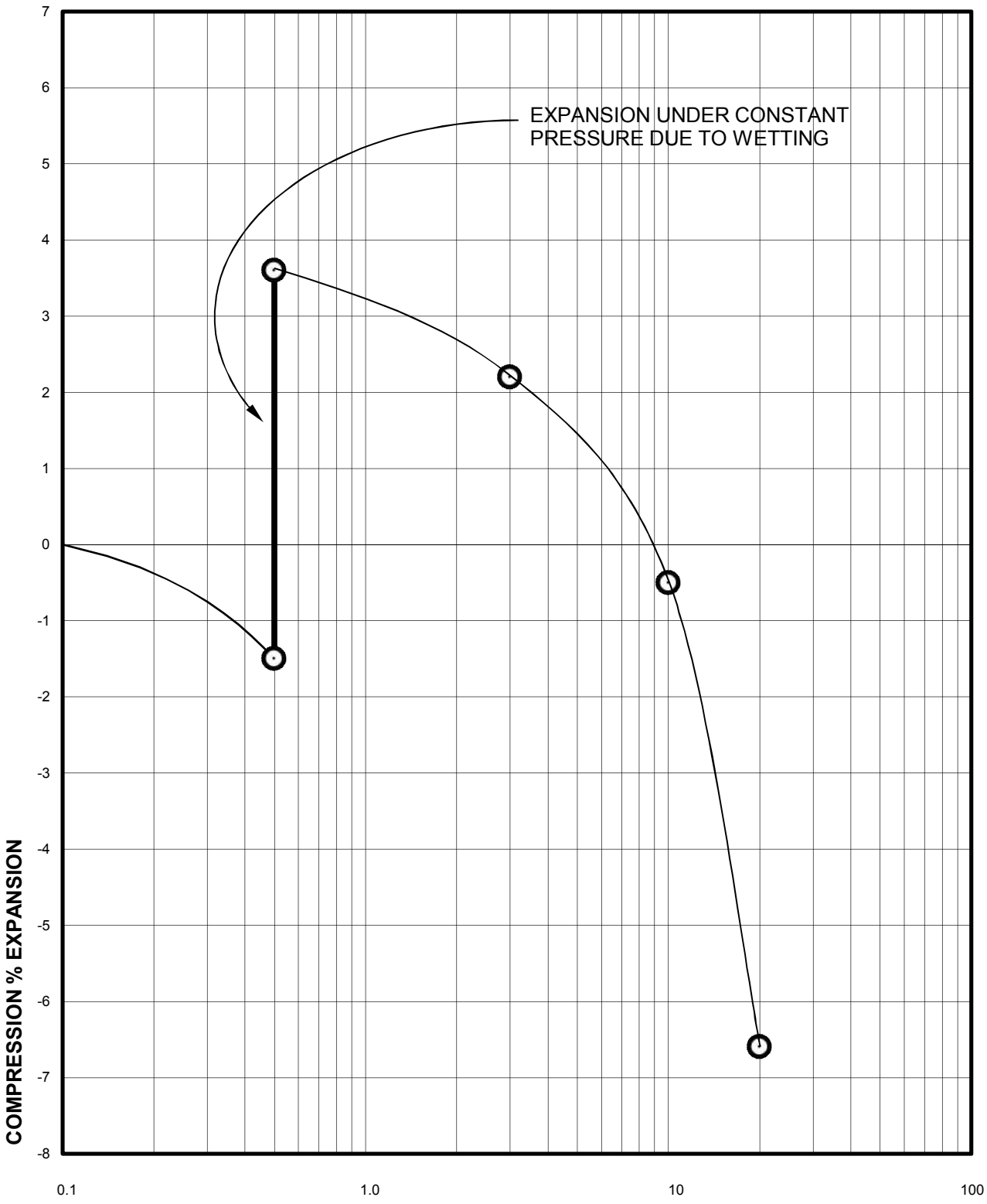
Sample of CLAYSTONE
From TH-8 AT 29 FEET

DRY UNIT WEIGHT= 112 PCF
MOISTURE CONTENT= 16.6 %

Swell Consolidation Test Results

FIG. B-15

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



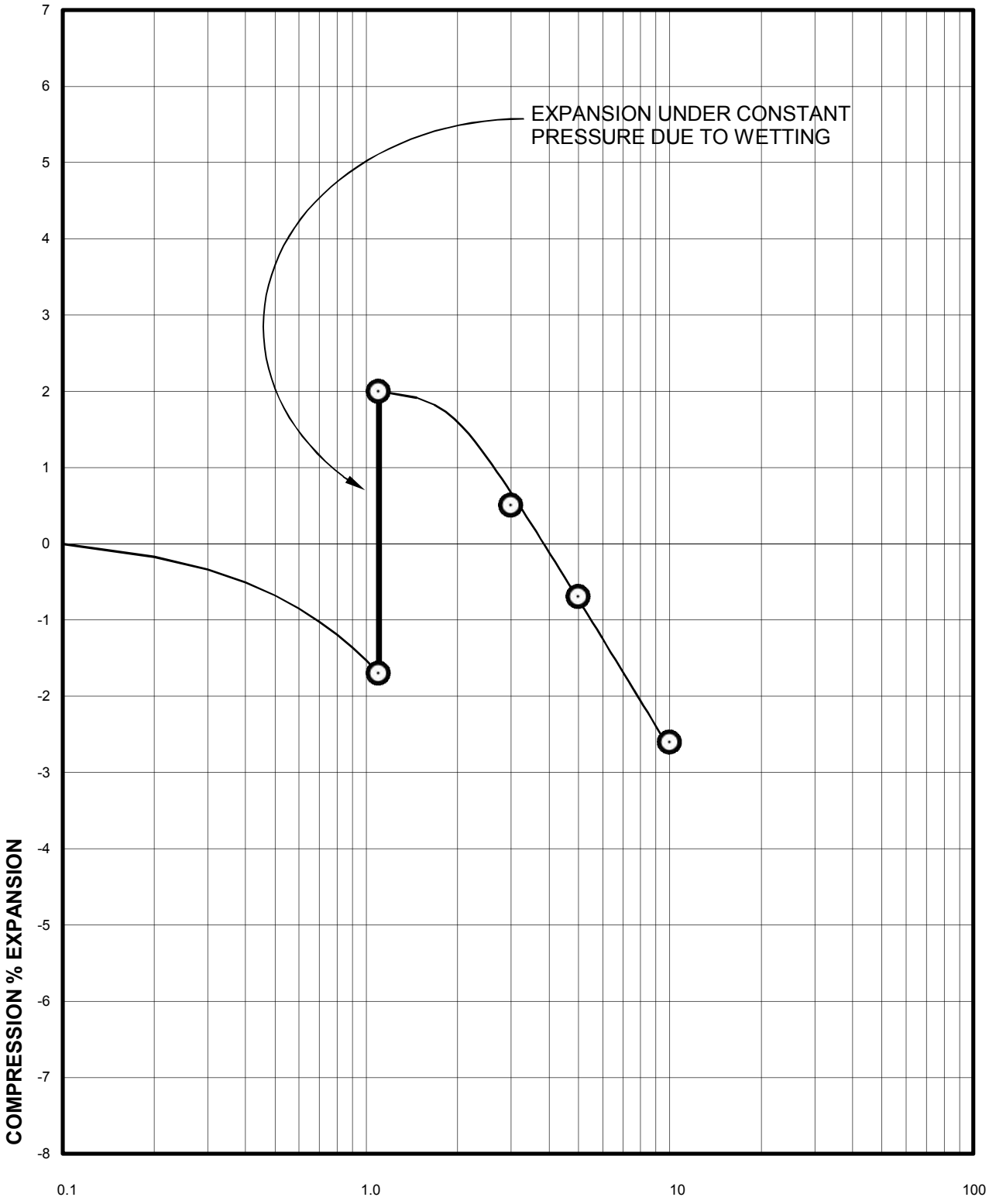
Sample of CLAYSTONE
From TH-9 AT 24 FEET

DRY UNIT WEIGHT= 119 PCF
MOISTURE CONTENT= 11.7 %

Swell Consolidation Test Results

FIG. B-16

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



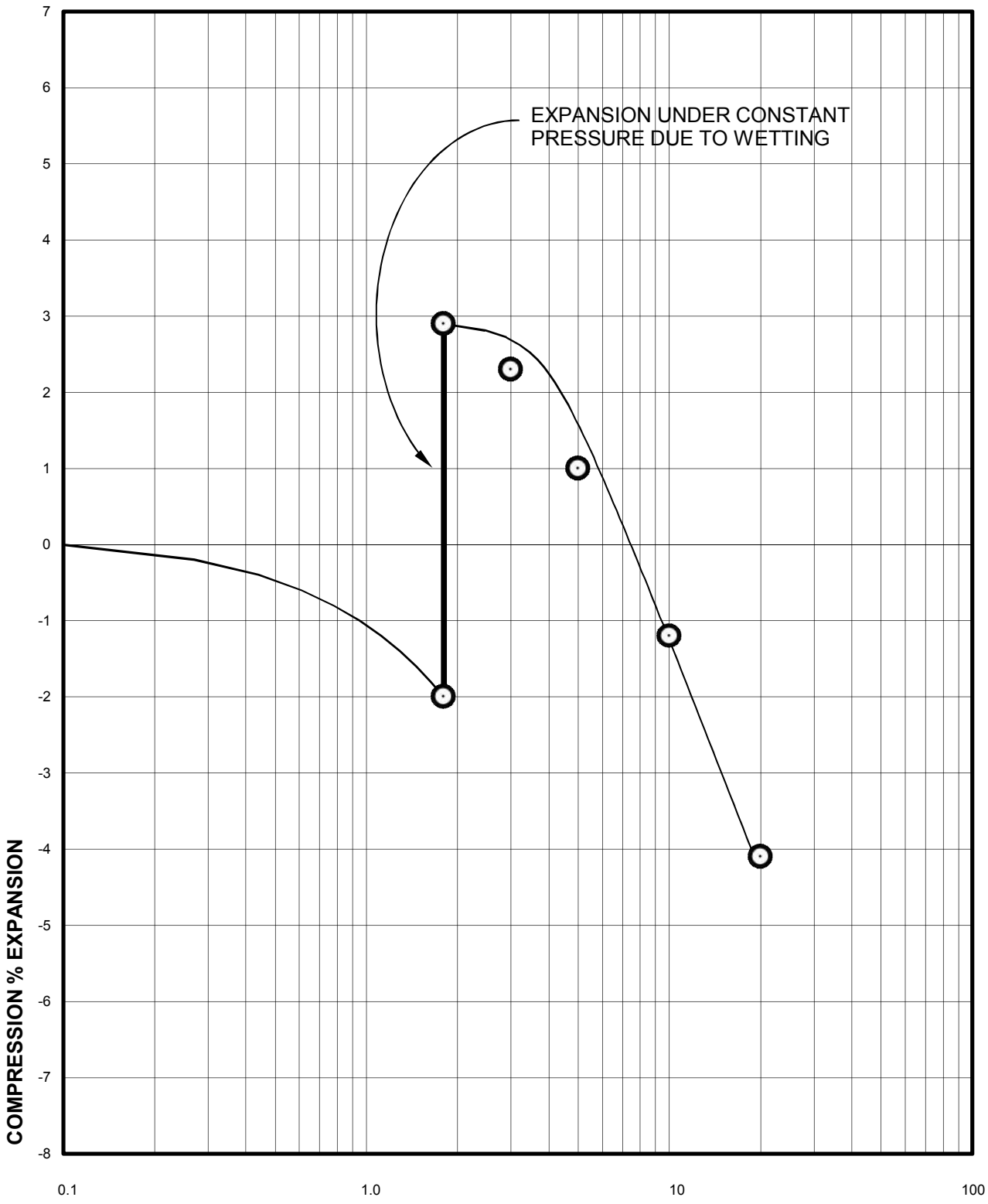
Sample of CLAYSTONE
From TH-9 AT 29 FEET

DRY UNIT WEIGHT= 118 PCF
MOISTURE CONTENT= 13.8 %

Swell Consolidation Test Results

FIG. B-17

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



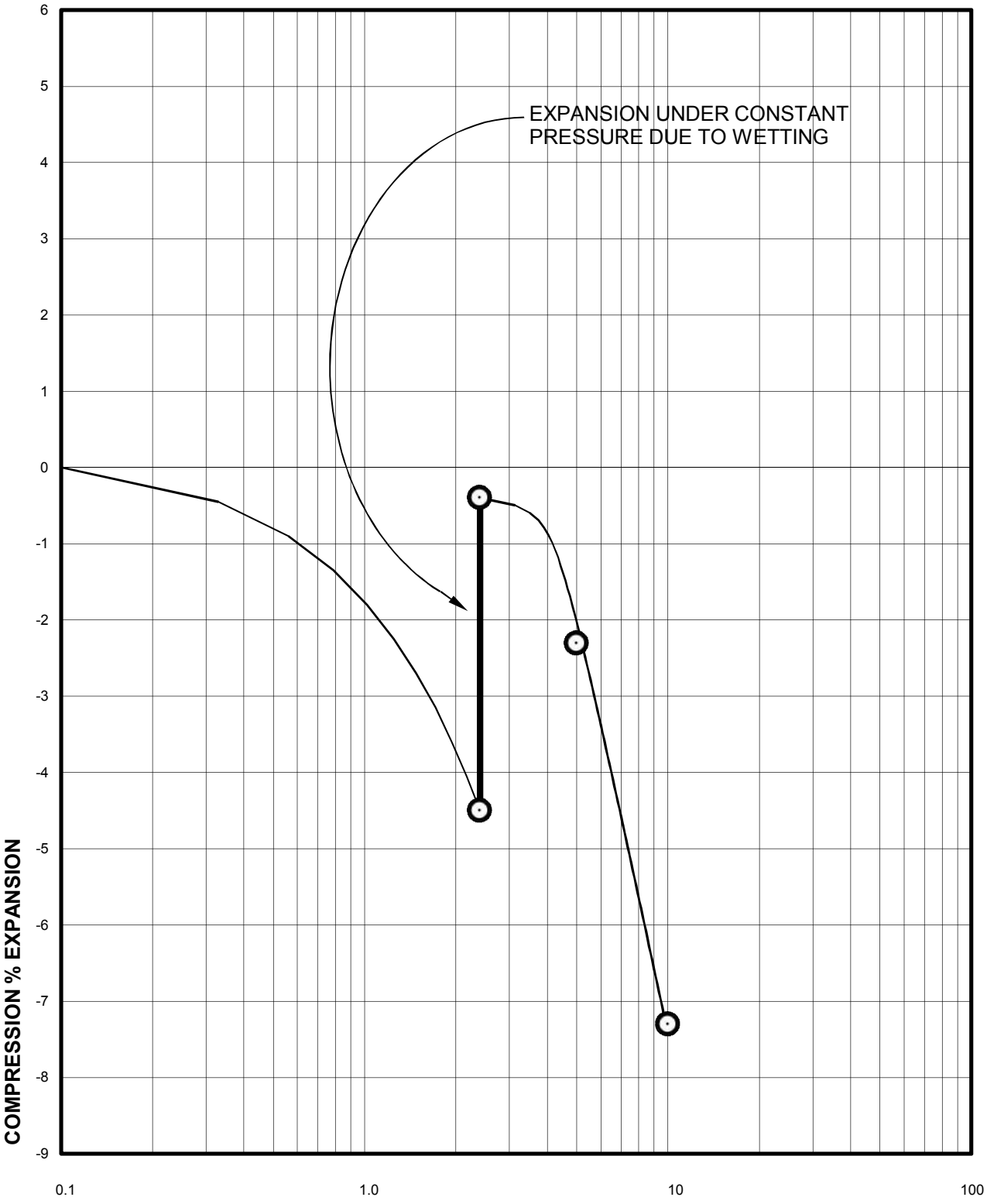
Sample of CLAYSTONE
From TH-9 AT 34 FEET

DRY UNIT WEIGHT= 109 PCF
MOISTURE CONTENT= 21.3 %

Swell Consolidation Test Results

FIG. B-18

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



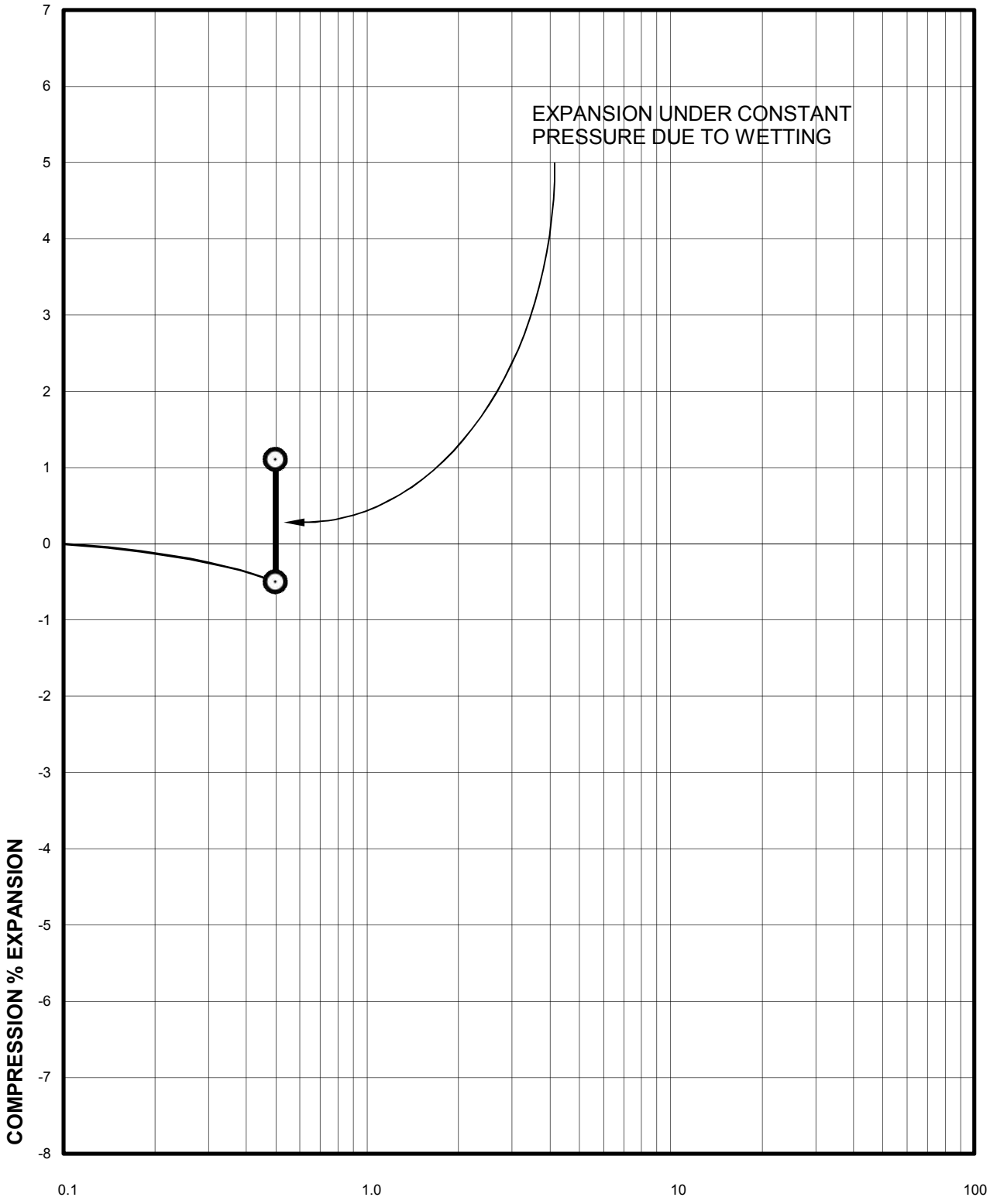
Sample of CLAYSTONE
From TH-9 AT 39 FEET

DRY UNIT WEIGHT= 104 PCF
MOISTURE CONTENT= 23.3 %

Swell Consolidation Test Results

FIG. B-19

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



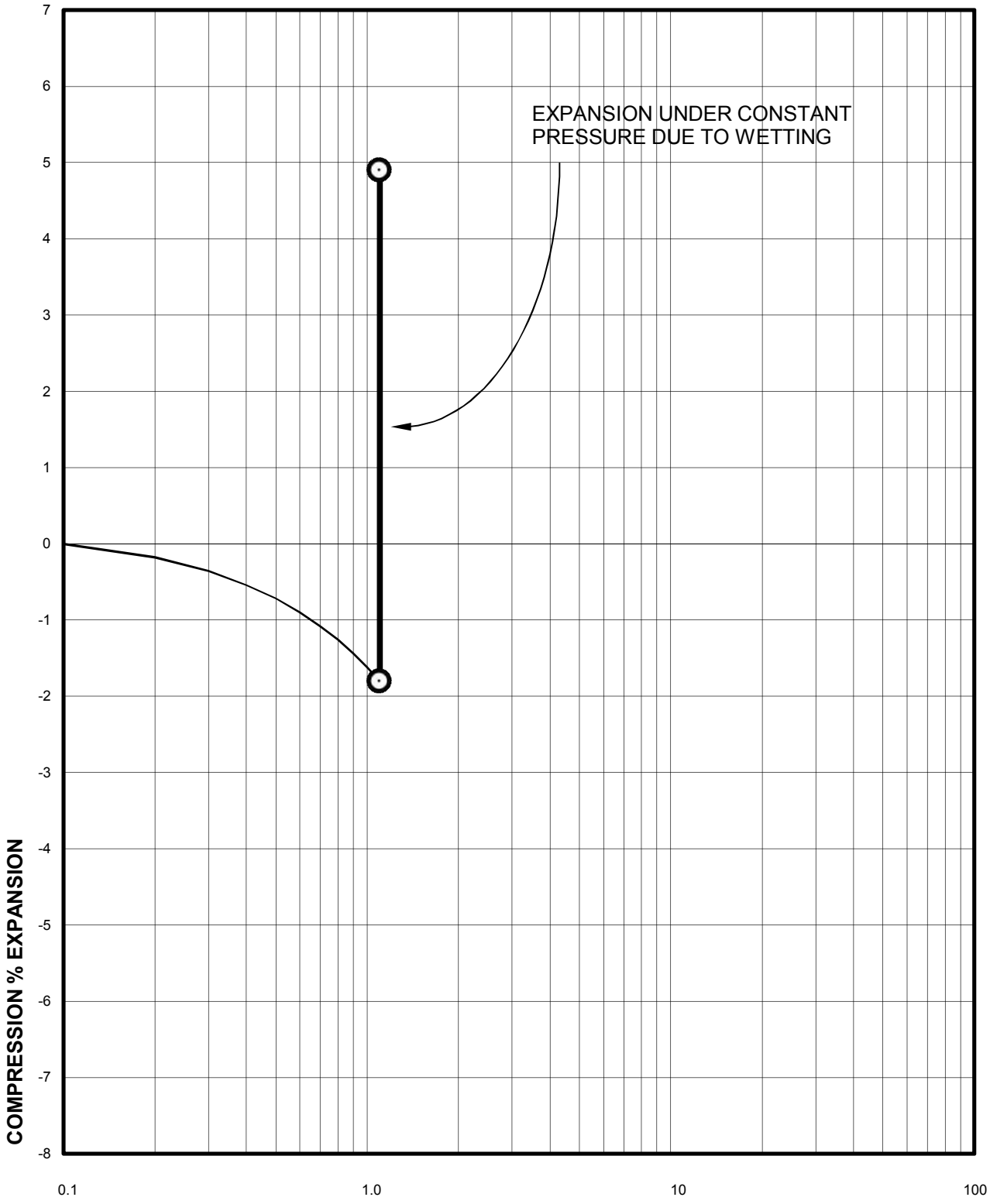
Sample of SANDSTONE
From TH-10 AT 19 FEET

DRY UNIT WEIGHT= 125 PCF
MOISTURE CONTENT= 9.0 %

Swell Consolidation Test Results

FIG. B-20

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



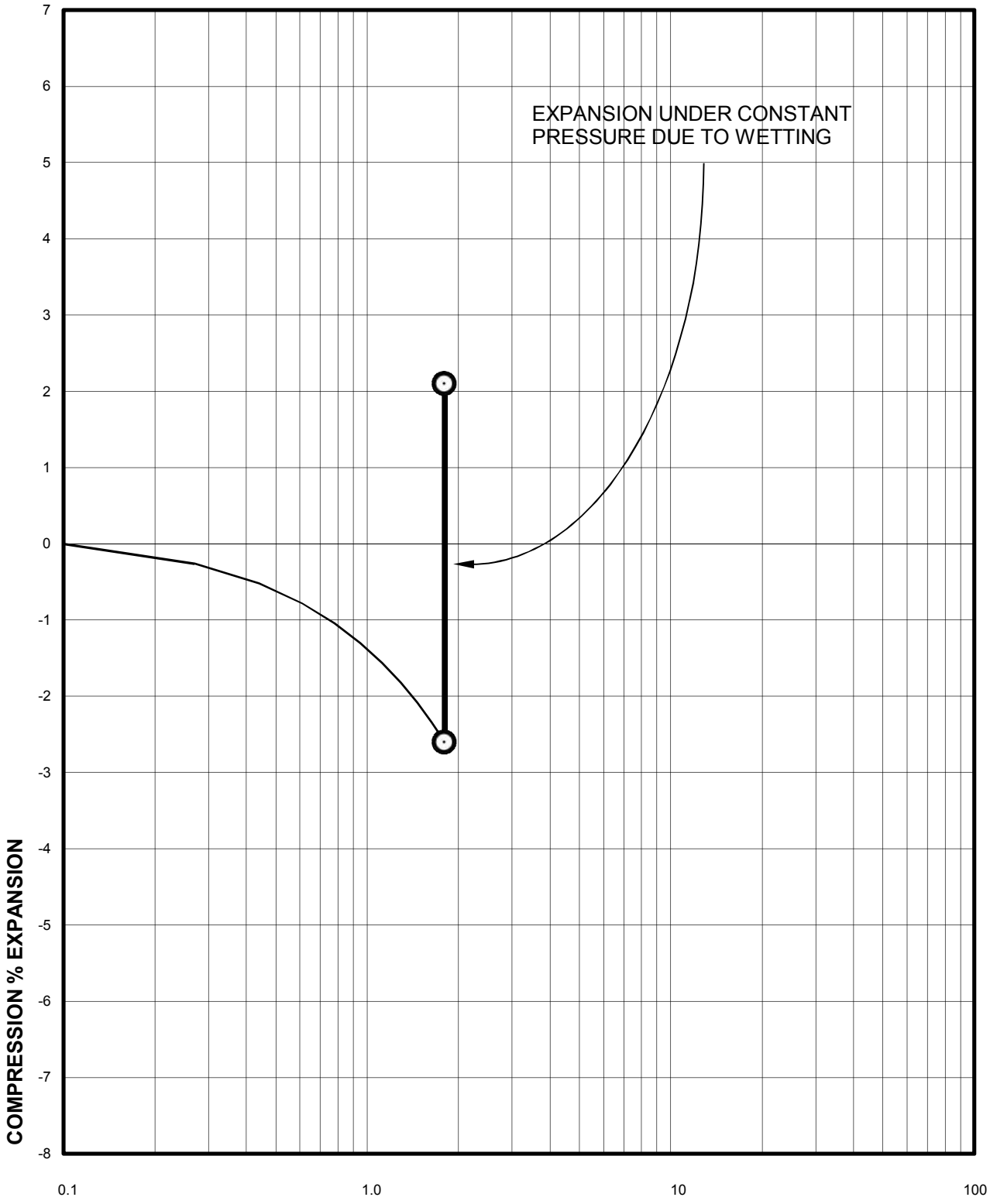
Sample of CLAYSTONE
From TH-10 AT 24 FEET

DRY UNIT WEIGHT= 113 PCF
MOISTURE CONTENT= 14.3 %

Swell Consolidation Test Results

FIG. B-21

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



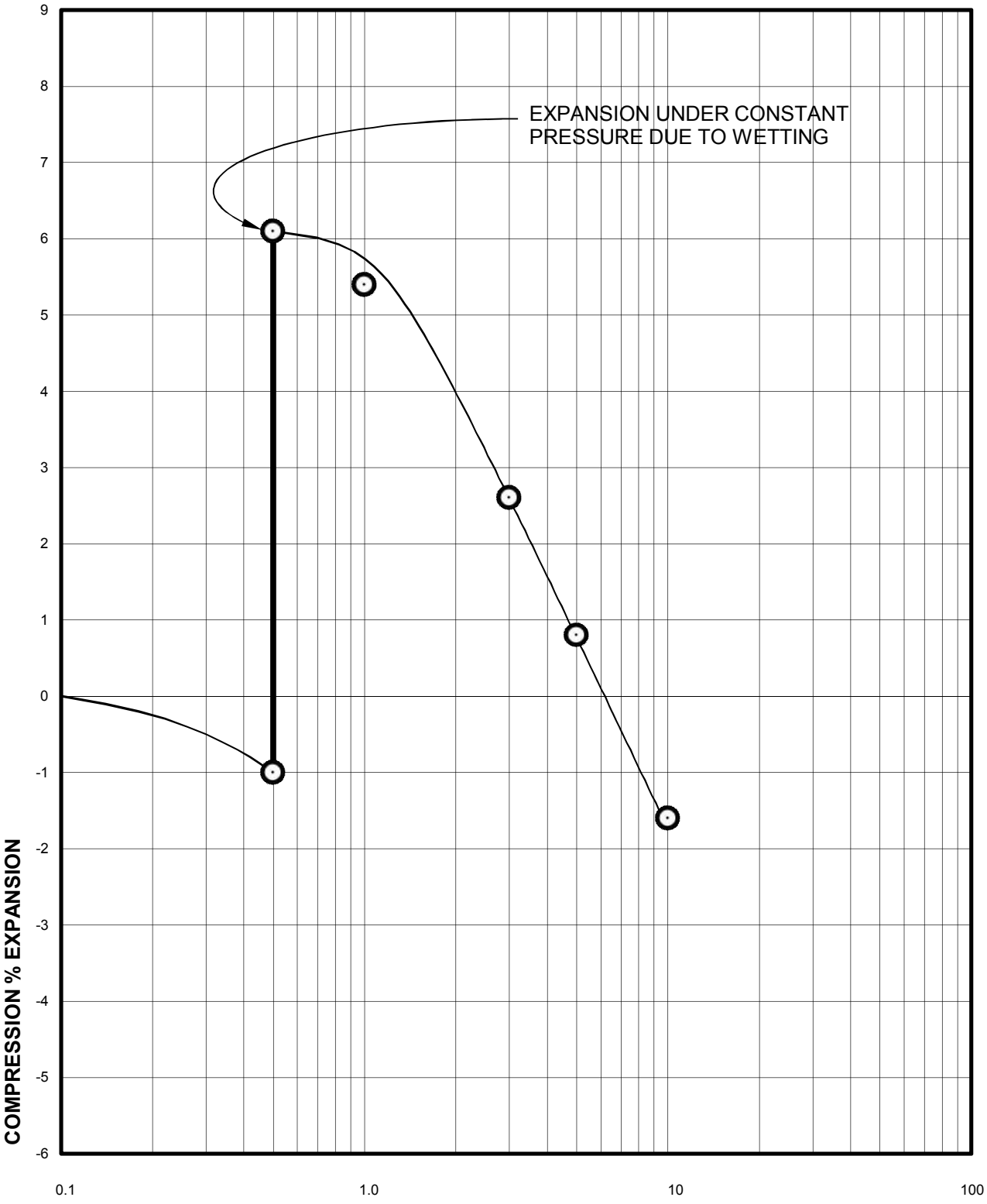
Sample of CLAYSTONE
From TH-10 AT 29 FEET

DRY UNIT WEIGHT= 97 PCF
MOISTURE CONTENT= 22.6 %

Swell Consolidation Test Results

FIG. B-22

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



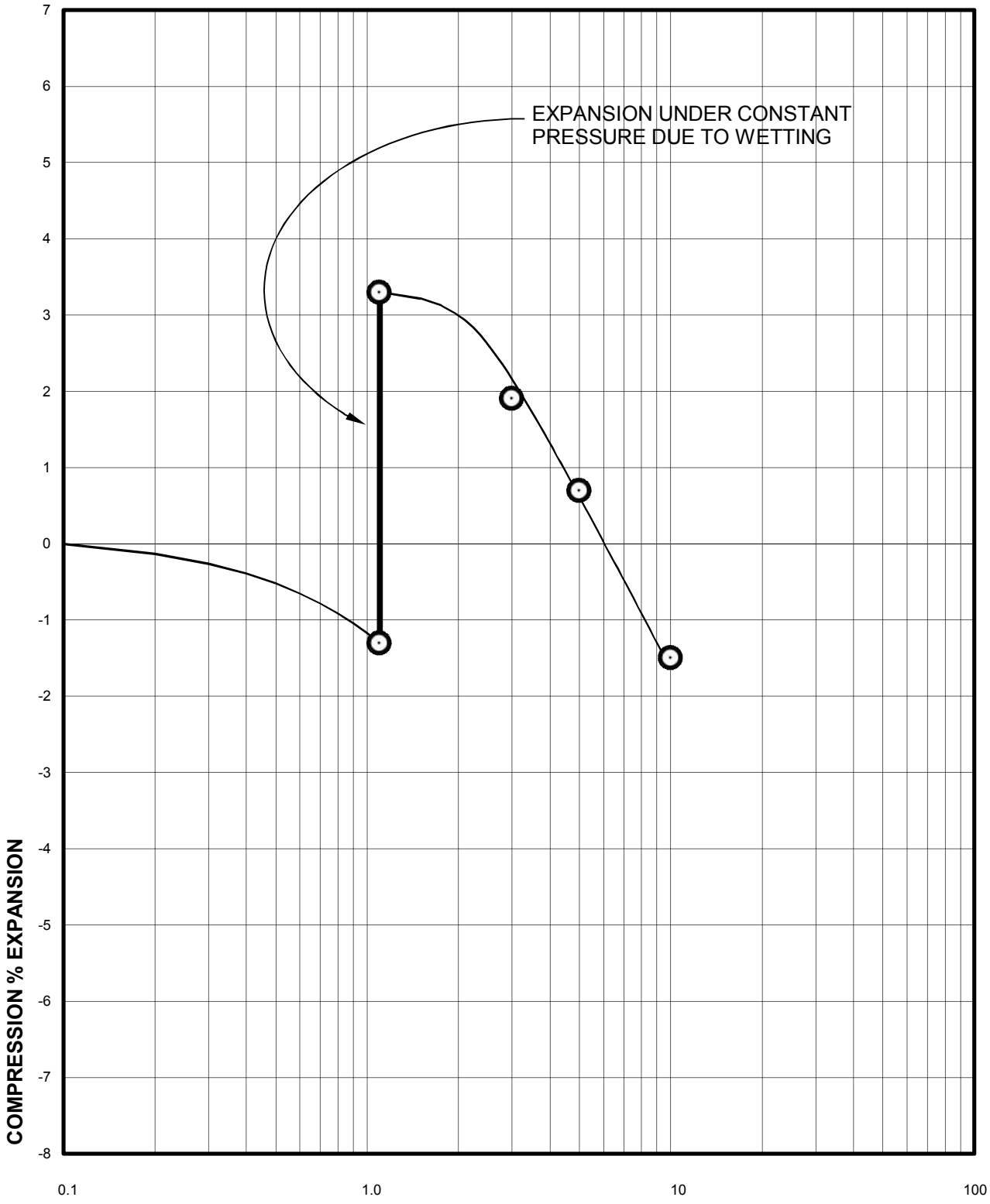
Sample of CLAYSTONE
From TH-11 AT 24 FEET

DRY UNIT WEIGHT= 118 PCF
MOISTURE CONTENT= 15.4 %

Swell Consolidation Test Results

FIG. B-23

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



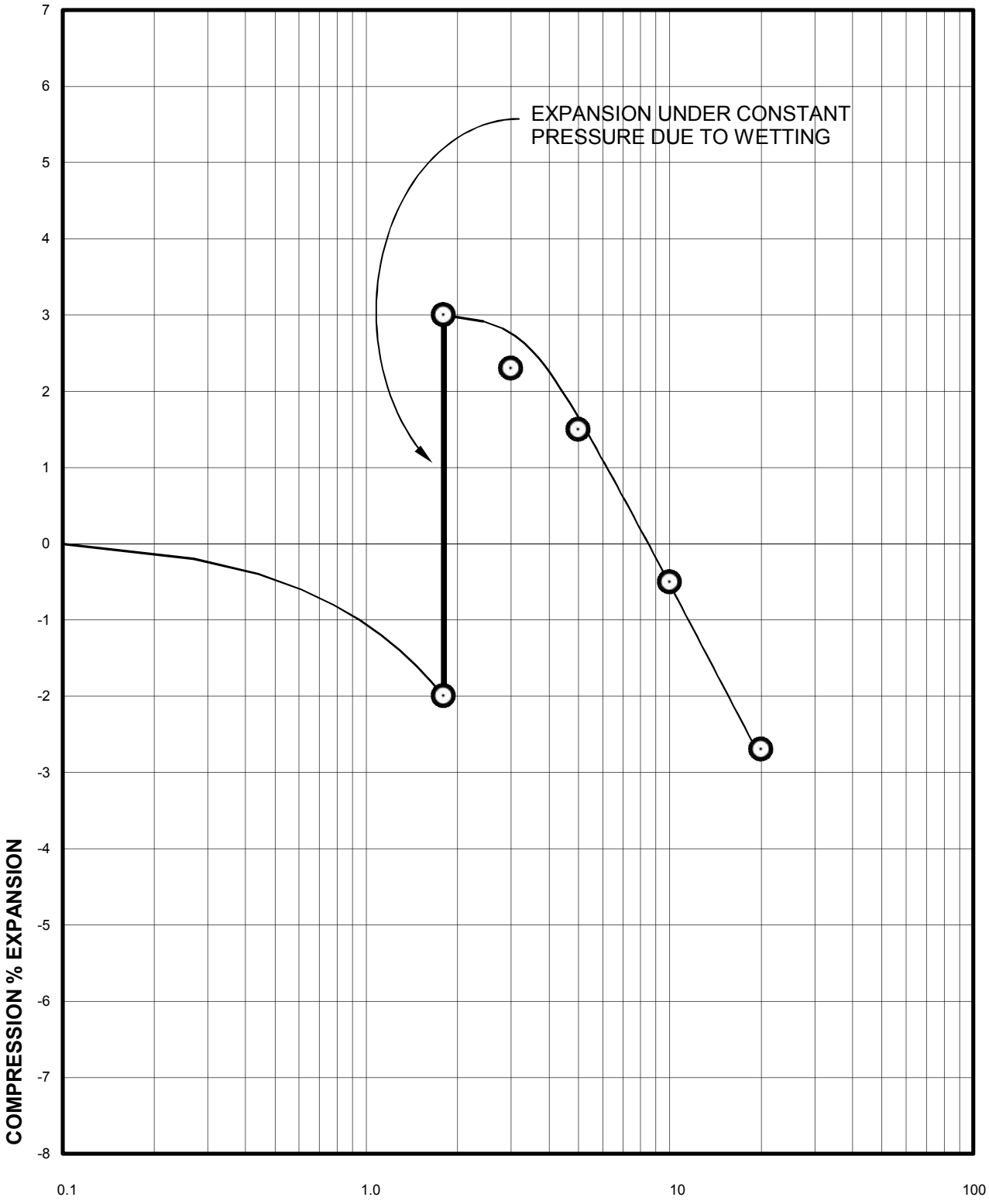
Sample of CLAYSTONE
From TH-11 AT 29 FEET

DRY UNIT WEIGHT= 108 PCF
MOISTURE CONTENT= 19.8 %

Swell Consolidation Test Results

FIG. B-24

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



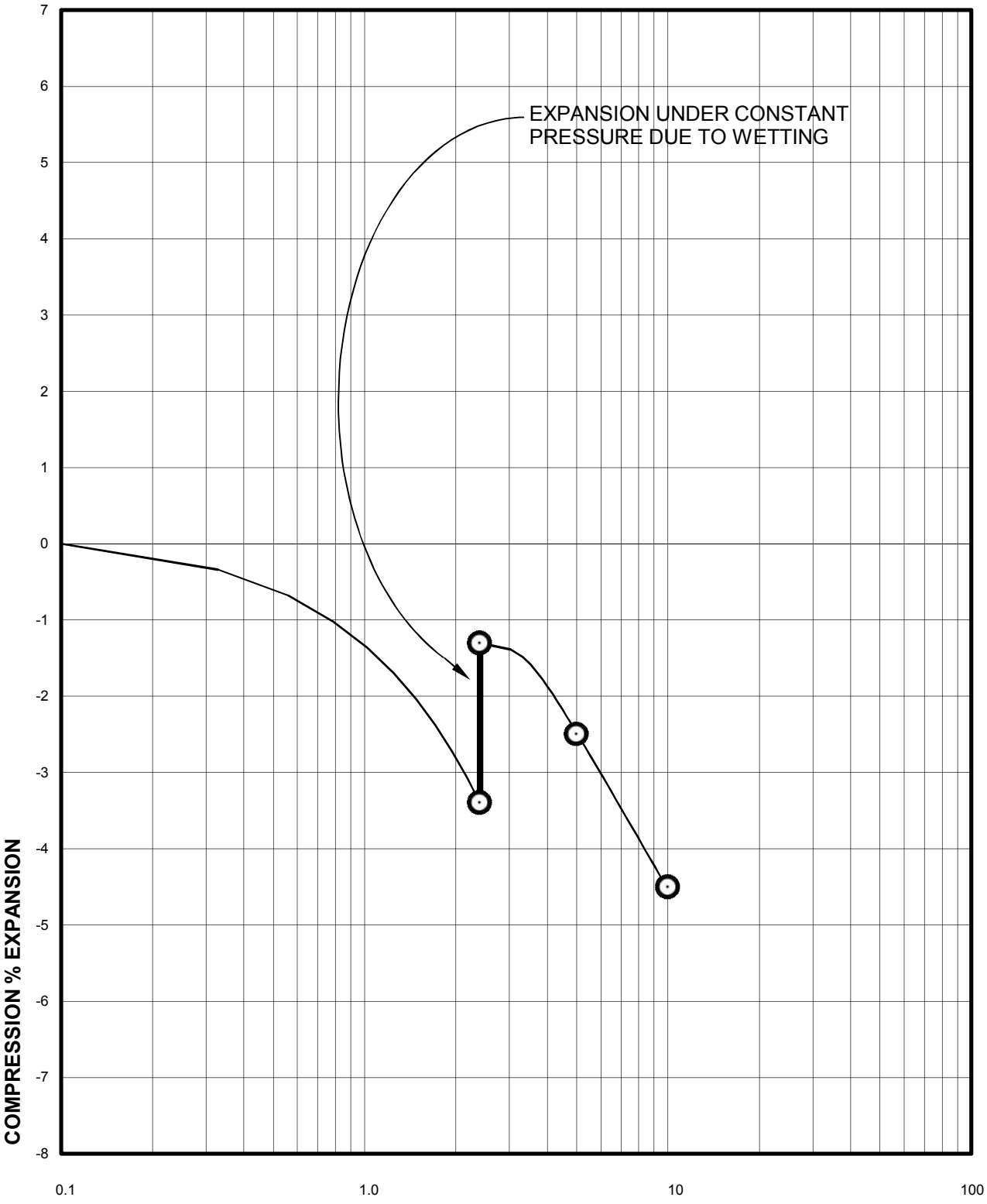
Sample of CLAYSTONE
From TH-11 AT 34 FEET

DRY UNIT WEIGHT= 115 PCF
MOISTURE CONTENT= 16.7 %

Swell Consolidation Test Results

FIG. B-25

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



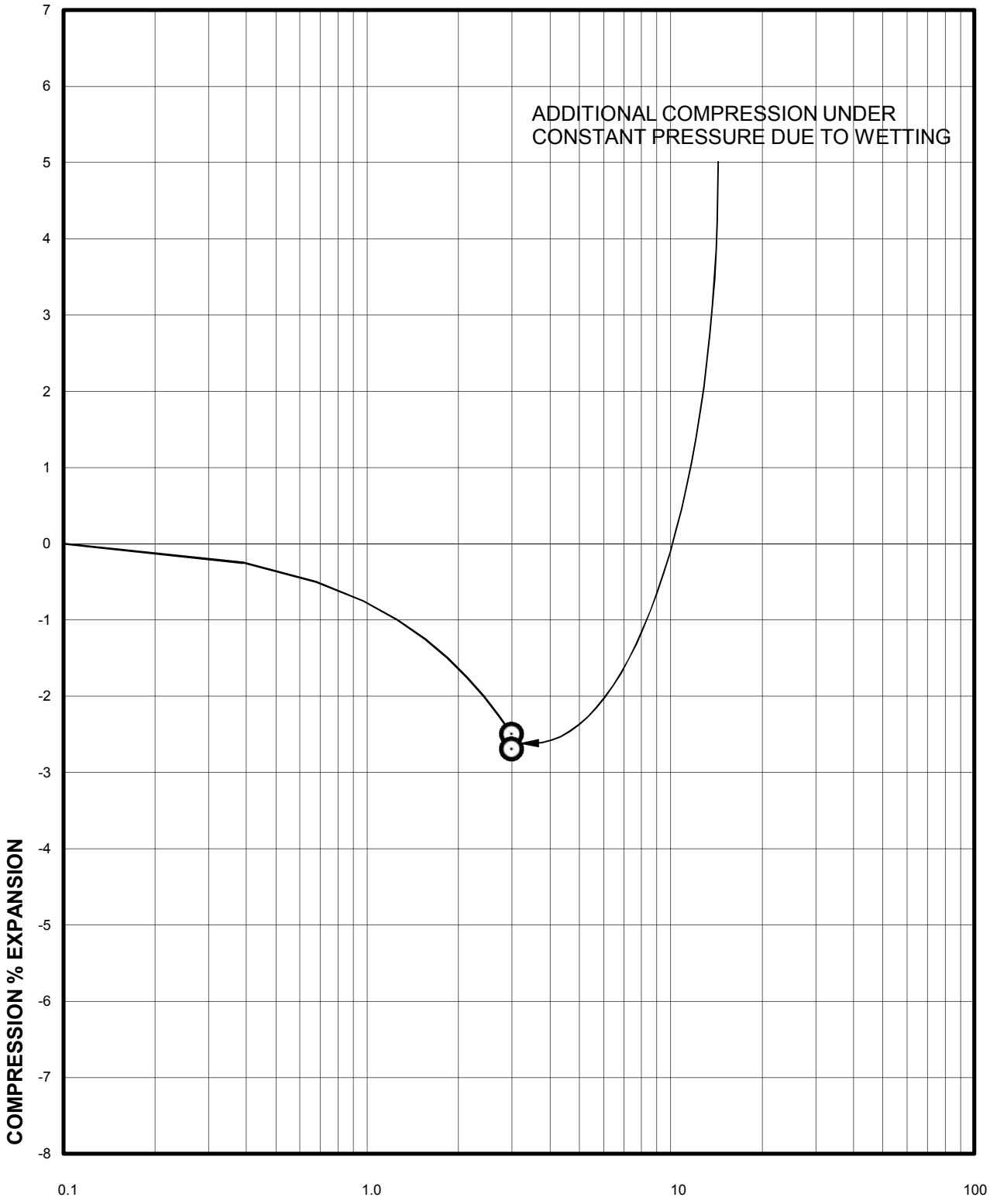
Sample of CLAYSTONE
From TH-11 AT 39 FEET

DRY UNIT WEIGHT= 113 PCF
MOISTURE CONTENT= 15.1 %

Swell Consolidation Test Results

FIG. B-26

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



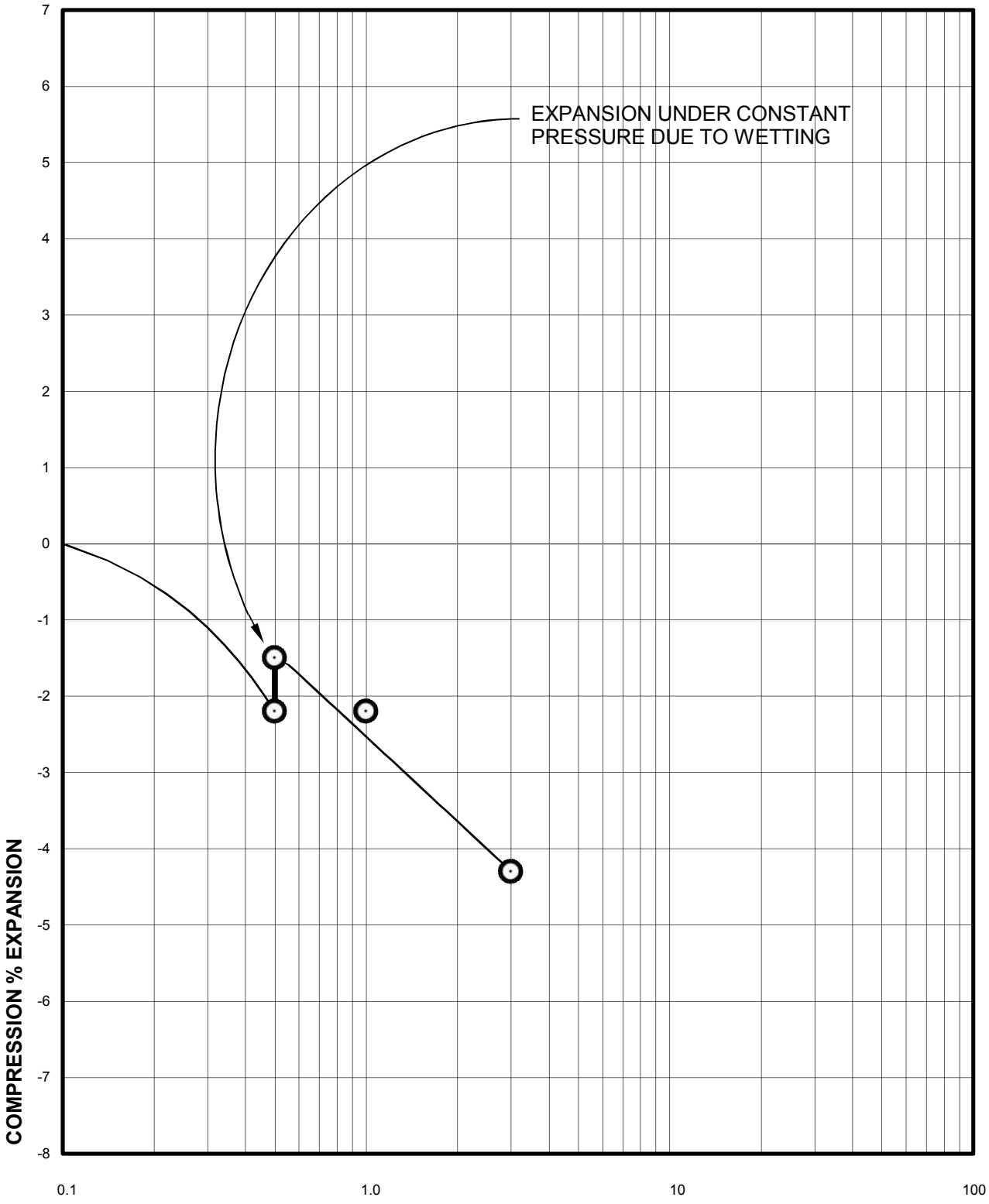
Sample of CLAYSTONE
From TH-11 AT 49 FEET

DRY UNIT WEIGHT= 121 PCF
MOISTURE CONTENT= 11.4 %

Swell Consolidation Test Results

FIG. B-27

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



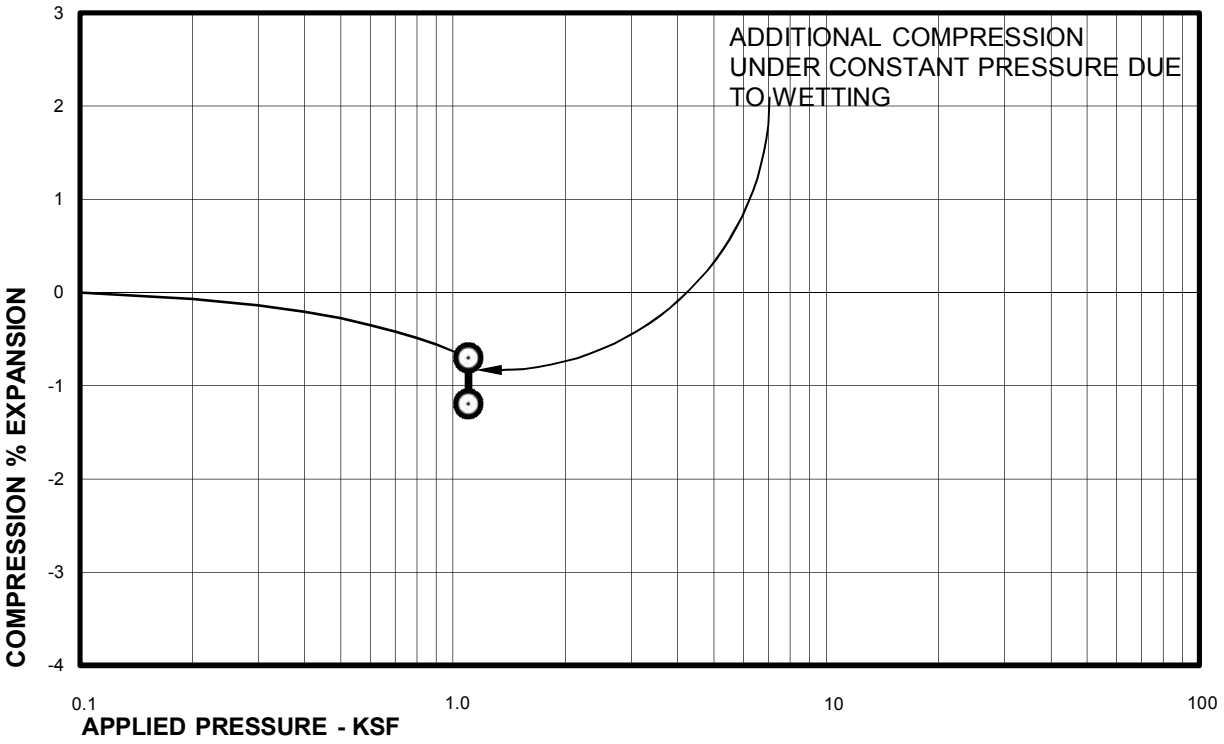
Sample of CLAYSTONE
From TH-13 AT 14 FEET

DRY UNIT WEIGHT= 113 PCF
MOISTURE CONTENT= 9.9 %

Swell Consolidation Test Results

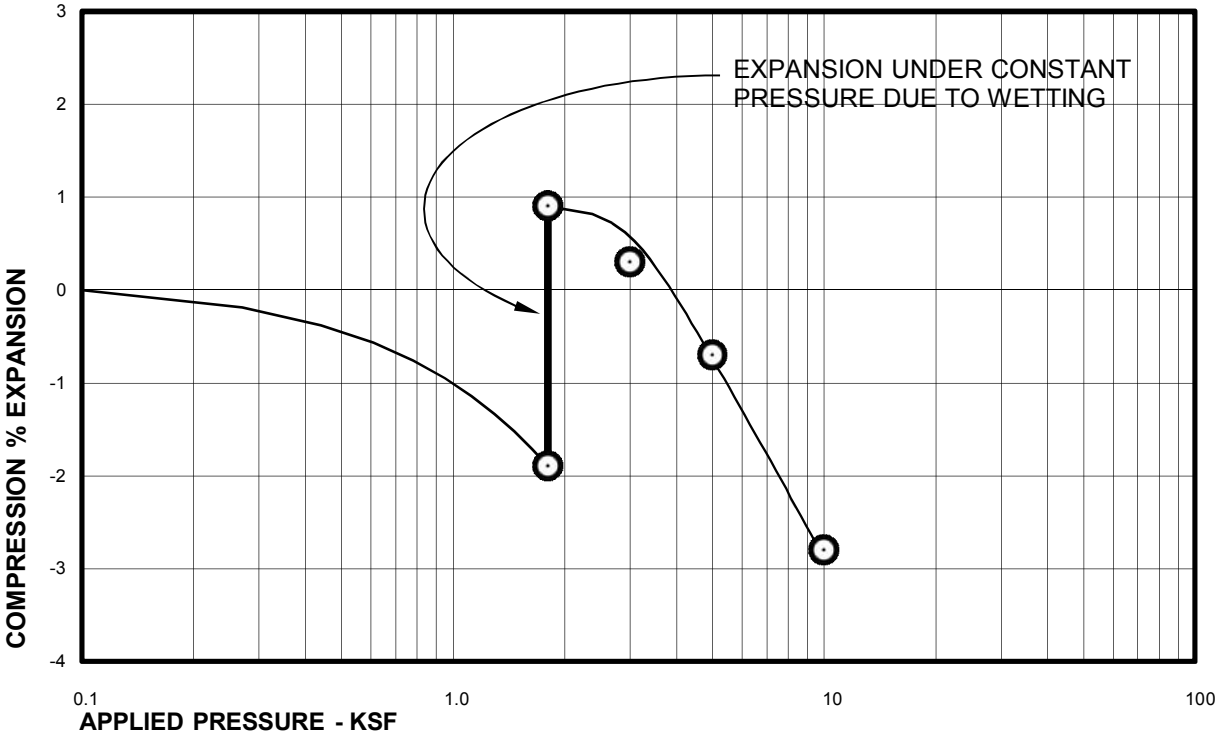
FIG. B-28

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of CLAYSTONE
From TH-13 AT 19 FEET

DRY UNIT WEIGHT= 103 PCF
MOISTURE CONTENT= 14.3 %



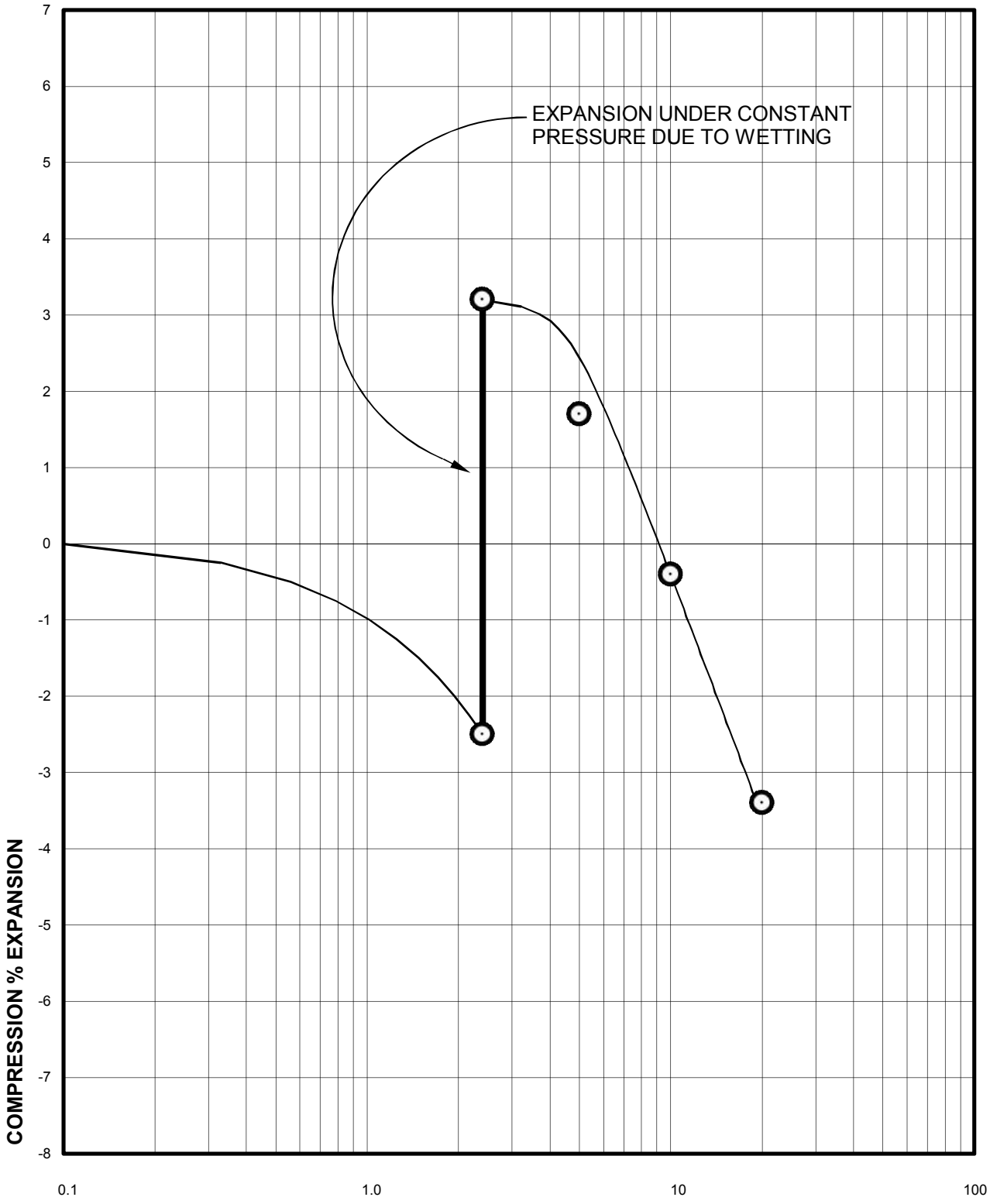
Sample of CLAYSTONE
From TH-13 AT 24 FEET

DRY UNIT WEIGHT= 110 PCF
MOISTURE CONTENT= 18.2 %

Swell Consolidation Test Results

FIG. B-29

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



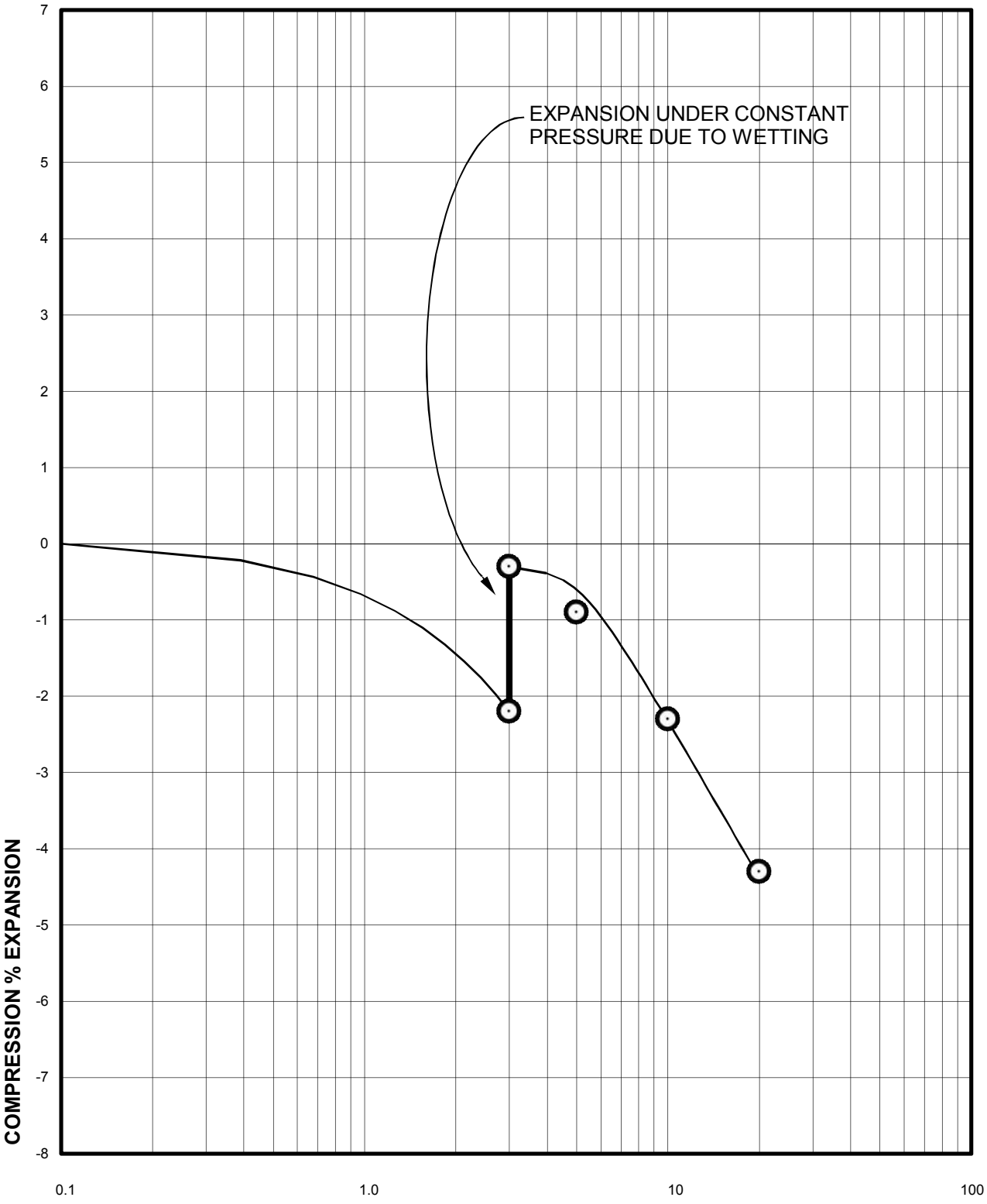
Sample of CLAYSTONE
From TH-13 AT 29 FEET

DRY UNIT WEIGHT= 107 PCF
MOISTURE CONTENT= 21.2 %

Swell Consolidation Test Results

FIG. B-30

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



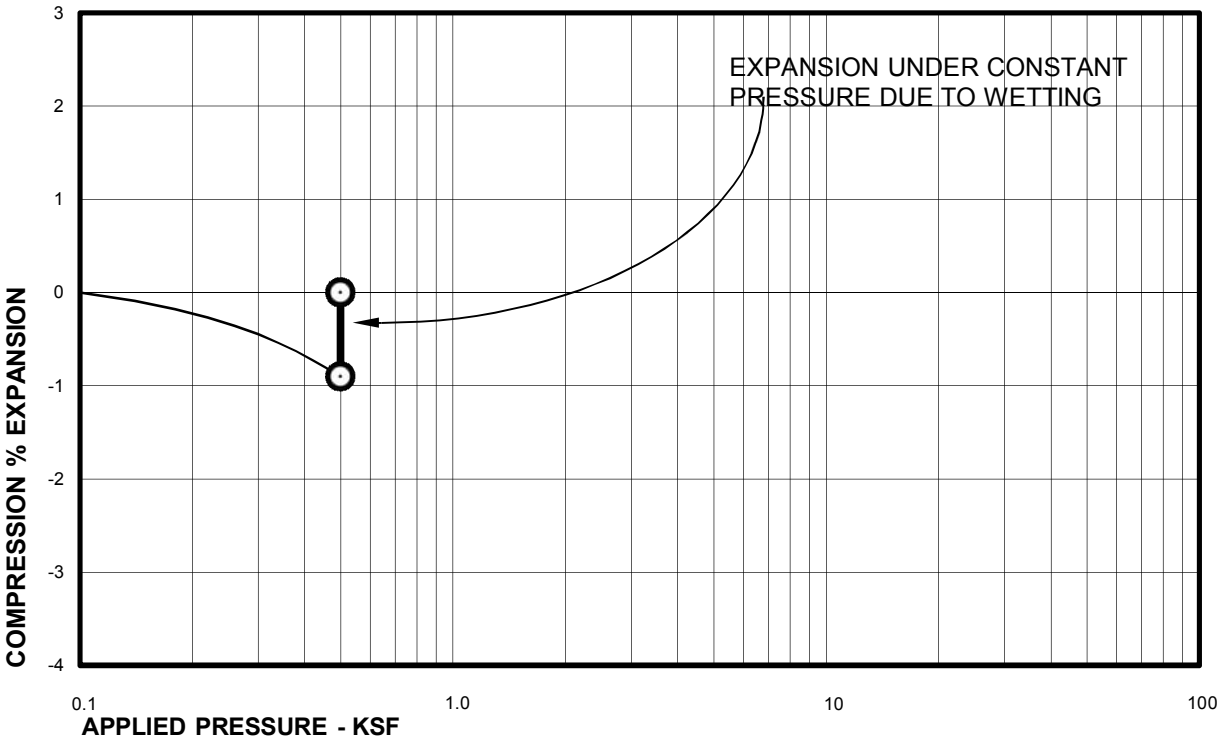
Sample of CLAYSTONE
From TH-13 AT 34 FEET

DRY UNIT WEIGHT= 115 PCF
MOISTURE CONTENT= 15.7 %

Swell Consolidation Test Results

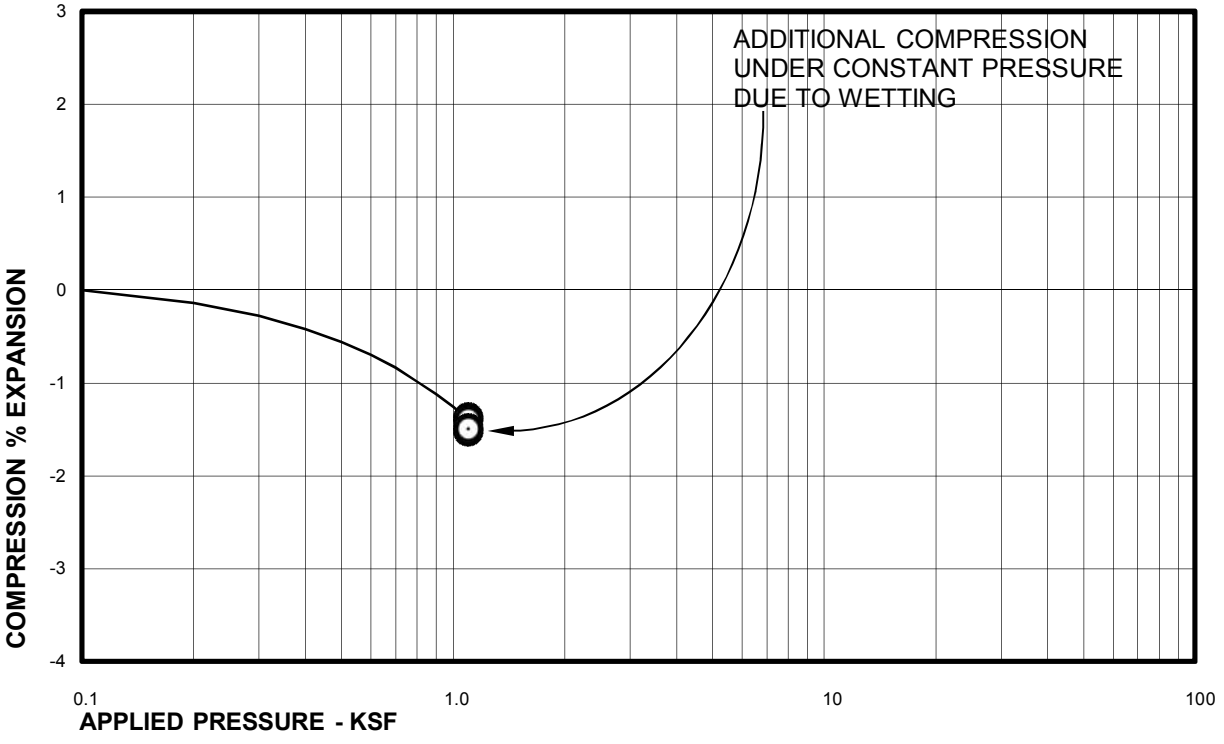
FIG. B-31

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of CLAY, SANDY (CL)
From TH-14 AT 4 FEET

DRY UNIT WEIGHT= 118 PCF
MOISTURE CONTENT= 9.5 %



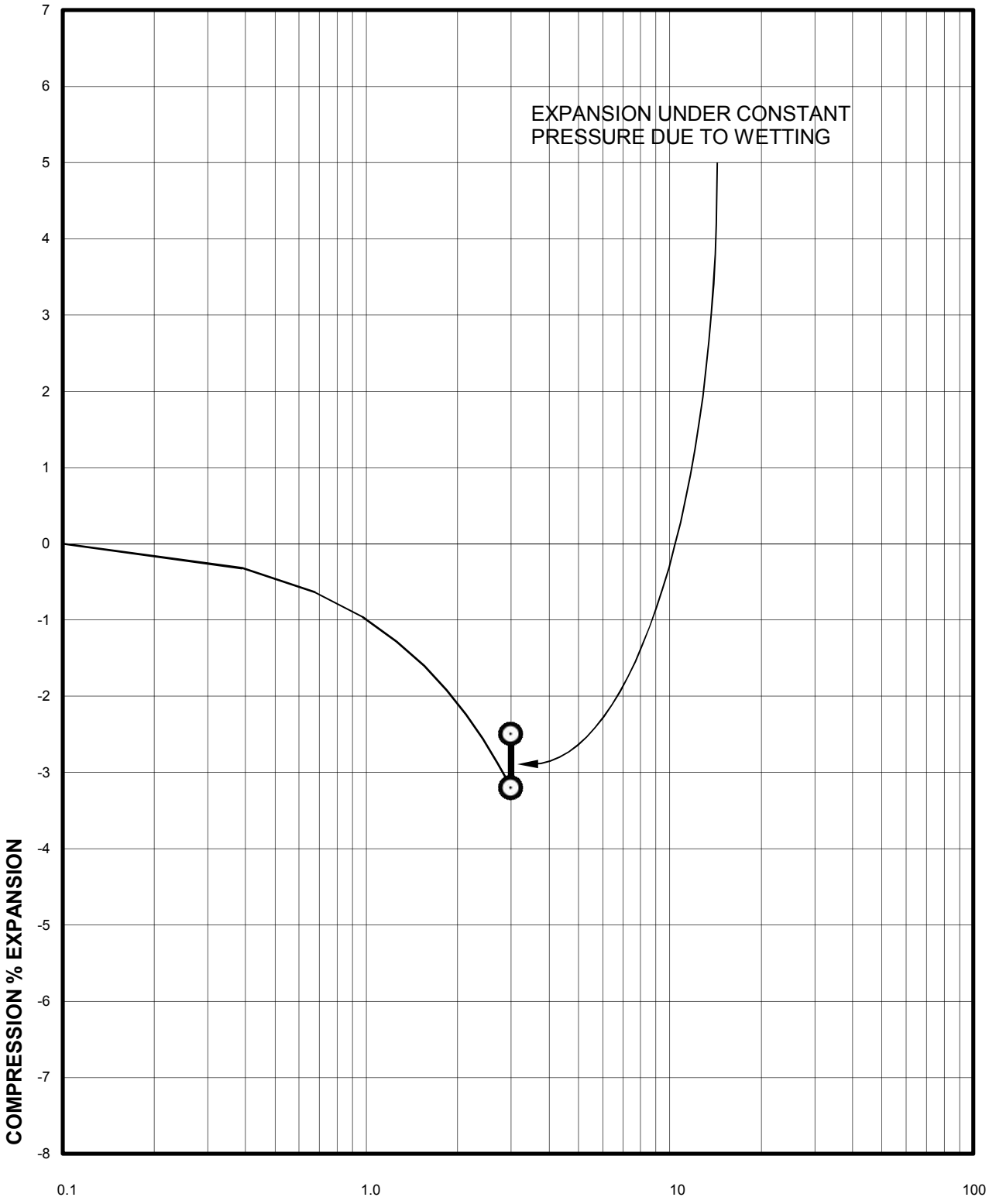
Sample of CLAY, SANDY (CL)
From TH-14 AT 9 FEET

DRY UNIT WEIGHT= 108 PCF
MOISTURE CONTENT= 15.8 %

Swell Consolidation Test Results

FIG. B-32

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



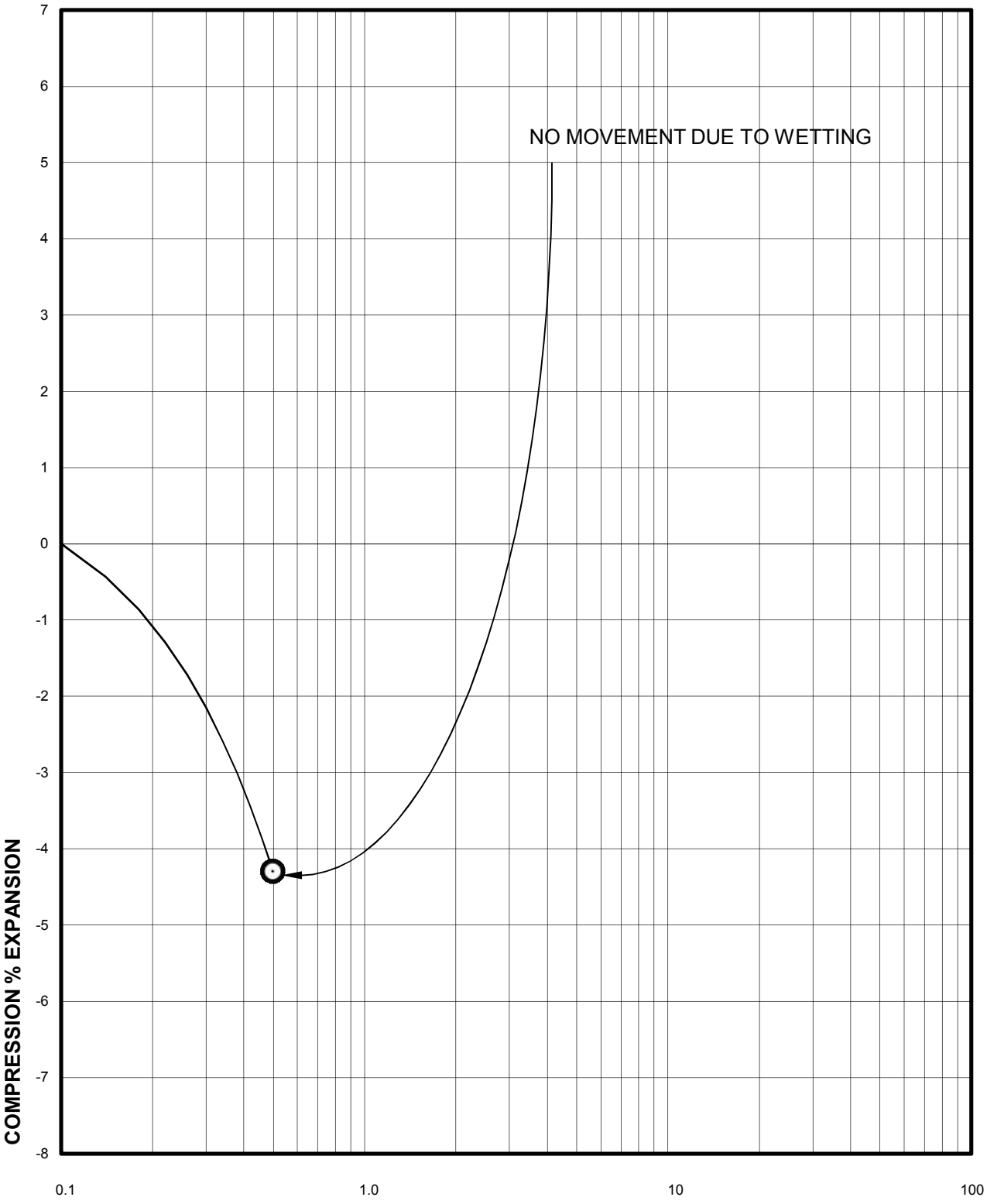
Sample of WEATHERED CLAYSTONE
From TH-14 AT 24 FEET

DRY UNIT WEIGHT= 109 PCF
MOISTURE CONTENT= 17.4 %

Swell Consolidation Test Results

FIG. B-33

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



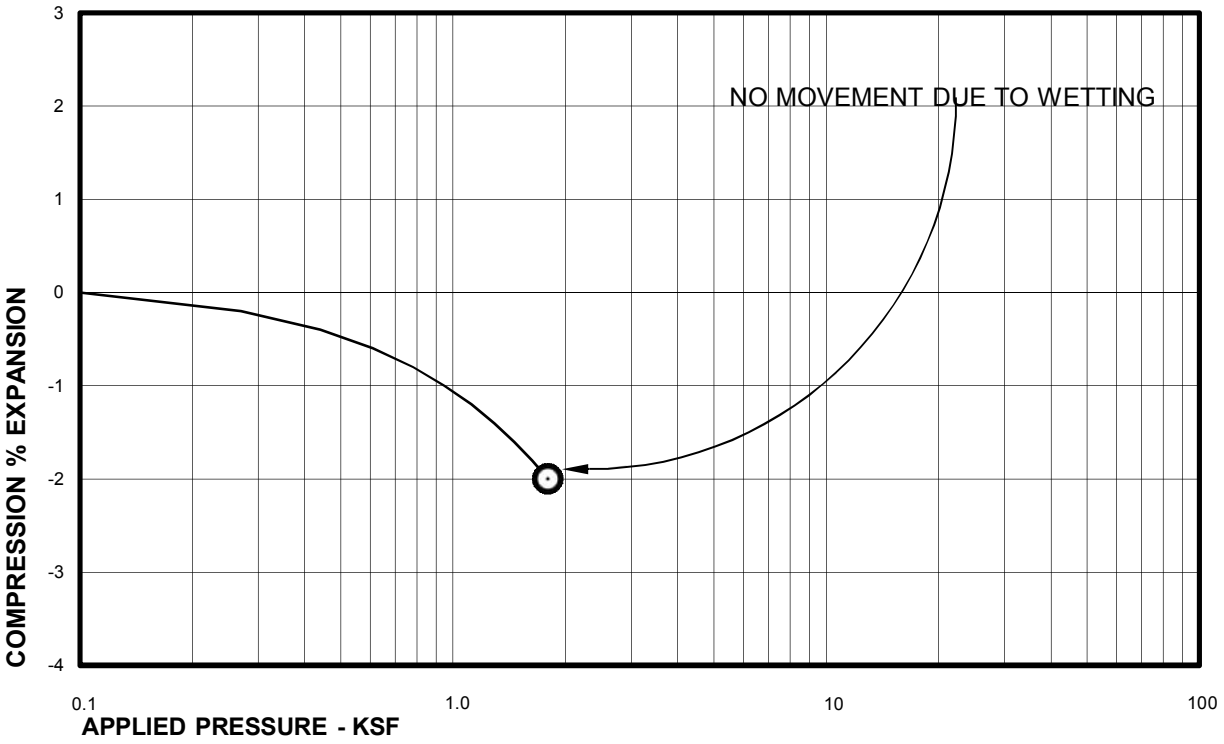
Sample of CLAY, SANDY (CL)
From TH-15 AT 4 FEET

DRY UNIT WEIGHT= 91 PCF
MOISTURE CONTENT= 27.7 %

Swell Consolidation Test Results

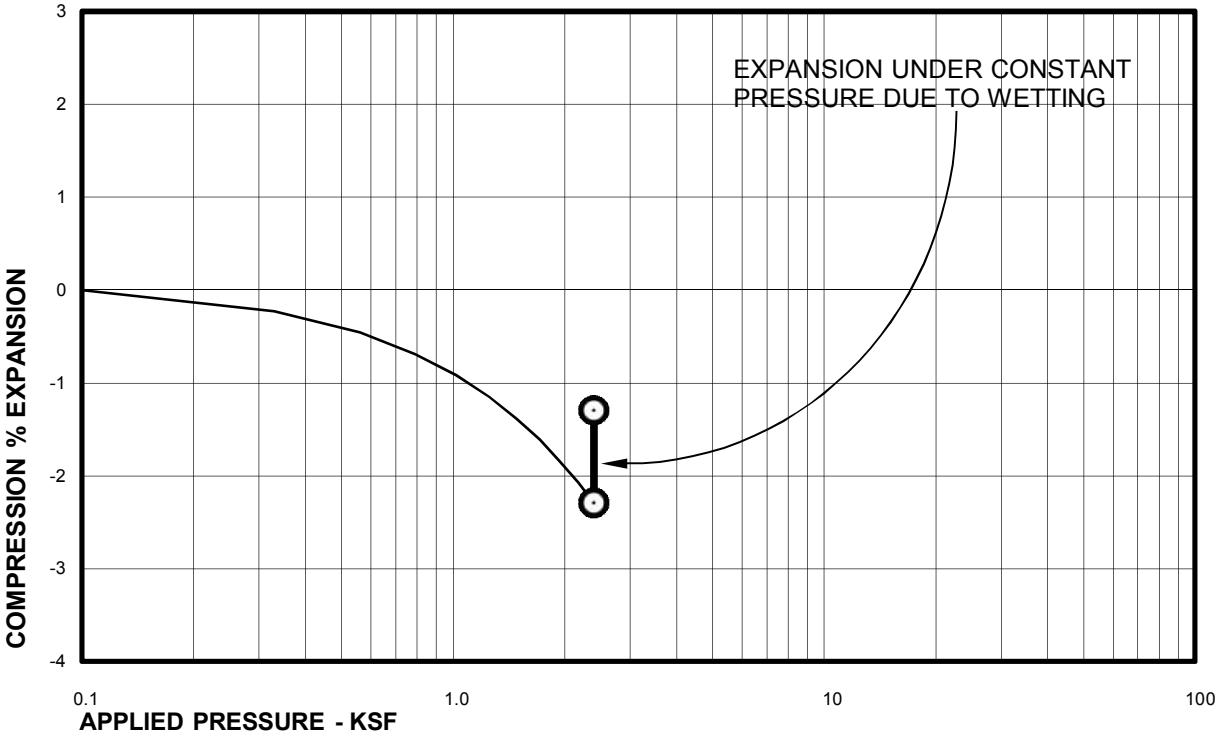
FIG. B-34

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of CLAY, SANDY (CL)
From TH-15 AT 14 FEET

DRY UNIT WEIGHT= 110 PCF
MOISTURE CONTENT= 17.5 %



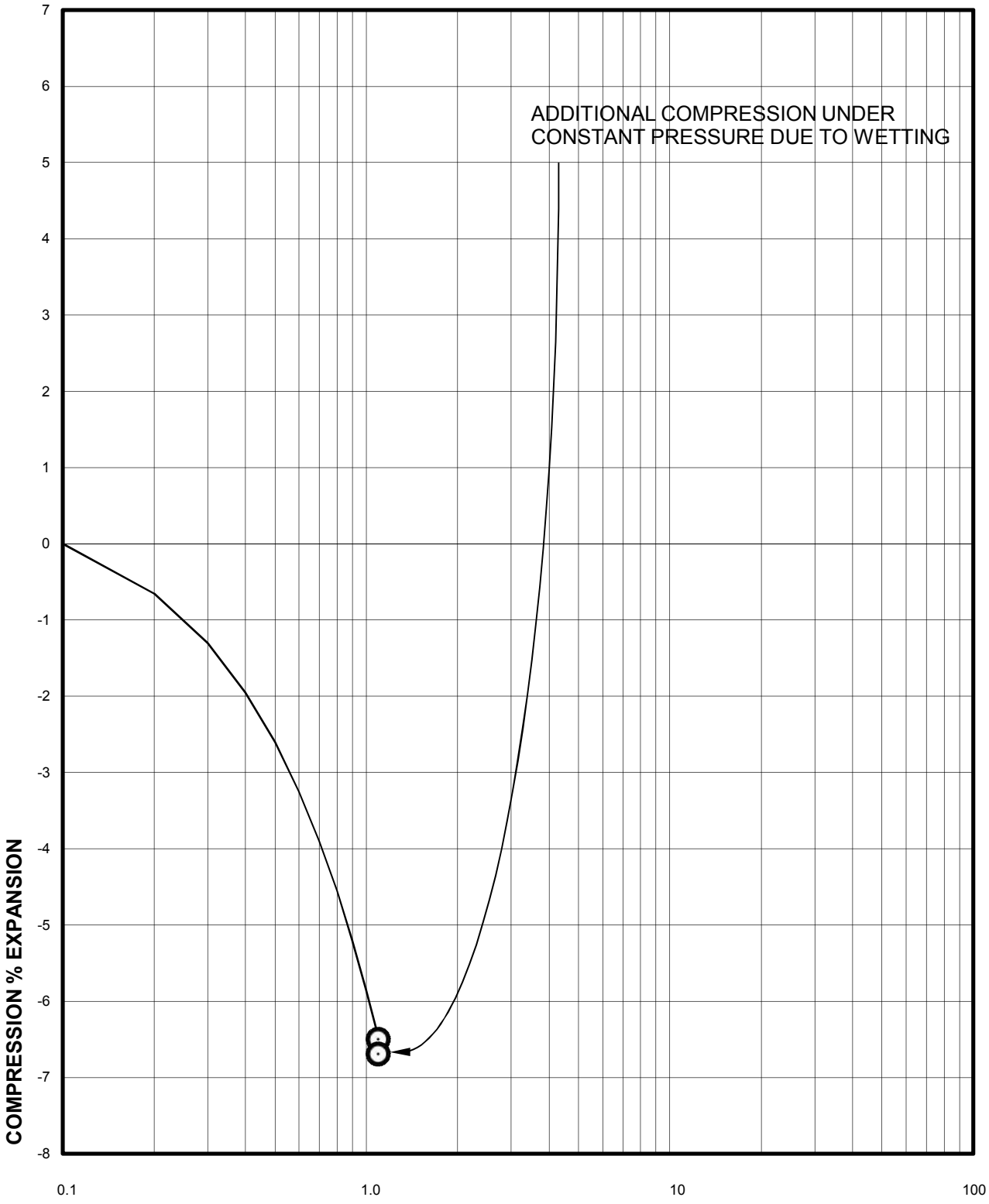
Sample of WEATHERED CLAYSTONE
From TH-15 AT 19 FEET

DRY UNIT WEIGHT= 111 PCF
MOISTURE CONTENT= 18.1 %

Swell Consolidation Test Results

FIG. B-35

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



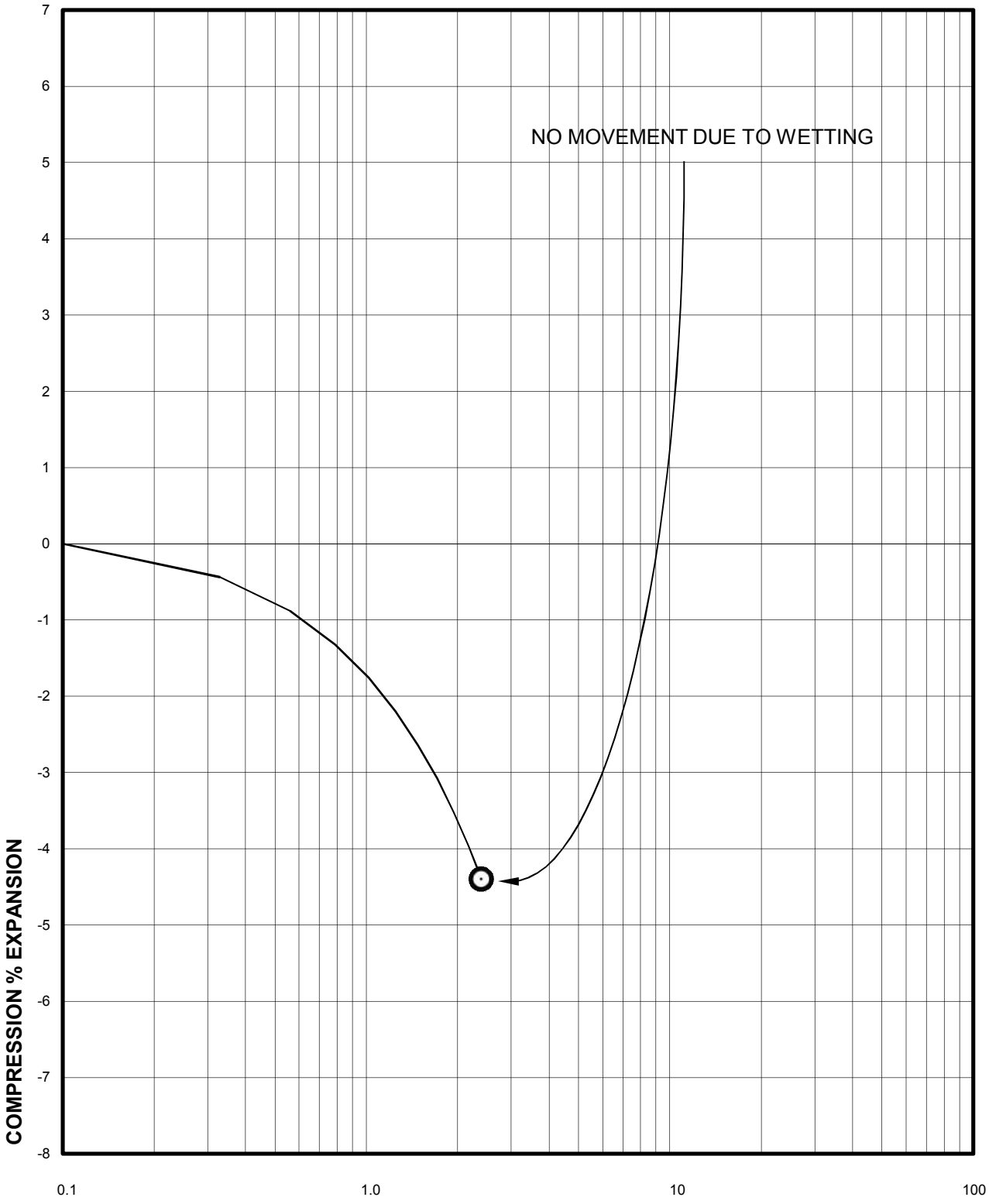
Sample of INTERLAYERED CLAY/SAND
From TH-16 AT 9 FEET

DRY UNIT WEIGHT= 101 PCF
MOISTURE CONTENT= 24.5 %

Swell Consolidation Test Results

FIG. B-36

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



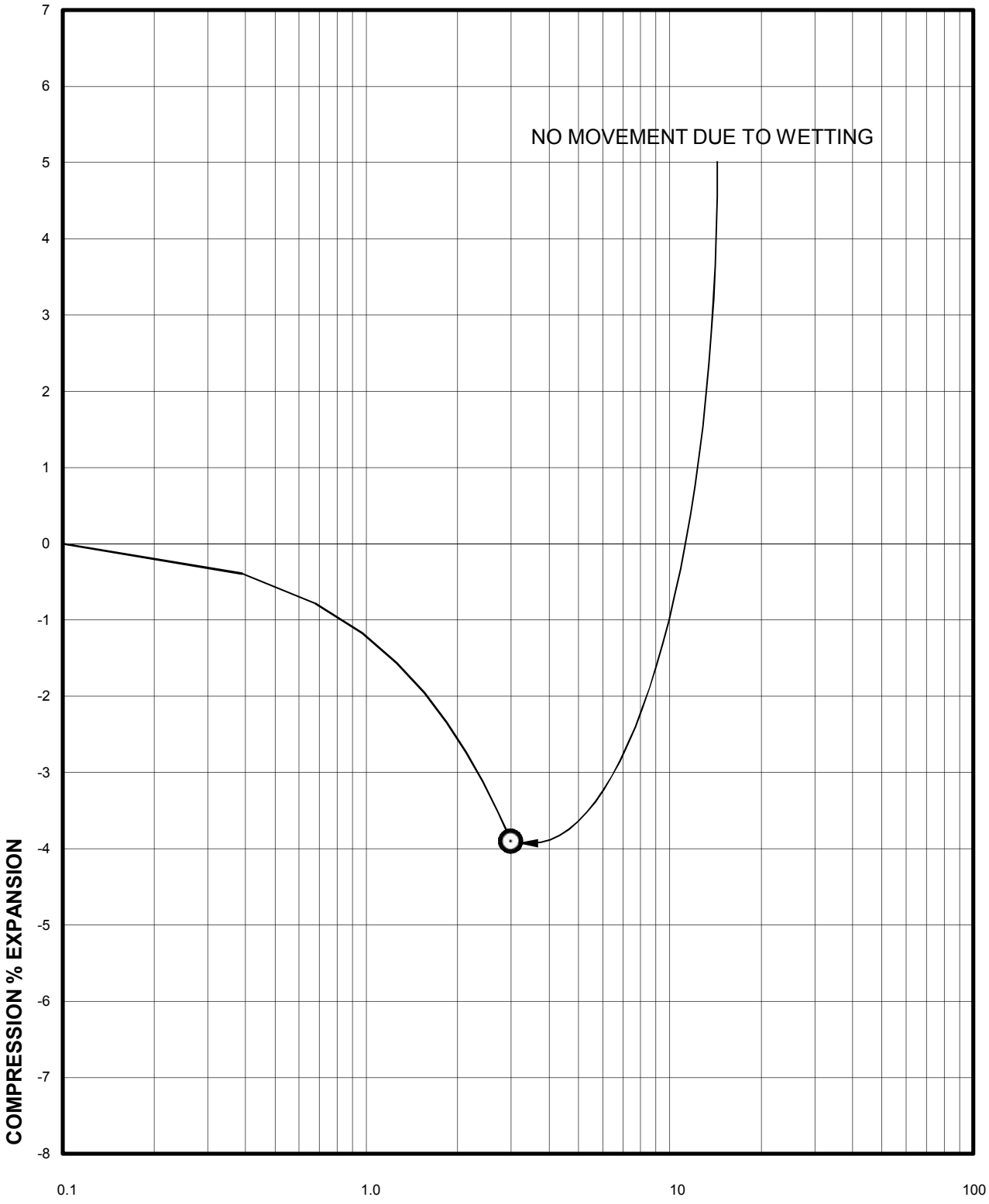
Sample of INTERLAYERED CLAY/SAND
From TH-16 AT 19 FEET

DRY UNIT WEIGHT= 108 PCF
MOISTURE CONTENT= 20.1 %

Swell Consolidation Test Results

FIG. B-37

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



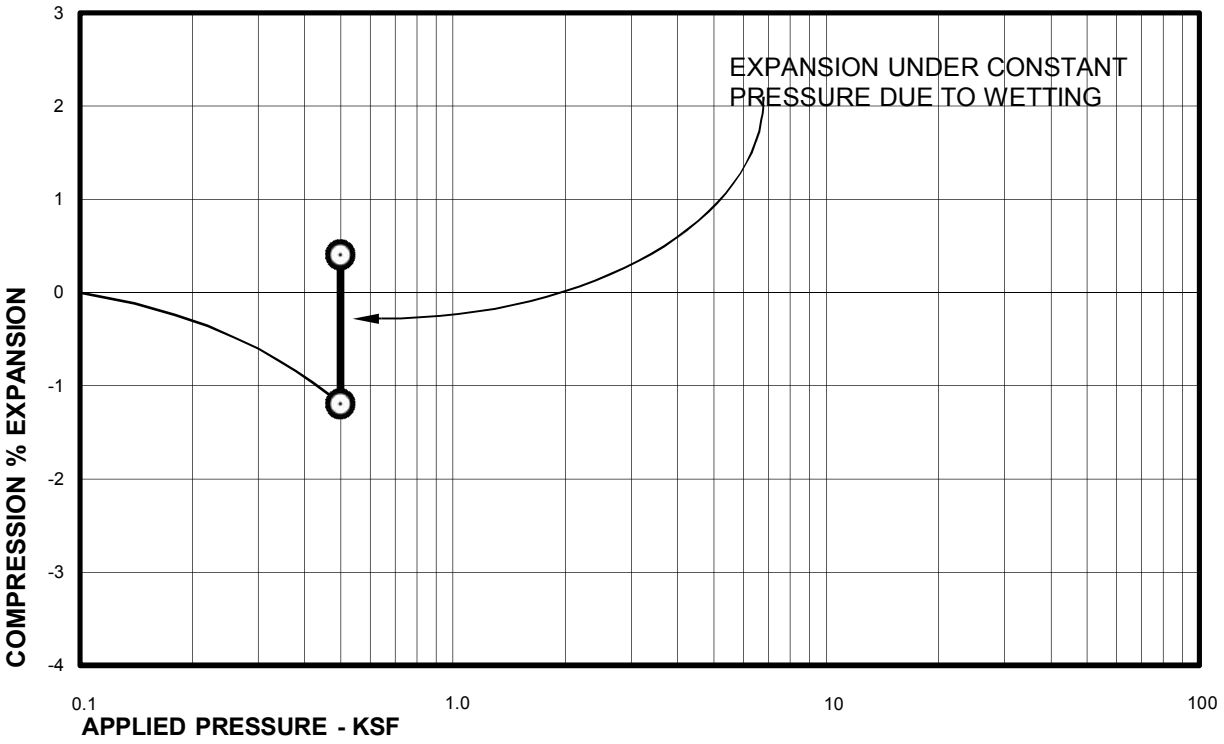
Sample of INTERLAYERED CLAY/SAND
From TH-16 AT 24 FEET

DRY UNIT WEIGHT= 110 PCF
MOISTURE CONTENT= 19.7 %

Swell Consolidation Test Results

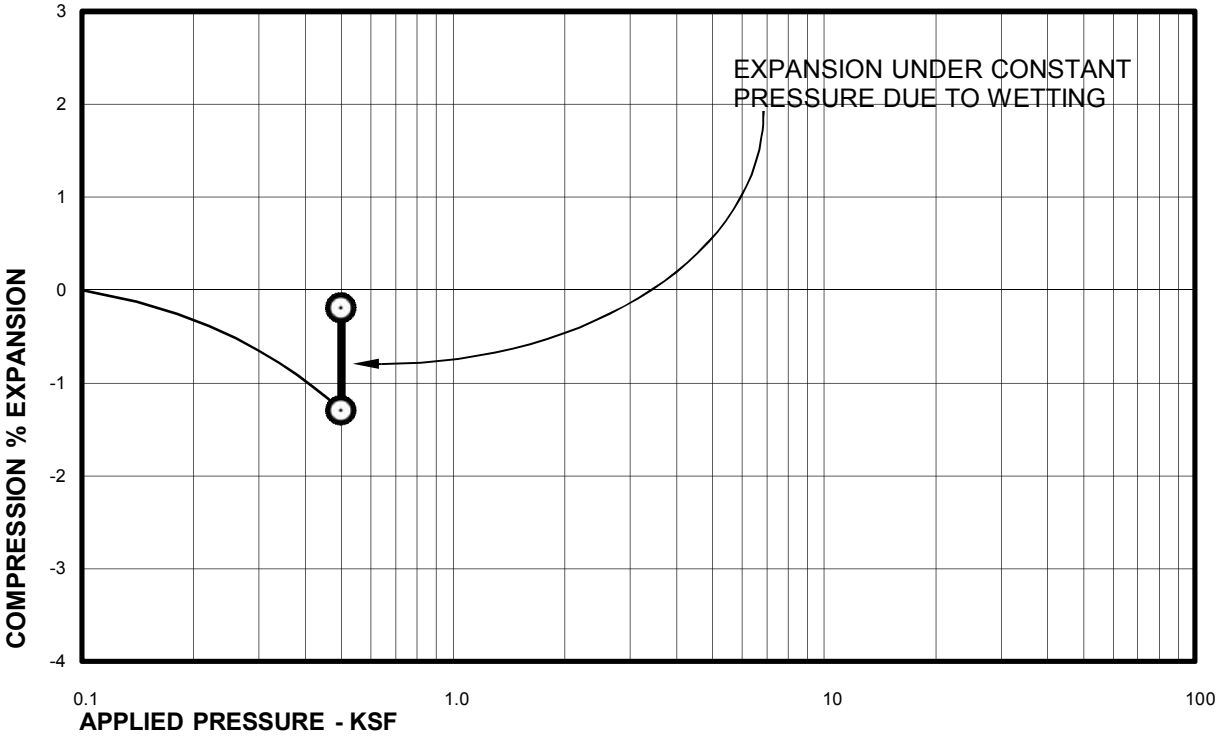
FIG. B-38

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of FILL, CLAY, SANDY
From TH-17 AT 4 FEET

DRY UNIT WEIGHT= 102 PCF
MOISTURE CONTENT= 22.1 %



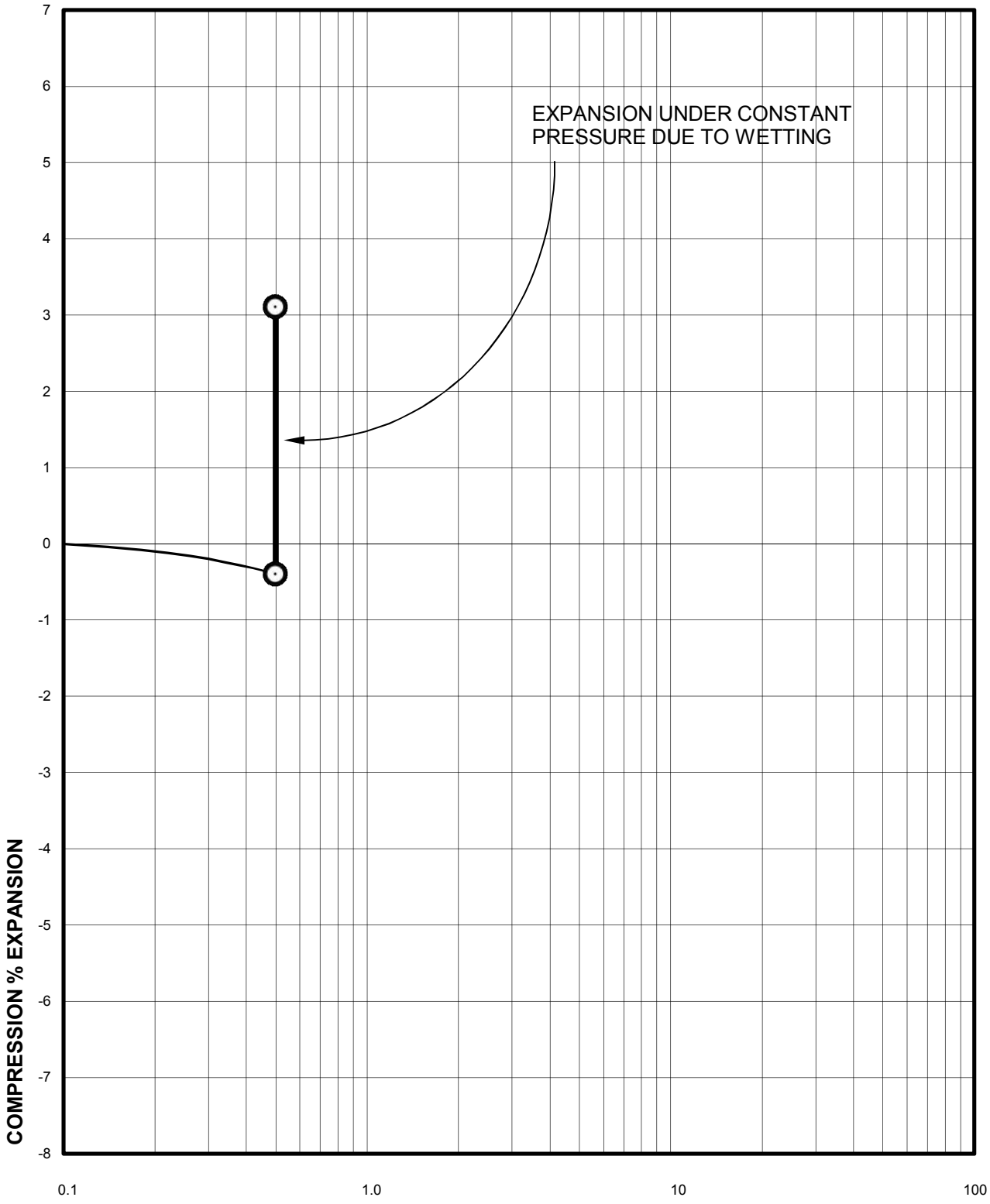
Sample of FILL, CLAY, SANDY
From TH-18 AT 4 FEET

DRY UNIT WEIGHT= 109 PCF
MOISTURE CONTENT= 18.7 %

Swell Consolidation Test Results

FIG. B-39

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



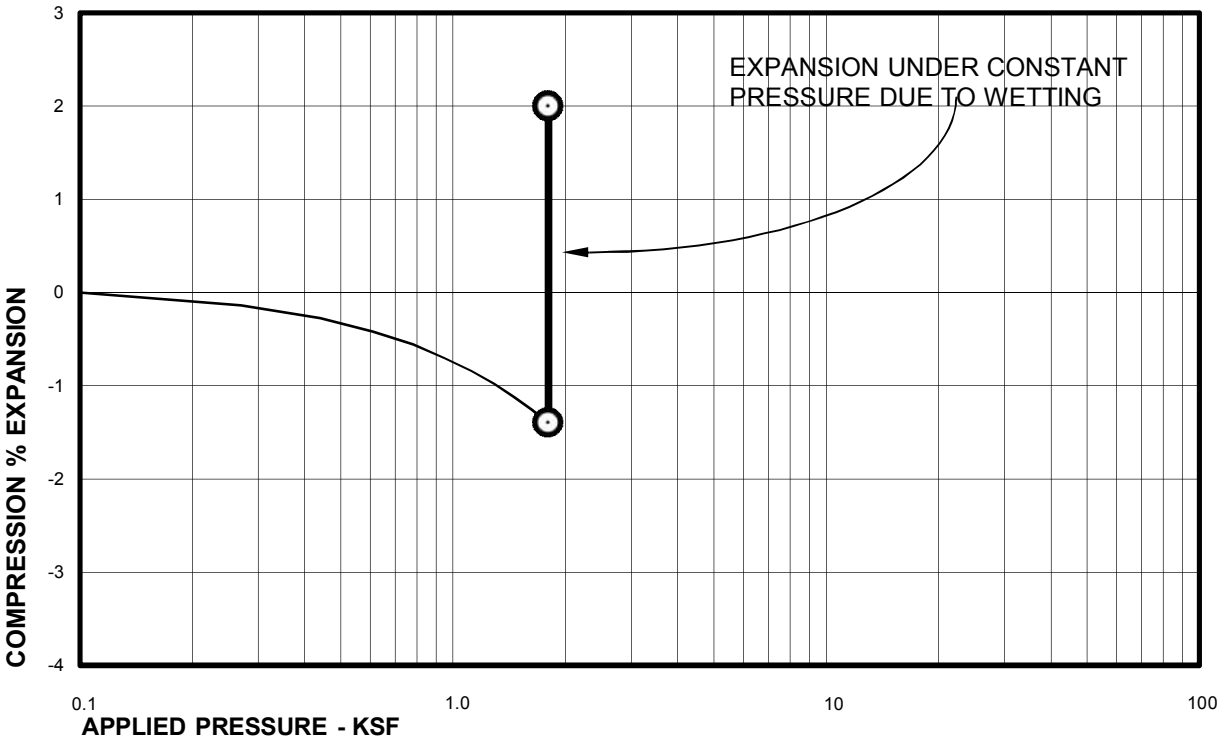
Sample of FILL, CLAY, SANDY
From TH-19 AT 4 FEET

DRY UNIT WEIGHT= 114 PCF
MOISTURE CONTENT= 17.9 %

Swell Consolidation Test Results

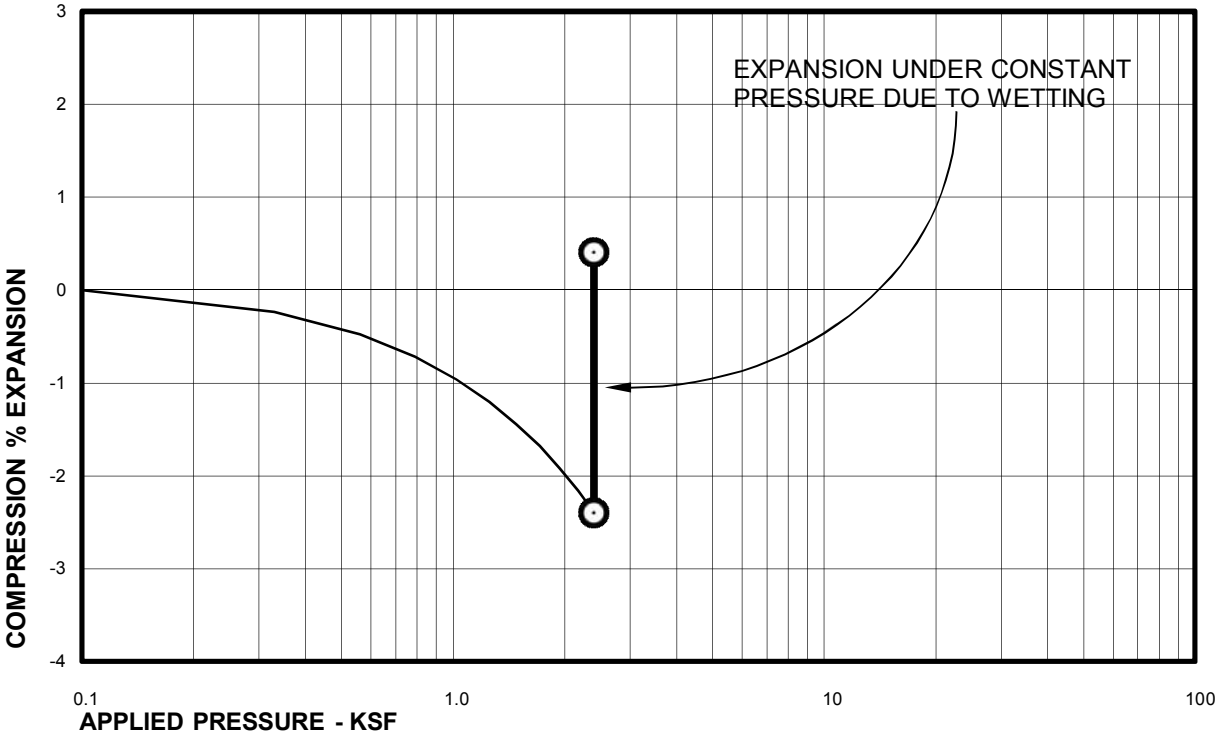
FIG. B-40

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of WEATHERED CLAYSTONE
From TH-20 AT 14 FEET

DRY UNIT WEIGHT= 108 PCF
MOISTURE CONTENT= 20.8 %



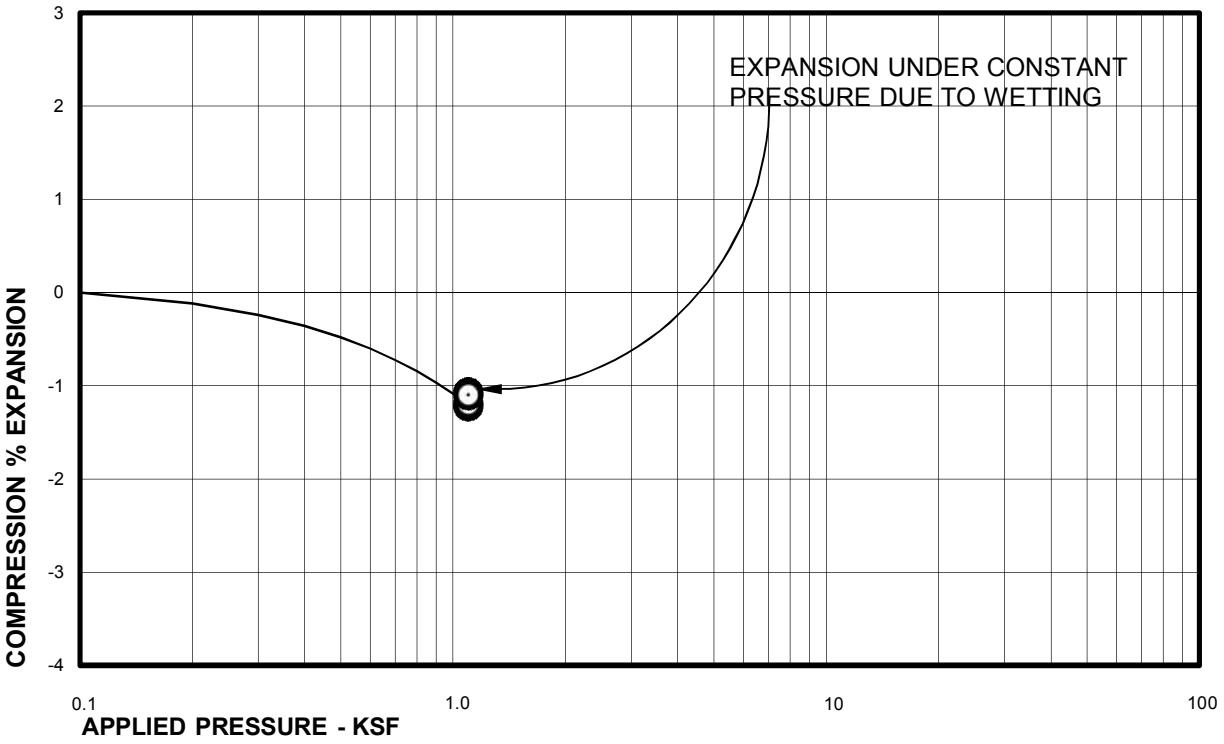
Sample of WEATHERED CLAYSTONE
From TH-20 AT 19 FEET

DRY UNIT WEIGHT= 111 PCF
MOISTURE CONTENT= 18.4 %

Swell Consolidation Test Results

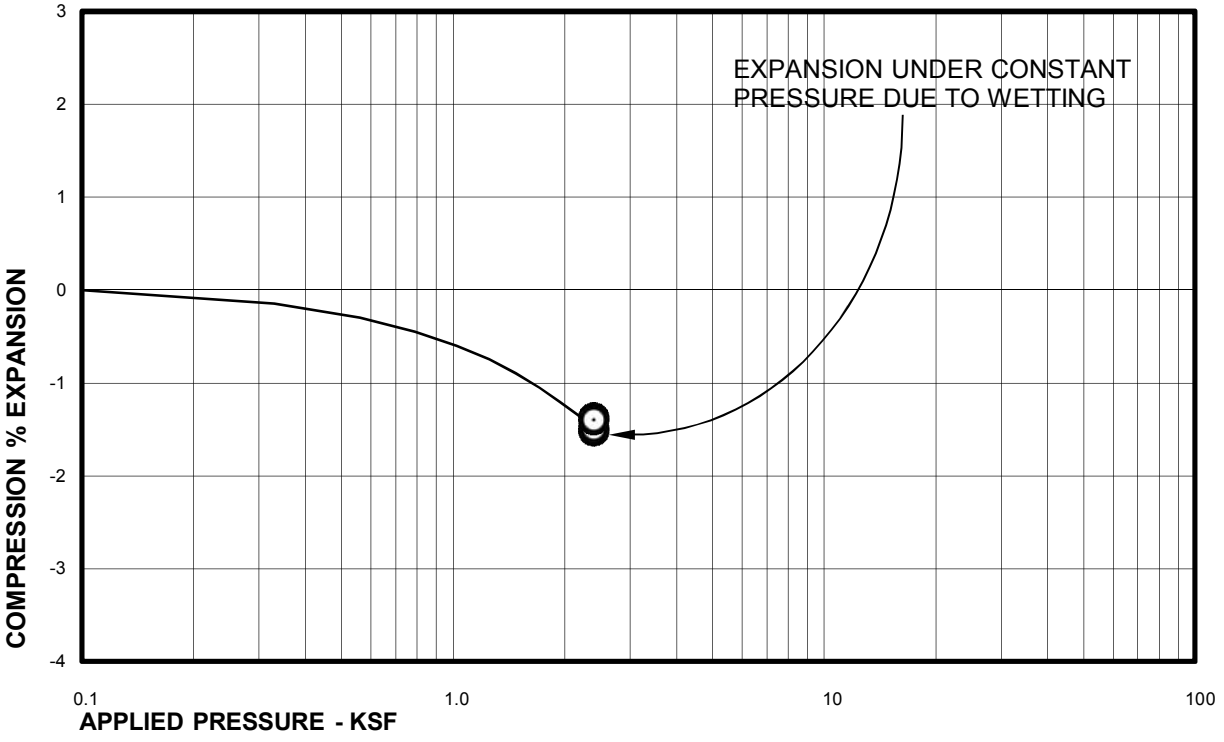
FIG. B-41

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of FILL, CLAY, SANDY
From TH-21 AT 9 FEET

DRY UNIT WEIGHT= 117 PCF
MOISTURE CONTENT= 13.5 %



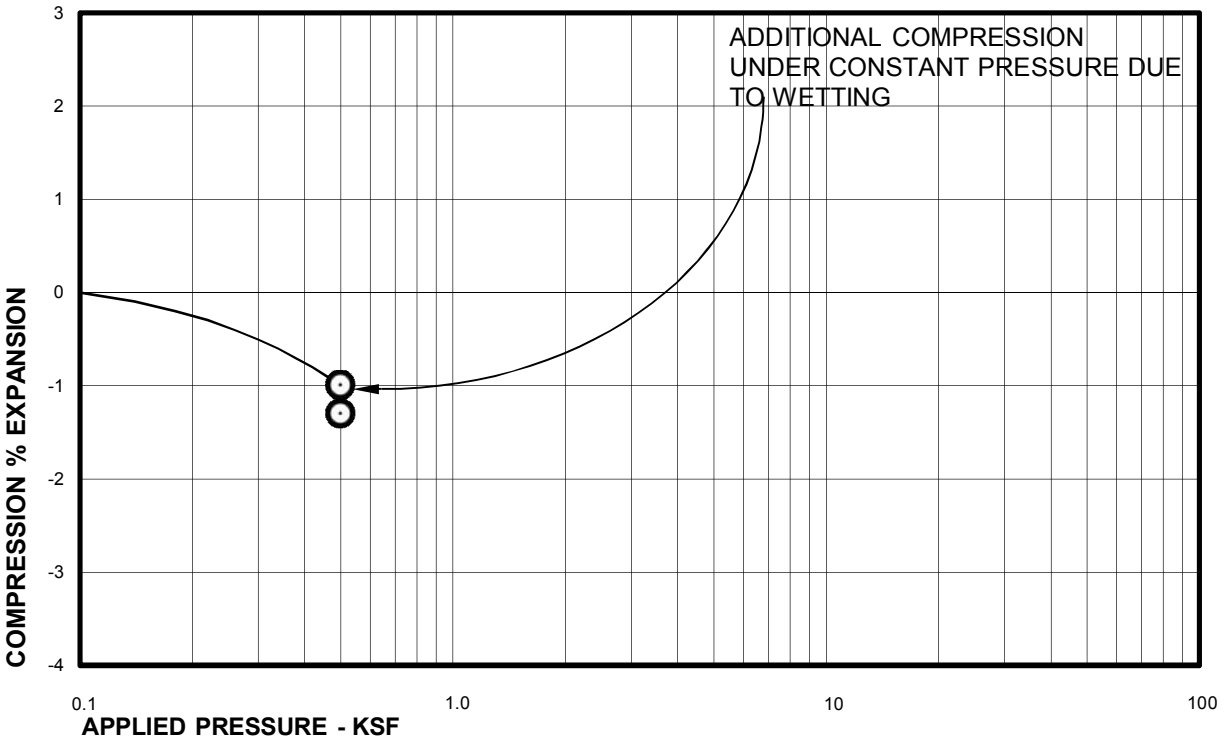
Sample of CLAYSTONE
From TH-21 AT 19 FEET

DRY UNIT WEIGHT= 118 PCF
MOISTURE CONTENT= 13.3 %

Swell Consolidation Test Results

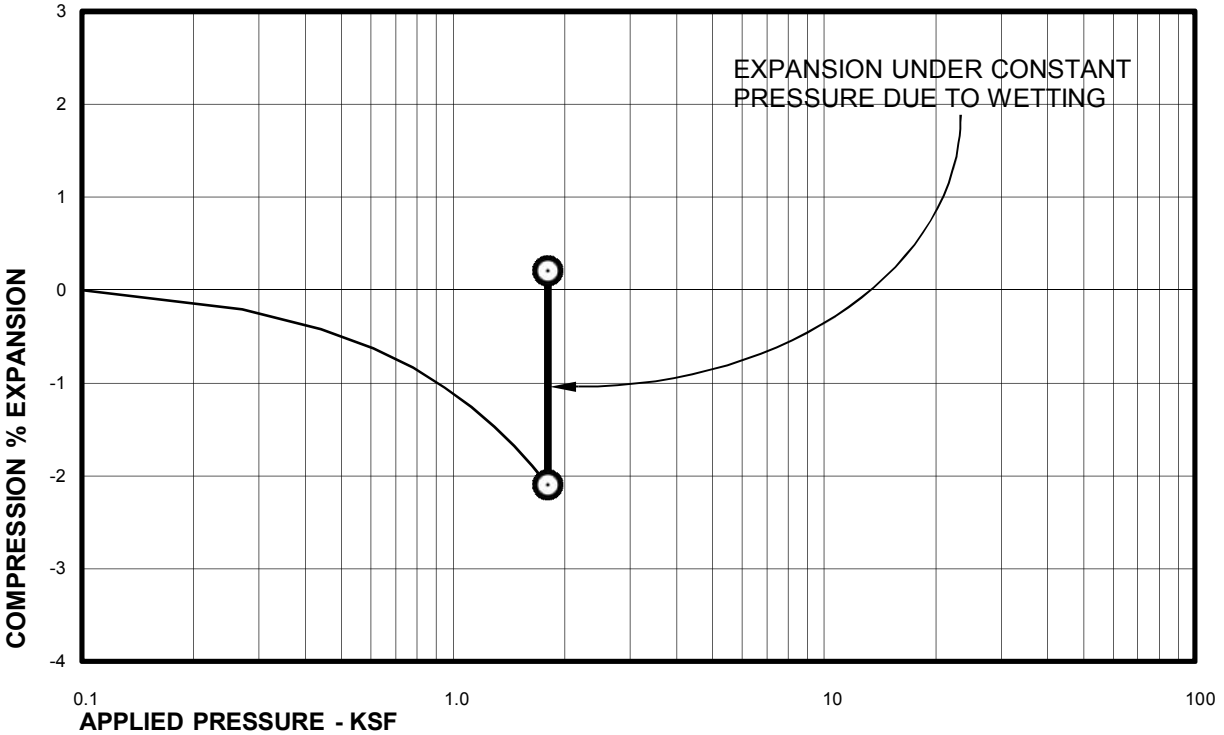
FIG. B-42

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of FILL, CLAY, SANDY
From TH-22 AT 4 FEET

DRY UNIT WEIGHT= 110 PCF
MOISTURE CONTENT= 12.2 %



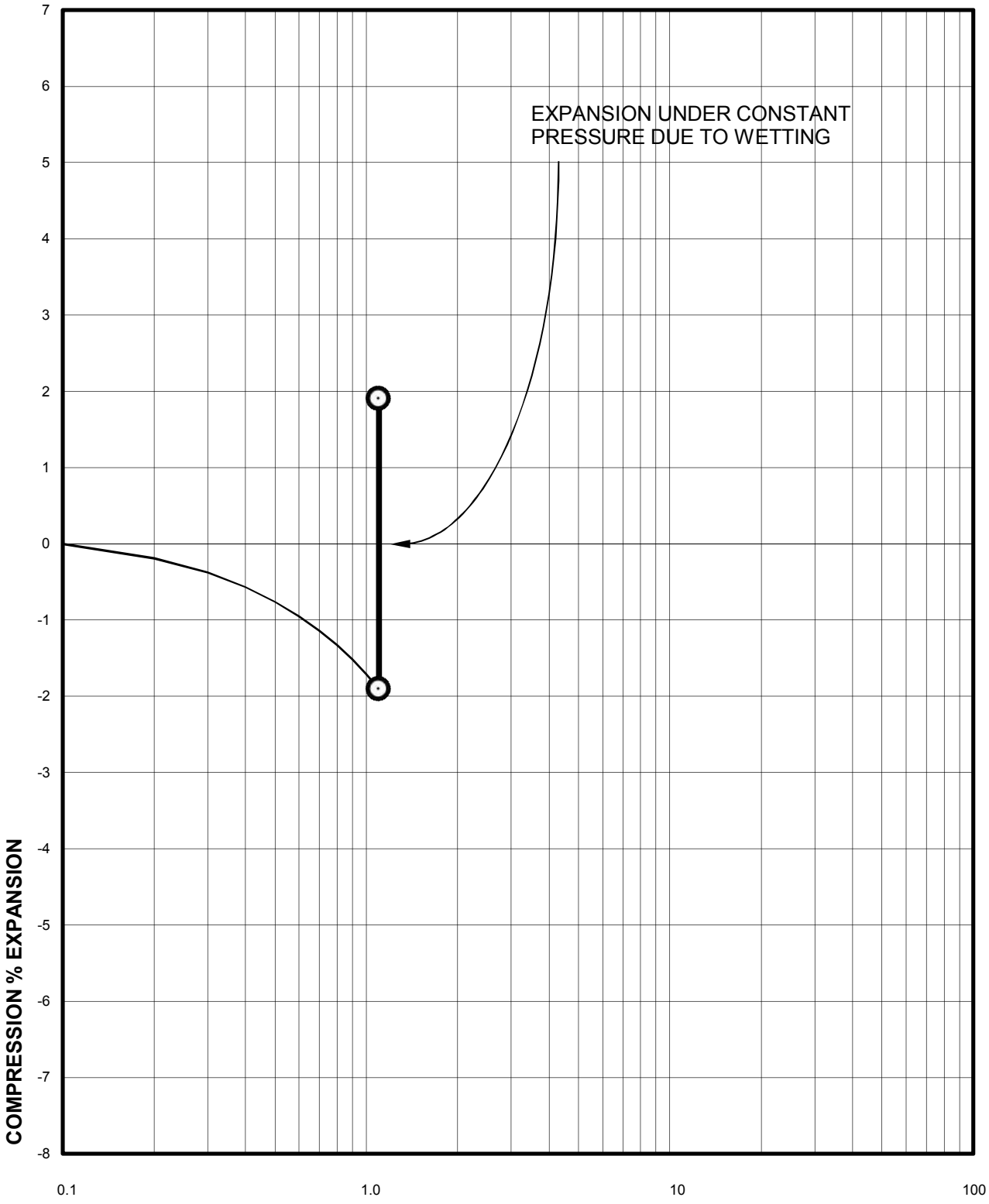
Sample of WEATHERED CLAYSTONE
From TH-22 AT 14 FEET

DRY UNIT WEIGHT= 111 PCF
MOISTURE CONTENT= 15.7 %

Swell Consolidation Test Results

FIG. B-43

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



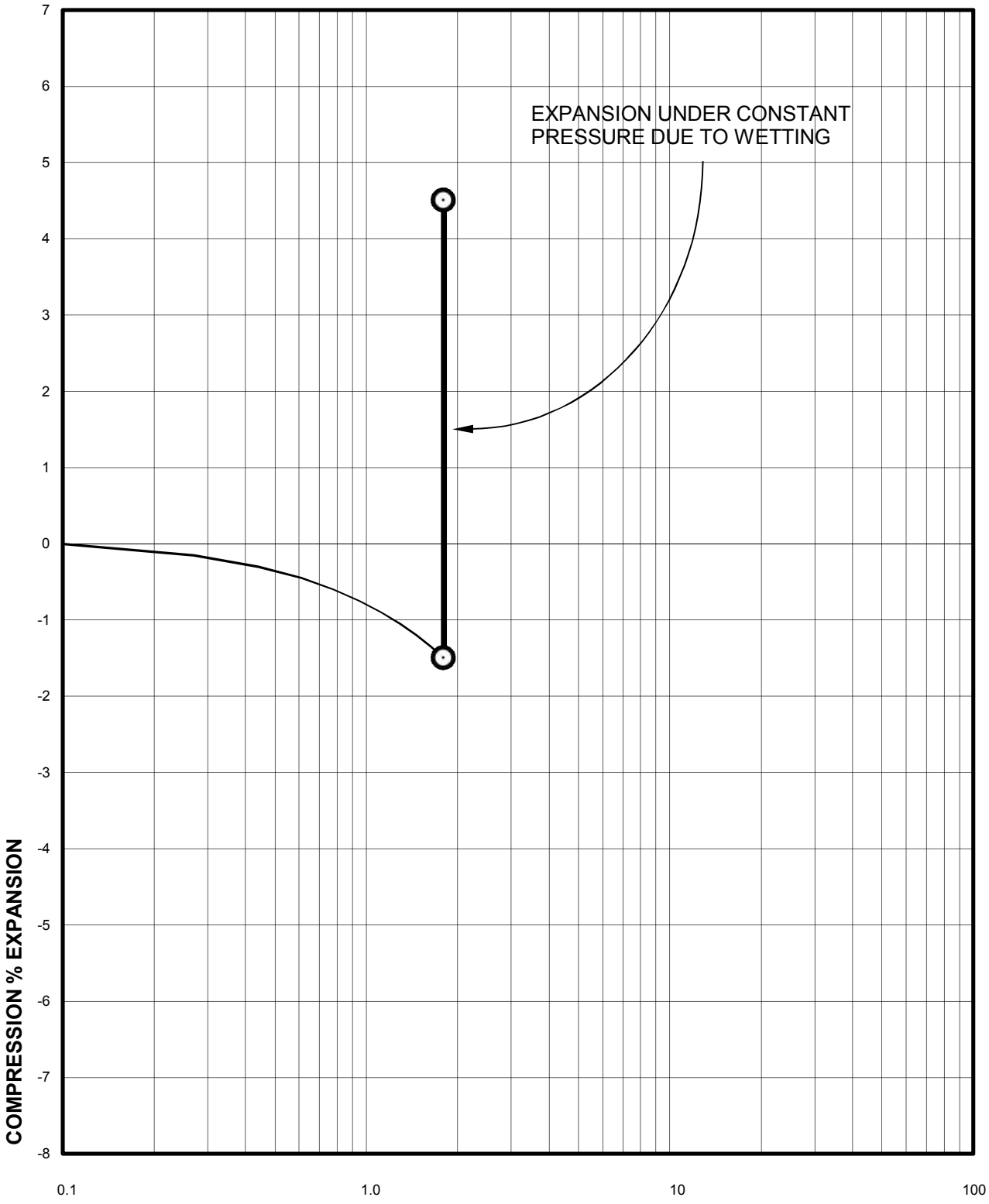
Sample of CLAYSTONE
From TH-23 AT 9 FEET

DRY UNIT WEIGHT= 112 PCF
MOISTURE CONTENT= 20.0 %

Swell Consolidation Test Results

FIG. B-44

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



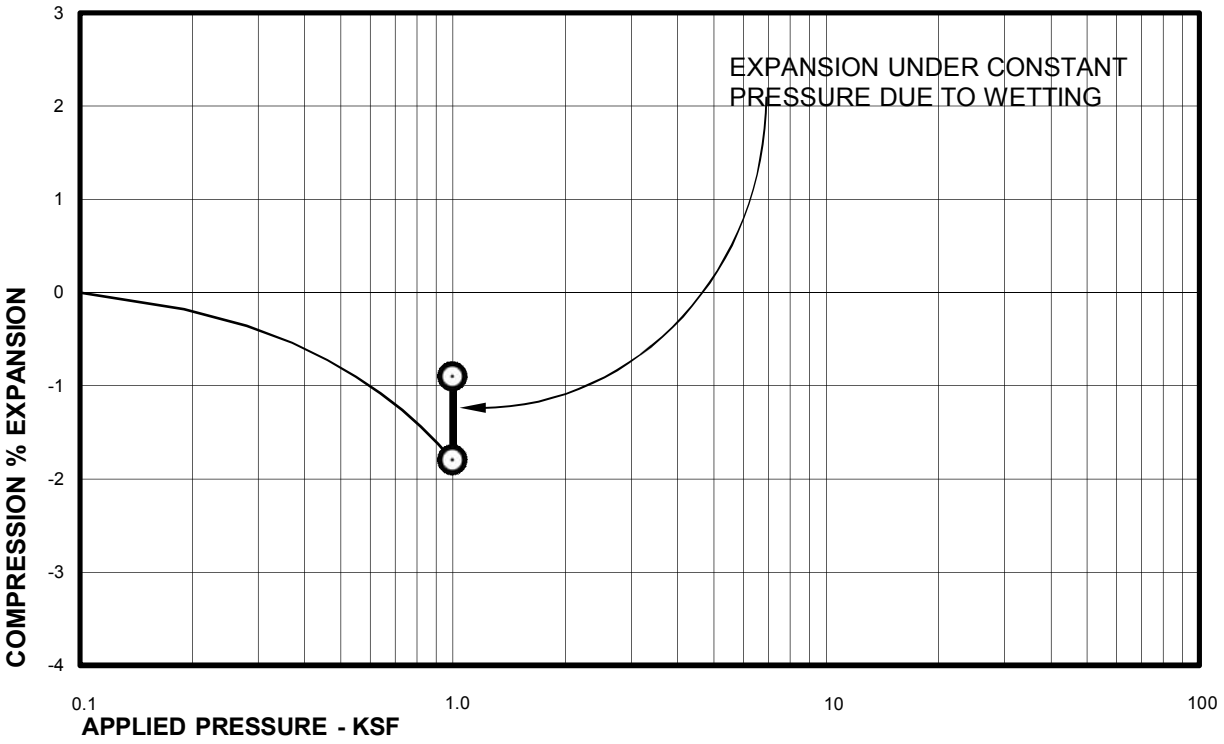
Sample of CLAYSTONE
From TH-23 AT 14 FEET

DRY UNIT WEIGHT= 112 PCF
MOISTURE CONTENT= 17.2 %

Swell Consolidation Test Results

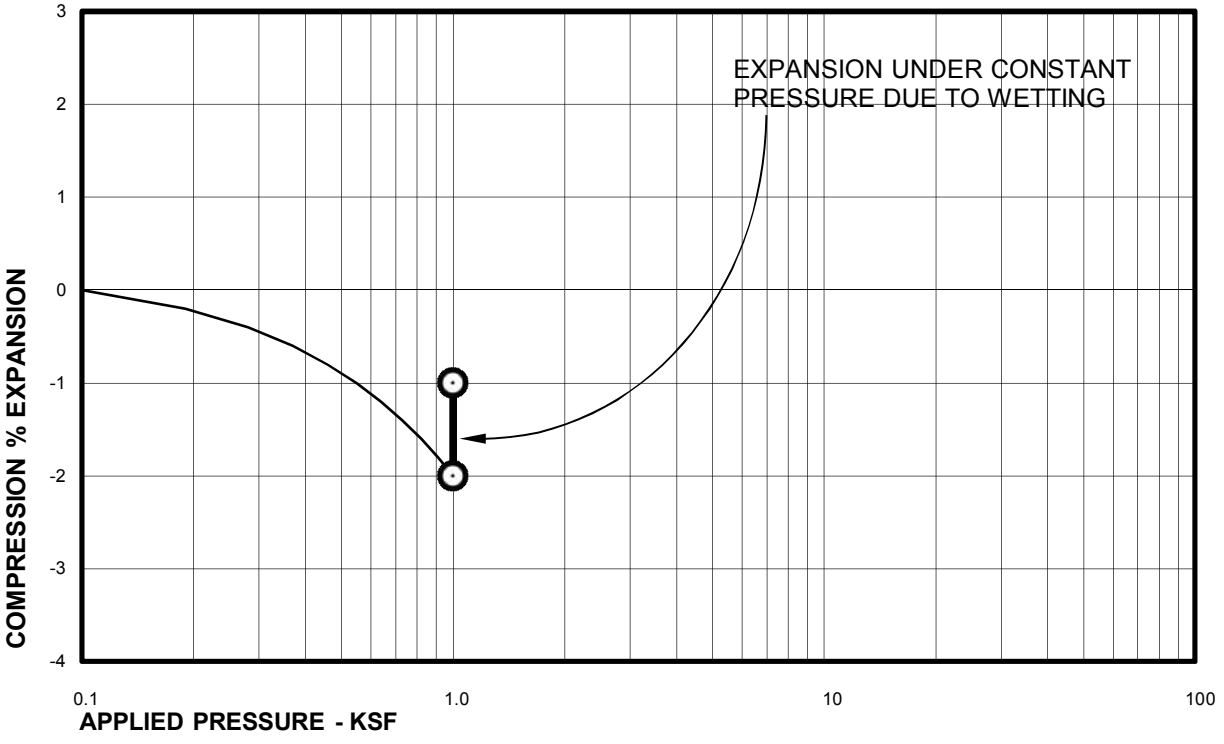
FIG. B-45

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1



Sample of REMOLDED CLAY
From TH-2 AT 0-10 FEET

DRY UNIT WEIGHT= 107 PCF
MOISTURE CONTENT= 17.8 %



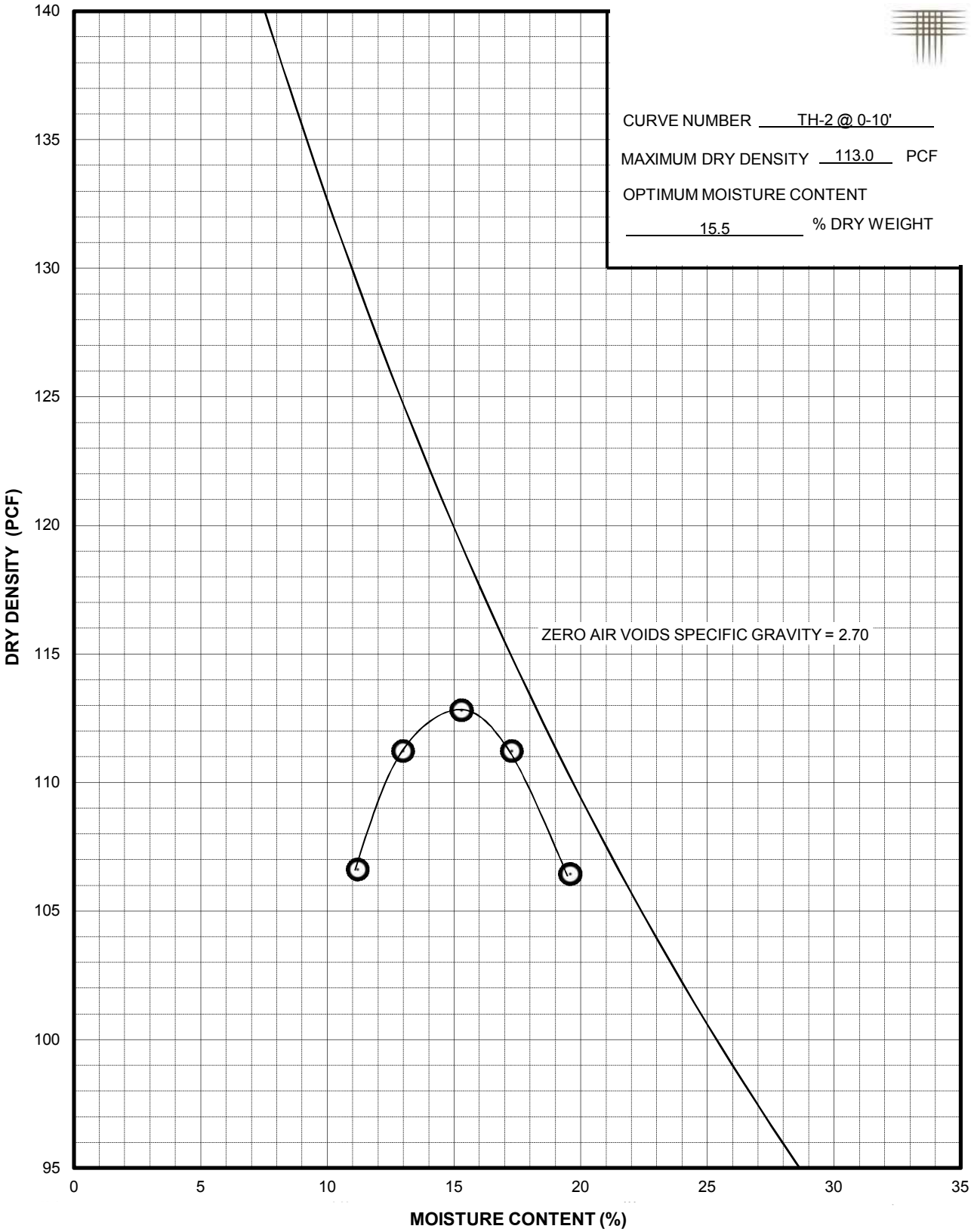
Sample of REMOLDED CLAY
From TH-9 AT 0-24 FEET

DRY UNIT WEIGHT= 100 PCF
MOISTURE CONTENT= 21.1 %

Swell Consolidation Test Results

FIG. B-46

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1

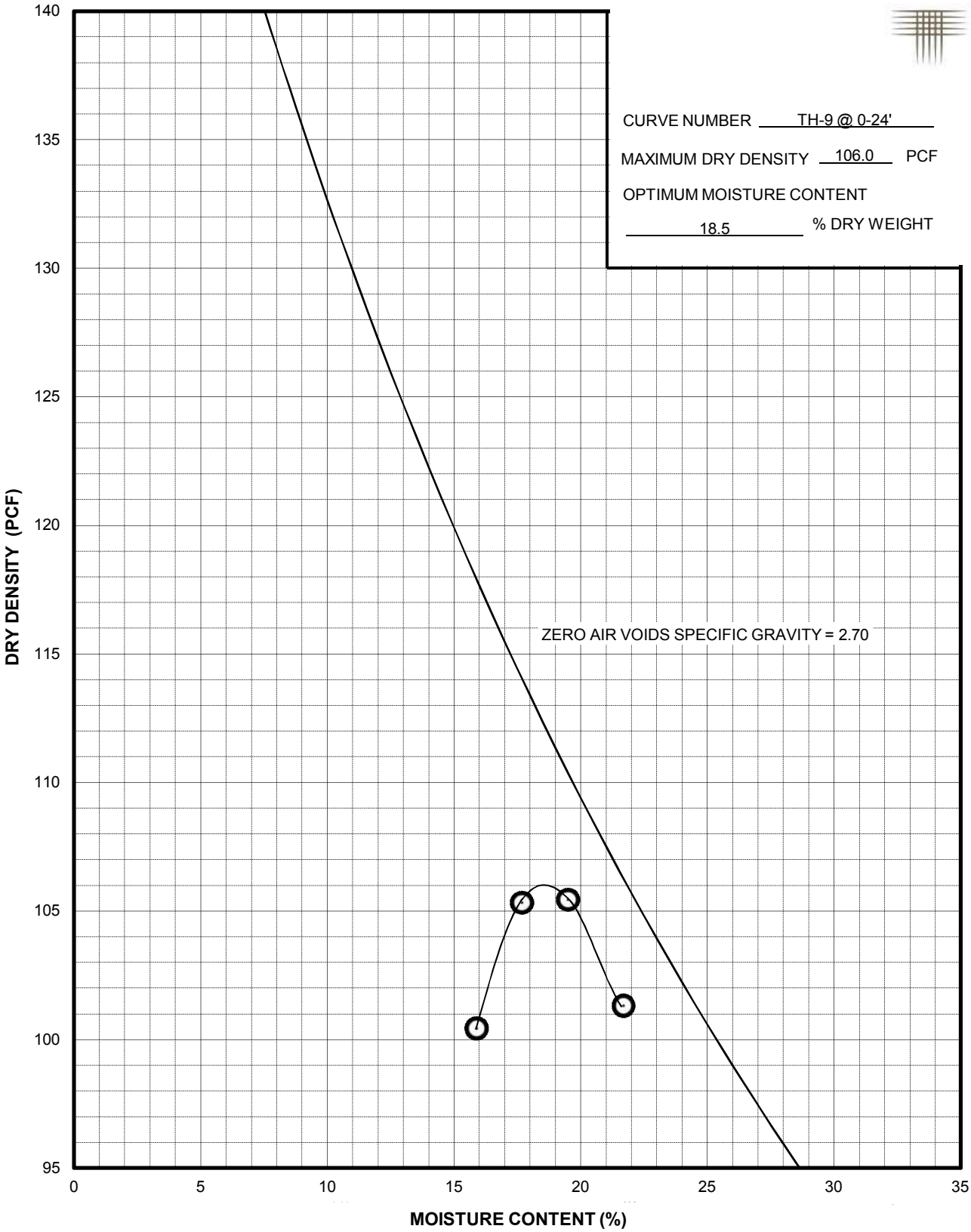


SAMPLE DESCRIPTION	CLAY, SANDY, BROWN		LIQUID LIMIT	40 %
			PLASTICITY INDEX	23 %
LOCATION	TH-2 @ 0-10'		GRAVEL	- %
			SAND	- %
COMPACTION TEST PROCEDURE	ASTM D698-00		SILT AND CLAY	78 %

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1

Laboratory Compaction Test Results

FIG. B-47

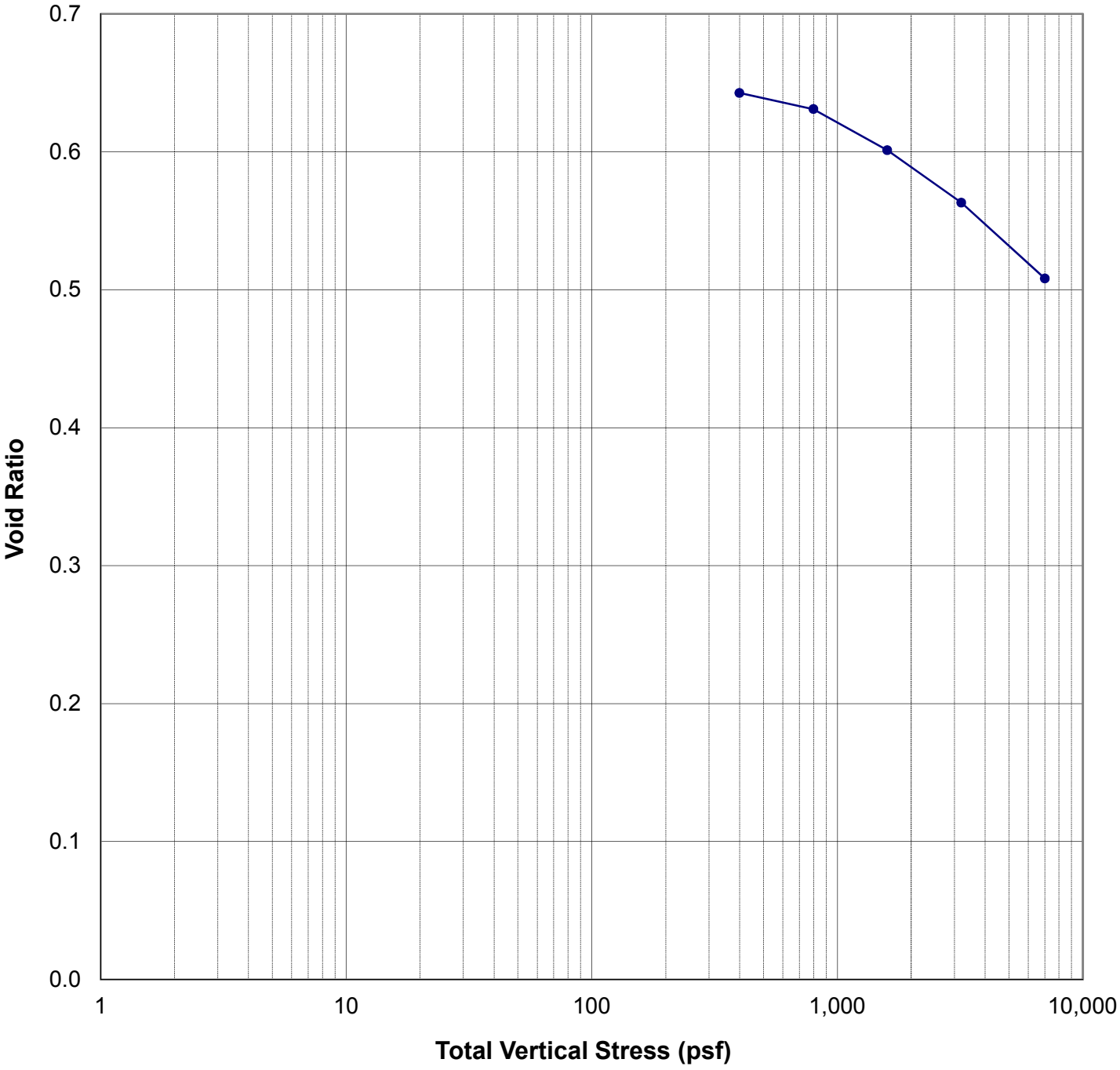


SAMPLE DESCRIPTION	CLAY, SANDY, BROWN		LIQUID LIMIT	50 %
			PLASTICITY INDEX	34 %
LOCATION	TH-9 @ 0-24'		GRAVEL	- %
			SAND	- %
COMPACTION TEST PROCEDURE	ASTM D698-00		SILT AND CLAY	88 %

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL | T PROJECT NO. DN48,647-125-R1

Laboratory Compaction Test Results

FIG. B-48



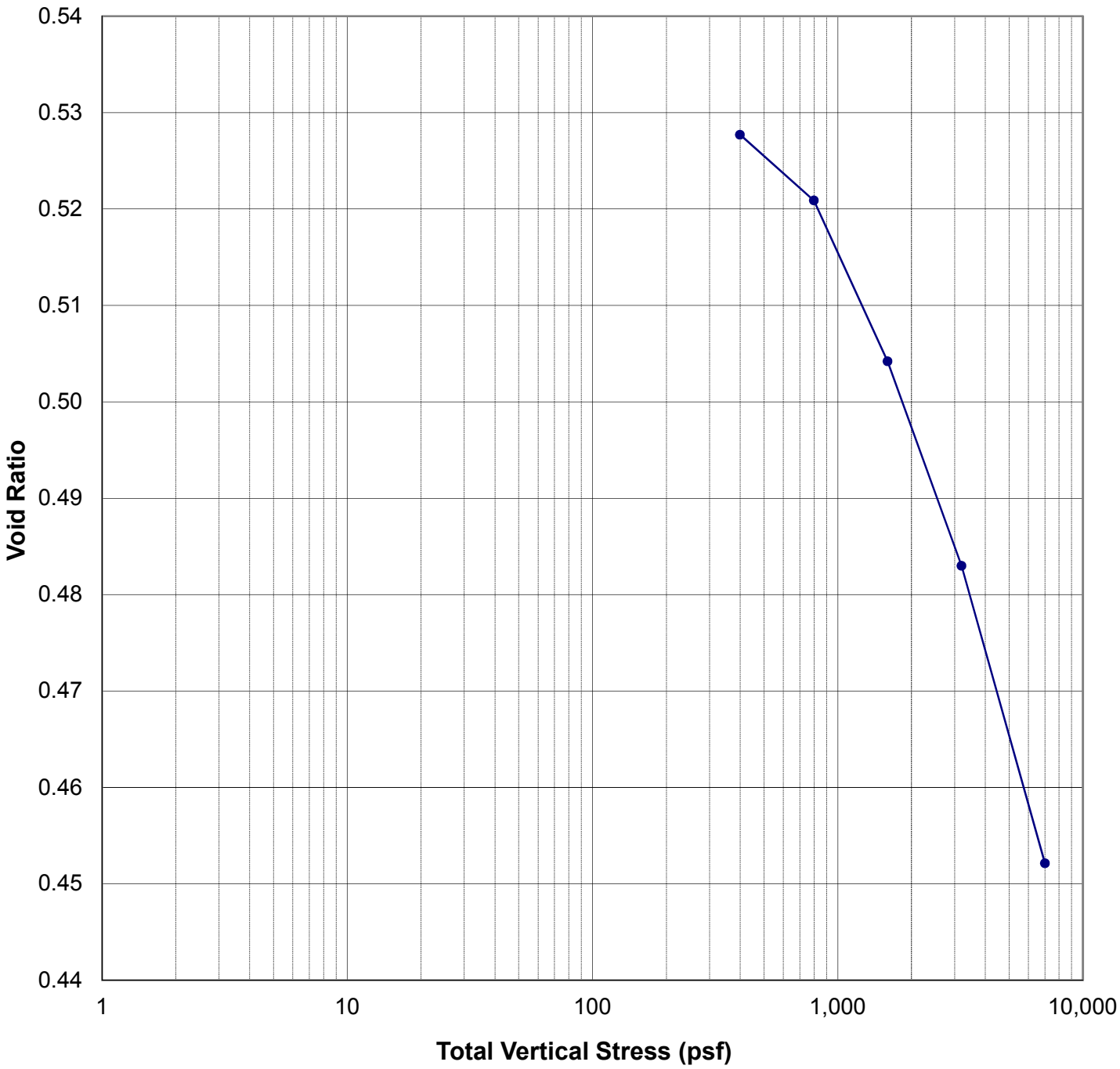
SAMPLE DESCRIPTION: Clay, Sandy, Soft, V. Moist, Brown
LOCATION: TH-17 @ 14'
MOISTURE CONTENT: 26.8 % (Before Test)
21.7 % (After Test)
DRY DENSITY: 97.3 pcf (Before Test)
TEST PROCEDURE: ASTM D2435

LIQUID LIMIT: ____ %
PLASTICITY INDEX: ____ %
GRAVEL: ____ %
SAND: ____ %
SILT AND CLAY: ____ %

One Dimensional Consolidation Test Results

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL|T PROJECT NO. DN48,647-125-R1

FIG. B-49

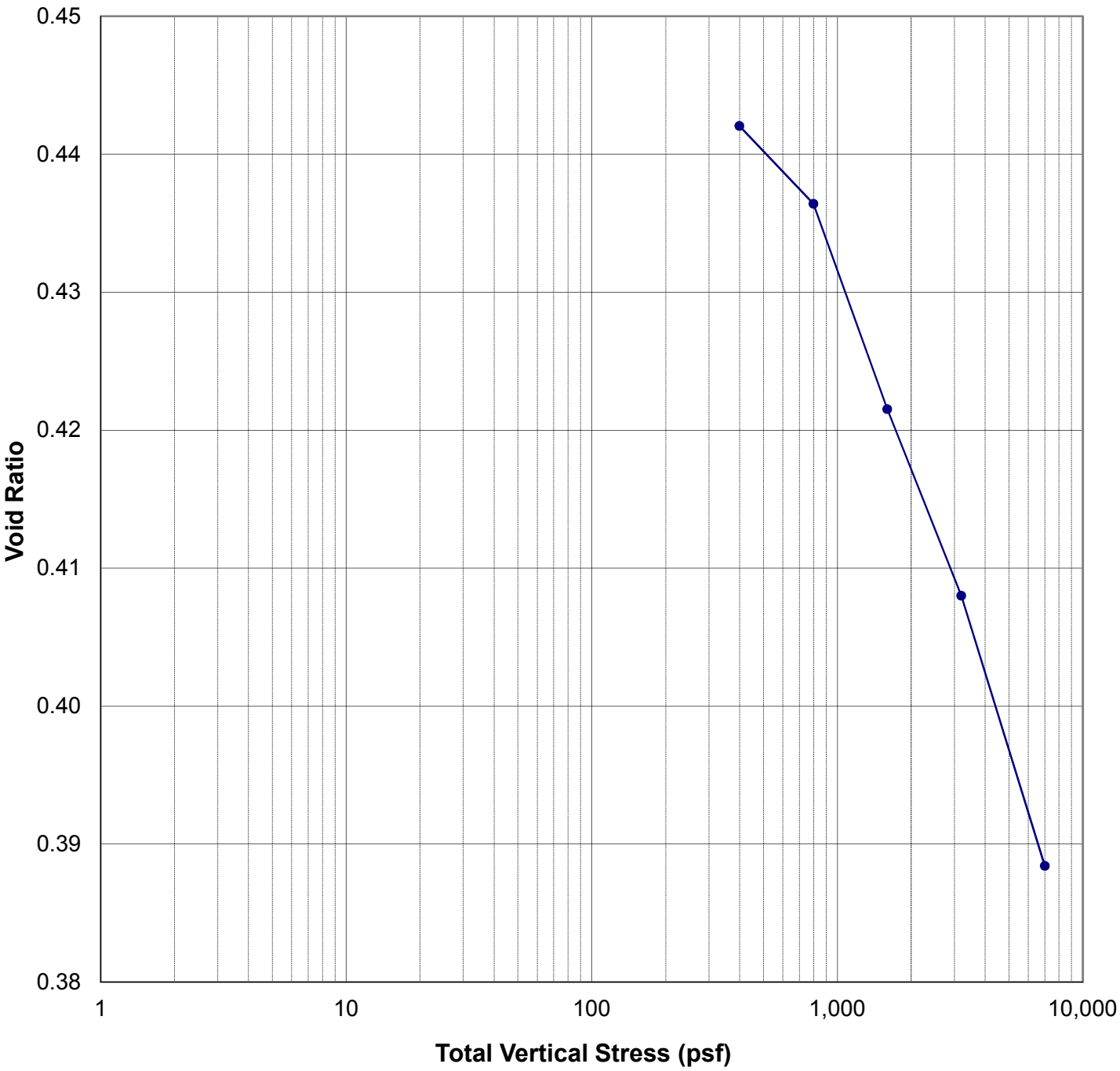


SAMPLE DESCRIPTION:	Clay, Sandy, Soft, V. Moist, Brown	LIQUID LIMIT:	%
LOCATION:	TH-18 @ 14'	PLASTICITY INDEX:	%
MOISTURE CONTENT:	20.3 % (Before Test)	GRAVEL:	%
	18.2 % (After Test)	SAND:	%
DRY DENSITY:	106.0 pcf (Before Test)	SILT AND CLAY:	%
TEST PROCEDURE:	ASTM D2435		

One Dimensional Consolidation Test Results

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL|T PROJECT NO. DN48,647-125-R1

FIG. B-50



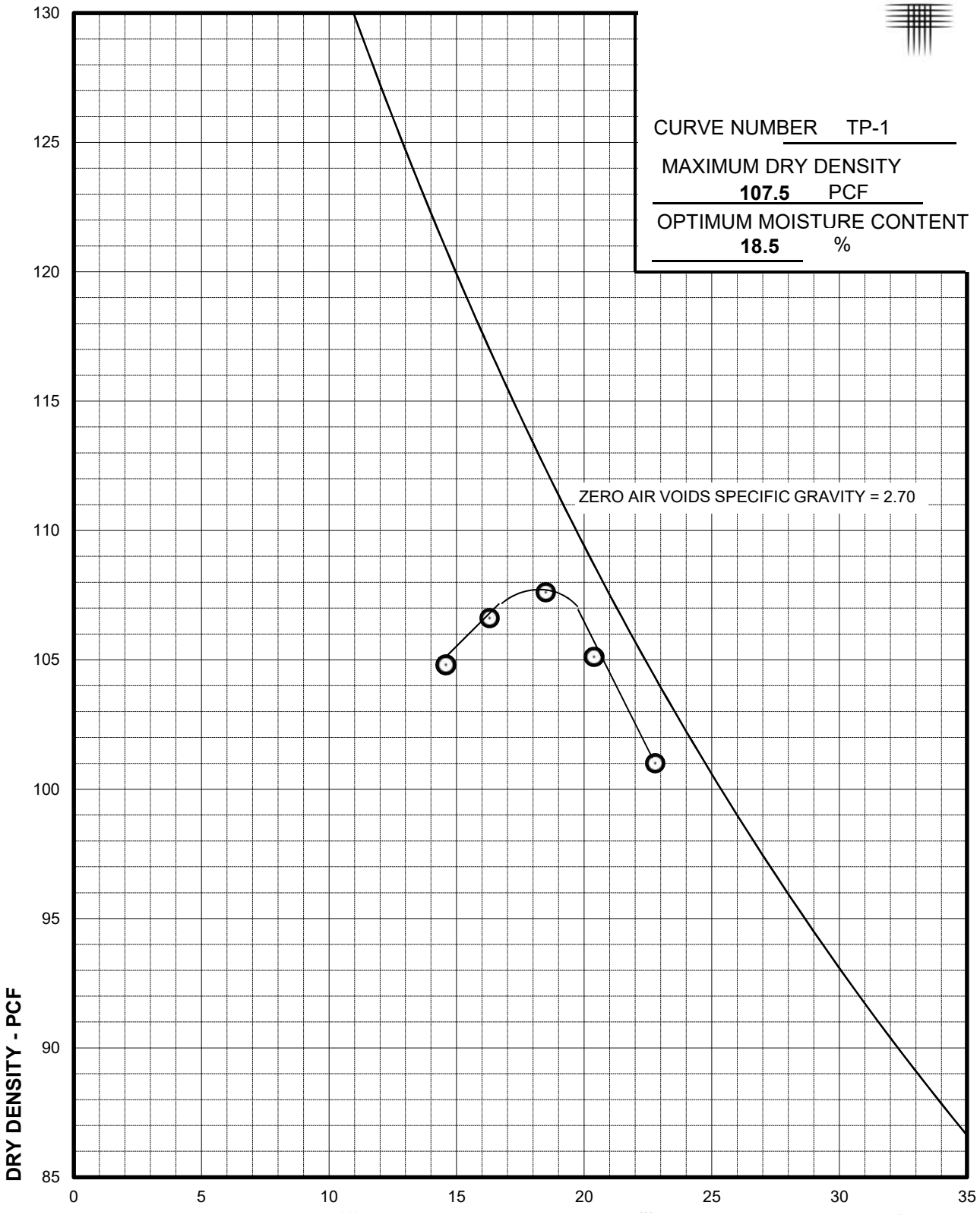
SAMPLE DESCRIPTION: Clay, Sandy, M. Stiff, Moist, Brown
LOCATION: TH-19 @ 19'
MOISTURE CONTENT: 17.3 % (Before Test)
15.9 % (After Test)
DRY DENSITY: 113.1 pcf (Before Test)
TEST PROCEDURE: ASTM D2435

LIQUID LIMIT: _____ %
PLASTICITY INDEX: _____ %
GRAVEL: _____ %
SAND: _____ %
SILT AND CLAY: _____ %

One Dimensional Consolidation Test Results

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL|T PROJECT NO. DN48,647-125-R1

FIG. B-51



CURVE NUMBER TP-1

MAXIMUM DRY DENSITY
107.5 PCF

OPTIMUM MOISTURE CONTENT
18.5 %

Sample Description Fill, Clay, Sandy

Location TP-1 at 20 feet

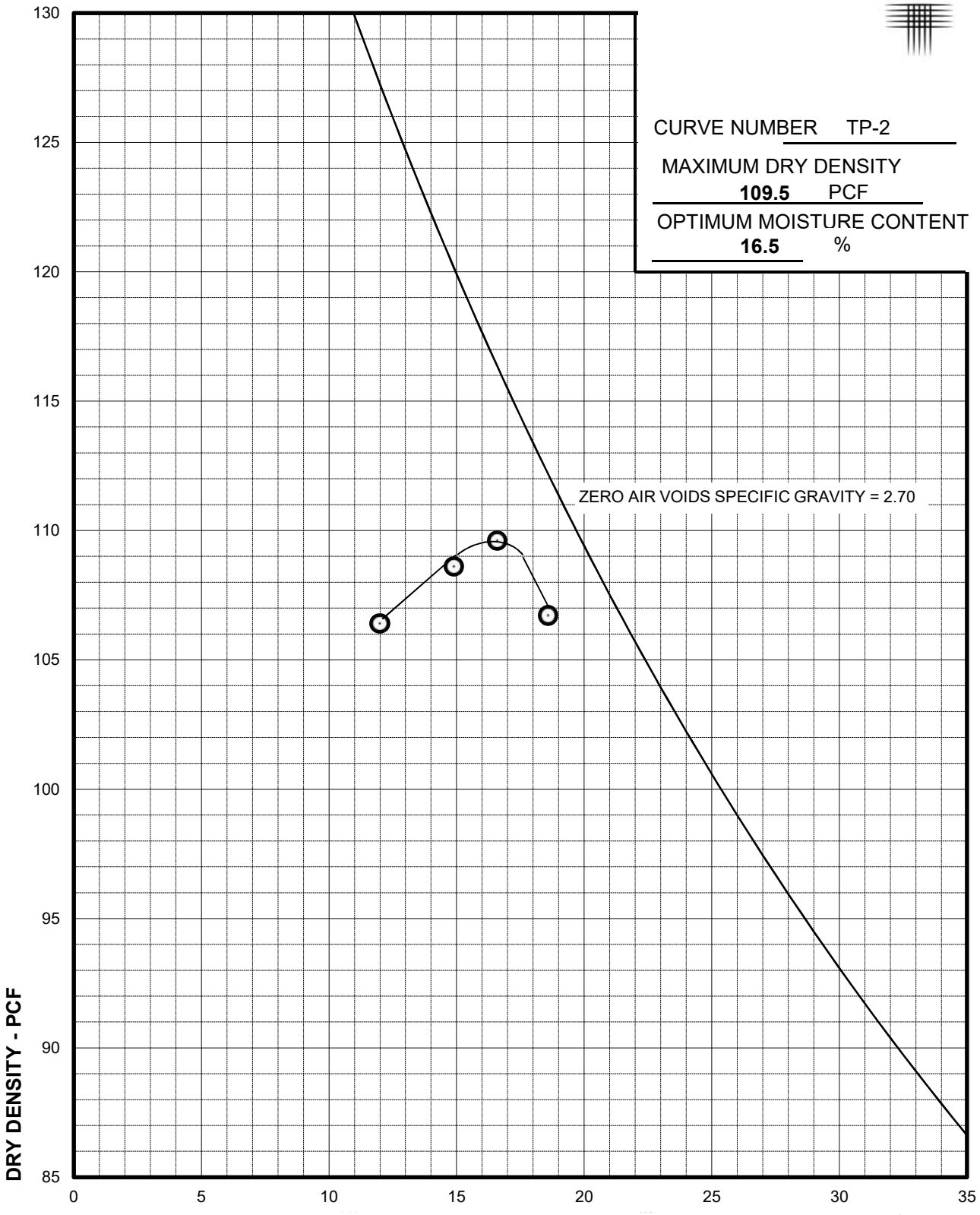
Compaction Test Procedure ASTM D 698
METHOD "A"

LIQUID LIMIT	50	
PLASTICITY INDEX	33	
GRAVEL	-	%
SAND	-	%
SILT AND CLAY	99	%

Compaction Test Results

FIG. B-52

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL|T PROJECT NO. DN48,647-125-R1



CURVE NUMBER TP-2

MAXIMUM DRY DENSITY
109.5 PCF

OPTIMUM MOISTURE CONTENT
16.5 %

Sample Description Fill, Clay, Sandy

Location TP-2 at 8 feet

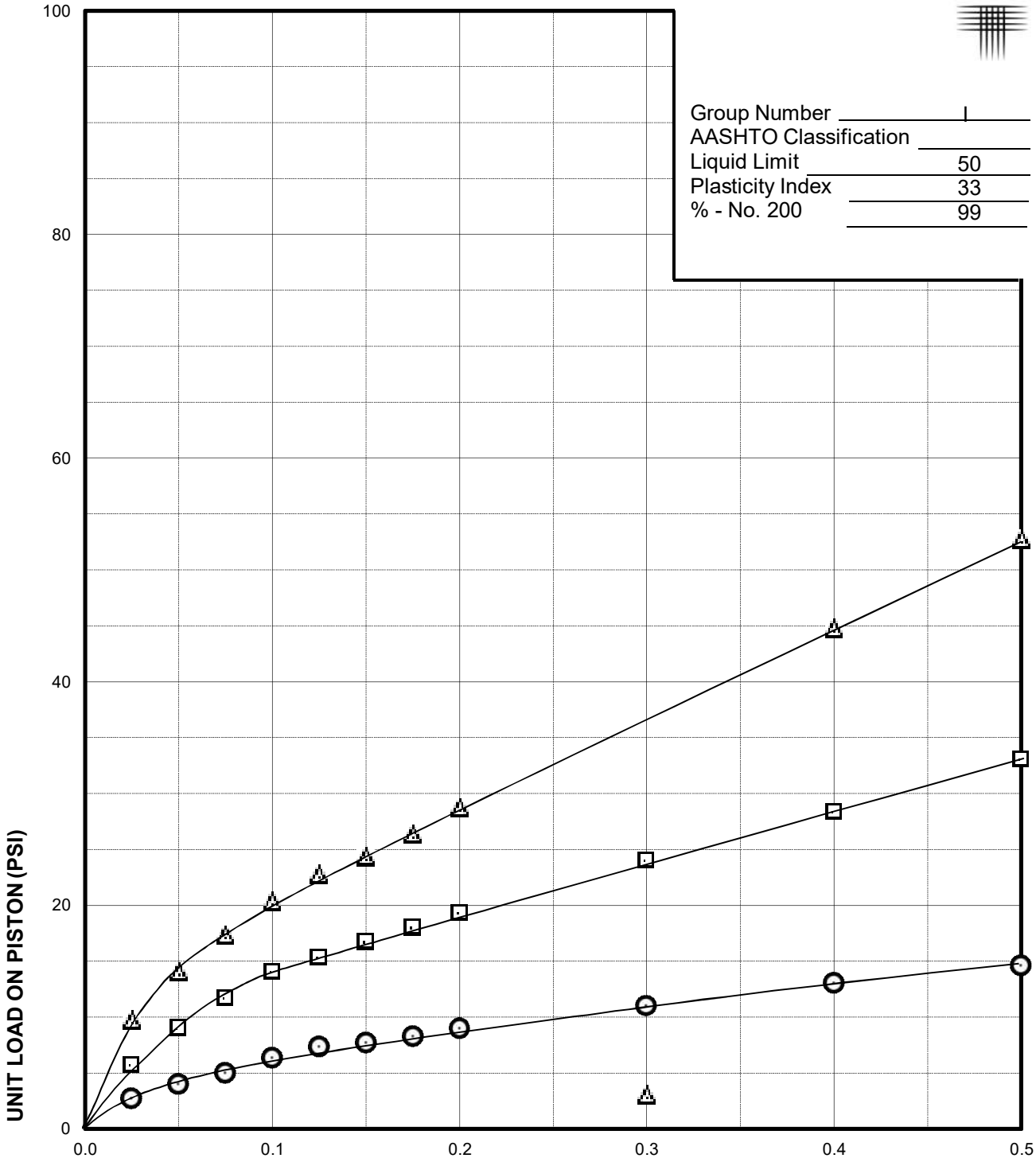
Compaction Test Procedure ASTM D 698
METHOD "A"

LIQUID LIMIT	37	
PLASTICITY INDEX	23	
GRAVEL	-	%
SAND	-	%
SILT AND CLAY	78	%

Compaction Test Results

FIG. B-53

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL|T PROJECT NO. DN48,647-125-R1



Group No. I
Surcharge Load: 10 lbs.

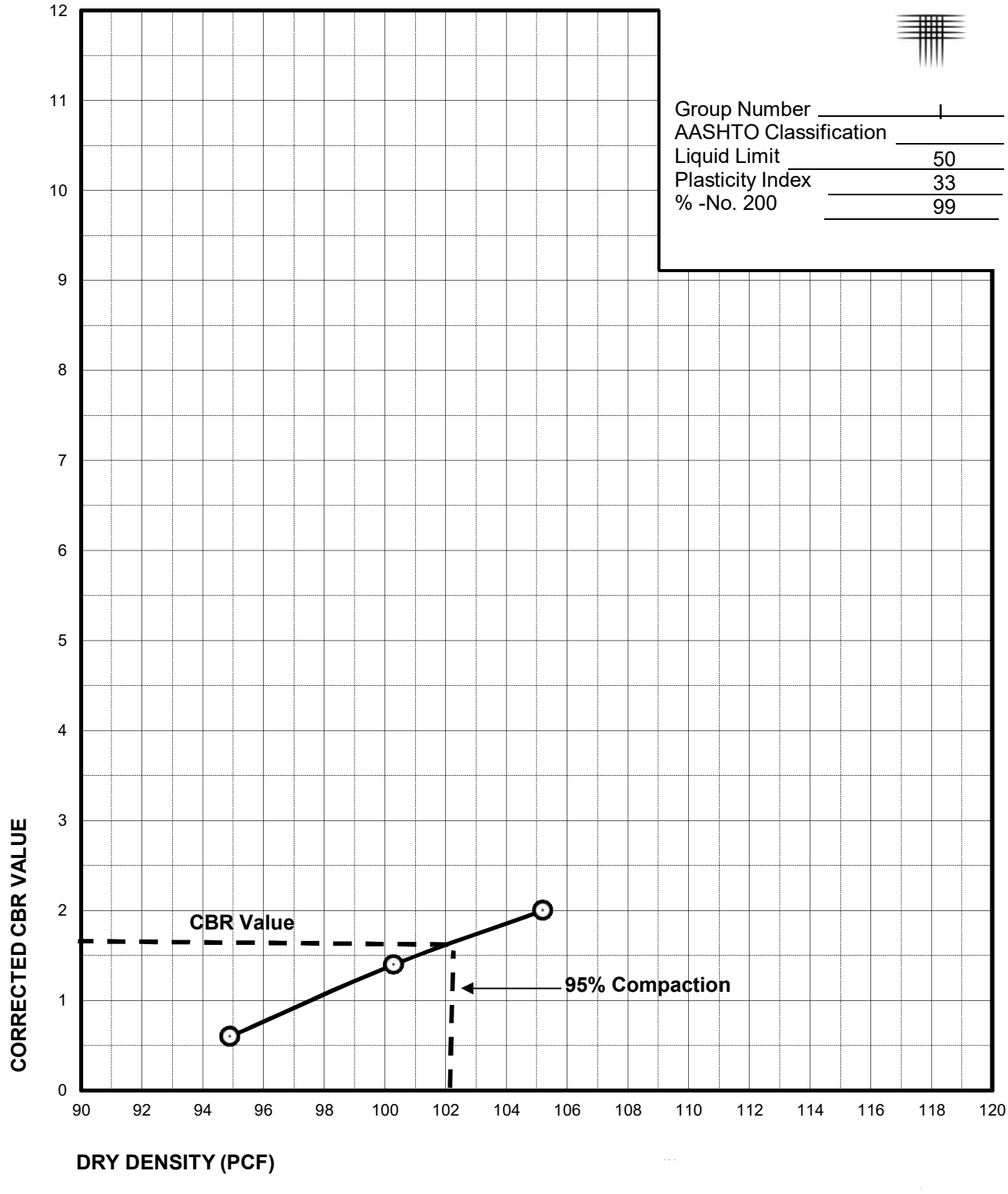
Description: Claystone
Moisture Content: 18.7 %

⊙ Compaction	88.3 %	Swell	5.47 %	CBR Value	0.6
⊡ Compaction	93.3 %	Swell	2.28 %	CBR Value	1.4
◬ Compaction	97.9 %	Swell	3.11 %	CBR Value	2.0

California Bearing Ratio

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL|T PROJECT NO. DN48,647-125-R1

Fig. B-54

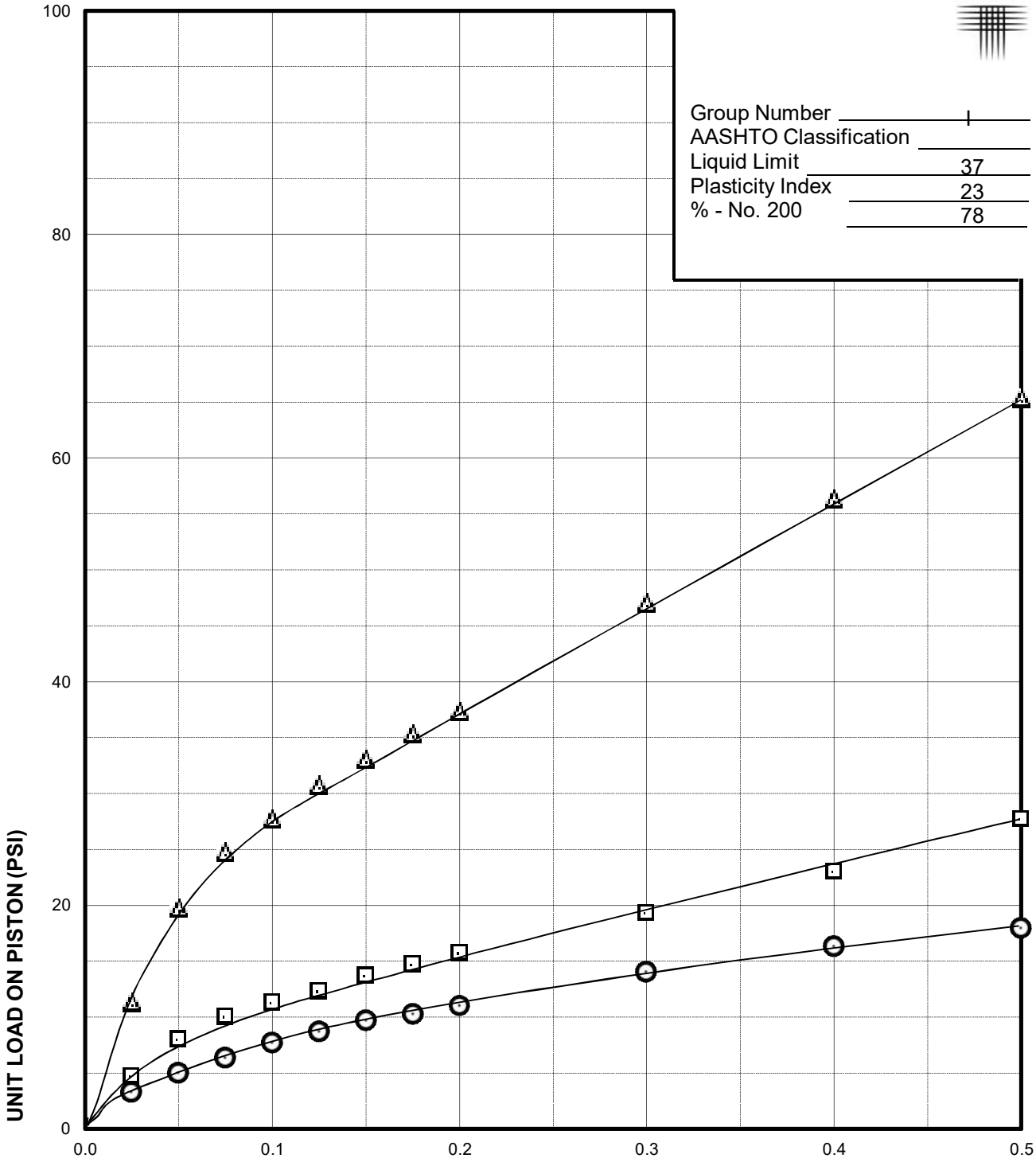


SYMBOL	GROUP NO.	95% COMPACTION	DESIGN CBR VALUE
⊙	I	102.1	2.2

California Bearing Ratio

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL|T PROJECT NO. DN48,647-125-R1

Fig. B-55



Group No. I
Surcharge Load: 10 lbs.

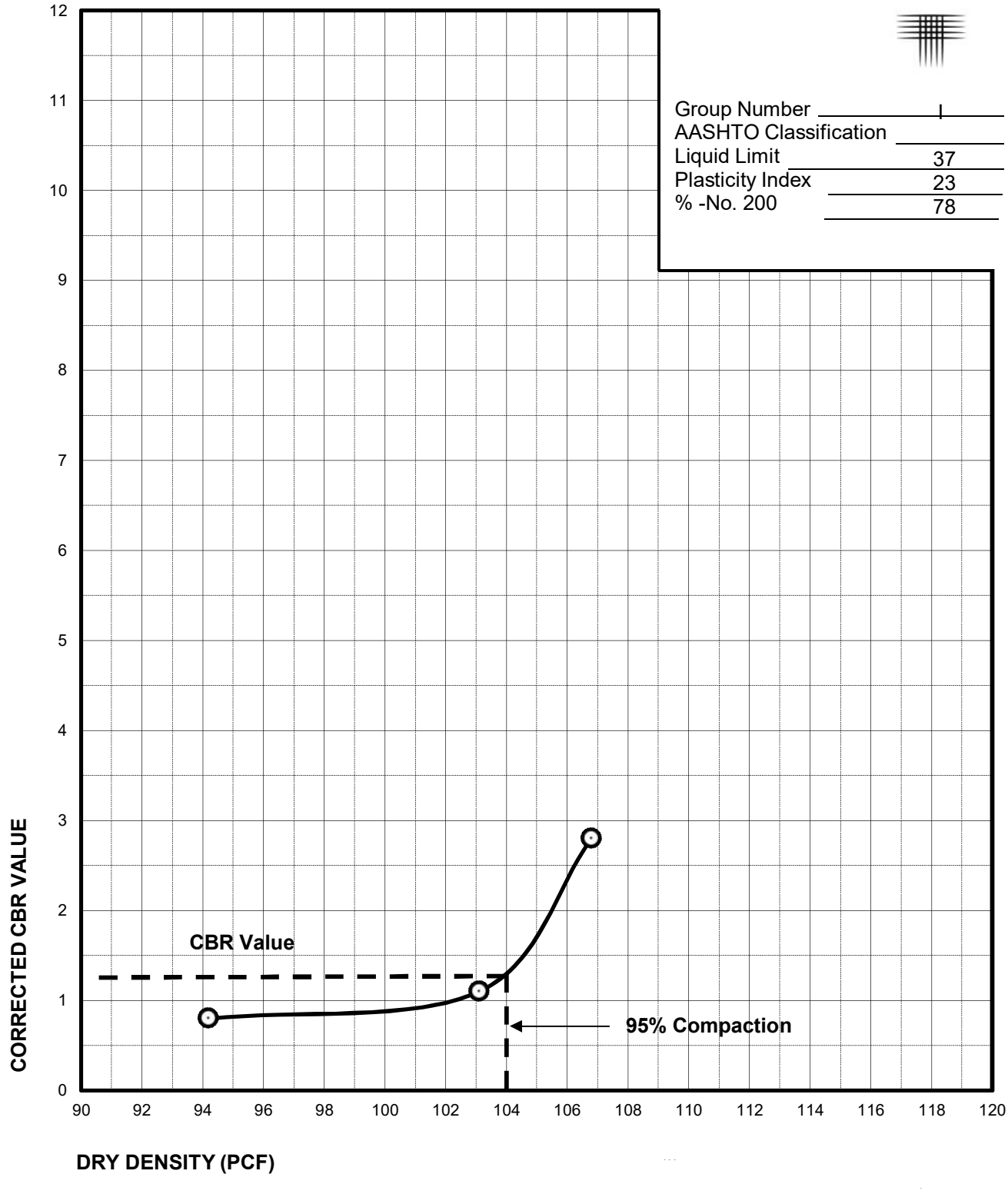
Description: Claystone
Moisture Content: 17.1 %

⊙ Compaction	86 %	Swell	3.91 %	CBR Value	0.8
⊡ Compaction	94.2 %	Swell	3.22 %	CBR Value	1.1
◬ Compaction	97.5 %	Swell	2.33 %	CBR Value	2.8

California Bearing Ratio

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL|T PROJECT NO. DN48,647-125-R1

Fig. B-56



SYMBOL	GROUP NO.	95% COMPACTION	DESIGN CBR VALUE
⊙	I	104	1.3

California Bearing Ratio

EVERGREEN DEVELOPMENT
NINE MILE CORNER - COMMERCIAL AREA
CTL|T PROJECT NO. DN48,647-125-R1

Fig. B-57

APPENDIX C

GUIDELINE SITE GRADING SPECIFICATIONS

Nine Mile Corner – Commercial Area
Erie, Colorado

GUIDELINE SITE GRADING SPECIFICATIONS

Nine Mile Corner – Commercial Area
Erie, Colorado

1. DESCRIPTION

This item shall consist of the excavation, transportation, placement and compaction of materials from locations indicated on the plans, or staked by the Engineer, as necessary to achieve preliminary street and overlot elevations. These specifications shall also apply to compaction of excess cut materials that may be placed outside of the development boundaries.

2. GENERAL

The Soils Representative shall be the Owner's representative. The Soils Representative shall approve fill materials, method of placement, moisture contents and percent compaction, and shall give written approval of the completed fill.

3. CLEARING JOB SITE

The Contractor shall remove all vegetation and debris before excavation or fill placement is begun. The Contractor shall dispose of the cleared material to provide the Owner with a clean, neat appearing job site. Cleared material shall not be placed in areas to receive fill or where the material will support structures of any kind.

4. AREA TO BE FILLED

All topsoil and vegetable matter shall be removed from the ground surface upon which fill is to be placed. The surface shall then be plowed or scarified until the surface is free from ruts, hummocks or other uneven features, which would prevent uniform compaction.

After the foundation for the fill has been cleared and scarified, it shall be disked or bladed until it is free from large clods, brought to the proper moisture content as outlined in Table C1 below.

Table C1 – Moisture and Compaction Specifications

Soil Type	Depth of Fill* (feet)	Moisture Content From Optimum	Minimum Compaction (ASTM D698)
Clay and Claystone	0 to 18	0 to +3	>95 %
	>18	-1 to +2	100 %
Sand	0 to 18	-2 to +2	>95
	>18	-2 to +2	100 %

* Depth below proposed grade

5. FILL MATERIALS

Fill soils shall be free from organics, debris or other deleterious substances, and shall not contain rocks or lumps having a diameter greater than six (6) inches. Claystone bedrock should be broken down to three (3) inches or smaller in size. Fill materials shall be obtained from cut areas shown on the plans or staked in the field by the Engineer.

On-site materials classifying as CL, CH, SC, SM, SW, SP, GP, GC and GM are acceptable. Concrete, asphalt, organic matter and other deleterious materials or debris shall not be used as fill.

6. MOISTURE CONTENT

Fill material classifying as CH and CL shall be moisture conditioned as outlined in Table C1. Granular soils classifying as SC, SM, SW, SP, GP, GC and GM shall be moisture conditioned as outlined in Table C1. Sufficient laboratory compaction tests shall be made to determine the optimum moisture content for the various soils encountered in borrow areas.

The Contractor may be required to add moisture to the excavation materials in the borrow area if, in the opinion of the Soils Representative, it is not possible to obtain uniform moisture content by adding water on the fill surface. The Contractor may be required to rake or disc the fill soils to provide uniform moisture content through the soils.

The application of water to embankment materials shall be made with any type of watering equipment approved by the Soils Representative, which will give the desired results. Water jets from the spreader shall not be directed at the embankment with such force that fill materials are washed out.

Should too much water be added to any part of the fill, such that the material is too wet to permit the desired compaction from being obtained, rolling and all work on that section of the fill shall be delayed until the material has been allowed to dry to the required moisture content. The Contractor will be permitted to rework wet material in an approved manner to hasten its drying.

7. COMPACTION OF FILL AREAS

Selected fill material shall be placed and mixed in evenly spread layers. After each fill layer has been placed, it shall be uniformly compacted to not less than the specified percentage of maximum density. Fill shall be compacted according to the specifications outlined Table C1. At the option of the Soils Representative, soils classifying as SW, GP, GC, or GM may be compacted to 95 percent of maximum density as determined in accordance with ASTM D 1557 or 70 percent relative density for cohesionless sand soils. Fill materials shall be placed such that

the thickness of loose materials does not exceed 10 inches and the compacted lift thickness does not exceed 6 inches.

Compaction as specified above, shall be obtained by the use of sheepsfoot rollers, multiple-wheel pneumatic-tired rollers, or other equipment for soils classifying as CL, CH, or SC. Granular fill shall be compacted using vibratory equipment or other approved equipment. Compaction shall be accomplished while the fill material is at the specified moisture content. Compaction of each layer shall be continuous over the entire area. Compaction equipment shall make sufficient trips to ensure that the required density is obtained.

8. COMPACTION OF SLOPES

Fill slopes shall be compacted by means of sheepsfoot rollers or other suitable equipment. Compaction operations shall be continued until slopes are stable, but not too dense for planting, and there is not appreciable amount of loose soils on the slopes. Compaction of slopes may be done progressively in increments of three to five feet (3' to 5') in height or after the fill is brought to its total height. Permanent fill slopes shall not exceed 3:1 (horizontal to vertical).

9. PLACEMENT OF FILL ON NATURAL SLOPES

Where natural slopes are steeper than 20 percent in grade and the placement of fill is required, benches shall be cut at the rate of one bench for each 5 feet in height (minimum of two benches). Benches shall be at least 10 feet in width. Larger bench widths may be required by the Engineer. Fill shall be placed on completed benches as outlined within this specification.

10. DENSITY TESTS

Field density tests shall be made by the Soils Representative at locations and depths of his choosing. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density tests shall be taken in compacted material below the disturbed surface. When density tests indicate that the density or moisture content of any layer of fill or portion thereof is not within specification, the particular layer or portion shall be reworked until the required density or moisture content has been achieved.

11. SEASONAL LIMITS

No fill material shall be placed, spread or rolled while it is frozen, thawing, or during unfavorable weather conditions. When work is interrupted by heavy precipitation, fill operations shall not be resumed until the Soils Representative indicates that the moisture content and density of previously placed materials are as specified.

12. NOTICE REGARDING START OF GRADING

The Contractor shall submit notification to the Soils Representative and Owner advising them of the start of grading operations at least three (3) days in advance of the starting date. Notification shall also be submitted at least 3 days in advance of any resumption dates when grading operations have been stopped for any reason other than adverse weather conditions.

13. REPORTING OF FIELD DENSITY TESTS

Density tests made by the Soils Representative, as specified under "Density Tests" above, shall be submitted progressively to the Owner. Dry density, moisture content, and percentage compaction shall be reported for each test taken.

14. DECLARATION REGARDING COMPLETED FILL

The Soils Engineer shall provide a written declaration stating that the site was filled with acceptable materials, and was placed in general accordance with the specifications.

APPENDIX D

GUIDELINE SITE GRADING SPECIFICATIONS
(SUB-EXCAVATION)

Nine Mile Corner – Commercial Area
Erie, Colorado

Note: This guideline is intended for use with sub-excavation. For general site grading, the guidelines in Appendix C should be followed.

GUIDELINE SITE GRADING SPECIFICATIONS
(SUB-EXCAVATION)

Nine Mile Corner – Commercial Area
Erie, Colorado

1. DESCRIPTION

This item shall consist of the excavation, transportation, placement and compaction of materials from locations indicated on the plans, or staked by the Engineer, as necessary to achieve preliminary street and overlot elevations. These specifications shall also apply to compaction of materials that may be placed outside of the development boundaries.

2. GENERAL

The Soils Engineer shall be the Owner's representative. The Soils Engineer shall observe fill materials, method of placement, moisture content and percent compaction, and shall provide written opinions of the completed fill.

3. CLEARING JOB SITE

The Contractor shall remove all vegetation and debris before excavation or fill placement is begun. The Contractor shall dispose of the cleared material to provide the Owner with a clean, neat appearing job site. Cleared material shall not be placed in areas to receive fill where the material will support structures of any kind.

4. SCARIFYING AREA TO BE FILLED

All topsoil and vegetable matter shall be removed from the ground surface where fill is to be placed. The surface shall then be plowed or scarified until the surface is free from ruts, hummocks or other uneven features that would prevent uniform compaction.

5. COMPACTING AREA TO BE FILLED

After the foundation for the fill has been cleared and scarified, it shall be disked or bladed until it is free from large clods, brought to the proper moisture content, (0 to 3 percent above optimum) and compacted to not less than 95 percent of maximum density as determined in accordance with ASTM D 698.

6. FILL MATERIALS

Fill soils shall be free from vegetable matter or other deleterious substances, and shall not contain clay and claystone having a diameter greater than three (3)

inches. Fill materials shall be obtained from cut areas shown on the plans or staked in the field by the Engineer.

On-site materials classifying as CL, CH, SC, SM, SP, GP, GC and GM are acceptable. Concrete, asphalt, and other deleterious materials or debris shall not be used as fill.

7. MOISTURE CONTENT

Fill materials shall be moisture-conditioned to within limits of optimum moisture content specified in “Moisture Content and Density Criteria”. Sufficient laboratory compaction tests shall be made to determine the optimum moisture content for the various soils encountered in borrow areas or imported to the site.

The Contractor may be required to add moisture to the excavation materials in the borrow area if, in the opinion of the Soils Engineer, it is not possible to obtain uniform moisture content by adding water on the fill surface. The Contractor will be required to rake or disc the fill to provide uniform moisture content throughout the fill.

The application of water to embankment materials shall be made with any type of watering equipment that will give the desire results. Water jets from the spreader shall not be directed at the embankment with such force that fill materials are washed out.

Should too much water be added to any part of the fill, such that the material is too wet to permit the desired compaction from being obtained, rolling and all work on that section of the fill shall be delayed until the material has been allowed to dry to the required moisture content. The Contractor will be permitted to rework wet material in an approved manner to hasten its drying.

8. COMPACTION OF FILL MATERIALS

Selected fill material shall be placed and mixed in evenly spread layers. After each fill layer has been placed, it shall be uniformly compacted to not less than the specified percentage of maximum density given in “Moisture Content and Density Criteria”. Fill materials shall be placed such that the thickness of loose material does not exceed 8 inches and the compacted lift thickness does not exceed 6 inches.

Compaction, as specified above, shall be obtained by the use of suitable equipment. Compaction shall be accomplished while the fill material is at the specified moisture content. Compaction of each layer shall be continuous over the entire area. Compaction equipment shall make sufficient trips to ensure that the required density is obtained.

9. MOISTURE CONTENT AND DENSITY CRITERIA

Fill material shall be substantially compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698, AASHTO T 99) dry density at 0 to 3 percent above optimum moisture content. Additional criteria for acceptance are presented in DENSITY TESTS.

10. DENSITY TESTS

Field density tests shall be made by the Soils Engineer at locations and depths of his choosing. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density tests shall be taken in compacted material below the disturbed surface. When density tests indicate the density or moisture content of any layer of fill or portion thereof not within specifications, the particular layer or portion shall be reworked until the required density or moisture content has been achieved.

Allowable ranges of moisture content and density given in MOISTURE CONTENT AND DENSITY CRITERIA are based on design considerations. The moisture shall be controlled by the Contractor so that moisture content of the compacted earth fill, as determined by tests performed by the Soils Engineer, shall be within the limits given. The Soils Engineer will inform the Contractor when the placement moisture is less than or exceeds the limits specified and the Contractor shall immediately make adjustments in procedures as necessary to maintain placement moisture content within the specified limits, to satisfy the following requirements.

A. Moisture

1. The average moisture content of material tested each day shall not be less than 1 percent over optimum moisture content.

2. Material represented by samples tested having moisture lower than optimum will be rejected. Such rejected materials shall be reworked until moisture equal to or greater than 1 percent above optimum is achieved.

B. Density

1. The average dry density of material tested each day shall not be less than shown in Appendix C.

2. No more than 10 percent of the material represented by the samples tested shall be at dry densities less than shown in Appendix C.

3. Material represented by samples tested having dry density more than 1 percent less than shown in Appendix C will be rejected. Such rejected materials shall be reworked until a dry density equal to or greater than the specified density is obtained.

11. OBSERVATION AND TESTING OF FILL

Observation by the Soils Engineer shall be sufficient during the placement of fill and compaction operations so that they can declare the fill was placed in general conformance with specifications. All observations necessary to test the placement of fill and observe compaction operations will be at the expense of the Owner.

12. SEASONAL LIMITS

No fill material shall be placed, spread or rolled while it is frozen, thawing, or during unfavorable weather conditions. When work is interrupted by heavy precipitation, fill operations shall not be resumed until the Soils Engineer indicates the moisture content and density of previously placed materials are as specified.

13. REPORTING OF FIELD DENSITY TESTS

Density tests made by the Soils Engineer, as specified under “Density Tests” above, shall be submitted progressively to the Owner. Dry density, moisture content and percentage compaction shall be reported for each test taken.