Print Form

TOWN OF ERIE
Community Development Department – Planning Division
645 Holbrook Street – PO Box 750 – Erie, CO 80516
Tel: 303.926.2770 – Fax: 303.926.2706 – Web: www.erieco.gov

LAND USE APPLICATION

Please fill in this form completely. Incomplete applications will not be processed.

STAFF USE ONLY

FILE NAME:

FILE NO: DATE SUBMITTED: FEES PAID:

PROJECT/BUSINESS NAME: Canyon Creek Filing No.10

PROJECT ADDRESS: Vacant Land (southwest corner of Erie Parkway and County Line Road)

PROJECT DESCRIPTION: Minor subdivision: 2 commercial lots.

LEGAL DESCRIPTION *(attach legal description if Metes & Bounds)*

Subdivision Name: Canyon Creek

Filing #: 10 Lot #: 1 and 2 Block #:

Section: 24 Township: 1 North Range: 69 West

OWNER *(attach separate sheets if multiple)*

Name/Company: Erie Four Corners, LLC

Contact Person: Justin McClure

Address: 1002 Griffith Street

City/State/Zip: Louisville, CO 80027

Phone: 303-475-2106 Fax:

E-mail: justin@foundrybuilders.com

AUTHORIZED REPRESENTATIVE

Company/Firm: RMCS, Inc.

Contact Person: Justin McClure & Alex Carlson

Address: 1002 Griffith Street

City/State/Zip: Louisville, CO 80027

Phone: 303-475-2106 Fax:

E-mail: justin@foundrybuilders.com & alex@foundrybuilders.com

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MINERAL RIGHTS OWNER *(attach separate sheets if multiple)*

Name/Company: Erie Four Corners, LLC

Address: 21 South Sunset Street

City/State/Zip: Longmont, CO 80501

MINERAL LEASE HOLDER *(attach separate sheets if multiple)*

Name/Company: N/A

Address:

City/State/Zip:

LAND-USE & SUMMARY INFORMATION

Present Zoning: Canyon Creek PD

Proposed Zoning:

Gross Acreage: 46.61

Gross Site Density (du/ac): N/A

Lots/Units Proposed: Commercial Lots

Gross Floor Area:

SERVICE PROVIDERS

Electric: Xcel Engergy

Metro District: Pending

Water *(if other than Town)*:

Gas: Xcel Energy

Fire District: Mountain View Fire Protection District

Sewer *(if other than Town)*:

PAGE TWO MUST BE SIGNED AND NOTARIZED

DEVELOPMENT REVIEW FEES

ANNEXATION	
☐ Major (10+ acres)	$ 4000.00
☐ Minor (less than 10 acres)	$ 2000.00
☐ Deannexation	$ 1000.00
COMPREHENSIVE PLAN AMENDMENT	
☐ Major	$ 3000.00
☐ Minor	$ 1200.00
ZONING/REZONING	
☐ Rezoning	$ 1700.00 + 10.00 per acre
☐ PUD Rezoning	$ 1700.00 + 10.00 per acre
☐ PUD Amendment	$ 1700.00 + 10.00 per acre
☐ Major PD Amendment	$ 3700.00 + 10.00 per acre
☐ Minor PD Amendment	$ 500.00
SPECIAL REVIEW USE	
☐ Major	$ 1000.00
☐ Minor	$ 400.00
☐ Oil & Gas	$ 1200.00

SUBDIVISION	
☐ Sketch Plan	$ 1000.00 + 10.00 per lot
☐ Preliminary Plat	$ 2000.00 + 40.00 per lot
☐ Final Plat	$ 2000.00 + 20.00 per lot
☑ Minor Subdivision Plat	$ 2000.00
☐ Minor Amendment Plat	$ 1000.00 + 10.00 per lot
☐ Road Vacation (constructed)	$ 1000.00
☐ Road Vacation (paper)	$ 100.00
SITE PLAN	
☐ Residential	$ 1400.00 + 10.00 per unit
☐ Non-Resi. (>10,000 sq. ft.)	$ 2200.00
☐ Non-Resi. (>2,000 sq. ft.)	$ 1000.00
☐ Non-Resi. (<2,000 sq. ft.)	$ 200.00
☐ Amendment (major)	$ 1100.00
☐ Amendment (minor)	$ 350.00
VARIANCE	$ 600.00
SERVICE PLAN	$ 10,000.00

*All fees **include** both Town of Erie Planning & Engineering review. These fees **do not include** referral agency review fees, outside consultant review fees, or review fees incurred by consultants acting on behalf of staff. See Town of Erie Municipal Code, Title 2-10-5 for all COMMUNITY DEVELOPMENT FEES.*

The undersigned is fully aware of the request/proposal being made and the actions being initiated on the referenced property. The undersigned understand that the application must be found to be complete by the Town of Erie before the request can officially be accepted and the development review process initiated. The undersigned is aware that the applicant is fully responsible for all reasonable costs associated with the review of the application/request being made to the Town of Erie. Pursuant to Chapter 7 (Section 7.2.B.5) of the Unified Development Code (UDC) of the Town of Erie, applicants shall pay all costs billed by the Town for legal, engineering and planning costs incurred by staff, including consultants acting on behalf of staff, necessary for project review. By this acknowledgement, the undersigned hereby certify that the above information is true and correct.

Owner: Erie Four Corners, LLC Date: 8.24.18

Owner: Date:

Applicant: RNCS, Inc. Date: 8-24-18

STATE OF COLORADO)
County of Boulder) ss.
)

The foregoing instrument was acknowledged before me this 24th day of August, 2018, by Justin McClure.

My commission expires: 4-16-19.
Witness my hand and official seal.

ALEXANDER F CARLSON
NOTARY PUBLIC - STATE OF COLORADO
Notary Identification #20154015351
My Commission Expires 4/16/2019

Notary Public

section A:

GENERAL PROJECT CONCEPT

Project Location

RMCS Inc., is pleased to present this introduction for Four Corners Site Plan. The Four Corners application covers a portion of land located in the North One-Half of the Southeast One-Quarter of Section 24, Township 1 North Range 69 West of the Sixth Principal Meridian, Town of Erie, County of Boulder, State of Colorado.

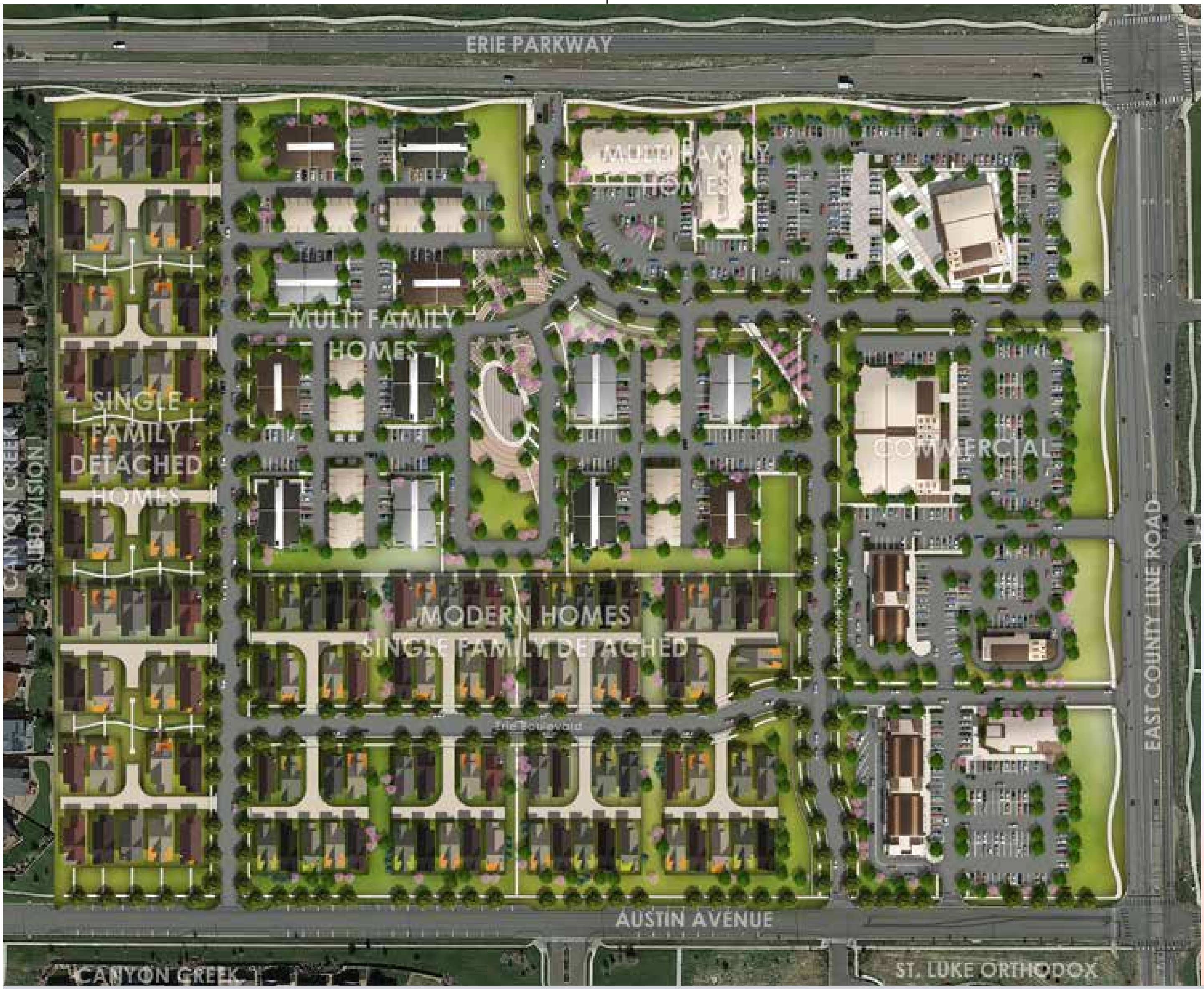
Overall Project Concept

Four Corners is envisioned as a vibrant mixed use community with a very strong emphasis on public and private amenities, diverse housing options, and most importantly, uniquely designed commercial space supported by restaurants and a shopping district. Four Corners will cater to a balanced range of uses and activities where people live, shop, reside and build their families. The proposed project plans to provide its residents with a sense of community, while also giving the Four Corners intersection a sense of identity.

A great deal of attention has been paid to maintaining a human scale in everything from street widths and a pedestrian friendly environment, to the commercial and retail uses along East County Line Road. By mixing both residential and commercial uses with recreational opportunities, the intent is to create a social and economic balance not commonly found in typical new residential developments. The overall proposed development encourages smart, compact growth, and proposes a maximum number of 500 dwelling units on the property, for a maximum overall density of approximately 15.6 dwelling units per acre. The clustered design approach, the transition between different densities and uses, and diverse housing is consistent with the spirit and intent of the residential and commercial policies set forth in the Town's Comprehensive Plan.

Overall Principal Land Uses Of Four Corners

The overall plan proposes Community Commercial, Medium and High Density Residential principal land uses within a PD Development Plan to accommodate diversified housing products, and to allow for a more creative approach to the clustering and the planning of parcels



within the overall development of the property. The PD limits the number of units allowed within the property to 500 dwelling units. In order to ensure compatibility with our surrounding neighbors, the PD established development areas, and transitional densities. The PD will also allow for dimensional standards that support the housing variations proposed to facilitate the Town of Erie Housing Diversity requirements. The commercial area is proposed to be a combination of services and retail for surrounding residents to enjoy and use.

Overall Public Benefits

The site plan identifies a landscape area to serve both as an outdoor recreational amenity, and as a transition from the commercial retail and shopping district to the high and medium density residential uses within the development. As requested by the Town of Erie, the plan proposes to enhance areas with the associated trails along County Line Road and Erie Parkway. These trails serve as a major pedestrian corridor and connection to the Town of Erie's Community Center. The remainder of the property will be preserved as non-dedicated green space areas with an internal trail network.

section B:

TOTAL LAND AREA TO BE SUBDIVIDED, TOTAL NUMBER OF LOTS AND TOTAL SQUARE FOOTAGE OF FLOOR AREA PROPOSED

Specific Purpose of the Request

This proposal requests planning approval for the commercial layout and design through the Town's of Erie Minor Subdivision process. The total property is approximately 46.61 Acres as dictated by the plat. However, more specifically, the area of interest is approximately 2.54 acres located at the South East corner of the property at the intersection of Austin Avenue and East County Line Road. The layout anticipates 11,250 square feet of in-line retail and restaurant in addition to a stand alone pad for future use

The commercial use proposed are allowed within the CC (Community Commercial) Land Use Category within the Canyon Creek PD Amendment No. 9. The proposed commercial site plan allows for a flexible approach to development that will encourage a diverse mix of commercial businesses. The design is consistent with both the spirit and intent of the commercial policies set forth in the Town's Comprehensive Plan. Furthermore the proposed development will result in both smart and compact growth, while adding to the Town of Erie's tax based income.

The Plat has been subdivided into two different Lots as well as 40' of future Right of Way for East County Line Road. A shared parking easement is proposed to be granted to all paved parking stalls within the different lots to allowed shared parking. A maintenance and access easement is proposed on all paved surfaces.

section C:

TOTAL LAND TO BE PRESERVED AS OPEN SPACE

Since this Minor Subdivision proposal is a commercial application, no land shall be dedicated as open space. However, a landscape buffer is proposed adjacent to County Line Road that incorporates a pedestrian walkway as well as drought tolerant landscape for seasonal interest in both the winter and summer.

section D:

DESCRIPTION REGARDING THE PHASING OF THE PROPOSED SUBDIVISION

The proposed development timeline and phasing is dependent on project approvals and market conditions. However, it is expected that construction will begin shortly after the Site Plan and Minor Subdivision approval. The applicant intends to request an early grading permit though the entitlement process so construction may commence as soon as possible.

The project is intended to be built in one phase. The roads, sewer, gutter and walks are expected to be completed following the approval of the submittal. The in-line retail building will be constructed first with the restaurant pad to follow. The in-line retail is anticipated to be completed 4 months following the roads and infrastructure construction. Landscape improvements will be done in phases with the irrigation mainlines all being installed as part of the building construction. Landscape/ softscape and improvements will follow after each building is completed.

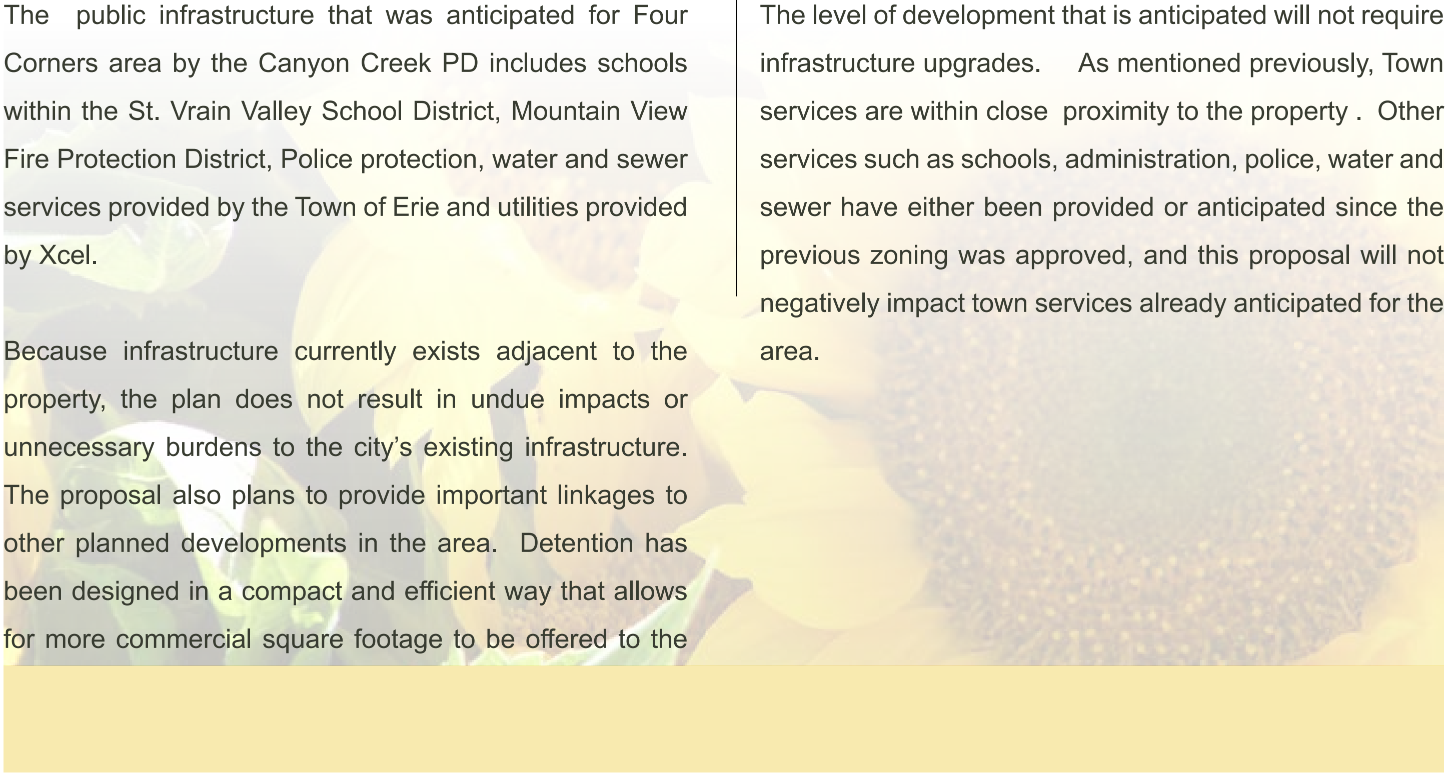
section E:

DESCRIPTION REGARDING THE AVAILABILITY AND ADEQUACY OF EXISTING INFRASTRUCTURE, AND OTHER NECESSARY SERVICES INCLUDING SCHOOLS, FIRE PROTECTION, ETC.

The property was originally part of the Homestake PUD, which was amended and approved by the Town in 2001 to the current Canyon Creek PD. Town services were anticipated for a commercial and retail zoned property. The public infrastructure that was anticipated for Four Corners area by the Canyon Creek PD includes schools within the St. Vrain Valley School District, Mountain View Fire Protection District, Police protection, water and sewer services provided by the Town of Erie and utilities provided by Xcel.

Because infrastructure currently exists adjacent to the property, the plan does not result in undue impacts or unnecessary burdens to the city's existing infrastructure. The proposal also plans to provide important linkages to other planned developments in the area. Detention has been designed in a compact and efficient way that allows for more commercial square footage to be offered to the town.

An 8" Sanitary Sewer line runs within the ROW at the intersection of East County Line Road and Erie Parkway and is in place to service the Four Corners development. The level of development that is anticipated will not require infrastructure upgrades. As mentioned previously, Town services are within close proximity to the property . Other services such as schools, administration, police, water and sewer have either been provided or anticipated since the previous zoning was approved, and this proposal will not negatively impact town services already anticipated for the area.



section F:

A DESCRIPTION REGARDING THE LOCATION, FUNCTION, AND OWNERSHIP / MAINTENANCE OF COMMON AREAS

A Commercial Owners Association is anticipated to assist with the maintenance and repair of the roads, walks, landscape and common spaces within Four Corners as determined by the covenants and restrictions set forth proceeding the approval of the community. These could include areas adjacent to County Line Road ROW and Austin Ave ROW, monumentation, lighting, and other shared use improvements.

The Plat has been subdivided into two different Lots as well as 40' of future Right of Way for East County Line Road. A shared parking easement is proposed to be granted to all paved parking stalls within the different lots to allowed shared parking. A maintenance and access easement is proposed on all paved surfaces.

section G:

DESCRIPTION REGARDING THE SUBSTANCE OF ANY EXISTING OR PROPOSED COVENANTS, SPECIAL CONDITIONS, GRANTS OR EASEMENTS OR OTHER RESTRICTIONS

Special conditions as they relate to mineral rights, signage, and other items have been included in this submittal. A portion of the Four Corners property was part of the Marfel and Pinnacle Mine, which encompassed much of the surrounding area to the North beyond the site. The property was undermined for minerals mainly consisting of coal. Also on the Eastern Edge of the property adjacent to County Line road are existing gas lines which run in a North/ South Direction.

The gas lines belong to Anadarco, and reside in an existing easement approximately 75' in width (which is depicted on the plat), straddling the eastern portion of the site. Within this easement, the plan proposes pedestrian, and vehicular improvements. However, building footprints and vertical structures that require a Certificate of Occupancy are outside of the easement. An agreement is anticipated that will dictate any disturbance to the proposed surface improvements because of gas line maintenance will be the responsibility of the Commercial Owners Associates of Four Corners.

The Pinnacle mine has been identified on the site plan with a setback radius of 40'. This mine has been studied, and a report from CTL Thompson further defines the mitigation measures and techniques employed as well as the suggested setback requirements to ensure a successful site plan design. These subsurface shafts have been inactive for decades. They have already been located by the applicant in the field and further physical property testing and depth of overburden has deemed them to be benign. Accommodations have been provided with the respected setback suggestions by CTL Thompson's Geotechnical Report. For further information please reference the Geotechnical report conducted by CTL Thompson. All building footprints and vertical structures that require a Certificate of Occupancy are outside this setback line.

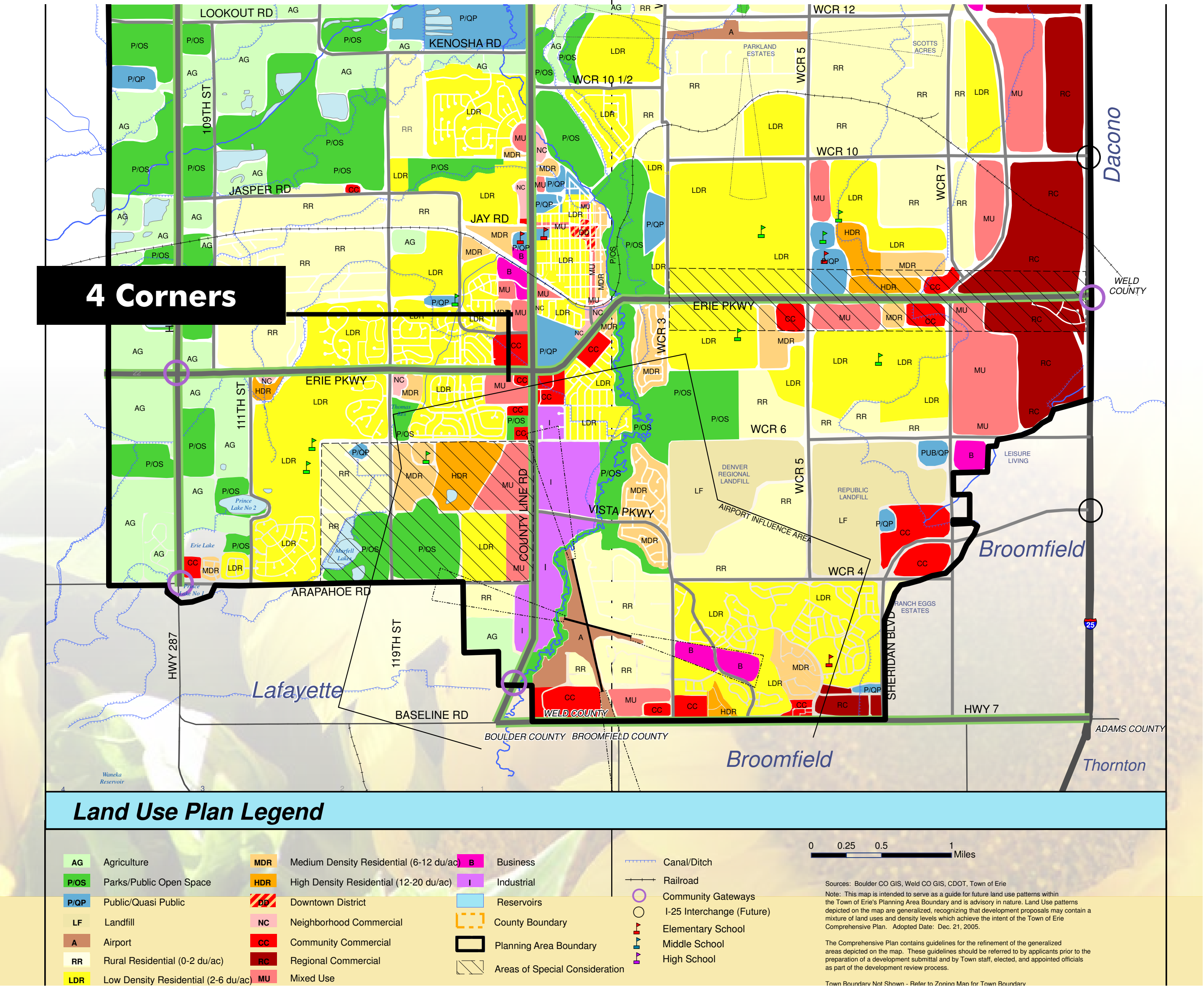
section H:

APPROVAL CRITERIA

1. Consistency With The Town' Comprehensive Plan

The property has been identified as Mixed Use & Community Commercial within the Town of Erie's 2005 Comprehensive Plan and is designated as Planned Development on the Town's zoning map. The principal land uses for the proposed commercial area is a combination of the land uses defined in the Unified Development Code as Community Commercial (CC).

The overall development at completion encourages smart, compact growth, and proposes a maximum number of 500 dwelling units on the property, for a maximum overall density of approximately 15.6 dwelling units per acre. The clustered design approach, the transition between different densities and uses, and diverse housing is consistent with the spirit and intent of the residential and commercial policies set forth in the Town's Comprehensive Plan.



Sources: Boulder CO GIS, Weld CO GIS, CDOT, Town of Erie

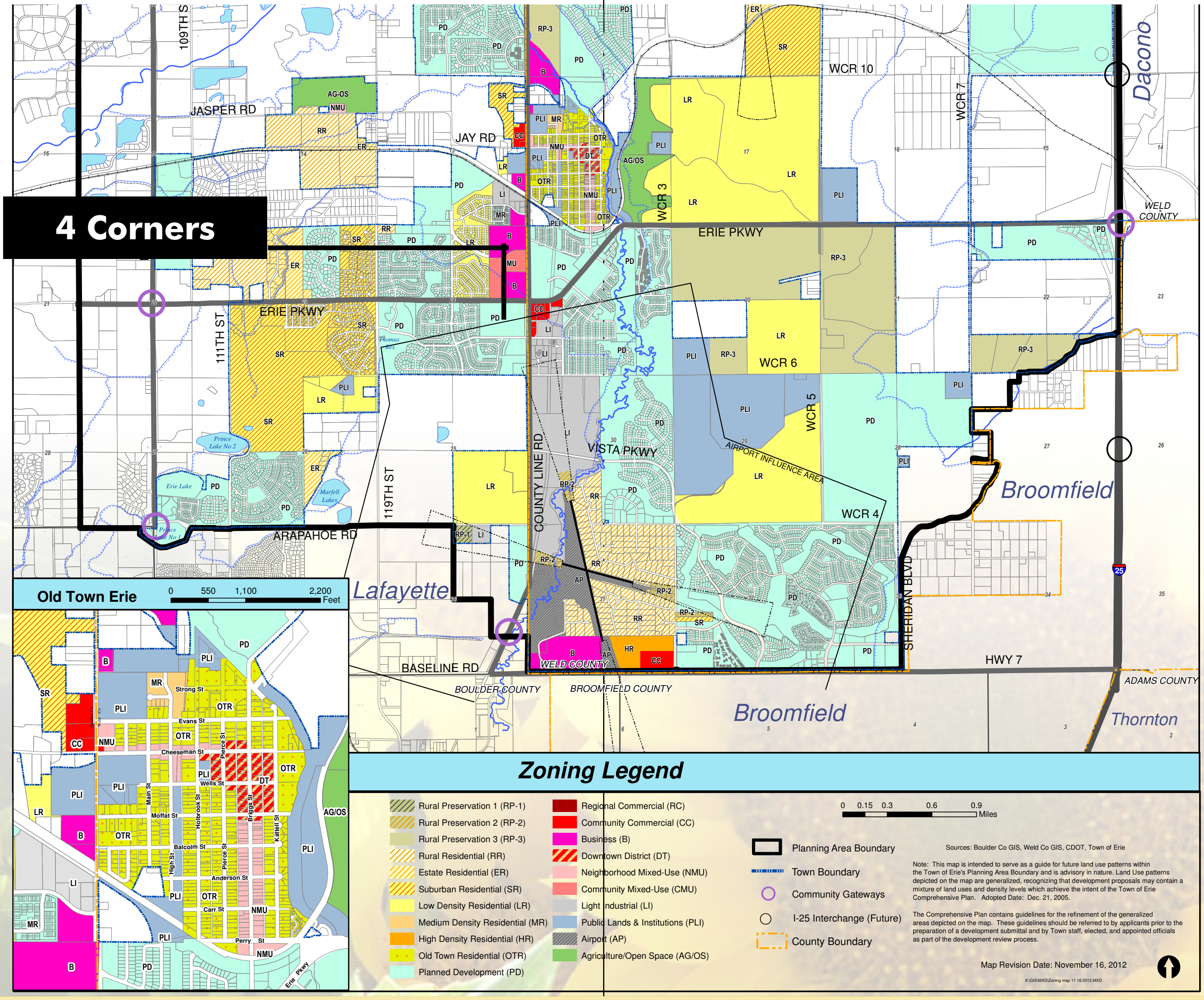
Note: This map is intended to serve as a guide for future land use patterns within the Town of Erie's Planning Area Boundary and is advisory in nature. Land Use patterns depicted on the map are generalized, recognizing that development proposals may contain a mixture of land uses and density levels which achieve the intent of the Town of Erie Comprehensive Plan. Adopted Date: Dec. 21, 2005.

The Comprehensive Plan contains guidelines for the refinement of the generalized areas depicted on the map. These guidelines should be referred to by applicants prior to the preparation of a development submittal and by Town staff, elected, and appointed officials as part of the development review process.

Town Boundary Not Shown - Refer to Zoning Map for Town Boundary

2. Consistent With Specific Zone District

This submittal and the anticipated site plan submittal include 11,250 square feet of in-line retail in addition to a future commercal pad site. The principal land uses and associated permitted uses are allowed within the CC (Community Commercial) Zone District within the Canyon Creek PD Amendment No.9.



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The Comprehensive Plan contains guidelines for the refinement of the generalized areas depicted on the map. These guidelines should be referred to by applicants prior to the preparation of a development submittal and by Town staff, elected, and appointed officials as part of the development review process.

3. As applicable, the Minor Subdivision is generally consistent with the terms and conditions of any previously approved development plan;

The site plan shall follow the Canon Creek PD Amendment No. 9 and its approved underlying land use and zoning. The property was annexed in 1975 with the expectation of being developed as a commercial site, with existing infrastructure already available to accommodate the proposed development. All of the services required for this project are already in place at this time. Furthermore, the proposed application respects and compliments the adjacent neighboring uses, access points and pedestrian connections.

4. Consistent With Use, Design And Development Standards Set Forth in the Municipal Code Title 10-UDC

Per Chapter 3 of the Unified Development Code, the anticipated uses for the commercial site plan application are a restaurant with a drive through and in-line retail and restaurant that would cater to services such as a barber shop, nail salon, or other retail conveniences for surrounding residents. All tenants are anticipated to fall within permitted use by rights and will not need a special use review.

Per Chapter 6 of the Unified Development Code, the current site plan as proposed respects many of the goals and policies set forth such as:

Natural and Scenic Resource Protection:
The property does not have any significant native tree species or vegetation. The proposed development would not adversely impact the visual or aesthetic quality of the Town or surrounding residents.

Community Gateway:
A 30' landscape buffer is maintained along Erie Parkway and will eventually incorporate a pedestrian sidewalk, and a variety of live plant material for seasonal interest.

Park Land & Open Space Dedication:
There is no park land or open space dedication requirement to fulfill within this commercial site plan application as no future residents are generated through the proposal.

Transportation and Access:
Vehicular connections are provided within the proposed site plan to both County Line Road (right in-right out) and Austin Avenue (full movement turn). This provides connections and choices for users, tenants and deliveries while mitigating traffic impacts on existing arterial and collector roads.

5. Adequate Public Safety, Transportation, Utilities

Facilities, Parks And Schools Are Available.

As mentioned previously in this proposal, the property was originally part of the Homestake PUD, which was amended and approved by the Town in 2001 to the current Canyon Creek PD. Town services were anticipated for a commercial and retail zoned property. The public infrastructure that was anticipated for Four Corners area by the Canyon Creek PD includes schools within the St. Vrain Valley School District, Mountain View Fire Protection District, Police protection, water and sewer services provided by the Town of Erie and utilities provided by Xcel.

This plan does not result in undue impacts or unnecessary burdens to the city's existing infrastructure and provides important linkages to other planned developments in the area. Detention has been designed in a compact and efficient way that allows for more commercial square footage.

An 8" Sanitary Sewer line runs within the ROW at the intersection of East County Line Road and Erie Parkway and is in place to service the Four Corners development. The level of development that is anticipated will not change this infrastructure in place nor will it change our existing road designations. As mentioned previously, Town services are within close proximity to the property Other services such as schools, administration, police, water and sewer have either been provided or anticipated since the previous zoning was approved, and this proposal will not negatively impact town services already anticipated for the area.

Erie Four Corners Project
Neighborhood Meeting

Meeting Date/Time: October 17, 2017 at 5 pm
Meeting Location: Erie Community Center, 450 Powers Street, Erie, CO 80516

Attendance:
Alex Carlson – Foundry Builders (Project Developer)
Dave Waldner – Foundry Builders (Project Developer)
7 members of the public – See attached sign-in sheet

Summary Meeting Notes:
Alex began the meeting at approximately 5:10pm with a brief overview of Foundry Builders and the local investor group. He then showed preliminary renderings and conceptual site plans of the project. He presented an overall vision for the site as a mixed-use development incorporating both low- and high-density residential uses including four phases of commercial development. The site will emphasize multi-modal transportation and provide connectivity to the surrounding amenities the Town of Erie has to offer. Alex reiterated that the purpose of the neighborhood meeting was to discuss the approximate 5-acre commercial parcel referred to as Phase One.

Following a brief overview of the conceptual plan for the entire site, Alex showed an illustrative site plan of phase one including the in-line commercial building and proposed lot for a unique future use. After viewing the site plan, several members of the public commented on the current stacking that occurs at Austin Ave between the hours of 7:15 and 8:15am waiting to turn onto County Line Road. The members of the public acknowledged that they should be expressing this concern with the Town of Erie and that the new median in Austin Avenue would not likely impact the current issue.

Alex then presented conceptual renderings of the in-line building. Members of the public were very interested in the type of user that might be a part of this project. He expressed that there are not currently any executed leases. However, Foundry Builders attended the International Council of Shopping Centers (ICSC) annual conference and engaged in several conversations with national food service companies. Alex explained that the project developer's goal is to incorporate two restaurants into the in-line space and have approximately 2-3 other commercial users. These could be businesses such as fitness studios, salons or other entrepreneurial establishments. Those in attendance at the meeting expressed a desire for a variety of restaurants. Alex mentioned that the vacant lot is envisioned to be a unique restaurant space ideal for a local restaurateur. The focus of the meeting then became the remaining City Process. Alex informed everyone that they would be receiving notice for the Planning and Zoning (P/Z) Commission and Board of Trustees hearing in the coming weeks/months.

To conclude the meeting, Alex showed an overall site-plan for the entire 46 acres. He reiterated that the purpose of the meeting was to discuss the Phase One commercial project submittal at the corner of Austin Avenue and East County Line Road but that it was important to show the surrounding property owners the overall vision for the site. The meeting concluded at approximately 6:15pm.

Four Corners Neighborhood Meeting – Attendance Sheet

Name	Address	E-Mail
John Grose	205 Grandview Cir. Medd	jr_lahn@gmail.com
Jeff Muhr	1401 NE Countyline Rd. Erie	targetcorporation@gmail.com
Joe Johnson	1463 Graham Cir.	jjohnson@abco-corp.com
Donnie Waller	1365 Argare Way	donniewaller@gmail.com
Sal Cambria	1331 Graham Cir.	nirpno@yahoo.com
Michael Mifsud	230 Bridges St. Erie	boomerandimprovements@comcast.net
Dennis Flaherty	407 Carden Pl.	dennisf@denix.us
Canyon Creek HOA Executive Board		board@canyoncreeksouth2.com
Dennis Flaherty	President	Dennis.flaherty@canyoncreeksouth2.com
Linda O'Day	Manager	loday@coloradomanagement.com

OIL AND GAS LEASE

THIS AGREEMENT, Made and entered into this 30th day of May, 2008, by and between **ECV Minerals, LLC, a Colorado limited liability company,** whose post office address is 7720 East Belleview Avenue, Suite 350, Greenwood Village, Colorado 80111, hereinafter called Lessor, and **EnCana Oil & Gas (USA), Inc.,** whose post office address is 370 17th Street, Suite 1700, Denver, Colorado 80202, hereinafter called Lessee:

WITNESSETH, That the said Lessor, for and in consideration of **Ten and More ($10.00)** DOLLARS, cash in hand paid, the receipt of which is hereby acknowledged, and the covenants and agreements hereinafter contained, has granted, demised, leased and let, and by these presents does grant, demise, lease and let exclusively unto the said Lessee, the land hereinafter described, with the exclusive right for the purpose of mining, exploring by geophysical and other methods, and operating for and producing therefrom oil and all gas of whatsoever nature or kind, with rights of way and easements for laying pipe lines, and erection of structures thereon to produce, save and take care of said products, all that certain tract of land situated in the County of Boulder, State of Colorado, described as follows, to-wit:

Township 1 North, Range 69 West, 6th PM
Section 24: A tract of land in the N/2SE/4 described as follows:
Beginning at the E¼ corner section of Section 24, which is also the True Point of Beginning; thence S0°59'04" E. 1326.54'; thence N89°52'59" W. 1699.28'; thence N0°54'34" W. 1327.96'; thence S89°50'03" E. 1697.57' to the True Point of Beginning;
Containing a total of 51.74 acres, more or less.

Said Lands are subject to NO SURFACE OCCUPANCY

1. It is agreed that this lease shall remain in force for a term of three (3) years from this date and as long thereafter as oil or gas of whatsoever nature or kind is produced from said leased premises or on acreage pooled therewith, or drilling operations are continued as hereinafter provided. If, at the expiration of the primary term of this lease, oil or gas is not being produced on the leased premises or on acreage pooled therewith but Lessee is then engaged in drilling or re-working operations thereon, then this lease shall continue in force so long as operations are being continuously prosecuted on the leased premises or on acreage pooled therewith; and operations shall be considered to be continuously prosecuted if not more than one hundred eighty (180) days shall elapse between the completion or abandonment of one well and the beginning of operations for the drilling of a subsequent well. If after discovery of oil or gas on said land or on acreage pooled therewith, the production thereof should cease from any cause after the primary term, this lease shall not terminate if Lessee commences additional drilling or re-working operations within one hundred eighty (180) days from date of cessation of production or from date of completion of dry hole. Drilling operations shall be deemed to be commenced when the first material is placed on the leased premises or when the first work, other than surveying or staking the location, is done thereon which is necessary for such operations. If oil or gas shall be discovered and produced as a result of such operations at or after the expiration of the primary term of this lease, this lease shall continue in force so long as oil or gas is produced from the lease premises or on acreage pooled therewith.

2. This is a **PAID-UP LEASE**. In consideration of the down cash payment, Lessor agrees that Lessee shall not be obligated, except as otherwise provided herein, to commence or continue any operations during the primary term. Lessee may at any time or times during or after the primary term surrender this lease as to all or any portion of said land and as to any strata or stratum by delivering to Lessor or by filing for record a release or releases, and be relieved of all obligation thereafter accruing as to the acreage surrendered.

3. In consideration of the premises the said Lessee covenants and agrees:

1st. To deliver to the credit of Lessor, free of cost in the pipe to which Lessee may connect his wells, the equal three-sixteenth (3/16th) part of all oil produced and saved from the leased premises, or at the Lessee's option, may pay to the Lessor for such three-sixteenth (3/16th) royalty, three-sixteenth (3/16th) of the then market value at the mouth of the well of all oil produced and saved hereunder by the Lessee from the leased premises.

2nd. To pay Lessor for gas of whatsoever nature or kind (with all of its constituents) produced and sold or used off the leased premises, or used in the manufacture of products therefrom, three-sixteenths (3/16th) of the gross proceeds received for the gas sold, used off the premises, or in the manufacture of products therefrom, but in no event more than three-sixteenth (3/16th) of the actual amount received by the Lessee, said payments to be made monthly. During any period (whether before or after expiration of the primary term hereof) when gas is not being so sold or used and the well or wells are shut in and there is no current production of oil or operations on said leased premises sufficient to keep this lease in force, Lessee shall pay or tender a royalty of One Dollar ($1.00) per year per net royalty acre retained hereunder, such payment or tender to be made, on or before the anniversary date of this lease next ensuing after the expiration of ninety (90) days from the date such well is shut in and thereafter on the anniversary date of this lease during the period such well is shut in, to the royalty owners or to the royalty owner's credit in the rental depository bank hereinafter designated. When such a payment or tender is made it will be considered that gas is being produced within the meaning of the entire lease.

3rd. To pay Lessor for gas produced from any oil well and used off the premises, or for the manufacture of casing-head gasoline or dry commercial gas, three-sixteenth (3/16th) of the gross proceeds, at the mouth of the well, received by Lessee for the gas during the time such gas shall be used, said payments to be made monthly.

4. If said Lessor owns a less interest in the above described land than the entire and undivided fee simple estate therein, then the royalties (including any shut-in gas royalty) herein provided for shall be paid the said Lessor only in the proportion which Lessor's interest bears to the whole and undivided fee.

5. The rights of Lessor and Lessee hereunder may be assigned in whole or part. No change in ownership of Lessor's interest (by assignment or otherwise) shall be binding on Lessee until Lessee has been furnished with notice, consisting of certified copies of all recorded instruments or documents and other information necessary to establish a complete chain of record title from Lessor, and then only with respect to payments thereafter made. No other kind of notice, whether actual or constructive, shall be binding on Lessee. No present or future division of Lessor's ownership as to different portions or parcels of said land shall operate to enlarge the obligations or diminish the rights of Lessee, and all Lessee's operations may be conducted without regard to any such division. If all or any part of this lease is assigned, no leasehold owner shall be liable for any act or omission of any other leasehold owner.

6. Lessee is hereby granted the right at any time and from time to time to unitize, pool or combine the leased premises or any portion or portions thereof, as to all strata or any stratum or strata, with any other lands as to all strata or any stratum or strata, for the production primarily of oil or primarily of gas with or without distillate. However, no unit for the production primarily of oil shall embrace more than 160 acres, or for the production primarily of gas with or without distillate more than 160 acres; provided that if any governmental regulation shall prescribe a spacing pattern for the development of the field or allocate a producing allowable based on acreage per well, then any such unit may embrace as much additional acreage as may be so prescribed or as may be used in such allocation of allowable. Operations upon and production from the unit shall be treated as if such operations were upon or such production were from the leased premises whether or not the well or wells are located thereon. The entire acreage within a unit shall be treated for all purposes as if it were covered by and included in this lease except that the royalty on production from the unit shall be as below provided, and except that in calculating the amount of any rentals or shut in gas royalties, only that part of the acreage originally leased and then actually embraced by this lease shall be counted. In respect to production from the unit, Lessee shall pay Lessor, in lieu of other royalties thereon, only such proportion of the royalties stipulated herein as the amount of his acreage placed in the unit, or his royalty interest therein on an acreage basis bears to the total acreage in the unit.

7. All express or implied covenants of this lease shall be subject to all Federal and State Laws, Executive Orders, Rules or Regulations, and this lease shall not be terminated, in whole or in part, nor Lessee held liable in damages, for failure to comply therewith, if compliance is prevented by, or if such failure is the result of, any such Law, Order, Rule or Regulation.

8. Lessor hereby warrants and agrees to defend the title to the lands herein described.

9. Should any one or more of the parties hereinabove named as Lessor fail to execute this lease, it shall nevertheless be binding upon all such parties who do execute it as Lessor. The word "Lessor", as used in this lease, shall mean any one or more or all of the parties who execute this lease as Lessor. All the provisions of this lease shall be binding on the heirs, successors and assigns of Lessor and Lessee.

10. Additional Provisions. This Lease is being entered into by Lessor with the specific understanding that no right has been granted to Lessee under the terms of this Lease to enter onto the surface of the lands that are the subject to this Lease ("Surface Estate") for any purpose whatsoever. Notwithstanding any other provision herein contained, Lessee acknowledges and agrees that it shall have no right to enter onto the Surface Estate for any purpose whatsoever. In addition to the foregoing, Lessee hereby specifically agrees to the following:

a. This Lease is specifically made subject to, and Lessee agrees to be bound by, the provisions contained in the Restrictive Covenant and Non-Disturbance Agreement, recorded on May 29, 2008, recorded at Reception Number 2932960, in the real property records of Boulder County, Colorado, between Erie Commercial Venture, LLLP, the owner of the Surface Estate, and ECV Minerals, LLC, the owner of the mineral estate.

b. Lessee hereby specifically agrees not to interfere with, hinder or delay, in any manner whatsoever, the development of the Surface Estate.

ARM

c. Lessee, for itself and its successors and/or assigns, (i) hereby waives any right to receive notice of the development of the Surface Estate pursuant C.R.S. §24-65.5-103(5), and (ii) hereby waives any right to object to the development of the Surface Estate pursuant to C.R.S. §24-65.5-103.3.

d. Lessee releases and holds harmless, and indemnifies, Lessor, its successors and assigns, of and from any and all liability for loss or damage of any kind or nature to persons or property, now or hereafter upon the Surface Estate, including without limitation environmental loss or damage, arising directly or indirectly from Lessee's acts, or the acts or failure to act of Lessee's officers, agents, employees, independent contractors or assigns.

IN WITNESS WHEREOF, this instrument is executed as of the date first above written.

ECV Minerals, LLC,
a Colorado limited liability company

BY____________________
A.L. (Sid) Overton, Manager

BY Stanley R Medsker
Stanley R. Medsker, Manager

ACKNOWLEDGMENT

STATE OF COLORADO)
COUNTY OF arapahoe) ss.

On this 30th day of May, 2008, before me personally appeared A. L. (Sid) Overton,, known to me to be the Manager of ECV Minerals, LLC, and that he executed the within and foregoing instrument, and acknowledged the said instrument to be the free and voluntary act and deed of said company, for the uses and purposes therein set forth.

My Commission Expires: 10/12/2010

Lisa M. Morris
Notary Public

(SEAL)

LISA M. MORRIS
NOTARY PUBLIC
STATE OF COLORADO
My Commission Expires Oct. 12, 2010

STATE OF COLORADO)
COUNTY OF arapahoe) ss.

On this 30th day of May, 2008, before me personally appeared Stanley R. Medsker,, known to me to be the Manager of ECV Minerals, LLC, and that he executed the within and foregoing instrument, and acknowledged the said instrument to be the free and voluntary act and deed of said company, for the uses and purposes therein set forth.

My Commission Expires: 10/12/2010

Lisa M. Morris
Notary Public

(SEAL)

LISA M. MORRIS
NOTARY PUBLIC
STATE OF COLORADO
My Commission Expires Oct. 12, 2010

2932960 05/29/2008 10:53:47 AM
COVENANT RF: $31.00 DF: $0.00 Page: 1 of 6
Electronically recorded in Boulder County Colorado.

RESTRICTIVE COVENANT AND NON-DISTURBANCE AGREEMENT

THIS RESTRICTIVE COVENANT AND NON-DISTURBANCE AGREEMENT ("Agreement") is made and entered into as of the 28 day of May, 2008 by and among Erie Commercial Venture, LLLP, a Colorado limited liability limited partnership, whose principal business address is 7720 East Belleview Avenue, Suite 350, Greenwood Village, Colorado 80111 (hereinafter "Erie Commercial"), and ECV Minerals, LLC, a Colorado limited liability company, whose principal business address is 7720 East Belleview Avenue, Suite 350, Greenwood Village, Colorado 80111 (hereinafter "ECV Minerals"). ECV Minerals and Erie Commercial may each be referred to herein, individually, as a "Party", or collectively, as "the Parties", each term shall include their respective successors and assigns.

RECITALS

WHEREAS, Erie Commercial is the owner of certain real property consisting of approximately 46.613 acres located in Boulder County, Colorado, as legally described in Exhibit A, attached hereto, and incorporated herein by reference ("Erie Commercial Property").

WHEREAS, Erie Commercial and/or its successors or assigns, desire to develop the Erie Commercial Property for commercial, retail or residential uses.

WHEREAS, Erie Commercial desires to obtain certain assurances by the mineral interest owner underlying the Erie Commercial Property that the surface of the Erie Commercial Property shall not be used for oil or gas production, which would significantly harm the ability of Erie Commercial to develop the Erie Commercial Property.

WHEREAS, ECV Minerals is the owner of all of the mineral interests, specifically including oil and gas, underlying the Erie Commercial Property ("ECV Mineral Estate").

WHEREAS, ECV Minerals and Erie Commercial desire to enter into this Agreement by virtue of which ECV Minerals shall covenant and agree that all future owners or lessee's of the ECV Mineral Estate shall be specifically restricted from any use of the surface of the Erie Commercial Property for any purpose except as specifically set forth herein.

WHEREAS, the Parties wish to memorialize their agreement in writing as hereinafter set forth.

AGREEMENT

NOW THEREFORE, in consideration of (1) the sum of Ten and no/100 ($10.00) Dollars, (2) for the promises and covenants herein contained, and (3) for other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, and intending to be legally bound, the Parties hereby agree as follows:

1. Restrictive Covenant/Non-Disturbance Agreement. ECV Minerals shall not, nor shall ECV Minerals permit any future owner or lessee of the ECV Mineral Estate underlying the Erie Commercial Property, to use the surface of the Erie Commercial Property, or the area five hundred (500) feet immediately below the surface of the Erie Commercial Property for (i) the

purpose of surveying by geological, geophysical and all other methods; (ii) mining, drilling or operating for oil and gas; (iii) drilling any wells for oil and gas; (iv) laying pipelines; (v) building tanks, power stations or any other structures on the Erie Commercial Property; or (vi) in any way extracting or producing oil and gas from the mineral interests owned by ECV Minerals to the extent that the surface of the Erie Commercial Property, or the area five hundred (500) feet immediately below the surface of the Erie Commercial Property is used for such purposes.

2. Cooperation. In consideration of Paragraph 1, Erie Commercial, on behalf of itself and its successors and assigns, hereby agrees not to object to or hinder ECV Minerals, its successors, assigns and future lessees, in ECV Minerals's efforts, or the efforts of a future lessee of ECV Minerals, in obtaining all necessary permits, licenses and other approvals from state, county and municipal authorities to permit or authorize ECV Minerals, its successors and assigns, or a future lessee of ECV Minerals, to drill and/or recomplete well(s) under the Erie Commercial Property, provided such drilling is from surface location(s) other then the Erie Commercial Property, to include an exception location(s) under the Rules and Regulations of the Colorado Oil & Gas Conservation Commission for any such well(s).

3. Covenants of any Future Lease. For the consideration recited herein, ECV Minerals shall include an appropriate provision in any future mineral lease for the ECV Mineral Estate to effectuate the restrictive covenants contained in this Agreement.

4. Term of Restrictive Covenants. The term of this Agreement, and the restrictive covenants contained herein, shall be perpetual.

5. Reservation. ECV Minerals reserves unto itself such rights in the ECV Mineral Estate subject to this Agreement for any purpose which does not interfere with the restrictive covenants granted herein.

6. Recording. This Agreement, and any amendments hereto, shall be recorded in the real property records of the Clerk and Recorder of Boulder County, Colorado.

7. Notice of Development. Pursuant to C.R.S. §24-65.5-103(5), a mineral estate owner may waive the right to notice of the development of the surface estate under C.R.S. §24-65.5-103. This Agreement prevents the use of the surface estate of the Erie Commercial Property by the owner(s) of the mineral estate, and as such, ECV Minerals, for itself and its successors and/or assigns, (i) hereby waives any right to receive notice of the development of the surface estate pursuant C.R.S. §24-65.5-103(5), and (ii) hereby waives any right to object to the development of the surface estate pursuant to C.R.S. §24-65.5-103.3.

8. Agreement Binding. This Agreement, and the restrictive covenants contained herein, shall be binding upon and shall inure to the successors and assigns of the Parties hereto, and shall be a covenant running with the land for so long as ECV Minerals or its successors and/or assigns, are the oil, gas or mineral interest owner or lessee of the mineral interests under the Erie Commercial Property.

9. Miscellaneous Provisions.

A. No Third Party Beneficiaries. This Agreement is entered into between and for the benefit of Erie Commercial and ECV Minerals and no other party. The Parties hereto disclaim and do not intend that any third party rely on or claim to benefit from this Agreement.

B. Governing Law. This Agreement shall be governed by and construed in accordance with the laws of the State of Colorado. The Parties hereto agree to submit to the jurisdiction of the federal and state courts of the State of Colorado with respect to the breach or interpretation of this Agreement or the enforcement of any and all rights, duties, liabilities, obligations, powers, and other relations between the Parties arising under this Agreement. The Parties hereby waive any right to trial by jury in any subsequent litigation between them where such litigation arises out of, is related to, or is in connection with any provision of this Agreement or any exhibit thereto, whether the Agreement is asserted as the basis for a claim, counterclaim or a crossclaim, or a defense to a claim, counterclaim or crossclaim.

C. Attorneys' Fees. The prevailing Party to any suit arising out of this Agreement shall be entitled to reasonable attorneys' fees, plus expenses and costs of court.

D. Entire Agreement. This Agreement, including Exhibit A (Legal Description), constitutes the sole and entire agreement between the Parties with respect to the subject matter hereof and supersedes any prior or contemporaneous letter of intent, agreement or understanding, whether written or oral, if any, between the parties with respect to such subject matter. THERE ARE NO ORAL AGREEMENTS CONCERNING THE SUBJECT MATTER OF THIS AGREEMENT.

E. Construction. This Agreement shall not be construed more strictly against one Party than against the other merely by virtue of the fact that it may have been prepared by counsel for one of the Parties, it being recognized that all of the Parties have contributed substantially and materially to the preparation of this Agreement, and as such, the language and all parts of this Agreement shall be in all cases construed in accordance with their fair meaning. The Recitals to this Agreement shall be deemed a substantive part of this Agreement. The subject headings of the paragraphs and subparagraphs of this Agreement are included for purposes of convenience only, and shall not affect the construction or interpretation of any of the provisions of this Agreement.

F. Counterparts. This Agreement may be executed in multiple counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.

G. Further Agreements. The Parties agree to execute such other and further written agreements which may be necessary and required to fully implement and carry out the intent of the Parties to this Agreement so as to conclude a full and final settlement of all issues between the Parties, and which such written agreement(s) shall be consistent with, and not in conflict with this Agreement between the Parties.

NRM

H. Amendments. This Agreement may be modified only by a further written agreement signed by all of the Parties hereto.

I. Adequate Consideration. All Parties acknowledge and agree that the covenants and promises contained herein are good and sufficient consideration for their respective obligations required hereunder.

J. Severability. If any provision of this Agreement is deemed to be illegal, invalid or unenforceable for any reason, the remaining provisions of this Agreement shall be unaffected, and this Agreement shall continue in full force and effect.

IN WITNESS WHEREOF, the Parties hereto have executed this Restrictive Covenant and Non-Disturbance Agreement on the dates adjacent to each Parties signature below.

"Erie Commercial"

Erie Commerical Ventures, LLLP, a
Colorado limited liability limited partnership

By: ______________________ May 28, 2008
A. L. (Sid) Overton, General Partner Date

By: Stanley R Medsker May 28, 2008
Stanley R. Medsker, General Partner Date

"ECV Minerals"

ECV Minerals, LLC, a Colorado
limited liability company

By: ______________________ May 28, 2008
A. L. (Sid) Overton, Manager Date

By: Stanley R Medsker May 28, 2008
Stanley R. Medsker, Manager Date

STATE OF Colorado)

COUNTY OF arapahoe)

The foregoing Restrictive Covenant and Non-Disturbance Agreement was voluntarily executed and acknowledged before me, a notary public, by A. L. (Sid) Overton, as General Partner of Erie Commercial Venture, LLLP, a Colorado limited liability limited partnership, and as Manager of ECV Minerals, LLC, a Colorado limited liability company, on this 28th day of May, 2008.

WITNESS MY HAND AND OFFICIAL SEAL

Lisa M. Morris
Notary Public

My commission expires: 10/12/2010

Address 12943 Lafayette St. #B
Thornton CO 80241

STATE OF Colorado)

COUNTY OF arapahoe)

LISA M. MORRIS
NOTARY PUBLIC
STATE OF COLORADO
My Commission Expires Oct. 12, 2010

The foregoing Restrictive Covenant and Non-Disturbance Agreement was voluntarily executed and acknowledged before me, a notary public, by Stanley R. Medsker, as General Partner of Erie Commercial Venture, LLLP, a Colorado limited liability limited partnership, and as Manager of ECV Minerals, LLC, a Colorado limited liability company, on this 28th day of May, 2008.

WITNESS MY HAND AND OFFICIAL SEAL

Lisa M. Morris
Notary Public

My commission expires: 10/12/2010

Address 12943 Lafayette ST. #B
Thornton CO 80241

LISA M. MORRIS
NOTARY PUBLIC
STATE OF COLORADO
My Commission Expires Oct. 12, 2010

EXHIBIT A

Erie Commercial Ventures, LLLP
Property Description

PARCEL DESCRIPTION

A PARCEL OF LAND IN THE N ½ OF THE SE ¼ OF SECTION 24, T1N, R69W OF THE 6TH P.M., DESCRIBED AS FOLLOWS:

BEGINNING AT THE E ¼ CORNER OF SECTION 24, WHICH IS ALSO THE TRUE POINT OF BEGINNING; THENCE S 0°59'04" E, 1326.54 FEET; THENCE N 89°52'59" W, 1699.28 FEET; THENCE N 0°54'34" W, 1327.96 FEET, THENCE S 89°50'03" E, 1697.57 FEET TO THE TRUE POINT OF BEGINNING;

EXCEPT THAT PORTION CONVEYED TO THE TOWN OF ERIE IN DEED RECORDED JANUARY 29, 2002 AT RECEPTION NO. 2247996, COUNTY OF BOULDER, STATE OF COLORADO.

CONTAINING 2,030,441 SQUARE FEET OR 46.613 ACRES MORE OR LESS.

EXCEPT THE EAST 30 FEET IN ROAD BOOK B, PAGE 285, AND THE SOUTH 40 FEET AS CONVEYED TO THE TOWN OF ERIE BY SPECIAL WARRANTY DEED RECORDED MARCH 28, 2001 AT RECEPTION NO. 2132136.

County of Boulder
State of Colorado

2927262 05/01/2008 12:32:43 PM
AG RF: $26.00 DF: $0.00 Page: 1 of 5
Electronically recorded in Boulder County Colorado.

WELL ABANDONMENT AGREEMENT

THIS AGREEMENT is made and entered into this 25th day of January, 2001, by and between North American Resources Company ("NARCO"), with offices at 1700 Broadway, Suite 2000, Denver, Colorado 80290 and Johnson Development Company ("Johnson"), with offices at 4380 South Syracuse Street, Denver, Colorado 80237.

RECITALS

1. Johnson either owns or has an option to purchase the entire S/2 of Section 24, Township 1 North, Range 69 West, Boulder County, Colorado ("Property").

2. The property is subject to the following oil and gas leases ("Leases"), to-wit:

a. Oil and gas lease dated August 20, 1981, from Maxine Johnson Haley Trust, James S. Haley, Trustee, as lessor, to J. Michael McGhee ("McGhee"), as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466152.

b. Oil and gas lease dated August 20, 1981, from Susan J. Troudt, Marian J. Bottinelli, Carla Johnson Hobbs, d/b/a Johnson Farms, as lessor, to J. Michael McGhee, as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466151.

c. Oil and gas lease dated August 18, 1981, from Wallace H. Grant and Douglas Grant, as lessor, to J. Michael McGhee, as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466154.

d. Oil and gas lease dated August 7, 1981, from The Longmont National Bank and Lorraine Miller as Co-Trustees of the Carl A. Miller Trust, as lessor, to J. Michael McGhee, as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466153.

3. NARCO has succeeded to all of the working interests of McGhee under the Leases.

4. NARCO operates two oil and gas wells on the Property known as the Erie Eight E Unit #1 located in the SE/4SE/4 of Section 24 ("Erie #1") and the Erie Eight E Unit #2 located in the SW/4SW/4 of Section 24 ("Erie #2") in which NARCO presently owns all the working interest. The Erie #1 and Erie #2 may be hereinafter collectively referred to as the "Wells."

5. Johnson wishes to develop the property free of the Wells and subsequent drilling.

6. NARCO and Johnson enter into this Agreement to provide for NARCO to plug and abandon the Wells, among other things, in exchange for certain payments from Johnson to NARCO as provided herein.

TERMS AND PROVISIONS

NOW, THEREFORE, in consideration of the covenants and the mutual benefits set forth herein, including the representations set forth in the recitals, the parties agree as follows:

1. Plugging and Abandonment of Erie #2 Well and Reclamation

NARCO shall plug and abandon the Erie #2 well and remove all equipment and production facilities from the wellsite and also reclaim and remediate the surface of the wellsite and all associated production facilities and pits, access and gas flowlines from the Erie #2 wellhead to the gas transmission line in accordance with the rules and regulations of the Colorado Oil and Gas Conservation Commission ("COGCC") on or before March 1, 2001. The completion of remediation at this site may be extended if unexpected complications are encountered, but NARCO will diligently pursue said remediation until it is completed. NARCO will provide Johnson notice of such extension as soon as it is practicable with an explanation of the cause of the delay.

AFTER RECORDING RETURN TO:
MARK OVERTON
7700 E. BELLEVIEW AVE #350
GREENWOOD VILLAGE, CO. 80111

FAITCO

HO206316 / HO135322

1

2. Plugging and Abandonment of Erie #1 Well and Reclamation

NARCO shall plug and abandon the Erie #1 well and remove all equipment and production facilities from the wellsite and also reclaim and remediate the surface of the wellsite and all associated production facilities and pits, access and gas flowlines from the Erie #1 wellhead to the gas transmission line in accordance with the rules and regulations of the Colorado Oil and Gas Conservation Commission ("COGCC"). This will be accomplished within fifty (50) days after receiving written notice from Johnson.

3. Wellhead Equipment and Production Facilities

NARCO shall continue to own the wellhead equipment and associated production facilities and equipment as to each respective well.

4. Purchase Price

As consideration for the terms and provisions contained herein, Johnson agrees to pay NARCO $500,000.00 as follows:

a. Johnson shall pay NARCO the sum of $250,000 in the form of a certified cashier's check contemporaneous with the execution of this agreement.

b. Johnson shall pay NARCO the sum of $125,000 ("Second Payment") in the form of a certified cashier's check to NARCO within five (5) business days of Johnson's receiving a copy of the successful final reclamation inspection of the Erie #2 wellsite and reclaimed areas in accordance with COGCC Rule 1004.c.

c. Johnson shall pay NARCO the sum of $125,000 ("Third Payment") in the form of a certified cashier's check to NARCO within five (5) business days of Johnson receiving a copy of the successful final reclamation inspection of the Erie #1 wellsite and reclaimed areas in accordance with COGCC Rule 1004.c.

d. Until such time as each well is plugged and abandoned, NARCO shall continue to receive all revenue attributable to the production as to each well, and shall continue to disburse those proceeds from each well attributable to the respective landowner and overriding royalty owner interests.

e. In the event that NARCO fails or refuses to plug and abandon the Erie #2 well and reclaim the surface of the wellsite and all associated production facilities and pits, access roads and pipelines as set forth above (hereinafter referred to as the "Work", whether referencing the Erie #2 well or the Erie #1 well) on or before February 15, 2001 (First Abandonment Date), the parties agree that, after the First Abandonment Date, Johnson may engage a contractor to perform the Work and that such contractor shall be the agent of NARCO and not of Johnson. In such event, the Second Payment shall be reduced by all of the costs incurred by the contractor to perform the work.

f. In the event that NARCO fails or refuses to plug and abandon and complete the Work for the Erie #1 well on or before March 15, 2001 (Second Abandonment Date), the parties agree that, after the Second Abandonment Date, Johnson will engage a contractor to perform the Work and that such contractor shall be the agent of NARCO and not of Johnson. In such event, the Third Payment shall be reduced by all of the costs incurred by the contractor to perform the work.

g. If NARCO is rendered unable to perform the plugging, abandoning and subsequent restoration of the property, wholly or in part, by force majeure preventing it from carrying out its obligations to do so, it shall be automatically granted such time as is necessary for the obligations to be completed over and above the times stated herein. "Force majeure" shall be defined herein as any act of God, strike, lockout or other industrial disturbance, act of the public enemy, war, public riot, lightning, storm, flood or other act of nature, explosion, governmental action, governmental delay, restraint or inaction, unavailability of equipment or qualified labor, whether specifically enumerated herein or otherwise, which is not reasonably in control of NARCO. NARCO will use all reasonable efforts to remedy the force majeure as quickly as is practicable.

h. Should the payments detailed in 4.a, 4.b, or 4.c above not be tendered in a timely manner, Johnson agrees to pay NARCO the sum so indicated plus interest at a rate of 8% per annum compounded weekly.

5. Use of the Surface of the Property

a. From and after the date of this agreement, NARCO shall not drill any other well on the property or extend its surface use of the property (with the exception of paragraph 5.b. below) beyond the current surface uses for the Wells. NARCO further agrees not to deepen or sidetrack either of the Wells.

b. Notwithstanding the foregoing, NARCO shall retain and have a continuing right of ingress and egress to both the surface and subsurface facilities currently located upon or under the Lands, including but not limited to, roads, flow lines and pipelines used in connection with the wells owned and operated by them and operations that are not located on the lands. The entire cost, risk and expense of rerouting any such roads, flowlines and pipelines shall be borne by Johnson exclusive of and in addition to those amounts set forth in Paragraphs 4a, 4b and 4c above, and shall be subject to the advance approval of NARCO as operator of such wells, which approval shall not be unreasonable withheld. The total cost of any installation and or relocation of any transmission line incurred by NARCO shall be paid by Johnson to NARCO upon completion for the relocation of said pipeline(s) and within thirty (30) days after Johnson receives from NARCO an invoice for such costs. In addition, immediately after the relocation of the line, all authorized parties agree to amend the Right-of-Way Agreements set forth below to correctly reflect the change in legal description of the relocated transmission line. Under no circumstances shall NARCO be prohibited from flowing gas through its transmission line at any time.

c. In addition to those rights listed above, NARCO excepts from this agreement and expressly reserves unto itself all right, title and interest for any Right-of-Way and/or Easement NARCO may have covering the above described lands which apply to its transmission line which lies approximately along the southern and eastern edge of the Property, including, but not limited to, the following Right-of-Way Agreements listed herewith:

1. Right-of-Way Agreement dated 3/22/88, filed 4/22/88 in folio 1525, reception #00914407, Boulder County Clerk and Recorder, together with any applicable permits or licenses.

2. Right-of-Way Agreement dated 4/22/85, filed 4/25/85 in folio 1350, reception #00684984, Boulder County Clerk and Recorder, together with any applicable permits or licenses.

3. Right-of-Way Agreement dated 4/22/85, filed 4/25/85 in folio 1350, reception #00684895, Boulder County Clerk and Recorder, together with any applicable permits or licenses.

6. Indemnification

a. Johnson shall defend, indemnify and hold NARCO harmless from and against all claims, losses and liabilities, including court costs, expert witness fees and reasonable attorney's fees that arise from the non-payment of any portion of the purchase price for the landowners royalty and/or overriding royalty and Johnson, as future owner of any interest in the mineral estate for the Property, hereby waives its rights to any portion of the purchase price.

b. Notwithstanding the provisions of Article 4 above, Johnson shall have the right to seek injunctive relief against NARCO for violating the terms of this agreement by drilling any additional oil and gas wells or for not plugging and abandoning the wells in a timely manner.

c. Should either party hereto be in breach of the provisions of this agreement, the aggrieved party shall provide written notice to the party inbreach, and the party in breachwill have thirty (30) days after receipt of such notice to rectify the breach. This time period may be extended for reasons of force majeure as provided herein.

7. Surrender of Leases

a. NARCO shall surrender and release all of its oil and gas leasehold interests to the respective lessors or each lease at the time the Erie #1 well is plugged and abandoned, and no later than the time Johnson is required to make the Third Payment as described in article 4.c. above. NARCO shall not be obligated to surrender any of its interests hereunder if it has not received all sums due and owing to it by Johnson under this agreement or if Johnson is in default of a material term of this agreement.

b. The surrender and release of the leasehold interests described in Article 7.a. shall be evidenced in releases in the form attached to this agreement as Exhibit "A".

8. Restriction on Assignment

NARCO shall not assign any interest it owns in the Leases or in either the Erie #1 well or the Erie #2 well except pursuant to the terms of this agreement.

9. NARCO's Representations and Warranties

NARCO represents and warrants that, to the best of its knowledge, NARCO is owner of 100% of the working interest in the wells and all of the oil and gas leasehold interest in the Property.

10. Successors and Assigns

This Agreement shall be binding and inure to the heirs, successors and assigns of both Johnson and NARCO.

IN WITNESS WHEREOF, the undersigned parties have caused this Agreement to be executed by a duly authorized representative effective as of the date first written above.

JOHNSON DEVELOPMENT COMPANY	**NORTH AMERICAN RESOURCES COMPANY**
by its attorney-in-fact	
Bruce L. Likoff	T Schmidtke
~~C. Howard Johnson, President~~ Bruce L. Likoff	Terry C. Schmidtke, Vice President

ACKNOWLEDGMENTS

Province of Alberta)
) ss.
Country of Canada)

RD 26th RD

The foregoing instrument was acknowledged before me on this 25th day of January 2001 by Terry C. Schmidtke, in his capacity as Vice President of North American Resources Company.

Witness my hand and official seal.

My Commission Expires: 12/31/2003

Notary Public

STATE OF COLORADO)
CITY AND) ss.
COUNTY OF DENVER)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, on this 31st day of January, 2001; personally appeared Bruce L. Likoff in his capacity as attorney-in-fact for Johnson Development Company, and who executed the within and foregoing instrument of his own free and voluntary act and deed for the benefit of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal this 31st day of January, 2001.

My Commission Expires:
December 5, 2001

Notary Public

EXHIBIT "A"

Attached to and made a part of that certain Well Abandonment Agreement dated January 25, 2001 by and between Johnson Development Company and North American Resources Company.

RELEASE OF OIL AND GAS LEASE

STATE OF COLORADO
COUNTY OF BOULDER

WHEREAS, North American Resources Company, with offices at 1700 Broadway, Suite 2000, Denver, CO 80290, is the owner of a leasehold interest in the oil and gas leases described below covering the described lands situated in the County of Boulder, State of Colorado, to-wit:

Township 1 North, Range 69 West, 6th P.M.
Section 24: S/2

said leases being recorded in the records of the Boulder County Clerk and Recorder.

NOW, THEREFORE, North American Resources Company does hereby release, relinquish and surrender to the lessors, their respective heirs, assigns and legal representatives, all right, title and interest in and to the following oil and gas leases:

a. Oil and gas lease dated August 20, 1981, from Maxine Johnson Haley Trust, James S. Haley, Trustee, as lessor, to J. Michael McGhee ("McGhee"), as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466152.

b. Oil and gas lease dated August 20, 1981, from Susan J. Troudt, Marian J. Bottinelli, Carla Johnson Hobbs, d/b/a Johnson Farms, as lessor, to J. Michael McGhee, as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466151.

c. Oil and gas lease dated August 18, 1981, from Wallace H. Grant and Douglas Grant, as lessor, to J. Michael McGhee, as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466154.

d. Oil and gas lease dated August 7, 1981, from The Longmont National Bank and Lorraine Miller as Co-Trustees of the Carl A. Miller Trust, as lessor, to J. Michael McGhee, as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466153.

Executed this 25th day of January, 2001 and effective as of the same date.

ATTEST:

Rachel L. Desroches

NORTH AMERICAN RESOURCES COMPANY

T. Schmidtke

Terry C. Schmidtke
Vice President

END OF DOCUMENT

2927262 05/01/2008 12:32:43 PM
AG RF: $26.00 DF: $0.00 Page: 1 of 5
Electronically recorded in Boulder County Colorado.

WELL ABANDONMENT AGREEMENT

THIS AGREEMENT is made and entered into this 25th day of January, 2001, by and between North American Resources Company ("NARCO"), with offices at 1700 Broadway, Suite 2000, Denver, Colorado 80290 and Johnson Development Company ("Johnson"), with offices at 4380 South Syracuse Street, Denver, Colorado 80237.

RECITALS

1. Johnson either owns or has an option to purchase the entire S/2 of Section 24, Township 1 North, Range 69 West, Boulder County, Colorado ("Property").

2. The property is subject to the following oil and gas leases ("Leases"), to-wit:

a. Oil and gas lease dated August 20, 1981, from Maxine Johnson Haley Trust, James S. Haley, Trustee, as lessor, to J. Michael McGhee ("McGhee"), as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466152.

b. Oil and gas lease dated August 20, 1981, from Susan J. Troudt, Marian J. Bottinelli, Carla Johnson Hobbs, d/b/a Johnson Farms, as lessor, to J. Michael McGhee, as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466151.

c. Oil and gas lease dated August 18, 1981, from Wallace H. Grant and Douglas Grant, as lessor, to J. Michael McGhee, as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466154.

d. Oil and gas lease dated August 7, 1981, from The Longmont National Bank and Lorraine Miller as Co-Trustees of the Carl A. Miller Trust, as lessor, to J. Michael McGhee, as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466153.

3. NARCO has succeeded to all of the working interests of McGhee under the Leases.

4. NARCO operates two oil and gas wells on the Property known as the Erie Eight E Unit #1 located in the SE/4SE/4 of Section 24 ("Erie #1") and the Erie Eight E Unit #2 located in the SW/4SW/4 of Section 24 ("Erie #2") in which NARCO presently owns all the working interest. The Erie #1 and Erie #2 may be hereinafter collectively referred to as the "Wells."

5. Johnson wishes to develop the property free of the Wells and subsequent drilling.

6. NARCO and Johnson enter into this Agreement to provide for NARCO to plug and abandon the Wells, among other things, in exchange for certain payments from Johnson to NARCO as provided herein.

TERMS AND PROVISIONS

NOW, THEREFORE, in consideration of the covenants and the mutual benefits set forth herein, including the representations set forth in the recitals, the parties agree as follows:

1. Plugging and Abandonment of Erie #2 Well and Reclamation

NARCO shall plug and abandon the Erie #2 well and remove all equipment and production facilities from the wellsite and also reclaim and remediate the surface of the wellsite and all associated production facilities and pits, access and gas flowlines from the Erie #2 wellhead to the gas transmission line in accordance with the rules and regulations of the Colorado Oil and Gas Conservation Commission ("COGCC") on or before March 1, 2001. The completion of remediation at this site may be extended if unexpected complications are encountered, but NARCO will diligently pursue said remediation until it is completed. NARCO will provide Johnson notice of such extension as soon as it is practicable with an explanation of the cause of the delay.

AFTER RECORDING RETURN TO:
MARK OVERTON
7700 E. BELLEVIEW AVE #350
GREENWOOD VILLAGE, CO. 80111

FAITC

HO 206316 / HO135322

1

2. Plugging and Abandonment of Erie #1 Well and Reclamation

NARCO shall plug and abandon the Erie #1 well and remove all equipment and production facilities from the wellsite and also reclaim and remediate the surface of the wellsite and all associated production facilities and pits, access and gas flowlines from the Erie #1 wellhead to the gas transmission line in accordance with the rules and regulations of the Colorado Oil and Gas Conservation Commission ("COGCC"). This will be accomplished within fifty (50) days after receiving written notice from Johnson.

3. Wellhead Equipment and Production Facilities

NARCO shall continue to own the wellhead equipment and associated production facilities and equipment as to each respective well.

4. Purchase Price

As consideration for the terms and provisions contained herein, Johnson agrees to pay NARCO $500,000.00 as follows:

a. Johnson shall pay NARCO the sum of $250,000 in the form of a certified cashier's check contemporaneous with the execution of this agreement.

b. Johnson shall pay NARCO the sum of $125,000 ("Second Payment") in the form of a certified cashier's check to NARCO within five (5) business days of Johnson's receiving a copy of the successful final reclamation inspection of the Erie #2 wellsite and reclaimed areas in accordance with COGCC Rule 1004.c.

c. Johnson shall pay NARCO the sum of $125,000 ("Third Payment") in the form of a certified cashier's check to NARCO within five (5) business days of Johnson receiving a copy of the successful final reclamation inspection of the Erie #1 wellsite and reclaimed areas in accordance with COGCC Rule 1004.c.

d. Until such time as each well is plugged and abandoned, NARCO shall continue to receive all revenue attributable to the production as to each well, and shall continue to disburse those proceeds from each well attributable to the respective landowner and overriding royalty owner interests.

e. In the event that NARCO fails or refuses to plug and abandon the Erie #2 well and reclaim the surface of the wellsite and all associated production facilities and pits, access roads and pipelines as set forth above (hereinafter referred to as the "Work", whether referencing the Erie #2 well or the Erie #1 well) on or before February 15, 2001 (First Abandonment Date), the parties agree that, after the First Abandonment Date, Johnson may engage a contractor to perform the Work and that such contractor shall be the agent of NARCO and not of Johnson. In such event, the Second Payment shall be reduced by all of the costs incurred by the contractor to perform the work.

f. In the event that NARCO fails or refuses to plug and abandon and complete the Work for the Erie #1 well on or before March 15, 2001 (Second Abandonment Date), the parties agree that, after the Second Abandonment Date, Johnson will engage a contractor to perform the Work and that such contractor shall be the agent of NARCO and not of Johnson. In such event, the Third Payment shall be reduced by all of the costs incurred by the contractor to perform the work.

g. If NARCO is rendered unable to perform the plugging, abandoning and subsequent restoration of the property, wholly or in part, by force majeure preventing it from carrying out its obligations to do so, it shall be automatically granted such time as is necessary for the obligations to be completed over and above the times stated herein. "Force majeure" shall be defined herein as any act of God, strike, lockout or other industrial disturbance, act of the public enemy, war, public riot, lightning, storm, flood or other act of nature, explosion, governmental action, governmental delay, restraint or inaction, unavailability of equipment or qualified labor, whether specifically enumerated herein or otherwise, which is not reasonably in control of NARCO. NARCO will use all reasonable efforts to remedy the force majeure as quickly as is practicable.

h. Should the payments detailed in 4.a, 4.b, or 4.c above not be tendered in a timely manner, Johnson agrees to pay NARCO the sum so indicated plus interest at a rate of 8% per annum compounded weekly.

5. Use of the Surface of the Property

a. From and after the date of this agreement, NARCO shall not drill any other well on the property or extend its surface use of the property (with the exception of paragraph 5.b. below) beyond the current surface uses for the Wells. NARCO further agrees not to deepen or sidetrack either of the Wells.

b. Notwithstanding the foregoing, NARCO shall retain and have a continuing right of ingress and egress to both the surface and subsurface facilities currently located upon or under the Lands, including but not limited to, roads, flow lines and pipelines used in connection with the wells owned and operated by them and operations that are not located on the lands. The entire cost, risk and expense of rerouting any such roads, flowlines and pipelines shall be borne by Johnson exclusive of and in addition to those amounts set forth in Paragraphs 4a, 4b and 4c above, and shall be subject to the advance approval of NARCO as operator of such wells, which approval shall not be unreasonable withheld. The total cost of any installation and or relocation of any transmission line incurred by NARCO shall be paid by Johnson to NARCO upon completion for the relocation of said pipeline(s) and within thirty (30) days after Johnson receives from NARCO an invoice for such costs. In addition, immediately after the relocation of the line, all authorized parties agree to amend the Right-of-Way Agreements set forth below to correctly reflect the change in legal description of the relocated transmission line. Under no circumstances shall NARCO be prohibited from flowing gas through its transmission line at any time.

c. In addition to those rights listed above, NARCO excepts from this agreement and expressly reserves unto itself all right, title and interest for any Right-of-Way and/or Easement NARCO may have covering the above described lands which apply to its transmission line which lies approximately along the southern and eastern edge of the Property, including, but not limited to, the following Right-of-Way Agreements listed herewith:

1. Right-of-Way Agreement dated 3/22/88, filed 4/22/88 in folio 1525, reception #00914407, Boulder County Clerk and Recorder, together with any applicable permits or licenses.

2. Right-of-Way Agreement dated 4/22/85, filed 4/25/85 in folio 1350, reception #00684984, Boulder County Clerk and Recorder, together with any applicable permits or licenses.

3. Right-of-Way Agreement dated 4/22/85, filed 4/25/85 in folio 1350, reception #00684895, Boulder County Clerk and Recorder, together with any applicable permits or licenses.

6. Indemnification

a. Johnson shall defend, indemnify and hold NARCO harmless from and against all claims, losses and liabilities, including court costs, expert witness fees and reasonable attorney's fees that arise from the non-payment of any portion of the purchase price for the landowners royalty and/or overriding royalty and Johnson, as future owner of any interest in the mineral estate for the Property, hereby waives its rights to any portion of the purchase price.

b. Notwithstanding the provisions of Article 4 above, Johnson shall have the right to seek injunctive relief against NARCO for violating the terms of this agreement by drilling any additional oil and gas wells or for not plugging and abandoning the wells in a timely manner.

c. Should either party hereto be in breach of the provisions of this agreement, the aggrieved party shall provide written notice to the party inbreach, and the party in breachwill have thirty (30) days after receipt of such notice to rectify the breach. This time period may be extended for reasons of force majeure as provided herein.

7. Surrender of Leases

a. NARCO shall surrender and release all of its oil and gas leasehold interests to the respective lessors or each lease at the time the Erie #1 well is plugged and abandoned, and no later than the time Johnson is required to make the Third Payment as described in article 4.c. above. NARCO shall not be obligated to surrender any of its interests hereunder if it has not received all sums due and owing to it by Johnson under this agreement or if Johnson is in default of a material term of this agreement.

b. The surrender and release of the leasehold interests described in Article 7.a. shall be evidenced in releases in the form attached to this agreement as Exhibit "A".

8. Restriction on Assignment

NARCO shall not assign any interest it owns in the Leases or in either the Erie #1 well or the Erie #2 well except pursuant to the terms of this agreement.

9. NARCO's Representations and Warranties

NARCO represents and warrants that, to the best of its knowledge, NARCO is owner of 100% of the working interest in the wells and all of the oil and gas leasehold interest in the Property.

10. Successors and Assigns

This Agreement shall be binding and inure to the heirs, successors and assigns of both Johnson and NARCO.

IN WITNESS WHEREOF, the undersigned parties have caused this Agreement to be executed by a duly authorized representative effective as of the date first written above.

JOHNSON DEVELOPMENT COMPANY
by its attorney-in-fact
Bruce L. Likoff
~~C. Howard Johnson, President~~
Bruce L. Likoff

NORTH AMERICAN RESOURCES COMPANY
T Schmidtke
Terry C. Schmidtke, Vice President

ACKNOWLEDGMENTS

Province of Alberta)
) ss.
Country of Canada)

RD 26th RD

The foregoing instrument was acknowledged before me on this 25th day of January 2001 by Terry, C. Schmidtke, in his capacity as Vice President of North American Resources Company.

Witness my hand and official seal.

My Commission Expires: 12/31/2003

Notary Public

STATE OF COLORADO)
CITY AND) ss.
COUNTY OF DENVER)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, on this 31st day of January, 2001; personally appeared Bruce L. Likoff in his capacity as attorney-in-fact ______ for Johnson Development Company, and who executed the within and foregoing instrument of his own free and voluntary act and deed for the benefit of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal this 31st day of January, 2001.

My Commission Expires:
December 5, 2001

Notary Public

EXHIBIT "A"

Attached to and made a part of that certain Well Abandonment Agreement dated January 25, 2001 by and between Johnson Development Company and North American Resources Company.

RELEASE OF OIL AND GAS LEASE

STATE OF COLORADO
COUNTY OF BOULDER

WHEREAS, North American Resources Company, with offices at 1700 Broadway, Suite 2000, Denver, CO 80290, is the owner of a leasehold interest in the oil and gas leases described below covering the described lands situated in the County of Boulder, State of Colorado, to-wit:

Township 1 North, Range 69 West, 6th P.M.
Section 24: S/2

said leases being recorded in the records of the Boulder County Clerk and Recorder.

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Executed this 25th day of January, 2001 and effective as of the same date.

ATTEST:

Rachel L. Desrochers

NORTH AMERICAN RESOURCES COMPANY

T. Schmidtke

Terry C. Schmidtke
Vice President

END OF DOCUMENT

WELL ABANDONMENT AGREEMENT

THIS AGREEMENT is made and entered into this 25th day of January, 2001, by and between North American Resources Company ("NARCO"), with offices at 1700 Broadway, Suite 2000, Denver, Colorado 80290 and Johnson Development Company ("Johnson"), with offices at 4380 South Syracuse Street, Denver, Colorado 80237.

RECITALS

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2. The property is subject to the following oil and gas leases ("Leases"), to-wit:

a. Oil and gas lease dated August 20, 1981, from Maxine Johnson Haley Trust, James S. Haley, Trustee, as lessor, to J. Michael McGhee ("McGhee"), as lessee, a copy of which was recorded on September 30, 1981, in the Clerk and Recorder's Office for Boulder County at Book 1182, Reception No. 466152.

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3. NARCO has succeeded to all of the working interests of McGhee under the Leases.

4. NARCO operates two oil and gas wells on the Property known as the Erie Eight E Unit #1 located in the SE/4SE/4 of Section 24 ("Erie #1") and the Erie Eight E Unit #2 located in the SW/4SW/4 of Section 24 ("Erie #2") in which NARCO presently owns all the working interest. The Erie #1 and Erie #2 may be hereinafter collectively referred to as the "Wells."

5. Johnson wishes to develop the property free of the Wells and subsequent drilling.

6. NARCO and Johnson enter into this Agreement to provide for NARCO to plug and abandon the Wells, among other things, in exchange for certain payments from Johnson to NARCO as provided herein.

TERMS AND PROVISIONS

NOW, THEREFORE, in consideration of the covenants and the mutual benefits set forth herein, including the representations set forth in the recitals, the parties agree as follows:

1. Plugging and Abandonment of Erie #2 Well and Reclamation

NARCO shall plug and abandon the Erie #2 well and remove all equipment and production facilities from the wellsite and also reclaim and remediate the surface of the wellsite and all associated production facilities and pits, access and gas flowlines from the Erie #2 wellhead to the gas transmission line in accordance with the rules and regulations of the Colorado Oil and Gas Conservation Commission ("COGCC") on or before March 1, 2001. The completion of remediation at this site may be extended if unexpected complications are encountered, but NARCO will diligently pursue said remediation until it is completed. NARCO will provide Johnson notice of such extension as soon as it is practicable with an explanation of the cause of the delay.

2. Plugging and Abandonment of Erie #1 Well and Reclamation

NARCO shall plug and abandon the Erie #1 well and remove all equipment and production facilities from the wellsite and also reclaim and remediate the surface of the wellsite and all associated production facilities and pits, access and gas flowlines from the Erie #1 wellhead to the gas transmission line in accordance with the rules and regulations of the Colorado Oil and Gas Conservation Commission ("COGCC"). This will be accomplished within fifty (50) days after receiving written notice from Johnson.

3. Wellhead Equipment and Production Facilities

NARCO shall continue to own the wellhead equipment and associated production facilities and equipment as to each respective well.

4. Purchase Price

As consideration for the terms and provisions contained herein, Johnson agrees to pay NARCO $500,000.00 as follows:

a. Johnson shall pay NARCO the sum of $250,000 in the form of a certified cashier's check contemporaneous with the execution of this agreement.

b. Johnson shall pay NARCO the sum of $125,000 ("Second Payment") in the form of a certified cashier's check to NARCO within five (5) business days of Johnson's receiving a copy of the successful final reclamation inspection of the Erie #2 wellsite and reclaimed areas in accordance with COGCC Rule 1004.c.

c. Johnson shall pay NARCO the sum of $125,000 ("Third Payment") in the form of a certified cashier's check to NARCO within five (5) business days of Johnson receiving a copy of the successful final reclamation inspection of the Erie #1 wellsite and reclaimed areas in accordance with COGCC Rule 1004.c.

d. Until such time as each well is plugged and abandoned, NARCO shall continue to receive all revenue attributable to the production as to each well, and shall continue to disburse those proceeds from each well attributable to the respective landowner and overriding royalty owner interests.

e. In the event that NARCO fails or refuses to plug and abandon the Erie #2 well and reclaim the surface of the wellsite and all associated production facilities and pits, access roads and pipelines as set forth above (hereinafter referred to as the "Work", whether referencing the Erie #2 well or the Erie #1 well) on or before February 15, 2001 (First Abandonment Date), the parties agree that, after the First Abandonment Date, Johnson may engage a contractor to perform the Work and that such contractor shall be the agent of NARCO and not of Johnson. In such event, the Second Payment shall be reduced by all of the costs incurred by the contractor to perform the work.

f. In the event that NARCO fails or refuses to plug and abandon and complete the Work for the Erie #1 well on or before March 15, 2001 (Second Abandonment Date), the parties agree that, after the Second Abandonment Date, Johnson will engage a contractor to perform the Work and that such contractor shall be the agent of NARCO and not of Johnson. In such event, the Third Payment shall be reduced by all of the costs incurred by the contractor to perform the work.

g. If NARCO is rendered unable to perform the plugging, abandoning and subsequent restoration of the property, wholly or in part, by force majeure preventing it from carrying out its obligations to do so, it shall be automatically granted such time as is necessary for the obligations to be completed over and above the times stated herein. "Force majeure" shall be defined herein as any act of God, strike, lockout or other industrial disturbance, act of the public enemy, war, public riot, lightning, storm, flood or other act of nature, explosion, governmental action, governmental delay, restraint or inaction, unavailability of equipment or qualified labor, whether specifically enumerated herein or otherwise, which is not reasonably in control of NARCO. NARCO will use all reasonable efforts to remedy the force majeure as quickly as is practicable.

h. Should the payments detailed in 4.a, 4.b, or 4.c above not be tendered in a timely manner, Johnson agrees to pay NARCO the sum so indicated plus interest at a rate of 8% per annum compounded weekly.

5. Use of the Surface of the Property

a. From and after the date of this agreement, NARCO shall not drill any other well on the property or extend its surface use of the property (with the exception of paragraph 5.b. below) beyond the current surface uses for the Wells. NARCO further agrees not to deepen or sidetrack either of the Wells.

b. Notwithstanding the foregoing, NARCO shall retain and have a continuing right of ingress and egress to both the surface and subsurface facilities currently located upon or under the Lands, including but not limited to, roads, flow lines and pipelines used in connection with the wells owned and operated by them and operations that are not located on the lands. The entire cost, risk and expense of rerouting any such roads, flowlines and pipelines shall be borne by Johnson exclusive of and in addition to those amounts set forth in Paragraphs 4a, 4b and 4c above, and shall be subject to the advance approval of NARCO as operator of such wells, which approval shall not be unreasonable withheld. The total cost of any installation and or relocation of any transmission line incurred by NARCO shall be paid by Johnson to NARCO upon completion for the relocation of said pipeline(s) and within thirty (30) days after Johnson receives from NARCO an invoice for such costs. In addition, immediately after the relocation of the line, all authorized parties agree to amend the Right-of-Way Agreements set forth below to correctly reflect the change in legal description of the relocated transmission line. Under no circumstances shall NARCO be prohibited from flowing gas through its transmission line at any time.

c. In addition to those rights listed above, NARCO excepts from this agreement and expressly reserves unto itself all right, title and interest for any Right-of-Way and/or Easement NARCO may have covering the above described lands which apply to its transmission line which lies approximately along the southern and eastern edge of the Property, including, but not limited to, the following Right-of-Way Agreements listed herewith:

1. Right-of-Way Agreement dated 3/22/88, filed 4/22/88 in folio 1525, reception #00914407, Boulder County Clerk and Recorder, together with any applicable permits or licenses.

2. Right-of-Way Agreement dated 4/22/85, filed 4/25/85 in folio 1350, reception #00684984, Boulder County Clerk and Recorder, together with any applicable permits or licenses.

3. Right-of-Way Agreement dated 4/22/85, filed 4/25/85 in folio 1350, reception #00684895, Boulder County Clerk and Recorder, together with any applicable permits or licenses.

6. Indemnification

a. Johnson shall defend, indemnify and hold NARCO harmless from and against all claims, losses and liabilities, including court costs, expert witness fees and reasonable attorney's fees that arise from the non-payment of any portion of the purchase price for the landowners royalty and/or overriding royalty and Johnson, as future owner of any interest in the mineral estate for the Property, hereby waives its rights to any portion of the purchase price.

b. Notwithstanding the provisions of Article 4 above, Johnson shall have the right to seek injunctive relief against NARCO for violating the terms of this agreement by drilling any additional oil and gas wells or for not plugging and abandoning the wells in a timely manner.

c. Should either party hereto be in breach of the provisions of this agreement, the aggrieved party shall provide written notice to the party inbreach, and the party in breachwill have thirty (30) days after receipt of such notice to rectify the breach. This time period may be extended for reasons of force majeure as provided herein.

7. Surrender of Leases

a. NARCO shall surrender and release all of its oil and gas leasehold interests to the respective lessors or each lease at the time the Erie #1 well is plugged and abandoned, and no later than the time Johnson is required to make the Third Payment as described in article 4.c. above. NARCO shall not be obligated to surrender any of its interests hereunder if it has not received all sums due and owing to it by Johnson under this agreement or if Johnson is in default of a material term of this agreement.

b. The surrender and release of the leasehold interests described in Article 7.a. shall be evidenced in releases in the form attached to this agreement as Exhibit "A".

8. Restriction on Assignment

NARCO shall not assign any interest it owns in the Leases or in either the Erie #1 well or the Erie #2 well except pursuant to the terms of this agreement.

9. NARCO's Representations and Warranties

NARCO represents and warrants that, to the best of its knowledge, NARCO is owner of 100% of the working interest in the wells and all of the oil and gas leasehold interest in the Property.

10. Successors and Assigns

This Agreement shall be binding and inure to the heirs, successors and assigns of both Johnson and NARCO.

IN WITNESS WHEREOF, the undersigned parties have caused this Agreement to be executed by a duly authorized representative effective as of the date first written above.

JOHNSON DEVELOPMENT COMPANY
by its attorney-in-fact
Bruce L. Likoff
~~C. Howard Johnson, President~~
Bruce L. Likoff

NORTH AMERICAN RESOURCES COMPANY
T Schmidtke
Terry C. Schmidtke, Vice President

ACKNOWLEDGMENTS

Province of Alberta)
) ss.
Country of Canada)

RD ✓ 26th ✓ RD

The foregoing instrument was acknowledged before me on this 25th day of January 2001 by Terry C. Schmidtke, in his capacity as Vice President of North American Resources Company.

Witness my hand and official seal.

My Commission Expires: 12/31/2003

Notary Public

State of Hawaii)

STATE OF COLORADO)
CITY AND) ss.
COUNTY OF DENVER)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, on this 31st day of January, 2001, personally appeared Bruce L. Likoff in his capacity as attorney-in-fact ________ for Johnson Development Company, and who executed the within and foregoing instrument of his own free and voluntary act and deed for the benefit of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal this 31st day of January, 2001.

My Commission Expires:
December 5, 2001

Notary Public

7. Surrender of Leases

a. NARCO shall surrender and release all of its oil and gas leasehold interests to the respective lessors or each lease at the time the Erie #1 well is plugged and abandoned, and no later than the time Johnson is required to make the Third Payment as described in article 4.c. above. NARCO shall not be obligated to surrender any of its interests hereunder if it has not received all sums due and owing to it by Johnson under this agreement or if Johnson is in default of a material term of this agreement.

b. The surrender and release of the leasehold interests described in Article 7.a. shall be evidenced in releases in the form attached to this agreement as Exhibit "A".

8. Restriction on Assignment

NARCO shall not assign any interest it owns in the Leases or in either the Erie #1 well or the Erie #2 well except pursuant to the terms of this agreement.

9. NARCO's Representations and Warranties

NARCO represents and warrants that, to the best of its knowledge, NARCO is owner of 100% of the working interest in the wells and all of the oil and gas leasehold interest in the Property.

10. Successors and Assigns

This Agreement shall be binding and inure to the heirs, successors and assigns of both Johnson and NARCO.

IN WITNESS WHEREOF, the undersigned parties have caused this Agreement to be executed by a duly authorized representative effective as of the date first written above.

JOHNSON DEVELOPMENT COMPANY
by its attorney-in-fact:
Bruce L. Likoff
~~C. Howard Johnson, President~~
Bruce L. Likoff

NORTH AMERICAN RESOURCES COMPANY
T Schmidtke
Terry C. Schmidtke, Vice President

ACKNOWLEDGMENTS

Province of Alberta)
) ss.
Country of Canada)

RD ✓ 26th ✓ RD

The foregoing instrument was acknowledged before me on this 25th day of January 2001 by Terry C. Schmidtke, in his capacity as Vice President of North American Resources Company.

Witness my hand and official seal.

My Commission Expires: 12/31/2003

Notary Public

State of Hawaii)

STATE OF COLORADO)
CITY AND) ss.
COUNTY OF DENVER)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, on this 31st day of January, 2001, personally appeared Bruce L. Likoff in his capacity as attorney-in-fact ________ for Johnson Development Company, and who executed the within and foregoing instrument of his own free and voluntary act and deed for the benefit of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal this 31st day of January, 2001.

My Commission Expires:
December 5, 2001

Notary Public

CUSTOM FARMING AGREEMENT

THIS **AGREEMENT**, is made and entered into by and between ERIE COMMERCIAL VENTURE, LLLP, a Colorado limited liability limited partnership, 6950 East Belleview Avenue, Suite 202, Greenwood Village, Colorado 80111 hereinafter referred to as "Owner"; and Virgil C. Harmon, 308 Westview Road, Erie, Colorado 80516 hereinafter referred to as "Farmer".

A. Owner is the owner of the following described premises (hereinafter referred to as "the Premises") as situated in the County of Boulder, and State of Colorado, to wit:

Approximately 46 acres of vacant farm land located at the southwest corner of Erie Commons Parkway and County Line Road, Erie Colorado, of which 40 acres will be farmed under the terms of this agreement.

B. Farmer owns and operates a farming operation at one or more farms located in Boulder/ Weld County, Colorado area; and

C. Owner and Farmer mutually desire to enter into an agreement whereby Owner shall engage Farmer to provide custom farming services to Owner on the Premises as more fully hereinafter described.

THEREFORE, in consideration of the fees to be paid to Farmer by Owner, as hereinafter described, the receipt and sufficiency of which is hereby acknowledged, and for other good and valuable consideration, Owner and Farmer hereby agree as follows:

1. Farmer agrees to provide the following custom farming services to Owner:
    - A. to disc certain parts of the soil on the Premises, as mutually agreed between Owner and Farmer; and/or
    - B. to cultivate certain parts of the soil on the Premises, as mutually agreed between Owner and Farmer; and /or
    - C. to plant and seed certain parts of the soil on the Premises, as mutually agreed between Owner and Farmer; and/or
    - D. to apply weed-control spray to the growing weeds on certain parts of the Premises, as mutually agreed between Owner and Farmer.
    - ~~E. to cut and swath (or rake) the grass (hay)~~ growing ~~on certain parts of the soil on the Premises, as mutually agreed between Owner and Farmer; and/or~~
    - ~~F. to bale and stack the baled grass (hay) which has been cut on certain parts of the Premises;~~ and
    - G. To remove all tractors, trucks, harvestors, cultivators and other farm equipment and machinery from the premises when not in use on the premises.
    - I. To assist Owner in locating a market, or purchaser, to purchase the crops produced on the Premises each year.

J. To plant and seed the wheat, barley, oats or other small seed crops by the end of October of each year.

~~K. To Cut, bale and stack the grass (hay) by the end of ________ of each year; and~~

L. To contract for a custom harvester to harvest the wheat, barley, oats, and/or other small seed crops by the end of July of each year, at a price and on terms acceptable to Owner.

2. Owner agrees to following:

A. To directly pay the supplier for the cost of seed, fertilizer and/or weed control spray , unless otherwise agreed to with Farmer.

B. To pay Farmer for all reasonable fees and costs, based upon the agreed rates set forth below, billed by Farmer to Owner, for custom farming services and costs, within 30 days of receipt of a Billing Statement for said services and costs, from Farmer.

C. To periodically confer with Farmer, to discuss and decide the custom farming services to be provided to Owner, by Farmer, and to verbally agree upon the following:

(1) the number and location of the acres on the Premises to be affected;
(2) the custom farming service to be performed; and
(3) the estimated cost of said custom farming service.

D. .To use said premises as a farm for growing wheat, barley, oats, hay and other small grains.

3. Agreed Rates for Custom Farming Services:

A. Disc Plowing - $25 per acre
B. Cultivating - $25 per acre
C. Planting and seeding - $30 per acre
~~D. Cutting/swathing - $_____ per acre~~
~~E. Baling and stacking - $_____ bale~~
F. Custom Harvesting – As negotiated with a third party harvester.

4. Assignment Prohibition

A. Farmer understands and agrees that this agreement shall not be assigned by Farmer, without the prioer written consent of Owner.

5. Crop Production Bonus

A. As a further incentive to Farmer, Owner shall pay Farmer a crop production bonuse equal to 10 percent of the net proceeds received by Farmer for the the sale of the crops produced each year. Said bonus payment shall be paid to Farmer not later than 30 day after Owner receives the final payment(s) for the crops for the production year.

6. Termination

A. This agreement may be terminated by either party, upon the delivery of 90 days prior written notice of termination to the other party. In the event said notice of termination is delivered by Owner to Farmer, Owner shall pay Farmer for all custom farming services rendered, and reasonable costs incurred, up to the date and time of receipt of said notice of termination by Farmer. Likewise, in the event said notice of termination is delivered by Farmer to Owner, Farmer shall assist, and fully cooperate with, Owner in the obtaining of a successor Farmer to provide said custom farming services to Owner.

This agreement is executed on the 20 day of October, 2010.

Owner:

Erie Commercial Venture, LLLP

By: ________________________

A. L. Sid Overton General Partner

Farmer:

Virgil C. Harmon

Sid Overton

From: Sid Overton
Sent: Monday, August 26, 2013 5:55 PM
To: 'Barry Goff'
Subject: RE: Fusion Advertising Agreement ERIE COMMERCIAL VENTURE LLLP
Attachments: Advertising Sign Lease from Richmond Amerian Homes 8-26-13.pdf

Hi Barry: I have revised and signed the attached proposed Advertising Sign lease agreement between Erie Commericial Venture, LLLP, Lessor, and Fusion Sign & Design, Lessee re Richmond American Homes, Advertiser. Please note that Paragraph 2, Line 3, of the lease agreement, as prepared by you, correctly stated the advance rent to be $200.00 per month. So we corrected the incorrrect amount shown in line 7. Upon receipt of the advance payment of $200.00, and a duplicate of the attached lease agreement, signed by an authorized agent or representative of the Lessee, you will be permitted to immediately place the sign on the property. We have also signed and attached a Form W-9 for income tax purposes. Thank you. Sid Overton

A. L. (Sid) Overton, Esq.
Overton, & Associates, LLC
6950 E. Belleview Avenue, Suite 202
Greenwood Village, Colorado 80111
Telephone: (303) 779-5900
Fax: (303) 779-6006
E-Mail: sidoverton@oalaw.net

From: Barry Goff [mailto:barry@fusionsign.com]
Sent: Monday, August 19, 2013 2:56 PM
To: sidoverton@oalaw.net
Subject: Fusion Advertising Agreement ERIE COMMERCIAL VENTURE LLLP

Mr Overton, attached are the documents needed for the Richmond American sign. Please review and let me know if this is acceptable, thanks and call with any questions or concerns.

Barry Goff
Service Manager

Fusion Sign and Design
4109 Wagon Trail Ave.
Las Vegas, NV 89118
T: 702.949.0760
F: 702.991.0103
C: 702.622.0065

FUSION

Sign and Design

Sign Lease Advertising Agreement

Company Name: _FUSION SIGN AND DESIGN

Advertiser: ___RICHMOND AMERICAN HOMES

Project: ___DAY BREAK AND ERIE COMMONS

Company requests the use of your property, as described below, to install and maintain an advertising sign.

Property Location: ___County Rd 1/Erie Pkwy

Parcel #: _146524000019___

$200.00 for 1 sign month to month, payable to the following:

Name: _ ERIE COMMERCIAL VENTURE LLLP__

Address:

Telephone: _303-779-5900__ SSN or Federal Tax I.D. # 84-1474626

Terms & Conditions:

1. I / we hereby grant to Fusion Sign and Design the right to enter the Property for the purpose of placing or causing placement of a _3'x 3' _ directional sign in approximately the location shown on the attached drawing. The sign will be installed by Fusion Sign and Design or its contractors in conformance with any governmental ordinances, rules and regulations. Lessee and its contractors shall maintain the sign and keep it in good repair at no cost to Lessor. Lessor grants Fusion Sign and Design, its employees, agents, or representatives, the right to access the Property seven days per week, between the hours of 7:00 a.m. and 7:00 p.m. for the purpose of placing, replacing, maintaining and/or removing the signage.
2. This Lease Agreement becomes effective upon execution. The term of this Lease Agreement shall be one year from the date of execution, and may be extended from time to time for additional one year terms by a writing executed by both parties. The Lessee agrees to pay rent in the amount of $200.00_ per month, payable in advance. In the event this Lease Agreement is terminated for any reason on any day other than the day of the month upon which the Lease Agreement payments are due, the amount due by Lessee will be pro-rated and any amounts paid by Lessee to Lessor which are unused shall be returned to Lessee by Lessor within 10 days of termination by either party.
3. Lessee or Lessor may terminate this Lease Agreement at any time, for any reason or no reason, upon delivery of written notice to the other party delivered to the address below by overnight courier service, US Mail, or facsimile with evidence of delivery. Lessee shall remove the sign within thirty (30) days of termination of this Lease Agreement. Lessee may, at Lessee's election, remove the sign from the Property at any time when Lessee no longer owns any lots in a community being advertised on the sign and this Lease Agreement shall automatically terminate upon such removal.

4. Lessee shall have no liability or responsibility for the maintenance, repair or condition of the Property upon which the signage is located, and shall further have no liability or responsibility for the actions or inactions of the Lessor with respect to the Property. Lessor agrees to hereby assume all liability for and agrees to indemnify and hold harmless Lessee from and against any and all claims, liabilities and causes of action arising out of or in any way related to (a) hazardous materials or conditions that are not placed on the Property or caused by Lessee or its agents, (b) latent defects, or (c) Lessor's actions or inactions.
5. Lessor hereby covenants and agrees that it is the current owner of the above-referenced property, there are no other owners of the property who need to execute this Lease Agreement, and the undersigned is/are fully authorized to enter into this Lease Agreement. In the event of sale or transfer of the property by Lessor, Lessor covenants and agrees to disclose the existence of this Lease Agreement and any conveyance shall be subject to this Lease Agreement.
6. Lessor shall be responsible for all taxes associated with the payments due hereunder, including but not limited to, sales taxes and taxes upon Lessor's income and property.
7. This lease shall commence on September 1, 2013, contingent upon advance payment of $200.00 rent by Lessee to Lessor.

Acceptance;

LESSEE: Fusion Sign & Design
By: ______________________
Date: ______________________

LESSOR: Erie Commercial Venture, LLLP
By: ______________________
A. L. Sid Overton, General Partner
Date: August 26, 2013

2927263 05/01/2008 12:32:43 PM
WD RF: $16.00 DF: $0.00 Page: 1 of 3
Electronically recorded in Boulder County Colorado.

MINERAL DEED CONTAINING SPECIAL WARRANTY OF TITLE

THIS MINERAL DEED CONTAINING SPECIAL WARRANTY OF TITLE ("Deed"), is made this 30 day of April, 2008, between Johnson Development Company, a Colorado corporation, whose address is 4380 South Syracuse Street, Suite 510, Denver, Colorado 80237, hereinafter called Grantor, and ECV Minerals, LLC, a Colorado limited liability company, whose address is 7720 East Belleview Avenue, Suite 350, Greenwood Village, Colorado 80111, hereinafter called Grantee.

In consideration of ten dollars ($10.00) and other valuable consideration, the receipt of which is hereby acknowledged, Grantor grants, bargains, sells, conveys, transfers and assigns to Grantee all of Grantor's right, title, and interest in and to the mineral estate in the lands described on Exhibit 1 attached hereto (the "Lands"), including any and all of the oil, gas and other hydrocarbon minerals owned by Grantor in and under the Lands (the "Mineral Interests").

By this Deed, Grantee is also conveyed any and all of the rights of ingress and egress owned by the Grantor for the purposes of mining, drilling, exploring, operating and developing the Lands for oil, gas and other hydrocarbon minerals and storing, handling, transporting and marketing the same from the Lands.

THIS DEED IS MADE WITHOUT REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS, IMPLIED OR STATUTORY, except that Grantor, for itself and its successors and assigns, warrants to and agrees with Grantee, and its successors and assigns, that the Mineral Interests are free and clear of all mineral leases, claims, liens, security interests, burdens, and encumbrances, of any kind or nature, created by, through or under Grantor, and Grantor shall warrant and forever defend the title of Grantee, its successors and assigns, to the Mineral Interests against all persons now or hereafter claiming an interest therein by, through or under Grantor.

Grantor agrees to execute such further documents as may be reasonably necessary to more fully and effectively grant, convey and assign to Grantee the rights, interests and properties conveyed hereby.

TO HAVE AND TO HOLD, the Lands unto the Grantee, its successors and assigns forever.

IN WITNESS WHEREOF, Grantor has executed this Deed on the date set forth above.

**JOHNSON DEVELOPMENT COMPANY, a
Colorado corporation**

By: M. Clementina Martins
M. Clementina Martins, Vice-President of Sales

AFTER RECORDING RETURN TO:
MARK OVERTON
7720 E. BELLEVIEW AVE #350
GREENWOOD VILLAGE, CO. 80111

FATCO

H0206316 / H0138322

2

STATE OF COLORADO)
) ss.
COUNTY OF DENVER)

The foregoing Mineral Deed Containing Special Warranty of Title was voluntarily executed and acknowledged before me, a notary public, by M. Clementina Martins, as Vice-President of Sales of Johnson Development Company, a Colorado corporation, on this 30th day of April, 2008.

Witness my hand and official seal.

My commission expires: 6/10/11

Notary Public

Gillian P. Godfrey
NOTARY PUBLIC
STATE OF COLORADO
My commission expires 06/10/2011

EXHIBIT 1

Mineral Interests Legal Description

PARCEL DESCRIPTION

A PARCEL OF LAND IN THE N ½ OF THE SE ¼ OF SECTION 24, T1N, R69W OF THE 6TH P.M., DESCRIBED AS FOLLOWS:

BEGINNING AT THE E ¼ CORNER OF SECTION 24, WHICH IS ALSO THE TRUE POINT OF BEGINNING; THENCE S 0°59'04" E, 1326.54 FEET; THENCE N 89°52'59" W, 1699.28 FEET; THENCE N 0°54'34" W, 1327.96 FEET, THENCE S 89°50'03" E, 1697.57 FEET TO THE TRUE POINT OF BEGINNING;

CONTAINING 51.74 ACRES MORE OR LESS.

County of Boulder
State of Colorado

J3 ENGINEERING
CONSULTANTS

"Your Project, Our Pride" ™

May 5, 2016

Town of Erie
Matt Wiederspahn, Engineering Division
Engineering Division
645 Holbrook St.
Erie, CO 80516

RE: Four Corner's, Overall Utility Findings

Dear Mr. Wiederspahn,

The purpose of this report is to provide the Town of Erie and RMCS the supporting calculations for the future design of the proposed Water and Sanitary utilities for the development of Four Corners Filing No. 1. The narrative provides a comprehensive description of the project, design methodologies utilized and a summary of the final design calculations.

The project is a parcel of land located in Section 24, Township 1 North, Range 69 West of the 6th Principal Meridian, Town of Erie, State of Colorado. The approximate latitude and longitude for the center of the project is 40^0 02' 05.6" N and 105^0 03' 30.2" W. Four Corner's Filing No. 1 is generally bound on the north by Erie Parkway, on the west by a residential subdivision, to the south by Austin Avenue and to the east by E County Line Road. Commercial parcel currently proposed to be developed include Lots 1-3 and Tracts A and B.

Existing utilities near and within the development include an 8 inch sanitary sewer system on the southwest corner of East County Line Road and Erie Parkway, a 12 inch water line within Austin Ave, and two main distribution lines within Erie Parkway; a 3-inch and 24 inch. The proposed development will tie into this 8" sanitary system with a proposed manhole.

Water demands for Commercial Parcel currently being developed and the remaining Planning Areas within the Overall Four Corners Development and were developed per the Town of Erie Standards and Specifications, January 2016, Section 600, Water Supply Facilities. The total peak demand, per the guidelines below, was 315 gpm or 0.45 mgd. Four Corners will interconnect with the 12-inch water line on Austin Ave and future connection to the 30 inch water line in Erie Parkway. Four Corner's Filing No. 1 proposes a trunk line of 12-inch along through the development connecting between Austin Avenue and Erie Parkway. All other water lines within Filing No.1 are proposed to be 8-inch lines.

Water Criteria				
	Populations (pp/D.U.)	Average / Capita Consumption	Max Day Factor	Peak Hour Factor
Single Family Detached	2.8	140 (gpd/capita)	2.6	3.9
Single Family Wee Cottages	2.1	140 (gpd/capita)	2.6	3.9
Multi Family	2.1	140 (gpd/capita)	2.6	3.9
Commercial	-	1651 (gpd/Acre)	2	3
Clubhouse	-	1651 (gpd/Acre)	2	3
Parks Recreation	-	1651 (gpd/Acre)	2	3

Sanitary Sewer Criteria			
	Populations (pp/D.U.)	Average / Capita Consumption	Peak Factor
Single Family Detached	2.8	90 (gpd/capita)	5
Single Family Wee Cottages	2.1	90 (gpd/capita)	5
Multi Family	2.1	90 (gpd/capita)	5
Commercial	-	1000 (gpd/Acre)	5
Clubhouse	-	50 (gpd/Acre)	5
Parks Recreation	-	50 (gpd/Acre)	5

Wastewater flow from the overall Four Corner's planned residential and commercial developments used a peak factor of 5 per calculations in Section of 712 and have a combined peak flow of approximately 0.48 cfs. The

Respectfully Submitted,

Sue Sibel, PE
J3 Engineering Consultants, Inc.

cc: file

J3 ENGINEERING CONSULTANTS

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SANITARY SEWER DESIGN FLOWS

COMPUTATION SHEET

Four Corner's Filing No. 1

Future Developed Conditions
Town of Erie, Colorado

Job No. 30019
Date 5/5/16
Calculated By MRL
Checked By AJM

		RESIDENTIAL						NON-RESIDENTIAL		TOTAL	PEAK ADJUSTMENT			SUMMARY	
LAND USE (1)	AREA (1) (ACRES)	GROSS DENSITY UNITS PER ACRE (1)	NO. UNITS	DENSITY (2) (P.P.U)	POPULATION	UNIT WASTEWATER FLOW RATE (5) (GPD)	AVERAGE FLOW (cfs)	AVERAGE DAILY FLOW PER ACRE (3) (GPAD)	AVERAGE FLOW (cfs)	TOTAL AVERAGE SEWAGE FLOW (cfs)	PEAK FACTOR (4)	PEAK FLOW (cfs)	INFILTRATION (5) 'cfs)	TOTAL PEAK SEWAGE FLOW (cfs)	TOTAL PEAK SEWAGE FLOW (MGD)
Single Family Detached West	6.09293	7.39	45	2.8	126	90	0.0171			0.0171	5.0	0.0854			
Single Family Detatched-Modern	5.22057	11.49	60	2.1	126	90	0.0171			0.0171	5.0	0.0854			
Multi-Family Attached Main	2.17929	61	132	2.1	278	90	0.0377			0.0377	5.0	0.1885			
Multi-Family Attached Optional	0.39624	61	24	2.1	51	90	0.0069			0.0069	5.0	0.0346			
Clubhouse	0.81933							50	0.0001	0.0001	5.0	0.0003			
Commercial 1	7.46515							1000	0.0116	0.0116	5.0	0.0578			
Commercial 2	2.29417							1000	0.0035	0.0035	5.0	0.0177			
Parks/Open Space	16.91							50	0.0013	0.0013	5.0	0.0065			
TOTAL	41.3777		261		581		0.0788		0.0165	**0.10**	5.0	0.48		**0.48**	0.31

COMMENTS

(1) Land Use, Area, and gross density units as defined by the Four Corner's Overall Devlopment Concept
(2) Density Per Town of Erie and Denver Water Board Engineering Standards
(3) Per Town of Erie Engineering Standards
(4) Peak factor calculated using the following equation, PF= 3.8/(ADF)^$^{0.17}$ where ADF = Average Daily Flow in cfs and ADF < 5
(5) Infiltration flow accounted for in Unit Wastewater Flow Rate profived in Town of Erie Engineering Standards

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TOTAL WATER DESIGN DEMAND

Four Corner's Filing No. 1

Future Developed Conditions
Town of Erie, CO

Job No. 30019
Date 5/5/2016
Calculated By MRL
Checked By AKM

TOTAL RESIDENTIAL DEMAND

					AVERAGE DAY (AD) DEMAND			MAXIMUM DAY DEMAND			PEAK HOUR DEMAND		
Land Use (1)	POPULATION EQUIV. (pp/D.U.) (2)	PROPOSED NUMBER OF UNITS (1)	AREA (ACRES)	ESTIMATED POPULATION	AVER. PER CAPITA CONSUMPTION (gpd/capita) (3)	AVG. DAY DEMAND (gpd)	AVG. DAY DEMAND (gpm)	MAX DAY TO AVERAGE DAY FACTOR (3)	MAX DAY DEMAND (gpd)	MAX DAY DEMAND (gpm)	PEAK HOUR TO MAX DAY DEMAND (3)	PEAK HOUR DEMAND (gpd)	PEAK HOUR DEMAND (gpm)
Single Family-Detached West	2.8	45		126	140	17640	12.25	2.6	45864	31.85	3.9	68796	47.8
Single Family-Detached Modern	2.1	60		126	140	17640	12.25	2.6	45864	31.85	3.9	68796	47.8
Multi Family-Attached Main	2.1	132		278	140	38920	27.03	2.6	101192	70.27	3.9	151788	105.4
Multi Family-Attached Optional	2.1	24		51	140	7140	4.96	2.6	18564	12.89	3.9	27846	19.3
Clubhouse			0.82 AC		1651	1353.82 AC	0.94	2	2708	1.88	3	4061	2.8
Commercial 1			7.5 AC		1651	12382.5 AC	8.60	2	24765	17.20	3	37148	25.8
Commercial 2			2.3 AC		1651	3797.3 AC	2.64	2	7595	5.27	3	11392	7.9
Parks/ Open Space			16.91 AC		1651	27918.4 AC	19.39	2	55837	38.78	3	83755	58.2
												453582 GPD **0.45 MGD**	315.0

COMMENTS

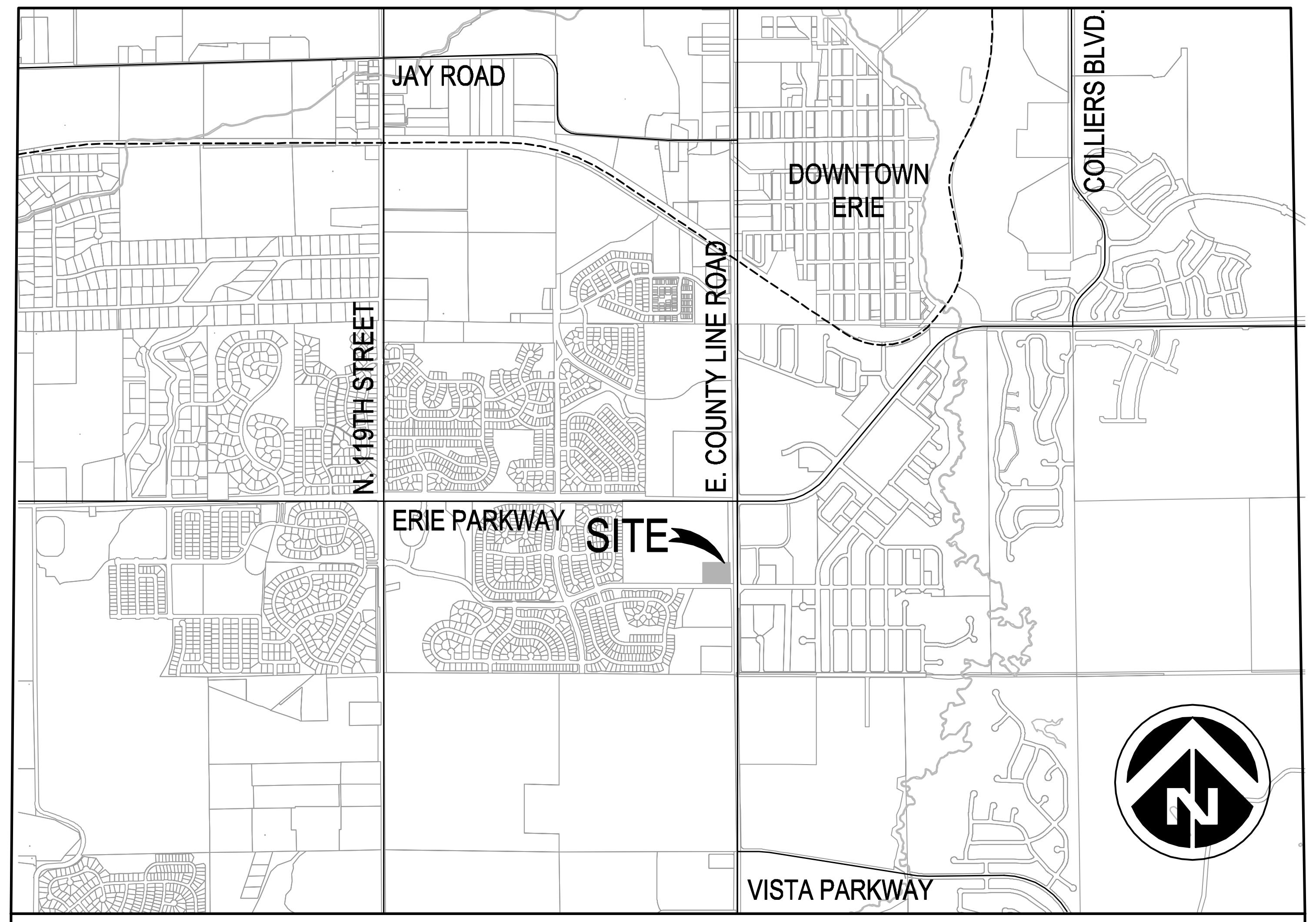
(1)	Land Use, Area, and gross density units as defined by the Four Corner's Overall Devlopment Concept
(2)	Density Per Town of Erie and Denver Water Board Engineering Standards
(3)	Average Day, Max Day and Peak Hour are per Town of Erie Standards and Specifications

CANYON CREEK FILING NO.10
FOUR CORNERS
COMMERCIAL AREA 1 EROSION AND SEDIMENT CONTROL PLANS

LOCATED IN THE NORTH ½ OF THE SE ¼ OF SECTION 24, TOWNSHIP 1 NORTH RANGE 69 WEST OF THE SIXTH PRINCIPAL MERIDIAN, TOWN OF ERIE, COUNTY OF BOULDER, STATE OF COLORADO

EROSION CONTROL LEGEND

CHECK DAM	CD	PERMANENT SEEDING	PS
CONSTRUCTION FENCE	CF	REINFORCED CHECK DAM	RCD
COMPOST BLANKET	CB	ROUGH CUT STREET CONTROL	RCS
CURB SOCK	CS	ROCK SOCKS/WATTLES	TS
CONCRETE/LIQUID WASTE WASHOUT AREA	CWS	SEDIMENT BASIN	SB
TEMPORARY DIVERSION DITCH	DD	SEDIMENT CONTROL LOG	SCL
EROSION CONTROL BLANKETS	ECB	SILT FENCE	SF
AREA INLET PROTECTION	IPA	SEEDING AND MULCHING	SM
CULVERT INLET PROTECTION	IPC	SURFACE ROUGHENING	SR
INTERIM INLET PROTECTION	IPI	STABILIZED STAGING AREA	SSA
ON-GRADE INLET PROTECTION	IPO	SEDIMENT TRAP	ST
SUMP INLET PROTECTION	IPS	TEMPORARY SLOPE DRAIN	TSD
LIMITS OF CONSTRUCTION	LOC	VEHICLE TRACKING CONTROL	VTC

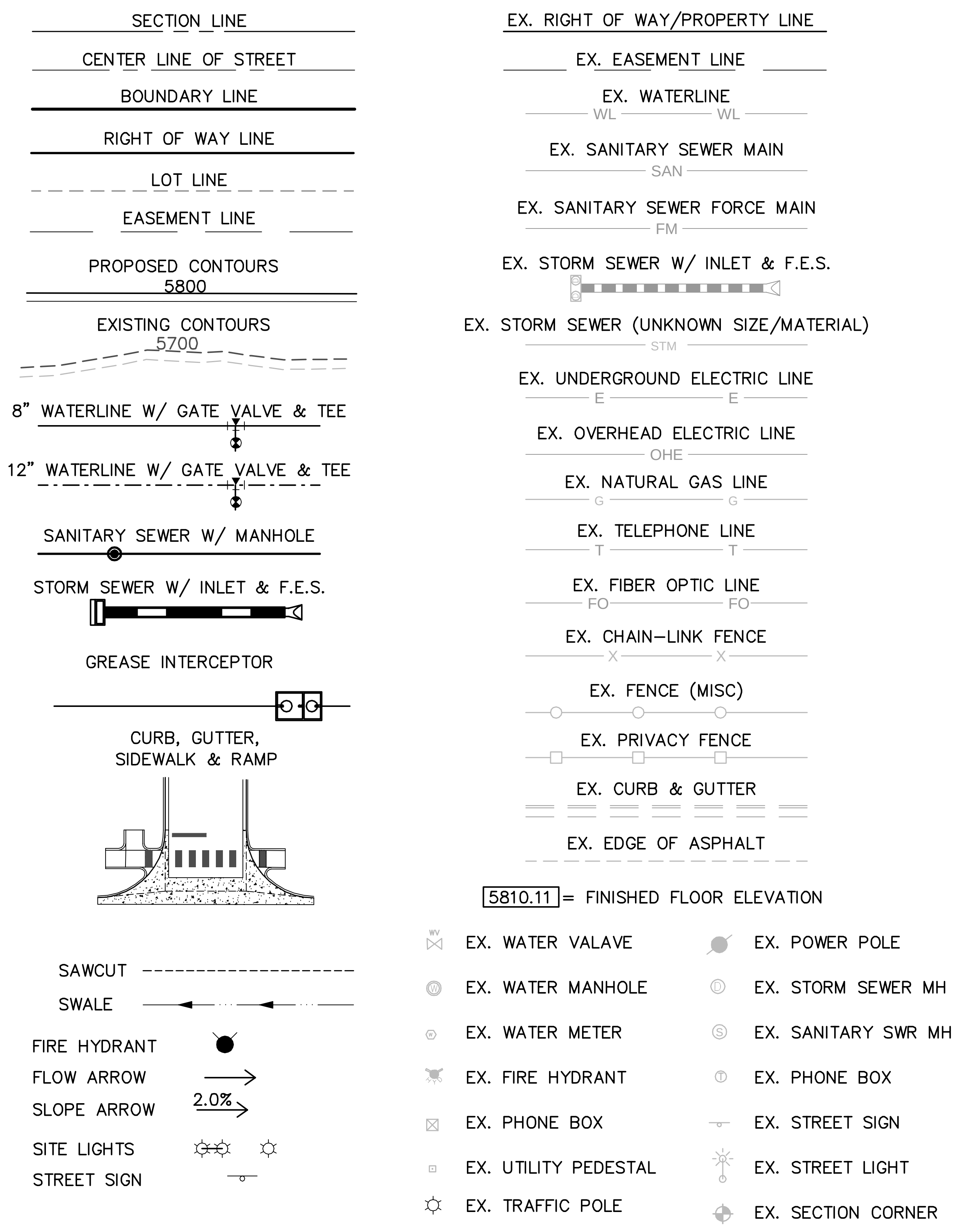


VICINITY MAP
SCALE: 1" = 2,000'

LIST OF ACRONYMS AND ABBREVIATIONS

A.D.	ALGEBRAIC DIFFERENCE
AC	ACRE
ADA	AMERICANS WITH DISABILITY ACT
ASSY	ASSEMBLY
B.O.	BLOW OFF
BMP	BEST MANAGEMENT PRACTICES
BNDY	BOUNDARY
BOW	BACK OF WALK
BW	BOTTOM OF WALL
CDS.	CONSTRUCTION PLANS
C.O.	CLEAN OUT
CFS	CUBIC FEET PER SECOND
CH	CHORD LENGTH
CHB	CHORD BEARING
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CONC	CONCRETE
D.E.	DRAINAGE EASEMENT
DFLCT	DEFLECTION
D.U.E.	DRAINAGE AND UTILITY EASEMENT
DIA.	DIAMETER
DIP	DUCTILE IRON PIPE
DTL.	DETAIL
E.A.E.	EMERGENCY ACCESS EASEMENT
EGL	ENERGY GRADE LINE
ELEV	ELEVATION
EX.	EXISTING
FEMA	FEDERAL EMERGENCY MANAGEMENT AGENCY
FES	FLARED END SECTION
FG	FINISHED GRADE
FH	FIRE HYDRANT
FHAD	FLOOD HAZARD AREA DELINEATION
FIRM	FLOOD INSURANCE RATE MAP
FL	FLOW LINE
FR	FROUDE NUMBER
FS	FIRE SERVICE
FT	FOOT
FUT	FUTURE
G.E.	GAS EASEMENT
GPM	GALLONS PER MINUTE
GSBD	GROUTED SLOPING BOULDER DROP
GV	GATE VALVE
HERCP	HORIZONTAL ELLIPTICAL REINFORCED CONCRETE PIPE
HGL	HYDRAULIC GRADE LINE
HORZ	HORIZONTAL
HP	HIGH POINT
HW	HEAD WALL
INT	INTERSECTION OR INTERCEPT
INV	INVERT
IRR	IRRIGATION
JT	JOINT
LF	LINEAR FOOT
LP	LOW POINT
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
N.T.S.	NOT TO SCALE
NO.	NUMBER
NWSEL	NORMAL WATER SURFACE ELEVATION
OSP	OUTFALL SYSTEM PLAN
PC	POINT OF CURVATURE
PCR	POINT OF CURVE RETURN
PL	PROPERTY LINE
PMF	PROBABLE MAXIMUM FLOOD
PRC	POINT OF REVERSE CURVATURE
PROP	PROPOSED
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENCY
PVC	POLYVINYL CHLORIDE
PVI	POINT OF VERTICAL INTERSECTION
Q10	10 YEAR DISCHARGE
Q100	100 YEAR DISCHARGE
RCBC	REINFORCED CONCRETE BOX CULVERT
RCP	REINFORCED CONCRETE PIPE
ROW	RIGHT OF WAY
S.U.E.	SIDEWALK AND UTILITY EASEMENT
SAN	SANITARY SEWER
SB	STILLING BASIN
SEC.	SECTION
SF	SQUARE FEET
STA	STATION
STD.	STANDARD
STM	STORM SEWER
SWMP	STORMWATER MANAGEMENT PLAN
TB	THRUST BLOCK
TBC	TOP BACK OF CURB
TEMP	TEMPORARY
TOF	TOP OF FOUNDATION
TOP	TOP OF PIPE
TOS	TOP OF SLAB
TW	TOP OF WALL
TYP	TYPICAL
U.D.	UNDERDRAIN
U.D.C.O.	UNDERDRAIN CLEAN OUT
U.E.	UTILITY EASEMENT
UDFCD	URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
VC	VERTICAL CURVE
VCP	VITRIFIED CLAY PIPE
VERT	VERTICAL
VN	NORMAL VELOCITY
W/	WITH
W/L	WATER LINE
WQ	WATER QUALITY
WQCV	WATER QUALITY CAPTURE VOLUME
WSEL	WATER SURFACE ELEVATION
YR	YEAR

SYMBOLS AND LINETYPES LEGEND



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Sheet List Table	
Sheet Number	Sheet Title
1	COVER SHEET
2	NOTES
3 - 4	INITIAL PLAN
5 - 6	FINAL PLAN
7 - 9	DETAIL SHEET

To request marking of underground facilities

811®
Know what's **below.**
Call before you dig.
Call 811 or visit call811.com
for more information

It is the contractor's responsibility to contact UNCC a minimum of 2 days prior to the start of construction operations.
J3 Engineering Consultants, Inc claims no responsibility for the underground facilities depicted in this plan set.

BASIS OF BEARINGS:

THE EAST LINE OF THE SOUTHEAST QUARTER OF SECTION 24, TOWNSHIP 1 NORTH, RANGE 69 WEST OF THE 6TH P.M. IS ASSUMED TO BEAR SOUTH ZERO DEGREES, 59 MINUTES, 04 SECONDS EAST BETWEEN A FOUND 2" ALUMINUM CAP MONUMENT IN RANGE BOX, WITH ILLEGIBLE STAMPING, AT THE NORTHEAST CORNER OF SAID SECTION 24 AND A FOUND 2" ALUMINUM CAP MONUMENT STAMPED LS 14083 AT THE SOUTHEAST CORNER OF SAID SECTION 24.

SITE BENCHMARK:

THE EAST QUARTER CORNER OF SECTION 25, TOWNSHIP 1 NORTH, RANGE 69 WEST OF THE 6TH PRINCIPAL MERIDIAN, A FOUND 2" DIAMETER ALUMINUM CAP MONUMENT IN RANGE BOX AT THE INTERSECTION OF WELD COUNTY ROAD 6 AND WELD COUNTY ROAD 1 (A.K.A. NE COUNTY ROAD) LINE ALSO BEING POINT NUMBER 59 ON THE TOWN OF ERIE CONTROL MAP, PREPARED BY EHRHART GRIFFIN AND ASSOCIATES, REVISION DATED 1/25/04, WITH PUBLISHED ELEVATION OF 5091.99 FEET (NAVD '88 VERTICAL DATUM).

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FOUR CORNERS
EROSION AND SEDIMENT CONTROL PLANS
COVER SHEET

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Contact: Justin McClure

DOCUMENT AMENDMENTS

No.	Date	Description
1	6/30/2016	ORIGINAL SUBMITTAL

PRELIMINARY
NOT FOR
CONSTRUCTION

Project Number: 030019
Designed By: AKM
Drawn By: MRL
Checked By: SOS
Sheet Number: 1

ENGINEERS' PROJECT NOTES:

1. EXISTING UTILITIES – THE LOCATIONS OF EXISTING UTILITIES SHOWN ON THE DRAWINGS ARE APPROXIMATE AND WERE BASED ON THE BEST AVAILABLE INFORMATION AND RECORDS AT THE TIME. THE DEPICTED LOCATION OF THE EXISTING UTILITIES MAY NOT BE EXACT AND OTHER UTILITIES MAY ALSO BE PRESENT. LOCATION OF THE EXISTING UTILITIES SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO ACTUAL CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING EXACT LOCATIONS AND ELEVATIONS OF ALL UTILITIES PRIOR TO EXCAVATION AND CONSTRUCTION. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 OR CALL811.COM.

2. EXISTING FACILITIES – EXISTING FACILITIES NOT INDICATED TO BE REMOVED SHALL BE PROTECTED IN PLACE OR REMOVED AND REPLACED IN KIND, AS APPROVED BY ENGINEER. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY CONFLICT.

3. SURVEY INFORMATION – TOPOGRAPHIC MAPPING SHOWN ON THE DRAWINGS WAS PREPARED BY ROCK CREEK SURVEYING, LLC BASED ON FIELD SURVEY. THE DATE OF SURVEY WAS ON OR ABOUT AUGUST 10, 2011. ACTUAL FEATURES AND TOPOGRAPHY MAY VARY. THE CONTRACTOR SHALL VERIFY SITE CONDITIONS BEFORE THE START OF WORK.

4. GEOTECHNICAL INFORMATION – A GEOTECHNICAL REPORT(S) HAS BEEN PERFORMED BY CTL THOMPSON, INC AND SHALL BE OBTAINED BY THE CONTRACTOR. IT IS THE CONTRACTOR'S RESPONSIBILITY TO MEET ALL REQUIREMENTS ASSOCIATED WITH THE GEOTECHNICAL REPORT DURING THE CONSTRUCTION OPERATIONS, INCLUDING BUT NOT LIMITED TO COMPACTION REQUIREMENTS, DEWATERING METHODS, OVER–EXCAVATION REQUIREMENTS, CHEMICAL STABILIZATION, CONSIDERATION OF MATERIALS LIKELY TO EXHIBIT REFUSAL, MATERIALS STANDARDS AND PLACEMENT SPECIFICATIONS, ETC. IT IS THE CONTRACTOR'S RESPONSIBILITY TO NOTIFY THE GEOTECHNICAL ENGINEER OF ANY CONFLICT OR DISCREPANCY BETWEEN THE GEOTECHNICAL REPORT REQUIREMENTS AND THE ASSOCIATED MUNICIPAL STANDARDS AND SPECIFICATIONS.

5. REFERENCE STANDARDS – EXCEPT WHERE OTHERWISE PROVIDED FOR IN THESE PLANS AND SPECIFICATIONS, THE TOWN OF ERIE AND/OR URBAN DRAINAGE AND FLOOD CONTROL DISTRICT STANDARDS AND SPECIFICATIONS SHALL APPLY.

6. QUANTITIES & BID TABULATION – ALL ESTIMATES OR QUANTITIES SHALL BE VERIFIED BY THE CONTRACTOR / SUBCONTRACTOR, WHO SHALL BE RESPONSIBLE FOR DETERMINING ALL QUANTITIES AND PROVIDING THE WORK AND MATERIALS AS SHOWN ON THESE PLANS. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PERFORM AN INDEPENDENT TAKE–OFF OF ALL QUANTITIES, TO NOTIFY THE OWNER AND ENGINEER OF ANY DISCREPANCIES (INCLUDING UNLISTED ITEMS), AND TO SUBMIT AN ADD–ALTERNATE BID IDENTIFYING THE DISCREPANCIES PRIOR TO FINAL EXECUTION OF THE CONSTRUCTION CONTRACT.

7. RETAINING WALLS – RETAINING WALLS DEPICTED IN THESE DRAWINGS REFERENCE TOP OF WALL AND BOTTOM OF WALL ELEVATIONS AT FINISHED GRADE. ADDITIONAL WALL BURY DEPTH MAY BE REQUIRED BASED ON MANUFACTURE SPECIFICATIONS AND/OR STRUCTURAL DESIGN, BY OTHERS. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING SHOP DRAWINGS AND PROVIDING A BID PRICE WHICH REFLECTS THE TOTAL WALL QUANTITY, INCLUDING THE BURY DEPTH.

8. WATERWAY/STREAM WORK – ANY WORK THAT WILL TAKE PLACE IN AND AROUND A STREAM OR DRAINAGEWAY MAY BE SUBJECT TO PERIODIC FLOODING. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONTROL OF SURFACE AND SUBSURFACE WATER DURING THE COURSE OF THE WORK. ANY DAMAGE TO THE WORK RESULTING FROM SURFACE FLOWS, BASE FLOWS, OR FLOOD FLOWS INCLUDING BUOYANCY FORCES ON PIPELINES AND OTHER FACILITIES SHALL BE CORRECTED BY THE CONTRACTOR AT THE CONTRACTOR'S SOLE COST. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING AND SATISFYING THE REQUIREMENTS OF ANY APPLICABLE PERMITS PERTAINING TO WATER AND EROSION CONTROL. STORMWATER MANAGEMENT PLANS HAVE BEEN APPROVED BY CITY OF LOUISVILLE AND SHALL REMAIN IN FULL FORCE DURING CONSTRUCTION ACTIVITIES AND AS REQUIRED BY THE MUNICIPALITY. THE COST OF THE STORMWATER MANAGEMENT PERMIT AND ALL OTHER INCIDENTAL COSTS ASSOCIATED WITH PERMIT COMPLIANCE AND SURFACE AND SUBSURFACE FLOODING PROTECTION SHALL BE PAID FOR BY THE CONTRACTOR.

9. DEWATERING – IT IS THE CONTRACTORS RESPONSIBILITY TO DETERMINE THE APPLICABILITY, MEANS, AND METHODS OF ANY DEWATERING ACTIVITIES REQUIRED FOR THE CONSTRUCTION OF THIS PROJECT AND AS DIRECTED ON THE PLAN OR GEOTECHNICAL REPORT. ADDITIONALLY, IT IS THE CONTRACTORS RESPONSIBILITY TO OBTAIN AND COMPLY WITH THE APPROPRIATE PERMITS. THIS EFFORT SHALL BE REFLECTED IN THE CONTRACTOR'S CONSTRUCTION SCHEDULE AND BASE BID AS NECESSARY.

10. FEDERAL FLOODPLAIN PERMITTING – CONSTRUCTION OF THE IMPROVEMENTS WITHIN THIS PLAN SET MAY LIE IN A FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) DESIGNATED FLOODPLAIN. THE CONTRACTOR IS TO ENSURE ALL PERMITS AND ASSOCIATED APPROVALS NECESSARY TO PERFORM WORK ARE OBTAINED PRIOR TO CONSTRUCTION ACTIVITIES.

11. WATERS OF THE US PERMITTING – CONSTRUCTION OF THE IMPROVEMENTS WITHIN THIS PLAN SET MAY LIE WITHIN IDENTIFIED WATERS OF THE US. THE CONTRACTOR IS TO ENSURE ALL PERMITS AND ASSOCIATED APPROVALS NECESSARY TO PERFORM WORK ARE OBTAINED PRIOR TO CONSTRUCTION ACTIVITIES.

12. STABLE EXCAVATION AND DEMOLITION LIABILITY – THE CONTRACTOR IS SOLELY RESPONSIBLE FOR PROVIDING STABLE EXCAVATIONS AND TEMPORARY SLOPES AND FOR SATISFYING ALL APPLICABLE OSHA, FEDERAL, STATE AND LOCAL REGULATIONS. TEMPORARY EXCAVATIONS SHALL PROVIDE, AT MINIMUM, THE TRENCH DIMENSIONS AND CLEARANCES SHOWN OR SPECIFIED BY MUNICIPAL STANDARDS, REQUIREMENTS OR DETAILS WITH THE APPROVED CONSTRUCTION PLANS AND PROJECT GEOTECHNICAL REPORT OR BY STANDARD ENGINEERING PRACTICE. TEMPORARY CONSTRUCTION SLOPES SHALL BE SLOPED, SHORED, SHEETED, AND/OR BRACED IN ACCORDANCE WITH STABILITY REQUIREMENTS OR APPLICABLE REGULATIONS, AND SHALL BE NO STEEPER THAN THE SLOPES SHOWN OR SPECIFIED WITH THE APPROVAL OF THE ENGINEER. ANY SUCH APPROVALS BY THE ENGINEER WILL NOT RELIEVE THE CONTRACTOR FROM SOLE RESPONSIBILITY FOR PROVIDING STABLE EXCAVATIONS AND TEMPORARY SLOPES.

13. LIMITS OF WORK – THE LIMITS OF CONSTRUCTION (LOC) FOR THIS PROJECT IS SHOWN WITHIN THE CONSTRUCTION PLANS. CONTRACTOR SHALL LIMIT ALL CONSTRUCTION ACTIVITIES AND DISTURBANCES TO LIMITS OF CONSTRUCTION OR AS ALLOWED BY THE MUNICIPAL INSPECTOR.

14. WORK CONDITIONS – THE CONTRACTOR SHALL BE SOLELY AND COMPLETELY RESPONSIBLE FOR ALL CONDITIONS AT AND ADJACENT TO THE JOB SITE, INCLUDING SAFETY OF ALL PEOPLE AND PROPERTY DURING PERFORMANCE OF THE WORK. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS.

15. PLANS AND CLARIFICATIONS – THE CONTRACTOR SHALL ENSURE ONE COPY OF THE APPROVED PLANS ARE ON SITE AT ALL TIMES. FURTHER, THE CONTRACTOR IS RESPONSIBLE FOR SUPPLYING ALL SUB–CONTRACTORS WITH THE APPROVED PLANS AND VERIFYING THAT ALL CONSTRUCTION IS IN ACCORDANCE WITH THAT PLAN SET(S). THE CONTRACTOR SHALL CONTACT THE ENGINEER FOR CLARIFICATIONS OR DISCREPANCIES ON ANY INFORMATION SHOWN ON THE DRAWINGS.

16. WEED CONTROL – CONTRACTOR SHALL MAINTAIN CONTROL OF WEEDS ON THE CONSTRUCTION SITE, AND WITHIN 50 FEET OF THE CONSTRUCTION SITE, IF NECESSARY, STARTING WITH CONSTRUCTION STARTUP AND CONTINUING THROUGH THE END OF THE PRESCRIBED MAINTENANCE PERIOD IDENTIFIED BY MUNICIPAL STANDARDS OR IN THE PROJECT SPECIFICATIONS. ANNUAL WEEDS MAY REQUIRE MOWING SEVERAL TIMES PER GROWING SEASON TO PREVENT SEED SET. BIENNIAL AND PERENNIAL WEEDS AND NOXIOUS WEEDS MAY REQUIRE SPOT APPLICATION OF APPROVED HERBICIDES BY A STATE CERTIFIED WEED CONTROL SPECIALIST TO PREVENT SEED SET. ALL WEED CONTROL SHALL BE IN ACCORDANCE WITH MUNICIPAL STANDARDS.

17. TREE PROTECTION – ALL TREES ARE TO BE PROTECTED DURING CONSTRUCTION UNLESS IDENTIFIED ON THE PLANS FOR REMOVAL. THE CONTRACTOR IS TO IDENTIFY TREES FOR REMOVAL AND THEN NOTIFY THE CONSTRUCTION MANAGER /ENGINEER PRIOR TO ANY TREE REMOVAL. THE CONSTRUCTION MANAGER/ ENGINEER WILL VERIFY THE TREES IDENTIFIED FOR REMOVAL PRIOR TO THE CONTRACTOR COMMENCING TREE MITIGATION. IN THE EVENT A PROTECTED TREE IS DAMAGED OR DESTROYED DURING CONSTRUCTION ACTIVITIES, THE CONTRACTOR WILL BE SOLELY RESPONSIBLE FOR THE MITIGATION REQUIREMENTS AND MAY PAY DAMAGES UP TO THREE TIMES MARKET VALUE OF THE TREE.

TOWN OF ERIE STANDARD GRADING AND EROSION & SEDIMENT CONTROL NOTES

1. ALL CONSTRUCTION ACTIVITIES THAT DISTURBS ONE OR MORE ACRES OF LAND, AS WELL AS ACTIVITIES THAT DISTURB LESS THAN ONE ACRE OF LAND, BUT IS PART OF A LARGER COMMON PLAN OF DEVELOPMENT, MUST COMPLY WITH BOTH LOCAL AND STATE REGULATIONS REGARDING STORMWATER DRAINAGE ON CONSTRUCTION SITES. OWNERS OR CONTRACTORS MUST OBTAIN A COLORADO STORMWATER DISCHARGE PERMIT FOR CONSTRUCTION ACTIVITIES FROM THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT (CDPHE) AND EITHER A PUBLIC IMPROVEMENT PERMIT OR A GRADING AND STORMWATER QUALITY PERMIT FROM THE TOWN OF ERIE. CONTRACTOR SHALL:

   A. MAINTAIN A COPY OF THE STORM WATER MANAGEMENT PLAN (SWMP) ONSITE AT ALL TIMES. THE SWMP MUST BE MAINTAINED AND MADE AVAILABLE TO TOWN OF ERIE INSPECTORS UPON REQUEST.

   B. INSTALL AND MAINTAIN EROSION, SEDIMENT, AND MATERIALS MANAGEMENT CONTROL BMPS AS SPECIFIED IN THE SWMP.

   C. INSPECT ALL BEST MANAGEMENT PRACTICES (BMPS) AT LEAST EVERY FOURTEEN (14) DAYS AND WITHIN TWENTY FOUR (24) HOURS AFTER ANY PRECIPITATION OR SNOWMELT EVENT THAT CAUSES SURFACE RUNOFF.

   D. MAINTAIN INSPECTION AND MAINTENANCE RECORDS OF BMPS ONSITE WITH THE SWMP. COPIES OF THESE REPORTS SHALL BE PROVIDED TO THE TOWN OF ERIE ENGINEERING STAFF.

   E. BASED ON INSPECTIONS PERFORMED BY THE PERMIT HOLDER OR BY TOWN PERSONNEL, MODIFICATIONS TO THE SWMP WILL BE NECESSARY IF AT ANY TIME THE SPECIFIED BMPS DO NOT MEET THE OBJECTIVES OF THE PERMIT. ALL MODIFICATIONS SHALL BE COMPLETED AS SOON AS PRACTICABLE AFTER THE REFERENCED INSPECTION, AND SHALL BE RECORDED ON THE OWNER'S COPY OF THE SWMP.

   F. THE OPERATOR SHALL AMEND THE SWMP WHENEVER THERE IS A SIGNIFICANT CHANGE IN DESIGN, CONSTRUCTION, OPERATION, OR MAINTENANCE, WHICH HAS A SIGNIFICANT EFFECT ON THE POTENTIAL FOR DISCHARGE OF POLLUTANTS TO THE RECEIVING WATERS, OR IF THE SWMP PROVES TO BE INEFFECTIVE IN ACHIEVING THE GENERAL OBJECTIVES OF CONTROLLING POLLUTANTS IN STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITIES.

   G. INSTALLATION AND MAINTENANCE OF BMPS SHALL BE SUPERVISED BY PERSONNEL CERTIFIED IN EROSION AND SEDIMENT CONTROL.

2. ALL SITE GRADING (EXCAVATION, EMBANKMENT, AND COMPACTION) SHALL CONFORM TO THE RECOMMENDATIONS OF THE LATEST SOILS INVESTIGATION FOR THIS PROPERTY AND SHALL FURTHER BE IN CONFORMANCE WITH THE TOWN OF ERIE "STANDARDS AND SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS", LATEST EDITION.

3. ALL GRADING AND FILLING OPERATIONS SHALL BE OBSERVED, INSPECTED AND TESTED BY A LICENSED SOILS ENGINEER. ALL TEST RESULTS SHALL BE SUBMITTED TO THE TOWN OF ERIE ENGINEERING STAFF.

4. NATURAL VEGETATION SHALL BE RETAINED AND PROTECTED WHEREVER POSSIBLE. EXPOSURE OF SOIL TO EROSION BY REMOVAL OR DISTURBANCE OF VEGETATION SHALL BE LIMITED TO THE AREA REQUIRED FOR IMMEDIATE CONSTRUCTION OPERATION AND FOR THE SHORTEST PRACTICAL PERIOD OF TIME. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO AVOID ANY DAMAGE TO EXISTING FOLIAGE THAT LIES IN THE PROJECT AREA UNLESS DESIGNATED FOR REMOVAL AND SHALL BE LIABLE FOR SUCH DAMAGE AT HIS/HER EXPENSE.

5. TOPSOIL SHALL BE STOCKPILED TO THE EXTENT PRACTICABLE ON THE SITE FOR USE ON AREAS TO BE RE–VEGETATED. ANY AND ALL STOCKPILES SHALL BE LOCATED AND PROTECTED FROM EROSIVE ELEMENTS.

6. TEMPORARY VEGETATION SHALL BE INSTALLED ON ALL DISTURBED AREAS WHERE PERMANENT SURFACE IMPROVEMENTS ARE NOT SCHEDULED FOR IMMEDIATE INSTALLATION. SEEDING WILL BE DONE ACROSS THE SLOPE FOLLOWING THE CONTOURS. VEGETATION SHALL CONFORM TO THE TOWN OF ERIE STANDARDS AND SPECIFICATIONS. PROJECT SCHEDULING SHOULD TAKE ADVANTAGE OF SPRING OR FALL PLANTING SEASONS FOR NATURAL GERMINATION. SEEDED AREAS SHALL BE IRRIGATED IN ACCORDANCE WITH THE TOWN OF ERIE'S STANDARDS AND SPECIFICATIONS.

7. AT ALL TIMES, A WATER TRUCK SHALL BE ON–SITE AND THE PROPERTY SHALL BE MAINTAINED AND/OR WATERED TO PREVENT WIND–CAUSED EROSION. EARTHWORK OPERATIONS SHALL BE DISCONTINUED WHEN FUGITIVE DUST SIGNIFICANTLY IMPACTS ADJACENT PROPERTY. IF EARTHWORK IS COMPLETE OR DISCONTINUED AND DUST FROM THE SITE CONTINUES TO CREATE PROBLEMS, THE OWNER/DEVELOPER SHALL IMMEDIATELY INSTITUTE MITIGATIVE MEASURES AND SHALL CORRECT DAMAGE TO ADJACENT PROPERTY.

8. FILL SLOPES SHALL BE COMPACTED BY MEANS OF SHEEPSFOOT COMPACTOR OR OTHER SUITABLE EQUIPMENT. COMPACTING SHALL CONTINUE UNTIL SLOPES ARE STABLE AND THERE IS NOT AN APPRECIABLE AMOUNT OF LOOSE SOIL ON THE SLOPES.

9. TEMPORARY CUT/FILL SLOPES SHALL ABIDE BY THE SOILS REPORT. PERMANENT SLOPES SHALL BE AS SHOWN ON PLANS.

10. DEPTH OF MOISTURE–DENSITY CONTROL SHALL BE FULL DEPTH ON ALL EMBANKMENT AND SIX (6) INCHES ON THE BASE OF CUTS AND FILLS.

11. OUTLET SIDES OF ALL STORM PIPES SHALL BE GRADED TO DRAIN AND SHALL HAVE SUFFICIENT EROSION PROTECTION.

12. THE PERMITTEE OR HIS AGENT SHALL NOTIFY THE SITE GEOTECHNICAL ENGINEER WHEN THE GRADING OPERATION IS READY FOR EACH OF THE FOLLOWING INSPECTIONS:

   A. INITIAL INSPECTION WHEN THE PERMITTEE IS READY TO BEGIN WORK, BUT NOT LESS THAN TWO (2) DAYS BEFORE ANY GRADING OR GRUBBING IS STARTED.

   B.AFTER THE NATURAL GROUND OR BEDROCK IS EXPOSED AND PREPARED TO RECEIVE FILL, BUT BEFORE FILL IS PLACED.

   C.EXCAVATION INSPECTION AFTER THE EXCAVATION IS STARTED BUT BEFORE THE VERTICAL DEPTH OF THE EXCAVATION EXCEEDS TEN (10) FEET.

FILL INSPECTION AFTER THE FILL PLACEMENT IS STARTED, BUT BEFORE THE FILL EXCEEDS TEN (10) FEET.

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FOUR CORNERS
EROSION AND SEDIMENT CONTROL PLANS
NOTES

Foundry Builders, Inc.

21 South Sunset
Longmont, CO 80503
Tel: (720) 524-3620

Contact: Justin McClure

No.	Date	Description
1	6/30/2016	ORIGINAL SUBMITTAL

DOCUMENT AMENDMENTS

PRELIMINARY
NOT FOR
CONSTRUCTION

Project Number: 030019
Designed By: AKM
Drawn By: MRL
Checked By: SOS
Sheet Number: 2

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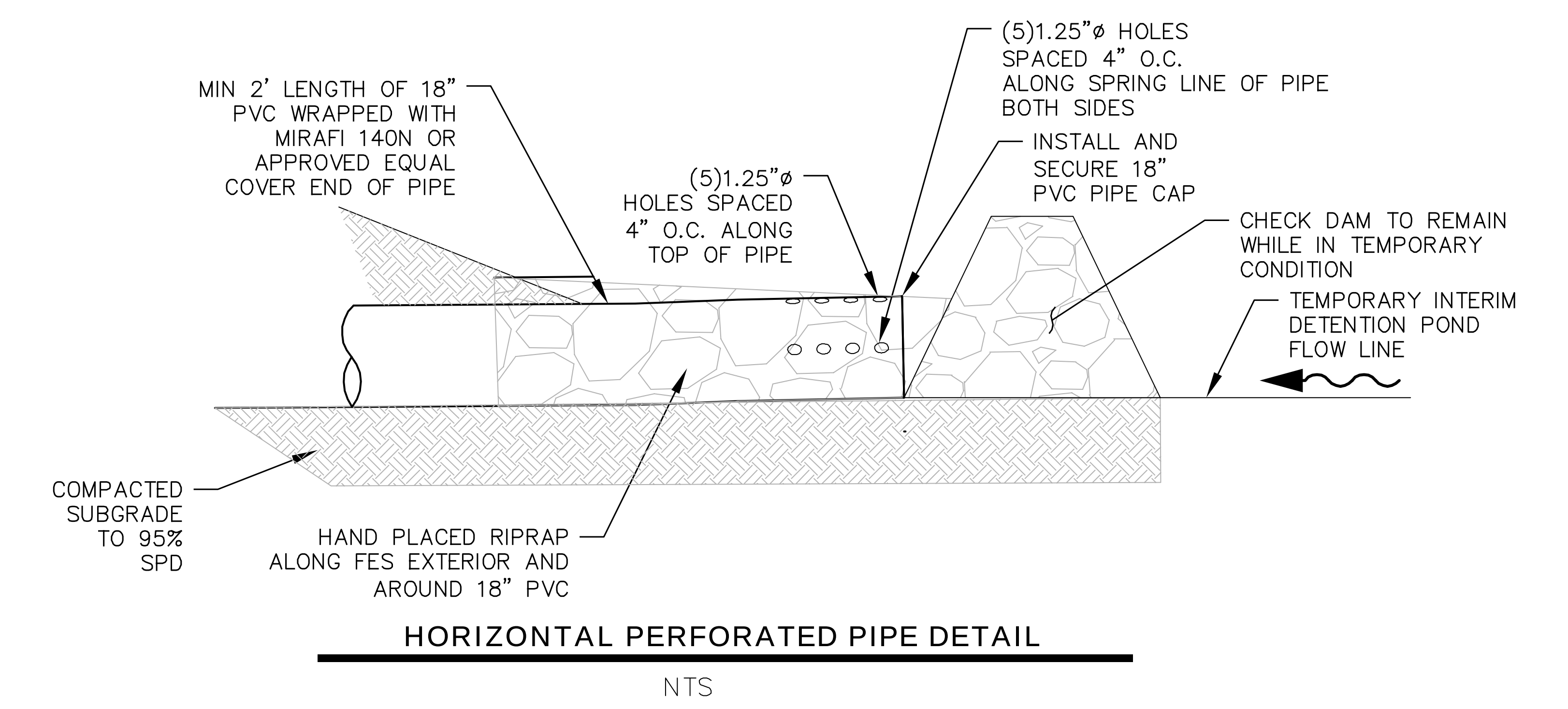
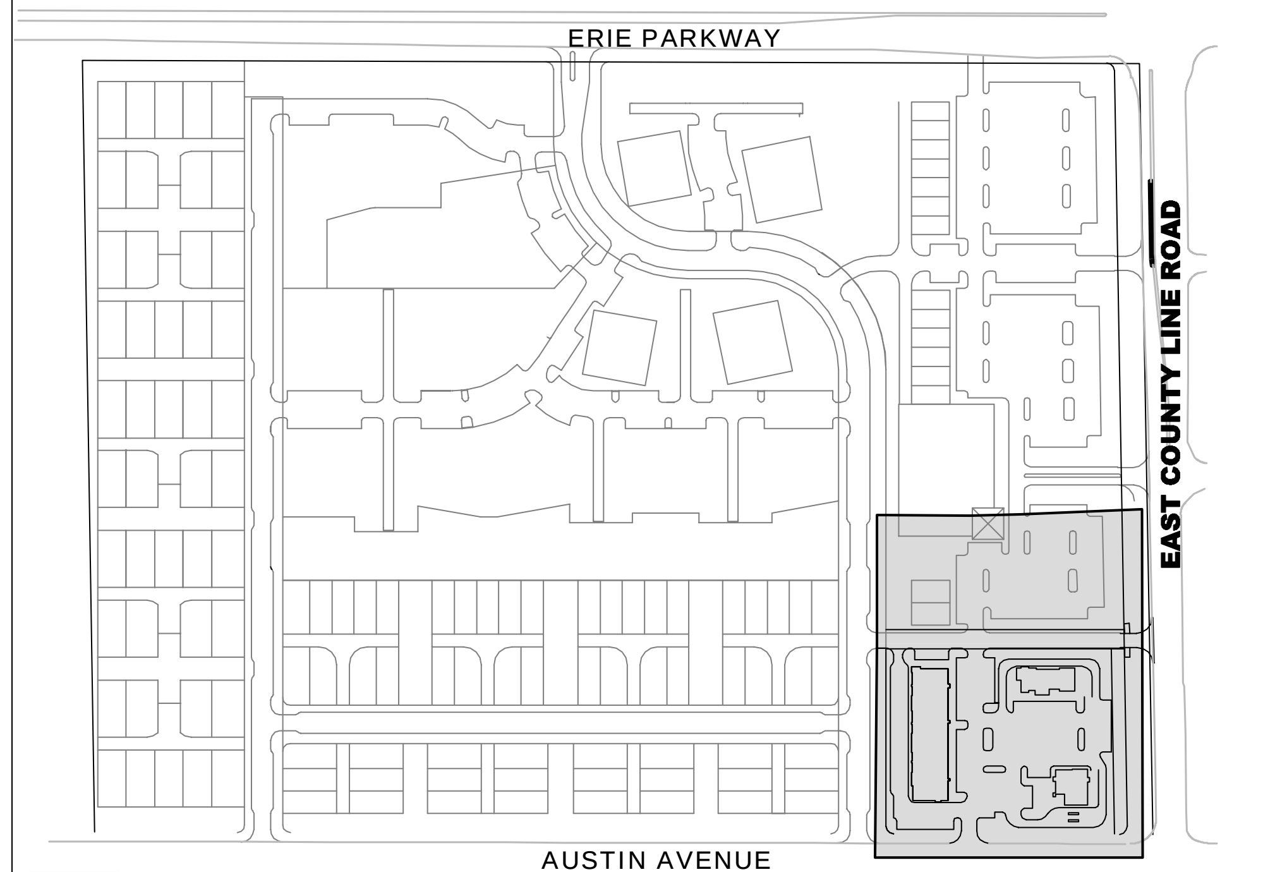


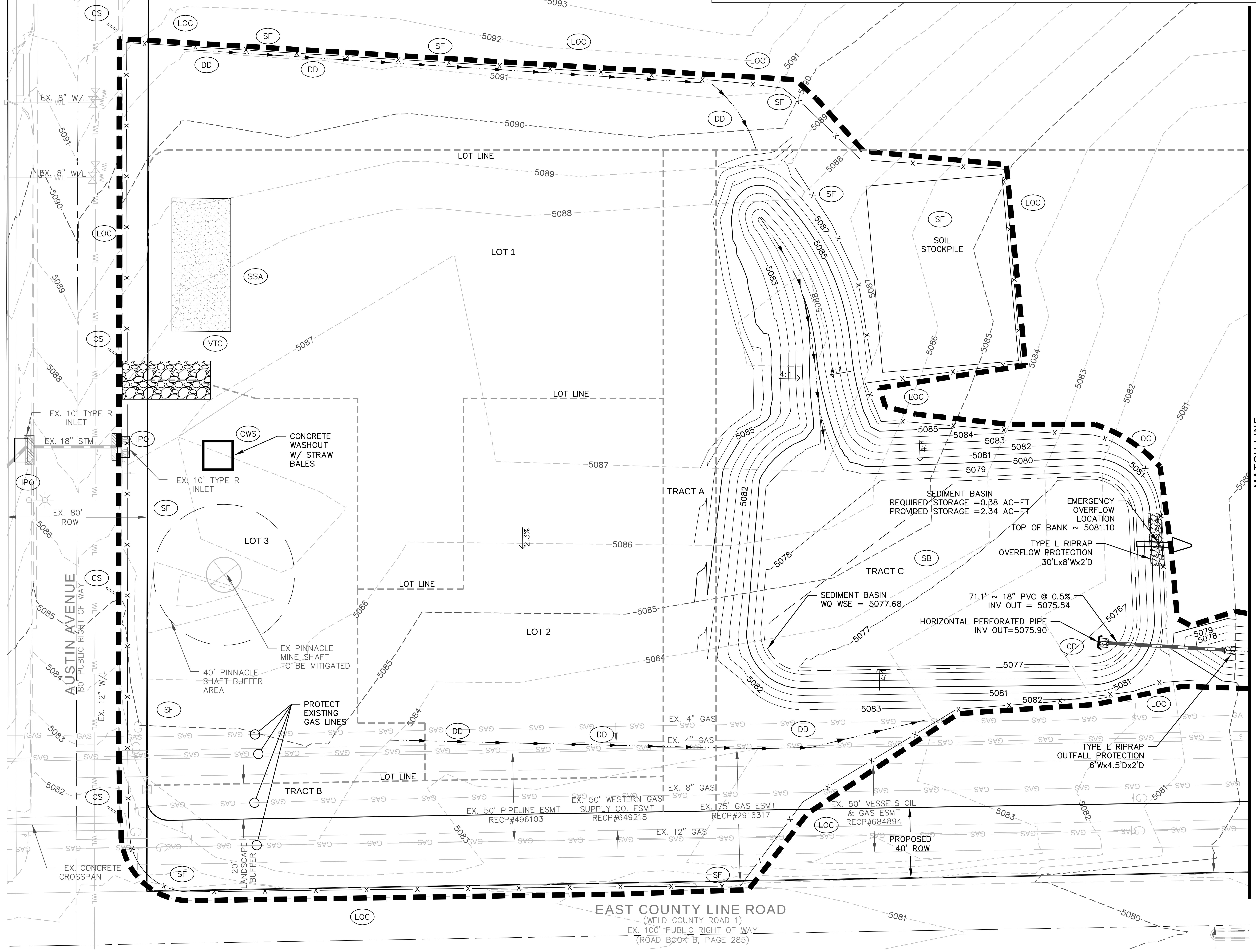
HORIZONTAL PERFORATED PIPE DETAIL

NTS



KEY MAP

N.T.S.



To request marking of underground facilities

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EROSION CONTROL NOTES:

1. SEE SHEET 2 FOR STANDARD NOTES AND EROSION AND SEDIMENT CONTROL (ESC) NOTES.
2. ALL PROPOSED STORM SEWER SHALL HAVE INLET AND OUTLET PROTECTION PER TOWN OF ERIE REQUIREMENTS.
3. THIS PLAN IS NOT COMPLETE WITHOUT THE APPROVED STORMWATER MANAGEMENT REPORT, THE FINAL SITE GEOTECHNICAL REPORT AND THE TOWN OF ERIE APPROVAL.
4. SHADED BMPS WERE INSTALLED IN INITIAL OR INTERIM CONDITIONS AND UNLESS OTHERWISE INDICATED, SHALL BE LEFT IN PLACE UNTIL REVEGETATION HAS BEEN ESTABLISHED AND ACCEPTED.
5. TRANSITION GRADING OPERATIONS AT 50–ACRE LIMITS OR AT PROJECT GRADING SUB PHASING MUST NOT EXCEED TEMPORARY 3:1 SLOPES (OR AS SPECIFIED IN THE APPROVED GEOTECHNICAL REPORT) AND MUST BE PROTECTED USING TOWN OF ERIE CRITERIA INCLUDING, BUT NOT LIMITED TO TEMPORARY SEEDING, SILT FENCE AND SURFACE ROUGHENING.
6. THE TEMPORARY SEDIMENT BASINS WILL BE INSPECTED WEEKLY AND AFTER EVERY PRECIPITATION EVENT AND REPAIRED AS NECESSARY. THE TEMPORARY SEDIMENT WILL BE MAINTAINED AS REQUIRED TO ENSURE PROPER FUNCTIONING AND SEDIMENT WILL BE REMOVED WHEN THE BASIN BECOMES HALF FULL. THESE TASKS ARE THE RESPONSIBILITY OF THE CONTRACTOR.
7. TEMPORARY GRADING MAY BE REQUIRED DUE TO PHASING AND TIMING OF THE CONSTRUCTION. PHASING GRADING SHALL TRANSITION AT RATES AND BE IN CONFORMANCE WITH ALL REQUIREMENTS OF THE APPROVED GEOTECHNICAL REPORT. TRANSITION GRADING SHALL BE STABILIZED AS SOON AS PRACTICAL AND NO LONGER THAN 7 DAYS.
8. THE GRADING DEPICTED IN THESE STORMWATER MANAGEMENT PLANS IS MASS GRADING. THE FINAL GRADES ASSOCIATED WITH THE APPROVED SITE CIVIL CONSTRUCTION MAY VARY FROM THAT DEPICTED WITHIN THIS PLAN SET. THE DEVELOPER AND CONTRACTOR UNDERSTAND THAT UPDATES TO THE GRADING IS LIKELY AND THAT ALL GRADING OPERATIONS PERFORMED OFF THE APPROVED STORMWATER MANAGEMENT PLANS ARE AT THEIR SOLE RISK.
9. FINAL LANDSCAPING AND PERMANENT STABILIZATION PLANS SUBMITTED BY SEPARATE DOCUMENT.
10. ALL EXISTING UTILITIES MUST BE PROTECTED AND IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
11. THE CONTRACTOR SHALL MAINTAIN EAST COUNTY LINE ROAD AND AUSTIN AVENUE ACCESS FOR PUBLIC TRAFFIC. THE ADJACENT STREETS SHALL BE MAINTAINED AND FREE OF DEBRIS AT ALL TIMES.
12. STABILIZED STAGING AREA TO BE USED FOR STORAGE OF ALL EQUIPMENT, FUEL, LUBRICANT, CHEMICALS AND WASTE.

BASIS OF BEARINGS:

THE EAST LINE OF THE SOUTHEAST QUARTER OF SECTION 24, TOWNSHIP 1 NORTH, RANGE 69 WEST OF THE 6TH P.M. IS ASSUMED TO BEAR SOUTH ZERO DEGREES, 59 MINUTES, 04 SECONDS EAST BETWEEN A FOUND 2" ALUMINUM CAP MONUMENT IN RANGE BOX, WITH ILLEGIBLE STAMPING, AT THE NORTHEAST CORNER OF SAID SECTION 24 AND A FOUND 2" ALUMINUM CAP MONUMENT STAMPED LS 14083 AT THE SOUTHEAST CORNER OF SAID SECTION 24.

SITE BENCHMARK:

THE EAST QUARTER CORNER OF SECTION 25, TOWNSHIP 1 NORTH, RANGE 69 WEST OF THE 6TH PRINCIPAL MERIDIAN, A FOUND 2" DIAMETER ALUMINUM CAP MONUMENT IN RANGE BOX AT THE INTERSECTION OF WELD COUNTY ROAD 6 AND WELD COUNTY ROAD 1 (A.K.A. NE COUNTY ROAD) LINE ALSO BEING POINT NUMBER 59 ON THE TOWN OF ERIE CONTROL MAP, PREPARED BY EHRHART GRIFFIN AND ASSOCIATES, REVISION DATED 1/25/04, WITH PUBLISHED ELEVATION OF 5091.99 FEET (NAVD '88 VERTICAL DATUM).

J3 ENGINEERING CONSULTANTS
Contact: Suzanne O. Sibel, PE
2011 Cherry Street, Suite 206 Louisville, CO 80027
Phone: (720) 975-0177
Email: ssibel@J3engineering.net

FOUR CORNERS
EROSION AND SEDIMENT CONTROL PLANS
INITIAL PLAN

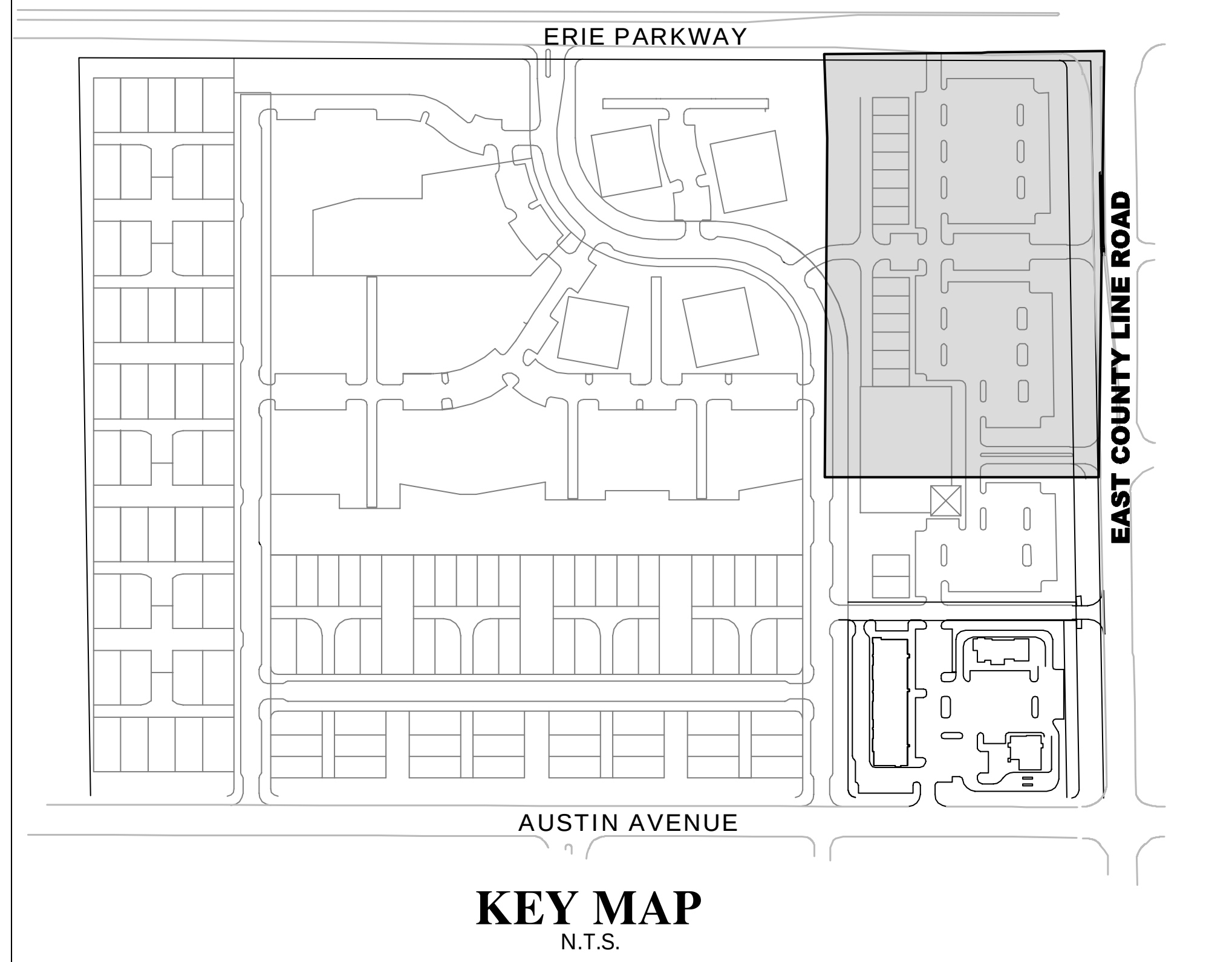
Foundry Builders, Inc.
21 South Sunset
Longmont, CO 80503
Tel: (720) 524-3620
Contact: Justin McClure

DOCUMENT AMENDMENTS

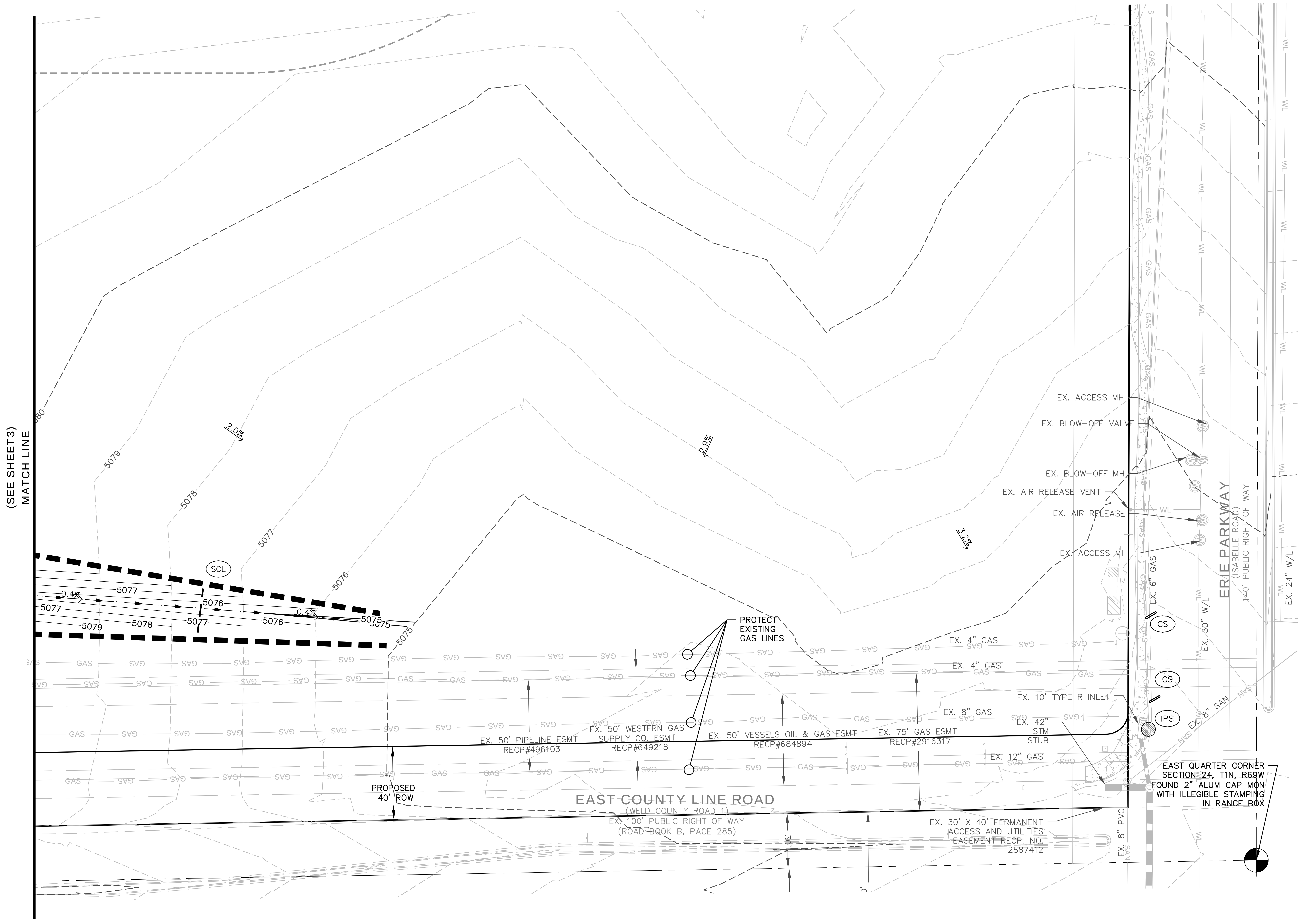
No.	Date	Description
1	6/30/2016	ORIGINAL SUBMITTAL

PRELIMINARY NOT FOR CONSTRUCTION

Project Number: 030019
Designed By: AKM
Drawn By: MRL
Checked By: SOS
Sheet Number: 3



KEY MAP
N.T.S.



EROSION CONTROL NOTES:

1. SEE SHEET 2 FOR STANDARD NOTES AND EROSION AND SEDIMENT CONTROL (ESC) NOTES.
2. ALL PROPOSED STORM SEWER SHALL HAVE INLET AND OUTLET PROTECTION PER TOWN OF ERIE REQUIREMENTS.
3. THIS PLAN IS NOT COMPLETE WITHOUT THE APPROVED STORMWATER MANAGEMENT REPORT, THE FINAL SITE GEOTECHNICAL REPORT AND THE TOWN OF ERIE APPROVAL.
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5. TRANSITION GRADING OPERATIONS AT 50-ACRE LIMITS OR AT PROJECT GRADING SUB PHASING MUST NOT EXCEED TEMPORARY 3:1 SLOPES (OR AS SPECIFIED IN THE APPROVED GEOTECHNICAL REPORT) AND MUST BE PROTECTED USING TOWN OF ERIE CRITERIA INCLUDING, BUT NOT LIMITED TO TEMPORARY SEEDING, SILT FENCE AND SURFACE ROUGHENING.
6. THE TEMPORARY SEDIMENT BASINS WILL BE INSPECTED WEEKLY AND AFTER EVERY PRECIPITATION EVENT AND REPAIRED AS NECESSARY. THE TEMPORARY SEDIMENT WILL BE MAINTAINED AS REQUIRED TO ENSURE PROPER FUNCTIONING AND SEDIMENT WILL BE REMOVED WHEN THE BASIN BECOMES HALF FULL. THESE TASKS ARE THE RESPONSIBILITY OF THE CONTRACTOR.
7. TEMPORARY GRADING MAY BE REQUIRED DUE TO PHASING AND TIMING OF THE CONSTRUCTION. PHASING GRADING SHALL TRANSITION AT RATES AND BE IN CONFORMANCE WITH ALL REQUIREMENTS OF THE APPROVED GEOTECHNICAL REPORT. TRANSITION GRADING SHALL BE STABILIZED AS SOON AS PRACTICAL AND NO LONGER THAN 7 DAYS.
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30 0 15 30 60
(IN FEET)
1 inch = 30 ft.

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BASIS OF BEARINGS:

THE EAST LINE OF THE SOUTHEAST QUARTER OF SECTION 24, TOWNSHIP 1 NORTH, RANGE 69 WEST OF THE 6TH P.M. IS ASSUMED TO BEAR SOUTH ZERO DEGREES, 59 MINUTES, 04 SECONDS EAST BETWEEN A
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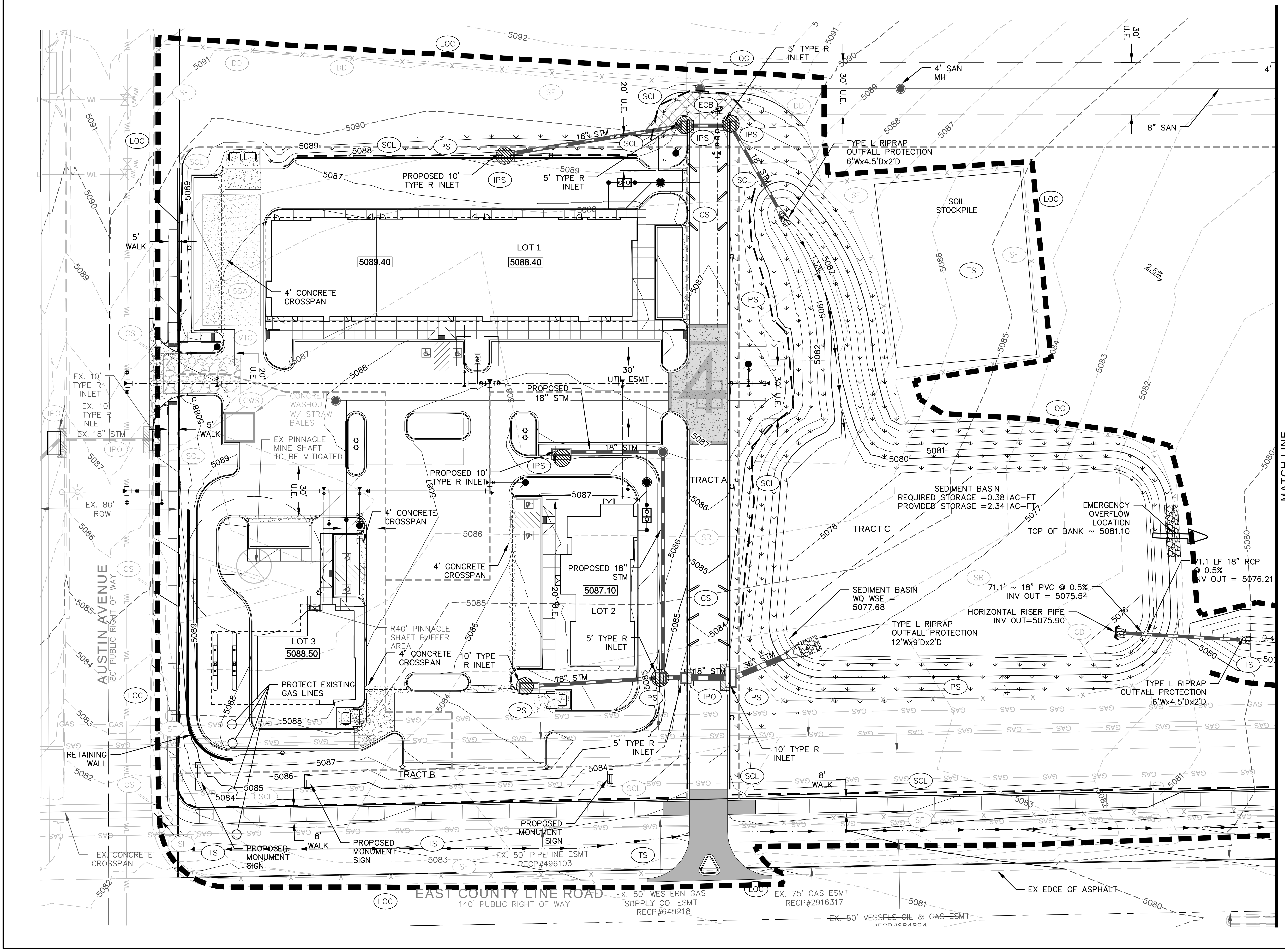

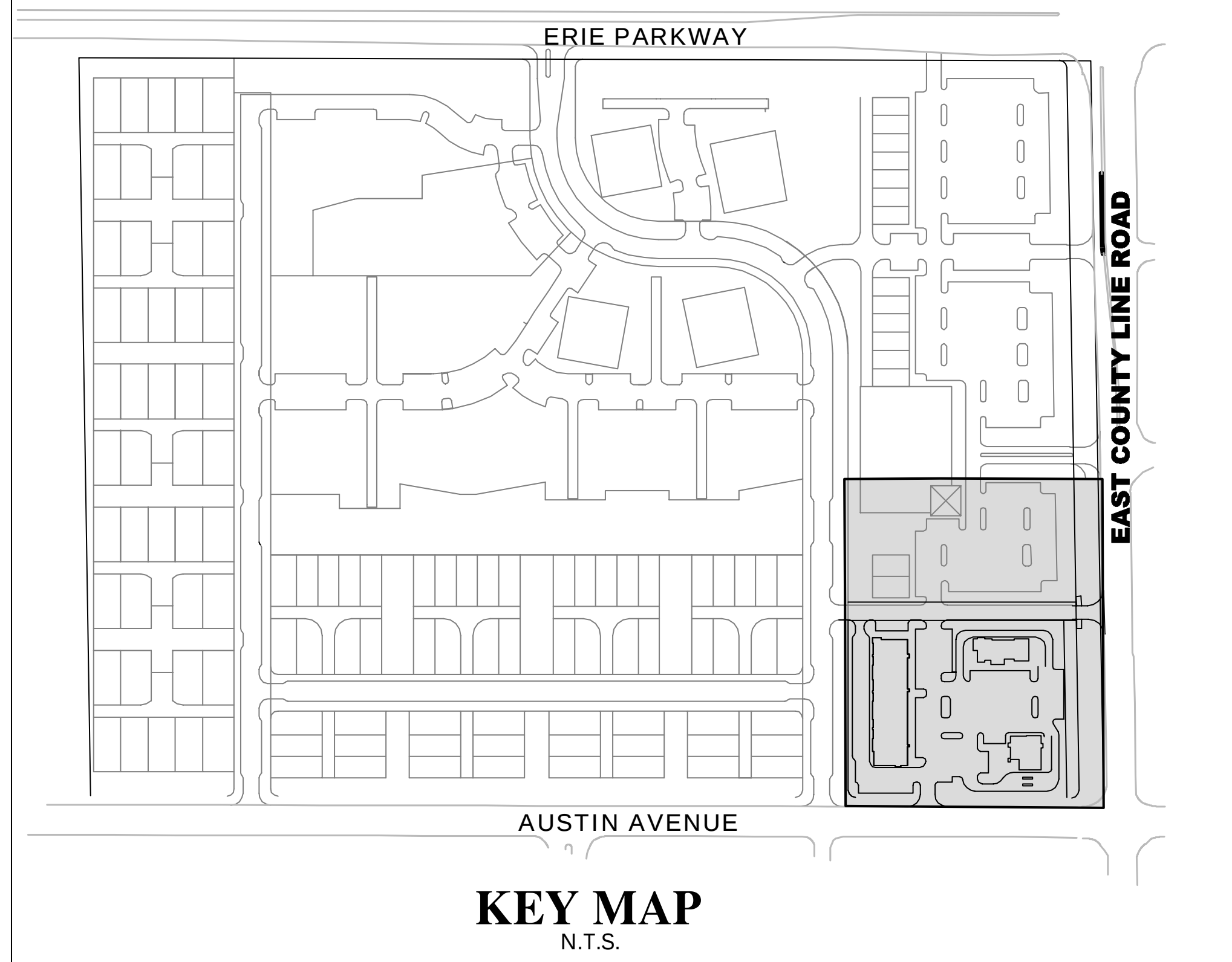

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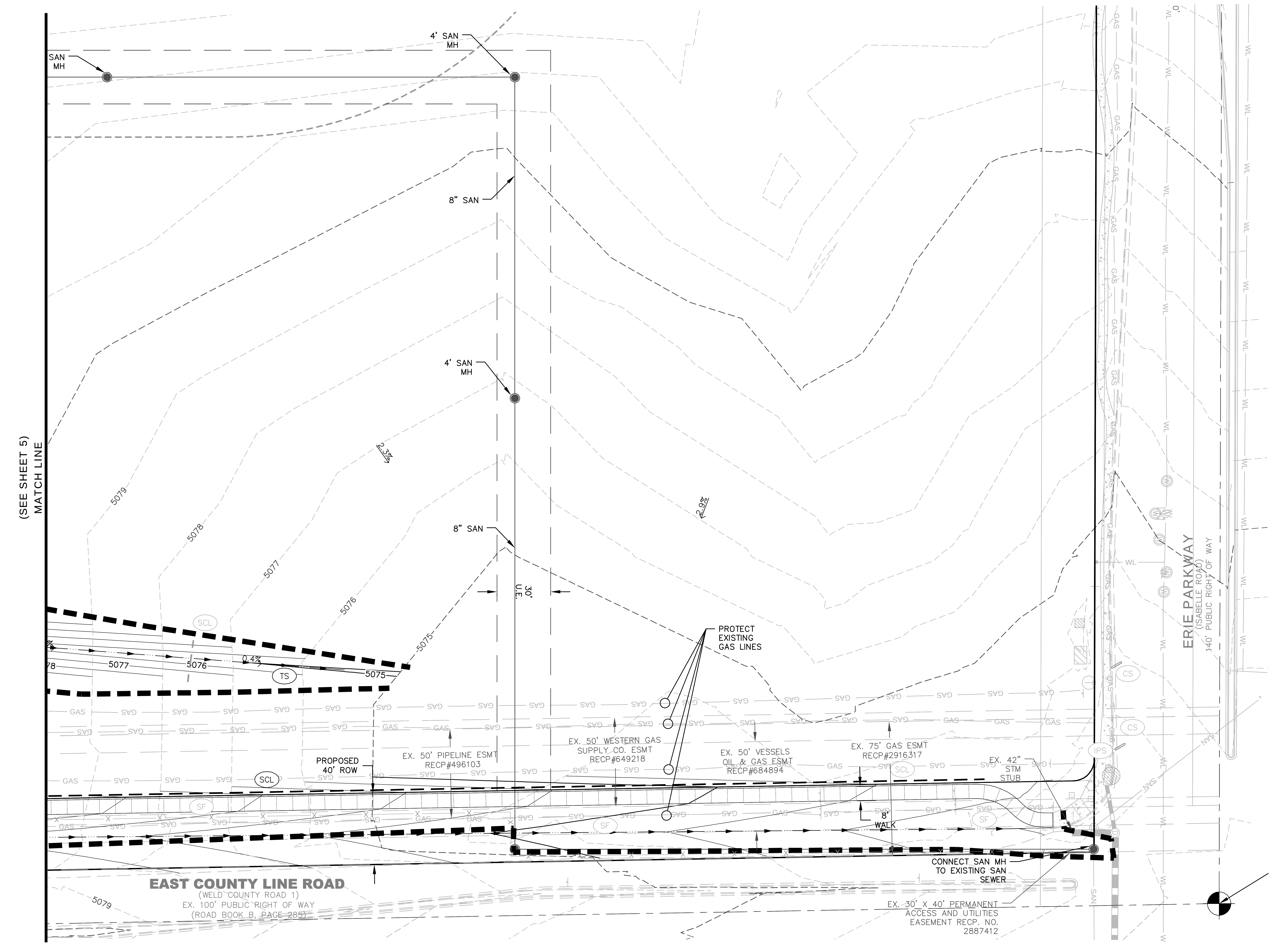

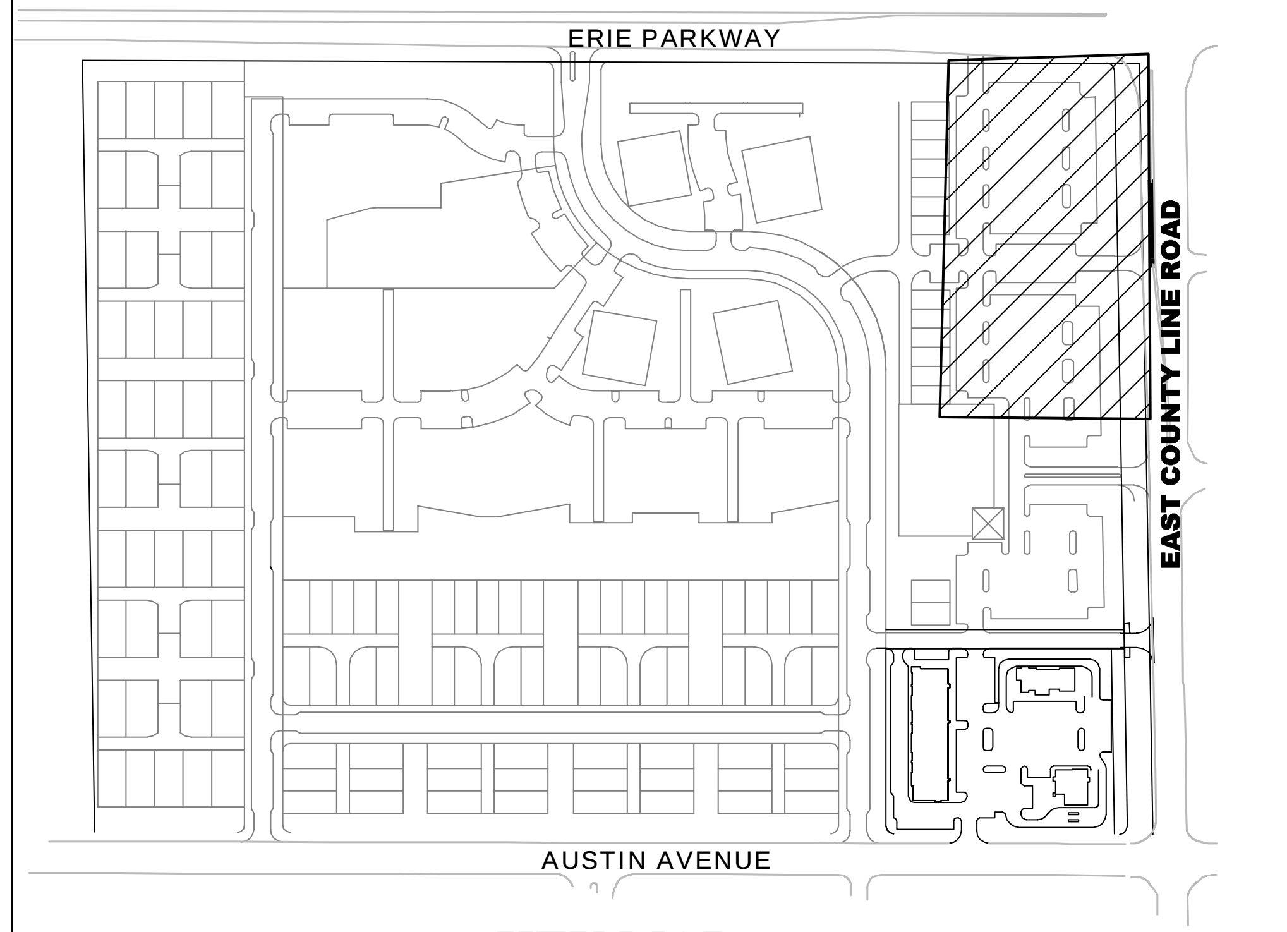

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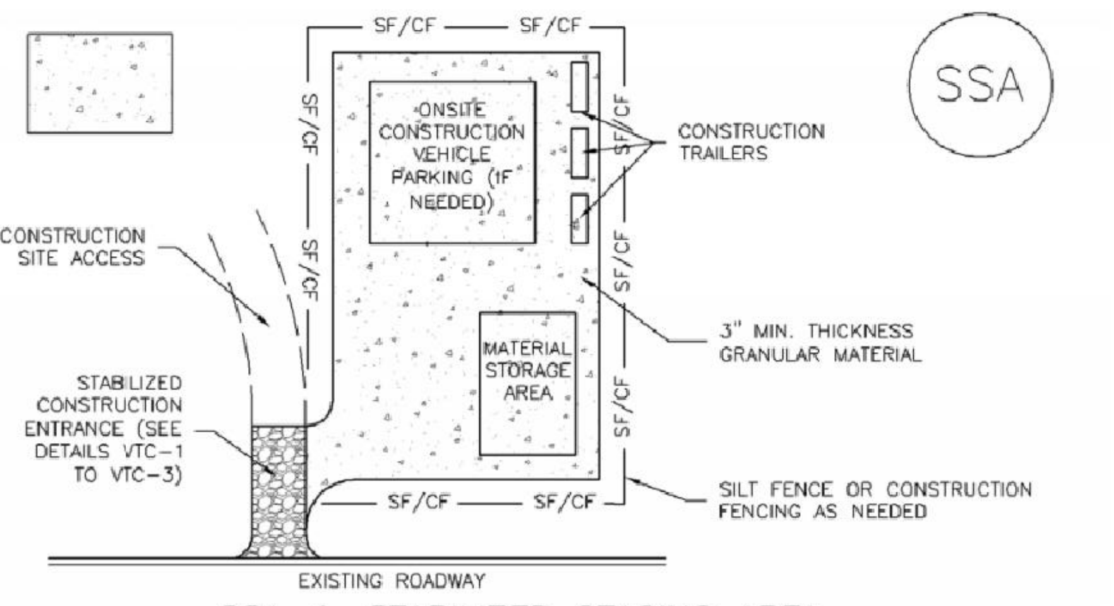
Stabilized Staging Area (SSA) SM-6



SSA-1. STABILIZED STAGING AREA

STABILIZED STAGING AREA INSTALLATION NOTES

1. SEE PLAN VIEW FOR
   -LOCATION OF STAGING AREA(S).
   -CONTRACTOR MAY ADJUST LOCATION AND SIZE OF STAGING AREA WITH APPROVAL FROM THE LOCAL JURISDICTION.

2. STABILIZED STAGING AREA SHOULD BE APPROPRIATE FOR THE NEEDS OF THE SITE. OVERSIZING RESULTS IN A LARGER AREA TO STABILIZE FOLLOWING CONSTRUCTION.

3. STAGING AREA SHALL BE STABILIZED PRIOR TO OTHER OPERATIONS ON THE SITE.

4. THE STABILIZED STAGING AREA SHALL CONSIST OF A MINIMUM 3" THICK GRANULAR MATERIAL.

5. UNLESS OTHERWISE SPECIFIED BY LOCAL JURISDICTION, ROCK SHALL CONSIST OF DOT SECT. #703, AASHTO #3 COARSE AGGREGATE OR 6" (MINUS) ROCK.

6. ADDITIONAL PERIMETER BMPs MAY BE REQUIRED INCLUDING BUT NOT LIMITED TO SILT FENCE AND CONSTRUCTION FENCING.

STABILIZED STAGING AREA MAINTENANCE NOTES

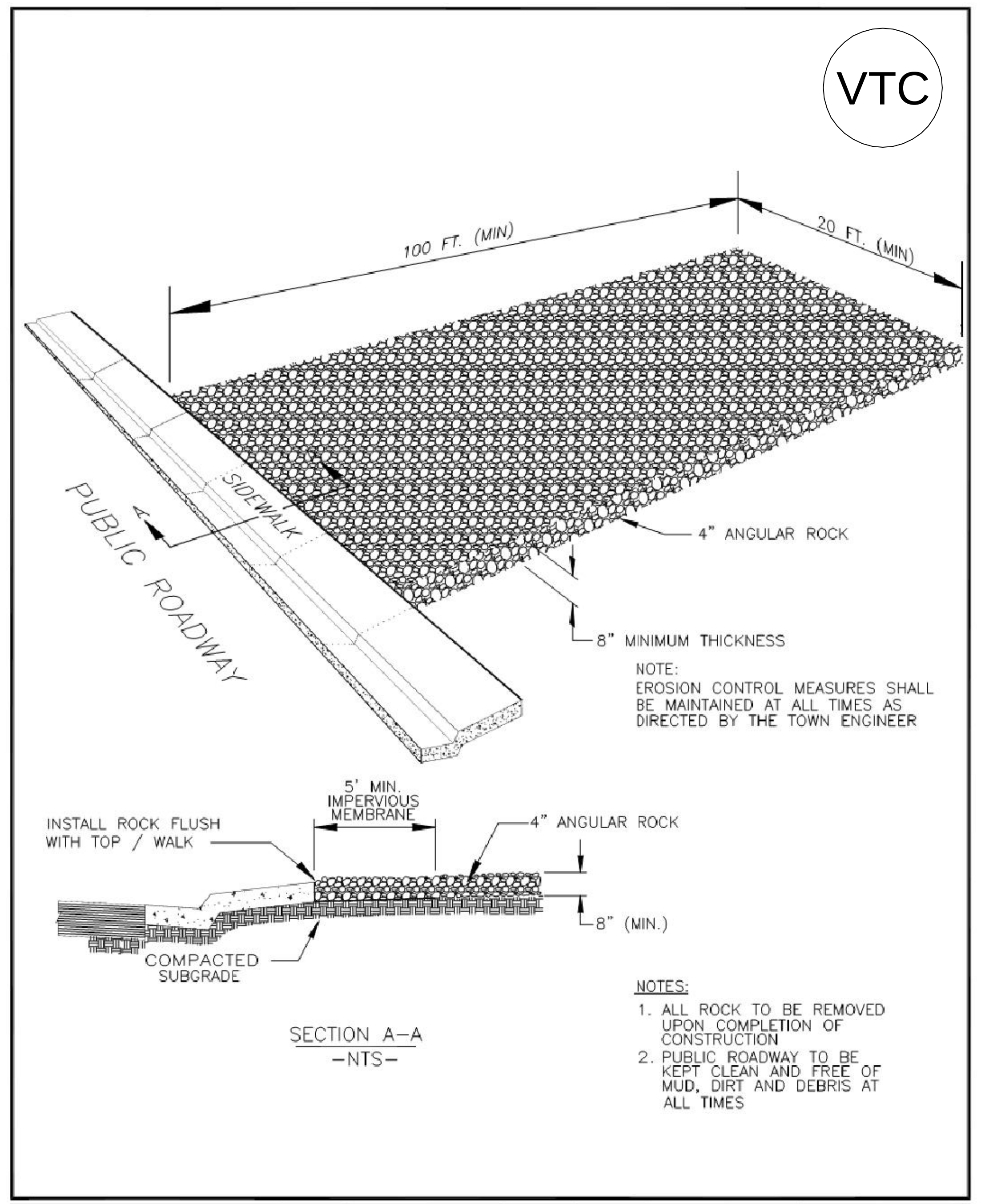
1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. ROCK SHALL BE REAPPLIED OR REGRADED AS NECESSARY IF RUTTING OCCURS OR UNDERLYING SUBGRADE BECOMES EXPOSED.

November 2010 Urban Drainage and Flood Control District SSA-3
Urban Storm Drainage Criteria Manual Volume 3



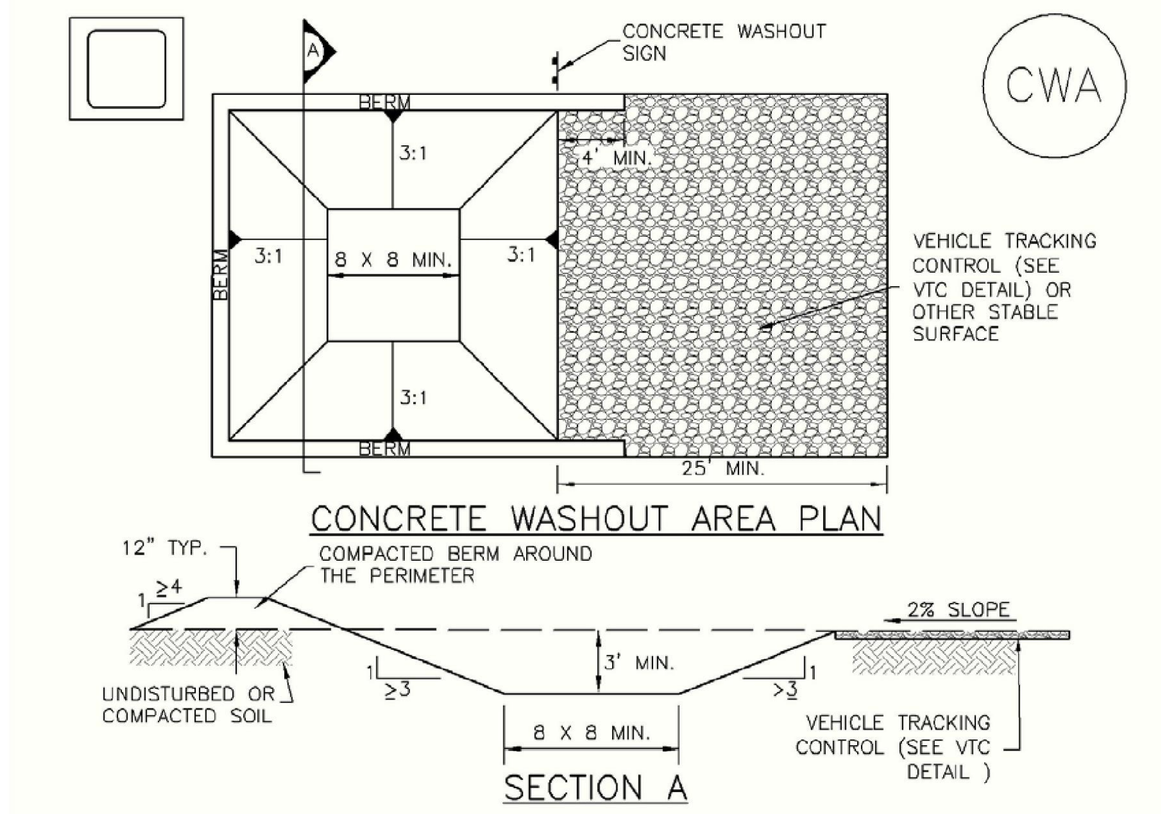
NOTE:
EROSION CONTROL MEASURES SHALL BE MAINTAINED AT ALL TIMES AS DIRECTED BY THE TOWN ENGINEER

NOTES:
1. ALL ROCK TO BE REMOVED UPON COMPLETION OF CONSTRUCTION
2. PUBLIC ROADWAY TO BE KEPT CLEAN AND FREE OF MUD, DIRT AND DEBRIS AT ALL TIMES

The Town of ERIE COLORADO

DRAWING TITLE: TRACKING CONTROL PAD- CRUSHED ROCK
DRAWING NUMBER: STM6A
DRAWN BY: D. JENKINS APPROVED BY: G. BEHLEN DATE: 1/2013

Concrete Washout Area (CWA) MM-1



CWA-1. CONCRETE WASHOUT AREA

CWA INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   -CWA INSTALLATION LOCATION.

2. DO NOT LOCATE AN UNLINED CWA WITHIN 400' OF ANY NATURAL DRAINAGE PATHWAY OR WATERBODY. DO NOT LOCATE WITHIN 1,000' OF ANY WELLS OR DRINKING WATER SOURCES. IF SITE CONSTRAINTS MAKE THIS INFEASIBLE, OR IF HIGHLY PERMEABLE SOILS EXIST ON SITE, THE CWA MUST BE INSTALLED WITH AN IMPERMEABLE LINER (16 MIL MIN. THICKNESS) OR SURFACE STORAGE ALTERNATIVES USING PREFABRICATED CONCRETE WASHOUT DEVICES OR A LINED ABOVE GROUND STORAGE ARE SHOULD BE USED.

3. THE CWA SHALL BE INSTALLED PRIOR TO CONCRETE PLACEMENT ON SITE.

4. CWA SHALL INCLUDE A FLAT SUBSURFACE PIT THAT IS AT LEAST 8' BY 8' SLOPES LEADING OUT OF THE SUBSURFACE PIT SHALL BE 3:1 OR FLATTER. THE PIT SHALL BE AT LEAST 3' DEEP.

5. BERM SURROUNDING SIDES AND BACK OF THE CWA SHALL HAVE MINIMUM HEIGHT OF 1'.

6. VEHICLE TRACKING PAD SHALL BE SLOPED 2% TOWARDS THE CWA.

7. SIGNS SHALL BE PLACED AT THE CONSTRUCTION ENTRANCE, AT THE CWA, AND ELSEWHERE AS NECESSARY TO CLEARLY INDICATE THE LOCATION OF THE CWA TO OPERATORS OF CONCRETE TRUCKS AND PUMP RIGS.

8. USE EXCAVATED MATERIAL FOR PERIMETER BERM CONSTRUCTION.

November 2010 Urban Drainage and Flood Control District CWA-3
Urban Storm Drainage Criteria Manual Volume 3

MM-1 Concrete Washout Area (CWA)

CWA MAINTENANCE NOTES

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4. THE CWA SHALL BE REPAIRED, CLEANED, OR ENLARGED AS NECESSARY TO MAINTAIN CAPACITY FOR CONCRETE WASTE. CONCRETE MATERIALS, ACCUMULATED IN PIT, SHALL BE REMOVED ONCE THE MATERIALS HAVE REACHED A DEPTH OF 2'.

5. CONCRETE WASHOUT WATER, WASTED PIECES OF CONCRETE AND ALL OTHER DEBRIS IN THE SUBSURFACE PIT SHALL BE TRANSPORTED FROM THE JOB SITE IN A WATER-TIGHT CONTAINER AND DISPOSED OF PROPERLY.

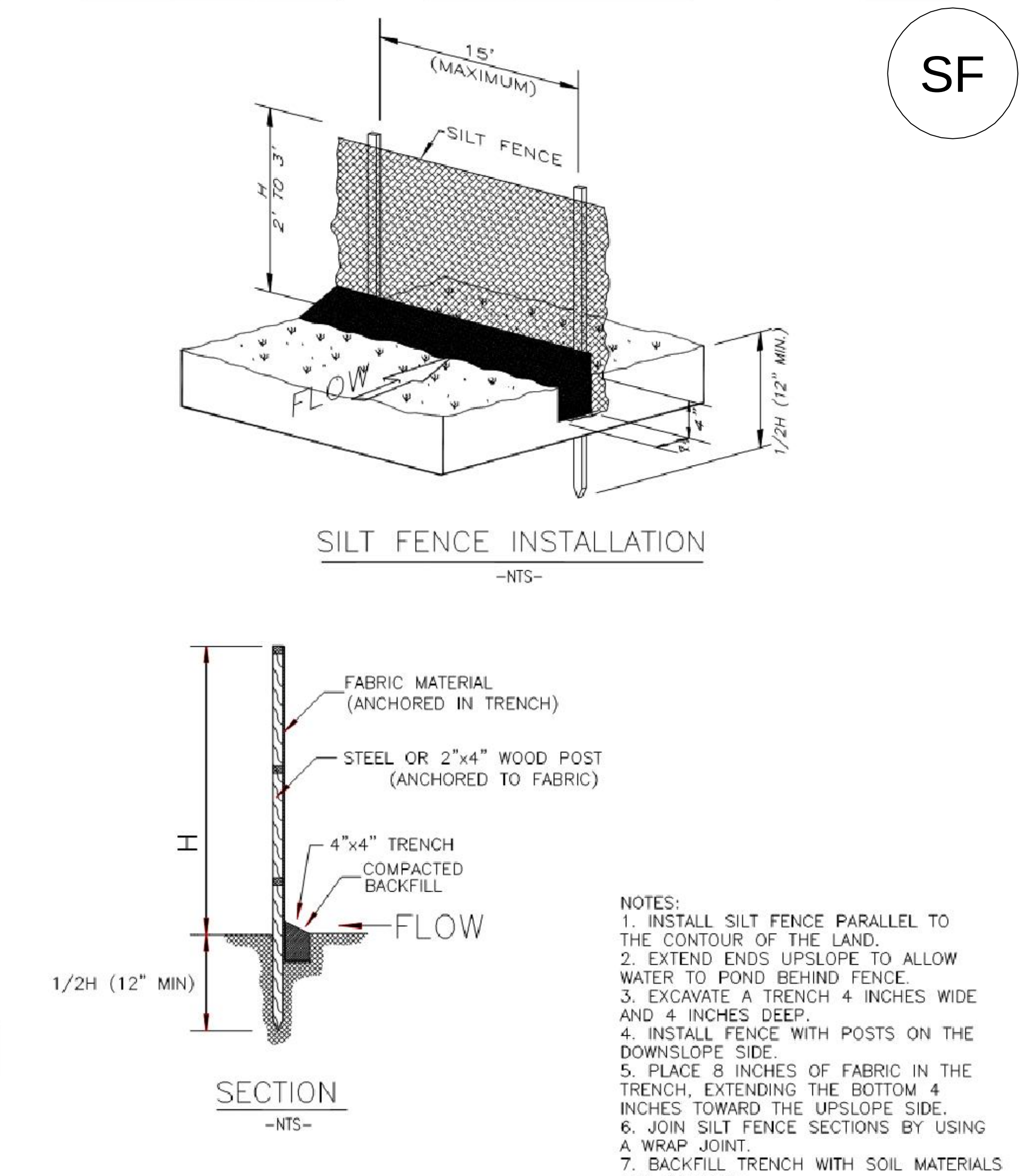
6. THE CWA SHALL REMAIN IN PLACE UNTIL ALL CONCRETE FOR THE PROJECT IS PLACED.

7. WHEN THE CWA IS REMOVED, COVER THE DISTURBED AREA WITH TOP SOIL, SEED AND MULCH OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAIL ADAPTED FROM DOUGLAS COUNTY, COLORADO AND THE CITY OF PARKER, COLORADO, NOT AVAILABLE IN AUTOCAD).

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

CWA-4 Urban Drainage and Flood Control District November 2010
Urban Storm Drainage Criteria Manual Volume 3

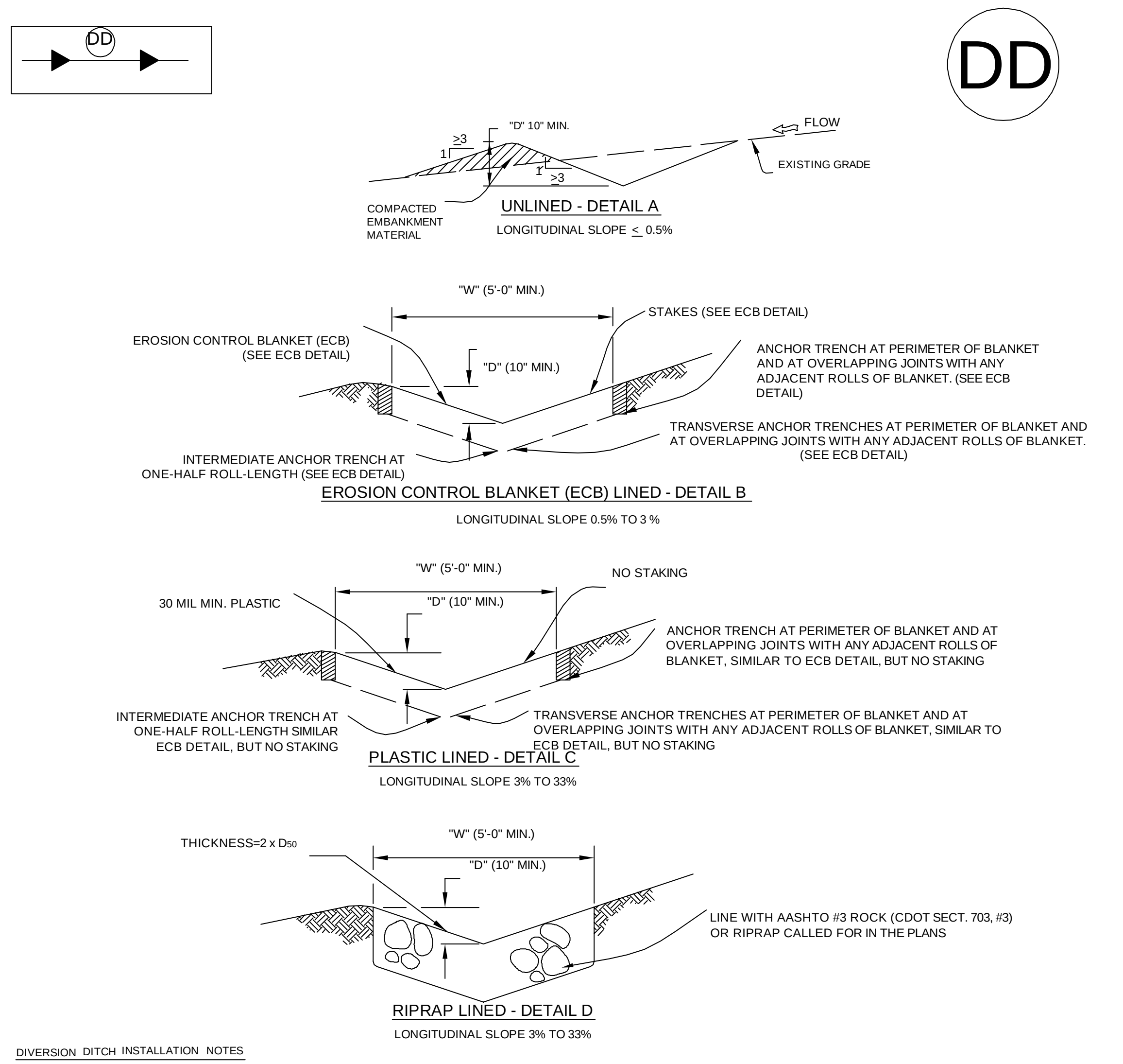


FOR SINGLE LOT EROSION CONTROL SEE SHEET STM8

NOTES:
1. INSTALL SILT FENCE PARALLEL TO THE CONTOUR OF THE LAND.
2. EXTEND ENDS UPSLOPE TO ALLOW WATER TO POND BEHIND FENCE.
3. EXCAVATE A TRENCH 4 INCHES WIDE AND 4 INCHES DEEP.
4. INSTALL FENCE WITH POSTS ON THE DOWNSLOPE SIDE.
5. PLACE 8 INCHES OF FABRIC IN THE TRENCH, EXTENDING THE BOTTOM 4 INCHES TOWARD THE UPSLOPE SIDE.
6. JOIN SILT FENCE SECTIONS BY USING A WRAP JOINT.
7. BACKFILL TRENCH WITH SOIL MATERIALS AND COMPACT.
8. INSPECT AT LEAST WEEKLY AND AFTER EACH STORM EVENT, REPAIRING AS NEEDED AND REMOVING SEDIMENT DEPOSITS WHEN THEY REACH ONE-HALF THE FENCE HEIGHT.

The Town of ERIE COLORADO

DRAWING TITLE: SILT FENCE EROSION BARRIER
DRAWING NUMBER: STM4
DRAWN BY: D. JENKINS APPROVED BY: G. BEHLEN DATE: 06/2004



DIVERSION DITCH INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - LOCATION OF DIVERSION DITCH.
   - TYPE OF DITCH (UNLINED, ECB LINED, PLASTIC LINED OR RIPRAP LINED).
   - LENGTH OF EACH TYPE OF DITCH.
   - DEPTH, "D", AND WIDTH, "W" DIMENSIONS.
   - FOR ECB LINED DITCH, EROSION CONTROL BLANKET TYPE (SEE ECB DETAIL).
   - FOR RIPRAP LINED DITCH, SIZE OF RIPRAP, "D_{50}".
2. SEE DRAINAGE PLANS FOR DETAILS OF ANY PERMANENT CONVEYANCE FACILITIES OR DIVERSION DITCHES EXCEEDING A 2-YEAR FLOW RATE OF 10 CFS.
3. DIVERSION DITCHES INDICATED ON INITIAL SWMPPLAN SHALL BE INSTALLED PRIOR TO ANY LAND-DISTURBING ACTIVITIES.
4. FOR ECB LINED DITCHES, INSTALLATION OF EROSION CONTROL BLANKET SHALL CONFORM TO THE REQUIREMENTS OF THE ECB DETAIL.
5. IN LOCATIONS WHERE CONSTRUCTION TRAFFIC MUST CROSS A DIVERSION DITCH, THE PERMITTEES SHALL INSTALL A TEMPORARY CULVERT WITH A MINIMUM DIAMETER OF 12-INCHES.

DIVERSION DITCH MAINTENANCE NOTES

1. THE SWMP MANAGER SHALL INSPECT DIVERSION DITCHES WEEKLY AND DURING AND AFTER ANY STORM. MAKE REPAIRS AS NECESSARY.

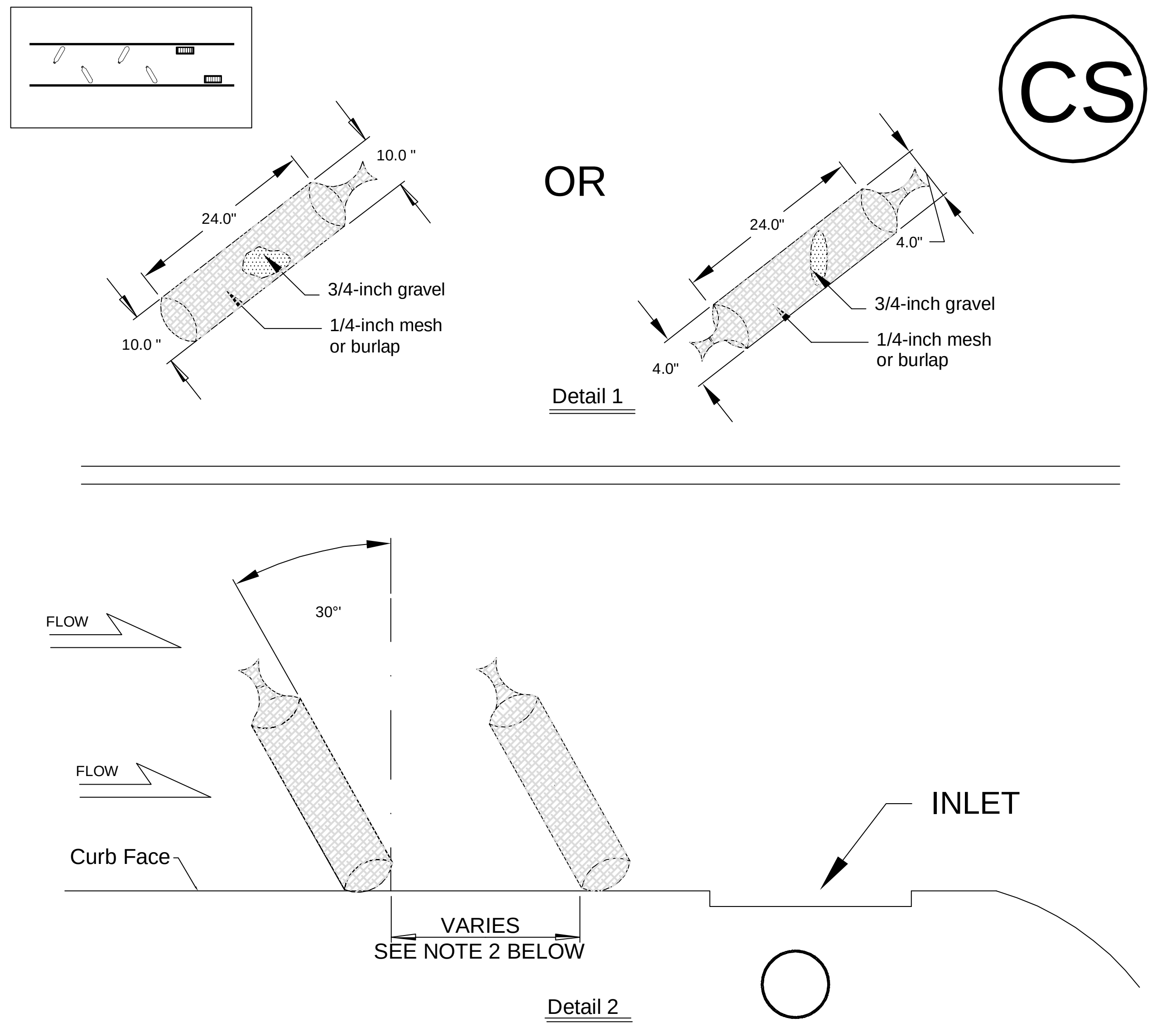
2. DIVERSION DITCHES ARE TO REMAIN IN PLACE UNTIL THE END OF CONSTRUCTION, OR IF APPROVED BY LOCAL JURISDICTION MAY BE LEFT IN PLACE.

3. IF DIVERSION DITCHES ARE REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOPSOIL, DRILL SEEDED, HAY CRIMPED MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY LOCAL JURISDICTION.

DETAIL BASED ON DETAILS PROVIDED BY DOUGLAS COUNTY

Urban Drainage and
Flood Control District
Drainage Criteria Manual (V.3)

Figure C5-3
DIVERSIN DITCH AND DIKE



NOTES:

1) Socks will be used upgradient of inlet perpendicular to and flush with curb.

2) No less than two 10-inch diameter socks must be used in sequence, spaced no more than five feet apart, upgradient of inlet.
No less than six socks shall be used if the 4-inch sock is used, also spaced at no more than 5 feet apart.

3) Incline at 30 degrees from perpendicular, opposite the direction of flow (see Detail 2).

4) Erosion control measures shall be maintained at all times as directed by the local jurisdiction.

Details based on those provided to District by City of Lakewood, Colorado

Urban Drainage and
Flood Control District
Drainage Criteria Manual (V.3)

Figure C5-23
Inlet Protection- Curb Sock

DRAINAGE CRITERIA MANUAL (V. 3) CONSTRUCTION BEST MANAGEMENT PRACTICES

MULCHING

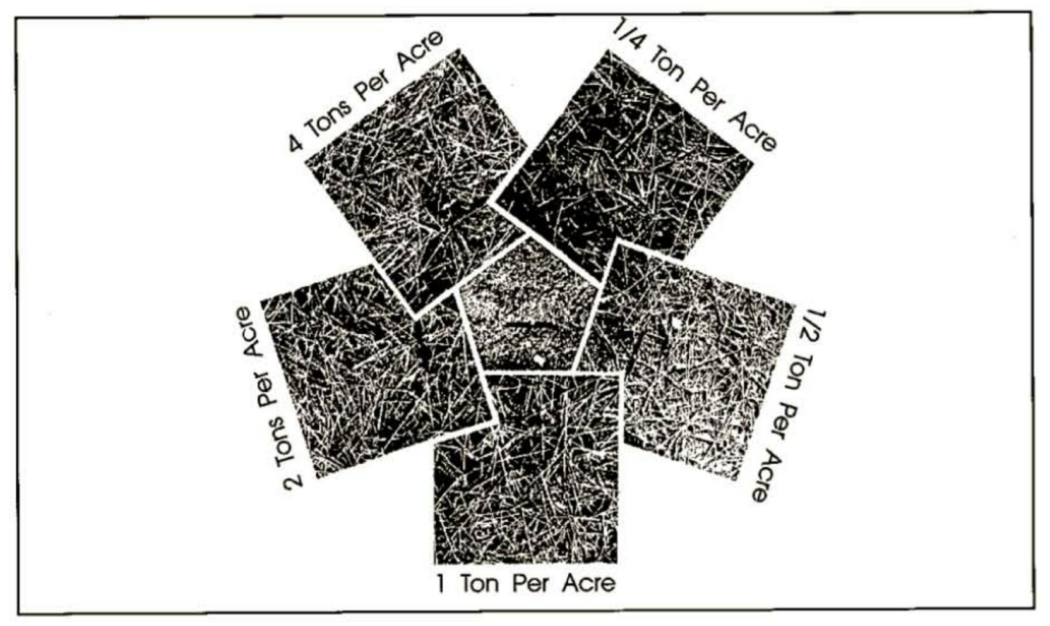
MU

Definition

Application of plant residues or other suitable materials to the soil surface.

Purposes

1. To prevent erosion by protecting the soil surface from raindrop impact and reducing the velocity of overland flow.
2. To foster the growth of vegetation by increasing available moisture and providing insulation against extreme heat and cold.



From: Environmental Protection Agency, 1976

Figure C4-2—Mulching

2007-10 C-41
Urban Drainage and Flood Control District

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Sheet Number: 7

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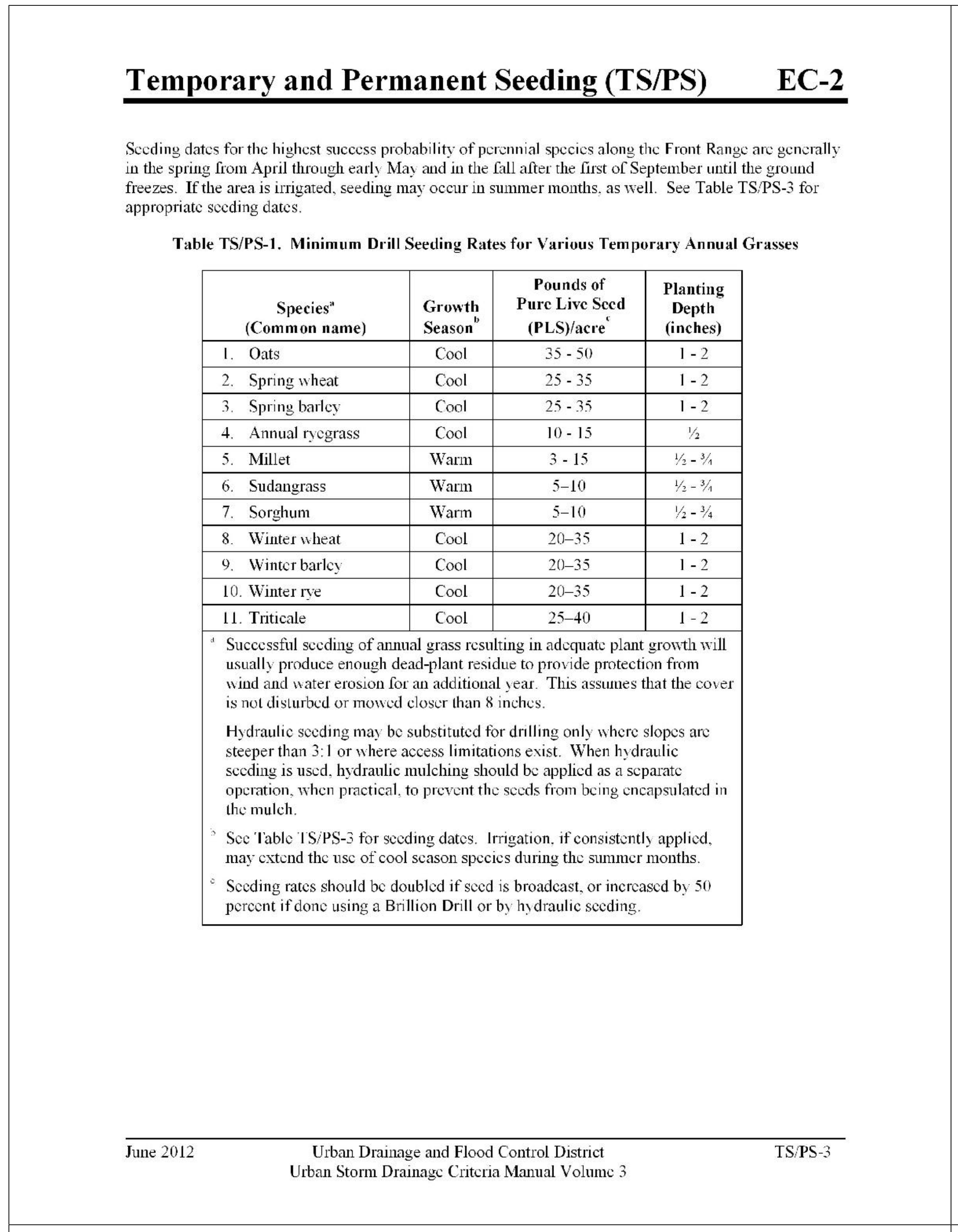

Seeding dates for the highest success probability of perennial species along the Front Range are generally in the spring from April through early May and in the fall after the first of September until the ground freezes. If the area is irrigated, seeding may occur in summer months, as well. See Table TS/PS-3 for appropriate seeding dates.

Table TS/PS-1. Minimum Drill Seeding Rates for Various Temporary Annual Grasses

Species[a] (Common name)	Growth Season[b]	Pounds of Pure Live Seed (PLS)/acre[c]	Planting Depth (inches)
1. Oats	Cool	35 - 50	1 - 2
2. Spring wheat	Cool	25 - 35	1 - 2
3. Spring barley	Cool	25 - 35	1 - 2
4. Annual ryegrass	Cool	10 - 15	½
5. Millet	Warm	3 - 15	½ - ¾
6. Sudangrass	Warm	5–10	½ - ¾
7. Sorghum	Warm	5–10	½ - ¾
8. Winter wheat	Cool	20–35	1 - 2
9. Winter barley	Cool	20–35	1 - 2
10. Winter rye	Cool	20–35	1 - 2
11. Triticale	Cool	25–40	1 - 2

[a] Successful seeding of annual grass resulting in adequate plant growth will usually produce enough dead-plant residue to provide protection from wind and water erosion for an additional year. This assumes that the cover is not disturbed or mowed closer than 8 inches.

Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1 or where access limitations exist. When hydraulic seeding is used, hydraulic mulching should be applied as a separate operation, when practical, to prevent the seeds from being encapsulated in the mulch.

[b] See Table TS/PS-3 for seeding dates. Irrigation, if consistently applied, may extend the use of cool season species during the summer months.

[c] Seeding rates should be doubled if seed is broadcast, or increased by 50 percent if done using a Brillion Drill or by hydraulic seeding.

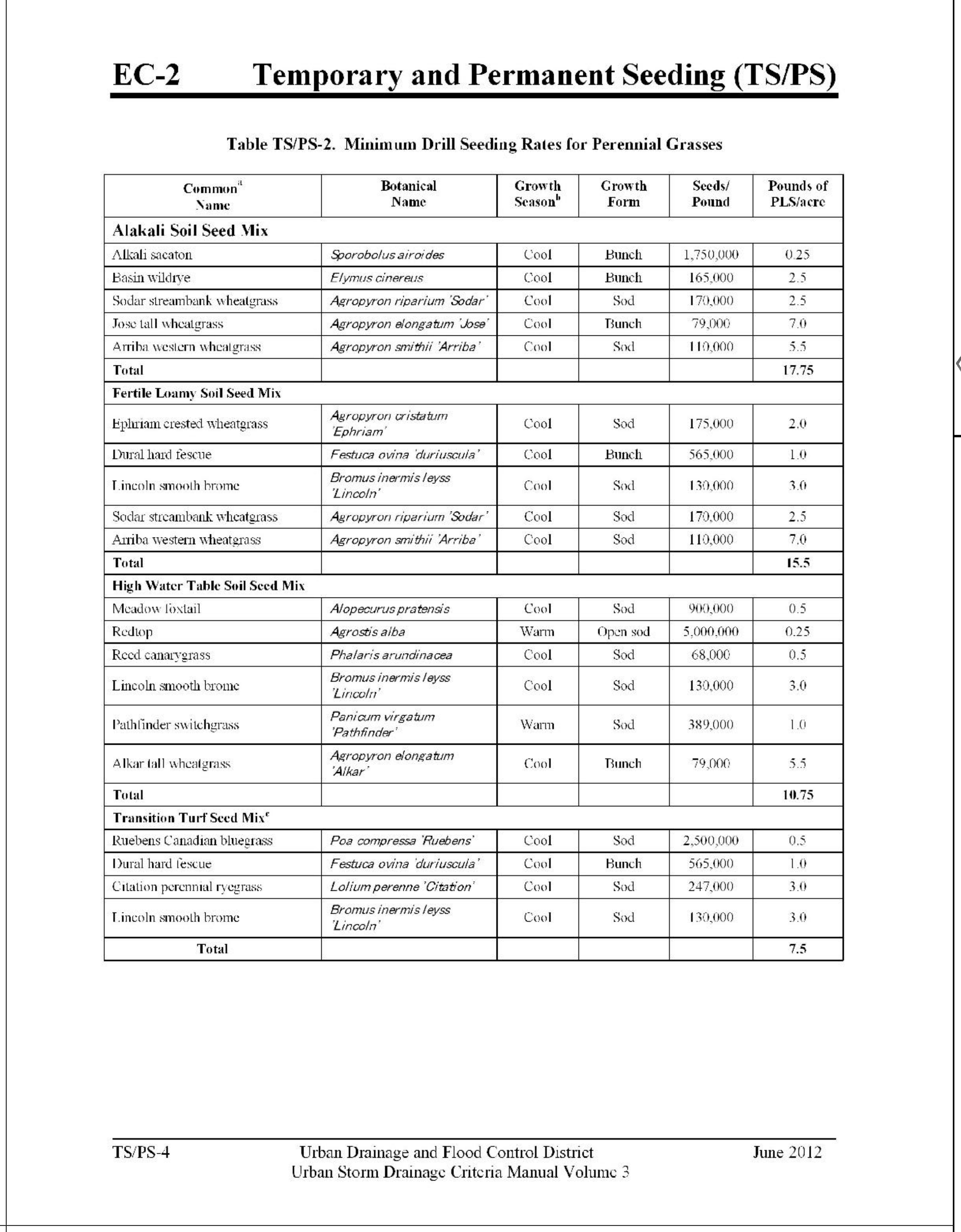

Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses

Common[a] Name	Botanical Name	Growth Season[b]	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Alakali Soil Seed Mix					
Alkali sacaton	*Sporobolus airoides*	Cool	Bunch	1,750,000	0.25
Basin wildrye	*Elymus cinereus*	Cool	Bunch	165,000	2.5
Sodar streambank wheatgrass	*Agropyron riparium 'Sodar'*	Cool	Sod	170,000	2.5
Jose tall wheatgrass	*Agropyron elongatum 'Jose'*	Cool	Bunch	79,000	7.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**17.75**
Fertile Loamy Soil Seed Mix					
Ephriam crested wheatgrass	*Agropyron cristatum 'Ephriam'*	Cool	Sod	175,000	2.0
Dural hard fescue	*Festuca ovina 'duriuscula'*	Cool	Bunch	565,000	1.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Sodar streambank wheatgrass	*Agropyron riparium 'Sodar'*	Cool	Sod	170,000	2.5
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	7.0
Total					**15.5**
High Water Table Soil Seed Mix					
Meadow foxtail	*Alopecurus pratensis*	Cool	Sod	900,000	0.5
Redtop	*Agrostis alba*	Warm	Open sod	5,000,000	0.25
Reed canarygrass	*Phalaris arundinacea*	Cool	Sod	68,000	0.5
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Pathfinder switchgrass	*Panicum virgatum 'Pathfinder'*	Warm	Sod	389,000	1.0
Alkar tall wheatgrass	*Agropyron elongatum 'Alkar'*	Cool	Bunch	79,000	5.5
Total					**10.75**
Transition Turf Seed Mix[c]					
Ruebens Canadian bluegrass	*Poa compressa 'Ruebens'*	Cool	Sod	2,500,000	0.5
Dural hard fescue	*Festuca ovina 'duriuscula'*	Cool	Bunch	565,000	1.0
Citation perennial ryegrass	*Lolium perenne 'Citation'*	Cool	Sod	247,000	3.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Total					**7.5**

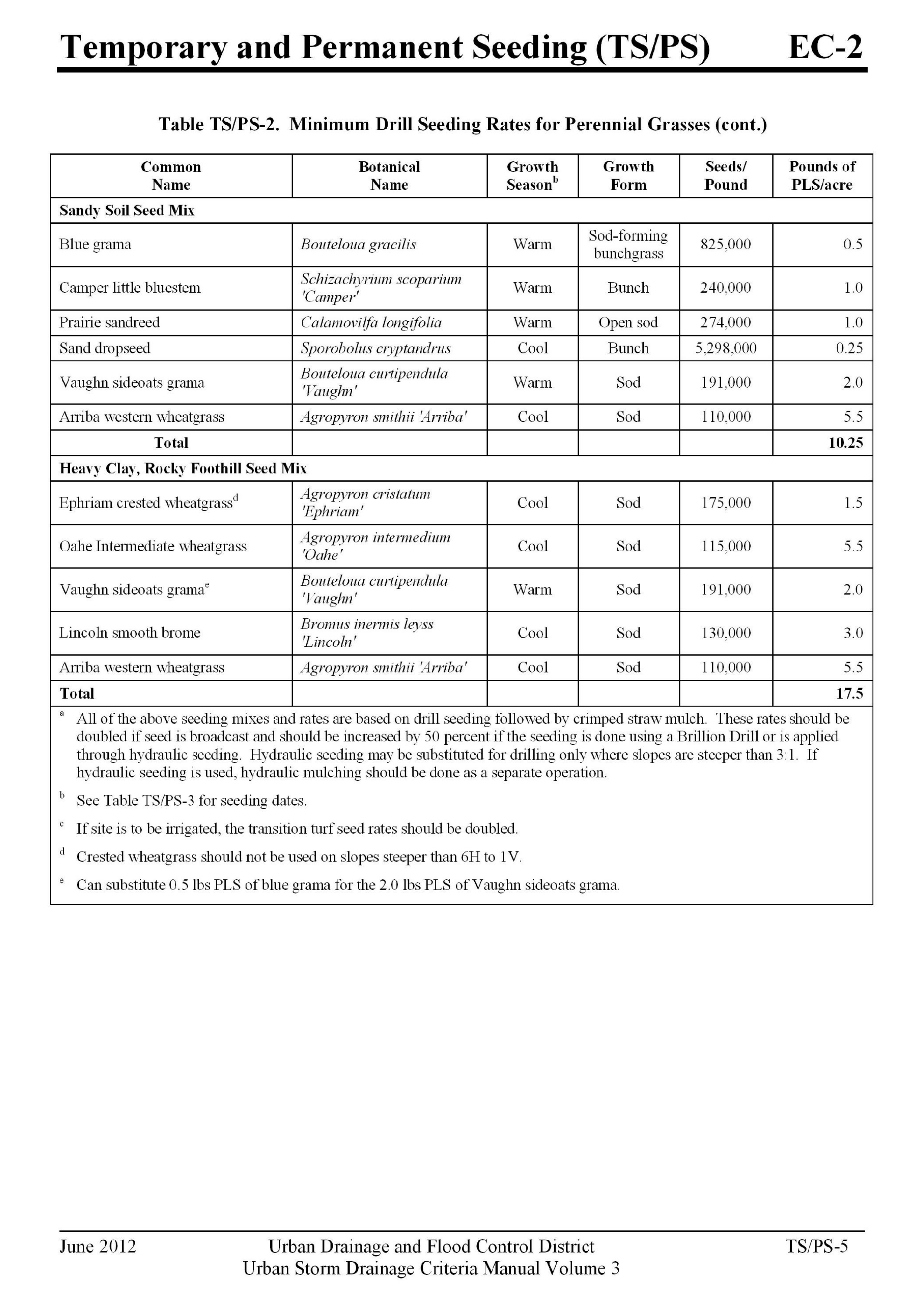

Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses (cont.)

Common Name	Botanical Name	Growth Season[b]	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Sandy Soil Seed Mix					
Blue grama	*Bouteloua gracilis*	Warm	Sod-forming bunchgrass	825,000	0.5
Camper little bluestem	*Schizachyrium scoparium 'Camper'*	Warm	Bunch	240,000	1.0
Prairie sandreed	*Calamovilfa longifolia*	Warm	Open sod	274,000	1.0
Sand dropseed	*Sporobolus cryptandrus*	Cool	Bunch	5,298,000	0.25
Vaughn sideoats grama	*Bouteloua curtipendula 'Vaughn'*	Warm	Sod	191,000	2.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**10.25**
Heavy Clay, Rocky Foothill Seed Mix					
Ephriam crested wheatgrass[d]	*Agropyron cristatum 'Ephriam'*	Cool	Sod	175,000	1.5
Oahe Intermediate wheatgrass	*Agropyron intermedium 'Oahe'*	Cool	Sod	115,000	5.5
Vaughn sideoats grama[e]	*Bouteloua curtipendula 'Vaughn'*	Warm	Sod	191,000	2.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**17.5**

[a] All of the above seeding mixes and rates are based on drill seeding followed by crimped straw mulch. These rates should be doubled if seed is broadcast and should be increased by 50 percent if the seeding is done using a Brillion Drill or is applied through hydraulic seeding. Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1. If hydraulic seeding is used, hydraulic mulching should be done as a separate operation.

[b] See Table TS/PS-3 for seeding dates.

[c] If site is to be irrigated, the transition turf seed rates should be doubled.

[d] Crested wheatgrass should not be used on slopes steeper than 6H to 1V.

[e] Can substitute 0.5 lbs PLS of blue grama for the 2.0 lbs PLS of Vaughn sideoats grama.

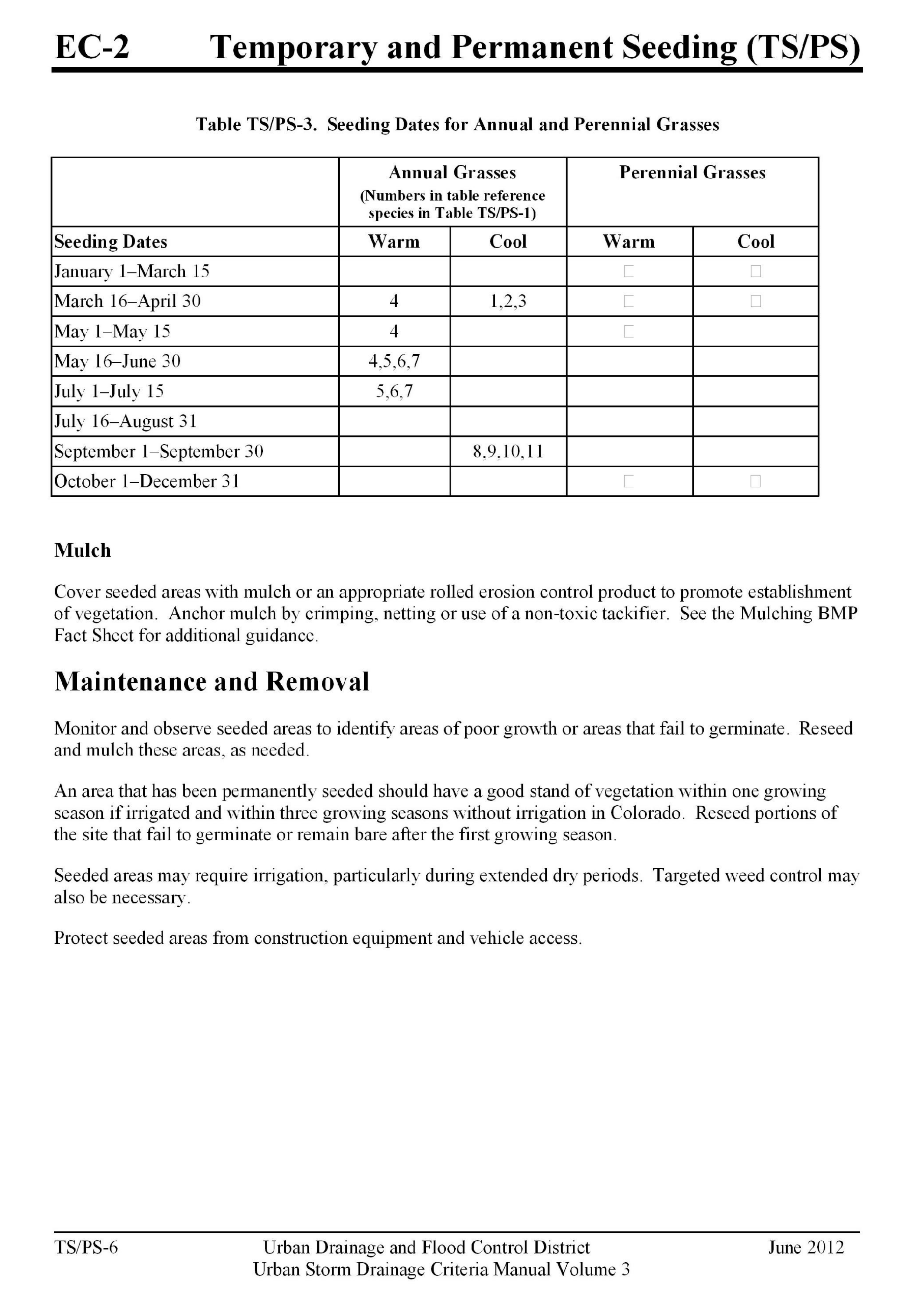

Table TS/PS-3. Seeding Dates for Annual and Perennial Grasses

	Annual Grasses (Numbers in table reference species in Table TS/PS-1)		Perennial Grasses	
Seeding Dates	Warm	Cool	Warm	Cool
January 1–March 15			☐	☐
March 16–April 30	4	1,2,3	☐	☐
May 1–May 15	4		☐	
May 16–June 30	4,5,6,7			
July 1–July 15	5,6,7			
July 16–August 31				
September 1–September 30		8,9,10,11		
October 1–December 31			☐	☐

Mulch

Cover seeded areas with mulch or an appropriate rolled erosion control product to promote establishment of vegetation. Anchor mulch by crimping, netting or use of a non-toxic tackifier. See the Mulching BMP Fact Sheet for additional guidance.

Maintenance and Removal

Monitor and observe seeded areas to identify areas of poor growth or areas that fail to germinate. Reseed and mulch these areas, as needed.

An area that has been permanently seeded should have a good stand of vegetation within one growing season if irrigated and within three growing seasons without irrigation in Colorado. Reseed portions of the site that fail to germinate or remain bare after the first growing season.

Seeded areas may require irrigation, particularly during extended dry periods. Targeted weed control may also be necessary.

Protect seeded areas from construction equipment and vehicle access.

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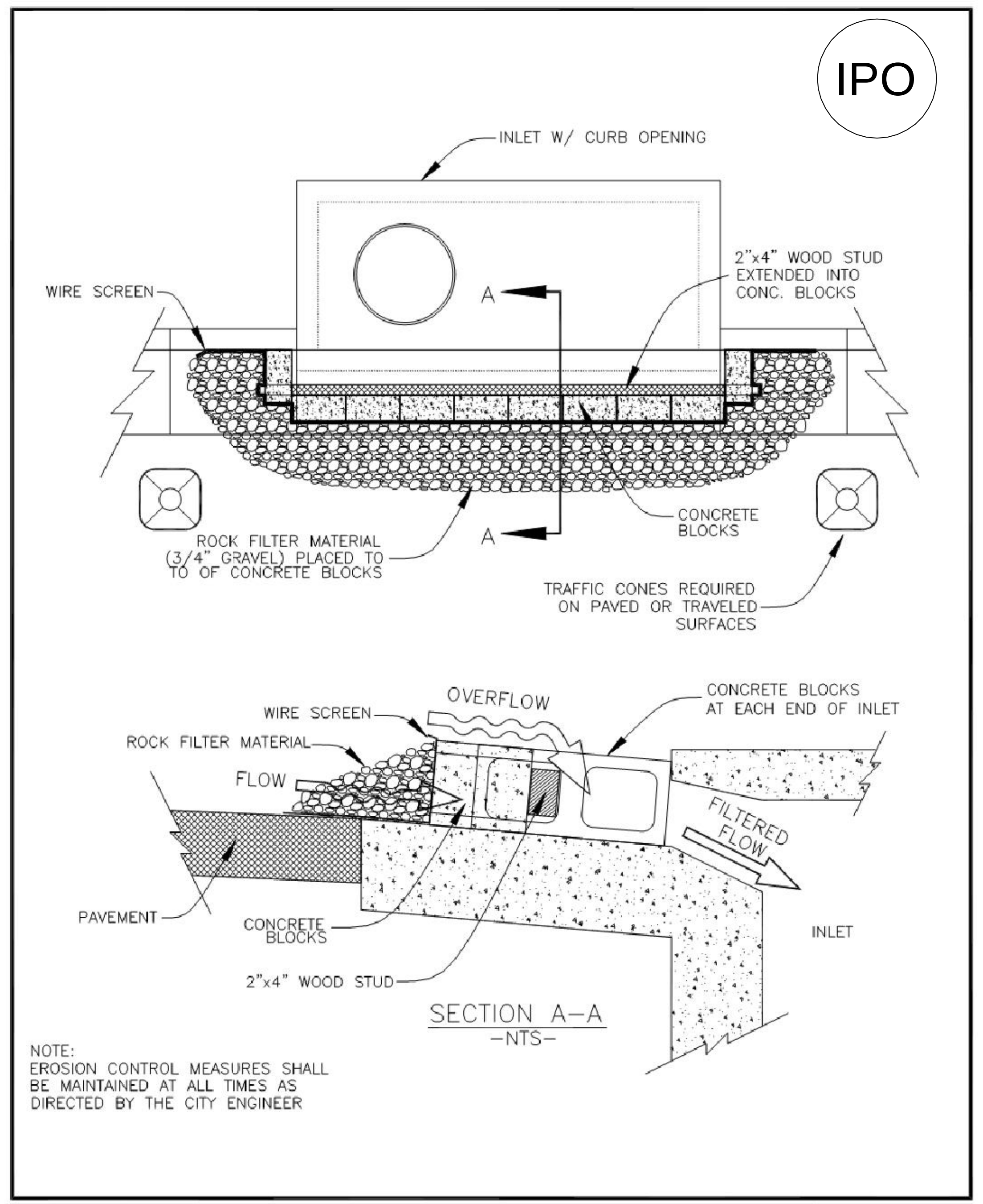
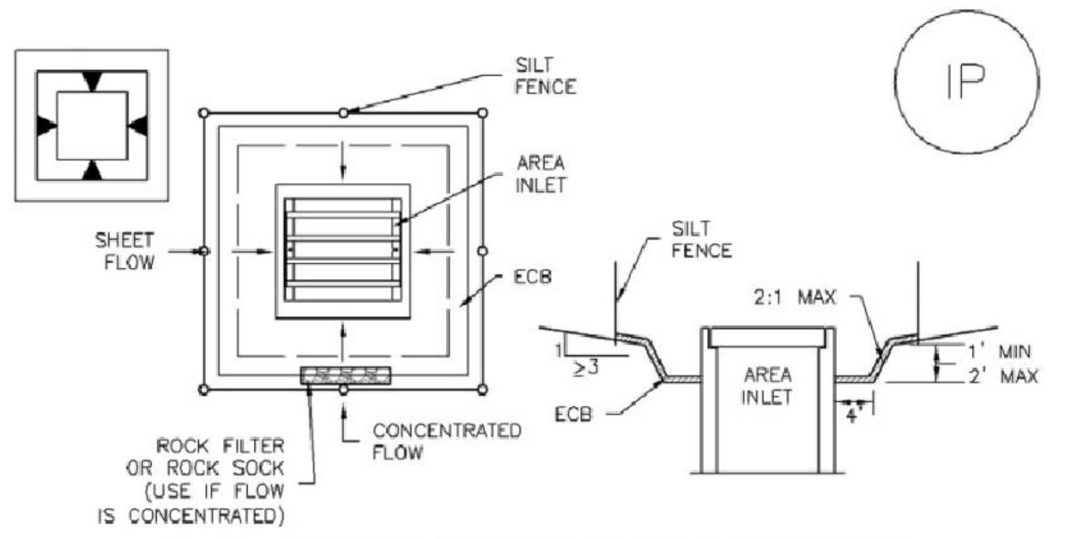


NOTE:
EROSION CONTROL MEASURES SHALL BE MAINTAINED AT ALL TIMES AS DIRECTED BY THE CITY ENGINEER

The Town of ERIE COLORADO

DRAWING TITLE: CURB INLET GRAVEL FILTER
DRAWING NUMBER: STM3
DRAWN BY: D. JENKINS APPROVED BY: G. BEHLEN DATE: 06/2004



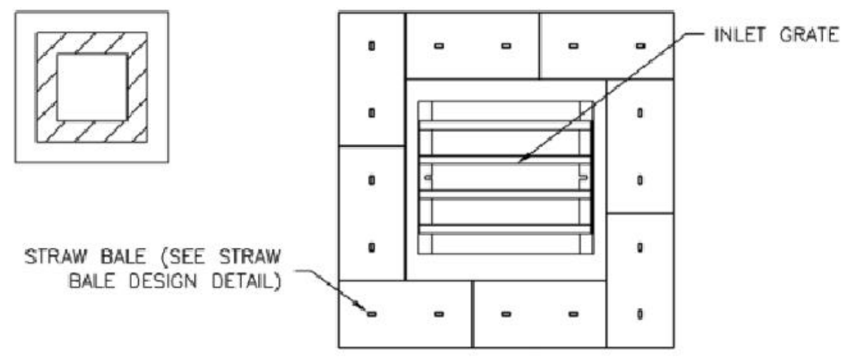
IP–5. OVEREXCAVATION INLET PROTECTION

OVEREXCAVATION INLET PROTECTION INSTALLATION NOTES

1. THIS FORM OF INLET PROTECTION IS PRIMARILY APPLICABLE FOR SITES THAT HAVE NOT YET REACHED FINAL GRADE AND SHOULD BE USED ONLY FOR INLETS WITH A RELATIVELY SMALL CONTRIBUTING DRAINAGE AREA.

2. WHEN USING FOR CONCENTRATED FLOWS, SHAPE BASIN IN 2:1 RATIO WITH LENGTH ORIENTED TOWARDS DIRECTION OF FLOW.

3. SEDIMENT MUST BE PERIODICALLY REMOVED FROM THE OVEREXCAVATED AREA.

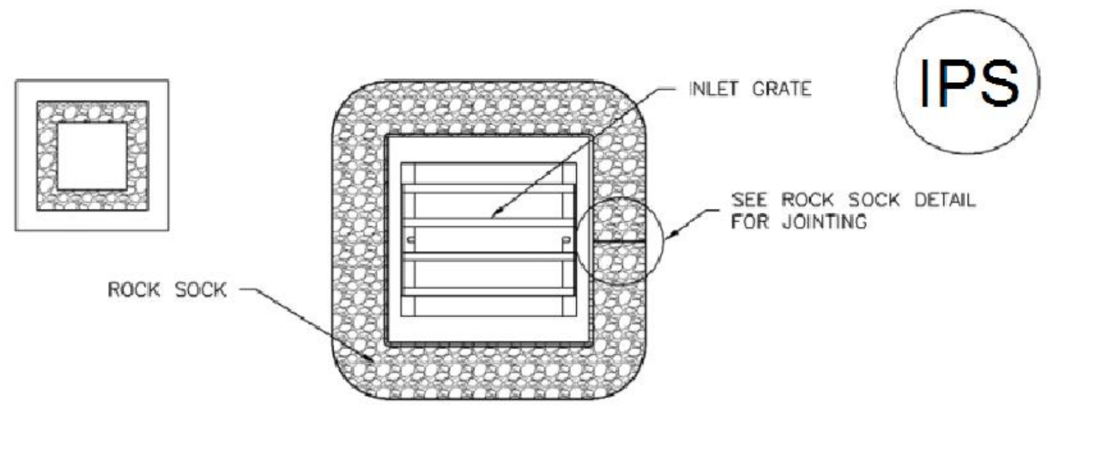


IP–6. STRAW BALE FOR SUMP INLET PROTECTION

STRAW BALE BARRIER INLET PROTECTION INSTALLATION NOTES

1. SEE STRAW BALE DESIGN DETAIL FOR INSTALLATION REQUIREMENTS.

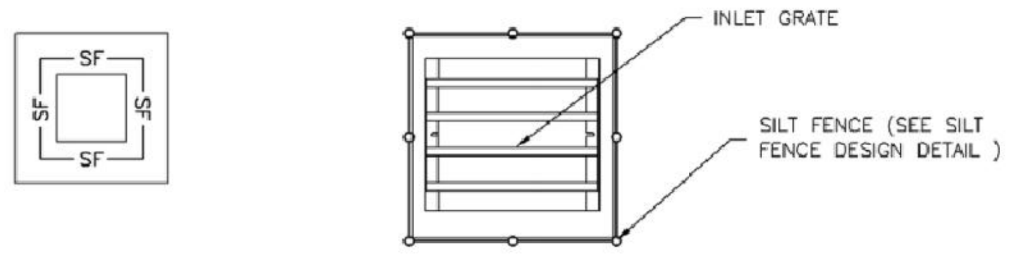
2. BALES SHALL BE PLACED IN A SINGLE ROW AROUND THE INLET WITH ENDS OF BALES TIGHTLY ABUTTING ONE ANOTHER.



IP–3. ROCK SOCK SUMP/AREA INLET PROTECTION

ROCK SOCK SUMP/AREA INLET PROTECTION INSTALLATION NOTES
1. SEE ROCK SOCK DESIGN DETAIL FOR INSTALLATION REQUIREMENTS.

2. STRAW WATTLES/SEDIMENT CONTROL LOGS MAY BE USED IN PLACE OF ROCK SOCKS FOR INLETS IN PERVIOUS AREAS. INSTALL PER SEDIMENT CONTROL LOG DETAIL.



IP–4. SILT FENCE FOR SUMP INLET PROTECTION

SILT FENCE INLET PROTECTION INSTALLATION NOTES

1. SEE SILT FENCE DESIGN DETAIL FOR INSTALLATION REQUIREMENTS.

2. POSTS SHALL BE PLACED AT EACH CORNER OF THE INLET AND AROUND THE EDGES AT A MAXIMUM SPACING OF 3 FEET.

3. STRAW WATTLES/SEDIMENT CONTROL LOGS MAY BE USED IN PLACE OF SILT FENCE FOR INLETS IN PERVIOUS AREAS. INSTALL PER SEDIMENT CONTROL LOG DETAIL.

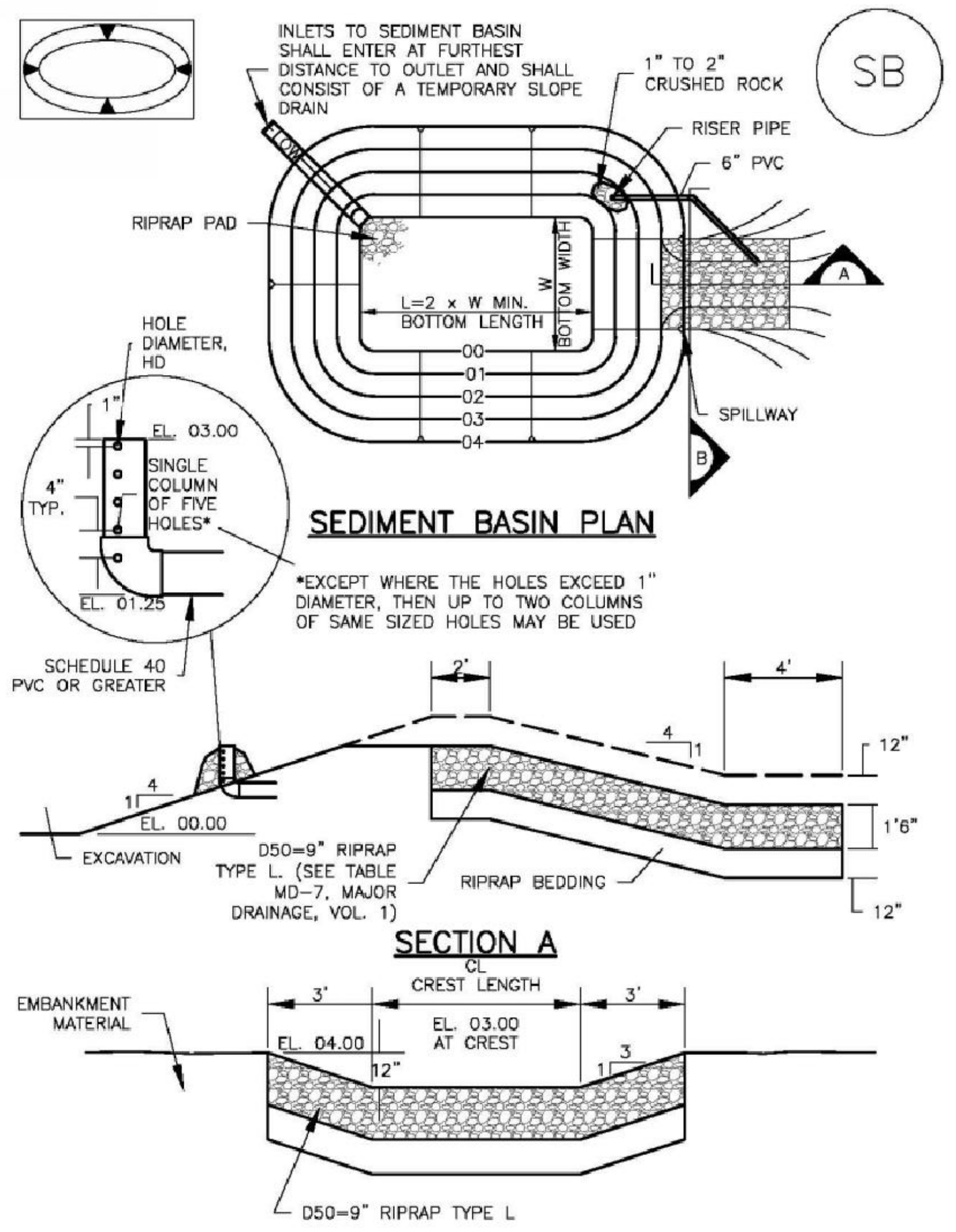


TABLE SB–1. SIZING INFORMATION FOR STANDARD SEDIMENT BASIN

Upstream Drainage Area (rounded to nearest acre), (ac)	Basin Bottom Width (W), (ft)	Spillway Crest Length (CL), (ft)	Hole Diameter (HD), (in)
1	$12\frac{1}{2}$	2	$\frac{9}{32}$
2	21	3	$\frac{13}{16}$
3	28	5	$\frac{1}{2}$
4	$33\frac{1}{2}$	6	$\frac{9}{16}$
5	$38\frac{1}{2}$	8	$\frac{21}{32}$
6	43	9	$\frac{21}{32}$
7	$47\frac{1}{4}$	11	$\frac{25}{32}$
8	51	12	$\frac{27}{32}$
9	55	13	$\frac{7}{8}$
10	$58\frac{1}{4}$	15	$\frac{15}{16}$
11	61	16	$\frac{31}{32}$
12	64	18	1
13	$67\frac{1}{2}$	19	$1\frac{1}{16}$
14	$70\frac{1}{2}$	21	$1\frac{1}{8}$
15	$73\frac{1}{4}$	22	$1\frac{3}{16}$

SEDIMENT BASIN INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - –LOCATION OF SEDIMENT BASIN.
   - –TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN).
   - –FOR STANDARD BASIN, BOTTOM WIDTH W, CREST LENGTH CL, AND HOLE DIAMETER, HD.
   - –FOR NONSTANDARD BASIN, SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT H, NUMBER OF COLUMNS N, HOLE DIAMETER HD AND PIPE DIAMETER D.

2. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.

3. SEDIMENT BASINS SHALL BE INSTALLED PRIOR TO ANY OTHER LAND–DISTURBING ACTIVITY THAT RELIES ON ON BASINS AS AS A STORMWATER CONTROL.

4. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.

5. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.

6. PIPE SCH 40 OR GREATER SHALL BE USED.

7. THE DETAILS SHOWN ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY, OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.

SEDIMENT BASIN MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED IN BASIN SHALL BE REMOVED AS NEEDED TO MAINTAIN BMP EFFECTIVENESS, TYPICALLY WHEN SEDIMENT DEPTH REACHES ONE FOOT (I.E., TWO FEET BELOW THE SPILLWAY CREST).

5. SEDIMENT BASINS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND GRASS COVER IS ACCEPTED BY THE LOCAL JURISDICTION.

6. WHEN SEDIMENT BASINS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

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Drawn By: MRL
Checked By: SOS
Sheet Number: 9

STORMWATER MANAGEMENT REPORT

FOR

Canyon Creek Filing No. 10
Four Corners
Commercial Area 1

June 30, 2016

Prepared for:
Foundry Builders, Inc.
21 South Sunset
Longmont, CO 80503
(720) 524-3620
Contact: Justin McClure

Prepared by:

J3 ENGINEERING CONSULTANTS

2011 W. Cherry Street, Suite 206
Louisville, CO 80027
Phone: 720-975-0177
Contact: Sue Sibel, P.E.

Project Owner/ Developer Signature Block
I have reviewed the information contained within the Erosion Control and Sediment Control Plan and accept responsibility for the requirements set forth.

____

Permittee/Affiliation
Date

Justin McClure
On Behalf of Foundry Builders, Inc.

Plan Preparer Signature Block
This erosion and sediment control plan included herein has been prepared under my direct supervision in accordance with the requirement of the erosions control criteria of the Town of Erie.

____

CO Professional Engineer
Sue Olson Sibel, #36710 Date

SWMP Administrator for Canyon Creek Filing No. 10- Four Corners Commercial Area 1

Company ______________________
Contact Name ______________________
Contact Phone ______________________
Contact email ______________________
Secondary Contact ______________________
Secondary Contact Phone ______________________
Secondary Contact email ______________________

TABLE OF CONTENTS

I. INTRODUCTION 1
II. SITE DESCRIPTION 1
  A. General Site Information 1
  B. Topography and Soils 1
  C. Existing Vegetation 2
  D. Construction Activities 2
  E. Project Schedule and Construction Sequence 2
  F. Potential Pollution Sources 3
  G. Non-Stormwater Discharges 4
  H. Receiving Waters 4
  I. SWMP Administrator and Record Retention 4
III. BMP's FOR STORMWATER POLLUTION PREVENTION 4
  A. Minimum Components 5
  B. Materials Handling and Spill Prevention, including a Spill Prevention, Control and Countermeasures Plan 8
IV. FINAL STABILIZATION AND LONG TERM STORMWATER MANAGEMENT 8
V. OTHER CONTROLS 8
VI. INSPECTION AND MAINTENANCE 9
VII. VARIANCES 9
VIII. CONCLUSIONS 9
  A. Compliance with Standards 10
  B. Summary of Concept 10
IX. REFERENCES 10

APPENDIX A – Vicinity Map, Figures and Supporting Documents

APPENDIX B – Calculations

APPENDIX C - Erosion and Sediment Control Inspection List

APPENDIX D – Spill Prevention and Control Plan

I. INTRODUCTION

The purpose of this report is to provide a guide to the RMCS, Developer and Contractor to use for the Stormwater Management and Erosion Control measures and facilities for Canyon Creek Filing No. 10, Four Corners Commercial Area 1 project.

II. SITE DESCRIPTION

A. General Site Information

The purpose of this project is to grade and construct the infrastructure (roads, water, storm drainage, sanitary sewer, dry utilities etc.) for the Development of Canyon Creek Filing No.10. The project is a parcel of land located in Section 24, Township 1 North, Range 69 West of the 6th Principal Meridian, Town of Erie, State of Colorado. The approximate latitude and longitude for the center of the project is 40^0 02' 05.6" N and 105^0 03' 30.2" W. Canyon Creek Filing No. 10 is generally bound on the north by Erie Parkway, on the west by a residential subdivision, to the south by Austin Avenue and to the east by E County Line Road. The development proposed with this phase of the development is Commercial Area 1, located northwest of the intersection of Austin Avenue and East County Line Road. The proposed development will be referred to as the “Site” for the remainder of this report. A Vicinity Map is included within the Appendix of this report. The property contains a total of approximately 46.61 platted acres, Commercial Area 1 contains 2.79 acres and the disturbed area will be about 4.6 acres.

The Site is undeveloped and contains two existing abandoned mine shafts located in the southwest corner and northeast portion of the Site. Abandoned mine shafts will be mitigated prior to construction of site.

The proposed Canyon Creek Filing No. 10, Four Corners Commercial Area 1 development will consist of roads, utilities, and grading related to development of a commercial parcel on the southwest corner of the site. Development will be subdivided into three Lots and four Tracts serving three buildings. A temporary water quality and detention pond will be constructed within Tract C to serve the development of this parcel until the overall water quality and detention facility is constructed in future phases in the northeast corner of the project.

B. Topography and Soils

Existing 1’ contours for the site and the surrounding area were obtained through a topographic survey provided by Rock Creek Surveying conducted during the Spring 2014. This information is the basis for the information that is being used during the design phase for the stormwater management plans. Being an undeveloped site, there are no apparent existing detention ponds on the site. The Site does have access to existing stormwater manhole and pipe stub within Erie Parkway on the northeast corner of the overall development. This stormwater connection will be used for the outfall of the final water quality and detention pond.

The Site slopes between 1% – 5%, with an average slope of about 3% across the site from the west side to east side of the project. Runoff from this area surface flows east where it collects and concentrates parallel to East County Line Road into the existing inflow pipe and storm manhole on the northeast corner of the site. The site ultimately drains to Coal Creek. The Erosion and Sediment Control Plan and (ESCP) Plan shows existing contours to graphically show how surface flows behave.

A soils study was performed using USDA Soil Survey database and the site contains Ascalon Loam, Soil Group B. The Ascalon Loam soils are found on the north and east sides of the overall Four Corners Development.

C. Existing Vegetation

As previously noted the site is undeveloped except for two existing abandoned mine shafts, the Marfel located in the north half and the Pinnacle shaft located within the Commercial Area 1. Existing vegetation consists of native grasses and shrubs and is estimated to cover 80% of the site. Existing ground cover is consistent with undeveloped areas within the Town of Erie.

D. Construction Activities

The proposed construction activities will consist of the installation of the stormwater management and erosion control measures as depicted in the plan set and this report; clearing, grubbing and grading of the site; installation of water mains, sanitary sewers, storm drainage and other dry utilities; construction of the temporary water quality and stormwater detention facility; construction of the roads, parking lots, and sidewalks; and landscaping of the tree lawns and open space.

E. Project Schedule and Construction Sequence

Erosion and sediment control measures will be placed in three general conditions; (1) prior to any construction activity that disturbs the existing land (silt fence, vehicle tracking control etc), (2) during construction of the proposed improvements (rough cut street control, inlet protection, etc) and (3) after completion of the infrastructure and open spaces (final landscaping). Construction is anticipated to begin September 2016. Utilities would begin in September 2016 with pavement and hardscaping to be installed October 2016. A detailed construction schedule will be provided by the selected contractor for the Site.

Storm water management and erosion control crews will mobilize the site and begin installing perimeter controls such as the Silt Fence (SF), Temporary Diversion Ditches (DD), Curb Sock (CS) for existing inlets and Inlet Protection (IP). Once perimeter control is established the contractor can install the remaining BMPs such as the Stabilized Staging Area (SSA).

The first construction operation will be grading of the Sediment Basin (SB). The earthwork contractor shall focus the operations on the northeast corner of the job. The Sediment Basin should be priority including measures associated to the basins such as the emergency overflow/riser pipe structures. Earthwork may proceed but shall not, under any circumstances, expand past stormwater and erosion control protection measures.

Once the Sediment Basin (SB) and supporting measures are installed and functioning as intended the earthwork contractor may begin formal mass-haul earthwork operations. It will be at the contractor’s discretion how and in what order material is moved. The earthwork contractor should strategically plan their work to minimize disturbed areas of work. They shall use standard construction industry methods to excavate, haul, place, compact and stabilize the smallest area feasible to efficiently complete the work. The contractor shall immediately stabilize all completed areas. Depending on the time frame, the contractor shall perform stabilizing measures such as Surface Roughening (SR) or Seeding & Mulching (SM) to the site as erosion prevention measure. The contractor may only remove BMPs once the site's tributary area is reclaimed and stabilized.

Additional construction BMPs should be installed without delay once the construction has progressed from perimeter controls. BMPs such as Curb Socks (CS) shall be place as soon as curb & gutter and roadway pavements are installed. Internal Inlet Protection for sump and on-grade inlets (IPS/IPO) shall be installed once inlets are place and are functional. Until inlets are functional they shall be blocked off using approved means and methods to prevent any runoff from entering. Outlet Protection (OP) should be placed before outlets become functional. Sediment Control Logs (SCL) and Erosion Control Blankets (ECB) will be placed on slopes as shown on the plans to protect the slopes and provide favorable conditions for the temporary and permanent seeding and revegetation.

The contractor shall keep surrounding roadways clean and free of construction debris regardless of construction phase. Under no circumstance shall the contractor track mud, dirt or debris onto public roadways. The contractor shall immediately clean all debris sourcing from the Site.

After grading and utility installation, the contractor shall install long-term site stabilization. The contractor may perform Surface Roughening (SR) in areas that will receive further development within a 30 day window of completion. These areas may include individual parcels, areas that will receive permanent landscaping or other permanent features. Areas that have no immediate plan within a 30 day window or are pending development shall receive Seed & Mulch (SM) as stabilization. No areas shall be left unprotected or unstabilized for any period greater than 14 days without receiving temporary seeding or approved equal.

BMPs shall remain in place until upstream tributary areas are fully stabilized. The contractor shall be responsible for removing BMPs at the appropriate time. The contractor should correspond with the onsite representative and coordinate removals prior to actual BMPs removal. BMPs shall be properly disposed of upon removal and the area cleaned better than preconstruction condition. The contractor is encouraged to capture video and pictures of pre-construction conditions prior to the start of construction.

F. Potential Pollution Sources

Potential pollution sources from construction activities include vehicle fueling and maintenance, concrete truck washout, and fertilizers for landscaping. Fueling and vehicle maintenance activities must occur in areas delineated on the Erosion and Sediment Control Plan & Report for this activity. If any spill occurs, the Spill Prevention, Control and Countermeasures Plan (SPCC) attached in the Appendix of this report should be reviewed and followed immediately including management of contaminated soils. Concrete truck washout must occur at the Concrete Washout Area (CWA) shown on the plans. The concrete washout location may be relocated as long as it complies with the Town of Erie specifications. It is not anticipated that there will be any dedicated masonry or batch plants on this site. Onsite storage and use of paints, chemicals and fertilizers are anticipated during construction activities and are limited to storage within the Stabilized Storage Area (SSA). Any mixing of paints or other chemicals should be done in a designated and protected area. If portable toilets are to be used on site, they will be placed at a location 100', at a minimum, from any drainageway, and will include the appropriate protective BMP's. Portable toilets should be located within the Stabilized Staging Area (SSA) and shall be secured to the ground to prevent tipping. The contractor shall maintain an onsite dumpster for the disposal of construction waste through the duration of the project.

G. Non-Stormwater Discharges

Allowable non-stormwater discharges from the site could include emergency firefighting activities, landscape irrigation return flow, construction dewatering and concrete washout water activities. Potable water is not anticipated to cause issues downstream, but any water discharged from the water line or fire hydrants will be directed to the temporary sediment pond and not offsite.

Discharges from other non-stormwater sources should immediately be remediated using the Spill Prevention, Control and Countermeasures Plan (SPCC) attached in the Appendix of this report.

H. Receiving Waters

The Site is located within the Coal Creek Basin as defined by the Town of Erie. The Beebe Draw infrastructure is covered within the Town of Erie MS4 permit. The Site outfalls into the existing piped stormwater system that conveys flows east to Coal Creek, with outfall near Erie Commons 1.

The Project Area lies within Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Map Panel Numbers 08013C0441J with a Revision Date of December 18, 2012. Based on the FIRM Map Panel, the site is within a Zone X, areas determined to be outside the 500-year floodplain. A FIRMette Map is included in the Appendix of this Report show the existing floodplain in its current state. A map for the area to the west of the site was unavailable.

I. SWMP Administrator and Record Retention

The Site's SWMP Administrator shall provide the company's contact information in the space provided at the beginning of this report. The Owner / Contractor / SWMP Administrator will be responsible to maintain records on-site of all erosion inspections, spill responses, field changes to the erosion control BMP for a minimum of three years after completion of the project.

III. BMP's FOR STORMWATER POLLUTION PREVENTION

Erosion and sediment control proposed within the Project Area will be per *Urban Storm Drainage Criteria Manual (USDCM),* Volume 3 (References 2). All runoff from the Project Area will be treated with the standard "Best Management Practices" (BMP's) as outlined in References 2 prior to discharging into the receiving waterways. Refer to the Four Corner Filing No. 1 Erosion and Sediment Control Plans (ESCP) for the proposed BMPs and locations.

The general approach to the BMP design is to provide a perimeter control consisting mainly of Silt Fence (SF) around the majority of the site. The contractor may elect to use Silt Fence (SF) in lieu of Construction Fence (CF) if approved by the Town of Erie. The Sediment Control Logs (SCL) will be used on steeper interior slopes, walkout lots and to protect the proposed channel. A proposed swale, approximately sloped at 0.5%, on the east side of the site will converge with the Sediment Basin in the northeast corner. Check Dams (CD) will be used to slow runoff to the sediment basin. Inlet protection (IP) is proposed for all off-site inlets adjacent to the site on

Austin Ave. Final erosion and sediment control will be accomplished by installation of hard surfaces (roads and sidewalks), final landscaping, Seed & Mulch (SM) or Surface Roughening (SR) for areas to be developed.

The proposed grading plan has one Sediment Basin located in the detention pond north of the site. This sediment basin will be converted to a temporary detention pond. After the site has been stabilized the sediment basin will be dredged and graded to the required Detention Pond grades. Calculations for the sediment basins and the outlet riser pipe are included in Appendix B.

The Sediment Basins are designed to hold storage volume for sediment storage and water quality volume for the upstream disturbed tributary area. The sediment basins include a riser pipe design. The water quality holes are designed per UDFCD Vol 2, storage equation SO13a, and release the water quality volume over 72 hours. The holes on the riser pipe begin at the top of the sediment volume elevation and continue up the riser pipe at 4-inch spacing. The top of the riser pipe is placed at the required water quality elevation. Storm events that exceed the water quality volume of the sediment basin will overtop the riser pipe to exit the pond and could overtop the emergency spillway. Construction sequencing will diminish the open disturbed area in both scenarios which could provide additional volume for storm events. Both scenarios for the sedimentation ponds will discharge into the existing drainage channel crossing the site. Please see the plans for the location and details of the overflow spillway, outfall pipe and riser pipe.

A. Minimum Components

Please refer to the *ESCP* for the location of erosion control measures in the construction phases of the Site. The following is a brief description of temporary / permanent sediment and erosion control BMP's which may be utilized on this Site, but are not limited to:

Inlet Protection (IP) – All downstream existing storm sewer inlets have area inlet protection around the grate. Area inlet protection provides a means of reducing sediment from entering the storm sewer prior to permanent stabilization of disturbed or open areas.

Outlet Protection (OP) – All storm sewer outlets have outlet protection downstream of the outfall. Outlet protection consists of utilizing a rock barrier or riprap to temporarily dissipate the velocities of flow exiting the pipe and capture sediment laden runoff.

Seed & Mulch (SM) – In areas of long-term stabilization of exposed soils from water and wind erosion, permanent seeding and mulching will occur within the Site. Permanent seeding and mulching consists of loosening soil, applying topsoil, and drill seeding disturbed areas with grasses and crimping in straw mulch. In the long-term, grass cover becomes established and can stabilize the soils. Please see the attached plans for specific seeding specifications and technical data.

Silt fence (SF) – Silt fence is a temporary sediment barrier constructed of woven fabric and supported with wooden posts. Placed along the perimeter of Site where sediment laden runoff could be conveyed off-Site or on slopes within the Site, silt fences can be an effective from of capturing sediment. The bottom edge of the silt fence fabric is placed in an anchor trench, backfilled and compacted.

Stabilized Staging Area (SSA) – A stabilized storage area is designated for the Site and consists of a formalized area for storing supplies, construction equipment, placing a construction trailer, etc. An interior portion near the entrance from Water Mill Drive will be utilized as the stabilized staging area. Please refer to the attached plans for the location of the Stabilized Storage Areas.

Surface roughening (SR) – In order to reduce wind erosion and the overland flow velocities that can cause rill and gully erosion, surface roughening consists of tilling parallel to (along) the contour in all disturbed, graded areas to capture runoff. In addition, surface roughening means to leave the slopes in a scarified condition by not fine-grading them.

Temporary and Permanent Seeding (TS/PS) – In order to assist with providing a short-term stabilization of exposed soils from water and wind erosion, temporary seeding and mulching could occur within the Site. Temporary seeding and mulching is not recommended as part of the project but in the event it is necessary, the contractor has the ability to utilize it as a form of temporary stabilization. It consists of loosening soil, applying topsoil if permanent seeding, and drill seeding disturbed areas with grasses and crimping in straw mulch. In the long-term, grass cover becomes established and can stabilize the soils. See the notes on the attached plans for specific seeding specifications and technical data.

Vehicle Tracking Control (VTC) – A vehicle tracking control pad shall be placed at the ingress and egress locations of the Project Area to reduce transportation of sediment from vehicle tires onto adjacent streets and off-site. The VTC shall consist of a pad of crushed aggregate greater than 3” but smaller than 6” at a depth of at least 9” installed over a liner of non-woven geotextile with a weight of at least 10 oz/yd^2 and a grab tensile strength of at least 250 pounds. Please refer to the attached plans for the specific locations of the vehicle tracking control.

Check Dams (CD) – A small rock berm used to slow runoff within swales to the sediment basin within the Site. This is utilized to convey flow to sediment traps and/or sediment ponds prior to release off-site. For specific locations of check dames within the Site, please refer to the attached plan set.

Sediment Control Log (SCL) – Sediment control log is bundle of straw or other fibrous material contained in long cylindrical casing which can be installed at the downstream end of exposed areas to help create a barrier for sediment. SCL’s can be used to protect adjacent properties, paved areas drainage ways, or established landscaped areas when exposed areas are adjacent.

Rock Sock (RS) – A rock sock is constructed of gravel that has been wrapped by wire mesh or a geotextile to form an elongated cylindrical filter. Rock socks are typically used either as a perimeter control or as part of inlet protection. When placed at angles in the curb line, rock socks are typically referred to as curb socks. Rock socks are intended to trap sediment from stormwater runoff that flows onto roadways as a result of construction activities.

Concrete Washout Area (CWA) – Concrete waste management involves designating and properly managing a specific area of the construction site as a concrete washout area. A concrete washout area can be created using one of several approaches designed to receive wash water from washing of tools and concrete mixer chutes, liquid concrete waste from dump trucks, mobile batch mixers, or pump trucks. Three basic approaches are available: excavation of a pit in the ground, use of an above ground storage area, or use of prefabricated haul-away concrete washout containers. Surface discharges of concrete washout water from construction sites are prohibited.

Construction Fence (CF) – A construction fence restricts site access to designated entrances and exits, delineates construction site boundaries, and keeps construction out of sensitive areas such as natural areas to be preserved as open space, wetlands and riparian areas.

Rough Cut Street Control (RCS) – Rough cut street controls are rock or earthen berms placed along dirt roadways that are under construction or used for construction access. These temporary berms intercept sheet flow and divert runoff from the roadway, and control erosion by minimizing concentration of flow and reducing runoff velocity.

Sediment Basin (SB) – A sediment basin is a temporary pond built on a construction site to capture eroded or disturbed soil transported in storm runoff prior to discharge from the site. Sediment basins are designed to capture site runoff and slowly release it to allow time for settling of sediment prior to discharge. Sediment basins are often constructed in locations that will later be modified to serve as post-construction stormwater basins.

Temporary Slope Drain (TSD) – A temporary slope drain is a pipe or culvert used to convey water down a slope where there is a high potential for erosion. A drainage channel or swale at the top of the slope typically directs upgradient runoff to the pipe entrance for conveyance down the slope. The pipe outlet must be equipped with outlet protection.

Street Sweeping (SS) – Street sweeping and vacuuming remove sediment that has been tracked onto roadways to reduce sediment transport into storm drain systems or a surface waterway.

Non-structural BMP's – these items include street sweeping, general Site upkeep and cleaning, as well as permanent landscaping and sod stabilization described further in Section V.

B. Materials Handling and Spill Prevention, including a Spill Prevention, Control and Countermeasures Plan

The Site has a stabilized staging area designated for vehicle fueling and storage of construction materials or equipment. This location is a potential pollution source and is identified on the Erosion and Sediment Control Plans. In the event of a materials spill, please refer to the Spill Prevention, Control and Countermeasures Plan provided in Appendix C.

Water quality protection from other possible pollutants will also use BMPs outlined in the *Urban Storm Drainage Criteria Manual (USDCM),* Volume 3 (Reference 2). Fueling for construction equipment will be achieved by a fuel truck. This truck will not be kept permanently on-Site. No structural fueling facilities will be built on the Site. Accidental spills will be cleaned up immediately and affected areas will be treated per the spill prevention plans for the Site. A spill prevention plan shall be provided by the contractor or within their Safety Project Manual and shall be kept at the Site in the event a spill occurs. All construction site operators shall control waste such as discarded building materials, concrete truck washout, hazardous chemicals (to include but not be limited to, heavy equipment maintenance fluids, motor oil, antifreeze and secondary containment of vehicle fuel), litter, and sanitary waste at the construction site that may cause adverse impacts to water quality.

IV. FINAL STABILIZATION AND LONG TERM STORMWATER MANAGEMENT

Final stabilization will be accomplished by the installation of hard surfaces (roads and sidewalks), permanent landscaping and seeding for areas. Landscape plans are submitted concurrently with the construction plans. Refer to construction documents for seed mix selection, application methods, soil preparation and amendments, soil stabilization practices, and sediment control BMPs. Coverage under the Stormwater Construction Permit can be terminated only when final stabilization of the site is complete, temporary erosion and sediments controls measures have been removed, and all components of the SWMP have been implemented.

V. OTHER CONTROLS

Waste disposal, temporary sanitary facilities, concrete washouts, liquid waste, dust, and other potential pollutants can adversely impact stormwater discharges. Adequate measures are necessary for the prevention of these pollutants from entering stormwater discharges.

Construction debris shall be collected daily and transported to the onsite dumpster located within the Stabilized Staging Area (SSA) or hauled off-site to a suitable landfill to avoid site contamination. Erosion control measures shall be maintained so that they are working properly at all times. In the event sediment, dirt and debris leaves the project area boundary on adjacent streets, those streets shall be cleaned as needed of any sediment and debris. Streets shall be cleaned by scraping and sweeping the dirt off the roadways. Scraped or swept material shall not be deposited in the storm sewer. Maintenance will be required to ensure that the proposed BMPs are functioning properly and should be inspected after each rainfall event or every 14 calendar days.

Fugitive dust emissions resulting from grading activities and/or wind erosion shall be controlled using reasonably available technology as defined by the CDPHE.

VI. INSPECTION AND MAINTENANCE

The construction manager or the designated SWMP manager (either for the contractor or the owner) is to ensure proper performance of BMP control measures until the next phase of construction begins and new BMPs are installed. Also, they are required to perform routine maintenance of all temporary BMP's. The inspection must include an observation of all disturbed areas, site perimeter and discharge points, areas used for waste/material storage, erosion control BMPs, and all other areas identified to have significant potential for Stormwater pollution. Routine inspections shall be completed every 14 calendar days and after each precipitation event during construction and corrective action should be taken immediately to rectify any damaged BMP's to ensure proper performance. BMP's shall be inspected within 24 hours after a precipitation event resulting in runoff or snowmelt or every 14 calendar days. A BMP Inspection Report has been provided in the Appendix of this report for documentation of routine inspections and verifying sufficient functioning of the BMP measures.

The contractor and any subcontractors shall keep a copy of Urban Drainage Volumes 1/2/3 Criteria Manuals shall be kept onsite as reference. A copy of the approved Stormwater Management Plans and Report shall be maintained onsite and any approved changes shall be recorded on this set. Copies of any required project permits shall be on-site be accessible. All documents related to Stormwater Management shall be readily obtainable for review at any time throughout the duration of construction. This will assist the construction manager with routine maintenance of BMP's.

After construction is complete and final stabilization measures are in place, routine maintenance of the final stabilization measures may be needed. This includes, but is not limited to, restoration of sediment control logs, removal of debris and sediment from the sediment ponds, mowing of grasses and weed management. Inspection and maintenance for these BMPs will be every 14 calendar days or more frequently to ensure proper functioning of the facilities. BMPs that have failed, or have the potential to fail without maintenance or modifications, must be addressed as soon as possible, immediately in most cases, to prevent the discharge of pollutants. Maintenance activities to correct problems noted must be documented. All changes in the field must be reflected in the SWMP within 72 hours.

VII. VARIANCES

There are no anticipated variances from the Town of Erie stormwater standards and specifications. Dialogue between the Town of Erie and the project team will determine the direction that allows for continued development of the Site while providing a stable erosion control plan in periods of work stoppage. Should a method of construction or type of BMP utilized differ from Erie or Urban Drainage and Flood Control District standards, the contractor will coordinate with the Town to obtain a variance.

VIII. CONCLUSIONS

A. Compliance with Standards

The Erosion and Sediment Control Plans provided with this report comply with all relevant Town of Erie Criteria and Urban Drainage and Flood Control District standards.

B. Summary of Concept

Appropriate sediment and erosion control BMP's will treat the majority of stormwater discharges associated with the Project Area. All Best Management Practice measures will be adhered to during implementation of this plan to effectively reduce pollutant loads being transported to receiving waters by stormwater. Methodologies specified in *Urban Storm Drainage Criteria Manual (USDCM),* Volume 3 (Reference 2) will be implemented at appropriate locations.

IX. REFERENCES

1. *Town of Erie Standards and Specifications for Design and Construction*, Town of Erie, January 2014.

2. *Urban Storm Drainage Criteria Manuals, Volumes 1-3*, Urban Drainage and Flood Control District; Revised August 2016.

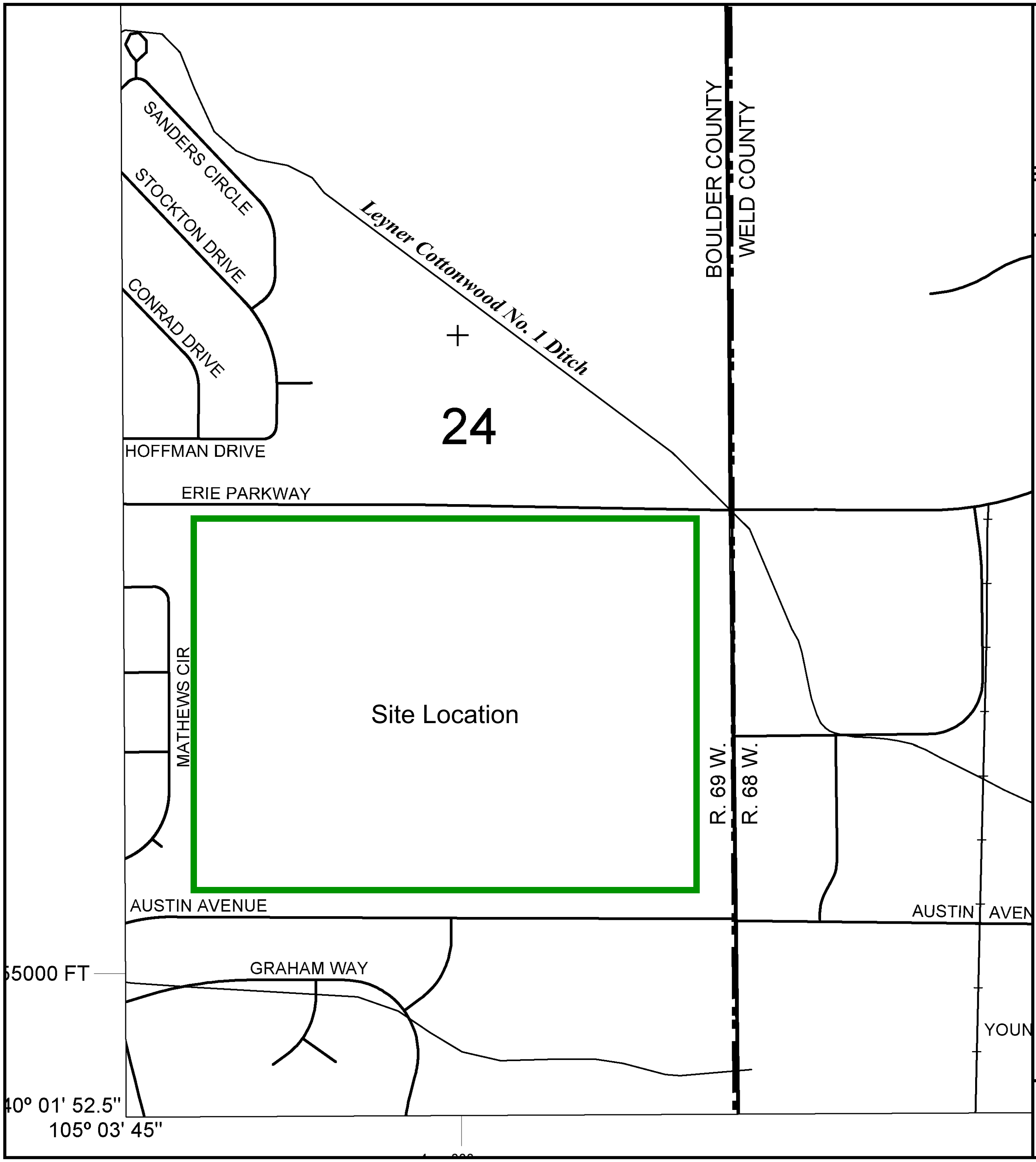
3. *Flood Insurance Rate Map, Boulder County, Colorado and Incorporated Areas, Panel 441 of 6155, Map Number 08013C0551J*, Federal Emergency Management Agency (FEMA), Map Revised December 18, 2012.

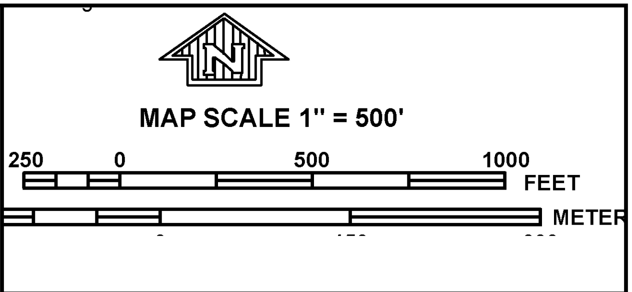
4. *Soil Survey of Boulder County Area, Colorado*, Natural Resources Conservation Service (NRCS), 1975.

5. *Town of Erie, Outfall Systems Plan (West of Coal Creek),* RESPEC Consultants & Services, January 2014

APPENDIX A

Vicinity Map, Figures and Supporting Documents





NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0441J

FIRM

FLOOD INSURANCE RATE MAP

BOULDER COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 441 OF 615

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BOULDER COUNTY	080023	0441	J
ERIE, TOWN OF	080181	0441	J

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08013C0441J

MAP REVISED
DECEMBER 18, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Boulder County Area, Colorado; and Weld County, Colorado, Southern Part

4 Corners

October 9, 2014

Soil Map

Map Scale: 1:3,720 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boulder County Area, Colorado
Survey Area Data: Version 10, Dec 30, 2013

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 12, Jan 3, 2014

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 22, 2011—Apr 13, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting

Map Unit Legend

Boulder County Area, Colorado (CO643)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AcA	MLRA 67B - Ascalon sandy loam, 0 to 3 percent slopes	17.8	28.7%
AcC	Ascalon sandy loam, 3 to 5 percent slopes	3.6	5.7%
MdD	Manter sandy loam, 3 to 9 percent slopes	34.6	55.6%
Subtotals for Soil Survey Area		**56.0**	**90.0%**
Totals for Area of Interest		**62.2**	**100.0%**

Weld County, Colorado, Southern Part (CO618)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
5	MLRA 67B - Ascalon sandy loam, 0 to 3 percent slopes	6.2	10.0%
Subtotals for Soil Survey Area		**6.2**	**10.0%**
Totals for Area of Interest		**62.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Boulder County Area, Colorado

AcA—MLRA 67B - Ascalon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2swl3
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ascalon and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Paleoterraces, plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk - 19 to 35 inches: sandy clay loam
C - 35 to 80 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: Sandy plains (R067BY024CO)

AcC—Ascalon sandy loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: jpr3
Elevation: 4,900 to 5,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ascalon and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Terraces
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed loamy alluvium and/or eolian deposits

Typical profile

H1 - 0 to 8 inches: sandy loam
H2 - 8 to 19 inches: sandy clay loam, sandy loam
H2 - 8 to 19 inches: fine sandy loam, loamy fine sand, sandy loam
H3 - 19 to 60 inches:
H3 - 19 to 60 inches:
H3 - 19 to 60 inches:

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Sandy (R067XB026CO)

MdD—Manter sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: jps4
Elevation: 4,900 to 5,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Manter and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manter

Setting

Landform: Terraces
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy eolian deposits and/or outwash

Typical profile

H1 - 0 to 5 inches: sandy loam
H2 - 5 to 14 inches: fine sandy loam, sandy loam
H2 - 5 to 14 inches: sandy loam, loamy sand, loamy fine sand
H3 - 14 to 60 inches:
H3 - 14 to 60 inches:
H3 - 14 to 60 inches:

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 18.1 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Sandy (R067XB026CO)

Weld County, Colorado, Southern Part

5—MLRA 67B - Ascalon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2swl3
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

Ascalon and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Paleoterraces, plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk - 19 to 35 inches: sandy clay loam
C - 35 to 80 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: Sandy plains (R067BY024CO)

Minor Components

Olnest

Percent of map unit: 10 percent
Landform: Plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy plains (R067BY024CO)

Vona

Percent of map unit: 5 percent
Landform: Plains
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy plains (R067BY024CO)

APPENDIX B

Calculations

Sedimentation Basin- Volume Calculations

Canyon Creek Flg 10 - Four Corners Commercial Area 1

Volume Equation:
Vol (V) = 1/3h(A1+A2+SQRT(A1*A2))

V = Volume in Cubic Feet (CF) or Acre-Feet (Ac-Ft)
h = Contour Interval in Feet (Ft)
A1,A2 = Area Enclosed by Successive Contours
In Square Feet (SF)

Tributary Area = 4.6 Acres

Dated: 06/20/16

Contour Elev. (Ft)	Area (SF)	A1+A2 (SF)	SQRT(A1*A2) (SF)	(A1+A2)+ SQRT(A1*A2) (SF)	h (Ft)	h/3 (Ft)	Volume V (CF)	Accum. Vol. AV (CF)	Accum. Vol. AV (Ac-ft)
5075.9	0							0	
		427	10	437	0.10	0.03	14.6		
5076	427							15	0.00
		11289	2154	13443	1.00	0.33	4481.0		
5077	10862							4496	0.10
		32278	15252	47530	1.00	0.33	15843.4		
5078	21416							20339	0.47
		47040	23426	70466	1.00	0.33	23488.7		
5079	25624							43828	1.01
		54694	27293	81987	1.00	0.33	27328.9		
5080	29070							71157	1.63
		61802	30847	92649	1.00	0.33	30882.9		
5081	32732							102040	2.34

Sediment Storage Volume=	0.10 ac-ft
Temporary WQ Volume =	0.29 ac-ft
Total Volume =	0.38 ac-ft

TOP of Emergency Spillway Elev: 5078.85

WATER SURFACE INTERPOLATIONS

Sediment Storage

Contour	Volume	Req Volume	Ac-ft
5078.0	20339		0.47
WSEL		4158	0.10
5079.0	43828		1.01

Total

Contour	Volume	Req Volume	Ac-ft
5078.0	20339		0.47
WSEL		16632	0.38
5080.0	71157		1.63

Sediment Storage
Water Surface Elev. = 5077.31

Total
Water Surface Elev. = 5077.85

APPENDIX C

Erosion and Sediment Control Inspection List

COLORADO DEPARTMENT OF TRANSPORTATION

STORMWATER FIELD INSPECTION REPORT AND WEEKLY MEETING NOTES - ACTIVE CONSTRUCTION

(1) Project Name:	(2) Project Contractor:	(3) SWMP Administrator:	Erosion Control Inspector:
(4) CDOT Project Engineer/CDOT Designee:	(5) Other Attendee(s) (Name and Title):		
(6) CDOT Project Number:	(7) Project Code (Sub Account #):	(8) CDPS-SCP Certification#:	(9) CDOT Region:
(10) Date of Project Inspection:	(11) Weather at Time of Inspection:		

(12) REASON FOR INSPECTION / EXCLUSION

☐ Routine Inspection: (minimum every 7 Calendar Days)

☐ Runoff Event: (Post-storm event inspections must be conducted within 24 hours after the end of any precipitation or snowmelt event that causes surface erosion. If no construction activities will occur following a storm event, post-storm event inspections shall be conducted prior to re-commencing construction activities, but no later than 72 hours following the storm event. The occurrence of any such delayed inspection must be documented in the inspection record.) Routine inspections still must be conducted every 7 calendar days.

Storm Start Date: Approximate End Time of Storm (hrs):

☐ Third Party Request:

☐ Winter Conditions Inspections Exclusion: Inspections are not required at sites where construction activities are temporarily halted, snow cover exists over the **entire site** for an extended period, and **melting conditions posing a risk of surface erosion do not exist**. This exception is applicable only during the period where **melting conditions do not exist**, and applies to the routine 7-day inspections, as well as the post-storm-event inspections. If **visual inspection** of the site verifies that all of these conditions are satisfied, document the conditions in section 18 (General Notes) and proceed to section 19 (Inspection Certification). Documentation must include: dates when snow cover occurred, date when construction activities ceased, and date when melting conditions began.

☐ Other:

(13) SWMP MANAGEMENT

	Yes	No	NA	(g) Reason for N/A
(a) Is the SWMP notebook located on site?				
(b) Are changes to the SWMP documents noted and approved?				
(c) Are the inspection reports retained in the SWMP notebook?				
(d) Are corrective actions from the last inspection completed?				
(e) Is the Spill Response Plan updated in the SWMP notebook?				
(f) Is a list of potential pollutants updated in the SWMP notebook?				

(14) CURRENT CONSTRUCTION ACTIVITIES

(a)Describe current construction Activities

(b)Estimate of disturbed area at the time of the inspection, use guidance found in 208.04 (e):

	Acres	Notes
Temporary Stabilization		
Interim Stabilization		
Permanent Stabilization Completed		

(c) Has the SWMP Phased BMP Implementation Matrix been updated? ☐ Yes ☐ No

(15) WEEKLY MEETING NOTES

Notes from last meeting (date___________________)

Items to discuss at next meeting (date_____________)

(16) CONSTRUCTION SITE ASSESSMENT & CORRECTIVE ACTIONS

****Off site Pollutant Discharges are a Violation of the Permit and Reason for Immediate Project Suspension****

The Construction Site Boundary/Limits of Construction (LOC) , all disturbed areas, material and/or waste storage areas that are exposed to precipitation, discharge locations, and locations where vehicles access the site shall be inspected for evidence of, or the **potential** for, pollutants leaving the LOC, entering the stormwater drainage system, or discharging to State waters. If there is evidence of sediment or other pollutants discharging from the site, see section 17 (Construction Site Assessment).

All erosion and sediment control practices identified in the SWMP shall be evaluated to ensure that they are maintained and operating correctly. Identify the condition of the BMP, using more than one letter if necessary: (**I**) Incorrect Installation; (**M**) Maintenance is needed; (**F**) BMP failed to operate; (**A**) Additional BMP is needed; (**R**) Remove BMP. Keep copies of this blank page for additional room if needed.

Continuous maintenance is required on all BMPs. **BMPs that are not operating effectively, have proven to be inadequate, or have failed must be addressed as soon as possible, immediately in most cases.**

Location	BMP	Condition	Comments: Description of Corrective Action and Preventative Measure Taken	Date Completed & Initials

(17) CONSTRUCTION SITE ASSESSMENT:**OFF SITE POLLUTANT DISCHARGES ARE A VIOLATION OF THE PERMIT AND REASON FOR IMMEDIATE PROJECT SUSPENSION**

(a) Is there evidence of discharge of sediment or other pollutants from the site? ☐ Yes ☐ No
*If yes, explain the discharge and the corrective actions in section 16 (Construction Site Assessment & Corrective Actions) or section 18 (General Notes).

(b) Has sediment or other pollutants discharging from the site reached State waters? ☐ Yes ☐ No
*If yes, see subsection 208.03(c) and Part II A.2 and 3 of the permit for reporting requirements.

(18) GENERAL NOTES

(19) INSPECTION CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assurethat qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Contractor’s SWMP Administrator
Print Name: Signature Required: Date:

Contractor’s Erosion Control Inspector (If Needed)
Print Name: Signature Required: Date:

Contractor’s Superintendent/Approved Designee
Print Name: Signature Required: Date:

CDOT Project Engineer/CDOT Designee
Print Name: Signature Required: Date:

(20) COMPLIANCE CERTIFICATION

Corrective action(s) has been taken, or where a report does not identify any incidents requiring corrective action, the report shall contain a signed statement indicating the site is in compliance with the permit to the best of the signer’s knowledge and belief.

Contractor’s SWMP Administrator
Print Name: Signature Required: Date:

CDOT Project Engineer/CDOT Designee (Signature Required)
Print Name: Signature Required: Date:

Stormwater Management Field Inspection Report Instructions

State waters are defined to be any and all surface and subsurface waters which are contained in or flow through the state, including, streams, rivers, lakes, drainage ditches, storm drains, ground water, and wetlands, but not including waters in sewage systems, waters in treatment works or disposal systems, waters in potable water distribution systems, and all water withdrawn for use until use and treatment have been completed. (Per subsection 107.25 and 25-8-103 (19) CRS)

(3) SWMP Administrator and Erosion Control Inspector: Indicate the name(s) of the individual responsible for implementing, maintaining and revising the SWMP. An Erosion Control Inspector(s) may be required see 208.03(c)2. for requirements.

(4) CDOT Project Engineer/CDOT Designee: Indicate the name of the CDOT representative performing the inspection with the SWMP Administrator/Erosion Control Inspector(s). This person should be the Project Engineer or an authorized representative.

(9) CDPS-SCP Certification #: Indicate the Colorado Discharge Permit System (CDPS) Stormwater Construction Permit (SCP) (for Stormwater Discharges Associated with Construction Activities) certification number, issued by CDPHE, for the project which the report is being completed. Certification number can be found on the first page of the SCP.

(12) Reason(s) for Inspection / Exclusion: Indicate the purpose for the inspection or exclusion. These inspections are required to comply with the CDOT Specifications and the CDPS-SCP.
☐ Routine Inspections. These inspections are required at least every 7 calendar days during active construction. Suspended projects require the 7 calendar day inspection unless snow cover exists over the entire site for an extended period of time, and melting conditions do not exist (see, Winter Conditions Inspections Exclusions).
☐ Runoff Event Inspection for Active Sites. See page 1 for definition.
☐ Third Party Request. Indicate the name of the third party requesting the inspection and, if known, the reason the request was made.
☐ Winter Conditions Inspections Exclusions. See page 1 for definition. An inspection does not need to be completed, but use this form to document the conditions that meet the Exclusion.
☐ Other. Specify any other reason(s) that resulted in the inspection.

(13) SWMP Management: Review the SWMP records and documents and use a ✓ to answer the question. To comply with CDOT Standard Specifications and the CDPS-SCP, all of the items identified must be adhered to. If No is checked, indicate the necessary corrective action in section 16 (Construction Site Assessment & Corrective Actions).
(a) Is the SWMP notebook located on site? A copy of the SWMP notebook must be retained on site, unless another location, specified by the permit, is approved by the Division.
(b) Are changes to the SWMP documents noted and approved? Indicate all changes that have been made to any portion of the SWMP notebook documents during construction. Changes shall be dated and signed at the time of occurrence. Amendments may include items listed in subsection 208.03(d).
(c) Are the inspection reports retained in the SWMP notebook? The SWMP Administrator shall keep a record of inspections. Inspection reports must identify any incidents of non-compliance with the terms and conditions of the CDOT specifications or the CDPS-SCP. Inspection records must be retained for three years from expiration or inactivation of permit coverage.
(d) Are corrective actions from the last inspection completed? Have corrective actions from the last inspection been addressed? Is a description of the corrective action(s), the date(s) of the corrective action(s), and the measure(s) taken to prevent future violations (including changes to the SWMP, as necessary) documented?
(e) Is a Spill Response Plan retained in the SWMP notebook? Subsection 208.06(c) requires that a Spill Response Plan be developed and implemented to establish operating procedures and that the necessary employee training be provided to minimize accidental releases of pollutants that can contaminate stormwater runoff. Records of spills, leaks or overflows that result in the discharge of pollutants must be documented and maintained. Information that should be recorded for all occurrences include the time and date, weather conditions, reasons for spill, etc. Some spills may need to be reported to the Water Quality Control Division immediately.
(f) Is a list of potential pollutants retained at the site? Subsection 107.25(b)6 requires the Erosion Control Supervisor to identify and describe all potential pollutant sources, including materials and activities, and evaluate them for the potential to contribute pollutants to stormwater discharge.
(g) If NA is checked for any of the items (a) through (f), indicate why in the space provided, if additional space is needed indicate in section 18 (General Notes).

Stormwater Management Field Inspection Report Instructions (continued)

(14) Current Construction Activities:

(a) Provide a short description of the current construction activities/phase at the project site; include summary of grading activities, installation of utilities, paving, excavation, landscaping, etc.

(b) Estimate of disturbed area at the time of the inspection, use guidance found in 208.04 (e). Estimate the acres of disturbed area at the time of the inspection. Include clearing, grading, excavation activities, areas receiving overburden (e.g. stockpiles), demolition areas and areas with heavy equipment/vehicle traffic, installation of new or improved haul roads and access roads, staging areas, borrow areas and storage that will disturb existing vegetative cover.

(c) Has the Phased BMP Implementation Matrix on the SWMP been updated? As part of the inspection the Phased BMP Implementation matrix for both the structural and non-structural BMPs found at the beginning of the SWMP sheets must be reviewed to ensure that "In use on site" box is checked for BMPs currently use at the time of the inspection.

(15) Weekly Meeting Notes: The SWMP Administrator shall take notes of water quality comments and action items at each weekly meeting. At the meeting the following shall be discussed and documented:

(1) Requirements of the SWMP.
(2) Problems that may have arisen in implementing the site specific SWMP or maintaining BMPs.
(3) Unresolved issues from inspections and concerns from last inspection
(4) BMPS that are to be installed, removed, modified, or maintained.
(5) Planned activities that will effect stormwater in order to proactively phase BMPs.
(6) Recalcitrant inspection findings

(16) Construction Site Assessment & Corrective Actions: Inspect the construction site and indicate where BMP feature(s) identified in section 13 (SWMP Management), require corrective action. Erosion and sediment control practices identified in the SWMP shall be evaluated to ensure that they are operating correctly.

- Location. Site location (e.g., project station number, mile marker, intersection quadrant, etc.).
- BMP. Indicate the type of BMP at this location that requires corrective action (e.g., silt fence, erosion logs, soil retention blankets, etc.).
- Condition. Identify the condition of the BMP, using more than one letter (identified in section 16) if necessary.
- Description of Corrective Action and Preventative Measure Taken. Provide the proposed corrective action needed to bring the area or BMP into compliance. Once corrective actions are completed, state the measures taken to prevent future violations andensure that the BMPs are operating correctly, including the required changes made to the SWMP.
- Date Completed & Initials. Date and initial when the corrective action was completed and the preventative measure statement finished.

(17) Construction Site Assessment: Was there any off site discharge of sediment at this site since the last inspection?

(a) Is there evidence of discharge of sediment or other pollutants from the site? **Off site pollutant discharges are a violation of the permit**. The construction site perimeter, all disturbed areas, material and/or waste storage areas that are exposed to precipitation, discharge locations, and locations where vehicles access the site shall be inspected for evidence of, or the **potential** for, pollutants leaving the construction site boundaries, entering the stormwater drainage system, or discharging to State water.

(b) Has sediment or other pollutants discharging from the site reached State waters? **Off site pollutant discharges are a violation of the permit.** If off site discharge has occurred, explain the discharge and the corrective actions in section 16 (Construction Site Assessment & Corrective Actions) or section 18 (General Notes).

(18) General Notes: Indicate any additional notes that add detail to the inspection; this may include positive practices noted on the project.

(19) Inspection Certification: In accordance with Part I, F.1.c of the CDPS-SCP, all reports for submittal shall be signed and certified for accuracy.

(20) Compliance Certification: In accordance with Part I, D.6.b.2.viii of the CDPS-SCP, compliance shall be certified through signature.

APPENDIX D
Spill Prevention and Control Plan

SPILL PREVENTION, CONTROL and COUNTERMEASURE PLAN (SPCC)

Whenever significant quantities of fuels, materials, vehicle fluids, or other pollutants are to be used on site, specific procedures for material containment and spill prevention shall be developed and implemented.

Introduction

The following Spill Prevention and Response Plan shall be implemented during the construction of The Lanterns. This plan will be implemented to meet the requirements of the Town of Erie.

Materials On-Site

Spill control procedures will be implemented when materials are stockpiled or when chemicals and/or fluids are used in the construction area.

Stockpiles of Dry Materials

The following spill prevention procedures shall be implemented:

All materials shall be stockpiled in designated areas, with BMPs used to prevent the runoff of contaminants. BMPs such as silt fence and sediment control logs will be installed according to Town of Erie criteria using the details shown in the Erosion Control plans. Loading and unloading operations shall be performed in a manner to prevent or limit materials from being spilled. Any spilled materials shall be swept up immediately after the operations are performed.

Vehicle Fueling

The following spill prevention procedures shall be implemented:

All vehicle fueling will be done off-site as much as possible. All on-site fueling operations will be performed in designated areas. Measures will be taken where necessary to prevent spills during vehicle fueling operations. These measures may include the placement of a temporary berm around the fueling area, covering the fueling area under a temporary portable structure, and/or the placement of drip pans under valves and tank openings. Berms will be constructed around all fueling areas. An adequate supply of absorbents will also be stockpiled at each fueling area.

Routine Vehicle and Equipment Maintenance

The following spill prevention procedures shall be implemented:

All vehicle maintenance will be performed off-site when possible. However, there may be occasions where construction equipment and vehicles may break down at the site and on-site repairs are more feasible. On-site vehicle and equipment maintenance, if needed, will be performed in designated areas, where practical, and enclosed by earthen berms. All maintenance areas will maintain an adequate supply of drip pans. These pans will be placed underneath vehicles as needed and absorbents will be used in the event of a minor spill or leak.

SPILL RESPONSE

NOTE: IN CASE OF FIRE, EVACUATE ALL PERSONNEL FROM THE IMMEDIATE AREA, RENDER FIRST AID TO ANYONE WHO IS INJURED, AND DIAL 911 IMMEDIATELY. TAKE APPROPRIATE STEPS TO PROTECT HUMAN LIFE AND TO CONTROL FIRES FIRST. SPILL CONTROL IS A SECONDARY CONCERN.

Cleanup and Removal Procedures

- Upon detection of any spill, the first action to be taken is to ensure personal safety. All possible ignition sources, including running engines, electrical equipment (including cellular telephones, etc.), or other hazards will be immediately turned off or removed from the area. The extent of the spill and the nature of the spilled material will be evaluated to determine if remedial actions could result in any health hazards, escalation of the spill, or further damage that would intensify the problem. If such conditions exist, a designated employee will oversee the area of the spill and the construction supervisor will be notified immediately.
- The source of the spill will be identified and if possible the flow of pollutants stopped if it can be done safely. However, no employee will attend to the source or begin cleanup of the spill until **ALL** emergency priorities (fire, injuries, etc.) have been addressed.

Small Spills

Small spills (usually <5 gallons) consist of minor quantities of gasoline, oil, anti-freeze, or other materials that can be cleaned up by a single employee using readily available materials.

The following procedures shall be used for clean up of small spills:

1. Ensure personal safety, evaluate the spill, and if possible, stop the flow of pollutants.

2. Contain the spread of the spill using absorbents, portable berms, sandbags, or other available measures.

3. Spread absorbent materials on the area to soak up as much of the liquid as possible and to prevent infiltration into the soil.

4. Once the liquids have been absorbed, remove all absorbents from the spill and place the materials in a suitable storage container. On paved areas, wipe any remaining liquids from the surface and place the materials in a storage container. Do not spray or wash down the area using water. For open soil areas, excavate any contaminated soil as soon as possible, immediately in most cases and place the soil in a suitable storage container. All materials will then be transported off-site for disposal.

5. If immediate transfer and storage of the contaminated soil is not practical, excavate and place the contaminated soil on a double thickness sheet of 3-mil or higher polyethylene film. In addition, a small berm should be formed around the outer edges of the soil

stockpile, underneath the polyethylene film, to ensure that contaminants are not washed from the site during precipitation events and those materials do not seep through the berm.

6. Record all significant facts and information about the spill, including the following:
    - Type of pollutant
    - Location
    - Apparent source
    - Estimated volume
    - Time of discovery
    - Actions taken to clean up spill

7. Notify the supervisor of the spill and provide the information from Item #6. The supervisor will then contact the Town of Erie.

Medium to Large Spills

Medium to large spills consist of larger quantities of materials (usually >5 – 25 gallons) that are used on site that cannot be controlled by a single employee. Generally, a number of facility personnel will be needed to control the spill and a response may require the suspension of other facility activities.

The following procedure shall be used for the cleanup of medium to large spills:

1. Ensure personal safety, evaluate the spill, and if possible, stop the flow of pollutants.

2. Immediately dispatch a front-end loader or similar equipment to the spill and construct a berm or berms down gradient of the spill to minimize the spread of potential pollutants. On paved surfaces, portable berms, sandbags, booms, or other measures will be used to control the lateral spread of the pollutants.

3. When the spread of the spill has been laterally contained, contact the supervisor or designated facility employee and provide them information on the location, type, and amount of spilled material, and a briefing on the extent of the spread and measures undertaken to contain the contaminants.

4. Depending on the nature of the spill, mobilize additional resources as needed to contain the contaminants.

5. Cleanup will commence when the lateral spread has been contained and the notification to the supervisor has been made.

6. Freestanding liquid will be bailed or pumped into 55-gallon storage drums, steel tanks, or other suitable storage containers. When all the liquid has been removed from the pavement or soil layer, absorbents will be applied to the surface and transferred to the storage containers when they have soaked up as much of the spill as possible.

7. On paved surfaces, the remaining contaminants will be removed to the extent possible, with rags, sweeping, or similar measures. The area of the spill will not be sprayed or washed down using water. Any contaminant soaked materials will be placed into the storage containers with the other absorbents.

8. The remaining contaminated soils will be excavated and loaded into a dump truck(s) for disposal off-site at a designated facility. If transport off-site is not immediately available, the remaining soils will be stockpiled on a double thickness sheet of 3-mil or higher polyethylene film. In addition, a small berm will be formed around the outer edges of the soil stockpile, underneath the polyethylene film, to ensure that contaminants are not washed from the site during precipitation and do not seep through the berm.

9. Record all significant facts and information about the spill, including the following:
    - Type of pollutant
    - Location
    - Apparent source
    - Estimated volume
    - Time of discovery
    - Actions taken to clean up spill

10. Provide the supervisor (or designated employee) with the information from Item #9. The supervisor will then contact the Town of Erie.

NOTIFICATION

Notification to the Colorado Department of Public Health & Environment (CDPHE) is required if there is any release or suspected release of any substance, including oil or other substances that spill into or threaten State waters. Unless otherwise noted, notifications are to be made by the supervisor and only after emergency responses related to the release have been implemented. This will prevent misinformation and assures that notifications are properly conducted.

The notification requirements are as follows:

1. **Spills into/or Threatens State Waters**: Immediate notification is required for releases that occur beneath the surface of the land or impact or threaten waters of the State of threaten the public health and welfare. Notifications that will be made are:
    a. For any substance, regardless of quantity, contact CDPHE at 1-877-518-5608. State as follows:
        a) Give you name.
        b) Give location of spill (name of city).
        c) Describe the nature of the spill, type of products, and estimate size of spill.
        d) Describe type of action taken thus far, type of assistance or equipment needed.
    b. For any quantity of oil or other fluids, call the National Response Center at 1-800-424-8802. State as follows:
        a) Give your name.
        b) Give location of spill (name of city and state).
        c) Describe the nature of the spill, type of product, and estimate size of spill.
        d) Describe type of action taken thus far, type of assistance or equipment needed.

2. **Reportable Quantity Spill on Land Surface**: Immediate notification is required of a release upon the land surface of an oil in quantity that exceeds 25 gallons, or of a hazardous substance that equals or exceeds 10 pounds or its reportable quantity under Section 101(14) of the Comprehensive Environmental Response, Compensation Liability Act (CERCLA) of 1980 as amended (40 CFR Part 302) and Section 329 (3) of the Emergency Planning and Community Right to Know Act of 1986 (40 CFR Part 355) whichever is less. This requirement does apply at a minimum to the substances listed in Table 1.

TABLE 1
Substances Requiring Notification

SUBSTANCE	REPORTABLE QUANTITY
Motor Oil	25 Gallons
Hydraulic Oil	25 Gallons
Gasoline/Diesel Fuel	25 Gallons

The notification procedures to be followed are:

a) Give your name.
b) Give location of spill (name of city and state).
c) Describe nature of the spill, type of product, and estimate size of spill.
d) Describe type of action taken thus far, type of assistance or equipment needed.

3. Notification is not required for release of oil upon the land surface of 25 gallons or less that will not constitute a threat to public health and welfare, the environmental or a threat of entering the waters of the State.

4. Notification, as required in paragraphs 1 and 2 above, will be made to the CDPHE using the 24-hour telephone number to report environmental spills. All information known about the release at the time of discovery is to be included, such as the time of occurrence, quantity and type of material, location and any corrective or clean-up actions presently being taken. Table 2 lists these phone numbers.

SPILL RESPONSE CONTACTS

TABLE 2
Emergency Notification Contacts

Name/Agency	Number
Town of Erie Fire Department	**911**
Town of Erie Police Department	**911**
Ambulance	**911**
Hospital	**911**
National Response Center	**1-800-424-8802**
CDPHE – Report Environmental Spills (24 hrs/day)	**1-877-518-5608**
Colorado Emergency Planning Committee	**303-273-1622**
Town of Erie Stormwater Division	**303-926-2858**

It is the responsibility of the supervisor to contact the Town of Erie, CDPHE, and/or the National Response Center.

- **The National Response Center** is to be contacted when a release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR 110, 4- DFR 117, or 40 CFR 302 occurs during a 24-hour period.

- Notification to the **CDPHE** is required if there is any release or suspected release of any material, including oil or hazardous substances that spill into or threaten state waters.

REPORTS

The CDPHE requires written notification of a spill or discharge of oil or other substance that may cause pollution of the waters of the State of Colorado. A written report must be submitted to the Water Quality Control District (WQCD) within five days after becoming aware of the spill or discharge.

The CDPHE requires a written final report within 15 days for all releases of an oil or hazardous substance that require implementation of a contingency plan. The CDPHE may also require additional reports on the status of the clean up until any required remedial action has been complete.

Written notification of reports must contain at a minimum:

1. Date, time, and duration of the release.
2. Location of the release.
3. Person or persons causing and responsible for the release.
4. Type and amount of oil or substance released.
5. Cause of the release.
6. Environmental damage caused by the release.
7. Actions taken to respond, contain, and clean up the release.
8. Location and method of ultimate disposal of the oil or other fluids.
9. Actions taken to prevent a reoccurrence of the release.
10. Any known or anticipated acute or chronic health risks associated with the release.

J3 ENGINEERING CONSULTANTS

"Your Project, Our Pride" ™

June 30, 2016

Town of Erie
Matt Wiederspahn, Engineering Division
Engineering Division
645 Holbrook St.
Erie, CO 80516

RE: Canyon Creek Filing No. 10, Four Corners Commercial Area 1, Phase III Final Drainage Report

Dear Mr. Wiederspahn,

On behalf of RMCS, we have prepared the Canyon Creek Filing No. 10, Four Corners Commercial Area 1, Phase III Drainage Report. The Four Corners Site, 46.61 acres, is undeveloped land located at the southwest corner of the intersection of Erie Parkway and East County Line Road. The first parcel of the site to be developed will be the southeast corner of the site at the corner of East County Line Road and Austin Avenue. The proposed development will consist of three commercial buildings with drive-thru accesses, a right in right out access to East County Line Road and a full roadway access to Austin Avenue. The remainder of the site will remain undeveloped, with this report.

Proposed storm sewer improvements will be constructed within the commercial parcel. A temporary, interim water quality and detention pond will be constructed north of the proposed commercial area. The interim detention pond will be removed and relocated as necessary until the overall site detention pond is constructed in the northeast corner of the site. The final water quality and detention pond will connect to the existing 42-inch storm sewer stub and comply with the Town of Erie, Outfall Systems Plan (West of Coal Creek) prepared by RESPEC in January 2014.

A variance is requested from Section 814.10 Compensating Detention Procedures. The release rate is based on the acreage being developed in the interim detention pond. If the interim detention pond release rate, based on acreage, is decreased by the flows leaving the site undetained the interim water quality and detention pond would not have a positive release rate. The water quality and detention pond being constructed with the first commercial phase of the Four Corners project will be a temporary interim condition until the Site detention pond is constructed in the northeast corner of the site. It is anticipated that the final detention pond allowable release rate will be large enough to handle the reduction of flows released undetained from the Site.

The drainage plan provided in this report complies with the *Town of Erie Storm Drainage Facilities Standards and Specifications* and the *Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manuals*, and the *Town of Erie Outfall Systems Plan*.

Respectfully Submitted,

Alaina Kneebone Marler, PE
J3 Engineering Consultants, Inc.

cc: file

PHASE III DRAINAGE REPORT
FOR
Canyon Creek Filing No. 10
Four Corners Commercial Area 1

June 30, 2016

Prepared for:

Foundry Builders, Inc
21 Sunset Street
Longmont CO 80501
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Job No. 030019

PHASE III DRAINAGE REPORT
FOR
Canyon Creek Filing No. 10
Four Corners

TOWN OF ERIE CERTIFICATION STATEMENT

"I hereby certify that this Phase III Drainage Report (plan) for the design of Canyon Creek Filing No. 10, Four Corners – Commercial Area 1 was prepared by me (or under my direct supervision) in accordance with the provisions of *Town of Erie Standards and Specifications for Design and Construction* for the owners thereof. I understand that the Town of Erie does not and will not assume liability for drainage facilities designed by others, including the designs presented in this report."

SIGNATURE: ______________________________

Alaina Kneebone Marler, P.E.
Registered Professional Engineer
State of Colorado No. 35781

TOWN ACCEPTANCE

"This report has been reviewed and found to be in general compliance with the *Town of Erie Standards and Specifications for Design and Construction* and other Town requirements. THE ACCURACY AND VALIDITY OF THE ENGINEERING DESIGN, DETAILS, DIMENSIONS, QUANTITIES AND CONCEPTS IN THIS REPORT REMAINS THE SOLE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE APPEAR HEREON.

Accepted by: ______________________________ ________________________
Deputy Public Works Director Date

TABLE OF CONTENTS

I. INTRODUCTION **1**
II. GENERAL LOCATION AND DESCRIPTION **1**
  A. Location of Property 1
  B. Description of the Proposed Project 1
  C. Adjacent Areas 2
III. DRAINAGE BASINS **2**
  A. Major Basins 2
IV. DESIGN CRITERIA **3**
  A. Regulations 3
  B. Development Criteria Reference and Constraints 3
  C. Hydrologic Criteria 3
  D. Hydraulic Criteria 4
V. DRAINAGE PLAN **5**
  A. General Concept 5
  B. Specific Details 5
  C. Detention / Water Quality / Regional Improvements 9
VI. CONCLUSIONS **10**
VII. REFERENCES **10**

APPENDIX A – FIGURES and SUPPORTING DOCUMENTS

Vicinity Map A1
FEMA FIRM Map Panel A2
USGS Soils Map and Properties A3-A12

APPENDIX B – HYDROLOGIC COMPUTATIONS

Supporting Tables and Figures B1-2
Figure B-3 from Town of Erie, Outfall Systems Plan B3
Imperviousness Calculations B4-5
Time of Concentration Calculations B6
Routed Flow Calculations B7-9

APPENDIX C – HYDRAULIC COMPUTATIONS

Street Flow Capacities C1-2
UDFCD UD Inlet Calculations C3-26
HGL Profiles with Summary Table C27-30
Outfall Pipe Capacity and Swale Calculations C31-33
Outfall Riprap Calculations C34

APPENDIX D – DETENTION COMPUTATIONS

UDFCD UD Detention Worksheet D1
Pond Volume and Water Surface Calculations D2
Horizontal Orifice Calculations for Outfall Pipe D3

Phase III Drainage Map .... Back Pocket

I. INTRODUCTION

The purpose of this report is to provide the Town of Erie and the developer the supporting calculations for the final design of the proposed drainage facilities for Canyon Creek Filing No. 10, Four Corners Commercial Area 1. The narrative provides a comprehensive description of the project, the hydrologic and hydraulic design methodologies utilized, and a summary of the final design of drainage facilities. The narrative also describes how this development complies with the Town of Erie Outfall Systems Plan (West of Coal Creek), dated January 2014.

II. GENERAL LOCATION AND DESCRIPTION

A. Location of Property

Canyon Creek Filing No. 10 is located in a portion of the southeast one-quarter of Section 13, and a portion of the Southeast One-Quarter of Section 13 and a portion of the south one-half Section 24, Township 1 North, Range 69 West of the 6th Principal Meridian, Town of Erie, Boulder County, Colorado. The property comprises of approximately 46.61 acres and is bounded on the south by Austin Avenue, on the north by Erie Parkway, on the west by existing Canyon Creek Subdivision Filing No.5, and to the east by the East County Line Road. The tributary area resides in the Erie Commons Reach 1 per the *Town of Erie, Outfall Systems Plan (West of Coal Creek), January 2014*. Canyon Creek Filing No. 10 is tributary to Reach 1, and ultimately Coal Creek. Four Corners Filing No. 1 will be referred to as the “Site” for the remainder of this report. A Vicinity Map is included in the Appendix for reference.

B. Description of the Proposed Project

The proposed development over the entire site will be phased. The first phase of the development will be a commercial area in the southeast corner of Austin Avenue and East County Line Road. The first phase, shown on Sheet 3 of the Phase III Drainage Map, is Lots 1-3 and Tracts A & B of Four Corners Commercial Area 1. The commercial area will have three main commercial buildings, parking areas and landscaped areas. The remaining undeveloped areas are shown as a Tract C & D on the Four Corners Filing 1 Plat.

As the development continues within the Site, subsequent Phase III Drainage Reports will be submitted with the appropriate planning documents.

On-Site soils consist primarily of sandy loams, as shown on the *Soil Conservation Service Soil Survey of Boulder County* maps (Reference 4) located in Appendix A of this report. Soil classifications with the Site include AcA and MdD. All of the Site soils lie within Hydrologic Soil Groups (HSG) B. Type ‘B’ soils are identified as having medium runoff, moderate infiltration rates and a moderate erosion hazard.

Per Flood Insurance Rate Map for Boulder County, Colorado, Panel 441 of 615 08013C0441J, the site is not within a floodway or floodplain.

There are two mine shafts, Marfel and Pinnacle present on the property. The Pinnacle shaft is located within the Commercial Area developed with this phase. The Pinnacle Shaft has a 40-foot buffer zone from buildings and the utilities within the buffer have benn limited to services. A separate Mine Subsidence Investigation has been conducted by CTL Thompson, February 2015, and the mine shafts present on the property will be mitigated before construction.

There are no wetlands areas on this property.

C. Adjacent Areas

The proposed development lies east of the Canyon Creek Subdivision Filing No. 5, which consists of existing, medium-density, residential development. Canyon Creek Subdivision has a large existing detention pond to the west of their development. To the east of the Site is the existing commercial property. To the south of the Site lies the existing residential development of Canyon Creek Subdivision Filing No. 5. Directly north of the Site are undeveloped commercial lots and Erie Parkway.

III. DRAINAGE BASINS

A. Major Basins

The Site consists of approximately 46.61 acres and is a single property. The existing land is zoned planned development (PD) and is undeveloped. The Site’s existing topography slopes from the southwest corner towards the northeast corner at approximately 2.5%.

The Site is contained within Basin 462 from the OSP (Reference 6) and has a proposed future imperviousness of 79% which correlates to Type B Soil runoff coefficients of 0.59 and 0.70, for the 5-year and 100-year events respectively. The final overall composite C-value for the 100-year event for the entire Site will be no greater than 0.70. Individual basins may be higher due to local basin characteristics. However, the overall composite C-value will be held at 0.70 or less.

As the Site will be built in phases, it is anticipated that all sub-basins within the Site will be captured and routed to a final proposed detention pond located south of Erie Parkway in a future Commercial Area.

The future detention pond outfall for the entire site will connect to the existing 42-inch RCP storm sewer that is within the intersection of Erie Parkway and East County Line Road. From there, flows will be conveyed to Reach 1 of Erie Commons 1 as outlined in the *Town of Erie, Outfall Systems Plan (West of Coal Creek)* (Reference 6).

IV. DESIGN CRITERIA

A. Regulations

A drainage plan is presented for the 5-year (minor-commercial) and 100-year (major) storm events based on the *Town of Erie Storm Drainage Facilities* (Reference 1). The drainage plan for Four Corners Filing No. 1 was based on the Town of Erie requirements (Reference 1), Urban Drainage and Flood Control District (UDFCD) UDSCM (Reference 2), and the *Town of Erie Outfall Systems Plan* (West of Coal Creek) (Reference 5).

B. Development Criteria Reference and Constraints

The undeveloped lot has historically drained to the northeast corner by the intersection of Erie Parkway and East County Line Road. There are no existing drainage or storage facilities on the site. There is an existing 10-Foot Type R inlet at the intersection of Erie Parkway and East County Line Road that is connected to the existing storm sewer system within Erie Parkway. There is a pair of existing, on grade Type R inlets along Austin Avenue that connects to a southern storm sewer system. These existing inlets will not be utilized in the development of the Four Corners parcel.

Local site constraints include the five existing gas lines along the right-of-ways of Erie Parkway and East County Line Road. The four existing gas lines along East County Line Road range from 4 to 12-inches in diameter while there is a single 6-inch gas line along Erie Parkway. Future outfall pipes from the site will be required to cross these four gas lines to connect to existing infrastructure within East County Line Road. Coordination with the gas line owners is ongoing.

C. Hydrologic Criteria

Hydrologic analyses for subsequent reports will be calculated using the Rational Method. Rainfall intensities were taken from the Town's *Manuals (Table 800-2)* (Reference 1) IDF equation and are based upon the 1-hour point rainfall depths as identified in Table 1.

Table 1: 1-hr Point Rainfall Depths

Storm Event	1-hr Rainfall Depth (in)
5-yr	1.43
10-yr	1.75
100-yr	2.70

The Rational Method procedures and methodology for the time of concentration and for the computation of peak flow rates follow the Town of Erie and Urban Drainage Criteria outlined in References 1 and 2, respectively.

D. Hydraulic Criteria

Street capacities, the sizing of inlets, and the size and layout of the storm sewer system have been analyzed and are reported within this Final Drainage Report for the commercial development of the site. The locations and sizes of proposed storm inlets within this commercial area will remain as constructed for the future phases of the development. The outfall pipes to the interim detention pond for this phase shall be considered a temporary pipe until the downstream storm sewer phases are designed and built. All future storm water capture and conveyance elements will be comprehensively analyzed and sized with previous phased constructed elements within the Final Drainage Report(s). Final Drainage Reports will be submitted consistent with Site phasing and shall analyze interim and final phases, if applicable.

Analysis of curb and gutter street flows are included herein and were calculated using a custom channel section analysis from Hydraflow Express Extension for AutoCAD Civil 3D 2016. This will allow the various future street sections with vertical curb to be drawn and modeled with Manning’s equation to determine the available flow within the street section. Street capacities were checked at pertinent design point locations. Street capacities were calculated using design constraints of 6 inches of ponding (to top back of curb) for minor storms and 18 inches of ponding for major storms, which complies with the Town of Erie criteria (Reference 1). Street capacity analyses are included in the appendix of this report.

Type R inlets are being proposed on-site within the parking lots at sump locations and at on-grade locations within the access drive. The Type R inlets were sized utilizing UDINLET 2013 version 3.14 spreadsheet provided by Urban Drainage and the results are included in the appendix of this report. Additional hydraulic software, Hydraflow Express Extension for AutoCAD Civil 3D 2016, has been be used for sizing the swales. The sizing of the proposed storm sewer within the development has been analyzed for the Phase III Drainage Report using AutoCAD Storm and Sanitary Analysis 2014, which used the Hydrodynamic method to model the hydraulic analysis for the onsite storm sewer. This type of routing most accurately accounts for the tailwater effect in the pipes.

V. DRAINAGE FACILITY DESIGN

A. General Concept

The majority of the Site was designed to generally follow historical drainage patterns and drain towards the northeast corner of the overall Four Corners Filing 1 site. The undeveloped portion of the site will follow historic conditions and flow undetained overland to the roadways. Drainage from the developed commercial area in southeast corner of the Site will be detained by an interim water quality and detention facility and outfall across the undeveloped portion of the Site. The interim water quality and detention facility will be resized, removed and replaced when the next phase of the adjacent commercial development is proposed. The interim detention pond will change location as necessary until the ultimate water quality and detention pond location in the northeast corner is finalized for the full build out of the 46.6 acre property.

The outfall from the interim water quality and detention facility will be restricted to the allowable release rate per the Town of Erie, Table 800-4, for Type B SCS Soil Group. This allowable release, approximately 3.68 cfs, will then follow historic conditions and surface flow to the roadways. The future water quality and detention pond location in the northeast corner of the site will connect to the existing storm network in Erie Parkway, Reach 1, as identified in the *Town of Erie Outfall Systems Plan* (Reference 5).

Variance Request

A variance is requested from Section 814.10 Compensating Detention Procedures. The undetained basin area from the initial phase of the site is 0.70 acres for Sub-Basins C1 and C2. The sum of the 10 year and 100 year flows from the C Sub-basins are 1.76 cfs and 3.68 cfs, respectively. These offsite flows are greater than the Allowable Release Rate for Type B Soils for the overall area, 4.25 acres, being collected into the pond, 0.98 cfs for the 10-year and 3.62 cfs for the 100-year. The detention pond being constructed with the first commercial phase of the Four Corners project will be a temporary interim condition until the Site detention pond is constructed in the northeast corner of the site. It is anticipated that the final detention pond allowable release rate will be large enough to handle the reduction of flows released undetained from the Site.

B. Specific Details

General

The proposed commercial improvements in the southeast corner, approximately 4.25 acres with the interim water quality and detention pond, will be collected by curb and gutter until it is captured by inlets that discharge into the interim water quality and detention pond located directly north of the commercial area. The inlets are placed within the parking lot in sump locations and along the road that are in conformance with guidelines established in the Town of Erie criteria (Reference 1).

Site Basins

Basin A

Sub-basin A1 is generally located on the west side of the north drive in the Site. Runoff from Sub-basin A1 is generated from 0.06 acres of private roadway. The runoff coefficients for Sub-basin A1 are 0.90 and 0.96 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin A1 is 0.20 cfs for the 5-yr storm event and 0.57 cfs for the 100-yr storm event. Runoff from this Sub-basin will be captured in a proposed 5’ Type R sump inlet (INLET 2-2). This inlet has been placed to accommodate a future low point within a north-south road. Overflow from this basin will overtop the curb and flow towards the interim detention pond. Future overflow paths will remain in the roadway and flow north to the next low point. From DP9, drainage discharges via an 18-inch storm sewer system to the interim detention pond at DP10.

Sub-basin A2 is generally located on the west side of the north drive in the Site. Runoff from Sub-basin A2 is generated from 0.14 acres of private roadway and landscaping. The runoff coefficients for Sub-basin A2 are 0.70 and 0.82 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin A2 is 0.42 cfs for the 5-yr storm event and 1.00 cfs for the 100-yr storm event. Runoff from this Sub-basin will be captured in a proposed 5’ Type R sump inlet (INLET 2-3). This inlet has been placed to accommodate a future low point within a north-south road. Overflow from this basin will overtop the curb and flow towards the interim detention pond. Future overflow paths will remain in the roadway and flow north to the next low point. From DP8, drainage discharges via an 18-inch storm sewer system to the interim detention pond at DP10.

Sub-basin A3 is generally located on the west side of the Site. Runoff from Sub-basin A3 is generated from 0.62 acres of building, private parking lot and landscaping. The runoff coefficients for Sub-basin A3 are 0.69 and 0.80 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin A3 is 2.08 cfs for the 5-yr storm event and 4.55 cfs for the 100-yr storm event. Runoff from this Sub-basin will be captured in a proposed 10’ Type R sump inlet (INLET 2-4). Overflow from this basin will continue north within the drive aisle to the pair of 5’ Type R inlets before overtopping the curb and flow towards the interim detention pond. From DP7, drainage discharges via an 18-inch storm sewer system to the interim detention pond at DP10.

Sub-basin A4 is generally located within the center of the Site. Runoff from Sub-basin A4 is generated from 0.54 acres of private parking lot and landscaping. The runoff coefficients for Sub-basin A4 are 0.78 and 0.88 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin A4 is 2.07 cfs for the 5-yr storm event and 4.37 cfs for the 100-yr storm event. Runoff from this Sub-basin will be captured in a proposed 10' Type R sump inlet (INLET 1-7). Overflow from this basin will continue north within the drive aisle and overtop the curb, flowing east, towards the on grade inlet within the entrance drive connection with East County Line Road. From DP2, drainage discharges via an 18-inch storm sewer system to the interim detention pond at DP6.

Sub-basin A5 is generally located within the center of the Site. Runoff from Sub-basin A5 is generated from 0.74 acres of building, private parking lot and landscaping. The runoff coefficients for Sub-basin A5 are 0.76 and 0.86 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin A5 is 2.75 cfs for the 5-yr storm event and 5.86 cfs for the 100-yr storm event. Runoff from this Sub-basin will be captured in a proposed 10' Type R sump inlet (INLET 1-5). Overflow from this basin will continue north within the drive aisle and overtop the curb, flowing east, towards the on grade inlet within the entrance drive connection with East County Line Road. From DP1, drainage discharges via an 18-inch storm sewer system to the interim detention pond at DP6.

Sub-basin A6 is generally located within the northeast of the Site. Runoff from Sub-basin A6 is generated from 0.14 acres of building, private parking lot and landscaping. The runoff coefficients for Sub-basin A6 are 0.69 and 0.80 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin A6 is 0.45 cfs for the 5-yr storm event and 0.99 cfs for the 100-yr storm event. Runoff from this Sub-basin will be captured in a proposed 5' Type R sump inlet (INLET 1-4). Overflow from this basin will overtop the curb, flowing east, towards the on grade inlet within the entrance drive connection with East County Line Road. From DP3, drainage discharges via a 24-inch storm sewer system to the interim detention pond at DP6.

Sub-basin A7 is generally located within the north drive of the Site. Runoff from Sub-basin A7 is generated from 0.05 acres of private roadway. The runoff coefficients for Sub-basin A7 are 0.90 and 0.96 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin A7 is 0.23 cfs for the 5-yr storm event and 0.46 cfs for the 100-yr storm event. Runoff from this Sub-basin will be captured in a proposed 5' Type R on grade inlet (INLET 1-3). Overflow from this basin will flow east towards East County Line Road. From DP4, drainage discharges via a 36-inch storm sewer system to the interim detention pond at DP6.

Sub-basin A8 is generally located within the north drive of the Site. Runoff from Sub-basin A8 is generated from 0.09 acres of private roadway and landscaping. The runoff coefficients for Sub-basin A8 are 0.51 and 0.69 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin A8 is 0.23 cfs for the 5-yr storm event and 0.54 cfs for the 100-yr storm event. Runoff from this Sub-basin will be captured in a proposed 5' Type R on grade inlet (INLET 1-2). Overflow from this basin will flow east towards East County Line Road. From DP5, drainage discharges via a 36-inch storm sewer system to the interim detention pond at DP6.

Sub-basin A9 is generally located on the north side of the Site. Runoff from Sub-basin A9 is generated from 1.20 acres of landscaping and the interim detention pond. The runoff coefficients for Sub-basin A9 are 0.17 and 0.45 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin A9 is 3.18 cfs for the 5-yr storm event and 8.20 cfs for the 100-yr storm event. Runoff from this Sub-basin will sheet flow into the proposed interim detention pond. Any emergency overflow from the interim detention pond will flow north in the outfall swale to Erie Parkway. From DP5, drainage discharges via a 36-inch storm sewer system to the interim detention pond at DP6.

Basin B

Sub-basin B1 is the large undeveloped portion of the Four Corners Site. Runoff from Sub-basin B1 is generated from 42.60 acres of existing vegetation. The runoff coefficients for Sub-basin B1 are 0.17 and 0.45 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin B1 is 26.86 cfs for the 5-yr storm event and 132.22 cfs for the 100-yr storm event. Runoff from this Sub-basin will follow historical conditions and flow northeast towards the intersection of Erie Parkway and East County Line Road. Future development of this Sub-Basin will include additional commercial and residential uses and will be further analyzed as the Site is developed.

Basin C

Sub-basin C1 is generally located on the east side of the Site. Runoff from Sub-basin C1 is generated from 0.62 acres of landscaping and public sidewalk. The runoff coefficients for Sub-basin C1 are 0.29 and 0.53 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin C1 is 0.88 cfs for the 5-yr storm event and 3.02 cfs for the 100-yr storm event. Runoff from this Sub-basin will sheet flow offsite undetained to East County Line Road.

Sub-basin C2 is generally located on the south side of the Site. Runoff from Sub-basin C2 is generated from 0.08 acres of private parking lot and landscaping. The runoff coefficients for Sub-basin C2 are 0.78 and 0.88 for the 5-yr and 100-yr storms, respectively. The runoff generated from Sub-basin C2 is 0.31 cfs for the 5-yr storm event and 0.66 cfs for the 100-yr storm event. Runoff from this Sub-basin will sheet flow offsite undetained to the existing 10-foot Type R inlet on the north half of Austin Avenue.

C. Detention / Water Quality / Regional Improvements

As a part of our drainage design J3 researched the Town's plans for drainage infrastructure in the area by studying the *Town of Erie Outfall System Plan* (OSP) (Reference 5). The OSP Land Use shows mixed-use zoning for the area west of East County Line Road from Austin Avenue to Telleen Avenue. The proposed development of commercial within the southeast corner of the Site, as outlined in the Canyon Creek PD Amendment No. 9, meets the intent of the comprehensive plan.

Upon review, OSP identifies that the basin containing the Four Corners Filing No. 1 site will contain a change from agricultural to mixed uses in the existing and developed conditions, which has assigned the basin a composite imperviousness of 79% (Figure B-3 from the OSP in the appendix). The Conceptual Design Plan for Erie Commons 1-Reach 1 in the OSP denotes the storage node for the SWMM model as 1047. This node is estimated as having a storage volume of 6 ac-ft. The release rate estimated in the OSP is 67 cfs. Estimated detention volumes for the entire site plan generally conform to the OSP with volumes ranging from 6.4 ac-ft to 4.9 ac-ft depending the final imperviousness for the site. The developed portion of the Site with this phase, approximately 4.25 acres including the interim detention pond, has a proposed composite imperviousness value of 72.5%, which complies with the OSP report.

Water Quality Control Volume (WQCV) will be stored in a stacked configuration under the Excess Urban Runoff Volume (EURV) and the 100-year Volume per the UDFCD current detention guidelines and UD Detention Worksheet released in 2016. See the UDFCD UD Detention Worksheet included in the Appendix.

	Required Volume	Water Surface Elevation
WQCV	0.085 Ac-Ft	5076.82
EURV	0.199 Ac-Ft	5077.73
100-YR Volume	0.186 Ac-Ft	5078.01
Total Storage	0.470 Ac-ft	

The calculated release rates for the 10-year Storm and the 100-year Storm are 0.98 cfs and 3.62 cfs. Per the previous stated Variance Request, the release rates will not be reduced by the offsite flows since the interim detention pond would not have a positive release rate. The temporary Interim Detention Pond will have a controlled release of the 100-yr storm through a horizontal perforated pipe due to the shallow detention height provided onsite. The 18-inch PVC horizontal pipe will be manually perforated with three rows of 5 holes with a diameter of 1.25-inches along the pipe spring line and the top of the pipe. The pipe will have a cap on the pond inlet side and the holes will be covered with a permeable fabric to allow water to pass through the holes. The inlet side of the pipe will also be surrounded by riprap to assist with sediment and debris control. A detail of the horizontal perforated pipe is shown on the Developed Drainage Map. This type of outlet within the Interim Detention Pond will be easily dismantled when the remaining commercial area is developed in the near future. The interim pond release of 3.62 cfs will flow in a swale sloped at 0.42% to the northeast corner of the site. The orifice and swale calculations are included in the Appendix.

VI. CONCLUSIONS

The drainage plan provided in this report complies with the *Town of Erie Storm Drainage Facilities Standards and Specifications* (Reference 1) and the *Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manuals* (Reference 2), and the *Town of Erie Outfall Systems Plan* (Reference 5).

The drainage plan and report depicts the design for the Four Corners Filing 1 conform to the Town's criteria. The drainage plan attempts to provide protection from flooding to the Site for at least the 100-year storm. Emergency drainage overflows will be provided where necessary and will be detailed within the subsequent Final Drainage Report. The planned improvements will minimize adverse effects on the public and associated infrastructure for the proposed development.

I. REFERENCES

1. *Town of Erie Standards and Specifications for Design and Construction*, Town of Erie, January 2016.

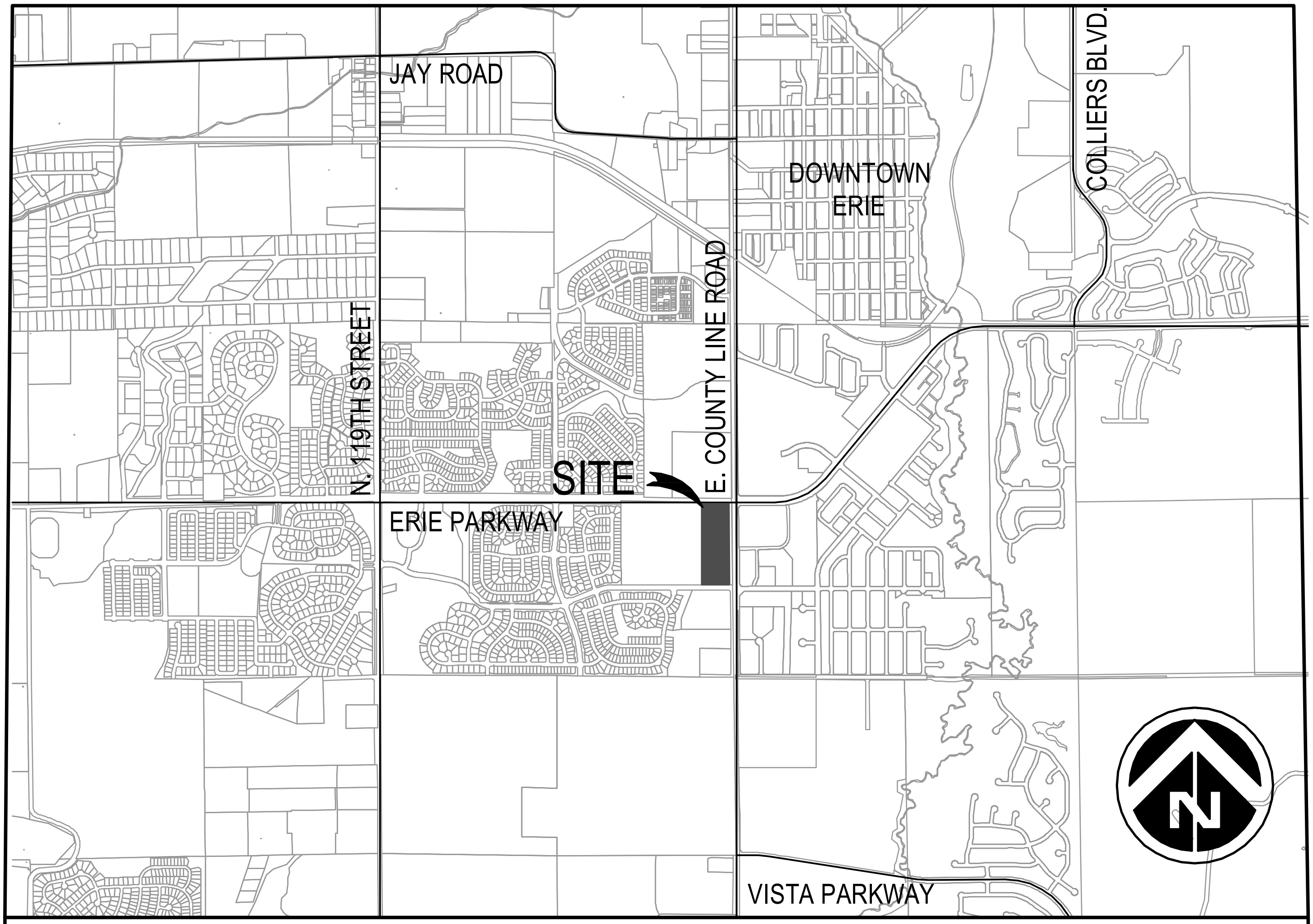
2. *Urban Storm Drainage Criteria Manuals, Volumes 1-3*, Urban Drainage and Flood Control District; Revised January 2016.

3. *Flood Insurance Rate Map, Boulder County, Colorado and Incorporated Areas, Panel 441 of 6155, Map Number 08013C0551J*, Federal Emergency Management Agency (FEMA), Map Revised December 18, 2012.

4. *Soil Survey of Boulder County Area, Colorado*, Natural Resources Conservation Service (NRCS), 1975.

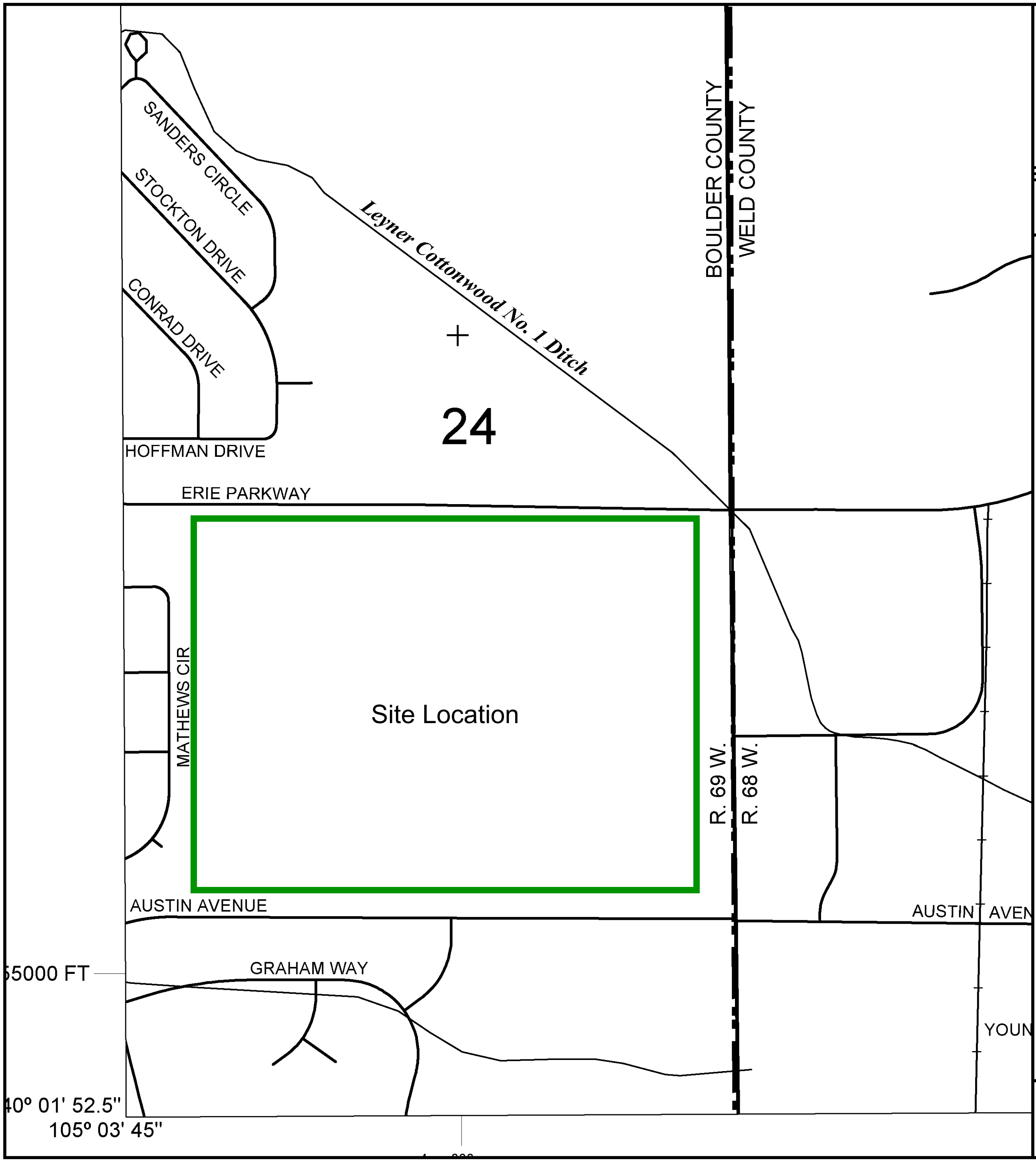
5. *Town of Erie, Outfall Systems Plan (West of Coal Creek),* RESPEC Consultants & Services, January 2014

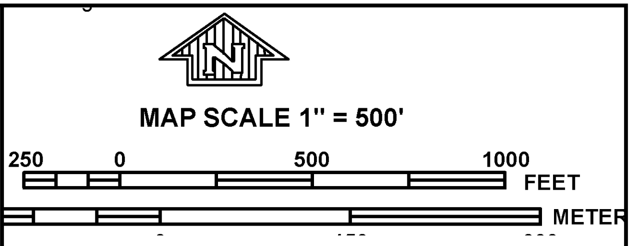
APPENDIX A
FIGURES and SUPPORTING DOCUMENTS



VICINITY MAP

SCALE: 1" = 2,000'





NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0441J

FIRM

FLOOD INSURANCE RATE MAP

BOULDER COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 441 OF 615

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BOULDER COUNTY	080023	0441	J
ERIE, TOWN OF	080181	0441	J

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08013C0441J

MAP REVISED
DECEMBER 18, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Boulder County Area, Colorado; and Weld County, Colorado, Southern Part

4 Corners

A3

October 9, 2014

A3

Custom Soil Resource Report
Soil Map

Map Scale: 1:3,720 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

▭ Area of Interest (AOI)

Soils

▭ Soil Map Unit Polygons

Soil Map Unit Lines

■ Soil Map Unit Points

Special Point Features

Blowout

☒ Borrow Pit

Clay Spot

◇ Closed Depression

Gravel Pit

∴ Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

◎ Miscellaneous Water

◎ Perennial Water

∨ Rock Outcrop

+ Saline Spot

Sandy Spot

Severely Eroded Spot

◇ Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

△ Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

▨ Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boulder County Area, Colorado
Survey Area Data: Version 10, Dec 30, 2013

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 12, Jan 3, 2014

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 22, 2011—Apr 13, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting

Map Unit Legend

Boulder County Area, Colorado (CO643)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AcA	MLRA 67B - Ascalon sandy loam, 0 to 3 percent slopes	17.8	28.7%
AcC	Ascalon sandy loam, 3 to 5 percent slopes	3.6	5.7%
MdD	Manter sandy loam, 3 to 9 percent slopes	34.6	55.6%
Subtotals for Soil Survey Area		**56.0**	**90.0%**
Totals for Area of Interest		**62.2**	**100.0%**

Weld County, Colorado, Southern Part (CO618)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
5	MLRA 67B - Ascalon sandy loam, 0 to 3 percent slopes	6.2	10.0%
Subtotals for Soil Survey Area		**6.2**	**10.0%**
Totals for Area of Interest		**62.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Boulder County Area, Colorado

AcA—MLRA 67B - Ascalon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2swl3
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ascalon and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Paleoterraces, plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk - 19 to 35 inches: sandy clay loam
C - 35 to 80 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: Sandy plains (R067BY024CO)

AcC—Ascalon sandy loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: jpr3
Elevation: 4,900 to 5,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ascalon and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Terraces
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed loamy alluvium and/or eolian deposits

Typical profile

H1 - 0 to 8 inches: sandy loam
H2 - 8 to 19 inches: sandy clay loam, sandy loam
H2 - 8 to 19 inches: fine sandy loam, loamy fine sand, sandy loam
H3 - 19 to 60 inches:
H3 - 19 to 60 inches:
H3 - 19 to 60 inches:

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Sandy (R067XB026CO)

MdD—Manter sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: jps4
Elevation: 4,900 to 5,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Manter and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manter

Setting

Landform: Terraces
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy eolian deposits and/or outwash

Typical profile

H1 - 0 to 5 inches: sandy loam
H2 - 5 to 14 inches: fine sandy loam, sandy loam
H2 - 5 to 14 inches: sandy loam, loamy sand, loamy fine sand
H3 - 14 to 60 inches:
H3 - 14 to 60 inches:
H3 - 14 to 60 inches:

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 18.1 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Sandy (R067XB026CO)

Weld County, Colorado, Southern Part

5—MLRA 67B - Ascalon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2swl3
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

Ascalon and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Paleoterraces, plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk - 19 to 35 inches: sandy clay loam
C - 35 to 80 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: Sandy plains (R067BY024CO)

Minor Components

Olnest

Percent of map unit: 10 percent
Landform: Plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy plains (R067BY024CO)

Vona

Percent of map unit: 5 percent
Landform: Plains
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy plains (R067BY024CO)

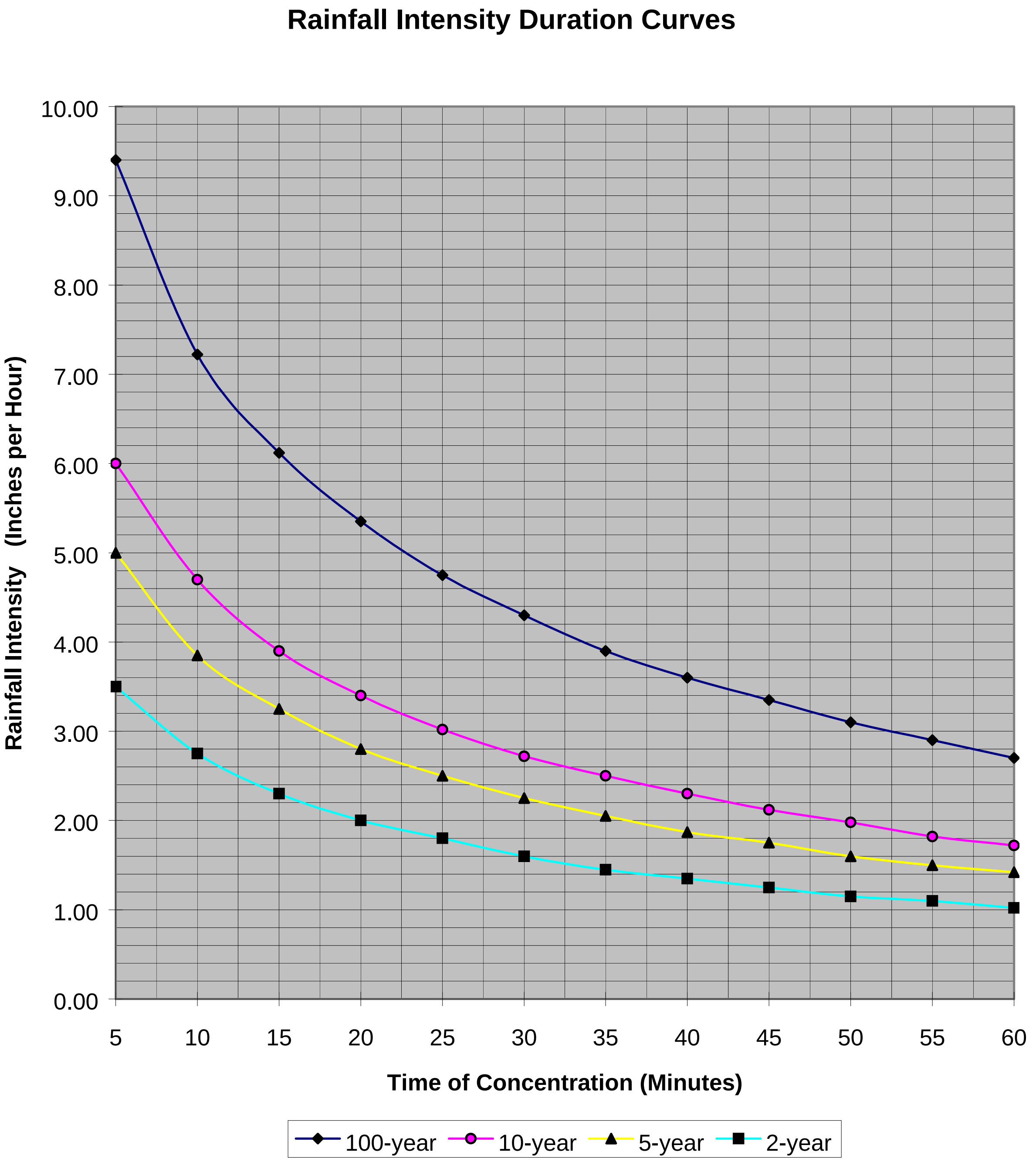
APPENDIX B

HYDROLOGIC COMPUTATIONS

Table RO-5— Runoff Coefficients, *C*

Percentage Imperviousness	Type C and D NRCS Hydrologic Soil Groups					
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
0%	0.04	0.15	0.25	0.37	0.44	0.50
5%	0.08	0.18	0.28	0.39	0.46	0.52
10%	0.11	0.21	0.30	0.41	0.47	0.53
15%	0.14	0.24	0.32	0.43	0.49	0.54
20%	0.17	0.26	0.34	0.44	0.50	0.55
25%	0.20	0.28	0.36	0.46	0.51	0.56
30%	0.22	0.30	0.38	0.47	0.52	0.57
35%	0.25	0.33	0.40	0.48	0.53	0.57
40%	0.28	0.35	0.42	0.50	0.54	0.58
45%	0.31	0.37	0.44	0.51	0.55	0.59
50%	0.34	0.40	0.46	0.53	0.57	0.60
55%	0.37	0.43	0.48	0.55	0.58	0.62
60%	0.41	0.46	0.51	0.57	0.60	0.63
65%	0.45	0.49	0.54	0.59	0.62	0.65
70%	0.49	0.53	0.57	0.62	0.65	0.68
75%	0.54	0.58	0.62	0.66	0.68	0.71
80%	0.60	0.63	0.66	0.70	0.72	0.74
85%	0.66	0.68	0.71	0.75	0.77	0.79
90%	0.73	0.75	0.77	0.80	0.82	0.83
95%	0.80	0.82	0.84	0.87	0.88	0.89
100%	0.89	0.90	0.92	0.94	0.95	0.96
	TYPE B NRCS HYDROLOGIC SOILS GROUP					
0%	0.02	0.08	0.15	0.25	0.30	0.35
5%	0.04	0.10	0.19	0.28	0.33	0.38
10%	0.06	0.14	0.22	0.31	0.36	0.40
15%	0.08	0.17	0.25	0.33	0.38	0.42
20%	0.12	0.20	0.27	0.35	0.40	0.44
25%	0.15	0.22	0.30	0.37	0.41	0.46
30%	0.18	0.25	0.32	0.39	0.43	0.47
35%	0.20	0.27	0.34	0.41	0.44	0.48
40%	0.23	0.30	0.36	0.42	0.46	0.50
45%	0.26	0.32	0.38	0.44	0.48	0.51
50%	0.29	0.35	0.40	0.46	0.49	0.52
55%	0.33	0.38	0.43	0.48	0.51	0.54
60%	0.37	0.41	0.46	0.51	0.54	0.56
65%	0.41	0.45	0.49	0.54	0.57	0.59
70%	0.45	0.49	0.53	0.58	0.60	0.62
75%	0.51	0.54	0.58	0.62	0.64	0.66
80%	0.57	0.59	0.63	0.66	0.68	0.70
85%	0.63	0.66	0.69	0.72	0.73	0.75
90%	0.71	0.73	0.75	0.78	0.80	0.81
95%	0.79	0.81	0.83	0.85	0.87	0.88
100%	0.89	0.90	0.92	0.94	0.95	0.96

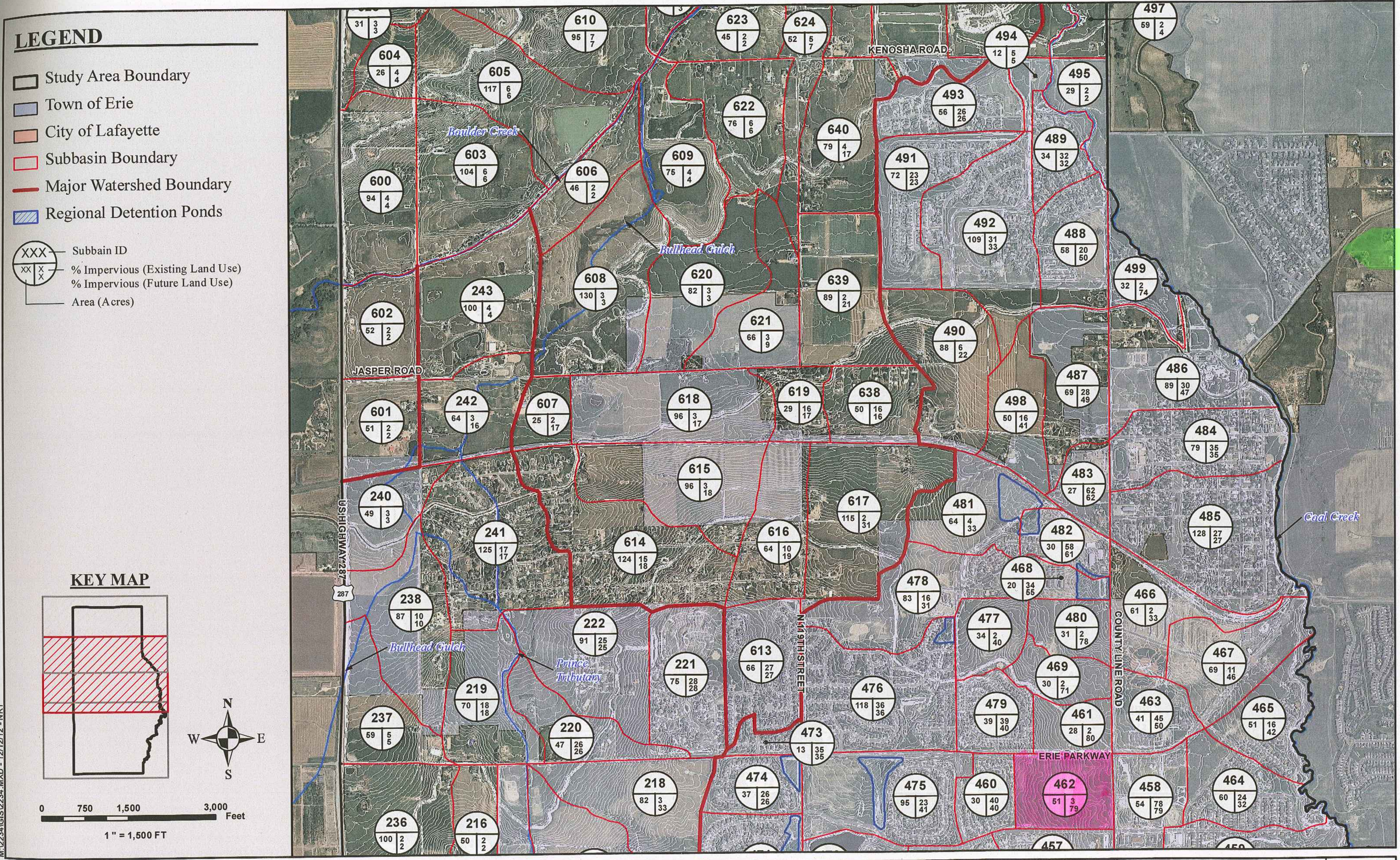
The rainfall intensities to be used in the computation of runoff using the Rational Method shall be obtained from the Rainfall Intensity Duration Curves for the Town of Erie, included in these STANDARDS AND SPECIFICATIONS.



814.00

Table 800-2
TOWN OF ERIE
ONE-HOUR RAINFALL DEPTH

Design Storm	Rainfall Depth (in.)
2-Year	1.01
5-Year	1.43
10-Year	1.73
50-Year	2.40
100-Year	2.70



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WRC ENGINEERING, INC.

WRC ENGINEERING, INC.
950 SOUTH CHERRY STREET, SUITE 404
DENVER, COLORADO 80246
PHONE: 303-757-8513
FAX: 303-758-3208

TOWN OF ERIE
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

TOWN OF ERIE OUTFALL SYSTEMS PLAN
(WEST OF COAL CREEK)

SUBBASIN MAP

FIGURE
B-3

Parcel Data Table

4 Corners

Fully-Developed Conditions

`

Job No.: 030019
Date: 12/5/2014
Calculated By: akm
Checked By: SOS

Parcel Data Table

`

Area	Land Use Category	Density (DU/acre)	C2	C5	C10	C100	I (%)	Comments
Streets	Arterial & Collector Roads	---	0.89	0.90	0.92	0.96	100	Asphalt Streets
Sidewalk/Concrete	Drives and Walks	---	0.73	0.75	0.77	0.83	90	Concrete surfaces & Woonerf Streets
Roofs	Building Roofs	---	0.73	0.75	0.77	0.83	90	Roof
Lawns, Sandy Soils	Open Space, Park and Landscape Tracts	---	0.06	0.17	0.26	0.45	2	Open Space, Parks and Landscape Tracts

*Ref. Urban Drainage Flood Control District Table RO-3 and Table RO-5 & Figures RO-3 and RO

J:\030019\Plan Sets\Drainage\COMM1\[COMM1-ERIE_PH3-rational.xls]Composite I

Composite Imperviousness Calculations

4 Corners

Developed Conditions

Town of Erie, Colorado

Job No. 030019

Date: 5/10/2016

By: AKM

Major Ba	Sub-Basin	Area	Parcel Imperviousness					Composite C Values			
			Streets / Ponds	Sidewalk / Concrete	Roofs	Lawns / Sandy Soil	Com Imperv	C2	C5	C10	C100
		(acres)	100	90	90	2	(%)				
Site	A1	0.05	0.05	0.00	0.00	0.00	100.0	0.89	0.90	0.92	0.96
	A2	0.12	0.07	0.03	0.00	0.03	76.1	0.67	0.70	0.74	0.82
	A3	0.62	0.18	0.05	0.29	0.11	77.7	0.66	0.69	0.72	0.80
	A4	0.54	0.42	0.05	0.00	0.08	85.1	0.76	0.78	0.81	0.88
	A5	0.74	0.49	0.08	0.06	0.11	83.3	0.73	0.76	0.79	0.86
	A6	0.14	0.04	0.00	0.07	0.03	76.6	0.65	0.69	0.72	0.80
	A7	0.05	0.05	0.00	0.00	0.00	100.0	0.89	0.90	0.92	0.96
	A8	0.09	0.04	0.00	0.00	0.05	46.5	0.45	0.51	0.56	0.69
	A9	0.96	0.45	0.00	0.00	0.51	47.8	0.06	0.17	0.57	0.45
	B1	42.60	0.00	0.16	0.00	42.43	2.3	0.06	0.17	0.26	0.45
	C1	0.62	0.06	0.05	0.00	0.50	19.6	0.20	0.29	0.37	0.53
	C2	0.08	0.07	0.00	0.00	0.01	83.7	0.75	0.78	0.81	0.88
	Sum	**46.61**	**1.91**	**0.42**	**0.41**	**43.86**	**7.6**	0.11	0.21	0.30	0.48
Interim Pond Total		4.01	1.91	0.26	0.41	1.42	**63.6**				
TOTAL	**Sum**	**46.61**	**1.91**	**0.42**	**0.41**	**43.86**	**7.6**				

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TIME OF CONCENTRATION

4 Corners

Developed Conditions

5/10/2016

Job No.: 030019
Date: 5/10/16
Calculated By: AKM
Checked By: SOS

BASIN	SUB-BASIN DATA			INITIAL/OVERLAND TIME (Tc)			TRAVEL TIME (Tt)						Rational Tc	Tc Check for Urban Catchments		FINAL Tc	CONVEYANCE REMARKS
	DESIG:	AREA (acres)	C_5	LENGTH (ft)	SLOPE (ft/ft)	Ti (min)	LENGTH (ft)	AVG. SLOPE DY	(%)	Conv. Type*	VEL (fps)	Tt (min)	COMP Tc (min)	TOTAL LENGTH (ft)	Tc=(L/180)+10 (min)	(min)	
A	A1	0.05	0.90	0	0.020		147	1.60	1.09	6	2.1	1.2	1.2	147	10.8	**5.0**	Paved Gutter
	A2	0.12	0.70	0	0.020		136	1.50	1.10	6	2.1	1.1	1.1	136	10.8	**5.0**	Paved Gutter
	A3	0.62	0.69	20	0.020	2.6	258	2.70	1.05	6	2.0	2.1	4.7	278	11.5	**5.0**	Paved Gutter
	A4	0.54	0.78	10	0.020	1.4	170	2.40	1.41	6	2.4	1.2	2.6	180	11.0	**5.0**	Paved Gutter
	A5	0.74	0.76	12	0.020	1.7	289	3.60	1.25	6	2.2	2.2	3.8	301	11.7	**5.0**	Paved Gutter
	A6	0.14	0.69	30	0.020	3.2	87	1.35	1.55	6	2.5	0.6	3.8	117	10.7	**5.0**	Paved Gutter
	A7	0.05	0.90	0	0.020		165	4.50	2.73	6	3.3	0.8	0.8	165	10.9	**5.0**	Paved Gutter
	A8	0.96	0.51	20	0.030	3.3	165	4.50	2.73	6	3.3	0.8	4.1	185	11.0	**5.0**	Paved Gutter
	A9	42.60	0.17	0	0.020		350	4.20	1.20	3	0.8	7.6	7.6	350	11.9	**7.6**	Pasture
	B1	42.60	0.17	100	0.020	13.3	160	45.50	28.44	3	3.7	0.7	14.0	260	11.4	**11.4**	Pasture
	C1	0.62	0.29	0	0.022		90	0.60	0.67	6	1.6	0.9	0.9	90	10.5	**5.0**	Paved Gutter
	C2	0.08	0.78	10	0.020	1.5	70	4.90	7.00	6	5.3	0.2	1.7	80	10.4	**5.0**	Paved Gutter

* *Note: Conveyance Coefficients - Type 1-Heavy Meadow, Type 2-Tillage/field, Type 3-Short Pasture & Lawn, Type 4-Nearly Bare Ground, Type 5-Grassed Waterway, Type 6-Paved Areas & Shallow Paved Swales.*

J3 Engineering Consultants, Inc.

J:\030019\Plan Sets\Drainage\COMM1\Calcs\[UD-Inlet_INLET 1-5.xlsm]Q-Peak

STANDARD FORM SF-2
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

5-year P1 = **1.43**

10-year P1 = 1.75

100-year P1 = 2.7

CALCULATED BY: AKM

CHECKED BY: SOS

PROJECT: 030019

DESIGN STORM: **5 -YEAR (minor storm)**

JOB NO: 030019

LOCATION: 030019

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
LOCATION	**DESIGN POINT**	**AREA DESIG.**	**AREA (Acres)**	**RUNOFF COEFF**	**Tc (min)**	**C A (Acres)**	**I (in/hour)**	**Q (cfs)**	**Tc (min)**	**(C A) (Acres)**	**I (in/hour)**	**Q (cfs)**	**SLOPE (%)**	**STREET FLOW (cfs)**	**DESIGN FLOW (cfs)**	**SLOPE (%)**	**PIPE SIZE**	**LENGTH (ft)**	**VELOCITY (fps)**	**Tt (min)**	REMARKS
A5	1	A5	0.74	0.76	5.0	0.57	4.85	2.75							2.75	0.5	18	79.5	4.1	0.3	SUMP INLET 1-5 (5' TYPE R)
A4	2	A4	0.54	0.78	5.0	0.43	4.85	2.07							2.07	0.5	18	68.4	4.1	0.3	SUMP INLET 1-7 (5' TYPE R)
	MH JP1	A4							5.3	0.43	4.78	2.04			2.04	0.5	18	130.0	4.1	0.5	STM MH 1-6
A6	3	A6 A5, A4	0.14	0.69	5.0	0.09	4.85	0.45	5.8	1.09	4.65	5.05			5.05	0.5	18	12.2	4.1	0.1	SUMP INLET 1-4 (5' TYPE R)
A8	4	A8 A6, A5, A4	0.09	0.51	5.0	0.05	4.85	0.23	5.9	1.13	4.64	5.26			5.26	0.5	18	28.3	4.1	0.1	ON GRADE INLET 1-3 (5' TYPE R)
A7	5	A7 A8, A6, A5, A4	0.05	0.90	5.0	0.05	4.85	0.23	6.0	1.18	4.62	5.45			5.45	0.5	18	37.1	4.1	0.2	ON GRADE INLET 1-2 (5' TYPE R)
	6	OUTFALL TO INTERIM POND A7, A8, A6, A5, A4							6.1	1.18	4.58	TO POND **5.41**									OUTFALL TO INTERIM POND
A3	7	A3	0.62	0.69	5.0	0.43	4.85	2.08							2.08	0.5	18	104.4	4.1	0.4	SUMP INLET 2-4 (5' TYPE R)
A2	8	A2 A3	0.12	0.70	5.0	0.09	4.85	0.42	5.4	0.52	4.74	2.45			2.45	0.5	18	28.3	4.1	0.1	SUMP INLET 2-3 (5' TYPE R)
A1	9	A1 A2, A3	0.05	0.90	5.0	0.04	4.85	0.20	5.5	0.56	4.73	2.63			2.63	0.5	18	57.8	4.1	0.2	SUMP INLET 2-2 (5' TYPE R)
	10	OUTFALL TO SWALE A1, A2, A3							5.7	0.56	4.67	TO POND **2.60**									OUTFALL TO INTERIM POND
A9	11	A1-A9	0.96	0.78	7.6	0.74	4.28	3.18	6.1	2.48	4.58	**11.36**									TOTAL WITH POND BASIN
B1	12	B1	42.60	0.17	11.4	7.34	3.66	26.86													WILL FOLLOW HISTORIC UNDEVELOPED PATTERNS
C1	13	C1	0.62	0.29	5.0	0.18	4.85	**0.88**													UNDETAINED DEVELOPED FLOW
C2	14	C2	0.08	0.78	5.0	0.06	4.85	**0.31**													UNDETAINED DEVELOPED FLOW

STANDARD FORM SF-2
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

5-year P1 =	1.43			DESIGN STORM:	**10 -YEAR**
10-year P1 =	**1.75**	CALCULATED BY: AKM	PROJECT: 030019	JOB NO:	030019
100-year P1 =	2.7	CHECKED BY: SOS		LOCATION:	030019

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
LOCATION	**DESIGN POINT**	**AREA DESIG.**	**AREA (Acres)**	**RUNOFF COEFF**	**Tc (min)**	**C A (Acres)**	**I (in/hour)**	**Q (cfs)**	**Tc (min)**	**(C A) (Acres)**	**I (in/hour)**	**Q (cfs)**	**SLOPE (%)**	**STREET FLOW (cfs)**	**DESIGN FLOW (cfs)**	**SLOPE (%)**	**PIPE SIZE**	**LENGTH (ft)**	**VELOCITY (fps)**	**Tt (min)**	REMARKS
A5	1	A5	0.74	0.76	5.0	0.57	5.94	3.37							3.37	0.5	18	79.5	4.1	0.3	SUMP INLET 1-5 (5' TYPE R)
A4	2	A4	0.54	0.78	5.0	0.43	5.94	2.53							2.53	0.5	18	68.4	4.1	0.3	SUMP INLET 1-7 (5' TYPE R)
	MH JP1	A4							5.3	0.43	5.85	2.49			2.49	0.5	18	130.0	4.1	0.5	STM MH 1-6
A6	3	A6 A5, A4	0.14	0.69	5.0	0.09	5.94	0.55	5.8	1.09	5.69	6.19			6.19	0.5	18	12.2	4.1	0.1	SUMP INLET 1-4 (5' TYPE R)
A8	4	A8 A6, A5, A4	0.09	0.51	5.0	0.05	5.94	0.28	5.9	1.13	5.68	6.43			6.43	0.5	18	28.3	4.1	0.1	ON GRADE INLET 1-3 (5' TYPE R)
A7	5	A7 A8, A6, A5, A4	0.05	0.90	5.0	0.05	5.94	0.28	6.0	1.18	5.65	6.67			6.67	0.5	18	37.1	4.1	0.2	ON GRADE INLET 1-2 (5' TYPE R)
	6	OUTFALL TO INTERIM POND A7, A8, A6, A5, A4							6.1	1.18	5.61	TO POND **6.62**									OUTFALL TO INTERIM POND
A3	7	A3	0.62	0.69	5.0	0.43	5.94	2.55							2.55	0.5	18	104.4	4.1	0.4	SUMP INLET 2-4 (5' TYPE R)
A2	8	A2 A3	0.12	0.70	5.0	0.09	5.94	0.51	5.4	0.52	5.81	2.99			2.99	0.5	18	28.3	4.1	0.1	SUMP INLET 2-3 (5' TYPE R)
A1	9	A1 A2, A3	0.05	0.90	5.0	0.04	5.94	0.24	5.5	0.56	5.78	3.22			3.22	0.5	18	57.8	4.1	0.2	SUMP INLET 2-2 (5' TYPE R)
	10	OUTFALL TO SWALE A1, A2, A3							5.7	0.56	5.72	TO POND **3.18**									OUTFALL TO INTERIM POND
A9	11	A1-A9	0.96	0.78	7.6	0.74	5.23	3.89	6.1	2.48	5.61	**13.91**									TOTAL WITH POND BASIN
B1	12	B1	42.60	0.17	11.4	7.34	4.48	32.88													WILL FOLLOW HISTORIC UNDEVELOPED PATTERNS
C1	13	C1	0.62	0.29	5.0	0.18	5.94	**1.08**													UNDETAINED DEVELOPED FLOW
C2	14	C2	0.08	0.78	5.0	0.06	5.94	**0.38**													UNDETAINED DEVELOPED FLOW

STANDARD FORM SF-2
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

5-year P1 = 1.43

10-year P1 = 1.75

100-year P1 = 2.7

CALCULATED BY: AKM

CHECKED BY: SOS

PROJECT: 030019

DESIGN STORM: **100 -YEAR (major storm)**

JOB NO: 030019

LOCATION: 030019

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
LOCATION	**DESIGN POINT**	**AREA DESIG.**	**AREA (Acres)**	**RUNOFF COEFF**	**Tc (min)**	**C A (Acres)**	**I (in/hour)**	**Q (cfs)**	**Tc (min)**	**(C A) (Acres)**	**I (in/hour)**	**Q (cfs)**	**SLOPE (%)**	**STREET FLOW (cfs)**	**DESIGN FLOW (cfs)**	**SLOPE (%)**	**PIPE SIZE**	**LENGTH (ft)**	**VELOCITY (fps)**	**Tt (min)**	REMARKS
A5	1	A5	0.74	0.86	5.0	0.64	9.16	5.86							5.86	0.5	18	79.5	4.1	0.3	SUMP INLET 1-5 (10' TYPE R)
A4	2	A4	0.54	0.88	5.0	0.48	9.16	4.37							4.37	0.5	18	68.4	4.1	0.3	SUMP INLET 1-7 (10' TYPE R)
	MH JP1	A4							5.3	0.48	9.03	4.30			4.30	0.5	18	130.0	4.1	0.5	STM MH 1-6
A6	3	A6 A5, A4	0.14	0.80	5.0	0.11	9.16	0.99	5.8	1.22	8.79	10.76			10.76	0.5	18	12.2	4.1	0.1	SUMP INLET 1-4 (5' TYPE R)
A8	4	A8 A6, A5, A4	0.09	0.65	5.0	0.06	9.16	0.54	5.9	1.28	8.76	11.24			11.24	0.5	18	28.3	4.1	0.1	ON GRADE INLET 1-3 (5' TYPE R)
A7	5	A7 A8, A6, A5, A4	0.05	0.96	5.0	0.05	9.16	0.46	6.0	1.33	8.71	11.62			11.62	0.5	18	37.1	4.1	0.2	ON GRADE INLET 1-2 (5' TYPE R)
	6	OUTFALL TO INTERIM POND A7, A8, A6, A5, A4							6.1	1.33	8.65	TO POND **11.54**									OUTFALL TO INTERIM POND
A3	7	A3	0.62	0.80	5.0	0.50	9.16	4.55							4.55	0.5	18	104.4	4.1	0.4	SUMP INLET 2-4 (10' TYPE R)
A2	8	A2 A3	0.14	0.78	5.0	0.11	9.16	1.00	5.4	0.61	8.96	5.43			5.43	0.5	18	28.3	4.1	0.1	SUMP INLET 2-3 (5' TYPE R)
A1	9	A1 A2, A3	0.06	0.96	5.0	0.06	9.16	0.57	5.5	0.67	8.92	5.96			5.96	0.5	18	57.8	4.1	0.2	SUMP INLET 2-2 (5' TYPE R)
	10	OUTFALL TO SWALE A1, A2, A3							5.7	0.67	8.82	TO POND **5.89**									OUTFALL TO INTERIM POND
A9	11	A1-A9	1.16	0.88	7.6	1.02	8.07	8.20	6.1	3.02	8.65	**26.10**									TOTAL WITH POND BASIN
B1	12	B1	42.35	0.45	11.4	19.12	6.92	132.22													WILL FOLLOW HISTORIC UNDEVELOPED PATTERNS
C1	13	C1	0.62	0.53	5.0	0.33	9.16	**3.02**													UNDETAINED DEVELOPED FLOW
C2	14	C2	0.08	0.88	5.0	0.07	9.16	**0.66**													UNDETAINED DEVELOPED FLOW

APPENDIX C

HYDRAULIC COMPUTATIONS

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, May 13 2016

TRACT A STREET SECTION

User-defined
Invert Elev (ft) = 9.00
Slope (%) = 2.80
N-Value = Composite

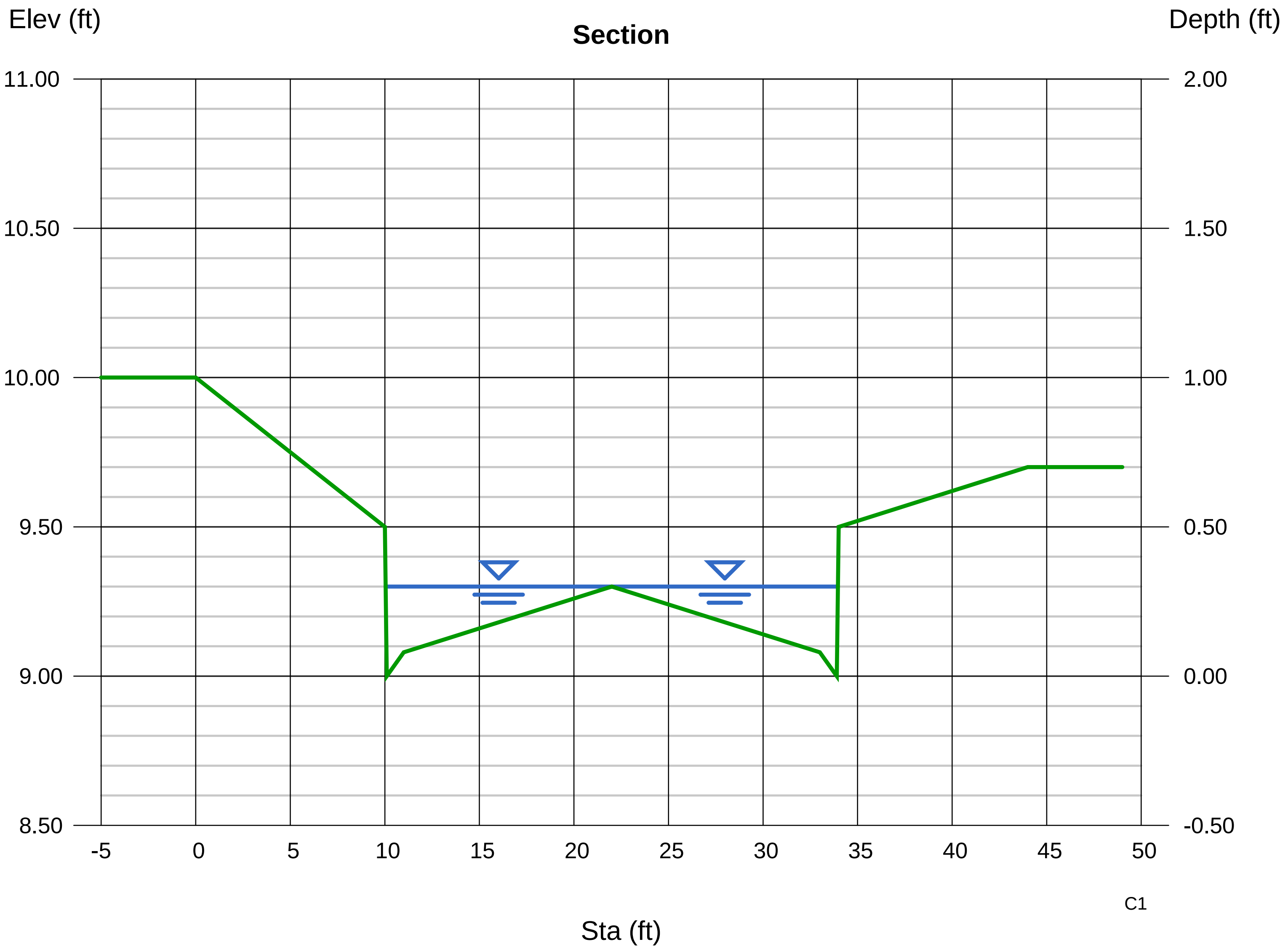
Calculations
Compute by: Q vs Depth
No. Increments = 10

Highlighted
Depth (ft) = 0.30
Q (cfs) = 11.67
Area (sqft) = 2.91
Velocity (ft/s) = 4.02
Wetted Perim (ft) = 24.42
Crit Depth, Yc (ft) = 0.38
Top Width (ft) = 23.92
EGL (ft) = 0.55

(Sta, El, n)-(Sta, El, n)...

(0.00, 10.00)-(10.00, 9.50, 0.030)-(10.10, 9.00, 0.015)-(11.00, 9.08, 0.015)-(22.00, 9.30, 0.015)-(33.00, 9.08, 0.015)-(33.90, 9.00, 0.015)
-(34.00, 9.50, 0.015)-(44.00, 9.70, 0.030)

AVAILABLE STREET
CAPACITY AT ROAD
CROWN



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, May 13 2016

TRACT A STREET SECTION

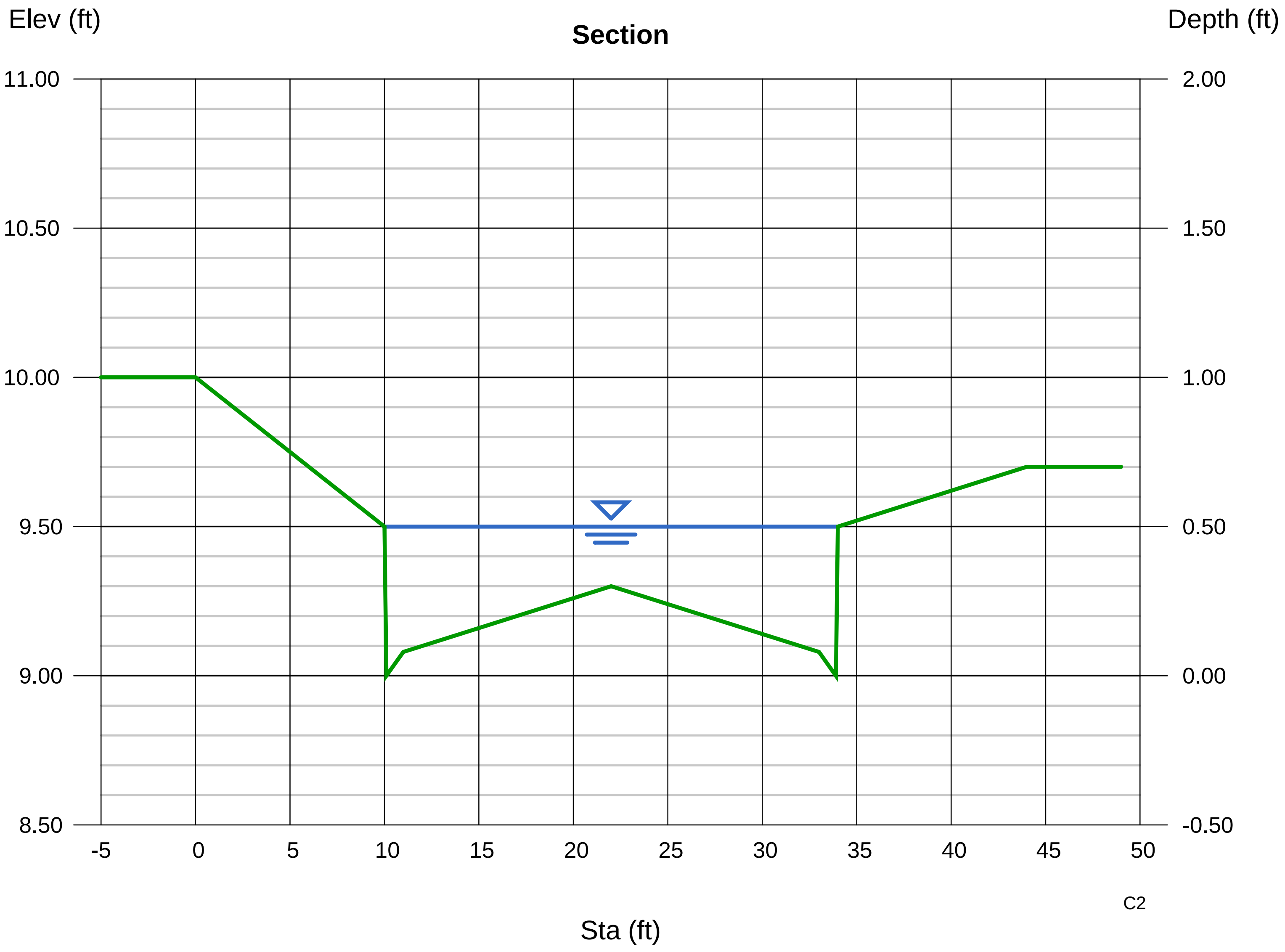
User-defined	
Invert Elev (ft)	= 9.00
Slope (%)	= 2.80
N-Value	= Composite
Calculations	
Compute by:	Q vs Depth
No. Increments	= 10

Highlighted	
Depth (ft)	= 0.50
Q (cfs)	= 58.55
Area (sqft)	= 7.70
Velocity (ft/s)	= 7.61
Wetted Perim (ft)	= 24.83
Crit Depth, Yc (ft)	= 0.76
Top Width (ft)	= 24.00
EGL (ft)	= 1.40

(Sta, El, n)-(Sta, El, n)...

(0.00, 10.00)-(10.00, 9.50, 0.030)-(10.10, 9.00, 0.015)-(11.00, 9.08, 0.015)-(22.00, 9.30, 0.015)-(33.00, 9.08, 0.015)-(33.90, 9.00, 0.015) -(34.00, 9.50, 0.015)-(44.00, 9.70, 0.030)

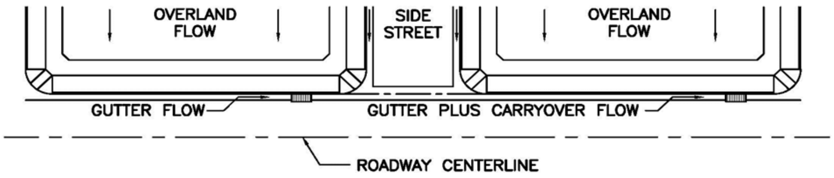
AVAILABLE STREET
CAPACITY AT TOP
BACK OF CURB



Worksheet Protected

DESIGN PEAK FLOW FOR ONE-HALF OF STREET
OR GRASS-LINED CHANNEL BY THE RATIONAL METHOD

Project: FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD
Inlet ID: INLET 1-2 5' ON GRADE



Show Details

Design Flow: ONLY if already determined through other methods:
(local peak flow for 1/2 of street OR grass-lined channel):

	Minor Storm	Major Storm	
* Q_{Known} =	0.2	0.5	cfs

*** If you enter values in Row 14, skip the rest of this sheet and proceed to sheet Q-Allow or Area Inlet.**

<--- FILL IN THIS SECTION OR… FILL IN THE SECTIONS BELOW. <---

Geographic Information: (Enter data in the blue cells):

Subcatchment Area = Acres
Percent Imperviousness = %
NRCS Soil Type = A, B, C, or D

Site Type:
○ Site is Urban
○ Site is Non-Urban

Flows Developed For:
○ Street Inlets
○ Area Inlets in a Median

	Slope (ft/ft)	Length (ft)
Overland Flow =		
Channel Flow =		

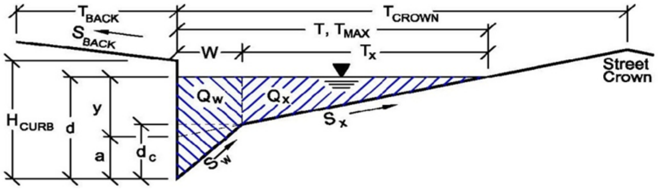
Rainfall Information: Intensity I (inch/hr) = $C_1 * P_1 / (C_2 + T_c) ^ C_3$

	Minor Storm	Major Storm	
Design Storm Return Period, T_r =			years
Return Period One-Hour Precipitation, P_1 =			inches
C_1 =			
C_2 =			
C_3 =			
User-Defined Storm Runoff Coefficient (leave this blank to accept a calculated value), C =			
User-Defined 5-yr. Runoff Coefficient (leave this blank to accept a calculated value), C_5 =			
Bypass (Carry-Over) Flow from upstream Subcatchments, Q_b =	0.0	0.0	cfs
Total Design Peak Flow, Q =	0.2	0.5	cfs

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

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

Project: **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**
Inlet ID: **INLET 1-2 5' ON GRADE**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	12.0	ft
Gutter Width	W =	1.00	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 =	0.027	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} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	18.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☑	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.88	2.88	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	1.0	1.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.76	0.76	inches
Water Depth at Gutter Flowline	d =	3.64	3.64	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.245	0.245	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	5.4	5.4	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**7.2**	**7.2**	**cfs**
Flow Velocity within the Gutter Section	V =	1.7	1.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	21.9	71.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	20.9	70.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.130	0.038	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	29.8	777.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	25.7	281.5	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.5	30.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	171.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	30.2	483.3	cfs
Average Flow Velocity Within the Gutter Section	V =	2.4	5.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.2	7.9	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq$ 6") Storm	R =	0.81	0.66	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**24.5**	**317.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.53	15.08	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	1.89	11.45	inches

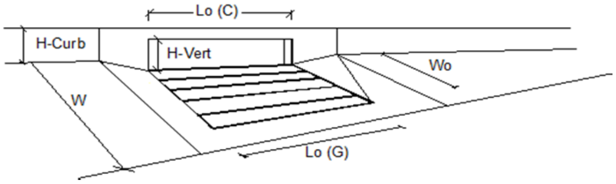
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**24.5**	**317.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET ON A CONTINUOUS GRADE

Project: FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD

Inlet ID: INLET 1-2 5' ON GRADE

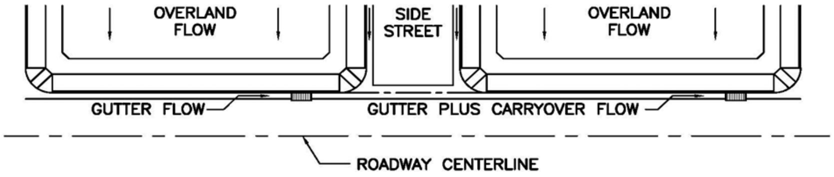


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.23**	**0.46**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

Worksheet Protected

DESIGN PEAK FLOW FOR ONE-HALF OF STREET
OR GRASS-LINED CHANNEL BY THE RATIONAL METHOD

Project: FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD
Inlet ID: INLET 1-3, 5' ON GRADE



Show Details

Design Flow: ONLY if already determined through other methods:

(local peak flow for 1/2 of street OR grass-lined channel):

	Minor Storm	Major Storm	
* Q_{Known} =	0.2	0.6	cfs

* If you enter values in Row 14, skip the rest of this sheet and proceed to sheet Q-Allow or Area Inlet.

<--- FILL IN THIS SECTION OR…

FILL IN THE SECTIONS BELOW. <---

Geographic Information: (Enter data in the blue cells):

Subcatchment Area =		Acres
Percent Imperviousness =		%
NRCS Soil Type =		A, B, C, or D

Site Type:
- ○ Site is Urban
- ○ Site is Non-Urban

Flows Developed For:
- ○ Street Inlets
- ○ Area Inlets in a Median

	Slope (ft/ft)	Length (ft)
Overland Flow =		
Channel Flow =		

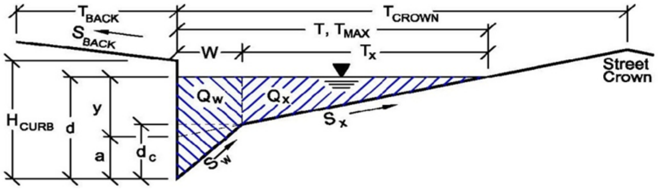
Rainfall Information: Intensity I (inch/hr) = $C_1 * P_1 / (C_2 + T_c) ^ C_3$

	Minor Storm	Major Storm	
Design Storm Return Period, T_r =			years
Return Period One-Hour Precipitation, P_1 =			inches
C_1 =			
C_2 =			
C_3 =			
User-Defined Storm Runoff Coefficient (leave this blank to accept a calculated value), C =			
User-Defined 5-yr. Runoff Coefficient (leave this blank to accept a calculated value), C_5 =			
Bypass (Carry-Over) Flow from upstream Subcatchments, Q_b =	**0.0**	**0.0**	**cfs**
Total Design Peak Flow, Q =	**0.2**	**0.6**	**cfs**

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

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

Project: **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**
Inlet ID: **INLET 1-3, 5' ON GRADE**



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0		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} =	12.0		ft
Gutter Width	W =	1.00		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 =	0.027		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} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	18.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☑	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.88	2.88	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	1.0	1.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.76	0.76	inches
Water Depth at Gutter Flowline	d =	3.64	3.64	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.245	0.245	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	5.4	5.4	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**7.2**	**7.2**	**cfs**
Flow Velocity within the Gutter Section	V =	1.7	1.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	21.9	71.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	20.9	70.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.130	0.038	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	29.8	777.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	25.7	281.5	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.5	30.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	171.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	30.2	483.3	cfs
Average Flow Velocity Within the Gutter Section	V =	2.4	5.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.2	7.9	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	0.81	0.66	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**24.5**	**317.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.53	15.08	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	1.89	11.45	inches

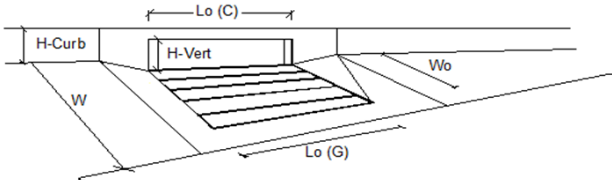
MINOR STORM Allowable Capacity is based on Depth Criterion		Minor Storm	Major Storm	
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**24.5**	**317.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET ON A CONTINUOUS GRADE

Project: FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD

Inlet ID: INLET 1-3, 5' ON GRADE

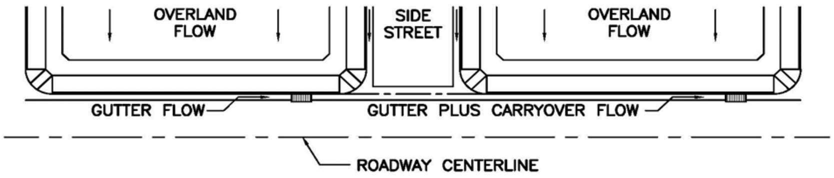


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < maximum allowable from sheet 'Q-Allow'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.23**	**0.57**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

Worksheet Protected

DESIGN PEAK FLOW FOR ONE-HALF OF STREET OR GRASS-LINED CHANNEL BY THE RATIONAL METHOD

Project: FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD
Inlet ID: INLET 1-4, 5' SUMP



Show Details

Design Flow: ONLY if already determined through other methods:

	Minor Storm	Major Storm	
(local peak flow for 1/2 of street OR grass-lined channel): *Q_{Known} =	0.5	1.0	cfs

*** If you enter values in Row 14, skip the rest of this sheet and proceed to sheet Q-Allow or Area Inlet.**

<--- FILL IN THIS SECTION OR…

FILL IN THE SECTIONS BELOW. <---

Geographic Information: (Enter data in the blue cells):

Subcatchment Area =		Acres
Percent Imperviousness =		%
NRCS Soil Type =		A, B, C, or D

Site Type:
○ Site is Urban
○ Site is Non-Urban

Flows Developed For:
○ Street Inlets
○ Area Inlets in a Median

	Slope (ft/ft)	Length (ft)
Overland Flow =		
Channel Flow =		

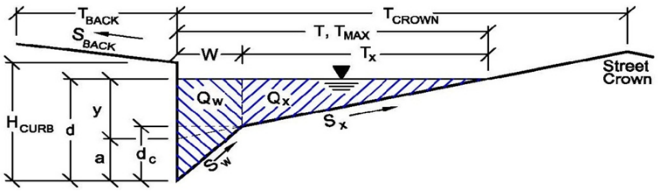
Rainfall Information: Intensity I (inch/hr) = C_1 * P_1 / (C_2 + T_c) ^ C_3

	Minor Storm	Major Storm	
Design Storm Return Period, T_r =			years
Return Period One-Hour Precipitation, P_1 =			inches
C_1 =			
C_2 =			
C_3 =			
User-Defined Storm Runoff Coefficient (leave this blank to accept a calculated value), C =			
User-Defined 5-yr. Runoff Coefficient (leave this blank to accept a calculated value), C_5 =			
Bypass (Carry-Over) Flow from upstream Subcatchments, Q_b =	0.0	0.0	cfs
Total Design Peak Flow, Q =	0.5	1.0	cfs

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

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

Project: **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**
Inlet ID: **INLET 1-4, 5' SUMP**



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	12.0	ft
Gutter Width	W =	1.00	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} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	18.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☑	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.88	2.88	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	1.0	1.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.76	0.76	inches
Water Depth at Gutter Flowline	d =	3.64	3.64	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.245	0.245	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

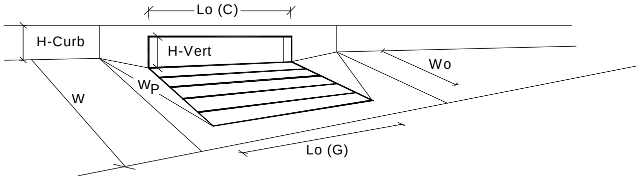
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	21.9	71.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	20.9	70.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.130	0.038	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

		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**

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET IN A SUMP OR SAG LOCATION

Project = FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD
Inlet ID = INLET 1-4, 5' SUMP



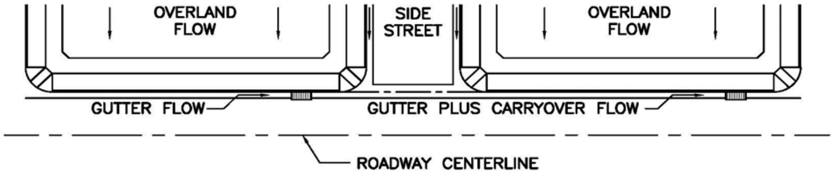
	Design Information (Input)		MINOR	MAJOR	
	Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
	Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
	Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
	Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.6	3.6	inches ☐ Override Depths
	Grate Information		MINOR	MAJOR	
	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) =	10.00	10.00	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
Warning 1	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	
			MINOR	MAJOR	
	Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**3.1**	**3.1**	**cfs**
	Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.5	1.0	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Worksheet Protected

DESIGN PEAK FLOW FOR ONE-HALF OF STREET OR GRASS-LINED CHANNEL BY THE RATIONAL METHOD

Project: FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD
Inlet ID: INLET 1-5, 10' SUMP



Show Details

Design Flow: ONLY if already determined through other methods:

(local peak flow for 1/2 of street OR grass-lined channel):

	Minor Storm	Major Storm	
*Q_{Known} =	2.8	5.9	cfs

* If you enter values in Row 14, skip the rest of this sheet and proceed to sheet Q-Allow or Area Inlet.

<--- FILL IN THIS SECTION OR…

FILL IN THE SECTIONS BELOW. <---

Geographic Information: (Enter data in the blue cells):

Subcatchment Area =		Acres
Percent Imperviousness =		%
NRCS Soil Type =		A, B, C, or D

Site Type:
- ○ Site is Urban
- ○ Site is Non-Urban

Flows Developed For:
- ○ Street Inlets
- ○ Area Inlets in a Median

	Slope (ft/ft)	Length (ft)
Overland Flow =		
Channel Flow =		

Rainfall Information: Intensity I (inch/hr) = C_1 * P_1 / (C_2 + T_c) ^ C_3

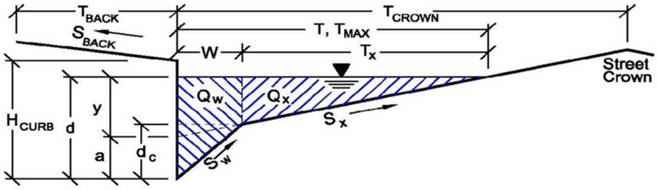
	Minor Storm	Major Storm	
Design Storm Return Period, T_r =			years
Return Period One-Hour Precipitation, P_1 =			inches
C_1 =			
C_2 =			
C_3 =			
User-Defined Storm Runoff Coefficient (leave this blank to accept a calculated value), C =			
User-Defined 5-yr. Runoff Coefficient (leave this blank to accept a calculated value), C_5 =			
Bypass (Carry-Over) Flow from upstream Subcatchments, Q_b =	0.0	0.0	cfs
Total Design Peak Flow, Q =	2.8	5.9	cfs

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

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

Project: **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**

Inlet ID: **INLET 1-5, 10' SUMP**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	12.0	ft
Gutter Width	W =	1.00	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} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	18.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☑	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.88	2.88	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	1.0	1.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.76	0.76	inches
Water Depth at Gutter Flowline	d =	3.64	3.64	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.245	0.245	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	21.9	71.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	20.9	70.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.130	0.038	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

		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**

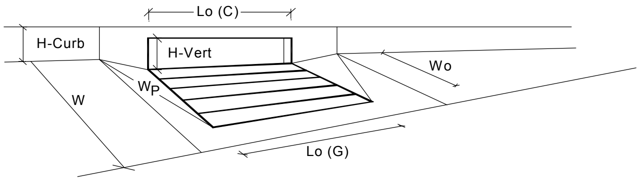
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET IN A SUMP OR SAG LOCATION

Project = **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**

Inlet ID = **INLET 1-5, 10' SUMP**



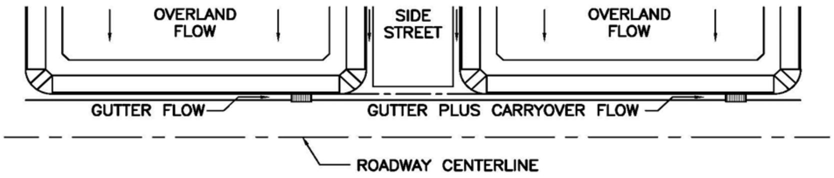
			MINOR	MAJOR	
	Design Information (Input)				
	Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
	Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
	Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
	Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.6	3.6	inches
					☐ Override Depths
	Grate Information		MINOR	MAJOR	
	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) =	10.00	10.00	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
Warning 1	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	
			MINOR	MAJOR	
	Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.1**	**5.1**	**cfs**
	WARNING: Inlet Capacity less than Q Peak for MAJOR Storm	Q PEAK REQUIRED =	2.8	5.9	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

DESIGN PEAK FLOW FOR ONE-HALF OF STREET
OR GRASS-LINED CHANNEL BY THE RATIONAL METHOD

Project: FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD

Inlet ID: INLET 1-7, 10' SUMP



Show Details

Design Flow: ONLY if already determined through other methods:

(local peak flow for 1/2 of street OR grass-lined channel):

	Minor Storm	Major Storm	
*Q_{Known} =	2.1	4.4	cfs

* If you enter values in Row 14, skip the rest of this sheet and proceed to sheet Q-Allow or Area Inlet.

<---
FILL IN THIS SECTION
OR…
FILL IN THE
SECTIONS BELOW.
<---

Geographic Information: (Enter data in the blue cells):

Subcatchment Area =		Acres
Percent Imperviousness =		%
NRCS Soil Type =		A, B, C, or D

Site Type:
○ Site is Urban
○ Site is Non-Urban

Flows Developed For:
○ Street Inlets
○ Area Inlets in a Median

	Slope (ft/ft)	Length (ft)
Overland Flow =		
Channel Flow =		

Rainfall Information: Intensity I (inch/hr) = $C_1 * P_1 / (C_2 + T_c) ^ C_3$

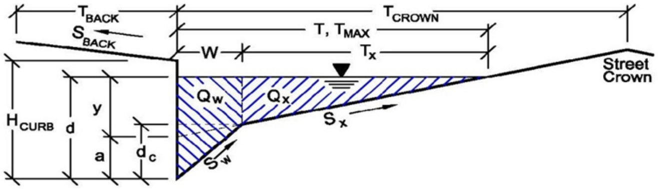
	Minor Storm	Major Storm	
Design Storm Return Period, T_r =			years
Return Period One-Hour Precipitation, P_1 =			inches
C_1 =			
C_2 =			
C_3 =			
User-Defined Storm Runoff Coefficient (leave this blank to accept a calculated value), C =			
User-Defined 5-yr. Runoff Coefficient (leave this blank to accept a calculated value), C_5 =			
Bypass (Carry-Over) Flow from upstream Subcatchments, Q_b =	0.0	0.0	cfs
Total Design Peak Flow, Q =	2.1	4.4	cfs

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

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

Project: **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**

Inlet ID: **INLET 1-7, 10' SUMP**



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	12.0	ft
Gutter Width	W =	1.00	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} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	18.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☑	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.88	2.88	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	1.0	1.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.76	0.76	inches
Water Depth at Gutter Flowline	d =	3.64	3.64	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.245	0.245	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	21.9	71.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	20.9	70.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.130	0.038	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

		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**

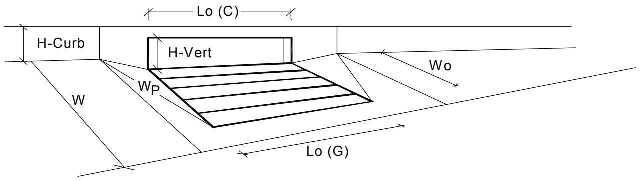
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET IN A SUMP OR SAG LOCATION

Project = FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD

Inlet ID = INLET 1-7, 10' SUMP



		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.6	3.6	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
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) =	10.00	10.00	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
Warning 1 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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.1**	**5.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.1	4.4	cfs

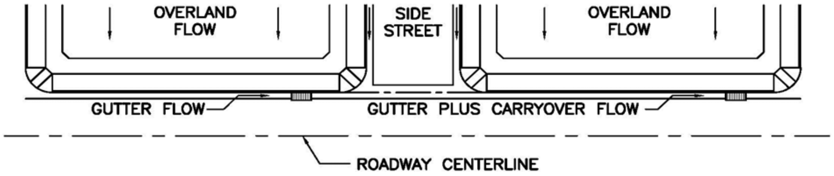
Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Worksheet Protected

DESIGN PEAK FLOW FOR ONE-HALF OF STREET
OR GRASS-LINED CHANNEL BY THE RATIONAL METHOD

Project: FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD

Inlet ID: INLET 2-2, 5' SUMP



Show Details

Design Flow: ONLY if already determined through other methods:

		Minor Storm	Major Storm	
(local peak flow for 1/2 of street OR grass-lined channel):	*Q_{Known} =	0.2	0.4	cfs

* If you enter values in Row 14, skip the rest of this sheet and proceed to sheet Q-Allow or Area Inlet.

<--- FILL IN THIS SECTION OR… FILL IN THE SECTIONS BELOW. <---

Geographic Information: (Enter data in the blue cells):

Subcatchment Area =		Acres
Percent Imperviousness =		%
NRCS Soil Type =		A, B, C, or D

Site Type:
- ○ Site is Urban
- ○ Site is Non-Urban

Flows Developed For:
- ○ Street Inlets
- ○ Area Inlets in a Median

	Slope (ft/ft)	Length (ft)
Overland Flow =		
Channel Flow =		

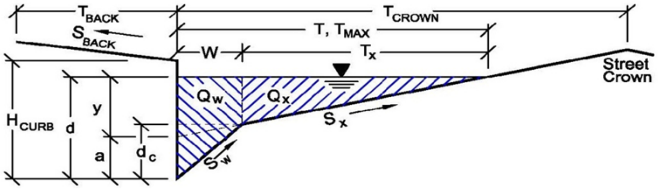
Rainfall Information: Intensity I (inch/hr) = $C_1 * P_1 / (C_2 + T_c) ^ C_3$

	Minor Storm	Major Storm	
Design Storm Return Period, T_r =			years
Return Period One-Hour Precipitation, P_1 =			inches
C_1 =			
C_2 =			
C_3 =			
User-Defined Storm Runoff Coefficient (leave this blank to accept a calculated value), C =			
User-Defined 5-yr. Runoff Coefficient (leave this blank to accept a calculated value), C_5 =			
Bypass (Carry-Over) Flow from upstream Subcatchments, Q_b =	0.0	0.0	cfs
Total Design Peak Flow, Q =	0.2	0.4	cfs

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

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

Project: **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**
Inlet ID: **INLET 2-2, 5' SUMP**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	12.0	ft
Gutter Width	W =	1.00	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} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	18.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☑	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.88	2.88	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	1.0	1.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.76	0.76	inches
Water Depth at Gutter Flowline	d =	3.64	3.64	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.245	0.245	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	21.9	71.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	20.9	70.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.130	0.038	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

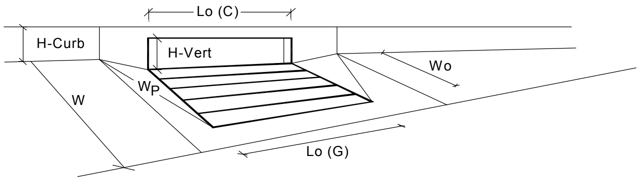
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET IN A SUMP OR SAG LOCATION

Project = **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**

Inlet ID = **INLET 2-2, 5' SUMP**



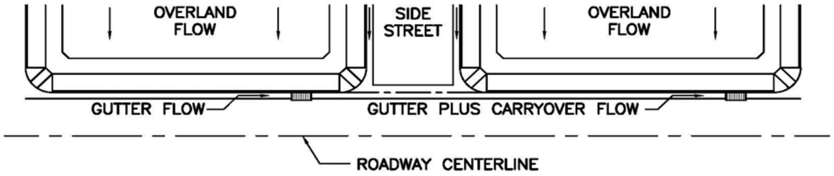
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.6	3.6	inches ☐ Override Depths
Grate Information		MINOR	MAJOR	
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) =	10.00	10.00	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
Warning 1 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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.1**	**3.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.2	0.4	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Worksheet Protected

DESIGN PEAK FLOW FOR ONE-HALF OF STREET OR GRASS-LINED CHANNEL BY THE RATIONAL METHOD

Project: FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD
Inlet ID: INLET 2-3, 5' SUMP



Show Details

Design Flow: ONLY if already determined through other methods:

		Minor Storm	Major Storm	
(local peak flow for 1/2 of street OR grass-lined channel):	*Q_{Known} =	0.4	0.9	cfs

* If you enter values in Row 14, skip the rest of this sheet and proceed to sheet Q-Allow or Area Inlet.

<---
FILL IN THIS SECTION
OR…
FILL IN THE
SECTIONS BELOW.
<---

Geographic Information: (Enter data in the blue cells):

Subcatchment Area =		Acres
Percent Imperviousness =		%
NRCS Soil Type =		A, B, C, or D

Site Type:
- ○ Site is Urban
- ○ Site is Non-Urban

Flows Developed For:
- ○ Street Inlets
- ○ Area Inlets in a Median

	Slope (ft/ft)	Length (ft)
Overland Flow =		
Channel Flow =		

Rainfall Information: Intensity I (inch/hr) = $C_1 * P_1 / (C_2 + T_c) ^ C_3$

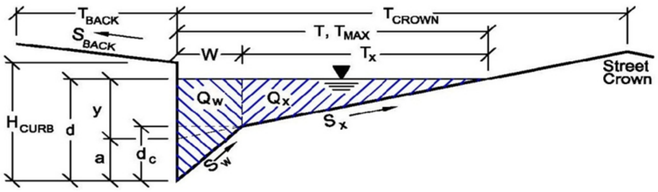
	Minor Storm	Major Storm	
Design Storm Return Period, T_r =			years
Return Period One-Hour Precipitation, P_1 =			inches
C_1 =			
C_2 =			
C_3 =			
User-Defined Storm Runoff Coefficient (leave this blank to accept a calculated value), C =			
User-Defined 5-yr. Runoff Coefficient (leave this blank to accept a calculated value), C_5 =			
Bypass (Carry-Over) Flow from upstream Subcatchments, Q_b =	0.0	0.0	cfs
Total Design Peak Flow, Q =	0.4	0.9	cfs

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

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

Project: **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**

Inlet ID: **INLET 2-3, 5' SUMP**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	12.0	ft
Gutter Width	W =	1.00	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} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	18.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☑	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.88	2.88	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	1.0	1.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.76	0.76	inches
Water Depth at Gutter Flowline	d =	3.64	3.64	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.245	0.245	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	21.9	71.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	20.9	70.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.130	0.038	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

		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**

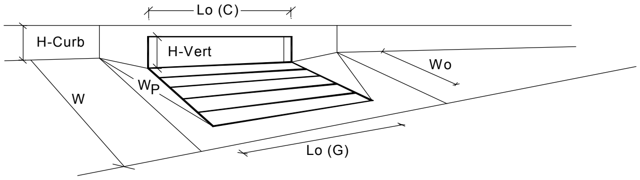
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET IN A SUMP OR SAG LOCATION

Project = **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**

Inlet ID = **INLET 2-3, 5' SUMP**



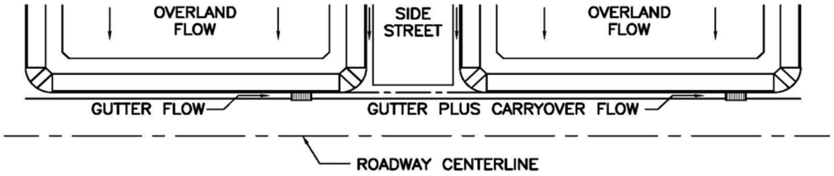
	Design Information (Input)		MINOR	MAJOR	
	Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
	Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
	Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
	Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.6	3.6	inches
					☐ Override Depths
	Grate Information		MINOR	MAJOR	
	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) =	10.00	10.00	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
Warning 1	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	
			MINOR	MAJOR	
	Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**3.1**	**3.1**	**cfs**
	Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.4	0.9	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Worksheet Protected

DESIGN PEAK FLOW FOR ONE-HALF OF STREET OR GRASS-LINED CHANNEL BY THE RATIONAL METHOD

Project: FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD
Inlet ID: INLET 2-4, 10' SUMP



Show Details

Design Flow: ONLY if already determined through other methods:

(local peak flow for 1/2 of street OR grass-lined channel):

	Minor Storm	Major Storm	
$^{*}Q_{Known}$ =	2.1	4.6	cfs

* If you enter values in Row 14, skip the rest of this sheet and proceed to sheet Q-Allow or Area Inlet.

<--- FILL IN THIS SECTION OR…

FILL IN THE SECTIONS BELOW. <---

Geographic Information: (Enter data in the blue cells):

Subcatchment Area =		Acres
Percent Imperviousness =		%
NRCS Soil Type =		A, B, C, or D

Site Type:
- ○ Site is Urban
- ○ Site is Non-Urban

Flows Developed For:
- ○ Street Inlets
- ○ Area Inlets in a Median

	Slope (ft/ft)	Length (ft)
Overland Flow =		
Channel Flow =		

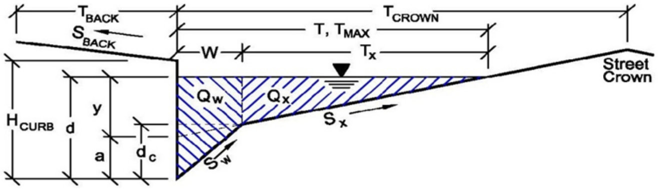
Rainfall Information: Intensity I (inch/hr) = $C_1 * P_1 / (C_2 + T_c) ^ C_3$

	Minor Storm	Major Storm	
Design Storm Return Period, T_r =			years
Return Period One-Hour Precipitation, P_1 =			inches
C_1 =			
C_2 =			
C_3 =			
User-Defined Storm Runoff Coefficient (leave this blank to accept a calculated value), C =			
User-Defined 5-yr. Runoff Coefficient (leave this blank to accept a calculated value), C_5 =			
Bypass (Carry-Over) Flow from upstream Subcatchments, Q_b =	0.0	0.0	cfs
Total Design Peak Flow, Q =	2.1	4.6	cfs

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

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

Project: **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**
Inlet ID: **INLET 2-4, 10' SUMP**



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	12.0	ft
Gutter Width	W =	1.00	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} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	18.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☑	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.88	2.88	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	1.0	1.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.76	0.76	inches
Water Depth at Gutter Flowline	d =	3.64	3.64	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.245	0.245	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	21.9	71.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	20.9	70.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.130	0.038	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

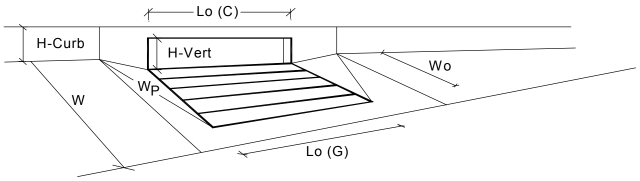
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

INLET IN A SUMP OR SAG LOCATION

Project = **FOUR CORNERS COMM 1 - AUSTIN AVENUE & EAST COUNTY LINE ROAD**

Inlet ID = **INLET 2-4, 10' SUMP**

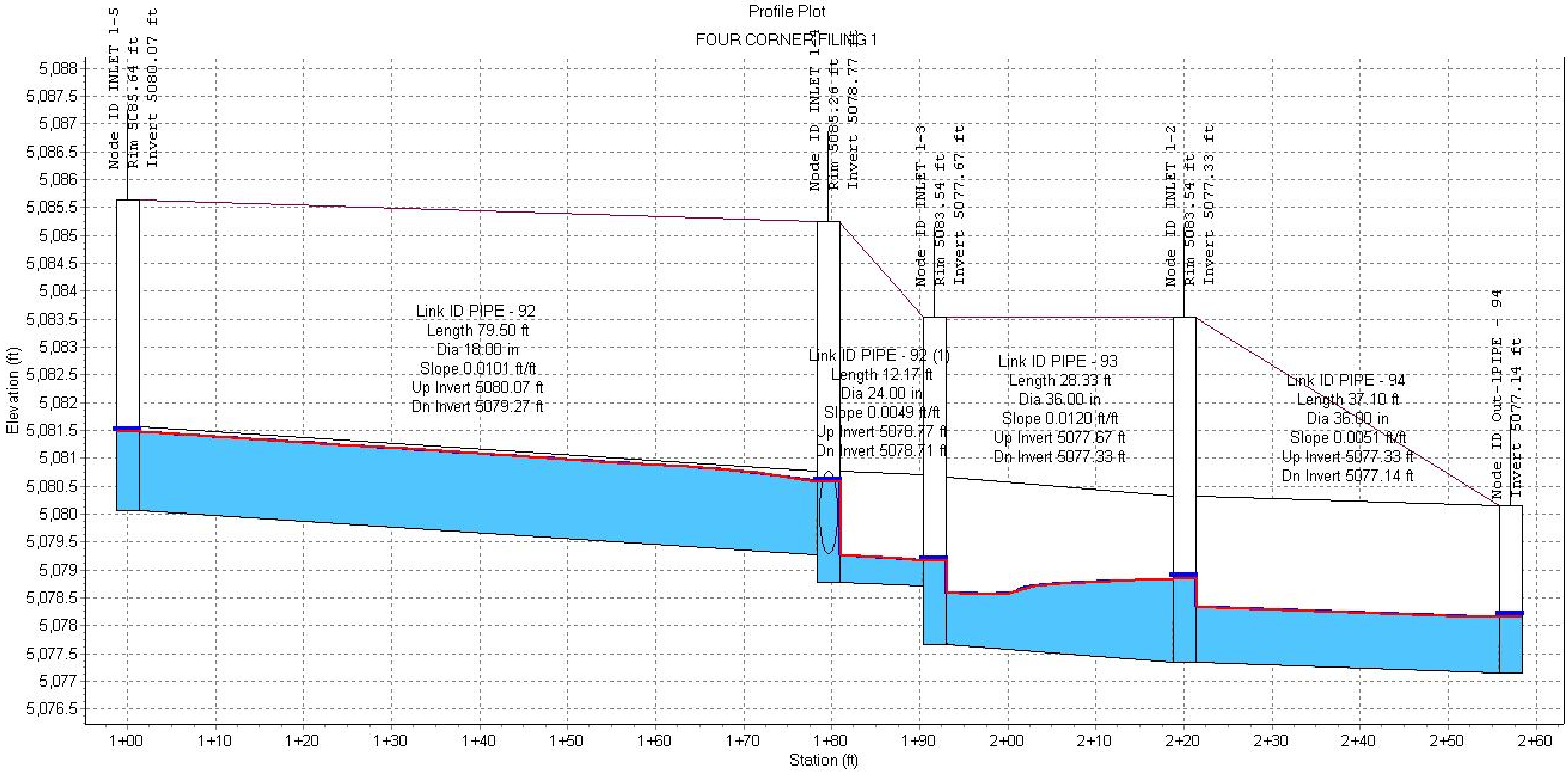


	Design Information (Input)		MINOR	MAJOR	
	Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
	Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
	Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
	Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.6	3.6	inches
					☐ Override Depths
	Grate Information		MINOR	MAJOR	
	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) =	10.00	10.00	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
Warning 1	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	
			MINOR	MAJOR	
	Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.1**	**5.1**	**cfs**
	Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.1	4.6	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Profile Plot

FOUR CORNER FILING 1

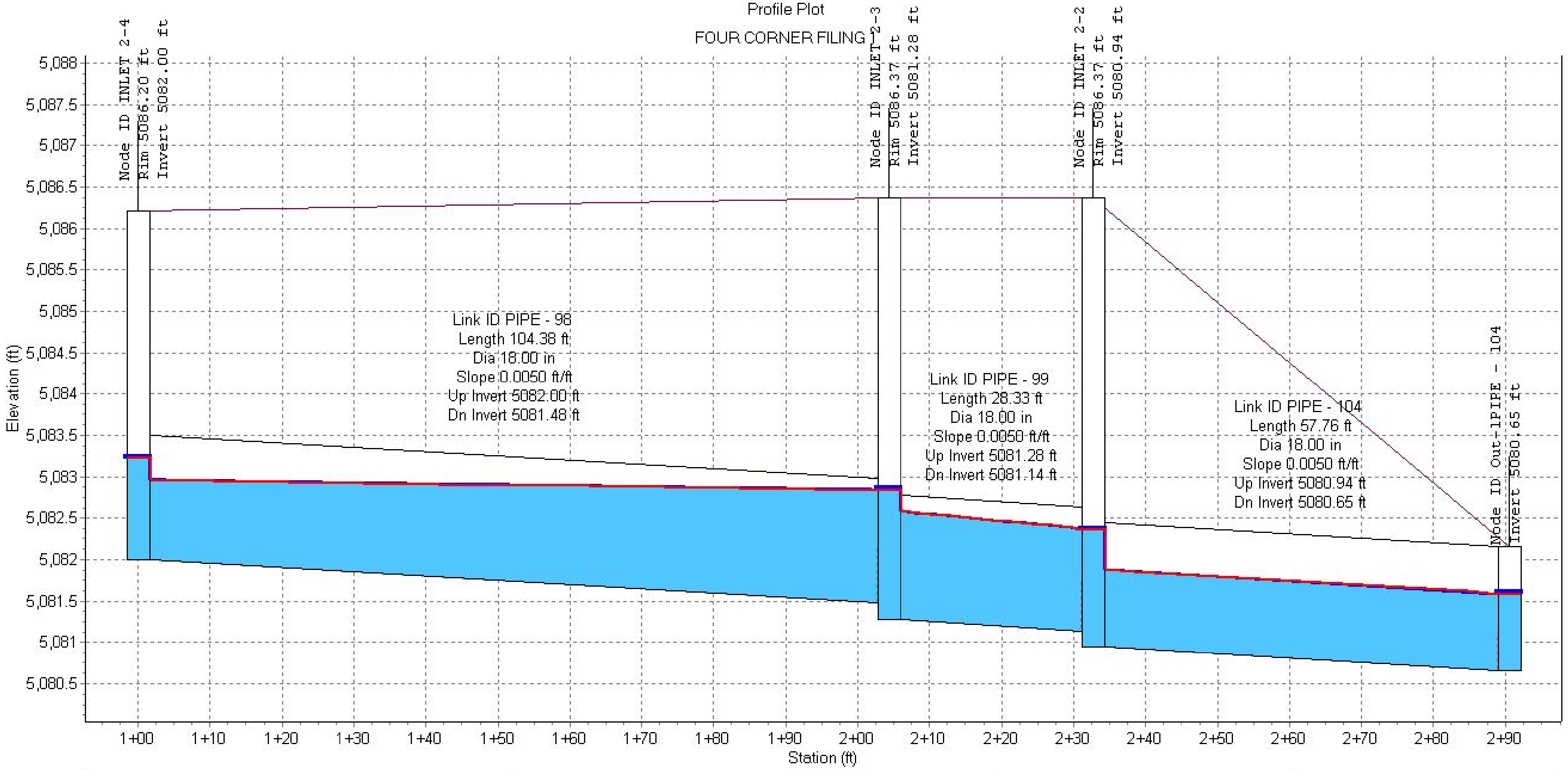


Node ID:	INLET 1-5		INLET 1-4	INLET 1-3	INLET 1-2	Out-1PIPE - 94
Rim (ft):	5085.64		5085.26	5083.54	5083.54	
Invert (ft):	5080.07		5078.77	5077.67	5077.33	5077.14
Min Pipe Cover (ft):	4.07		4.49	2.83	3.21	
Max HGL (ft):	5081.50		5080.59	5079.17	5078.88	5078.18

Link ID:		PIPE - 92	PIPE - 92 (1)	PIPE - 93	PIPE - 94	
Length (ft):		79.50	12.17	28.33	37.10	
Dia (in):		18.00	24.00	36.00	36.00	
Slope (ft/ft):		0.0101	0.0049	0.0120	0.0051	
Up Invert (ft):		5080.07	5078.77	5077.67	5077.33	
Dn Invert (ft):		5079.27	5078.71	5077.33	5077.14	
Max Q (cfs):		5.91	11.22	12.02	12.25	
Max Vel (ft/s):		4.06	4.41	4.74	4.28	
Max Depth (ft):		1.37	1.51	1.53	1.29	

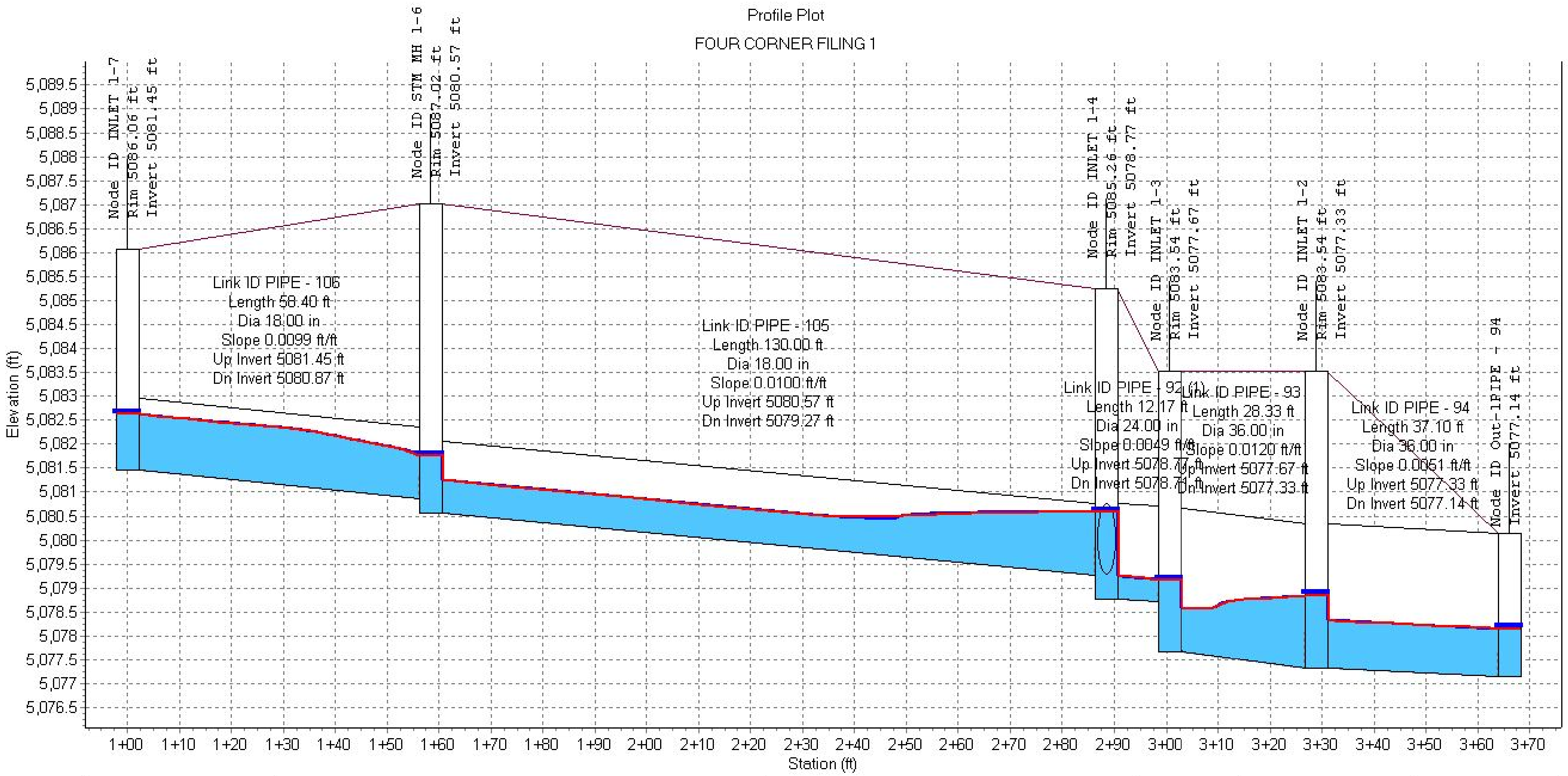
Profile Plot

FOUR CORNER FILING



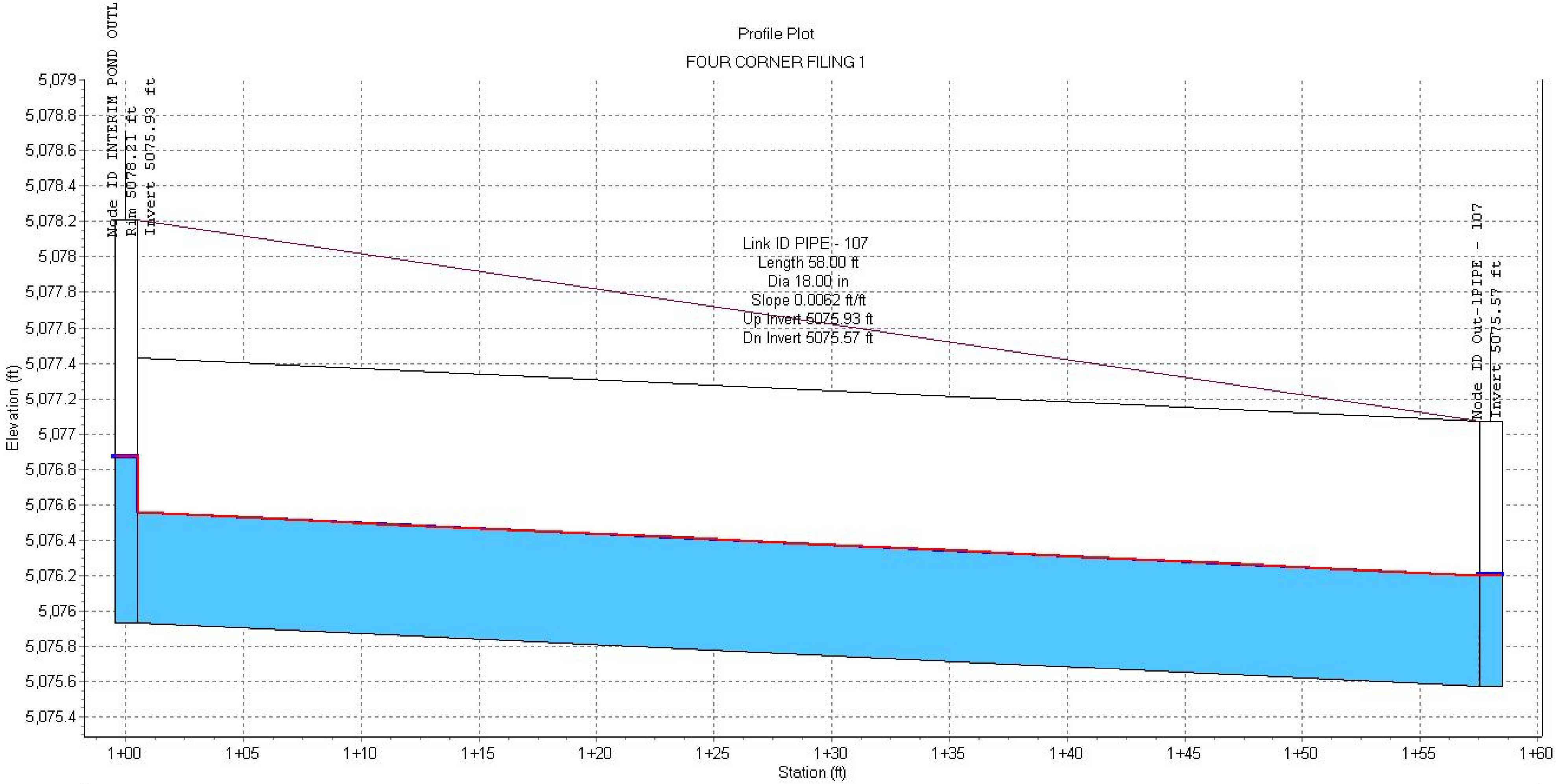
Node ID:	INLET 2-4	INLET 2-3	INLET 2-2	
Rim (ft):	5086.20	5086.37	5086.37	
Invert (ft):	5082.00	5081.28	5080.94	5080.65
Min Pipe Cover (ft):	2.70	3.39	3.73	
Max HGL (ft):	5083.22	5082.84	5082.36	5081.59

Link ID:		PIPE - 98	PIPE - 99	PIPE - 104	
Length (ft):		104.38	28.33	57.76	
Dia (in):		18.00	18.00	18.00	
Slope (ft/ft):		0.0050	0.0050	0.0050	
Up Invert (ft):		5082.00	5081.28	5080.94	
Dn Invert (ft):		5081.48	5081.14	5080.65	
Max Q (cfs):		4.55	5.47	5.87	
Max Vel (ft/s):		3.42	3.34	3.94	
Max Depth (ft):		1.29	1.36	1.18	



Node ID:	INLET 1-7	STM MH 1-6	INLET 1-4	INLET 1-3	INLET 1-2	Out-1PIPE - 94
Rim (ft):	5086.06	5087.02	5085.26	5083.54	5083.54	
Invert (ft):	5081.45	5080.57	5078.77	5077.67	5077.33	5077.14
Min Pipe Cover (ft):	3.11	4.65	4.49	2.83	3.21	
Max HGL (ft):	5082.64	5081.76	5080.59	5079.17	5078.88	5078.18

Link ID:	PIPE - 106	PIPE - 105	PIPE - 92 (1)	PIPE - 93	PIPE - 94
Length (ft):	58.40	130.00	12.17	28.33	37.10
Dia (in):	18.00	18.00	24.00	36.00	36.00
Slope (ft/ft):	0.0099	0.0100	0.0049	0.0120	0.0051
Up Invert (ft):	5081.45	5080.57	5078.77	5077.67	5077.33
Dn Invert (ft):	5080.87	5079.27	5078.71	5077.33	5077.14
Max Q (cfs):	4.37	4.37	11.22	12.02	12.25
Max Vel (ft/s):	3.67	3.35	4.41	4.74	4.28
Max Depth (ft):	1.04	1.25	1.51	1.53	1.29



Node ID:		
Rim (ft):	5078.21	
Invert (ft):	5075.93	5075.57
Min Pipe Cover (ft):	0.78	
Max HGL (ft):	5076.87	5076.20

Link ID:	PIPE - 107
Length (ft):	58.00
Dia (in):	18.00
Slope (ft/ft):	0.0062
Up Invert (ft):	5075.93
Dn Invert (ft):	5075.57
Max Q (cfs):	3.02
Max Vel (ft/s):	3.23
Max Depth (ft):	0.78

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Jun 20 2016

OUTFALL PIPE TO SWALE

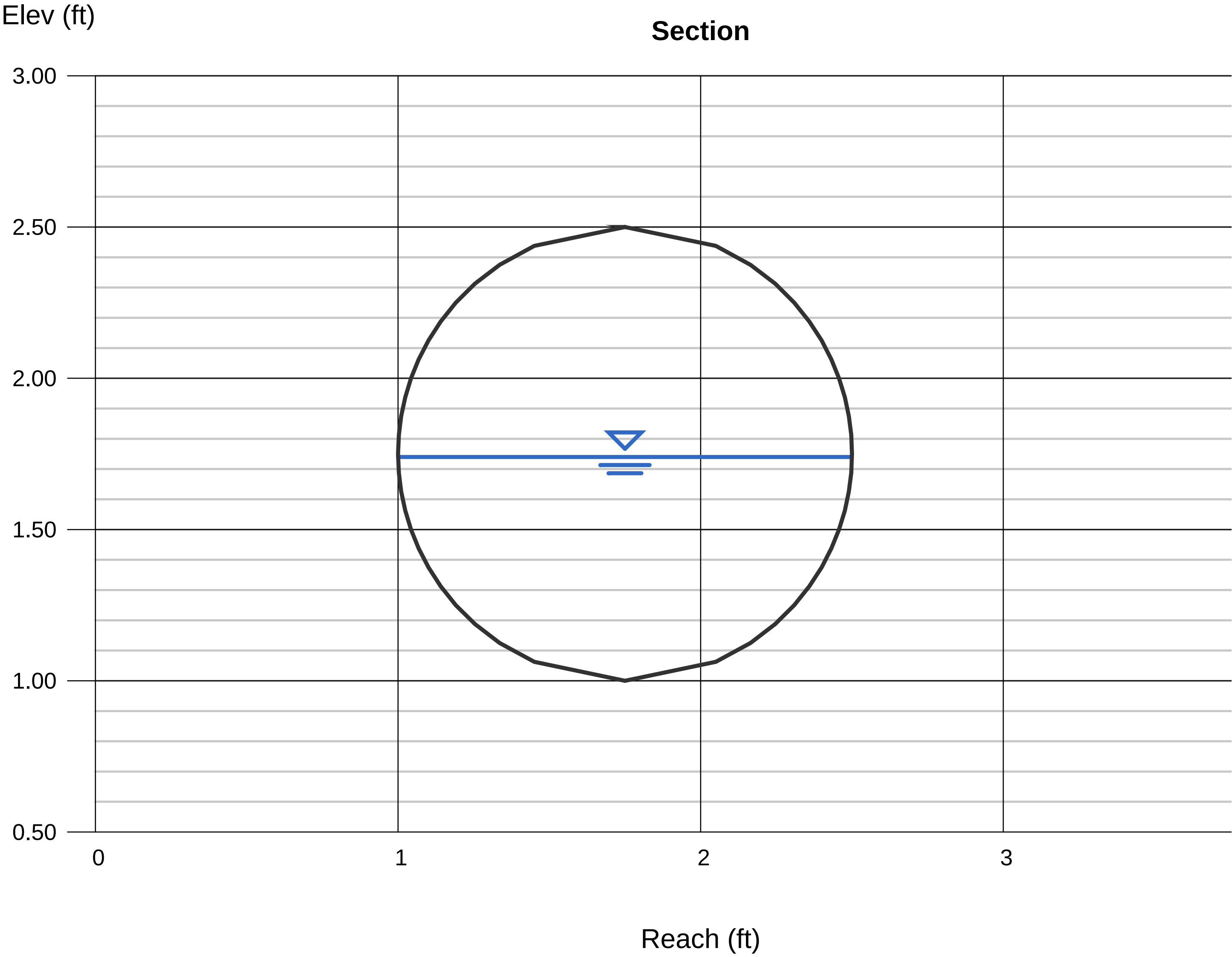
Circular
Diameter (ft) = 1.50

Invert Elev (ft) = 1.00
Slope (%) = 0.50
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 3.62

Allowable Release Rate

Highlighted
Depth (ft) = 0.74
Q (cfs) = 3.620
Area (sqft) = 0.87
Velocity (ft/s) = 4.15
Wetted Perim (ft) = 2.34
Crit Depth, Yc (ft) = 0.73
Top Width (ft) = 1.50
EGL (ft) = 1.01



Channel Report

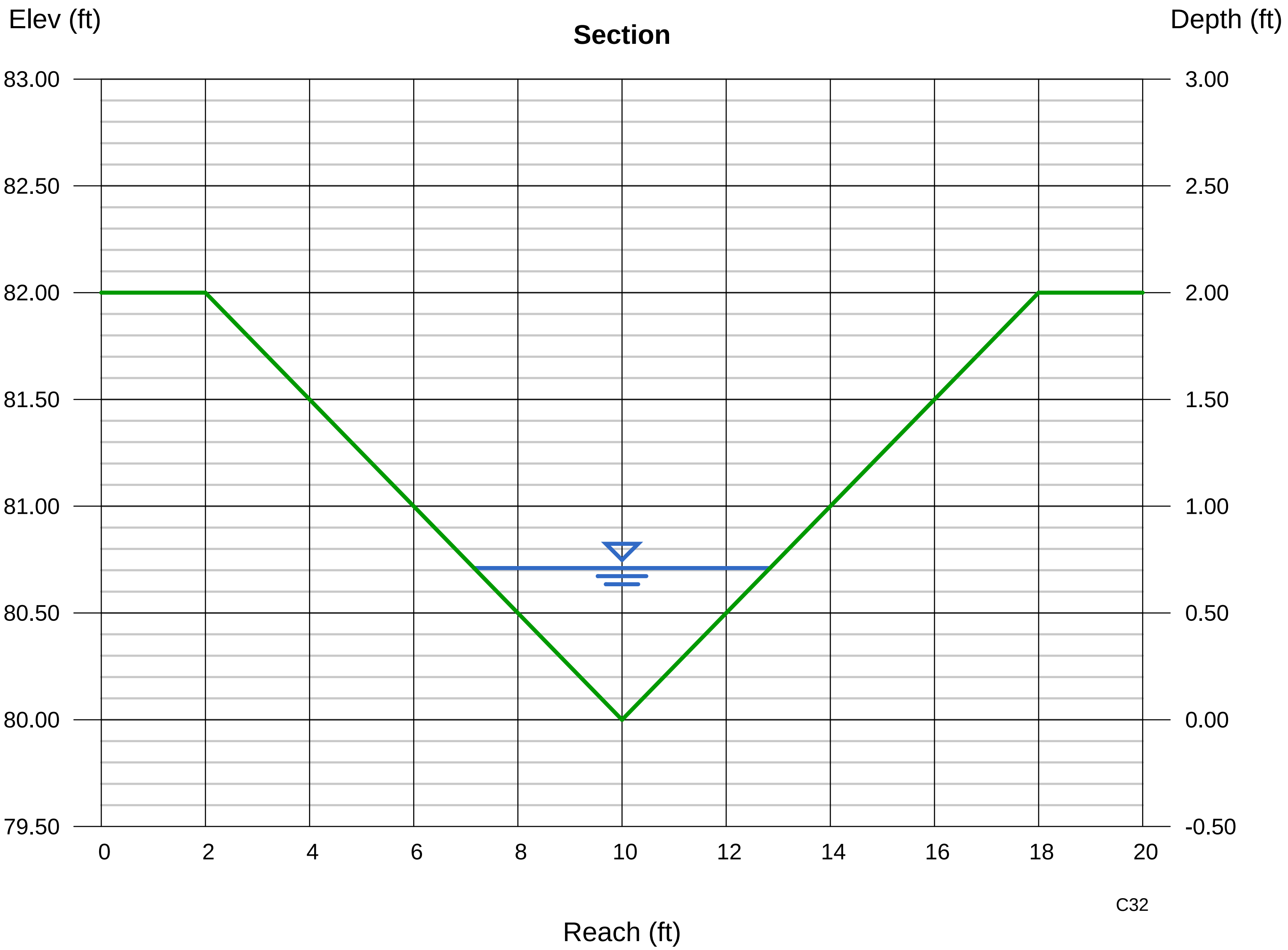
PIPE OUTFALL SWALE INTO POND DP10

Triangular
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.00

Invert Elev (ft) = 80.00
Slope (%) = 1.45
N-Value = 0.030

Calculations
Compute by: Known Q
Known Q (cfs) = 5.89

Highlighted
Depth (ft) = 0.71
Q (cfs) = 5.890
Area (sqft) = 2.02
Velocity (ft/s) = 2.92
Wetted Perim (ft) = 5.85
Crit Depth, Yc (ft) = 0.67
Top Width (ft) = 5.68
EGL (ft) = 0.84



Channel Report

OUTFALL PIPE TO SWALE

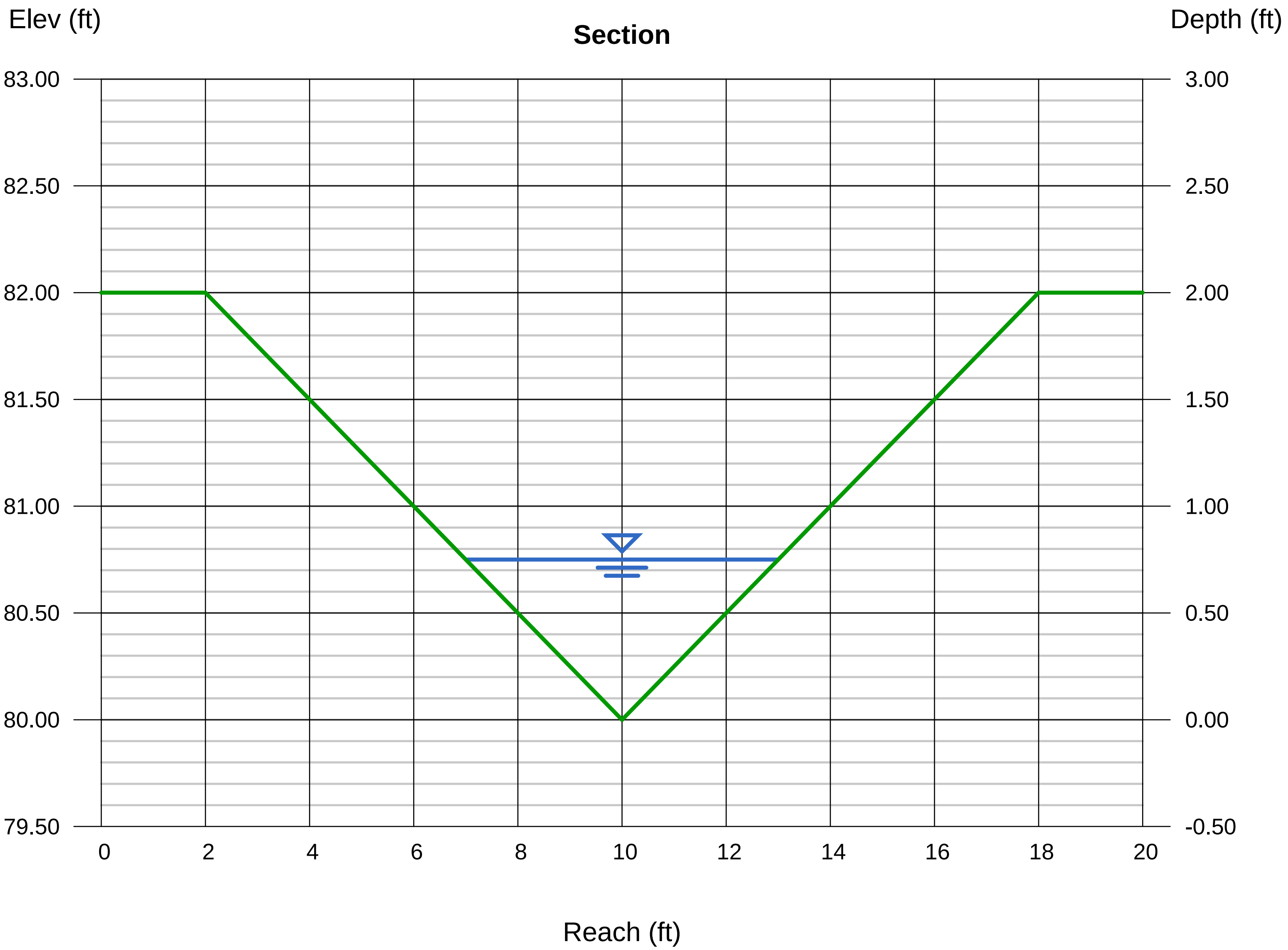
Triangular
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.00

Invert Elev (ft) = 80.00
Slope (%) = 0.42
N-Value = 0.030

Calculations
Compute by: Known Q
Known Q (cfs) = 3.62

Allowable Release Rate

Highlighted
Depth (ft) = 0.75
Q (cfs) = 3.620
Area (sqft) = 2.25
Velocity (ft/s) = 1.61
Wetted Perim (ft) = 6.18
Crit Depth, Yc (ft) = 0.56
Top Width (ft) = 6.00
EGL (ft) = 0.79



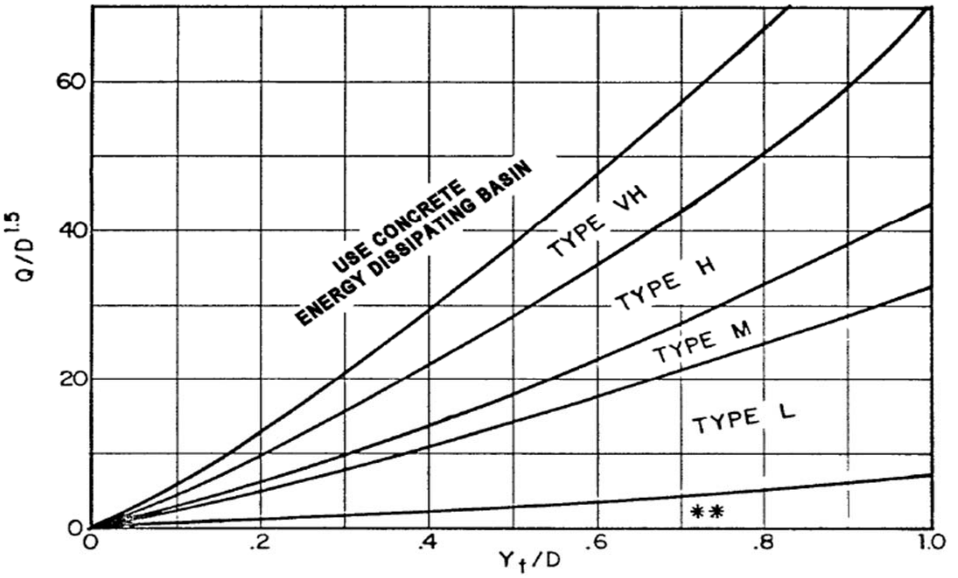
4 Corners
Town of Erie, Colorado

Riprap Design for Circular Culvert Protection
Developed Conditions

Fig MD-21 EQ. MD-22

Outfall Location	Q_{out} In Pipe cfs	V (out) fps	Pipe size (in)	Tailwater depth	$Q/D^{2.5}$ <6	$Q/D^{1.5}$	Yt/D	Riprap Size	Expan Factor from MD-23	At=Q/V	Length Riprap (Min 4D)
DP6	11.54	4.06	36	0.95	0.74	2.22	0.32	L*	0.30	2.84	12.00
DP10	5.89	4.06	18	0.01	2.14	3.21	0.007	L*	0.30	1.45	6.00
POND	3.02	3.95	18	0.01	1.10	1.64	0.007	L*	0.30	0.76	6.00

*VL RIPRAP HAS BEEN UPSIZED TO TYPE L



Use D_a instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

Figure MD-21—Riprap Erosion Protection at Circular Conduit Outlet Valid for $Q/D^{2.5} \leq 6.0$

APPENDIX D
DRAINAGE MAPS

Allowable Pond Release and Interim Pond Summary

4 Corners

Developed Conditions

Town of Erie, Colorado

Job No. 030019
Date: 5/10/2016
By: AKM

Type B Soils

Allowable Release Rate

Developed Acres	4.25	
Allowable 10yr Release Factor	0.23	0.98 cfs
Allowable 100yr Release Factor	0.85	3.62 cfs

Offsite Flow Reductions	C1	C2	**Total**
10 yr	1.36	0.40	1.76 cfs
100 yr	3.02	0.66	3.68 cfs

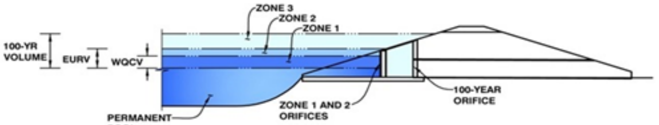
Undetained offsite flow Reduction Factors Are Greater than the Initial Allowable Release Rate, therefore a variance is requested from Section 814.10 for the Compensating Allowable Release Rate for the Temporary Interim Pond.

INTERIM DETENTION POND

REQUIRED TOTAL VOL	0.47 ac-ft
PROVIDED 100YR VOL	1.01 ac-ft
100YR WSE	5078.01
100YR ALLOWABLE RELEASE	3.62 cfs
10YR ALLOWABLE RELEASE	0.98 cfs

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

Project: Four Corners Filing No. 1
Basin ID: Comm-1



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB			
Watershed Area =	3.55	acres		
Watershed Length =	300	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	72.50%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	UDFCD Default			
Water Quality Capture Volume (WQCV) =	0.085	acre-feet		
Excess Urban Runoff Volume (EURV) =	0.283	acre-feet		
2-yr Runoff Volume (P1 = 1.01 in.) =	0.207	acre-feet	1.01	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	0.319	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.73 in.) =	0.405	acre-feet	1.73	inches
25-yr Runoff Volume (P1 = 2.02 in.) =	0.508	acre-feet		inches
50-yr Runoff Volume (P1 = 2.4 in.) =	0.626	acre-feet	2.40	inches
100-yr Runoff Volume (P1 = 2.7 in.) =	0.730	acre-feet	2.70	inches
500-yr Runoff Volume (P1 = 3.29 in.) =	0.924	acre-feet		inches
Approximate 2-yr Detention Volume =	0.196	acre-feet		
Approximate 5-yr Detention Volume =	0.302	acre-feet		
Approximate 10-yr Detention Volume =	0.343	acre-feet		
Approximate 25-yr Detention Volume =	0.362	acre-feet		
Approximate 50-yr Detention Volume =	0.409	acre-feet		
Approximate 100-yr Detention Volume =	0.470	acre-feet		

Note: L / W Ratio < 1
L / W Ratio = 0.6

Optional User Input
1-hr Precipitation

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.085	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.199	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.186	acre-feet
Total Detention Basin Volume =	0.470	acre-feet
Initial Surcharge Volume (ISV) =	11	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	4.00	ft
Depth of Trickle Channel (H_{TC}) =	0.00	ft
Slope of Trickle Channel (S_{TC}) =	0.000	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	34	ft^2
Surcharge Volume Length (L_{ISV}) =	5.8	ft
Surcharge Volume Width (W_{ISV}) =	5.8	ft
Depth of Basin Floor (H_{FLOOR}) =	0.00	ft
Length of Basin Floor (L_{FLOOR}) =	105.8	ft
Width of Basin Floor (W_{FLOOR}) =	55.8	ft
Area of Basin Floor (A_{FLOOR}) =	5,903	ft^2
Volume of Basin Floor (V_{FLOOR}) =	0	ft^3
Depth of Main Basin (H_{MAIN}) =	3.67	ft
Length of Main Basin (L_{MAIN}) =	135.2	ft
Width of Main Basin (W_{MAIN}) =	85.2	ft
Area of Main Basin (A_{MAIN}) =	11,509	ft^2
Volume of Main Basin (V_{MAIN}) =	31,384	ft^3
Calculated Total Basin Volume (V_{total}) =	**0.721**	acre-feet

STAGE STORAGE NOT USED ON THIS FORM

Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)
Micropool	0.00		5.8	5.8	34
ISV	0.33		5.8	5.8	34
Floor	0.33		5.8	5.8	34
	0.50		107.1	57.1	6,111
	0.75		109.1	59.1	6,444
Zone 1 (WQCV)	0.92		110.5	60.5	6,688
	1.00		111.1	61.1	6,784
	1.25		113.1	63.1	7,132
	1.50		115.1	65.1	7,489
	1.75		117.1	67.1	7,853
	2.00		119.1	69.1	8,225
Zone 2 (EURV)	2.07		119.7	69.7	8,346
	2.25		121.2	71.2	8,621
	2.50		123.2	73.2	9,010
	2.75		125.2	75.2	9,406
Zone 3 (100-year)	2.99		127.1	77.1	9,794
	3.00		127.2	77.2	9,811
	3.25		129.2	79.2	10,223
	3.50		131.2	81.2	10,644
	3.75		133.2	83.2	11,073
	4.00		135.2	85.2	11,509
	4.25		137.2	87.2	11,954
	4.50		139.2	89.2	12,407
	4.75		141.2	91.2	12,867
	5.00		143.2	93.2	13,336
	5.25		145.2	95.2	13,812
	5.50		147.2	97.2	14,297
	5.75		149.2	99.2	14,790
	6.00		151.2	101.2	15,290
	6.25		153.2	103.2	15,799
	6.50		155.2	105.2	16,315
	6.75		157.2	107.2	16,840
	7.00		159.2	109.2	17,373
	7.25		161.2	111.2	17,913
	7.50		163.2	113.2	18,462
	7.75		165.2	115.2	19,019
	8.00		167.2	117.2	19,583
	8.25		169.2	119.2	20,156
	8.50		171.2	121.2	20,736
	8.75		173.2	123.2	21,325
	9.00		175.2	125.2	21,922
	9.25		177.2	127.2	22,526
	9.50		179.2	129.2	23,139
	9.75		181.2	131.2	23,760
	10.00		183.2	133.2	24,388
	10.25		185.2	135.2	25,025
	10.50		187.2	137.2	25,669
	10.75		189.2	139.2	26,322
	11.00		191.2	141.2	26,983
	11.25		193.2	143.2	27,651
	11.50		195.2	145.2	28,328
	11.75		197.2	147.2	29,013
	12.00		199.2	149.2	29,705
	12.25		201.2	151.2	30,406

J3 ENGINEERING CONSULTANTS

CANYON CREEK FILING NO. 10
FOUR CORNERS COMMERCIAL AREA 1
INTERIM POND VOLUME CALCULATIONS

Job No.: 030019
Date: 5/5/16
Calculated By: akm
Checked By: sos

"Your Project, Our Pride" TM

Volume Equation:
Vol (V) = 1/3h(A1+A2+SQRT(A1*A2))

$$Vol = \frac{1h}{3} A_1 A_2 \sqrt{A_1 A_2}$$

V = Volume in Cubic Feet (CF) or Acre-Feet (Ac-Ft)
h = Contour Interval in Feet (Ft)
A1,A2 = Area Enclosed by Successive Contours In Square Feet (SF)

Contour Elev. (Ft)	Area (SF)	A1+A2 (SF)	SQRT(A1*A2) (SF)	(A1+A2)+ SQRT(A1*A2) (SF)	h (Ft)	h/3 (Ft)	Volume V (CF)	Accum. Vol. AV (CF)	Accum. Vol. AV (Ac-ft)
5075.9	0							0	
		427	10	437	0.10	0.03	14.6		
5076	427							15	0.00
		11289	2154	13443	1.00	0.33	4481.0		
5077	10862							4496	0.10
		32278	15252	47530	1.00	0.33	15843.4		
5078	21416							20339	0.47
		47040	23426	70466	1.00	0.33	23488.7		
5079	25624							43828	1.01
		54694	27293	81987	1.00	0.33	27328.9		
5080	29070							71157	1.63
		61802	30847	92649	1.00	0.33	30882.9		
5081	32732							102040	2.34

Water Quality Storage Volume=	0.085 ac-ft
EURV Storage Volume*=	0.284 ac-ft
100YR Storage Volume*=	0.470 ac-ft
Total Volume =	0.47 ac-ft

Pond invert 5076.5
Bottom of Emergency Spillway Elev: 5078.01

WATER SURFACE INTERPOLATIONS

WQCV Storage

Contour	Volume	Req Volume	Ac-ft
5076.0	15		0.00
WSEL		3703	0.09
5077.0	4496		0.10

WCQV Storage
Water Surface Elev. = 5076.82

100YR Storage - Interim Pond

Contour	Volume	Req Volume	Ac-ft
5078.0	20339		0.47
WSEL		20473	0.47
5079.0	43828		1.01

Total
100 yr Water Surface Elev. = 5078.01

EURV Volume Storage

Contour	Volume	Req Volume	Ac-ft
5077.0	4496		0.10
WSEL		16074	0.37
5078.0	20339		0.47

EURV includes WQCV
EURV Water Surface Elev. = 5077.73

*EURV and the 100-year volumes are stacked upon the WQCV volume see the UD Detention Worksheet

J3 ENGINEERING CONSULTANTS

Four Corners
Town of Erie, Colorado
Temporary Interim Detention Pond

Job No.: 030019
Date: 6/20/16
Calculated By: akm
Checked By: sos

"Your Project, Our Pride" TM

Temporary Pond Horizontal Perf Pipe ORIFICE

Enter required Q	3.62	cfs
Water Surface Elev.	5078.01	
Invert Elev	5075.93	
Depth	2.1	ft
Centroid Elev	5075.9	
h (Depth-Centroid Elev)	2.08	
Pipe Dia	1.5	ft

Allowable Discharge 3.62 cfs

$$Q = 0.6A\sqrt{2gh}$$

	Hole Dia	Holes per Row	Centroid Elev	h	Discharge	
Row 1	1.25	5	5076.68	1.33	**1.18**	spring line
Row 2	1.25	5	5077.43	0.58	**0.78**	TOP
Row 3	1.25	5	5076.68	1.33	**1.18**	spring line
			Total Flow from Openings		**3.14**	

TRANSPORTATION
CONSULTANTS, INC.

LSC TRANSPORTATION CONSULTANTS, INC.

1889 York Street
Denver, CO 80206
(303) 333-1105
FAX (303) 333-1107
E-mail: lsc@lscdenver.com

May 31, 2016

Mr. Justin McClure
RMCS, Inc.
21 S. Sunset Street
Longmont, CO 80503

Re: Four Corners
Traffic Impact Analysis
Erie, CO
(LSC #141101)

Dear Mr. McClure:

In response to your request, LSC Transportation Consultants, Inc. has prepared this traffic impact analysis for the proposed Four Corners development to update the February 12, 2015 TIA based on modifications to the land use and access plan. As shown on Figure 1, the site is located south of Erie Parkway, north of Austin Avenue, and west of County Line Road in Erie, Colorado.

REPORT CONTENTS

The report contains the following: the existing roadway and traffic conditions in the vicinity of the site including the lane geometries, traffic controls, posted speed limits, etc.; the existing weekday peak-hour traffic volumes; the existing daily traffic volumes in the area; the typical weekday site-generated traffic volume projections for the site; the assignment of the projected traffic volumes to the area roadways; the projected short-term and long-term background and resulting total traffic volumes on the area roadways; the site's projected traffic impacts; and any recommended roadway improvements to mitigate the site's traffic impacts.

LAND USE AND ACCESS

The site is proposed to include 105 single-family homes, up to 60 ancillary dwelling units, up to 156 townhome dwelling units, and up to 180,000 square feet of shopping center. Access is proposed from one right-in/right-out and one full movement access to Erie Parkway, two right-in/right-out and one three-quarter movement access locations to County Line Road, and three full movement accesses to Austin Avenue as shown in the conceptual site plan in Figure 2.

ROADWAY AND TRAFFIC CONDITIONS

Area Roadways

The major roadways in the site's vicinity are shown on Figure 1 and are described below.

- **Erie Parkway** is an east-west, four-lane minor arterial roadway north of the site. The intersection with County Line Road is signalized with auxiliary turn lanes. The posted speed limit in the vicinity of the site is 35 mph. The 2030 Roadway System Plan in the *Town of Erie Master Transportation Plan* shows Erie Parkway as a four-lane principal arterial. The *Buildout Roadway Network* shows a six-lane principal arterial.

- **County Line Road** is a north-south, two-lane minor arterial roadway east of the site. The intersection with Austin Avenue is two-way stop-sign controlled on Austin Avenue. The posted speed limit in the vicinity of the site is 45 mph. The 2030 Roadway Plan in the *Town of Erie Transportation Master Plan* shows County Line Road as a two-lane principal arterial. The *Buildout Roadway Network* shows a six-lane principal arterial.

- **Austin Avenue** is an east-west, two-lane collector roadway south of the site. The intersection with County Line Road is stop-sign controlled. The posted speed limit is 25 mph.

Existing Traffic Conditions

Figure 3 shows the existing lane geometries, traffic controls, posted speed limits, and traffic volumes in the site's vicinity on a typical weekday. The weekday peak-hour traffic volumes and daily traffic counts are from the attached traffic counts conducted by Counter Measures in May, 2016.

2020 and 2035 Background Traffic

Figure 4 shows the estimated 2020 background traffic and Figure 5 shows the estimated 2035 background traffic. The projected 2020 and 2035 background traffic volumes are based on an annual growth rate of three percent for the collector and arterial streets.

Existing, 2020, and 2035 Background Levels of Service

Level of service (LOS) is a quantitative measure of the level of congestion or delay at an intersection. Level of service is indicated on a scale from "A" to "F." LOS A is indicative of little congestion or delay and LOS F is indicative of a high level of congestion or delay. Attached are specific level of service definitions for signalized and unsignalized intersections.

The intersections in Figures 3, 4, and 5 were analyzed as appropriate to determine the existing, 2020, and 2035 background levels of service using Synchro Version 8. The existing and 2020 scenarios assume the existing signal timings at the intersection of Erie Parkway/E. County Line Road. The timings for the 2035 scenario were adjusted to reflect the future traffic volumes. Table 1 shows the level of service analysis results. The level of service reports are attached.

- **Erie Parkway/E. County Line Road:** This signalized intersection currently operates at an overall LOS "C" or better during both morning and afternoon peak-hours. By 2020, the shared southbound through movement is expected to operate at LOS "E" during the morning peak-hour. This will be mitigated once a dedicated southbound right-turn lane is provided. By 2035, it is expected to continue to operate at LOS "C during both morning and afternoon peak-hours.

- **Erie Parkway/Full Movement Access:** This future intersection is expected to operate at LOS "C" for all movements through 2020 with stop sign control. By 2035 it is expected to be signalized and operate at an overall LOS "A".

- **County Line Road/Walgreens/North RIRO Access:** All approaches at this stop-sign controlled intersection currently operate at LOS "B" during both morning and afternoon peak-hours and are expected to do so through 2035.

- **County Line Road/Mitchell Way:** All approaches at this stop-sign controlled intersection currently operate at LOS "C" or better during both morning and afternoon peak-hours and are expected to do so through 2035. This intersection currently exists as a full movement intersection but is recommended to be limited to three-quarter movement in the future - most likely when a traffic signal is installed at the County Line Road/Austin Avenue intersection. This is based on the findings of the May, 2010 *Coal Creek Center TIA* by LSC and confirmed by this analysis.

- **E. County Line Road/Austin Avenue**: The westbound left-turn movement at this stop-sign controlled intersection currently operates at LOS "F" during the morning and afternoon peak-hours. By 2020, this intersection is expected to be signalized and is expected to operate at an overall LOS "A" during both morning and afternoon peak-hours through 2035.

- **Austin Avenue/Graham Way:** All approaches at this stop-sign controlled intersection currently operate at LOS "A" during both morning and afternoon peak-hours and are expected to do so through 2035.

TRIP GENERATION

Table 2 shows the estimated average weekday, morning peak-hour, and afternoon peak-hour trip generation for the proposed site based on the rates from *Trip Generation, 9th Edition, 2012* by the Institute of Transportation Engineers (ITE) for the proposed land use. An internal capture reduction of ten percent was assumed for the development. A pass-by trip reduction of 25 percent was assumed for the shopping center land use only.

The proposed land use is projected to generate about 8,362 net external primary vehicle-trips on the average weekday, with about half entering and half exiting during a 24-hour period. During the morning peak-hour, which generally occurs for one hour between 6:30 and 8:30 a.m., about 128 primary trip vehicles would enter and about 164 primary trip vehicles would exit the site. During the afternoon peak-hour, which generally occurs for one hour between 4:00 and 6:00 p.m., about 391 primary trip vehicles would enter and about 370 primary trip vehicles would exit.

The proposed land use is projected to generate about 2,488 pass-by vehicle-trips on the average weekday. During the morning peak-hour, which generally occurs for one hour between 6:30 and 8:30 a.m., about 28 pass-by trip vehicles would enter and about 28 pass-by trip vehicles would exit the site. During the afternoon peak-hour, which generally occurs for one hour between 4:00 and 6:00 p.m., about 111 pass-by trip vehicles would enter and about 111 pass-by trip vehicles would exit.

TRIP DISTRIBUTION

Figure 6 shows the estimated directional distribution of the primary site-generated traffic volumes on the area roadways. The estimates were based on the location of the site with respect to the regional population, employment, and activity centers; and the site's proposed land use.

TRIP ASSIGNMENT

Figure 7a shows the estimated pass-by site-generated traffic volumes based on the trip generation estimate in Table 2. Figure 7b shows the estimated primary site-generated traffic volumes based on the directional distribution percentages (from Figure 6) and the trip generation estimate (from Table 2).

Figure 7c show the estimated total site-generated traffic volumes which is the sum of pass-by (Figure 7a) and primary (Figure 7b) site-generated trips.

2020 and 2035 TOTAL TRAFFIC

Figure 8 shows the 2020 total traffic which is the sum of the 2020 background traffic volumes (from Figure 4) and the total site-generated traffic volumes (from Figure 7c). Figure 8 also shows the recommended 2020 lane geometry and traffic control.

Figure 9 shows the 2035 total traffic which is the sum of 2035 background traffic volumes (from Figure 5) and the total site-generated traffic volumes (from Figure 7c). Figure 9 also shows the recommended 2035 lane geometry and traffic control.

Figures 10 and 11 detail the conceptual improvements to County Line Road and Erie Parkway shown in Figures 8 and 9 to accommodate 2020 and 2035 total traffic.

PROJECTED LEVELS OF SERVICE

The intersections in Figures 8 and 9 were analyzed to determine the 2020 and 2035 total levels of service. Table 1 shows the level of service analysis results. The level of service reports are attached.

- **Erie Parkway/E. County Line Road:** This signalized intersection is expected to operate at LOS "C" during both morning and afternoon peak-hours through 2035.

- **Erie Parkway/Full Movement Access:** This future intersection is expected to operate at LOS "D" or better for all movements through 2020 with stop sign control. By 2035 it is expected to be signalized and operate at an overall LOS "B" or better.

- **Erie Parkway/RIRO Site Access:** The northbound approach to this stop-sign controlled intersection is expected to operate at LOS "C" or better during both morning and afternoon peak-hours through 2020 and LOS "F" by 2035. The 2035 poor levels of service will be mitigated by providing a right-turn acceleration lane on Erie Parkway which will take the form of a continuous right-turn lane on Erie Parkway between the RIRO access and County Line Road.

- **County Line Road/Walgreens/North RIRO Access:** All approaches at this stop-sign controlled intersection are expected to operate at LOS “C” or better during both morning and afternoon peak-hours through 2035 with the addition of site traffic.

- **County Line Road/Mitchell Way:** All approaches at this stop-sign controlled intersection are expected to operate at LOS “C” or better during both morning and afternoon peak-hours through 2035 with or without the addition of site traffic assuming the intersection is converted from full movement to three-quarter movement when or after the County Line Road/Austin Avenue intersection is signalized. This is consistent with the findings of the May 2010 *Coal Creek Center TIA* by LSC and verified by this analysis.

- **County Line Road/Austin Avenue**: As a signalized intersection it is expected to operate at an overall LOS “D” or better during both morning and afternoon peak-hours through 2035. Prior to signalization the side road approaches will have significant delay.

- **Austin Avenue/Graham Way:** All approaches at this stop-sign controlled intersection are expected to operate at LOS “A” during both morning and afternoon peak-hours through 2035 with or without the addition of site traffic.

- **County Line Road/South RIRO Access:** All approaches at this stop-sign controlled intersection are expected to operate at LOS “C” or better during both morning and afternoon peak-hours through 2035.

- **Austin Avenue/East Full Movement Access:** All approaches at this stop-sign controlled intersection are expected to operate at LOS “B” or better during both morning and afternoon peak-hours through 2035.

- **Austin Avenue/West Full Movement Access:** All approaches at this stop-sign controlled intersection are expected to operate at LOS “B” or better during both morning and afternoon peak-hours through 2035.

- **Austin Avenue/Alley Access:** All approaches at this stop-sign controlled intersection are expected to operate at LOS “B” or better during both morning and afternoon peak-hours through 2035.

CONCLUSIONS AND RECOMMENDATIONS

Trip Generation

1. The site is projected to generate about 8,362 net external primary vehicle-trips on the average weekday, with about half entering and half exiting during a 24-hour period. During the morning peak-hour, about 128 primary trip vehicles would enter and about 164 primary trip vehicles would exit the site. During the afternoon peak-hour, about 391 primary trip vehicles would enter and about 370 primary trip vehicles would exit.

2. The site use is projected to generate about 2,488 pass-by vehicle-trips on the average weekday. During the morning peak-hour, about 28 pass-by trip vehicles would enter and

about 28 pass-by trip vehicles would exit the site. During the afternoon peak-hour, about 111 pass-by trip vehicles would enter and about 111 pass-by trip vehicles would exit.

Projected Levels of Service

3. All movements at the intersections analyzed are expected to operate at LOS "D" or better during both morning and afternoon peak-hours in 2035 assuming the recommended improvements are implemented.

Conclusions

The impact of the Four Corners development site can be accommodated by the existing and proposed roadway network with the recommended improvements below.

2020 Recommended Improvements

4. The conceptual lane geometry and traffic control improvements for the County Line Road site frontage is shown in Figure 10. These improvements will accommodate the projected traffic volumes through 2035. Beyond 2035 it is likely County Line Road will be widened to four and possibly six lanes per the *Erie Transportation Master Plan.*

5. The conceptual lane geometry and traffic control improvements for the Erie Parkway frontage is shown in Figure 11.

6. A two-way left-turn lane is recommended on Austin Avenue along the site frontage consistent with Austin Avenue east of County Line Road. This can likely be accomplished by re-striping.

* * * * *

We trust our findings will assist you in gaining approval of the proposed Four Corners development. Please contact me if you have any questions or need further assistance.

Sincerely,

LSC TRANSPORTATION CONSULTANTS, INC.

By____
Christopher S. McGranahan, PE, PTOE
Principal

COLORADO LICENSED
CHRISTOPHER S. MCGRANAHAN
39018
PROFESSIONAL ENGINEER

5-31-16

CSM/wc

Enclosures: Tables 1 and 2
Figures 1 - 11
Traffic Count Reports
Level of Service Definitions
Level of Service Reports

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Table 1 (Page 1 of 2)
Intersection Levels of Service Analysis
Four Corners Update
Erie, CO
(LSC #141101; May, 2015)

		Existing Traffic		2020 Background		2020 Total Traffic		2035 Background		2035 Total	
Intersection Location	Traffic Control	Level of Service AM	Level of Service PM	Level of Service AM	Level of Service PM	Level of Service AM	Level of Service PM	Level of Service AM	Level of Service PM	Level of Service AM	Level of Service PM
Erie Parkway/North Site Access/Future Access	TWSC										
NB Left		--	--	--	--	C	D	--	--	--	--
NB Through/Right		--	--	--	--	B	C	--	--	--	--
EB Left		--	--	A	A	A	A	--	--	--	--
WB Left		--	--	--	--	A	A	--	--	--	--
SB Left		--	--	C	C	C	C	--	--	--	--
SB Right		--	--	B	A	--	--	--	--	--	--
SB Through/Right		--	--	--	--	C	C	--	--	--	--
Critical Movement Delay		--	--	19.2	19.9	22.4	31	--	--	--	--
	Signalized										
EB Left		--	--	--	--	--	--	A	A	A	A
EB Through		--	--	--	--	--	--	A	A	A	B
EB Right		--	--	--	--	--	--	--	--	A	A
WB Left		--	--	--	--	--	--	--	--	A	A
WB Through		--	--	--	--	--	--	A	A	A	A
WB Right		--	--	--	--	--	--	A	A	A	A
NB Left		--	--	--	--	--	--	--	--	C	C
NB Through/Right		--	--	--	--	--	--	--	--	D	D
SB Left		--	--	--	--	--	--	D	D	C	C
SB Right		--	--	--	--	--	--	D	D	D	D
Entire Intersection Delay (sec /veh)		--	--	--	--	--	--	2.8	6.8	4.7	11.3
Entire Intersection LOS		--	--	--	--	--	--	A	A	A	B
Erie Parkway/E. County Line Road	Signalized										
EB Left		B	B	B	B	B	B	C	B	C	B
EB Through		B	B	C	C	C	C	C	A	C	B
EB Right		B	B	C	C	C	C	D	B	C	C
WB Left		B	B	B	B	B	D	B	B	C	D
WB Through		B	B	C	B	C	B	C	B	C	B
WB Right		B	B	B	B	B	B	C	B	C	C
NB Left		C	C	C	C	C	C	B	C	D	D
NB Through		C	C	C	C	C	C	C	D	C	D
NB Right		C	D	C	D	C	D	C	D	B	D
SB Left		C	C	C	C	C	C	C	C	D	D
SB Through/Right		D	C	E	C	F	D	--	--	--	--
SB Through		--	--	--	--	--	--	C	D	C	D
SB Right		--	--	--	--	--	--	C	C	C	C
Entire Intersection Delay (sec /veh)		25.7	23.0	30.1	25.3	32.0	29.7	24.9	22.9	28.8	30.7
Entire Intersection LOS		C	C	C	C	C	C	C	C	C	C
E. County Line Road/Walgreens/North RIRO	TWSC										
EB Approach		--	--	--	--	B	C	--	--	C	C
WB Approach		B	B	B	B	B	B	B	B	B	B
Critical Movement Delay		10.3	11.0	10.7	11.6	14.6	15.1	12.3	13.2	19.9	24.2
E. County Line Road/Mitchell Way	TWSC										
NB Left		--	--	--	--	A	A	--	--	B	B
EB Approach		--	--	--	--	B	B	--	--	C	C
WB Approach		C	D	B	B	B	B	C	C	C	C
SB Left		A	A	A	A	A	A	B	B	B	B
Critical Movement Delay		21.1	28.8	13.8	14.3	14.0	14.9	21.2	21.7	22.2	24.2

Table 1 (Page 2 of 2)
Intersection Levels of Service Analysis
Four Corners Update
Erie, CO
(LSC #141101; May, 2015)

		Existing Traffic		2020 Background		2020 Total Traffic		2035 Background		2035 Total	
Intersection Location	Traffic Control	Level of Service AM	Level of Service PM	Level of Service AM	Level of Service PM	Level of Service AM	Level of Service PM	Level of Service AM	Level of Service PM	Level of Service AM	Level of Service PM
E. County Line Road/South RIRO Access	TWSC										
EB Approach		--	--	--	--	B	B	--	--	C	C
Critical Movement Delay		--	--	--	--	13.6	13.6	--	--	17.6	20.0
E. County Line Road/Austin Avenue	TWSC										
NB Left		A	A	--	--	--	--	--	--	--	--
EB Approach		D	E	--	--	--	--	--	--	--	--
WB Left		F	F	--	--	--	--	--	--	--	--
WB Through/Right		D	D	--	--	--	--	--	--	--	--
SB Left		A	A	--	--	--	--	--	--	--	--
Critical Movement Delay		56.8	68.3	--	--	--	--	--	--	--	--
	Signalized										
EB Left		--	--	B	B	B	B	B	B	C	C
EB Through/Right		--	--	B	B	B	B	B	A	D	D
WB Left		--	--	B	B	B	B	B	B	C	C
WB Through/Right		--	--	B	B	B	A	B	B	D	D
NB Left		--	--	A	A	A	B	B	B	B	C
NB Through		--	--	A	A	A	B	C	B	C	C
NB Right		--	--	A	A	A	A	A	A	B	B
SB Left		--	--	A	A	A	B	C	B	C	B
SB Through		--	--	A	A	A	A	B	C	C	D
SB Right		--	--	A	A	A	A	A	A	A	B
Entire Intersection Delay (sec /veh)		--	--	7.9	7.7	8.9	9.8	17.8	17.9	28.2	36.5
Entire Intersection LOS		--	--	A	A	A	A	B	B	C	D
Austin Avenue/East FMA Access	TWSC										
EB Approach		--	--	--	--	A	A	--	--	A	A
SB Approach		--	--	--	--	B	B	--	--	B	B
Critical Movement Delay		--	--	--	--	10.1	12.3	--	--	10.7	13.4
Austin Avenue/Alley Access	TWSC										
EB Approach		--	--	--	--	A	A	--	--	A	A
SB Approach		--	--	--	--	A	B	--	--	B	B
Critical Movement Delay		--	--	--	--	9.9	10.3	--	--	10.5	10.8
Austin Avenue/Graham Way	TWSC										
NB Approach		A	A	A	A	A	A	A	A	A	A
WB Approach		A	A	A	A	A	A	A	A	A	A
Critical Movement Delay		8.7	8.7	8.9	8.9	9.1	9.3	9.2	9.0	9.4	9.0
Austin Avenue/West FMA Access	TWSC										
EB Approach		--	--	--	--	A	A	--	--	A	A
SB Approach		--	--	--	--	A	B	--	--	A	B
Critical Movement Delay		--	--	--	--	9.5	10.1	--	--	9.9	10.2
Erie Parkway/North RIRO Site Access											
NB Approach		--	--	--	--	B	C	--	--	B	F
Critical Movement Delay		--	--	--	--	10.5	20.6	--	--	12.0	65.5

Table 2
ESTIMATED TRAFFIC GENERATION
Four Corners Update
Erie, CO
(LSC #141101; May, 2016)

	Trip	Trip Generation Rates (1)					Total Trips Generated				
	Generation	Average	AM Peak-Hour		PM Peak-Hour		Average	AM Peak-Hour		PM Peak-Hour	
Land Use Description	Units	Weekday	In	Out	In	Out	Weekday	In	Out	In	Out
Single-Family (2)	105 DU (3)	9.52	0.188	0.563	0.630	0.370	1,000	20	59	66	39
Townhomes (4)	156 DU	5.81	0.075	0.365	0.348	0.172	906	12	57	54	27
Multi-Family (5)	30 DU	6.65	0.102	0.408	0.403	0.217	200	3	12	12	7
Shopping Center (6)	180 KSF (7)	55.28	0.769	0.471	2.369	2.566	9,950	138	85	426	462
						Subtotal =	**12,056**	**173**	**213**	**558**	**535**
						Internal Capture Reduction (10%)	1,206	17	21	56	54
						Pass-By Trips (25%) (8)	2,488	28	28	111	111
						Net External Trip Total =	**8,362**	**128**	**164**	**391**	**370**

Notes:

(1) Source: *Trip Generation*, Institute of Transportation Engineers, 9th Edition, 2012.
(2) ITE Land Use No. 210 - Single-Family Detached Housing
(3) DU = Dwelling Units
(4) ITE Land Use No. 230 - Residential Condominium/ Townhouse
(5) ITE Land Use No. 220 - Apartments
(6) ITE Land Use No. 820 - Shopping Center - formula rates based on the total square footage
(7) KSF = 1,000 Square Feet
(8) Pass-by trips assumed for shopping center land use only

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N

Approximate Scale
Scale: 1"=1,200'

Figure 1

Vicinity Map

Four Corners Update (LSC # 141101)

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Figure 2

Site Plan

Four Corners Update (LSC # 141101)

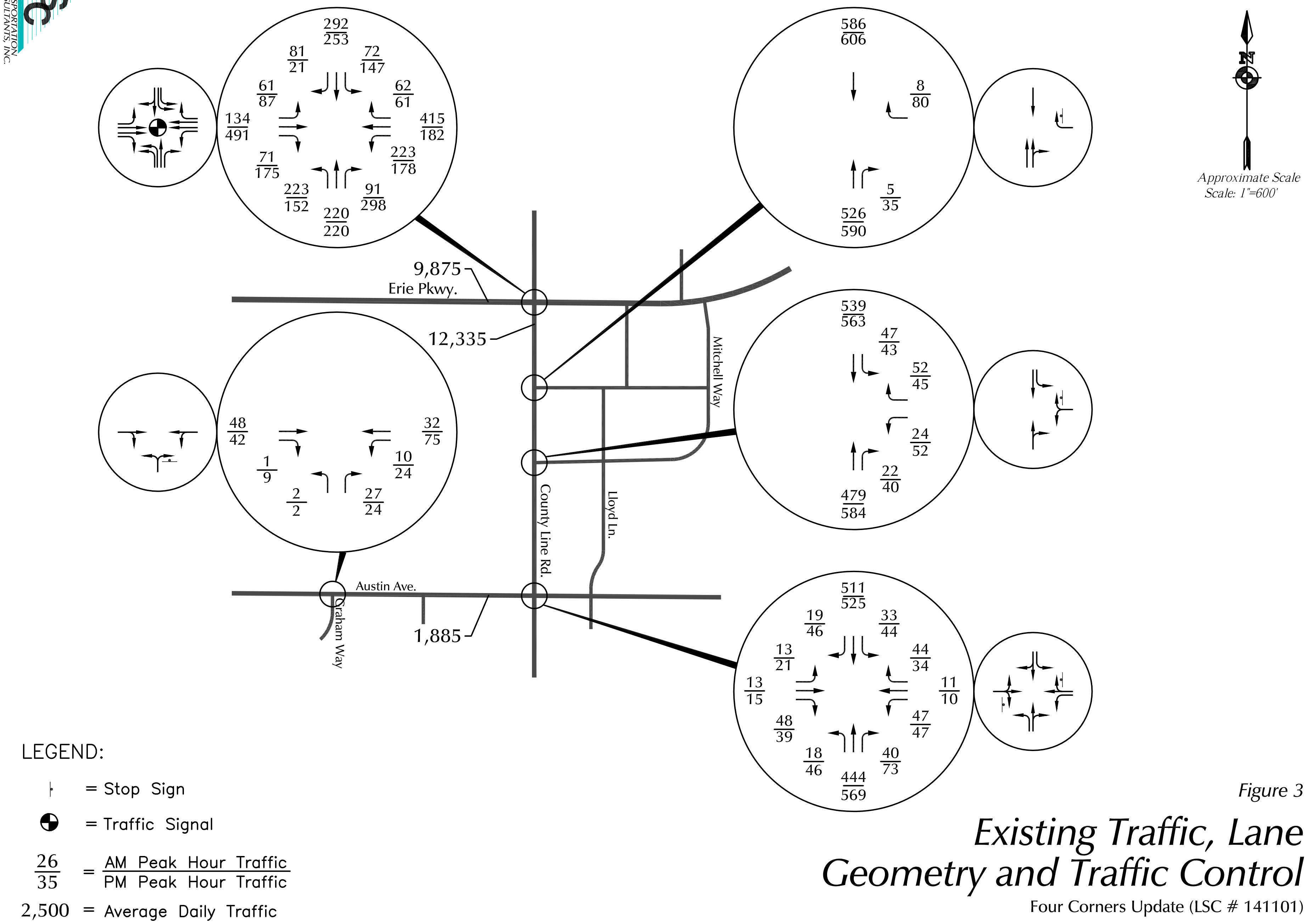
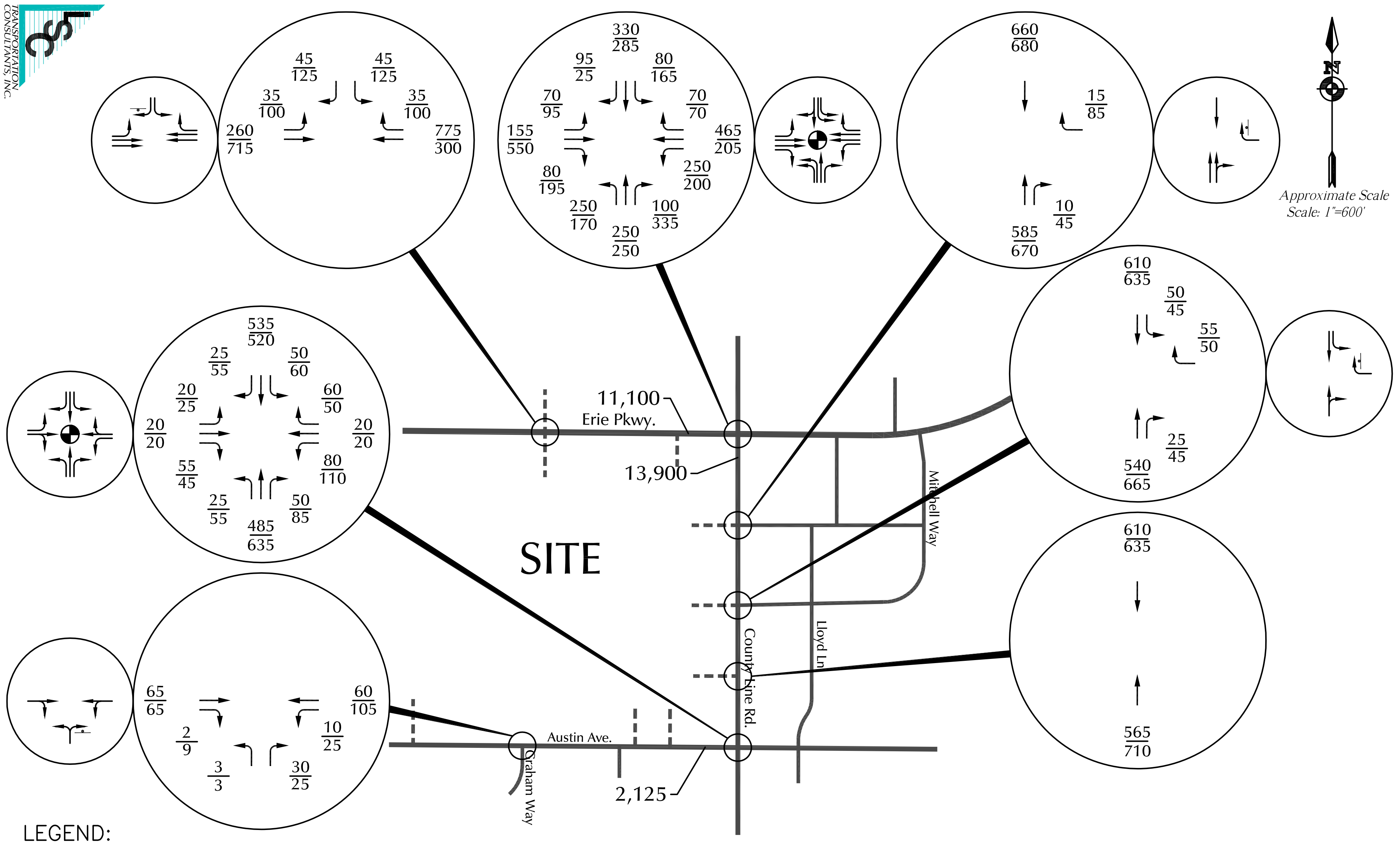


Figure 3

Existing Traffic, Lane Geometry and Traffic Control

Four Corners Update (LSC # 141101)



LEGEND:

= Stop Sign

= Traffic Signal

26/35 = AM Peak Hour Traffic / PM Peak Hour Traffic

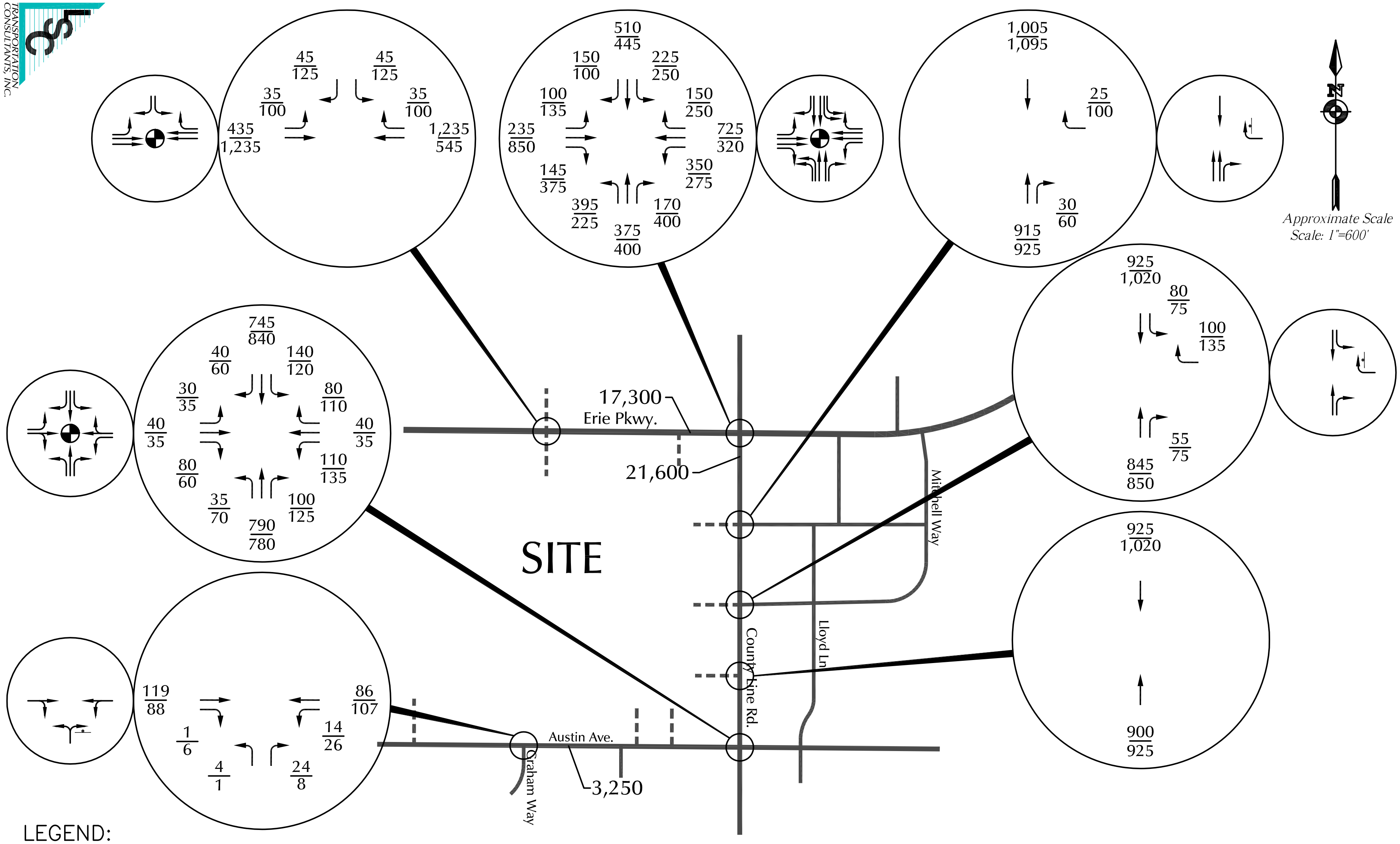
2,500 = Average Daily Traffic

Note:
Lane geometry and traffic control is the same as shown on Figure 3 unless shown different above. Assumes three percent annual growth on arterial roadways.

Figure 4

Year 2020 Background Traffic

Four Corners Update (LSC # 141101)



LEGEND:

| = Stop Sign

⊕ = Traffic Signal

26/35 = AM Peak Hour Traffic / PM Peak Hour Traffic

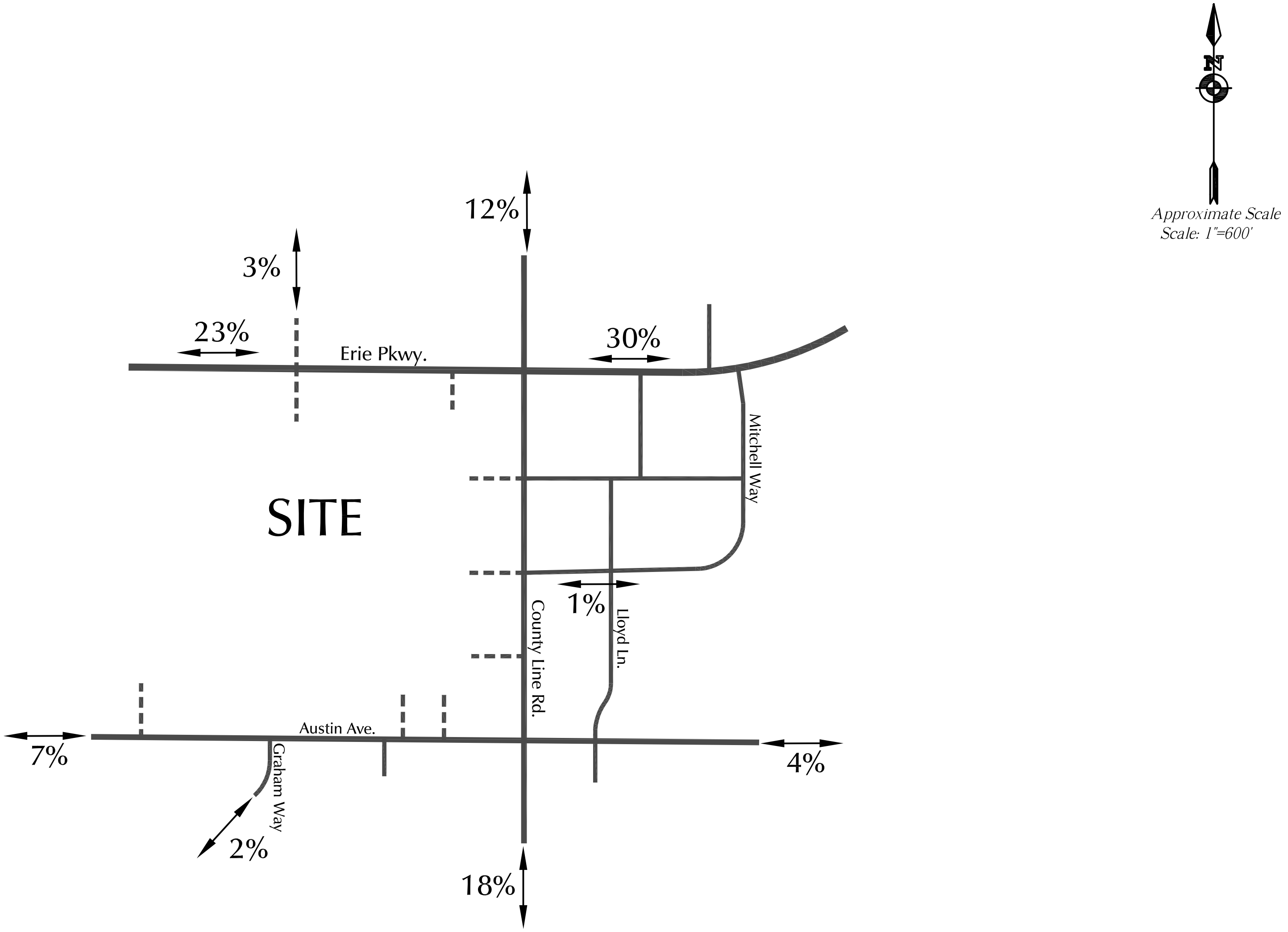
2,500 = Average Daily Traffic

Note:
Lane geometry and traffic control is the same as shown on Figure 3 unless shown different above. Assume three percent annual growth on arterial roadways.

Figure 5

Year 2035 Background Traffic

Four Corners Update (LSC # 141101)



LEGEND:

65% = Percent Directional Distribution

Figure 6

Directional Distribution of Primary Site-Generated Traffic

Four Corners Update (LSC # 141101)

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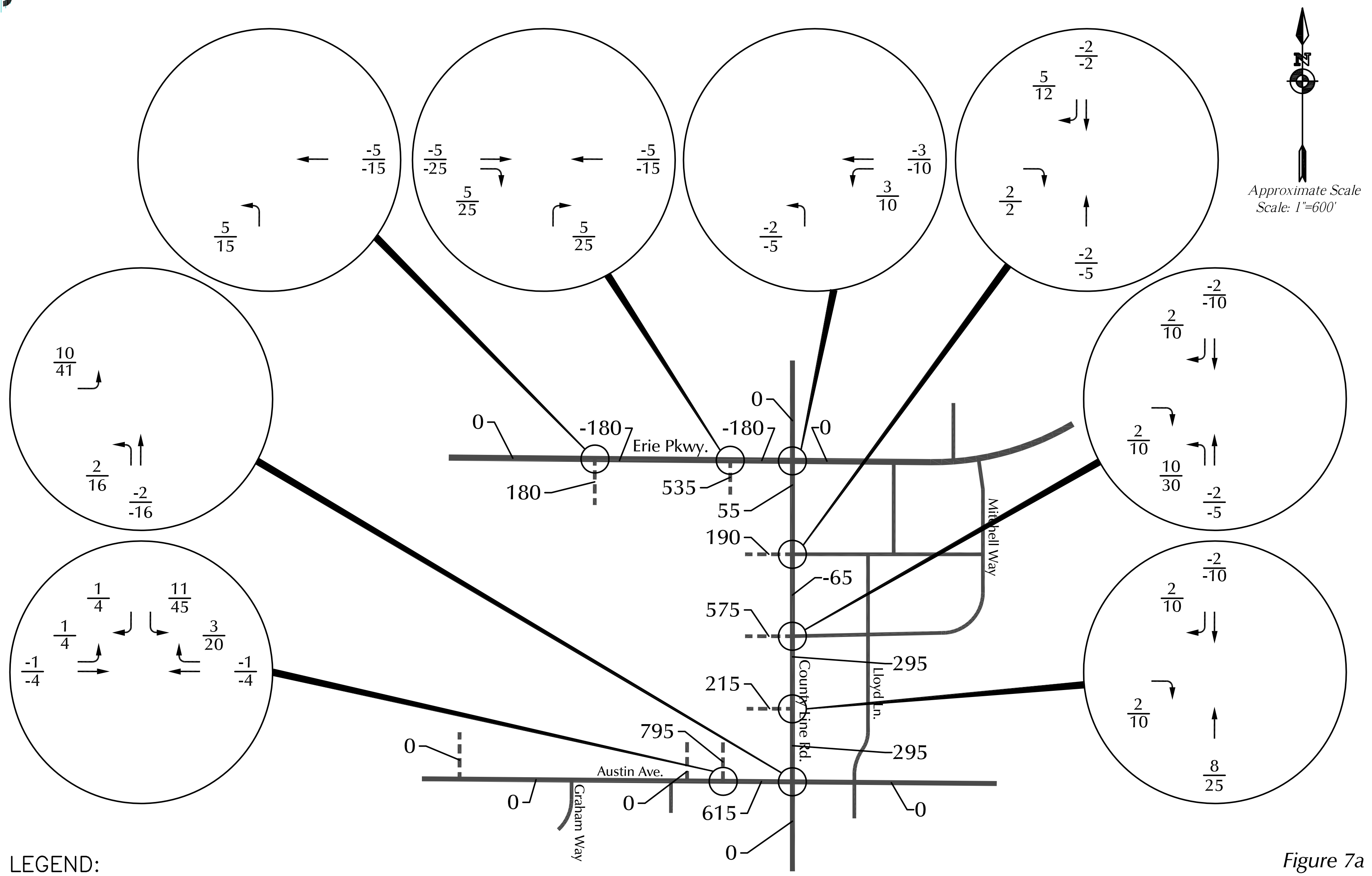


LEGEND:

26/35 = AM Peak Hour Traffic / PM Peak Hour Traffic

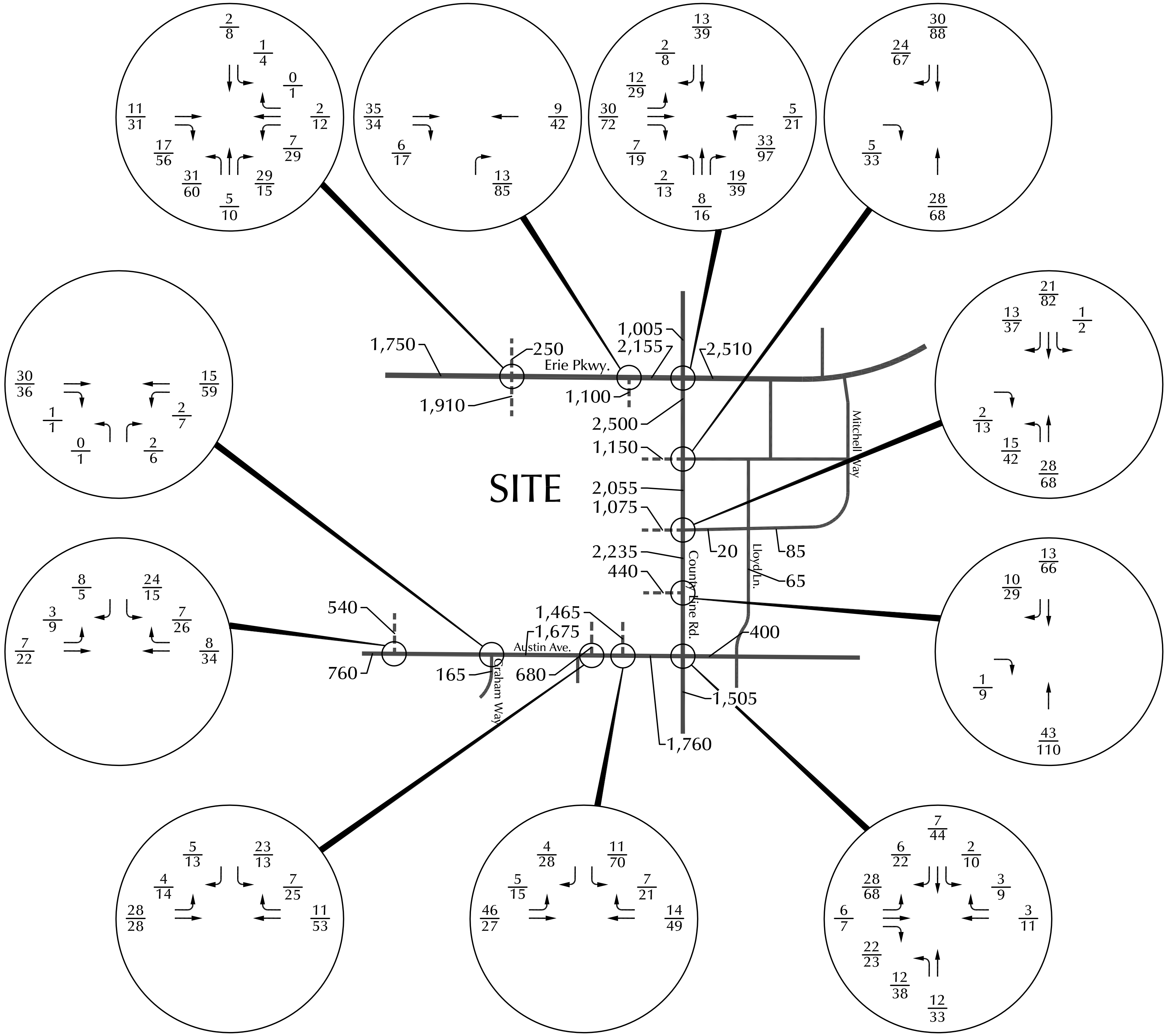
2,500 = Average Daily Traffic

Figure 7a

Assignment of Pass-by Site-Generated Traffic

Four Corners Update (LSC # 141101)

Approximate Scale
Scale: 1"=600'



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LEGEND:

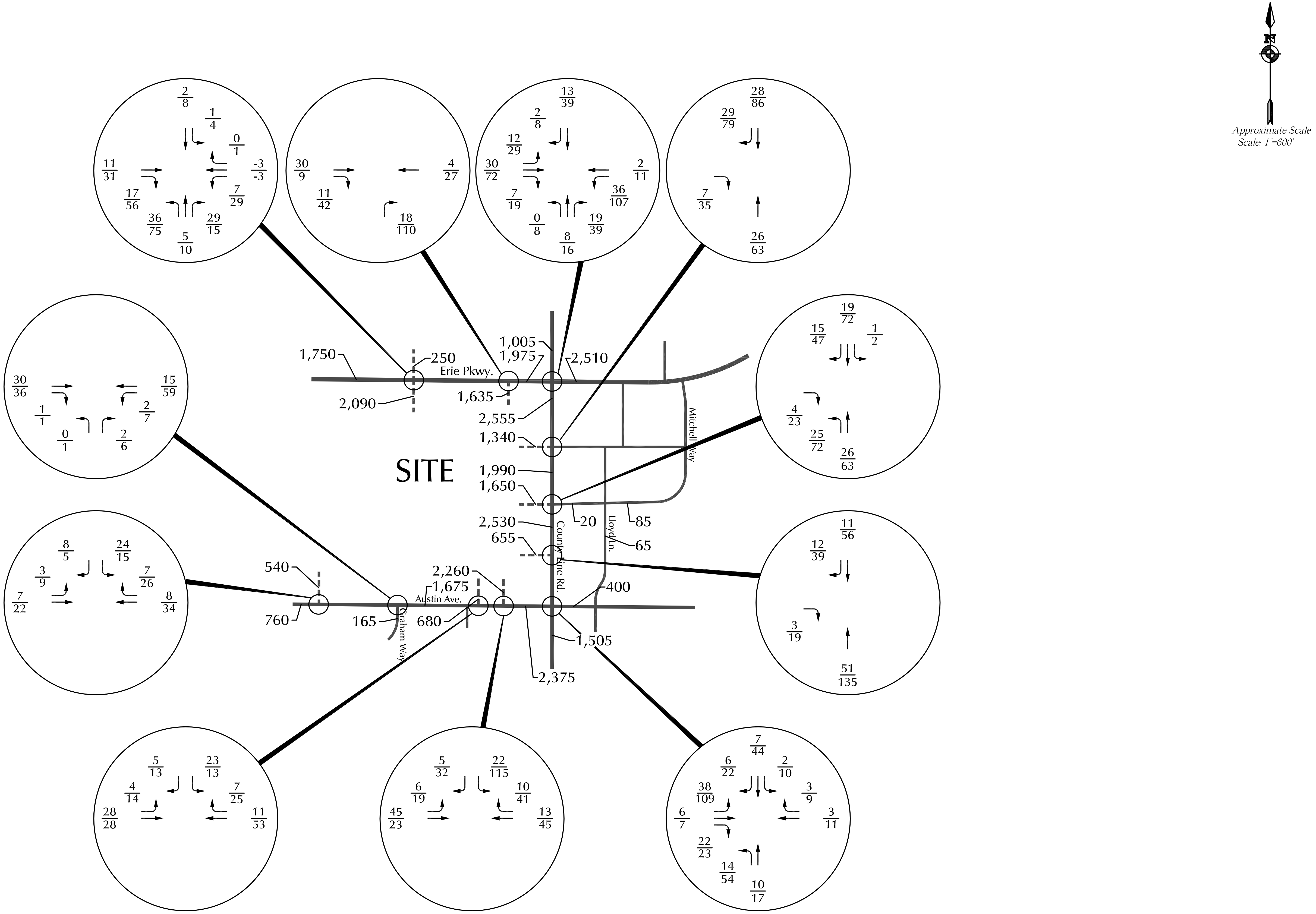
$\frac{26}{35}$ = AM Peak Hour Traffic / PM Peak Hour Traffic

2,500 = Average Daily Traffic

Figure 7b

Assignment of Primary Site-Generated Traffic

Four Corners Update (LSC # 141101)



LEGEND:

$\frac{26}{35}$ = AM Peak Hour Traffic / PM Peak Hour Traffic

2,500 = Average Daily Traffic

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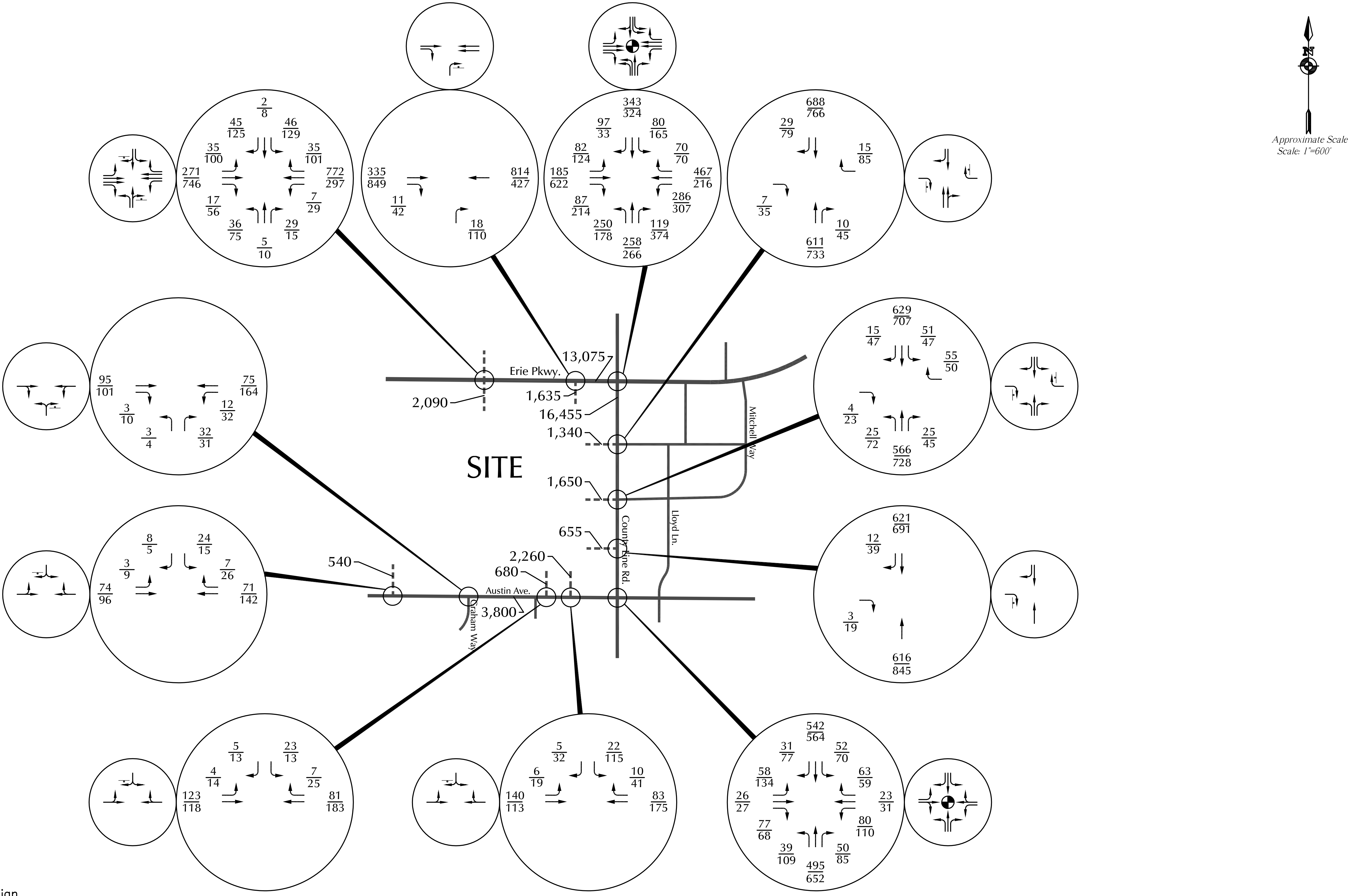
Figure 7c

Assignment of Total Site-Generated Traffic

Four Corners Update (LSC # 141101)



LEGEND:

$\vdash$ = Stop Sign

● = Traffic Signal

$\frac{26}{35}$ = $\frac{\text{AM Peak Hour Traffic}}{\text{PM Peak Hour Traffic}}$

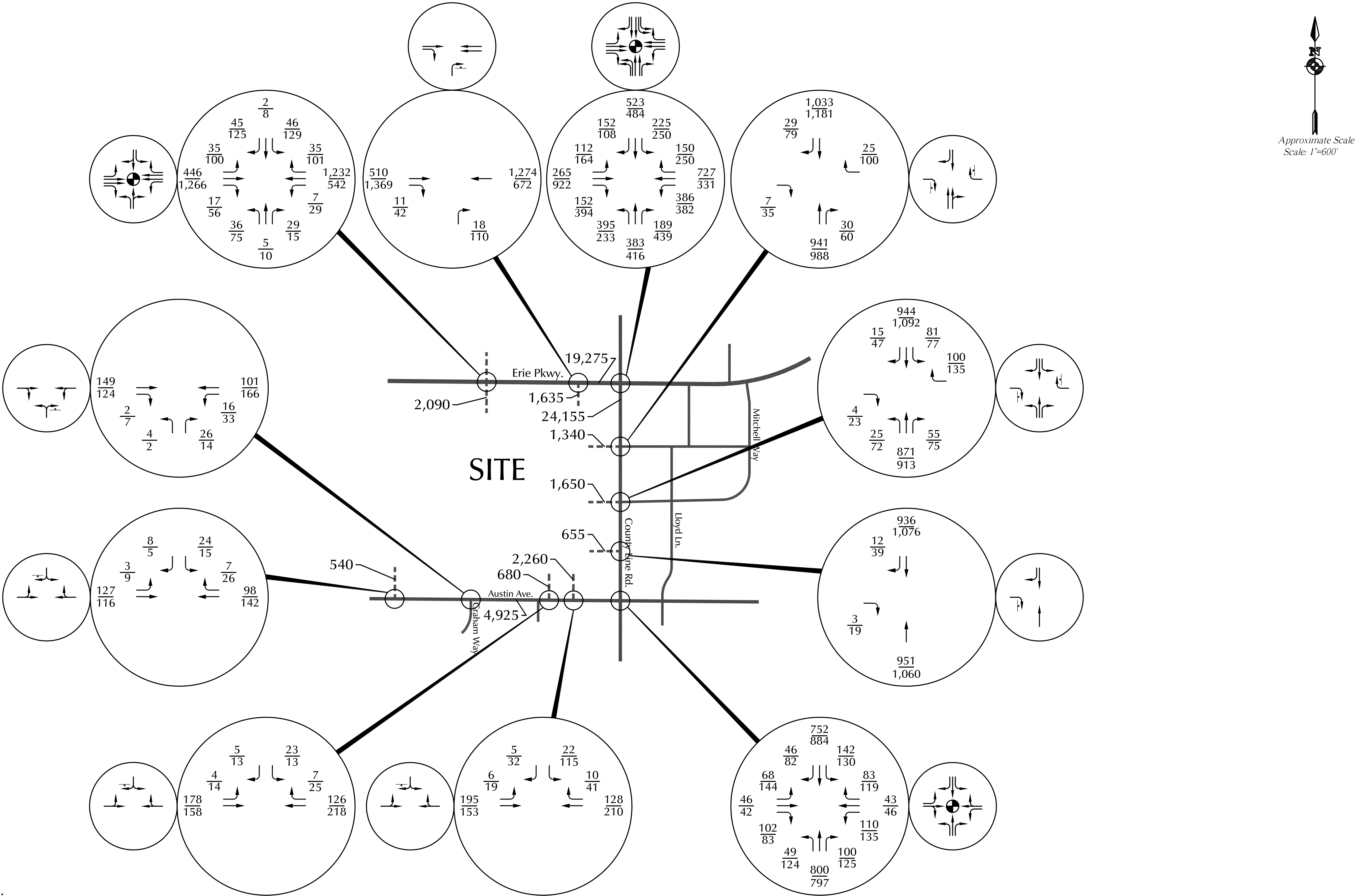
2,500 = Average Daily Traffic

LSC TRANSPORTATION CONSULTANTS, INC.

Figure 8

Year 2020 Total Traffic, Lane Geometry and Traffic Control

Four Corners Update (LSC # 141101)



LEGEND:

ᛁ = Stop Sign

● = Traffic Signal

26/35 = AM Peak Hour Traffic / PM Peak Hour Traffic

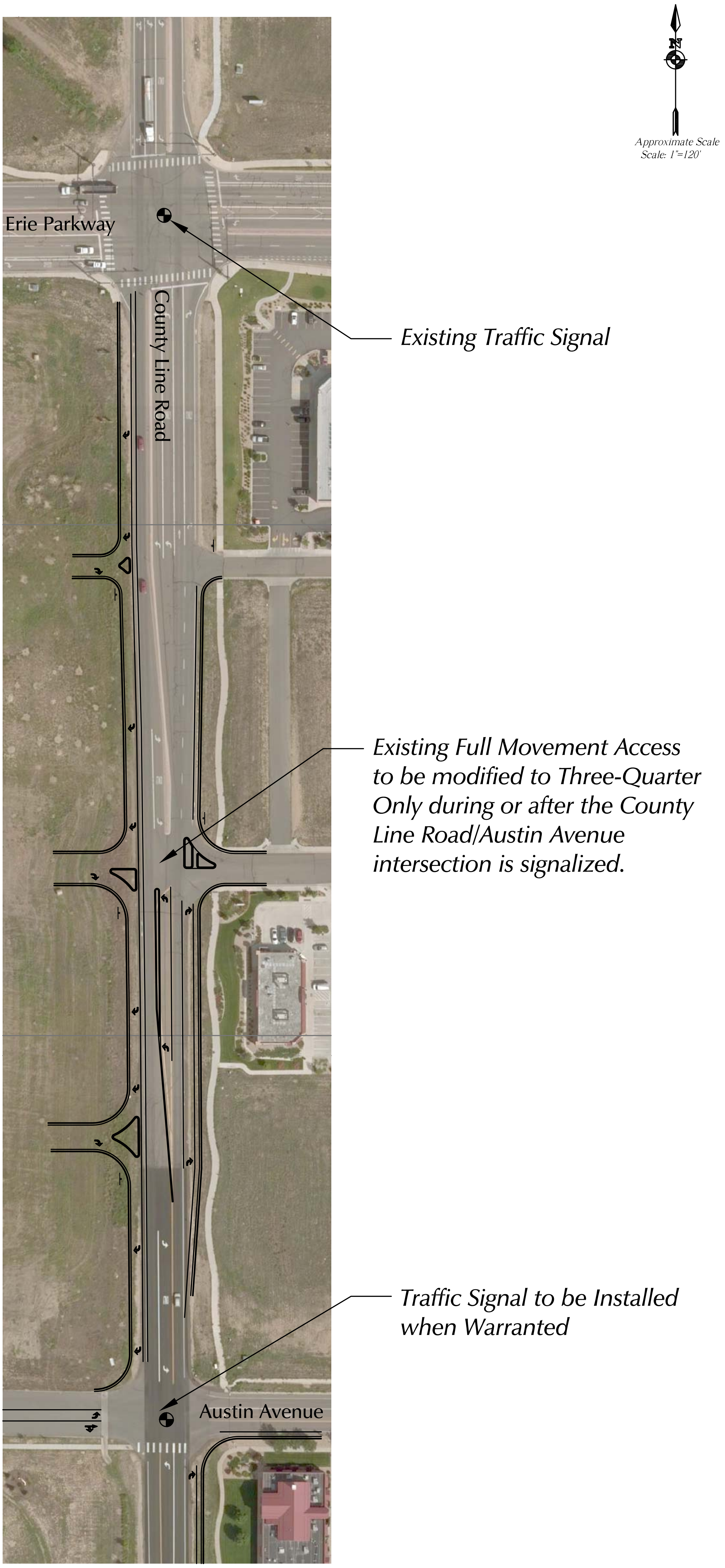
2,500 = Average Daily Traffic

TRANSPORTATION CONSULTANTS, INC.

Figure 9

Year 2035 Total Traffic, Lane Geometry and Traffic Control

Four Corners Update (LSC # 141101)



Existing Traffic Signal

Existing Full Movement Access to be modified to Three-Quarter Only during or after the County Line Road/Austin Avenue intersection is signalized.

Traffic Signal to be Installed when Warranted

LEGEND:

ト = Stop Sign

◕ = Traffic Signal

Note:
Auxiliary lanes on the east side of County Line Road are expected to be constructed by future development on the east side of County Line Road.

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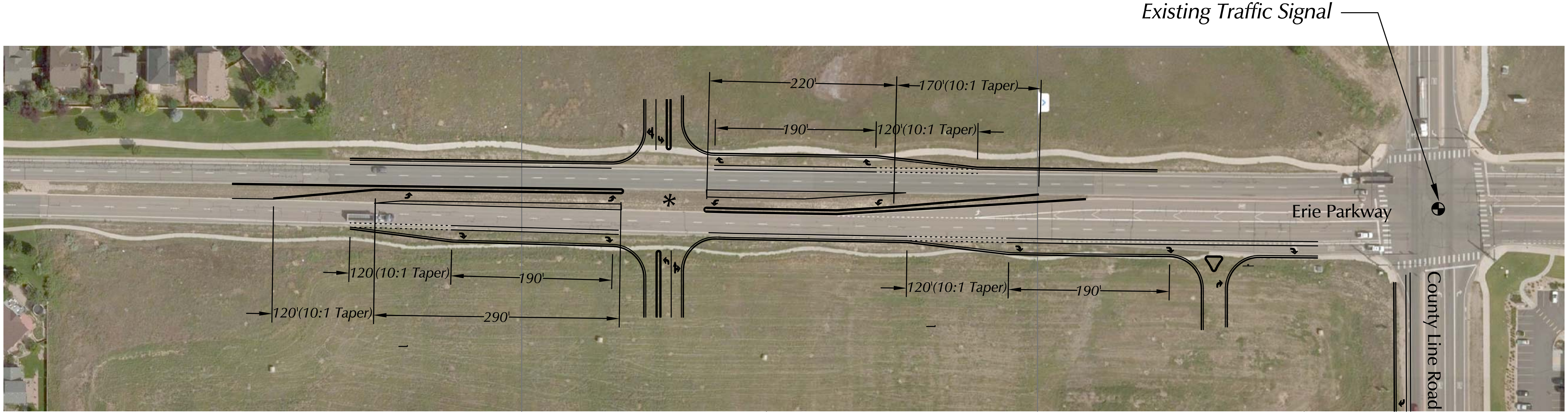
Figure 10

Recommended Improvements to County Line Road

Four Corners Update (LSC # 141101)

LSC TRANSPORTATION CONSULTANTS, INC.

Approximate Scale
Scale: 1"=120'



* = Northbound and southbound stop sign control through 2020 or until traffic signal warrant is met. Traffic signal control by 2035.

LEGEND:

⊢ = Stop Sign

⊕ = Traffic Signal

Note:
Lane lengths are based on a posted speed limit of 35mph.

Figure 11

Recommended Improvements to Erie Parkway

Four Corners Update (LSC # 141101)

COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COUNTY LINE RD
E/W STREET: ERIE PKWY
CITY: ERIE
COUNTY: WELD

File Name : COUNERIE1
Site Code : 00000022
Start Date : 5/3/2016
Page No : 1

Groups Printed- VEHICLES

	COUNTY LINE RD Southbound				ERIE PKWY Westbound				COUNTY LINE RD Northbound				ERIE PKWY Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
06:30 AM	9	35	5	0	32	62	9	0	31	23	13	1	5	18	11	0	254
06:45 AM	13	42	8	2	37	65	9	2	24	24	26	0	2	31	11	0	296
Total	22	77	13	2	69	127	18	2	55	47	39	1	7	49	22	0	550
07:00 AM	8	57	13	2	48	85	7	0	43	35	39	0	3	60	14	0	414
07:15 AM	17	64	17	1	57	104	11	1	54	55	14	0	11	40	14	0	460
07:30 AM	12	78	14	0	66	116	18	0	65	59	20	0	18	30	20	0	516
07:45 AM	19	102	29	0	63	99	13	0	59	57	27	0	22	35	16	0	541
Total	56	301	73	3	234	404	49	1	221	206	100	0	54	165	64	0	1931
08:00 AM	24	48	21	0	37	96	20	0	45	49	30	0	10	29	21	0	430
08:15 AM	12	58	15	0	43	64	22	0	72	34	38	0	5	35	38	0	436
Total	36	106	36	0	80	160	42	0	117	83	68	0	15	64	59	0	866
04:00 PM	40	60	11	3	38	41	18	0	24	47	55	3	17	73	20	1	451
04:15 PM	29	41	9	1	42	38	13	1	26	42	43	2	9	72	32	0	400
04:30 PM	20	53	11	2	32	47	27	2	25	48	54	2	22	102	40	1	488
04:45 PM	57	42	10	0	56	48	12	1	29	64	74	0	13	115	36	0	557
Total	146	196	41	6	168	174	70	4	104	201	226	7	61	362	128	2	1896
05:00 PM	28	61	6	2	36	42	19	2	42	64	78	2	28	126	43	1	580
05:15 PM	37	70	7	0	39	59	13	2	38	60	74	4	22	128	43	1	597
05:30 PM	50	58	4	1	58	31	12	0	35	43	58	0	17	122	53	0	542
05:45 PM	32	64	4	1	45	50	17	0	37	53	88	1	20	115	36	0	563
Total	147	253	21	4	178	182	61	4	152	220	298	7	87	491	175	2	2282
Grand Total	407	933	184	15	729	1047	240	11	649	757	731	15	224	1131	448	4	7525
Apprch %	26.4	60.6	12.0	1.0	36.0	51.7	11.8	0.5	30.2	35.2	34.0	0.7	12.4	62.6	24.8	0.2	
Total %	5.4	12.4	2.4	0.2	9.7	13.9	3.2	0.1	8.6	10.1	9.7	0.2	3.0	15.0	6.0	0.1	

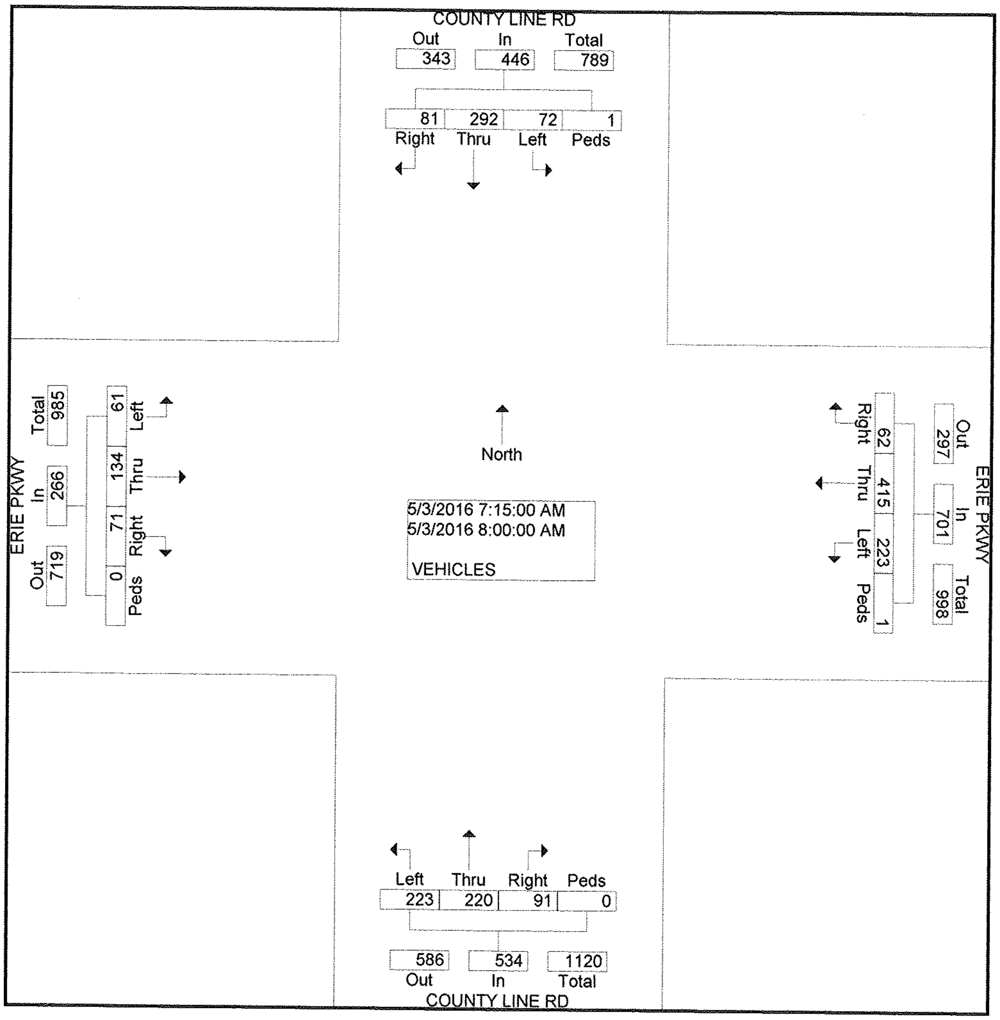
COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COUNTY LINE RD
E/W STREET: ERIE PKWY
CITY: ERIE
COUNTY: WELD

File Name : COUNERIE1
Site Code : 00000022
Start Date : 5/3/2016
Page No : 2

	COUNTY LINE RD Southbound					ERIE PKWY Westbound					COUNTY LINE RD Northbound					ERIE PKWY Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 06:30 AM to 08:30 AM - Peak 1 of 1																					
Intersection	07:15 AM																				
Volume	72	292	81	1	446	223	415	62	1	701	223	220	91	0	534	61	134	71	0	266	1947
Percent	16.1	65.5	18.2	0.2		31.8	59.2	8.8	0.1		41.8	41.2	17.0	0.0		22.9	50.4	26.7	0.0		
07:45 Volume	19	102	29	0	150	63	99	13	0	175	59	57	27	0	143	22	35	16	0	73	541
Peak Factor																					0.900
High Int.	07:45 AM					07:30 AM					07:30 AM					07:45 AM					
Volume	19	102	29	0	150	66	116	18	0	200	65	59	20	0	144	22	35	16	0	73	
Peak Factor					0.743					0.876					0.927					0.911	



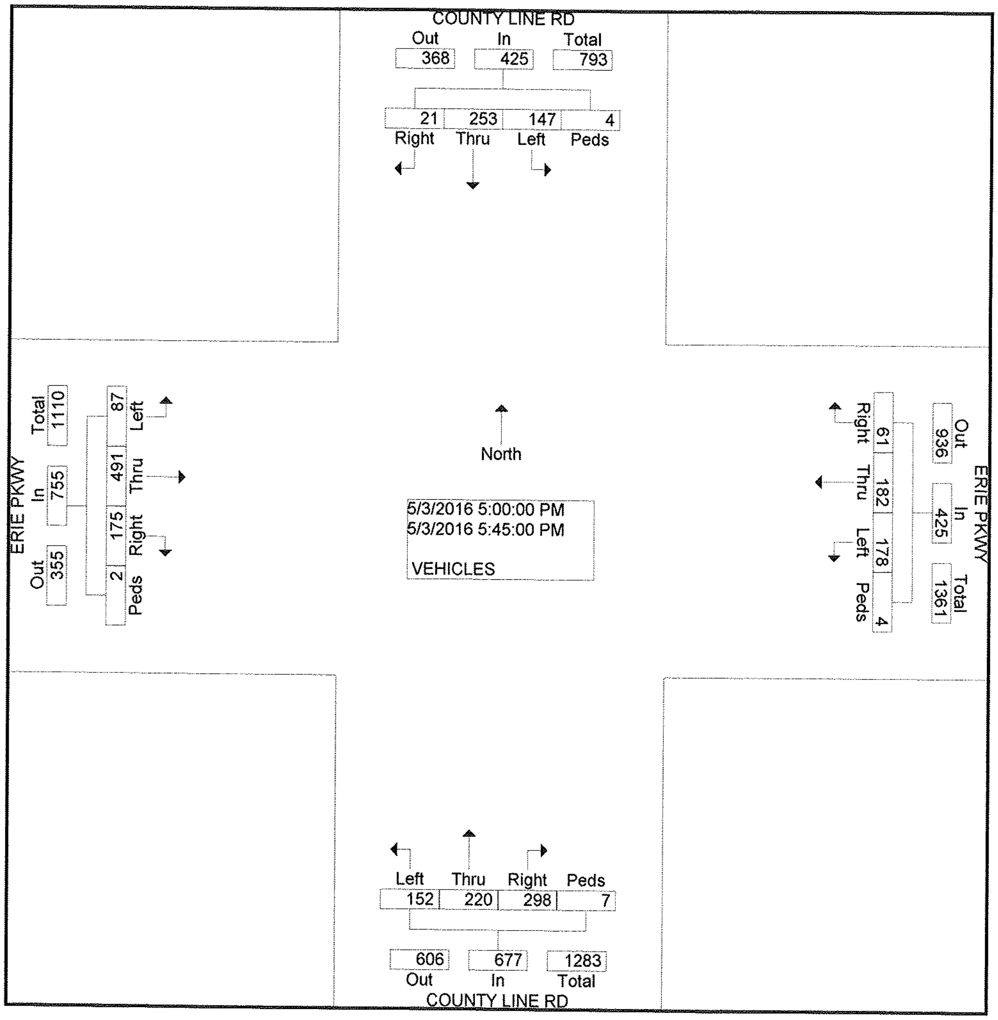
COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COUNTY LINE RD
E/W STREET: ERIE PKWY
CITY: ERIE
COUNTY: WELD

File Name : COUNERIE1
Site Code : 00000022
Start Date : 5/3/2016
Page No : 2

	COUNTY LINE RD Southbound					ERIE PKWY Westbound					COUNTY LINE RD Northbound					ERIE PKWY Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	05:00 PM																				
Volume	147	253	21	4	425	178	182	61	4	425	152	220	298	7	677	87	491	175	2	755	2282
Percent	34.6	59.5	4.9	0.9		41.9	42.8	14.4	0.9		22.5	32.5	44.0	1.0		11.5	65.0	23.2	0.3		
05:15 Volume	37	70	7	0	114	39	59	13	2	113	38	60	74	4	176	22	128	43	1	194	597
Peak Factor																					0.956
High Int.	05:15 PM					05:15 PM					05:00 PM					05:00 PM					
Volume	37	70	7	0	114	39	59	13	2	113	42	64	78	2	186	28	126	43	1	198	
Peak Factor					0.932					0.940					0.910					0.953	



5/3/2016 5:00:00 PM
5/3/2016 5:45:00 PM

VEHICLES

COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COUNTY LINE RD
E/W STREET: WALGREENS ACCESS
CITY: ERIE
COUNTY: WELD

File Name : COUNWALG1
Site Code : 00000016
Start Date : 5/3/2016
Page No : 1

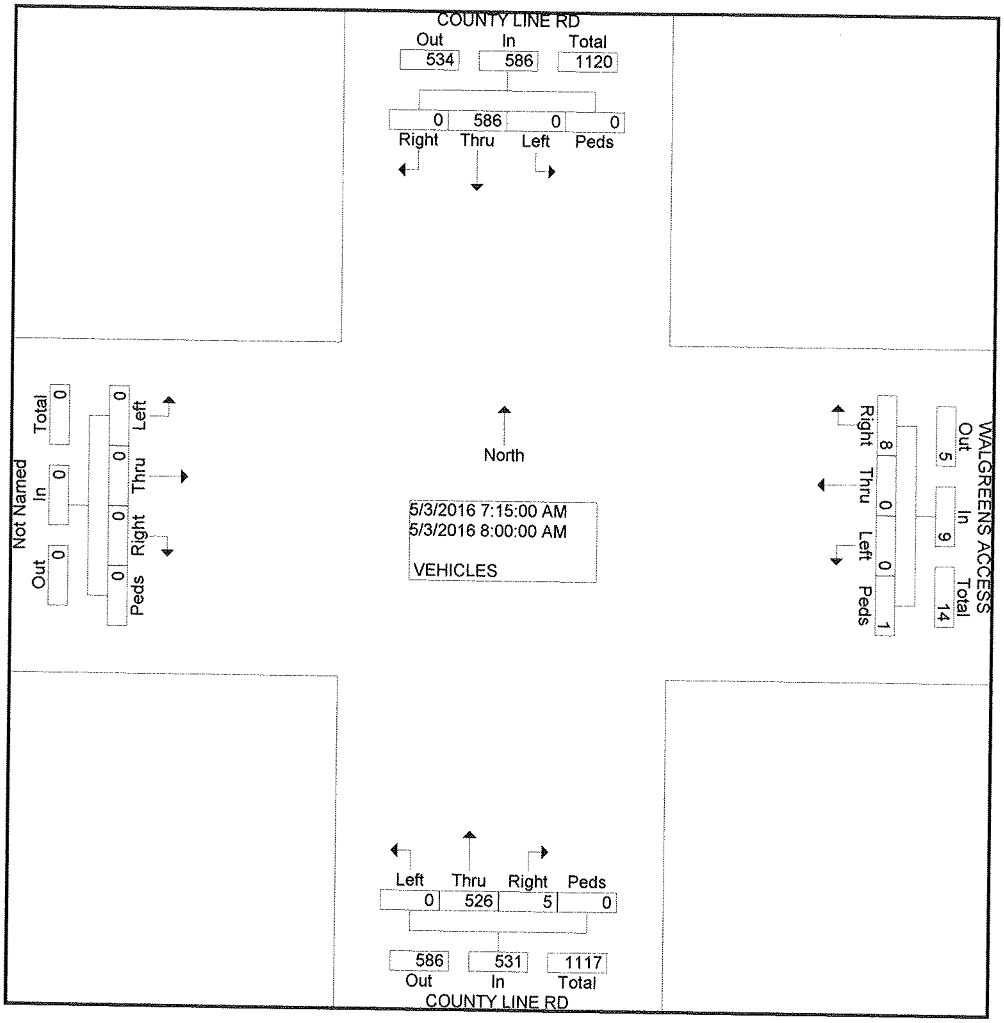
Groups Printed- VEHICLES

	COUNTY LINE RD Southbound				WALGREENS ACCESS Westbound				COUNTY LINE RD Northbound				Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
06:30 AM	0	78	0	0	0	0	0	0	0	67	0	0	0	0	0	0	145
06:45 AM	0	90	0	0	0	0	1	1	0	73	0	0	0	0	0	0	165
Total	0	168	0	0	0	0	1	1	0	140	0	0	0	0	0	0	310
07:00 AM	0	119	0	0	0	0	0	0	0	117	0	0	0	0	0	0	236
07:15 AM	0	135	0	0	0	0	1	0	0	122	1	0	0	0	0	0	259
07:30 AM	0	164	0	0	0	0	1	0	0	143	2	0	0	0	0	0	310
07:45 AM	0	181	0	0	0	0	3	0	0	140	2	0	0	0	0	0	326
Total	0	599	0	0	0	0	5	0	0	522	5	0	0	0	0	0	1131
08:00 AM	0	106	0	0	0	0	3	1	0	121	0	0	0	0	0	0	231
08:15 AM	0	139	0	0	0	0	6	0	0	138	2	0	0	0	0	0	285
Total	0	245	0	0	0	0	9	1	0	259	2	0	0	0	0	0	516
04:00 PM	0	118	0	0	0	0	13	0	0	113	10	0	0	0	0	0	254
04:15 PM	0	115	0	0	0	0	17	0	0	104	12	0	0	0	0	0	248
04:30 PM	0	125	0	0	0	0	18	1	0	109	9	0	0	0	0	0	262
04:45 PM	0	134	0	0	0	0	16	0	0	151	11	0	0	0	0	0	312
Total	0	492	0	0	0	0	64	1	0	477	42	0	0	0	0	0	1076
05:00 PM	0	140	0	0	0	0	21	0	0	163	12	0	0	0	0	0	336
05:15 PM	0	152	0	0	0	0	11	0	0	161	5	0	0	0	0	0	329
05:30 PM	0	169	0	0	0	0	21	0	0	115	9	0	0	0	0	0	314
05:45 PM	0	145	0	0	0	0	27	0	0	151	9	0	0	0	0	0	332
Total	0	606	0	0	0	0	80	0	0	590	35	0	0	0	0	0	1311
Grand Total	0	2110	0	0	0	0	159	3	0	1988	84	0	0	0	0	0	4344
Apprch %	0.0	100.0	0.0	0.0	0.0	0.0	98.1	1.9	0.0	95.9	4.1	0.0	0.0	0.0	0.0	0.0	
Total %	0.0	48.6	0.0	0.0	0.0	0.0	3.7	0.1	0.0	45.8	1.9	0.0	0.0	0.0	0.0	0.0	

N/S STREET: COUNTY LINE RD
E/W STREET: WALGREENS ACCESS
CITY: ERIE
COUNTY: WELD

File Name : COUNWALG1
Site Code : 00000016
Start Date : 5/3/2016

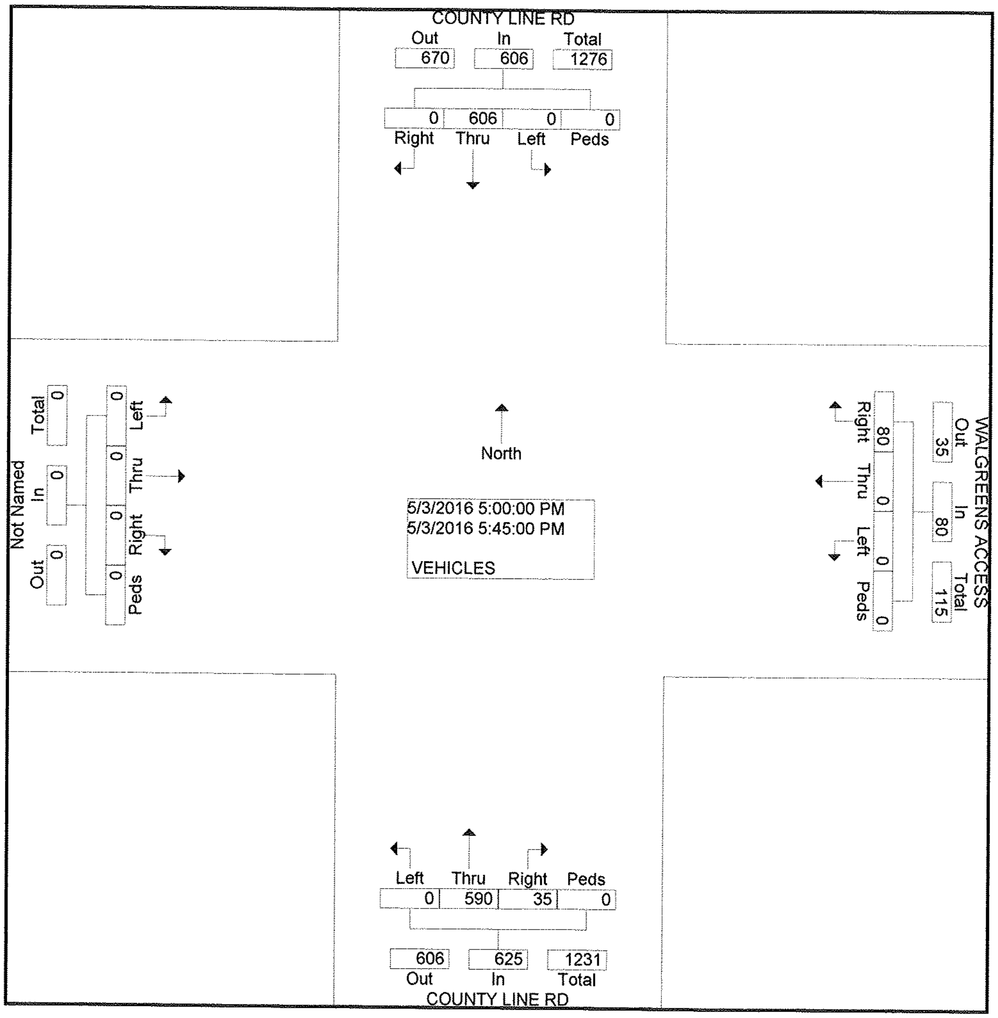
	COUNTY LINE RD Southbound					WALGREENS ACCESS Westbound					COUNTY LINE RD Northbound					Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:15 AM to 08:00 AM - Peak 1 of 1																					
Intersection	07:15 AM																				
Volume	0	586	0	0	586	0	0	8	1	9	0	526	5	0	531	0	0	0	0	0	1126
Percent	0.0	100.0	0.0	0.0		0.0	0.0	88.9	11.1		0.0	99.1	0.9	0.0		0.0	0.0	0.0	0.0		
07:45 Volume	0	181	0	0	181	0	0	3	0	3	0	140	2	0	142	0	0	0	0	0	326
Peak Factor																					0.863
High Int.	07:45 AM					08:00 AM					07:30 AM										
Volume	0	181	0	0	181	0	0	3	1	4	0	143	2	0	145						
Peak Factor					0.809					0.563					0.916						



N/S STREET: COUNTY LINE RD
E/W STREET: WALGREENS ACCESS
CITY: ERIE
COUNTY: WELD

File Name : COUNWALG1
Site Code : 00000016
Start Date : 5/3/2016
Page No : 2

	COUNTY LINE RD Southbound					WALGREENS ACCESS Westbound					COUNTY LINE RD Northbound					Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	05:00 PM																				
Volume	0	606	0	0	606	0	0	80	0	80	0	590	35	0	625	0	0	0	0	0	1311
Percent	0.0	100.0	0.0	0.0		0.0	0.0	100.0	0.0		0.0	94.4	5.6	0.0		0.0	0.0	0.0	0.0		
05:00 Volume	0	140	0	0	140	0	0	21	0	21	0	163	12	0	175	0	0	0	0	0	336
Peak Factor																					0.975
High Int.	05:30 PM					05:45 PM					05:00 PM										
Volume	0	169	0	0	169	0	0	27	0	27	0	163	12	0	175						
Peak Factor					0.896					0.741					0.893						



COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COUNTY LINE RD
E/W STREET: STOP N SAVE ACCESS
CITY: ERIE
COUNTY: WELD

File Name : COUNSTOP
Site Code : 00000017
Start Date : 5/3/2016
Page No : 1

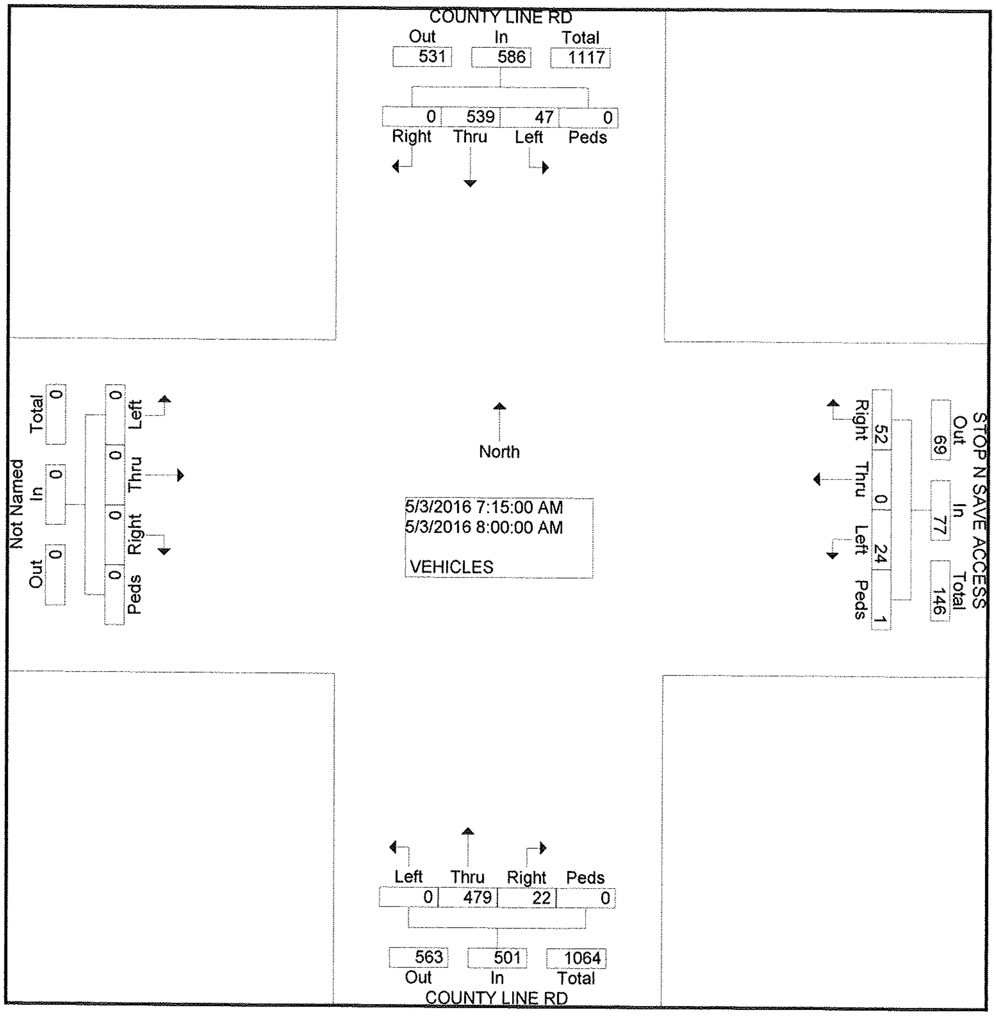
Groups Printed- VEHICLES

	COUNTY LINE RD Southbound				STOP N SAVE ACCESS Westbound				COUNTY LINE RD Northbound				Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
06:30 AM	11	67	0	0	7	0	8	0	0	59	6	0	0	0	0	0	158
06:45 AM	9	81	0	0	5	0	4	1	0	69	1	0	0	0	0	0	170
Total	20	148	0	0	12	0	12	1	0	128	7	0	0	0	0	0	328
07:00 AM	8	111	0	0	2	0	12	0	0	105	5	0	0	0	0	0	243
07:15 AM	10	125	0	0	5	0	13	1	0	110	2	0	0	0	0	0	266
07:30 AM	12	152	0	0	4	0	14	0	0	131	7	0	0	0	0	0	320
07:45 AM	7	174	0	0	7	0	13	0	0	129	9	0	0	0	0	0	339
Total	37	562	0	0	18	0	52	1	0	475	23	0	0	0	0	0	1168
08:00 AM	18	88	0	0	8	0	12	0	0	109	4	0	0	0	0	0	239
08:15 AM	12	127	0	0	13	0	22	0	0	118	13	0	0	0	0	0	305
Total	30	215	0	0	21	0	34	0	0	227	17	0	0	0	0	0	544
04:00 PM	11	107	0	0	13	0	6	0	0	117	11	0	0	0	0	0	265
04:15 PM	10	105	0	0	16	0	6	0	0	110	11	0	0	0	0	0	258
04:30 PM	11	114	0	0	15	0	3	1	0	115	5	0	0	0	0	0	264
04:45 PM	19	115	0	0	7	0	10	0	0	152	12	0	0	0	0	0	315
Total	51	441	0	0	51	0	25	1	0	494	39	0	0	0	0	0	1102
05:00 PM	11	129	0	0	15	0	8	0	0	167	9	0	0	0	0	0	339
05:15 PM	9	143	0	0	9	0	14	1	0	156	8	0	0	0	0	0	340
05:30 PM	9	160	0	0	12	0	9	0	0	115	14	0	0	0	0	0	319
05:45 PM	14	131	0	0	16	0	14	1	0	146	9	0	0	0	0	0	331
Total	43	563	0	0	52	0	45	2	0	584	40	0	0	0	0	0	1329
Grand Total	181	1929	0	0	154	0	168	5	0	1908	126	0	0	0	0	0	4471
Apprch %	8.6	91.4	0.0	0.0	47.1	0.0	51.4	1.5	0.0	93.8	6.2	0.0	0.0	0.0	0.0	0.0	
Total %	4.0	43.1	0.0	0.0	3.4	0.0	3.8	0.1	0.0	42.7	2.8	0.0	0.0	0.0	0.0	0.0	

N/S STREET: COUNTY LINE RD
E/W STREET: STOP N SAVE ACCESS
CITY: ERIE
COUNTY: WELD

File Name : COUNSTOP
Site Code : 00000017
Start Date : 5/3/2016
Page No : 2

	COUNTY LINE RD Southbound					STOP N SAVE ACCESS Westbound					COUNTY LINE RD Northbound					Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:15 AM to 08:00 AM - Peak 1 of 1																					
Intersection	07:15 AM																				
Volume	47	539	0	0	586	24	0	52	1	77	0	479	22	0	501	0	0	0	0	0	1164
Percent	8.0	92.0	0.0	0.0		31.2	0.0	67.5	1.3		0.0	95.6	4.4	0.0		0.0	0.0	0.0	0.0		
07:45 Volume	7	174	0	0	181	7	0	13	0	20	0	129	9	0	138	0	0	0	0	0	339
Peak Factor																					0.858
High Int.	07:45 AM					07:45 AM					07:30 AM										
Volume	7	174	0	0	181	7	0	13	0	20	0	131	7	0	138						
Peak Factor					0.809					0.963					0.908						



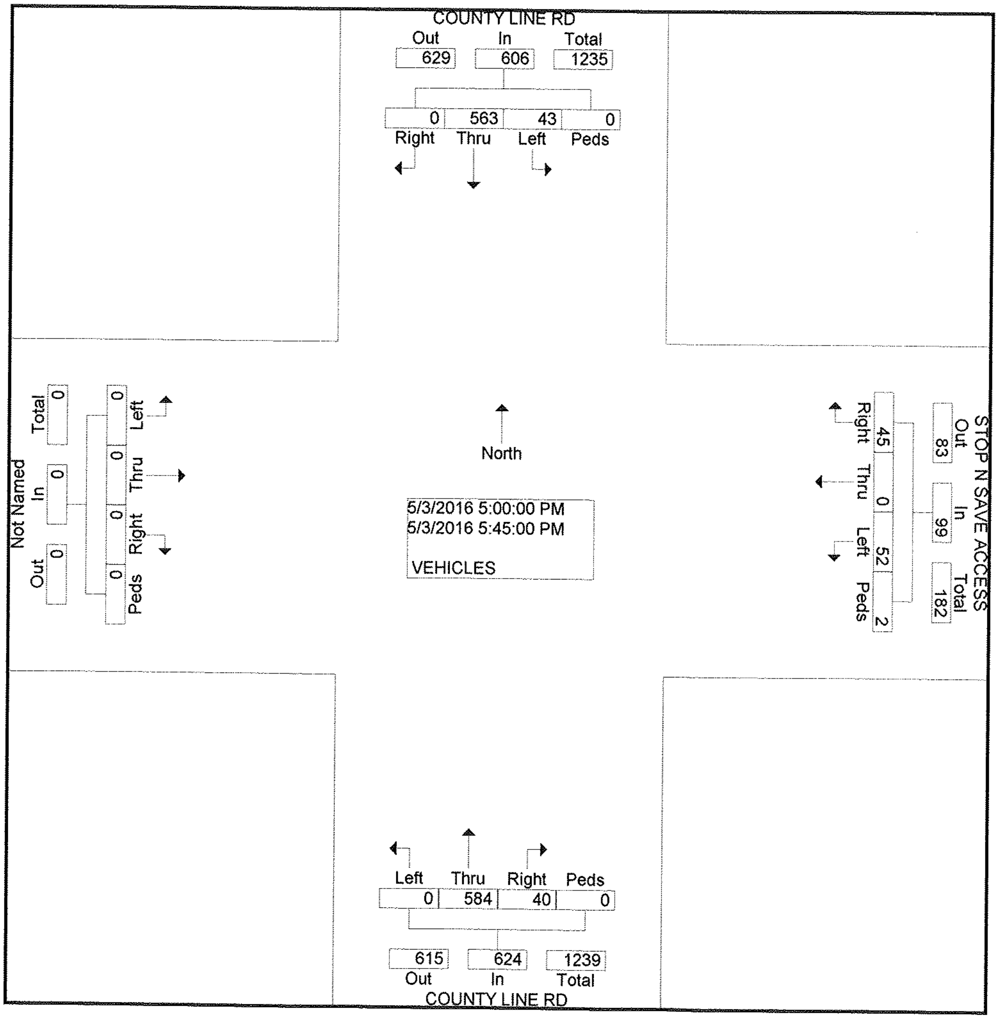
COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COUNTY LINE RD
E/W STREET: STOP N SAVE ACCESS
CITY: ERIE
COUNTY: WELD

File Name : COUNSTOP
Site Code : 00000017
Start Date : 5/3/2016
Page No : 2

	COUNTY LINE RD Southbound					STOP N SAVE ACCESS Westbound					COUNTY LINE RD Northbound					Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	05:00 PM																				
Volume	43	563	0	0	606	52	0	45	2	99	0	584	40	0	624	0	0	0	0	0	1329
Percent	7.1	92.9	0.0	0.0		52.5	0.0	45.5	2.0		0.0	93.6	6.4	0.0		0.0	0.0	0.0	0.0		
05:15 Volume	9	143	0	0	152	9	0	14	1	24	0	156	8	0	164	0	0	0	0	0	340
Peak Factor																					0.977
High Int.	05:30 PM					05:45 PM					05:00 PM										
Volume	9	160	0	0	169	16	0	14	1	31	0	167	9	0	176						
Peak Factor					0.896					0.798					0.886						



COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COUNTY LINE RD
E/W STREET: AUSTIN AVE
CITY: ERIE
COUNTY: WELD

File Name : COUNAUST3
Site Code : 00000020
Start Date : 5/3/2016
Page No : 1

Groups Printed- VEHICLES

	COUNTY LINE RD Southbound				AUSTIN AVE Westbound				COUNTY LINE RD Northbound				AUSTIN AVE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
06:30 AM	1	69	4	0	12	0	5	2	1	55	2	2	5	3	9	0	170
06:45 AM	2	79	5	0	11	1	7	0	4	58	11	0	5	4	3	0	190
Total	3	148	9	0	23	1	12	2	5	113	13	2	10	7	12	0	360
07:00 AM	5	107	1	0	11	1	14	0	1	91	3	1	5	2	11	0	253
07:15 AM	7	118	5	0	7	2	13	1	4	95	8	2	4	5	13	0	284
07:30 AM	8	143	5	0	13	1	13	0	3	121	14	0	4	4	14	0	343
07:45 AM	11	163	7	0	17	4	10	0	7	125	8	1	3	3	6	0	365
Total	31	531	18	0	48	8	50	1	15	432	33	4	16	14	44	0	1245
08:00 AM	7	87	2	0	10	4	8	0	4	103	10	0	2	1	15	0	253
08:15 AM	30	107	3	0	29	9	28	0	8	98	8	0	5	13	10	0	348
Total	37	194	5	0	39	13	36	0	12	201	18	0	7	14	25	0	601
04:00 PM	11	102	7	0	13	3	7	0	14	118	21	0	3	0	6	1	306
04:15 PM	4	109	8	1	8	4	10	0	12	106	14	0	5	6	4	1	292
04:30 PM	7	114	8	0	14	3	5	1	11	113	8	1	2	0	6	3	296
04:45 PM	14	93	15	0	10	4	4	0	17	156	14	1	4	3	10	0	345
Total	36	418	38	1	45	14	26	1	54	493	57	2	14	9	26	5	1239
05:00 PM	10	131	3	0	16	1	8	1	15	161	13	1	7	5	11	1	384
05:15 PM	5	135	12	0	13	4	14	0	11	146	23	0	4	3	8	1	379
05:30 PM	16	139	17	1	9	2	7	1	10	120	15	1	2	3	9	0	352
05:45 PM	13	120	14	0	9	3	5	1	10	142	22	1	8	4	11	0	363
Total	44	525	46	1	47	10	34	3	46	569	73	3	21	15	39	2	1478
Grand Total	151	1816	116	2	202	46	158	7	132	1808	194	11	68	59	146	7	4923
Apprch %	7.2	87.1	5.6	0.1	48.9	11.1	38.3	1.7	6.2	84.3	9.0	0.5	24.3	21.1	52.1	2.5	
Total %	3.1	36.9	2.4	0.0	4.1	0.9	3.2	0.1	2.7	36.7	3.9	0.2	1.4	1.2	3.0	0.1	

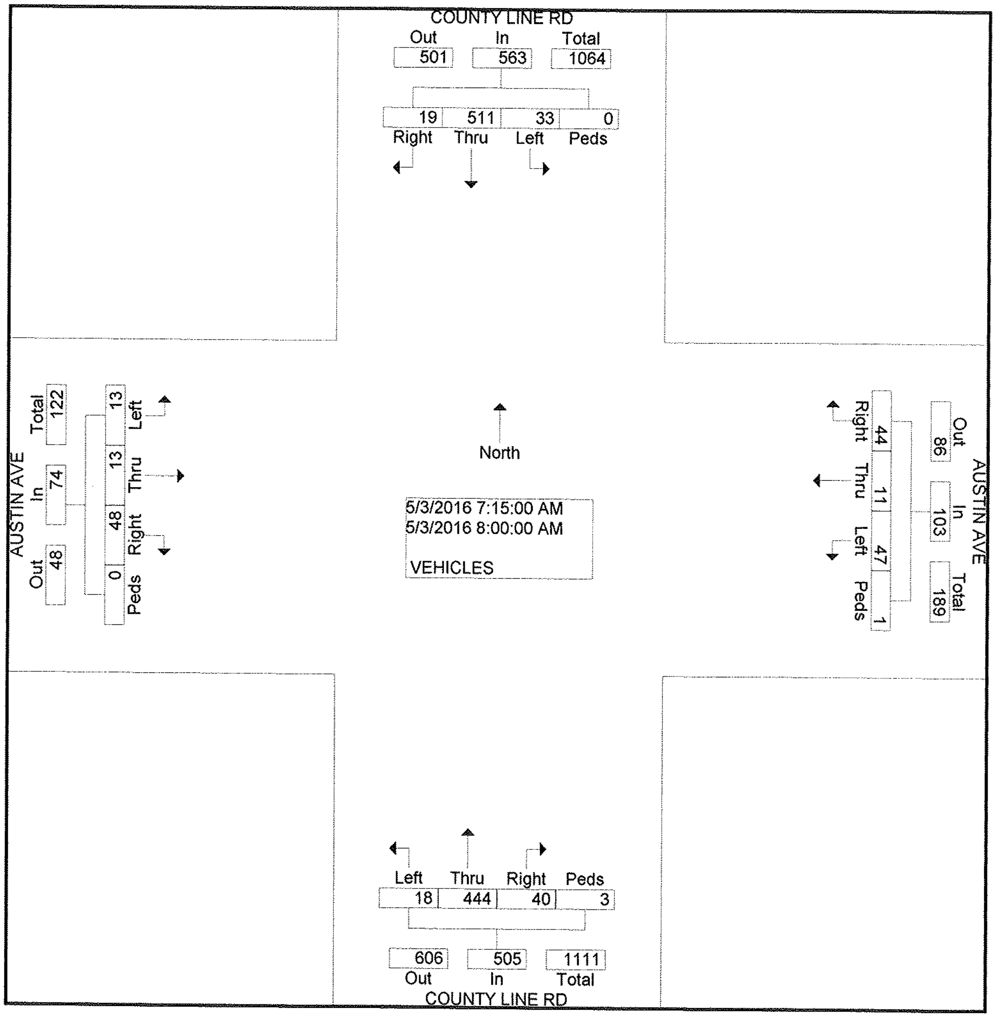
COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COUNTY LINE RD
E/W STREET: AUSTIN AVE
CITY: ERIE
COUNTY: WELD

File Name : COUNAUST3
Site Code : 00000020
Start Date : 5/3/2016
Page No : 2

	COUNTY LINE RD Southbound					AUSTIN AVE Westbound					COUNTY LINE RD Northbound					AUSTIN AVE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:15 AM to 08:00 AM - Peak 1 of 1																					
Intersection	07:15 AM																				
Volume	33	511	19	0	563	47	11	44	1	103	18	444	40	3	505	13	13	48	0	74	1245
Percent	5.9	90.8	3.4	0.0		45.6	10.7	42.7	1.0		3.6	87.9	7.9	0.6		17.6	17.6	64.9	0.0		
07:45 Volume	11	163	7	0	181	17	4	10	0	31	7	125	8	1	141	3	3	6	0	12	365
Peak Factor																					0.853
High Int.	07:45 AM					07:45 AM					07:45 AM					07:15 AM					
Volume	11	163	7	0	181	17	4	10	0	31	7	125	8	1	141	4	5	13	0	22	
Peak Factor					0.778					0.831					0.895					0.841	



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1889 YORK STREET
DENVER.COLORADO
303-333-7409

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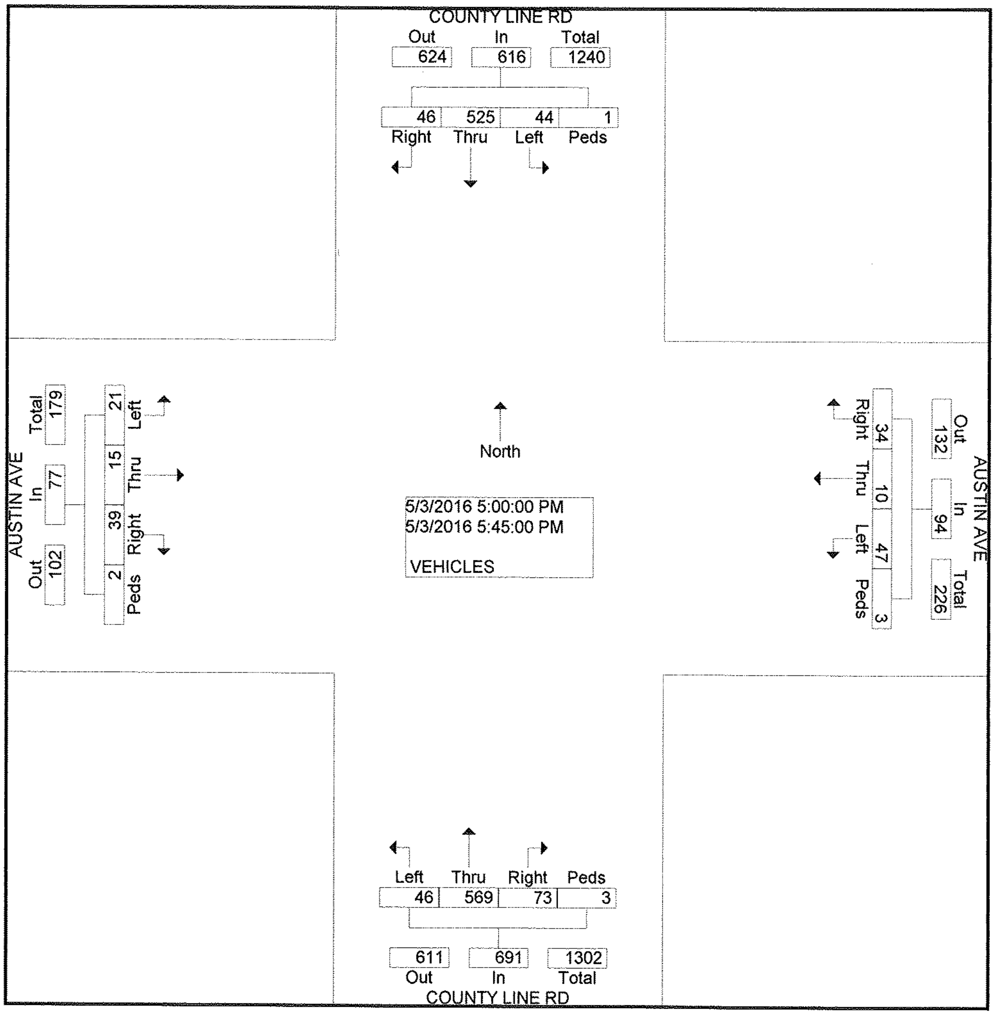
	COUNTY LINE RD Southbound					AUSTIN AVE Westbound					COUNTY LINE RD Northbound					AUSTIN AVE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	05:00 PM																				
Volume	44	525	46	1	616	47	10	34	3	94	46	569	73	3	691	21	15	39	2	77	1478
Percent	7.1	85.2	7.5	0.2		50.0	10.6	36.2	3.2		6.7	82.3	10.6	0.4		27.3	19.5	50.6	2.6		
05:00 Volume	10	131	3	0	144	16	1	8	1	26	15	161	13	1	190	7	5	11	1	24	384
Peak Factor																					0.962
High Int.	05:30 PM					05:15 PM					05:00 PM					05:00 PM					
Volume	16	139	17	1	173	13	4	14	0	31	15	161	13	1	190	7	5	11	1	24	
Peak Factor					0.890					0.758					0.909					0.802	



COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: GRAHAM WAY
E/W STREET: AUSTION WAY
CITY: ERIE
COUNTY: WELD

File Name : GRAHAUST1
Site Code : 00000005
Start Date : 5/3/2016
Page No : 1

Groups Printed- VEHICLES

	Southbound				AUSTIN AVE Westbound				GRAHAM WAY Northbound				AUSTIN AVE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
06:30 AM	0	0	0	0	0	4	0	0	0	0	9	4	0	8	0	0	25
06:45 AM	0	0	0	0	3	8	0	0	1	0	1	1	0	11	0	0	25
Total	0	0	0	0	3	12	0	0	1	0	10	5	0	19	0	0	50
07:00 AM	0	0	0	0	1	2	0	0	2	0	4	1	0	14	0	0	24
07:15 AM	0	0	0	0	2	8	0	0	0	0	8	2	0	15	1	0	36
07:30 AM	0	0	0	0	4	5	0	0	1	0	11	1	0	11	0	0	33
07:45 AM	0	0	0	0	3	12	0	0	0	0	2	1	0	11	0	0	29
Total	0	0	0	0	10	27	0	0	3	0	25	5	0	51	1	0	122
08:00 AM	0	0	0	0	1	7	0	0	1	0	6	0	0	11	0	0	26
08:15 AM	0	0	0	0	2	16	0	0	0	0	7	0	0	19	0	0	44
Total	0	0	0	0	3	23	0	0	1	0	13	0	0	30	0	0	70
04:00 PM	0	0	0	0	8	16	0	0	1	0	4	0	0	6	0	0	35
04:15 PM	0	0	0	0	2	22	0	0	1	0	2	1	0	12	2	0	42
04:30 PM	0	0	0	0	6	16	0	0	1	0	1	0	0	7	1	0	32
04:45 PM	0	0	0	0	14	21	0	0	1	0	4	1	0	13	1	0	55
Total	0	0	0	0	30	75	0	0	4	0	11	2	0	38	4	0	164
05:00 PM	0	0	0	0	4	16	0	0	0	0	9	1	0	9	4	0	43
05:15 PM	0	0	0	0	7	15	0	0	1	0	4	0	0	10	0	0	37
05:30 PM	0	0	0	0	8	21	0	0	1	0	4	2	0	10	4	0	50
05:45 PM	0	0	0	0	5	23	0	0	0	0	7	1	0	13	1	0	50
Total	0	0	0	0	24	75	0	0	2	0	24	4	0	42	9	0	180
Grand Total	0	0	0	0	70	212	0	0	11	0	83	16	0	180	14	0	586
Apprch %	0.0	0.0	0.0	0.0	24.8	75.2	0.0	0.0	10.0	0.0	75.5	14.5	0.0	92.8	7.2	0.0	
Total %	0.0	0.0	0.0	0.0	11.9	36.2	0.0	0.0	1.9	0.0	14.2	2.7	0.0	30.7	2.4	0.0	

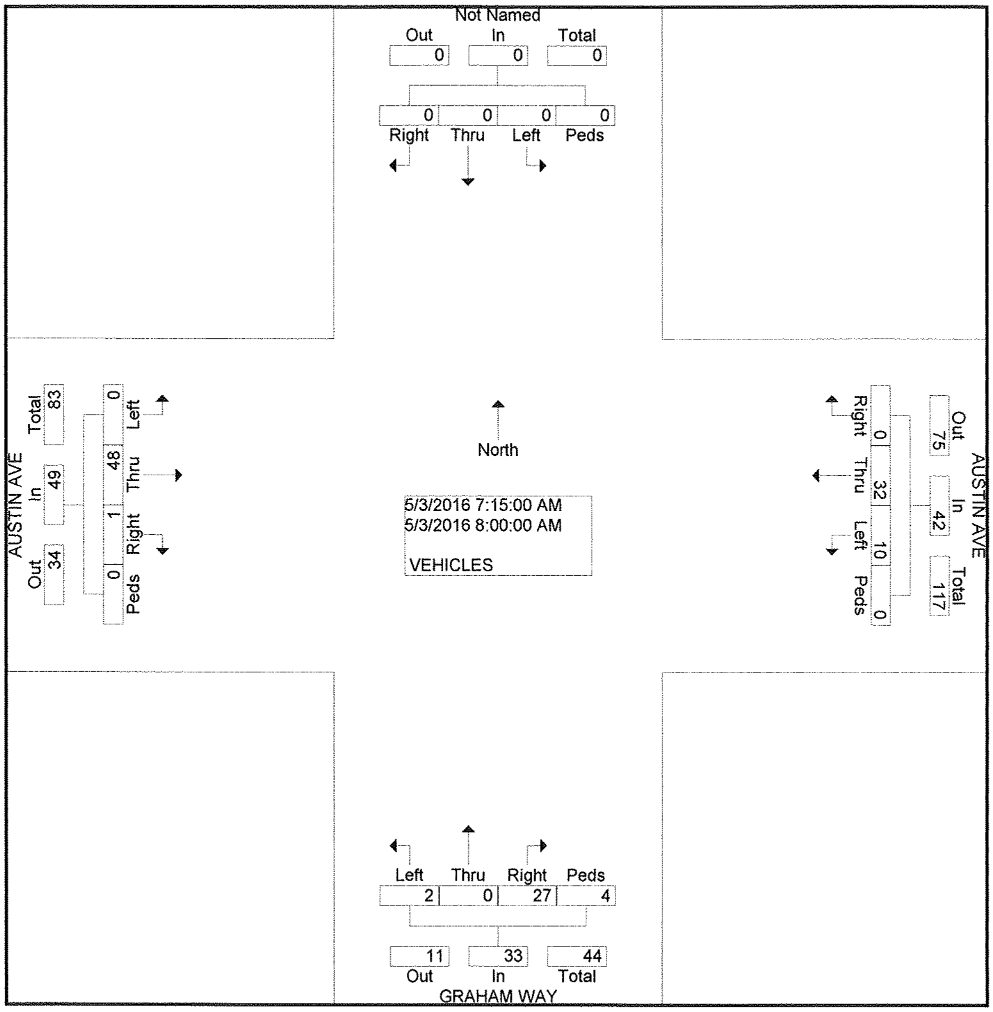
COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: GRAHAM WAY
E/W STREET: AUSTION WAY
CITY: ERIE
COUNTY: WELD

File Name : GRAHAUST1
Site Code : 00000005
Start Date : 5/3/2016
Page No : 2

	Southbound					AUSTIN AVE Westbound					GRAHAM WAY Northbound					AUSTIN AVE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:15 AM to 08:00 AM - Peak 1 of 1																					
Intersection	07:15 AM																				
Volume	0	0	0	0	0	10	32	0	0	42	2	0	27	4	33	0	48	1	0	49	124
Percent	0.0	0.0	0.0	0.0		23.8	76.2	0.0	0.0		6.1	0.0	81.8	12.1		0.0	98.0	2.0	0.0		
07:15 Volume	0	0	0	0	0	2	8	0	0	10	0	0	8	2	10	0	15	1	0	16	36
Peak Factor																					0.861
High Int.						07:45 AM					07:30 AM					07:15 AM					
Volume	0	0	0	0	0	3	12	0	0	15	1	0	11	1	13	0	15	1	0	16	
Peak Factor										0.700					0.635					0.766	



COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: GRAHAM WAY
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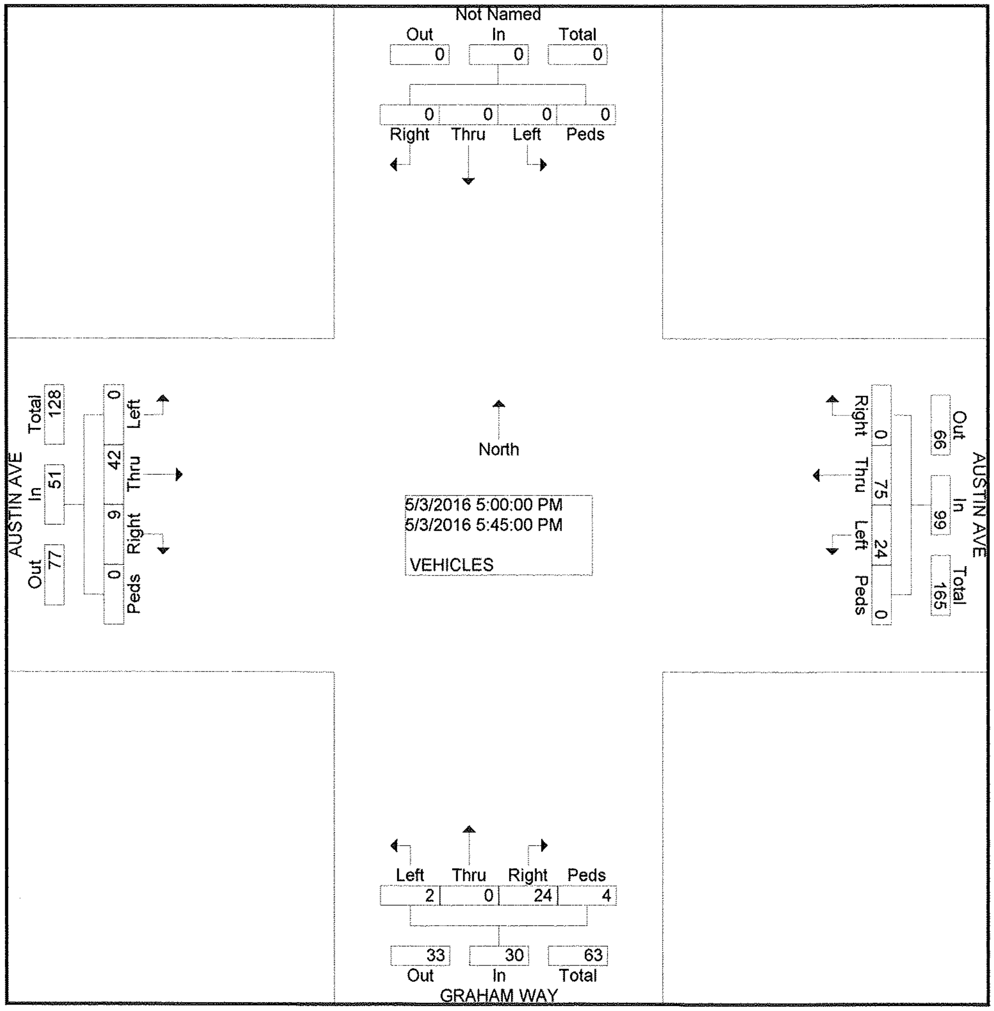
File Name : GRAHAUST1
Site Code : 00000005
Start Date : 5/3/2016
Page No : 2

	Southbound					AUSTIN AVE Westbound					GRAHAM WAY Northbound					AUSTIN AVE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 05:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	05:00 PM																				
Volume	0	0	0	0	0	24	75	0	0	99	2	0	24	4	30	0	42	9	0	51	180
Percent	0.0	0.0	0.0	0.0		24.2	75.8	0.0	0.0		6.7	0.0	80.0	13.3		0.0	82.4	17.6	0.0		
05:45 Volume	0	0	0	0	0	5	23	0	0	28	0	0	7	1	8	0	13	1	0	14	50
Peak Factor																					0.900
High Int.						05:30 PM					05:00 PM					05:30 PM					
Volume	0	0	0	0	0	8	21	0	0	29	0	0	9	1	10	0	10	4	0	14	
Peak Factor										0.853					0.750					0.911	



LEVEL OF SERVICE DEFINITIONS

From *Highway Capacity Manual*, Transportation Research Board, 2010

SIGNALIZED INTERSECTION LEVEL OF SERVICE (LOS)

LOS	**Average Vehicle Delay** sec/vehicle	**Operational Characteristics**
A	<10 seconds	Describes operations with low control delay, up to 10 sec/veh. This LOS occurs when progression is extremely favorable and most vehicles arrive during the green phase. Many vehicles do not stop at all. Short cycle lengths may tend to contribute to low delay values.
B	10 to 20 seconds	Describes operations with control delay greater than 10 seconds and up to 20 sec/veh. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of delay.
C	20 to 35 seconds	Describes operations with control delay greater than 20 and up to 35 sec/veh. These higher delays may result from only fair progression, longer cycle length, or both. Individual cycle failures may begin to appear at this level. Cycle failure occurs when a given green phase does not serve queued vehicles, and overflows occur. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.
D	35 to 55 seconds	Describes operations with control delay greater than 35 and up to 55 sec/veh. At LOS D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, and high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
E	55 to 80 seconds	Describes operations with control delay greater than 55 and up to 80 sec/veh. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent.
F	>80 seconds	Describes operations with control delay in excess of 80 sec/veh. This level, considered unacceptable to most drivers, often occurs with over-saturation, that is, when arrival flow rates exceed the capacity of lane groups. It may also occur at high v/c ratios with many individual cycle failures. Poor progression and long cycle lengths may also contribute significantly to high delay levels.

LEVEL OF SERVICE DEFINITIONS

From *Highway Capacity Manual*, Transportation Research Board, 2010

UNSIGNALIZED INTERSECTION LEVEL OF SERVICE (LOS)

Applicable to Two-Way Stop Control, All-Way Stop Control, and Roundabouts

LOS	Average Vehicle Control Delay	Operational Characteristics
A	<10 seconds	Normally, vehicles on the stop-controlled approach only have to wait up to 10 seconds before being able to clear the intersection. Left-turning vehicles on the uncontrolled street do not have to wait to make their turn.
B	10 to 15 seconds	Vehicles on the stop-controlled approach will experience delays before being able to clear the intersection. The delay could be up to 15 seconds. Left-turning vehicles on the uncontrolled street may have to wait to make their turn.
C	15 to 25 seconds	Vehicles on the stop-controlled approach can expect delays in the range of 15 to 25 seconds before clearing the intersection. Motorists may begin to take chances due to the long delays, thereby posing a safety risk to through traffic. Left-turning vehicles on the uncontrolled street will now be required to wait to make their turn causing a queue to be created in the turn lane.
D	25 to 35 seconds	This is the point at which a traffic signal may be warranted for this intersection. The delays for the stop-controlled intersection are not considered to be excessive. The length of the queue may begin to block other public and private access points.
E	35 to 50 seconds	The delays for all critical traffic movements are considered to be unacceptable. The length of the queues for the stop-controlled approaches as well as the left-turn movements are extremely long. There is a high probability that this intersection will meet traffic signal warrants. The ability to install a traffic signal is affected by the location of other existing traffic signals. Consideration may be given to restricting the accesses by eliminating the left-turn movements from and to the stop-controlled approach.
F	>50 seconds	The delay for the critical traffic movements are probably in excess of 100 seconds. The length of the queues are extremely long. Motorists are selecting alternative routes due to the long delays. The only remedy for these long delays is installing a traffic signal or restricting the accesses. The potential for accidents at this intersection are extremely high due to motorist taking more risky chances. If the median permits, motorists begin making two-stage left-turns.

HCM 2010 Signalized Intersection Summary
2: County Line Rd & Erie Pkwy

Existing
AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑	↱	↰↰	↑↱	
Volume (veh/h)	61	134	71	223	415	62	223	220	91	72	292	81
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	190.0
Lanes	1	2	1	1	2	1	2	1	1	2	1	0
Cap, veh/h	428	1295	550	616	1496	636	479	538	457	666	357	99
Arrive On Green	0.04	0.35	0.35	0.09	0.40	0.40	0.07	0.29	0.29	0.04	0.25	0.25
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	3442	1863	1583	3442	1404	390
Grp Volume(v), veh/h	68	149	79	248	461	69	248	244	101	80	0	414
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1583	1721	0	1794
Q Serve(g_s), s	2.1	2.3	3.0	6.8	7.3	2.4	4.3	9.3	4.2	1.5	0.0	19.3
Cycle Q Clear(g_c), s	2.1	2.3	3.0	6.8	7.3	2.4	4.3	9.3	4.2	1.5	0.0	19.3
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.22
Lane Grp Cap(c), veh/h	428	1295	550	616	1496	636	479	538	457	666	0	456
V/C Ratio(X)	0.16	0.12	0.14	0.40	0.31	0.11	0.52	0.45	0.22	0.12	0.00	0.91
Avail Cap(c_a), veh/h	524	1295	550	616	1496	636	543	538	457	849	0	499
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	17.0	19.1	19.3	12.4	17.6	16.2	22.2	25.1	23.3	22.3	0.0	31.2
Incr Delay (d2), s/veh	0.2	0.2	0.5	0.4	0.5	0.3	0.9	0.6	0.2	0.1	0.0	19.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	0.9	1.0	1.2	2.7	3.2	0.9	1.7	4.2	1.6	0.6	0.0	10.7
Lane Grp Delay (d), s/veh	17.1	19.3	19.9	12.9	18.2	16.5	23.1	25.7	23.6	22.4	0.0	50.7
Lane Grp LOS	B	B	B	B	B	B	C	C	C	C		D
Approach Vol, veh/h		296			778			593			494	
Approach Delay, s/veh		19.0			16.3			24.2			46.1	
Approach LOS		B			B			C			D	

Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	8.3	35.0		13.0	39.7		11.4	29.9		8.4	26.9	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	8.0	30.0		8.0	30.0		8.0	24.0		8.0	24.0	
Max Q Clear Time (g_c+I1), s	4.1	5.0		8.8	9.3		6.3	11.3		3.5	21.3	
Green Ext Time (p_c), s	0.0	4.3		0.0	4.1		0.1	3.3		0.1	0.6	

Intersection Summary			
HCM 2010 Ctrl Delay			25.7
HCM 2010 LOS			C

Notes

3: County Line Rd & Walgreens

Intersection	
Intersection Delay, s/veh	0.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	8	526	5	0	586
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	9	612	6	0	681

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1296	309	0	0	617	0
Stage 1	615	-	-	-	-	-
Stage 2	681	-	-	-	-	-
Follow-up Headway	3.519	3.319	-	-	2.22	-
Pot Capacity-1 Maneuver	166	688	-	-	959	-
Stage 1	503	-	-	-	-	-
Stage 2	502	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	166	688	-	-	959	-
Mov Capacity-2 Maneuver	305	-	-	-	-	-
Stage 1	503	-	-	-	-	-
Stage 2	502	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.3	0	0
HCM LOS	B		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	688	959	-
HCM Lane V/C Ratio	-	-	0.014	-	-
HCM Control Delay (s)	-	-	10.3	0	-
HCM Lane LOS			B	A	
HCM 95th %tile Q(veh)	-	-	0.041	0	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	1.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	24	52	479	22	47	539
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	115	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	28	60	557	26	55	627

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1306	570	0	0	583	0
Stage 1	570	-	-	-	-	-
Stage 2	736	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	176	521	-	-	991	-
Stage 1	566	-	-	-	-	-
Stage 2	474	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	166	521	-	-	991	-
Mov Capacity-2 Maneuver	166	-	-	-	-	-
Stage 1	566	-	-	-	-	-
Stage 2	448	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	21.1	0	0.7
HCM LOS	C		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	311	991	-
HCM Lane V/C Ratio	-	-	0.284	0.055	-
HCM Control Delay (s)	-	-	21.1	8.845	-
HCM Lane LOS			C	A	
HCM 95th %tile Q(veh)	-	-	1.144	0.175	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

6: County Line Rd & Austin Ave

Intersection	
Intersection Delay, s/veh	5.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	13	13	48	47	11	44	18	444	40	33	511	19
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	195	-	-	470	-	-	210	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	15	15	56	55	13	52	21	522	47	39	601	22

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1311	1302	612	1314	1289	546	624	0	0	569	0	0
Stage 1	690	690	-	588	588	-	-	-	-	-	-	-
Stage 2	621	612	-	726	701	-	-	-	-	-	-	-
Follow-up Headway	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Capacity-1 Maneuver	136	161	493	135	164	538	957	-	-	1003	-	-
Stage 1	435	446	-	495	496	-	-	-	-	-	-	-
Stage 2	475	484	-	416	441	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-		-	-
Mov Capacity-1 Maneuver	110	151	493	105	154	538	957	-	-	1003	-	-
Mov Capacity-2 Maneuver	110	151	-	105	154	-	-	-	-	-	-	-
Stage 1	425	429	-	484	485	-	-	-	-	-	-	-
Stage 2	409	473	-	341	424	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	27.6	37.3	0.3	0.5
HCM LOS	D	E		

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	957	-	-	245	105	234	1003	-	-
HCM Lane V/C Ratio	0.022	-	-	0.355	0.351	0.355	0.039	-	-
HCM Control Delay (s)	8.847	-	-	27.6	56.8	28.6	8.734	-	-
HCM Lane LOS	A			D	F	D	A		
HCM 95th %tile Q(veh)	0.068	-	-	1.534	1.395	1.529	0.121	-	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	2.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	48	1	10	32	2	27
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	56	1	12	37	2	31

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	57	0	116	56
Stage 1	-	-	-	-	56	-
Stage 2	-	-	-	-	60	-
Follow-up Headway	-	-	2.218	-	3.518	3.318
Pot Capacity-1 Maneuver	-	-	1547	-	880	1011
Stage 1	-	-	-	-	967	-
Stage 2	-	-	-	-	963	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1547	-	873	1011
Mov Capacity-2 Maneuver	-	-	-	-	873	-
Stage 1	-	-	-	-	967	-
Stage 2	-	-	-	-	955	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.7	8.7
HCM LOS			A

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	1000	-	-	1547	-
HCM Lane V/C Ratio	0.034	-	-	0.008	-
HCM Control Delay (s)	8.7	-	-	7.345	0
HCM Lane LOS	A			A	A
HCM 95th %tile Q(veh)	0.105	-	-	0.023	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 Signalized Intersection Summary
2: County Line Rd & Erie Pkwy

Existing
PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑	↱	↰↰	↑↱	
Volume (veh/h)	87	491	175	178	182	61	152	220	298	147	253	21
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	190.0
Lanes	1	2	1	1	2	1	2	1	1	2	1	0
Cap, veh/h	594	1387	589	441	1514	644	585	445	378	597	403	34
Arrive On Green	0.05	0.37	0.37	0.08	0.41	0.41	0.06	0.24	0.24	0.06	0.24	0.24
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	3442	1863	1583	3442	1696	141
Grp Volume(v), veh/h	91	511	182	185	190	64	158	229	310	153	0	286
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1583	1721	0	1838
Q Serve(g_s), s	2.5	8.0	6.6	4.8	2.6	2.0	2.7	8.6	14.9	2.6	0.0	11.3
Cycle Q Clear(g_c), s	2.5	8.0	6.6	4.8	2.6	2.0	2.7	8.6	14.9	2.6	0.0	11.3
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.08
Lane Grp Cap(c), veh/h	594	1387	589	441	1514	644	585	445	378	597	0	436
V/C Ratio(X)	0.15	0.37	0.31	0.42	0.13	0.10	0.27	0.52	0.82	0.26	0.00	0.66
Avail Cap(c_a), veh/h	683	1387	589	469	1514	644	725	555	472	741	0	547
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	14.2	18.4	17.9	12.7	15.0	14.8	21.7	26.6	29.0	21.5	0.0	27.7
Incr Delay (d2), s/veh	0.1	0.8	1.4	0.6	0.2	0.3	0.2	0.9	9.0	0.2	0.0	1.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	1.0	3.6	2.5	1.9	1.1	0.7	1.1	3.9	6.5	1.1	0.0	5.2
Lane Grp Delay (d), s/veh	14.3	19.2	19.3	13.3	15.1	15.1	22.0	27.6	38.1	21.7	0.0	29.7
Lane Grp LOS	B	B	B	B	B	B	C	C	D	C		C
Approach Vol, veh/h		784			439			697			439	
Approach Delay, s/veh		18.6			14.3			31.0			26.9	
Approach LOS		B			B			C			C	

Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	9.0	35.0		11.7	37.8		9.7	24.2		9.6	24.1	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	8.0	30.0		8.0	30.0		8.0	24.0		8.0	24.0	
Max Q Clear Time (g_c+I1), s	4.5	10.0		6.8	4.6		4.7	16.9		4.6	13.3	
Green Ext Time (p_c), s	0.1	5.0		0.1	5.3		0.1	2.3		0.1	2.9	

Intersection Summary			
HCM 2010 Ctrl Delay			23.0
HCM 2010 LOS			C

Notes

Intersection	
Intersection Delay, s/veh	0.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	80	590	35	0	606
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	82	602	36	0	618

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1238	319	0	0	638	0
Stage 1	620	-	-	-	-	-
Stage 2	618	-	-	-	-	-
Follow-up Headway	3.519	3.319	-	-	2.22	-
Pot Capacity-1 Maneuver	180	677	-	-	942	-
Stage 1	500	-	-	-	-	-
Stage 2	537	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	180	677	-	-	942	-
Mov Capacity-2 Maneuver	180	-	-	-	-	-
Stage 1	500	-	-	-	-	-
Stage 2	537	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11	0	0
HCM LOS	B		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	677	942	-
HCM Lane V/C Ratio	-	-	0.121	-	-
HCM Control Delay (s)	-	-	11	0	-
HCM Lane LOS			B	A	
HCM 95th %tile Q(veh)	-	-	0.409	0	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	2.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	52	45	584	40	43	563
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	115	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	53	46	596	41	44	574

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1278	616	0	0	637	0
Stage 1	616	-	-	-	-	-
Stage 2	662	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	183	491	-	-	947	-
Stage 1	539	-	-	-	-	-
Stage 2	513	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	174	491	-	-	947	-
Mov Capacity-2 Maneuver	174	-	-	-	-	-
Stage 1	539	-	-	-	-	-
Stage 2	489	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	28.8	0	0.6
HCM LOS	D		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	248	947	-
HCM Lane V/C Ratio	-	-	0.399	0.046	-
HCM Control Delay (s)	-	-	28.8	8.986	-
HCM Lane LOS			D	A	
HCM 95th %tile Q(veh)	-	-	1.816	0.146	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

6: County Line Rd & Austin Ave

Intersection	
Intersection Delay, s/veh	5.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	21	15	39	47	10	34	46	569	73	44	525	46
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	195	-	-	470	-	-	210	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	96	96	96	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	22	16	41	49	10	35	48	593	76	46	547	48

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1412	1428	571	1418	1413	631	595	0	0	669	0	0
Stage 1	663	663	-	727	727	-	-	-	-	-	-	-
Stage 2	749	765	-	691	686	-	-	-	-	-	-	-
Follow-up Headway	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Capacity-1 Maneuver	116	135	520	114	138	481	981	-	-	921	-	-
Stage 1	450	459	-	415	429	-	-	-	-	-	-	-
Stage 2	404	412	-	435	448	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-		-	-
Mov Capacity-1 Maneuver	93	122	520	88	125	481	981	-	-	921	-	-
Mov Capacity-2 Maneuver	93	122	-	88	125	-	-	-	-	-	-	-
Stage 1	428	436	-	395	408	-	-	-	-	-	-	-
Stage 2	347	392	-	367	426	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	40.5	46.3	0.6	0.7
HCM LOS	E	E		

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	981	-	-	177	88	182	921	-	-
HCM Lane V/C Ratio	0.049	-	-	0.441	0.371	0.341	0.05	-	-
HCM Control Delay (s)	8.858	-	-	40.5	68.3	34.7	9.113	-	-
HCM Lane LOS	A			E	F	D	A		
HCM 95th %tile Q(veh)	0.154	-	-	2.035	1.46	1.421	0.157	-	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	2.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	42	9	24	75	2	24
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	47	10	27	83	2	27

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	57	0	189	52
Stage 1	-	-	-	-	52	-
Stage 2	-	-	-	-	137	-
Follow-up Headway	-	-	2.218	-	3.518	3.318
Pot Capacity-1 Maneuver	-	-	1547	-	800	1016
Stage 1	-	-	-	-	970	-
Stage 2	-	-	-	-	890	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1547	-	786	1016
Mov Capacity-2 Maneuver	-	-	-	-	786	-
Stage 1	-	-	-	-	970	-
Stage 2	-	-	-	-	874	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.8	8.7
HCM LOS			A

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	994	-	-	1547	-
HCM Lane V/C Ratio	0.029	-	-	0.017	-
HCM Control Delay (s)	8.7	-	-	7.368	0
HCM Lane LOS	A			A	A
HCM 95th %tile Q(veh)	0.09	-	-	0.053	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	1.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	35	260	775	35	45	45
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	150	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	39	289	861	39	50	50

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	861	0	-	0	1083	431
Stage 1	-	-	-	-	861	-
Stage 2	-	-	-	-	222	-
Follow-up Headway	2.22	-	-	-	3.52	3.32
Pot Capacity-1 Maneuver	776	-	-	-	212	573
Stage 1	-	-	-	-	374	-
Stage 2	-	-	-	-	794	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	776	-	-	-	201	573
Mov Capacity-2 Maneuver	-	-	-	-	304	-
Stage 1	-	-	-	-	374	-
Stage 2	-	-	-	-	754	-

Approach	EB	WB	SB
HCM Control Delay, s	1.2	0	15.6
HCM LOS			C

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	776	-	-	-	304	573
HCM Lane V/C Ratio	0.05	-	-	-	0.164	0.087
HCM Control Delay (s)	9.884	-	-	-	19.2	11.9
HCM Lane LOS	A				C	B
HCM 95th %tile Q(veh)	0.158	-	-	-	0.58	0.286

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑	↱	↰↰	↑↱	
Volume (veh/h)	70	155	80	250	465	70	250	250	100	80	330	95
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	190.0
Lanes	1	2	1	1	2	1	2	1	1	2	1	0
Cap, veh/h	392	1257	534	581	1429	607	443	573	487	657	375	108
Arrive On Green	0.04	0.34	0.34	0.09	0.38	0.38	0.08	0.31	0.31	0.04	0.27	0.27
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	3442	1863	1583	3442	1390	402
Grp Volume(v), veh/h	78	172	89	278	517	78	278	278	111	89	0	473
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1583	1721	0	1792
Q Serve(g_s), s	2.5	2.9	3.5	8.0	8.8	2.8	4.8	10.8	4.6	1.6	0.0	23.3
Cycle Q Clear(g_c), s	2.5	2.9	3.5	8.0	8.8	2.8	4.8	10.8	4.6	1.6	0.0	23.3
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.22
Lane Grp Cap(c), veh/h	392	1257	534	581	1429	607	443	573	487	657	0	484
V/C Ratio(X)	0.20	0.14	0.17	0.48	0.36	0.13	0.63	0.49	0.23	0.14	0.00	0.98
Avail Cap(c_a), veh/h	474	1257	534	581	1429	607	486	573	487	829	0	484
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	17.9	20.5	20.7	14.7	19.6	17.8	22.4	25.1	22.9	22.1	0.0	32.2
Incr Delay (d2), s/veh	0.2	0.2	0.7	0.6	0.7	0.4	2.2	0.6	0.2	0.1	0.0	35.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	1.0	1.3	1.4	3.3	3.9	1.1	3.1	4.9	0.0	0.7	0.0	14.7
Lane Grp Delay (d), s/veh	18.2	20.7	21.3	15.3	20.3	18.2	24.6	25.7	23.2	22.1	0.0	67.2
Lane Grp LOS	B	C	C	B	C	B	C	C	C	C		E
Approach Vol, veh/h		339			873			667			562	
Approach Delay, s/veh		20.3			18.5			24.8			60.1	
Approach LOS		C			B			C			E	
Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	8.9	35.0		13.0	39.1		11.9	32.3		8.6	29.0	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	8.0	30.0		8.0	30.0		8.0	24.0		8.0	24.0	
Max Q Clear Time (g_c+I1), s	4.5	5.5		10.0	10.8		6.8	12.8		3.6	25.3	
Green Ext Time (p_c), s	0.0	4.9		0.0	4.5		0.1	3.6		0.1	0.0	
Intersection Summary												
HCM 2010 Ctrl Delay			30.1									
HCM 2010 LOS			C									
Notes												

Intersection	
Intersection Delay, s/veh	0.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	15	585	10	0	660
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	17	680	12	0	767

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1453	346	0	0	692	0
Stage 1	686	-	-	-	-	-
Stage 2	767	-	-	-	-	-
Follow-up Headway	3.519	3.319	-	-	2.22	-
Pot Capacity-1 Maneuver	132	651	-	-	899	-
Stage 1	462	-	-	-	-	-
Stage 2	457	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	132	651	-	-	899	-
Mov Capacity-2 Maneuver	270	-	-	-	-	-
Stage 1	462	-	-	-	-	-
Stage 2	457	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.7	0	0
HCM LOS	B		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	651	899	-
HCM Lane V/C Ratio	-	-	0.027	-	-
HCM Control Delay (s)	-	-	10.7	0	-
HCM Lane LOS			B	A	
HCM 95th %tile Q(veh)	-	-	0.083	0	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 TWSC

4: County Line Rd & Mitchell Way

2020 Background
AM Peak

Intersection	
Intersection Delay, s/veh	1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	55	540	25	50	610
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	115	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	64	628	29	58	709

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1468	642	0	0	657	0
Stage 1	642	-	-	-	-	-
Stage 2	826	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	141	474	-	-	931	-
Stage 1	524	-	-	-	-	-
Stage 2	430	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	132	474	-	-	931	-
Mov Capacity-2 Maneuver	132	-	-	-	-	-
Stage 1	524	-	-	-	-	-
Stage 2	403	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	13.8	0	0.7
HCM LOS	B		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	474	931	-
HCM Lane V/C Ratio	-	-	0.135	0.062	-
HCM Control Delay (s)	-	-	13.8	9.124	-
HCM Lane LOS			B	A	
HCM 95th %tile Q(veh)	-	-	0.464	0.199	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↑	↱	↰	↑	↱
Volume (veh/h)	20	20	55	80	20	60	25	485	50	50	535	25
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	190.0	186.3	186.3	190.0	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	1	0	1	1	0	1	1	1	1	1	1
Cap, veh/h	430	87	235	436	81	240	474	1000	850	505	1000	850
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.54	0.54	0.54	0.54	0.54	0.54
Sat Flow, veh/h	1295	445	1205	1303	416	1230	773	1863	1583	793	1863	1583
Grp Volume(v), veh/h	24	0	89	94	0	95	29	571	59	59	629	29
Grp Sat Flow(s),veh/h/ln	1295	0	1650	1303	0	1646	773	1863	1583	793	1863	1583
Q Serve(g_s), s	0.5	0.0	1.4	2.0	0.0	1.5	0.8	6.1	0.5	1.6	7.0	0.3
Cycle Q Clear(g_c), s	2.0	0.0	1.4	3.3	0.0	1.5	7.9	6.1	0.5	7.7	7.0	0.3
Prop In Lane	1.00		0.73	1.00		0.75	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	430	0	322	436	0	321	474	1000	850	505	1000	850
V/C Ratio(X)	0.06	0.00	0.28	0.22	0.00	0.30	0.06	0.57	0.07	0.12	0.63	0.03
Avail Cap(c_a), veh/h	873	0	886	881	0	883	474	1000	850	505	1000	850
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	11.1	0.0	10.2	11.6	0.0	10.3	7.6	4.6	3.3	7.2	4.8	3.3
Incr Delay (d2), s/veh	0.1	0.0	0.5	0.2	0.0	0.5	0.2	2.4	0.2	0.5	3.0	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	0.1	0.0	0.4	0.5	0.0	0.4	0.1	1.8	0.1	0.2	2.1	0.1
Lane Grp Delay (d), s/veh	11.1	0.0	10.7	11.9	0.0	10.8	7.8	7.0	3.5	7.7	7.8	3.3
Lane Grp LOS	B		B	B		B	A	A	A	A	A	A
Approach Vol, veh/h		113			189			659			717	
Approach Delay, s/veh		10.8			11.3			6.7			7.6	
Approach LOS		B			B			A			A	

Timer												
Assigned Phs		4			8			2			6	
Phs Duration (G+Y+Rc), s		9.8			9.8			20.0			20.0	
Change Period (Y+Rc), s		4.0			4.0			4.0			4.0	
Max Green Setting (Gmax), s		16.0			16.0			16.0			16.0	
Max Q Clear Time (g_c+I1), s		4.0			5.3			9.9			9.7	
Green Ext Time (p_c), s		1.1			1.0			3.7			3.8	

Intersection Summary			
HCM 2010 Ctrl Delay			7.9
HCM 2010 LOS			A

Notes

Intersection	
Intersection Delay, s/veh	2.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	65	2	10	60	3	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	76	2	12	70	3	35

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	78	0	170	77
Stage 1	-	-	-	-	77	-
Stage 2	-	-	-	-	93	-
Follow-up Headway	-	-	2.218	-	3.518	3.318
Pot Capacity-1 Maneuver	-	-	1520	-	820	984
Stage 1	-	-	-	-	946	-
Stage 2	-	-	-	-	931	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1520	-	813	984
Mov Capacity-2 Maneuver	-	-	-	-	813	-
Stage 1	-	-	-	-	946	-
Stage 2	-	-	-	-	924	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	8.9
HCM LOS			A

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	966	-	-	1520	-
HCM Lane V/C Ratio	0.04	-	-	0.008	-
HCM Control Delay (s)	8.9	-	-	7.387	0
HCM Lane LOS	A			A	A
HCM 95th %tile Q(veh)	0.124	-	-	0.023	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	3.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	100	715	300	100	125	125
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	150	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	104	745	312	104	130	130

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	313	0	-	0	894	156
Stage 1	-	-	-	-	313	-
Stage 2	-	-	-	-	581	-
Follow-up Headway	2.22	-	-	-	3.52	3.32
Pot Capacity-1 Maneuver	1244	-	-	-	281	862
Stage 1	-	-	-	-	715	-
Stage 2	-	-	-	-	522	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1244	-	-	-	258	862
Mov Capacity-2 Maneuver	-	-	-	-	371	-
Stage 1	-	-	-	-	715	-
Stage 2	-	-	-	-	478	-

Approach	EB	WB	SB
HCM Control Delay, s	1	0	14.9
HCM LOS			B

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1244	-	-	-	371	862
HCM Lane V/C Ratio	0.084	-	-	-	0.351	0.151
HCM Control Delay (s)	8.158	-	-	-	19.9	9.9
HCM Lane LOS	A				C	A
HCM 95th %tile Q(veh)	0.274	-	-	-	1.543	0.531

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

2: County Line Rd & Erie Pkwy

PM Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑	↱	↰↰	↑↱	
Volume (veh/h)	95	550	195	200	205	70	170	250	335	165	285	25
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	190.0
Lanes	1	2	1	1	2	1	2	1	1	2	1	0
Cap, veh/h	567	1325	563	413	1466	623	577	476	405	590	430	38
Arrive On Green	0.05	0.36	0.36	0.09	0.39	0.39	0.06	0.26	0.26	0.06	0.25	0.25
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	3442	1863	1583	3442	1689	148
Grp Volume(v), veh/h	99	573	203	208	214	73	177	260	349	172	0	323
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1583	1721	0	1837
Q Serve(g_s), s	2.9	9.9	8.0	5.7	3.1	2.5	3.1	10.2	17.8	3.0	0.0	13.4
Cycle Q Clear(g_c), s	2.9	9.9	8.0	5.7	3.1	2.5	3.1	10.2	17.8	3.0	0.0	13.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.08
Lane Grp Cap(c), veh/h	567	1325	563	413	1466	623	577	476	405	590	0	467
V/C Ratio(X)	0.17	0.43	0.36	0.50	0.15	0.12	0.31	0.55	0.86	0.29	0.00	0.69
Avail Cap(c_a), veh/h	641	1325	563	419	1466	623	692	530	451	709	0	523
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	15.6	20.7	20.1	14.1	16.5	16.3	21.9	27.2	30.0	21.5	0.0	28.4
Incr Delay (d2), s/veh	0.1	1.0	1.8	1.0	0.2	0.4	0.3	1.0	14.6	0.3	0.0	3.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	1.2	4.5	3.2	2.3	1.4	0.9	1.3	4.6	8.3	1.2	0.0	6.3
Lane Grp Delay (d), s/veh	15.7	21.7	21.9	15.0	16.7	16.6	22.2	28.1	44.6	21.8	0.0	31.8
Lane Grp LOS	B	C	C	B	B	B	C	C	D	C		C
Approach Vol, veh/h		875			495			786			495	
Approach Delay, s/veh		21.1			16.0			34.1			28.3	
Approach LOS		C			B			C			C	
Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	9.5	35.0		12.7	38.2		10.2	26.6		10.1	26.5	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	8.0	30.0		8.0	30.0		8.0	24.0		8.0	24.0	
Max Q Clear Time (g_c+I1), s	4.9	11.9		7.7	5.1		5.1	19.8		5.0	15.4	
Green Ext Time (p_c), s	0.1	5.5		0.0	6.1		0.1	1.8		0.1	3.0	
Intersection Summary												
HCM 2010 Ctrl Delay			25.3									
HCM 2010 LOS			C									
Notes												

Intersection	
Intersection Delay, s/veh	0.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	85	670	45	0	680
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	87	684	46	0	694

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1401	365	0	0	730	0
Stage 1	707	-	-	-	-	-
Stage 2	694	-	-	-	-	-
Follow-up Headway	3.519	3.319	-	-	2.22	-
Pot Capacity-1 Maneuver	142	633	-	-	870	-
Stage 1	451	-	-	-	-	-
Stage 2	495	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	142	633	-	-	870	-
Mov Capacity-2 Maneuver	142	-	-	-	-	-
Stage 1	451	-	-	-	-	-
Stage 2	495	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.6	0	0
HCM LOS	B		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	633	870	-
HCM Lane V/C Ratio	-	-	0.137	-	-
HCM Control Delay (s)	-	-	11.6	0	-
HCM Lane LOS			B	A	
HCM 95th %tile Q(veh)	-	-	0.473	0	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

4: County Line Rd & Mitchell Way

Intersection	
Intersection Delay, s/veh	0.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	50	665	45	45	635
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	115	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	51	679	46	46	648

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1442	702	0	0	724	0
Stage 1	702	-	-	-	-	-
Stage 2	740	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	146	438	-	-	879	-
Stage 1	491	-	-	-	-	-
Stage 2	472	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	138	438	-	-	879	-
Mov Capacity-2 Maneuver	138	-	-	-	-	-
Stage 1	491	-	-	-	-	-
Stage 2	447	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	14.3	0	0.6
HCM LOS	B		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	438	879	-
HCM Lane V/C Ratio	-	-	0.116	0.052	-
HCM Control Delay (s)	-	-	14.3	9.321	-
HCM Lane LOS			B	A	
HCM 95th %tile Q(veh)	-	-	0.392	0.165	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↑	↱	↰	↑	↱
Volume (veh/h)	25	20	45	110	20	50	55	635	85	60	520	55
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	190.0	186.3	186.3	190.0	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	1	0	1	1	0	1	1	1	1	1	1
Cap, veh/h	445	97	218	449	90	224	530	1006	855	447	1006	855
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.54	0.54	0.54	0.54	0.54	0.54
Sat Flow, veh/h	1322	513	1148	1328	476	1179	816	1863	1583	709	1863	1583
Grp Volume(v), veh/h	26	0	68	115	0	73	57	661	89	62	542	57
Grp Sat Flow(s),veh/h/ln	1322	0	1660	1328	0	1655	816	1863	1583	709	1863	1583
Q Serve(g_s), s	0.5	0.0	1.0	2.4	0.0	1.1	1.4	7.5	0.8	2.0	5.6	0.5
Cycle Q Clear(g_c), s	1.6	0.0	1.0	3.4	0.0	1.1	7.0	7.5	0.8	9.5	5.6	0.5
Prop In Lane	1.00		0.69	1.00		0.71	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	445	0	315	449	0	314	530	1006	855	447	1006	855
V/C Ratio(X)	0.06	0.00	0.22	0.26	0.00	0.23	0.11	0.66	0.10	0.14	0.54	0.07
Avail Cap(c_a), veh/h	907	0	897	914	0	894	530	1006	855	447	1006	855
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	10.9	0.0	10.1	11.6	0.0	10.2	6.7	4.9	3.3	8.2	4.4	3.3
Incr Delay (d2), s/veh	0.1	0.0	0.3	0.3	0.0	0.4	0.4	3.4	0.2	0.6	2.1	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	0.1	0.0	0.3	0.6	0.0	0.3	0.2	2.2	0.2	0.3	1.6	0.1
Lane Grp Delay (d), s/veh	10.9	0.0	10.5	11.9	0.0	10.5	7.1	8.2	3.6	8.9	6.5	3.4
Lane Grp LOS	B		B	B		B	A	A	A	A	A	A
Approach Vol, veh/h		94			188			807			661	
Approach Delay, s/veh		10.6			11.4			7.6			6.4	
Approach LOS		B			B			A			A	

Timer												
Assigned Phs		4			8			2			6	
Phs Duration (G+Y+Rc), s		9.6			9.6			20.0			20.0	
Change Period (Y+Rc), s		4.0			4.0			4.0			4.0	
Max Green Setting (Gmax), s		16.0			16.0			16.0			16.0	
Max Q Clear Time (g_c+I1), s		3.6			5.4			9.5			11.5	
Green Ext Time (p_c), s		0.9			0.8			4.0			3.0	

Intersection Summary			
HCM 2010 Ctrl Delay			7.7
HCM 2010 LOS			A

Notes

Intersection	
Intersection Delay, s/veh	1.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	65	9	25	105	3	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	72	10	28	117	3	28

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	82	0	249	77
Stage 1	-	-	-	-	77	-
Stage 2	-	-	-	-	172	-
Follow-up Headway	-	-	2.218	-	3.518	3.318
Pot Capacity-1 Maneuver	-	-	1515	-	739	984
Stage 1	-	-	-	-	946	-
Stage 2	-	-	-	-	858	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1515	-	724	984
Mov Capacity-2 Maneuver	-	-	-	-	724	-
Stage 1	-	-	-	-	946	-
Stage 2	-	-	-	-	841	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.4	8.9
HCM LOS			A

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	948	-	-	1515	-
HCM Lane V/C Ratio	0.033	-	-	0.018	-
HCM Control Delay (s)	8.9	-	-	7.421	0
HCM Lane LOS	A			A	A
HCM 95th %tile Q(veh)	0.102	-	-	0.056	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	2.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	35	271	17	7	772	35	36	5	29	46	2	45
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	150	150	-	150	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	39	301	19	8	858	39	40	6	32	51	2	50

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	858	0	0	301	0	0	825	1252	151	1104	1252	429
Stage 1	-	-	-	-	-	-	379	379	-	873	873	-
Stage 2	-	-	-	-	-	-	446	873	-	231	379	-
Follow-up Headway	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Capacity-1 Maneuver	779	-	-	1257	-	-	265	171	868	166	171	574
Stage 1	-	-	-	-	-	-	615	613	-	311	366	-
Stage 2	-	-	-	-	-	-	561	366	-	751	613	-
Time blocked-Platoon, %		-	-		-	-						
Mov Capacity-1 Maneuver	779	-	-	1257	-	-	230	161	868	150	161	574
Mov Capacity-2 Maneuver	-	-	-	-	-	-	340	255	-	241	271	-
Stage 1	-	-	-	-	-	-	584	582	-	295	364	-
Stage 2	-	-	-	-	-	-	506	364	-	680	582	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.1	0.1	14	17.6
HCM LOS			B	C

Minor Lane / Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	340	521	779	-	-	1257	-	-	241	417
HCM Lane V/C Ratio	0.078	0.098	0.05	-	-	0.006	-	-	0.141	0.166
HCM Control Delay (s)	16.5	12.7	9.864	-	-	7.882	-	-	22.4	15.3
HCM Lane LOS	C	B	A			A			C	C
HCM 95th %tile Q(veh)	0.254	0.325	0.157	-	-	0.019	-	-	0.485	0.59

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑	↱	↰↰	↑↱	
Volume (veh/h)	82	185	87	286	467	70	250	258	119	80	343	97
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	190.0
Lanes	1	2	1	1	2	1	2	1	1	2	1	0
Cap, veh/h	396	1257	534	561	1406	597	429	573	487	639	377	107
Arrive On Green	0.05	0.34	0.34	0.09	0.38	0.38	0.08	0.31	0.31	0.04	0.27	0.27
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	3442	1863	1583	3442	1397	396
Grp Volume(v), veh/h	91	206	97	318	519	78	278	287	132	89	0	489
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1583	1721	0	1793
Q Serve(g_s), s	2.9	3.4	3.8	8.0	9.0	2.9	4.8	11.2	5.6	1.6	0.0	24.0
Cycle Q Clear(g_c), s	2.9	3.4	3.8	8.0	9.0	2.9	4.8	11.2	5.6	1.6	0.0	24.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.22
Lane Grp Cap(c), veh/h	396	1257	534	561	1406	597	429	573	487	639	0	484
V/C Ratio(X)	0.23	0.16	0.18	0.57	0.37	0.13	0.65	0.50	0.27	0.14	0.00	1.01
Avail Cap(c_a), veh/h	467	1257	534	561	1406	597	472	573	487	811	0	484
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	17.8	20.6	20.8	16.8	20.0	18.1	22.4	25.2	23.3	22.1	0.0	32.4
Incr Delay (d2), s/veh	0.3	0.3	0.7	1.3	0.7	0.5	2.7	0.7	0.3	0.1	0.0	43.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	1.2	1.5	0.1	1.3	4.0	1.1	3.2	5.1	2.1	0.7	0.0	16.1
Lane Grp Delay (d), s/veh	18.0	20.9	21.5	18.2	20.8	18.6	25.1	25.9	23.5	22.2	0.0	75.9
Lane Grp LOS	B	C	C	B	C	B	C	C	C	C		F
Approach Vol, veh/h		394			915			697			578	
Approach Delay, s/veh		20.4			19.7			25.1			67.6	
Approach LOS		C			B			C			E	
Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	9.5	35.0		13.0	38.5		11.9	32.3		8.6	29.0	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	8.0	30.0		8.0	30.0		8.0	24.0		8.0	24.0	
Max Q Clear Time (g_c+I1), s	4.9	5.8		10.0	11.0		6.8	13.2		3.6	26.0	
Green Ext Time (p_c), s	0.0	5.1		0.0	4.8		0.1	3.7		0.1	0.0	
Intersection Summary												
HCM 2010 Ctrl Delay			32.0									
HCM 2010 LOS			C									
Notes												

Intersection	
Intersection Delay, s/veh	0.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	0	7	0	0	15	0	611	10	0	688	29
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	-	-	-	-	-	0
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	86	86	86	86	86	86	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	8	0	0	17	0	710	12	0	800	34

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1155	1522	800	1516	1516	361	800	0	0	722	0	0
Stage 1	800	800	-	716	716	-	-	-	-	-	-	-
Stage 2	355	722	-	800	800	-	-	-	-	-	-	-
Follow-up Headway	3.519	4.019	3.319	3.519	4.019	3.319	2.218	-	-	2.22	-	-
Pot Capacity-1 Maneuver	163	118	384	90	119	636	823	-	-	876	-	-
Stage 1	378	396	-	388	433	-	-	-	-	-	-	-
Stage 2	636	430	-	378	396	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-		-	-
Mov Capacity-1 Maneuver	159	118	384	88	119	636	823	-	-	876	-	-
Mov Capacity-2 Maneuver	281	242	-	213	243	-	-	-	-	-	-	-
Stage 1	378	396	-	388	433	-	-	-	-	-	-	-
Stage 2	619	430	-	370	396	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	14.6	10.8	0	0
HCM LOS	B	B		

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	823	-	-	384	636	876	-	-
HCM Lane V/C Ratio	-	-	-	0.021	0.027	-	-	-
HCM Control Delay (s)	0	-	-	14.6	10.8	0	-	-
HCM Lane LOS	A			B	B	A		
HCM 95th %tile Q(veh)	0	-	-	0.065	0.085	0	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

4: County Line Rd & Three-Quarter Site Access/Mitchell Way

Intersection	
Intersection Delay, s/veh	1.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	0	4	0	0	55	25	566	25	51	629	15
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	150	-	150	115	-	0
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	86	86	86	86	86	86	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	5	0	0	64	29	658	29	59	731	17

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1566	1566	731	1566	1566	658	731	0	0	658	0	0
Stage 1	850	850	-	716	716	-	-	-	-	-	-	-
Stage 2	716	716	-	850	850	-	-	-	-	-	-	-
Follow-up Headway	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Capacity-1 Maneuver	90	111	422	90	111	464	873	-	-	930	-	-
Stage 1	355	377	-	421	434	-	-	-	-	-	-	-
Stage 2	421	434	-	355	377	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-		-	-
Mov Capacity-1 Maneuver	72	101	422	83	101	464	873	-	-	930	-	-
Mov Capacity-2 Maneuver	72	101	-	83	101	-	-	-	-	-	-	-
Stage 1	343	353	-	407	420	-	-	-	-	-	-	-
Stage 2	351	420	-	329	353	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.6	14	0.4	0.7
HCM LOS	B	B		

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	873	-	-	422	464	930	-	-
HCM Lane V/C Ratio	0.033	-	-	0.011	0.138	0.064	-	-
HCM Control Delay (s)	9.266	-	-	13.6	14	9.134	-	-
HCM Lane LOS	A			B	B	A		
HCM 95th %tile Q(veh)	0.103	-	-	0.033	0.475	0.204	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 TWSC
5: County Line Rd & Southeast RIRO Site Access

Intersection	
Intersection Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	0	3	0	616	621	12
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	4	0	725	731	14

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1456	731	731	0	-	0
Stage 1	731	-	-	-	-	-
Stage 2	725	-	-	-	-	-
Follow-up Headway	3.518	3.318	2.218	-	-	-
Pot Capacity-1 Maneuver	143	422	873	-	-	-
Stage 1	476	-	-	-	-	-
Stage 2	479	-	-	-	-	-
Time blocked-Platoon, %				-	-	-
Mov Capacity-1 Maneuver	143	422	873	-	-	-
Mov Capacity-2 Maneuver	143	-	-	-	-	-
Stage 1	476	-	-	-	-	-
Stage 2	479	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.6	0	0
HCM LOS	B		

Minor Lane / Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	873	-	422	-	-
HCM Lane V/C Ratio	-	-	0.008	-	-
HCM Control Delay (s)	0	-	13.6	-	-
HCM Lane LOS	A		B		
HCM 95th %tile Q(veh)	0	-	0.025	-	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

6: County Line Rd & Austin Ave

AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↑	↱	↰	↑	↱
Volume (veh/h)	58	26	77	80	23	63	39	495	50	52	542	31
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	190.0	186.3	186.3	190.0	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	1	0	1	1	0	1	1	1	1	1	1
Cap, veh/h	458	94	277	439	99	273	434	962	818	465	962	818
Arrive On Green	0.23	0.23	0.23	0.23	0.23	0.23	0.52	0.52	0.52	0.52	0.52	0.52
Sat Flow, veh/h	1288	418	1228	1264	441	1209	761	1863	1583	785	1863	1583
Grp Volume(v), veh/h	68	0	122	94	0	101	46	582	59	61	638	36
Grp Sat Flow(s),veh/h/ln	1288	0	1646	1264	0	1649	761	1863	1583	785	1863	1583
Q Serve(g_s), s	1.4	0.0	1.9	2.1	0.0	1.6	1.5	6.8	0.6	1.8	7.8	0.3
Cycle Q Clear(g_c), s	3.0	0.0	1.9	4.0	0.0	1.6	9.3	6.8	0.6	8.6	7.8	0.3
Prop In Lane	1.00		0.75	1.00		0.73	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	458	0	371	439	0	372	434	962	818	465	962	818
V/C Ratio(X)	0.15	0.00	0.33	0.21	0.00	0.27	0.11	0.61	0.07	0.13	0.66	0.04
Avail Cap(c_a), veh/h	833	0	850	807	0	852	434	962	818	465	962	818
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	11.1	0.0	10.0	11.7	0.0	9.9	8.9	5.3	3.8	8.3	5.5	3.7
Incr Delay (d2), s/veh	0.1	0.0	0.5	0.2	0.0	0.4	0.5	2.8	0.2	0.6	3.6	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	0.3	0.0	0.6	0.5	0.0	0.5	0.2	2.0	0.1	0.3	2.6	0.1
Lane Grp Delay (d), s/veh	11.3	0.0	10.6	12.0	0.0	10.3	9.4	8.1	3.9	8.9	9.1	3.8
Lane Grp LOS	B		B	B		B	A	A	A	A	A	A
Approach Vol, veh/h		190			195			687			735	
Approach Delay, s/veh		10.8			11.1			7.8			8.8	
Approach LOS		B			B			A			A	

Timer												
Assigned Phs		4			8			2			6	
Phs Duration (G+Y+Rc), s		11.0			11.0			20.0			20.0	
Change Period (Y+Rc), s		4.0			4.0			4.0			4.0	
Max Green Setting (Gmax), s		16.0			16.0			16.0			16.0	
Max Q Clear Time (g_c+I1), s		5.0			6.0			11.3			10.6	
Green Ext Time (p_c), s		1.3			1.2			3.1			3.4	

Intersection Summary			
HCM 2010 Ctrl Delay			8.9
HCM 2010 LOS			A

Notes

Intersection	
Intersection Delay, s/veh	1.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	6	140	83	10	22	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	165	98	12	26	6

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	109	0	-	0	283	104
Stage 1	-	-	-	-	104	-
Stage 2	-	-	-	-	179	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1481	-	-	-	707	951
Stage 1	-	-	-	-	920	-
Stage 2	-	-	-	-	852	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1481	-	-	-	703	951
Mov Capacity-2 Maneuver	-	-	-	-	703	-
Stage 1	-	-	-	-	920	-
Stage 2	-	-	-	-	848	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	10.1
HCM LOS			B

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1481	-	-	-	739
HCM Lane V/C Ratio	0.005	-	-	-	0.043
HCM Control Delay (s)	7.442	0	-	-	10.1
HCM Lane LOS	A	A			B
HCM 95th %tile Q(veh)	0.014	-	-	-	0.135

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	1.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	4	123	81	7	23	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	145	95	8	27	6

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	104	0	-	0	253	99
Stage 1	-	-	-	-	99	-
Stage 2	-	-	-	-	154	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1488	-	-	-	736	957
Stage 1	-	-	-	-	925	-
Stage 2	-	-	-	-	874	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1488	-	-	-	733	957
Mov Capacity-2 Maneuver	-	-	-	-	733	-
Stage 1	-	-	-	-	925	-
Stage 2	-	-	-	-	871	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	9.9
HCM LOS			A

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1488	-	-	-	765
HCM Lane V/C Ratio	0.003	-	-	-	0.043
HCM Control Delay (s)	7.427	0	-	-	9.9
HCM Lane LOS	A	A			A
HCM 95th %tile Q(veh)	0.01	-	-	-	0.135

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	1.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	95	3	12	75	3	32
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	110	3	14	87	3	37

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	114	0	227	112
Stage 1	-	-	-	-	112	-
Stage 2	-	-	-	-	115	-
Follow-up Headway	-	-	2.218	-	3.518	3.318
Pot Capacity-1 Maneuver	-	-	1475	-	761	941
Stage 1	-	-	-	-	913	-
Stage 2	-	-	-	-	910	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1475	-	753	941
Mov Capacity-2 Maneuver	-	-	-	-	753	-
Stage 1	-	-	-	-	913	-
Stage 2	-	-	-	-	901	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1	9.1
HCM LOS			A

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	921	-	-	1475	-
HCM Lane V/C Ratio	0.044	-	-	0.009	-
HCM Control Delay (s)	9.1	-	-	7.464	0
HCM Lane LOS	A			A	A
HCM 95th %tile Q(veh)	0.139	-	-	0.029	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	1.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	3	74	71	7	24	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	4	87	84	8	28	9

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	92	0	-	0	182	88
Stage 1	-	-	-	-	88	-
Stage 2	-	-	-	-	94	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1503	-	-	-	807	970
Stage 1	-	-	-	-	935	-
Stage 2	-	-	-	-	930	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1503	-	-	-	805	970
Mov Capacity-2 Maneuver	-	-	-	-	805	-
Stage 1	-	-	-	-	935	-
Stage 2	-	-	-	-	927	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	9.5
HCM LOS			A

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1503	-	-	-	841
HCM Lane V/C Ratio	0.002	-	-	-	0.045
HCM Control Delay (s)	7.401	0	-	-	9.5
HCM Lane LOS	A	A			A
HCM 95th %tile Q(veh)	0.007	-	-	-	0.14

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 TWSC
26: North RIRO Site Access & Erie Pkwy

Intersection	
Intersection Delay, s/veh	0.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	335	11	0	814	0	18
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	372	12	0	904	0	20

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	372	0	824	372
Stage 1	-	-	-	-	372	-
Stage 2	-	-	-	-	452	-
Follow-up Headway	-	-	2.218	-	3.519	3.319
Pot Capacity-1 Maneuver	-	-	1186	-	327	673
Stage 1	-	-	-	-	696	-
Stage 2	-	-	-	-	609	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1186	-	327	673
Mov Capacity-2 Maneuver	-	-	-	-	327	-
Stage 1	-	-	-	-	696	-
Stage 2	-	-	-	-	609	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	10.5
HCM LOS			B

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	673	-	-	1186	-
HCM Lane V/C Ratio	0.03	-	-	-	-
HCM Control Delay (s)	10.5	-	-	0	-
HCM Lane LOS	B			A	
HCM 95th %tile Q(veh)	0.092	-	-	0	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	5.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	100	746	56	29	297	101	75	10	15	129	8	125
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	0	150	-	150	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	96	96	96	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	104	777	58	30	309	105	78	10	16	134	8	130

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	309	0	0	777	0	0	1204	1355	389	972	1355	155
Stage 1	-	-	-	-	-	-	985	985	-	370	370	-
Stage 2	-	-	-	-	-	-	219	370	-	602	985	-
Follow-up Headway	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Capacity-1 Maneuver	1248	-	-	835	-	-	140	148	610	207	148	863
Stage 1	-	-	-	-	-	-	266	324	-	622	619	-
Stage 2	-	-	-	-	-	-	763	619	-	453	324	-
Time blocked-Platoon, %		-	-		-	-						
Mov Capacity-1 Maneuver	1248	-	-	835	-	-	105	131	610	177	131	863
Mov Capacity-2 Maneuver	-	-	-	-	-	-	190	223	-	276	216	-
Stage 1	-	-	-	-	-	-	244	297	-	570	597	-
Stage 2	-	-	-	-	-	-	616	597	-	390	297	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.9	0.6	27.1	18.4
HCM LOS			D	C

Minor Lane / Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	190	249	1248	-	-	835	-	-	276	521
HCM Lane V/C Ratio	0.274	0.209	0.083	-	-	0.036	-	-	0.325	0.352
HCM Control Delay (s)	31	23.2	8.147	-	-	9.473	-	-	24.2	15.6
HCM Lane LOS	D	C	A			A			C	C
HCM 95th %tile Q(veh)	1.067	0.769	0.273	-	-	0.112	-	-	1.362	1.57

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑	↱	↰↰	↑↱	
Volume (veh/h)	124	622	214	307	216	70	178	266	374	165	324	33
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	190.0
Lanes	1	2	1	1	2	1	2	1	1	2	1	0
Cap, veh/h	559	1292	549	380	1389	590	538	503	428	582	445	45
Arrive On Green	0.07	0.35	0.35	0.09	0.37	0.37	0.06	0.27	0.27	0.06	0.27	0.27
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	3442	1863	1583	3442	1666	168
Grp Volume(v), veh/h	129	648	223	320	225	73	185	277	390	172	0	372
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1583	1721	0	1833
Q Serve(g_s), s	4.0	11.9	9.3	8.0	3.5	2.6	3.3	11.0	20.6	3.1	0.0	16.1
Cycle Q Clear(g_c), s	4.0	11.9	9.3	8.0	3.5	2.6	3.3	11.0	20.6	3.1	0.0	16.1
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.09
Lane Grp Cap(c), veh/h	559	1292	549	380	1389	590	538	503	428	582	0	490
V/C Ratio(X)	0.23	0.50	0.41	0.84	0.16	0.12	0.34	0.55	0.91	0.30	0.00	0.76
Avail Cap(c_a), veh/h	605	1292	549	380	1389	590	643	517	439	697	0	509
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	16.1	22.3	21.5	20.9	18.1	17.8	22.1	27.1	30.6	21.4	0.0	29.1
Incr Delay (d2), s/veh	0.2	1.4	2.2	15.6	0.3	0.4	0.4	1.2	22.7	0.3	0.0	6.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	1.6	5.5	3.7	4.5	1.5	1.0	1.3	5.1	10.4	1.2	0.0	8.0
Lane Grp Delay (d), s/veh	16.3	23.7	23.7	36.5	18.4	18.3	22.5	28.2	53.3	21.7	0.0	35.4
Lane Grp LOS	B	C	C	D	B	B	C	C	D	C		D
Approach Vol, veh/h		1000			618			852			544	
Approach Delay, s/veh		22.8			27.7			38.4			31.1	
Approach LOS		C			C			D			C	

Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	10.8	35.0		13.0	37.2		10.4	28.4		10.1	28.1	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	8.0	30.0		8.0	30.0		8.0	24.0		8.0	24.0	
Max Q Clear Time (g_c+I1), s	6.0	13.9		10.0	5.5		5.3	22.6		5.1	18.1	
Green Ext Time (p_c), s	0.1	5.8		0.0	6.8		0.1	0.7		0.1	2.6	

Intersection Summary			
HCM 2010 Ctrl Delay			29.7
HCM 2010 LOS			C

Notes

Intersection	
Intersection Delay, s/veh	0.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	0	35	0	0	85	0	733	45	0	766	79
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	-	-	-	-	-	0
Veh in Median Storage, #	-	0	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	98	98	98	98	98	98	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	36	0	0	87	0	748	46	0	782	81

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1156	1576	782	1553	1553	397	782	0	0	794	0	0
Stage 1	782	782	-	771	771	-	-	-	-	-	-	-
Stage 2	374	794	-	782	782	-	-	-	-	-	-	-
Follow-up Headway	3.519	4.019	3.319	3.519	4.019	3.319	2.218	-	-	2.22	-	-
Pot Capacity-1 Maneuver	162	109	393	84	113	603	836	-	-	823	-	-
Stage 1	386	404	-	360	409	-	-	-	-	-	-	-
Stage 2	620	399	-	386	404	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-		-	-
Mov Capacity-1 Maneuver	139	109	393	76	113	603	836	-	-	823	-	-
Mov Capacity-2 Maneuver	139	109	-	76	113	-	-	-	-	-	-	-
Stage 1	386	404	-	360	409	-	-	-	-	-	-	-
Stage 2	531	399	-	351	404	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	15.1	12	0	0
HCM LOS	C	B		

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	836	-	-	393	603	823	-	-
HCM Lane V/C Ratio	-	-	-	0.091	0.144	-	-	-
HCM Control Delay (s)	0	-	-	15.1	12	0	-	-
HCM Lane LOS	A			C	B	A		
HCM 95th %tile Q(veh)	0	-	-	0.298	0.5	0	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

4: County Line Rd & Three-Quarter Site Access/Mitchell Way

Intersection	
Intersection Delay, s/veh	1.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	0	23	0	0	50	72	728	45	47	707	47
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	0	-	0	115	-	0
Veh in Median Storage, #	-	0	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	98	98	98	98	98	98	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	23	0	0	51	73	743	46	48	721	48

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1707	1707	721	1707	1707	743	721	0	0	743	0	0
Stage 1	817	817	-	890	890	-	-	-	-	-	-	-
Stage 2	890	890	-	817	817	-	-	-	-	-	-	-
Follow-up Headway	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Capacity-1 Maneuver	72	91	427	72	91	415	881	-	-	864	-	-
Stage 1	370	390	-	337	361	-	-	-	-	-	-	-
Stage 2	337	361	-	370	390	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-		-	-
Mov Capacity-1 Maneuver	57	79	427	61	79	415	881	-	-	864	-	-
Mov Capacity-2 Maneuver	57	79	-	61	79	-	-	-	-	-	-	-
Stage 1	339	368	-	309	331	-	-	-	-	-	-	-
Stage 2	271	331	-	330	368	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.9	14.9	0.8	0.6
HCM LOS	B	B		

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	881	-	-	427	415	864	-	-
HCM Lane V/C Ratio	0.083	-	-	0.055	0.123	0.056	-	-
HCM Control Delay (s)	9.458	-	-	13.9	14.9	9.411	-	-
HCM Lane LOS	A			B	B	A		
HCM 95th %tile Q(veh)	0.272	-	-	0.174	0.417	0.176	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

5: County Line Rd & Southeast RIRO Site Access

Intersection	
Intersection Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	0	19	0	845	691	39
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	19	0	862	705	40

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1567	705	705	0	-	0
Stage 1	705	-	-	-	-	-
Stage 2	862	-	-	-	-	-
Follow-up Headway	3.518	3.318	2.218	-	-	-
Pot Capacity-1 Maneuver	122	436	893	-	-	-
Stage 1	490	-	-	-	-	-
Stage 2	414	-	-	-	-	-
Time blocked-Platoon, %				-	-	-
Mov Capacity-1 Maneuver	122	436	893	-	-	-
Mov Capacity-2 Maneuver	122	-	-	-	-	-
Stage 1	490	-	-	-	-	-
Stage 2	414	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.6	0	0
HCM LOS	B		

Minor Lane / Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	893	-	436	-	-
HCM Lane V/C Ratio	-	-	0.044	-	-
HCM Control Delay (s)	0	-	13.6	-	-
HCM Lane LOS	A		B		
HCM 95th %tile Q(veh)	0	-	0.139	-	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 Signalized Intersection Summary
6: County Line Rd & Austin Ave

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↑	↱	↰	↑	↱
Volume (veh/h)	134	27	68	110	31	59	109	652	85	70	564	77
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	190.0	186.3	186.3	190.0	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	1	0	1	1	0	1	1	1	1	1	1
Cap, veh/h	483	113	286	477	139	264	440	942	801	382	942	801
Arrive On Green	0.24	0.24	0.24	0.24	0.24	0.24	0.51	0.51	0.51	0.51	0.51	0.51
Sat Flow, veh/h	1298	468	1186	1291	574	1095	766	1863	1583	697	1863	1583
Grp Volume(v), veh/h	140	0	99	115	0	93	114	679	89	73	588	80
Grp Sat Flow(s),veh/h/ln	1298	0	1653	1291	0	1670	766	1863	1583	697	1863	1583
Q Serve(g_s), s	3.1	0.0	1.5	2.5	0.0	1.4	4.0	9.0	0.9	2.9	7.2	0.8
Cycle Q Clear(g_c), s	4.5	0.0	1.5	4.0	0.0	1.4	11.2	9.0	0.9	11.8	7.2	0.8
Prop In Lane	1.00		0.72	1.00		0.66	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	483	0	399	477	0	403	440	942	801	382	942	801
V/C Ratio(X)	0.29	0.00	0.25	0.24	0.00	0.23	0.26	0.72	0.11	0.19	0.62	0.10
Avail Cap(c_a), veh/h	826	0	836	818	0	844	440	942	801	382	942	801
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	11.4	0.0	9.7	11.3	0.0	9.6	9.7	6.1	4.1	10.7	5.6	4.1
Incr Delay (d2), s/veh	0.3	0.0	0.3	0.3	0.0	0.3	1.4	4.8	0.3	1.1	3.1	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	0.8	0.0	0.4	0.6	0.0	0.4	0.7	3.3	0.2	0.5	2.4	0.2
Lane Grp Delay (d), s/veh	11.8	0.0	10.0	11.6	0.0	9.9	11.1	10.8	4.4	11.8	8.8	4.3
Lane Grp LOS	B		B	B		A	B	B	A	B	A	A
Approach Vol, veh/h		239			208			882			741	
Approach Delay, s/veh		11.0			10.8			10.2			8.6	
Approach LOS		B			B			B			A	

Timer												
Assigned Phs		4			8			2			6	
Phs Duration (G+Y+Rc), s		11.6			11.6			20.0			20.0	
Change Period (Y+Rc), s		4.0			4.0			4.0			4.0	
Max Green Setting (Gmax), s		16.0			16.0			16.0			16.0	
Max Q Clear Time (g_c+I1), s		6.5			6.0			13.2			13.8	
Green Ext Time (p_c), s		1.3			1.3			2.1			1.6	

Intersection Summary			
HCM 2010 Ctrl Delay			9.8
HCM 2010 LOS			A

Notes

7: Austin Ave & East Full-Movement Site Access

Intersection	
Intersection Delay, s/veh	3.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	19	113	175	41	115	32
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	123	190	45	125	35

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	235	0	-	0	377	213
Stage 1	-	-	-	-	213	-
Stage 2	-	-	-	-	164	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1332	-	-	-	625	827
Stage 1	-	-	-	-	823	-
Stage 2	-	-	-	-	865	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1332	-	-	-	614	827
Mov Capacity-2 Maneuver	-	-	-	-	614	-
Stage 1	-	-	-	-	823	-
Stage 2	-	-	-	-	850	-

Approach	EB	WB	SB
HCM Control Delay, s	1.1	0	12.3
HCM LOS			B

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1332	-	-	-	650
HCM Lane V/C Ratio	0.016	-	-	-	0.246
HCM Control Delay (s)	7.745	0	-	-	12.3
HCM Lane LOS	A	A			B
HCM 95th %tile Q(veh)	0.047	-	-	-	0.963

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	14	118	183	25	13	13
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	15	128	199	27	14	14

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	226	0	-	0	372	213
Stage 1	-	-	-	-	213	-
Stage 2	-	-	-	-	159	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1342	-	-	-	629	827
Stage 1	-	-	-	-	823	-
Stage 2	-	-	-	-	870	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1342	-	-	-	621	827
Mov Capacity-2 Maneuver	-	-	-	-	621	-
Stage 1	-	-	-	-	823	-
Stage 2	-	-	-	-	860	-

Approach	EB	WB	SB
HCM Control Delay, s	0.8	0	10.3
HCM LOS			B

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1342	-	-	-	709
HCM Lane V/C Ratio	0.011	-	-	-	0.04
HCM Control Delay (s)	7.713	0	-	-	10.3
HCM Lane LOS	A	A			B
HCM 95th %tile Q(veh)	0.034	-	-	-	0.124

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	1.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	101	10	32	164	4	31
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	112	11	36	182	4	34

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	123	0	371	118
Stage 1	-	-	-	-	118	-
Stage 2	-	-	-	-	253	-
Follow-up Headway	-	-	2.218	-	3.518	3.318
Pot Capacity-1 Maneuver	-	-	1464	-	630	934
Stage 1	-	-	-	-	907	-
Stage 2	-	-	-	-	789	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1464	-	613	934
Mov Capacity-2 Maneuver	-	-	-	-	613	-
Stage 1	-	-	-	-	907	-
Stage 2	-	-	-	-	768	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.2	9.3
HCM LOS			A

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	881	-	-	1464	-
HCM Lane V/C Ratio	0.044	-	-	0.024	-
HCM Control Delay (s)	9.3	-	-	7.52	0
HCM Lane LOS	A			A	A
HCM 95th %tile Q(veh)	0.138	-	-	0.075	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

10: Austin Ave & West Full-Movement Site Access

Intersection	
Intersection Delay, s/veh	0.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	9	96	142	26	15	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	10	104	154	28	16	5

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	183	0	-	0	292	168
Stage 1	-	-	-	-	168	-
Stage 2	-	-	-	-	124	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1392	-	-	-	699	876
Stage 1	-	-	-	-	862	-
Stage 2	-	-	-	-	902	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1392	-	-	-	693	876
Mov Capacity-2 Maneuver	-	-	-	-	693	-
Stage 1	-	-	-	-	862	-
Stage 2	-	-	-	-	895	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	10.1
HCM LOS			B

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1392	-	-	-	731
HCM Lane V/C Ratio	0.007	-	-	-	0.03
HCM Control Delay (s)	7.605	0	-	-	10.1
HCM Lane LOS	A	A			B
HCM 95th %tile Q(veh)	0.021	-	-	-	0.092

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	1.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	849	42	0	427	0	110
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	884	44	0	445	0	115

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	884	0	1106	884
Stage 1	-	-	-	-	884	-
Stage 2	-	-	-	-	222	-
Follow-up Headway	-	-	2.218	-	3.519	3.319
Pot Capacity-1 Maneuver	-	-	765	-	218	344
Stage 1	-	-	-	-	403	-
Stage 2	-	-	-	-	794	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	765	-	218	344
Mov Capacity-2 Maneuver	-	-	-	-	218	-
Stage 1	-	-	-	-	403	-
Stage 2	-	-	-	-	794	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	20.6
HCM LOS			C

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	344	-	-	765	-
HCM Lane V/C Ratio	0.333	-	-	-	-
HCM Control Delay (s)	20.6	-	-	0	-
HCM Lane LOS	C			A	
HCM 95th %tile Q(veh)	1.427	-	-	0	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑	↑↑	↱	↰	↱
Volume (veh/h)	35	435	1235	35	45	45
Number	7	4	8	18	1	16
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	2	2	1	1	1
Cap, veh/h	440	3178	2894	1230	90	81
Arrive On Green	0.03	0.85	1.00	1.00	0.05	0.05
Sat Flow, veh/h	1774	3725	3725	1583	1774	1583
Grp Volume(v), veh/h	38	473	1342	38	49	49
Grp Sat Flow(s),veh/h/ln	1774	1863	1863	1583	1774	1583
Q Serve(g_s), s	0.3	1.8	0.0	0.0	2.2	2.5
Cycle Q Clear(g_c), s	0.3	1.8	0.0	0.0	2.2	2.5
Prop In Lane	1.00			1.00	1.00	1.00
Lane Grp Cap(c), veh/h	440	3178	2894	1230	90	81
V/C Ratio(X)	0.09	0.15	0.46	0.03	0.54	0.61
Avail Cap(c_a), veh/h	561	3178	2894	1230	448	399
HCM Platoon Ratio	1.00	1.00	1.33	1.33	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.78	0.78	1.00	1.00
Uniform Delay (d), s/veh	1.3	1.0	0.0	0.0	38.6	38.7
Incr Delay (d2), s/veh	0.1	0.1	0.4	0.0	5.0	7.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	0.1	0.3	0.2	0.0	1.1	0.2
Lane Grp Delay (d), s/veh	1.4	1.1	0.4	0.0	43.5	45.9
Lane Grp LOS	A	A	A	A	D	D
Approach Vol, veh/h		511	1380		98	
Approach Delay, s/veh		1.1	0.4		44.7	
Approach LOS		A	A		D	
Timer						
Assigned Phs	7	4	8			
Phs Duration (G+Y+Rc), s	6.3	75.0	68.7			
Change Period (Y+Rc), s	4.0	4.0	4.0			
Max Green Setting (Gmax), s	8.0	71.0	59.0			
Max Q Clear Time (g_c+I1), s	2.3	3.8	2.0			
Green Ext Time (p_c), s	0.0	20.8	20.1			
Intersection Summary						
HCM 2010 Ctrl Delay			2.8			
HCM 2010 LOS			A			
Notes						

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱
Volume (veh/h)	100	235	145	350	725	150	395	375	170	225	510	150
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	2	1	1	2	1	2	2	1	2	2	1
Cap, veh/h	292	921	392	544	1289	548	730	1028	437	744	879	374
Arrive On Green	0.02	0.08	0.08	0.16	0.35	0.35	0.12	0.28	0.28	0.08	0.24	0.24
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	3442	3725	1583	3442	3725	1583
Grp Volume(v), veh/h	109	255	158	380	788	163	429	408	185	245	554	163
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1583	1721	1863	1583
Q Serve(g_s), s	3.8	5.4	7.9	10.8	14.7	6.3	7.2	7.5	8.0	4.4	11.2	7.4
Cycle Q Clear(g_c), s	3.8	5.4	7.9	10.8	14.7	6.3	7.2	7.5	8.0	4.4	11.2	7.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	292	921	392	544	1289	548	730	1028	437	744	879	374
V/C Ratio(X)	0.37	0.28	0.40	0.70	0.61	0.30	0.59	0.40	0.42	0.33	0.63	0.44
Avail Cap(c_a), veh/h	292	921	392	623	1289	548	974	1555	661	921	1333	567
HCM Platoon Ratio	0.33	0.33	0.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.7	31.5	32.6	14.3	22.7	20.0	19.1	24.7	24.9	21.2	28.7	27.3
Incr Delay (d2), s/veh	0.8	0.7	3.0	2.9	2.2	1.4	0.8	0.2	0.7	0.3	0.7	0.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	1.7	2.7	3.6	4.5	6.7	2.5	2.8	3.3	3.1	1.8	5.1	2.9
Lane Grp Delay (d), s/veh	23.5	32.2	35.7	17.2	24.9	21.4	19.9	24.9	25.5	21.5	29.5	28.1
Lane Grp LOS	C	C	D	B	C	C	B	C	C	C	C	C
Approach Vol, veh/h		522			1331			1022			962	
Approach Delay, s/veh		31.4			22.3			22.9			27.2	
Approach LOS		C			C			C			C	
Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	10.0	25.7		18.3	34.0		15.0	28.1		11.7	24.8	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	5.0	17.0		17.0	29.0		16.0	35.0		11.0	30.0	
Max Q Clear Time (g_c+I1), s	5.8	9.9		12.8	16.7		9.2	10.0		6.4	13.2	
Green Ext Time (p_c), s	0.0	4.1		0.5	6.0		0.9	7.7		0.3	6.6	
Intersection Summary												
HCM 2010 Ctrl Delay			24.9									
HCM 2010 LOS			C									
Notes												

Intersection	
Intersection Delay, s/veh	0.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	25	915	30	0	1005
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	0	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	27	995	33	0	1092

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	2087	497	0	0	995	0
Stage 1	995	-	-	-	-	-
Stage 2	1092	-	-	-	-	-
Follow-up Headway	3.519	3.319	-	-	2.22	-
Pot Capacity-1 Maneuver	51	519	-	-	691	-
Stage 1	319	-	-	-	-	-
Stage 2	321	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	51	519	-	-	691	-
Mov Capacity-2 Maneuver	169	-	-	-	-	-
Stage 1	319	-	-	-	-	-
Stage 2	321	-	-	-	-	-

Approach	WB		NB		SB	
HCM Control Delay, s	12.3		0		0	
HCM LOS	B					

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	519	691	-
HCM Lane V/C Ratio	-	-	0.052	-	-
HCM Control Delay (s)	-	-	12.3	0	-
HCM Lane LOS			B	A	
HCM 95th %tile Q(veh)	-	-	0.165	0	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	1.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	100	845	55	80	925
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	0	115	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	109	918	60	87	1005

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	2097	918	0	0	918	0
Stage 1	918	-	-	-	-	-
Stage 2	1179	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	57	329	-	-	743	-
Stage 1	389	-	-	-	-	-
Stage 2	292	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	50	329	-	-	743	-
Mov Capacity-2 Maneuver	50	-	-	-	-	-
Stage 1	389	-	-	-	-	-
Stage 2	258	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	21.2	0	0.8
HCM LOS	C		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	329	743	-
HCM Lane V/C Ratio	-	-	0.33	0.117	-
HCM Control Delay (s)	-	-	21.2	10.486	-
HCM Lane LOS			C	B	
HCM 95th %tile Q(veh)	-	-	1.408	0.396	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↑	↱	↰	↑	↱
Volume (veh/h)	30	40	80	110	40	80	35	790	100	140	745	40
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	190.0	186.3	186.3	190.0	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	1	0	1	1	0	1	1	1	1	1	1
Cap, veh/h	457	137	276	457	137	276	302	934	794	269	934	794
Arrive On Green	0.25	0.25	0.25	0.25	0.25	0.25	0.50	0.50	0.50	0.50	0.50	0.50
Sat Flow, veh/h	1255	551	1115	1255	551	1115	644	1863	1583	578	1863	1583
Grp Volume(v), veh/h	33	0	130	120	0	130	38	859	109	152	810	43
Grp Sat Flow(s),veh/h/ln	1255	0	1666	1255	0	1666	644	1863	1583	578	1863	1583
Q Serve(g_s), s	0.7	0.0	2.0	2.8	0.0	2.0	1.8	13.6	1.2	2.4	12.2	0.4
Cycle Q Clear(g_c), s	2.7	0.0	2.0	4.8	0.0	2.0	14.0	13.6	1.2	16.0	12.2	0.4
Prop In Lane	1.00		0.67	1.00		0.67	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	457	0	413	457	0	413	302	934	794	269	934	794
V/C Ratio(X)	0.07	0.00	0.31	0.26	0.00	0.31	0.13	0.92	0.14	0.57	0.87	0.05
Avail Cap(c_a), veh/h	775	0	835	775	0	835	302	934	794	269	934	794
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	10.9	0.0	9.8	11.7	0.0	9.8	13.2	7.4	4.3	15.6	7.0	4.1
Incr Delay (d2), s/veh	0.1	0.0	0.4	0.3	0.0	0.4	0.9	15.4	0.4	8.3	10.7	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	0.2	0.0	0.6	0.7	0.0	0.6	0.3	6.9	0.3	1.6	5.5	0.1
Lane Grp Delay (d), s/veh	11.0	0.0	10.2	12.0	0.0	10.2	14.0	22.8	4.6	24.0	17.7	4.2
Lane Grp LOS	B		B	B		B	B	C	A	C	B	A
Approach Vol, veh/h		163			250			1006			1005	
Approach Delay, s/veh		10.4			11.1			20.5			18.1	
Approach LOS		B			B			C			B	
Timer												
Assigned Phs		4			8			2			6	
Phs Duration (G+Y+Rc), s		11.9			11.9			20.0			20.0	
Change Period (Y+Rc), s		4.0			4.0			4.0			4.0	
Max Green Setting (Gmax), s		16.0			16.0			16.0			16.0	
Max Q Clear Time (g_c+I1), s		4.7			6.8			16.0			18.0	
Green Ext Time (p_c), s		1.5			1.3			0.0			0.0	
Intersection Summary												
HCM 2010 Ctrl Delay			17.8									
HCM 2010 LOS			B									
Notes												

Intersection	
Intersection Delay, s/veh	1.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	119	1	14	86	4	24
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	129	1	15	93	4	26

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	130	0	254	130
Stage 1	-	-	-	-	130	-
Stage 2	-	-	-	-	124	-
Follow-up Headway	-	-	2.218	-	3.518	3.318
Pot Capacity-1 Maneuver	-	-	1455	-	735	920
Stage 1	-	-	-	-	896	-
Stage 2	-	-	-	-	902	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1455	-	727	920
Mov Capacity-2 Maneuver	-	-	-	-	727	-
Stage 1	-	-	-	-	896	-
Stage 2	-	-	-	-	892	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	9.2
HCM LOS			A

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	886	-	-	1455	-
HCM Lane V/C Ratio	0.034	-	-	0.01	-
HCM Control Delay (s)	9.2	-	-	7.5	0
HCM Lane LOS	A			A	A
HCM 95th %tile Q(veh)	0.107	-	-	0.032	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑	↑↑	↱	↰	↱
Volume (veh/h)	100	1235	545	100	125	125
Number	7	4	8	18	1	16
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	2	2	1	1	1
Cap, veh/h	700	2983	2660	1131	193	173
Arrive On Green	0.04	0.80	1.00	1.00	0.11	0.11
Sat Flow, veh/h	1774	3725	3725	1583	1774	1583
Grp Volume(v), veh/h	104	1286	568	104	130	130
Grp Sat Flow(s),veh/h/ln	1774	1863	1863	1583	1774	1583
Q Serve(g_s), s	1.2	9.3	0.0	0.0	6.2	7.1
Cycle Q Clear(g_c), s	1.2	9.3	0.0	0.0	6.2	7.1
Prop In Lane	1.00			1.00	1.00	1.00
Lane Grp Cap(c), veh/h	700	2983	2660	1131	193	173
V/C Ratio(X)	0.15	0.43	0.21	0.09	0.67	0.75
Avail Cap(c_a), veh/h	786	2983	2660	1131	420	375
HCM Platoon Ratio	1.00	1.00	2.00	2.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.96	0.96	1.00	1.00
Uniform Delay (d), s/veh	2.3	2.7	0.0	0.0	38.0	38.3
Incr Delay (d2), s/veh	0.1	0.5	0.2	0.2	4.0	6.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	0.3	2.5	0.1	0.0	3.0	0.3
Lane Grp Delay (d), s/veh	2.4	3.1	0.2	0.2	42.0	44.9
Lane Grp LOS	A	A	A	A	D	D
Approach Vol, veh/h		1390	672		260	
Approach Delay, s/veh		3.1	0.2		43.4	
Approach LOS		A	A		D	

Timer			
Assigned Phs	7	4	8
Phs Duration (G+Y+Rc), s	7.7	75.0	67.3
Change Period (Y+Rc), s	4.0	4.0	4.0
Max Green Setting (Gmax), s	8.0	71.0	59.0
Max Q Clear Time (g_c+I1), s	3.2	11.3	2.0
Green Ext Time (p_c), s	0.1	21.4	21.1

Intersection Summary	
HCM 2010 Ctrl Delay	6.8
HCM 2010 LOS	A

Notes

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱
Volume (veh/h)	135	850	375	275	320	250	225	400	400	250	445	100
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	2	1	1	2	1	2	2	1	2	2	1
Cap, veh/h	514	1502	638	406	1665	707	558	736	486	554	758	322
Arrive On Green	0.13	0.81	0.81	0.11	0.45	0.45	0.08	0.20	0.20	0.08	0.20	0.20
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	3442	3725	1583	3442	3725	1583
Grp Volume(v), veh/h	141	885	391	286	333	260	234	417	417	260	464	104
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1583	1721	1863	1583
Q Serve(g_s), s	4.5	8.4	9.1	8.0	5.2	10.5	5.1	9.7	19.0	5.6	10.9	5.4
Cycle Q Clear(g_c), s	4.5	8.4	9.1	8.0	5.2	10.5	5.1	9.7	19.0	5.6	10.9	5.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	514	1502	638	406	1665	707	558	736	486	554	758	322
V/C Ratio(X)	0.27	0.59	0.61	0.71	0.20	0.37	0.42	0.57	0.86	0.47	0.61	0.32
Avail Cap(c_a), veh/h	526	1502	638	580	1665	707	654	736	486	665	774	329
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.88	0.88	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	13.7	6.4	6.4	13.6	16.2	17.6	27.9	34.9	31.4	27.3	34.9	32.7
Incr Delay (d2), s/veh	0.3	1.5	3.8	2.3	0.3	1.5	0.5	1.0	14.2	0.6	1.4	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	1.7	2.4	2.6	3.3	2.3	4.0	2.1	4.6	10.9	2.4	5.1	2.1
Lane Grp Delay (d), s/veh	14.0	7.9	10.3	15.9	16.4	19.1	28.4	35.9	45.6	27.9	36.2	33.2
Lane Grp LOS	B	A	B	B	B	B	C	D	D	C	D	C
Approach Vol, veh/h		1417			879			1068			828	
Approach Delay, s/veh		9.1			17.0			38.0			33.2	
Approach LOS		A			B			D			C	
Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	11.4	43.8		15.5	48.0		12.3	24.0		12.9	24.6	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	7.0	30.0		20.0	43.0		10.0	19.0		11.0	20.0	
Max Q Clear Time (g_c+I1), s	6.5	11.1		10.0	12.5		7.1	21.0		7.6	12.9	
Green Ext Time (p_c), s	0.0	10.0		0.6	12.6		0.2	0.0		0.3	4.0	
Intersection Summary												
HCM 2010 Ctrl Delay			22.9									
HCM 2010 LOS			C									
Notes												

3: County Line Rd & Walgreens

Intersection	
Intersection Delay, s/veh	0.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	100	925	60	0	1095
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	0	-	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	102	944	61	0	1117

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	2061	472	0	0	944	0
Stage 1	944	-	-	-	-	-
Stage 2	1117	-	-	-	-	-
Follow-up Headway	3.519	3.319	-	-	2.22	-
Pot Capacity-1 Maneuver	53	539	-	-	722	-
Stage 1	340	-	-	-	-	-
Stage 2	312	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	53	539	-	-	722	-
Mov Capacity-2 Maneuver	53	-	-	-	-	-
Stage 1	340	-	-	-	-	-
Stage 2	312	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	13.2	0	0
HCM LOS	B		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	539	722	-
HCM Lane V/C Ratio	-	-	0.189	-	-
HCM Control Delay (s)	-	-	13.2	0	-
HCM Lane LOS			B	A	
HCM 95th %tile Q(veh)	-	-	0.692	0	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

4: County Line Rd & Mitchell Way

Intersection	
Intersection Delay, s/veh	1.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	135	850	75	75	1020
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	0	115	-
Veh in Median Storage, #	1	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	138	867	77	77	1041

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	2061	867	0	0	867	0
Stage 1	867	-	-	-	-	-
Stage 2	1194	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	60	352	-	-	777	-
Stage 1	411	-	-	-	-	-
Stage 2	287	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	54	352	-	-	777	-
Mov Capacity-2 Maneuver	54	-	-	-	-	-
Stage 1	411	-	-	-	-	-
Stage 2	259	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	21.7	0	0.7
HCM LOS	C		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	352	777	-
HCM Lane V/C Ratio	-	-	0.391	0.098	-
HCM Control Delay (s)	-	-	21.7	10.139	-
HCM Lane LOS			C	B	
HCM 95th %tile Q(veh)	-	-	1.807	0.327	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↑	↱	↰	↑	↱
Volume (veh/h)	35	35	60	135	35	110	70	780	125	120	840	60
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	190.0	186.3	186.3	190.0	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	1	0	1	1	0	1	1	1	1	1	1
Cap, veh/h	434	151	260	482	96	306	264	938	797	297	938	797
Arrive On Green	0.25	0.25	0.25	0.25	0.25	0.25	0.50	0.50	0.50	0.50	0.50	0.50
Sat Flow, veh/h	1231	616	1060	1292	391	1251	595	1863	1583	593	1863	1583
Grp Volume(v), veh/h	36	0	98	141	0	151	73	812	130	125	875	62
Grp Sat Flow(s),veh/h/ln	1231	0	1676	1292	0	1642	595	1863	1583	593	1863	1583
Q Serve(g_s), s	0.8	0.0	1.5	3.1	0.0	2.4	2.0	12.2	1.4	3.8	14.0	0.6
Cycle Q Clear(g_c), s	3.2	0.0	1.5	4.6	0.0	2.4	16.0	12.2	1.4	16.0	14.0	0.6
Prop In Lane	1.00		0.63	1.00		0.76	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	434	0	411	482	0	402	264	938	797	297	938	797
V/C Ratio(X)	0.08	0.00	0.24	0.29	0.00	0.38	0.28	0.87	0.16	0.42	0.93	0.08
Avail Cap(c_a), veh/h	752	0	843	816	0	826	264	938	797	297	938	797
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	11.3	0.0	9.6	11.5	0.0	10.0	15.4	7.0	4.3	14.8	7.4	4.1
Incr Delay (d2), s/veh	0.1	0.0	0.3	0.3	0.0	0.6	2.6	10.6	0.4	4.3	17.1	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	0.2	0.0	0.4	0.8	0.0	0.7	0.6	5.5	0.4	1.1	7.6	0.2
Lane Grp Delay (d), s/veh	11.4	0.0	9.9	11.8	0.0	10.6	18.0	17.5	4.7	19.1	24.5	4.3
Lane Grp LOS	B		A	B		B	B	B	A	B	C	A
Approach Vol, veh/h		134			292			1015			1062	
Approach Delay, s/veh		10.3			11.2			15.9			22.7	
Approach LOS		B			B			B			C	

Timer												
Assigned Phs		4			8			2			6	
Phs Duration (G+Y+Rc), s		11.8			11.8			20.0			20.0	
Change Period (Y+Rc), s		4.0			4.0			4.0			4.0	
Max Green Setting (Gmax), s		16.0			16.0			16.0			16.0	
Max Q Clear Time (g_c+I1), s		5.2			6.6			18.0			18.0	
Green Ext Time (p_c), s		1.5			1.4			0.0			0.0	

Intersection Summary			
HCM 2010 Ctrl Delay			17.9
HCM 2010 LOS			B

Notes

Intersection	
Intersection Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	88	6	26	107	1	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	96	7	28	116	1	9

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	102	0	272	99
Stage 1	-	-	-	-	99	-
Stage 2	-	-	-	-	173	-
Follow-up Headway	-	-	2.218	-	3.518	3.318
Pot Capacity-1 Maneuver	-	-	1490	-	717	957
Stage 1	-	-	-	-	925	-
Stage 2	-	-	-	-	857	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1490	-	703	957
Mov Capacity-2 Maneuver	-	-	-	-	703	-
Stage 1	-	-	-	-	925	-
Stage 2	-	-	-	-	840	-

Approach	EB		WB		NB	
HCM Control Delay, s	0		1.5		9	
HCM LOS					A	

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	920	-	-	1490	-
HCM Lane V/C Ratio	0.011	-	-	0.019	-
HCM Control Delay (s)	9	-	-	7.463	0
HCM Lane LOS	A			A	A
HCM 95th %tile Q(veh)	0.032	-	-	0.058	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰	↑↱		↰	↑↱	
Volume (veh/h)	35	446	17	7	1232	35	36	5	29	46	2	45
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	190.0	186.3	186.3	190.0
Lanes	1	2	1	1	2	1	1	1	0	1	1	0
Cap, veh/h	410	2596	1103	689	2519	1070	181	11	73	196	4	88
Arrive On Green	0.03	0.70	0.70	0.02	1.00	1.00	0.03	0.05	0.05	0.03	0.06	0.06
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	1774	218	1398	1774	62	1530
Grp Volume(v), veh/h	38	485	18	8	1339	38	39	0	37	50	0	51
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1774	0	1616	1774	0	1593
Q Serve(g_s), s	0.5	3.5	0.3	0.1	0.0	0.0	1.6	0.0	1.7	2.0	0.0	2.4
Cycle Q Clear(g_c), s	0.5	3.5	0.3	0.1	0.0	0.0	1.6	0.0	1.7	2.0	0.0	2.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.86	1.00		0.96
Lane Grp Cap(c), veh/h	410	2596	1103	689	2519	1070	181	0	85	196	0	92
V/C Ratio(X)	0.09	0.19	0.02	0.01	0.53	0.04	0.21	0.00	0.44	0.25	0.00	0.56
Avail Cap(c_a), veh/h	543	2596	1103	859	2519	1070	314	0	336	319	0	331
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	3.0	4.1	3.6	3.8	0.0	0.0	33.2	0.0	35.3	32.6	0.0	35.3
Incr Delay (d2), s/veh	0.1	0.2	0.0	0.0	0.8	0.1	0.6	0.0	3.5	0.7	0.0	5.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	0.1	1.2	0.1	0.0	0.3	0.0	0.7	0.0	0.8	0.9	0.0	1.1
Lane Grp Delay (d), s/veh	3.1	4.2	3.6	3.9	0.8	0.1	33.8	0.0	38.8	33.3	0.0	40.5
Lane Grp LOS	A	A	A	A	A	A	C		D	C		D
Approach Vol, veh/h		541			1385			76			101	
Approach Delay, s/veh		4.1			0.8			36.2			36.9	
Approach LOS		A			A			D			D	

Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	6.2	57.6		4.6	56.0		6.3	8.0		6.7	8.4	
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Max Green Setting (Gmax), s	8.0	52.0		8.0	52.0		8.0	16.0		8.0	16.0	
Max Q Clear Time (g_c+I1), s	2.5	5.5		2.1	2.0		3.6	3.7		4.0	4.4	
Green Ext Time (p_c), s	0.0	19.1		0.0	19.6		0.0	0.3		0.0	0.3	

Intersection Summary			
HCM 2010 Ctrl Delay			4.7
HCM 2010 LOS			A

Notes

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱
Volume (veh/h)	112	265	152	386	727	150	395	383	189	225	523	152
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	2	1	1	2	1	2	2	1	2	2	1
Cap, veh/h	271	796	338	540	1229	522	516	1085	735	325	878	373
Arrive On Green	0.11	0.43	0.43	0.17	0.33	0.33	0.15	0.29	0.29	0.09	0.24	0.24
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	3442	3725	1583	3442	3725	1583
Grp Volume(v), veh/h	122	288	165	420	790	163	429	416	205	245	568	165
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1583	1721	1863	1583
Q Serve(g_s), s	4.8	4.6	6.6	12.9	15.8	6.8	10.6	7.8	7.0	6.1	12.1	7.8
Cycle Q Clear(g_c), s	4.8	4.6	6.6	12.9	15.8	6.8	10.6	7.8	7.0	6.1	12.1	7.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	271	796	338	540	1229	522	516	1085	735	325	878	373
V/C Ratio(X)	0.45	0.36	0.49	0.78	0.64	0.31	0.83	0.38	0.28	0.75	0.65	0.44
Avail Cap(c_a), veh/h	271	796	338	576	1229	522	627	1484	905	431	1272	540
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	23.8	21.1	21.7	15.9	25.0	22.0	36.3	24.9	14.5	38.8	30.3	28.7
Incr Delay (d2), s/veh	1.2	1.3	5.0	6.3	2.6	1.6	7.9	0.2	0.2	5.2	0.8	0.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	1.9	2.0	2.6	5.7	7.4	2.7	5.0	3.5	2.5	2.8	5.5	3.0
Lane Grp Delay (d), s/veh	25.0	22.4	26.7	22.2	27.6	23.5	44.2	25.1	14.7	44.0	31.1	29.5
Lane Grp LOS	C	C	C	C	C	C	D	C	B	D	C	C
Approach Vol, veh/h		575			1373			1050			978	
Approach Delay, s/veh		24.2			25.5			30.9			34.1	
Approach LOS		C			C			C			C	

Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	10.0	23.8		20.2	34.0		18.2	30.6		13.3	25.7	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	5.0	17.0		17.0	29.0		16.0	35.0		11.0	30.0	
Max Q Clear Time (g_c+I1), s	6.8	8.6		14.9	17.8		12.6	9.8		8.1	14.1	
Green Ext Time (p_c), s	0.0	4.7		0.3	5.8		0.5	8.0		0.2	6.6	

Intersection Summary			
HCM 2010 Ctrl Delay			28.8
HCM 2010 LOS			C

Notes

Intersection	
Intersection Delay, s/veh	0.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	0	7	0	0	25	0	941	30	0	1033	29
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	-	-	-	-	-	0
Veh in Median Storage, #	-	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	8	0	0	27	0	1023	33	0	1123	32

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1634	2178	1123	2162	2162	528	1123	0	0	1055	0	0
Stage 1	1123	1123	-	1039	1039	-	-	-	-	-	-	-
Stage 2	511	1055	-	1123	1123	-	-	-	-	-	-	-
Follow-up Headway	3.519	4.019	3.319	3.519	4.019	3.319	2.218	-	-	2.22	-	-
Pot Capacity-1 Maneuver	74	46	249	30	47	496	622	-	-	656	-	-
Stage 1	249	280	-	247	307	-	-	-	-	-	-	-
Stage 2	514	302	-	249	280	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-		-	-
Mov Capacity-1 Maneuver	70	46	249	29	47	496	622	-	-	656	-	-
Mov Capacity-2 Maneuver	178	154	-	125	155	-	-	-	-	-	-	-
Stage 1	249	280	-	247	307	-	-	-	-	-	-	-
Stage 2	486	302	-	241	280	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	19.9	12.7	0	0
HCM LOS	C	B		

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	622	-	-	249	496	656	-	-
HCM Lane V/C Ratio	-	-	-	0.031	0.055	-	-	-
HCM Control Delay (s)	0	-	-	19.9	12.7	0	-	-
HCM Lane LOS	A			C	B	A		
HCM 95th %tile Q(veh)	0	-	-	0.094	0.173	0	-	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

4: County Line Rd & Three-Quarter Site Access/Mitchell Way

Intersection	
Intersection Delay, s/veh	1.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	0	4	0	0	100	25	871	55	81	944	15
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	150	-	0	115	-	0
Veh in Median Storage, #	-	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	4	0	0	109	27	947	60	88	1026	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2203	2203	1026	2203	2203	947	1026	0	0	947	0	0
Stage 1	1202	1202	-	1001	1001	-	-	-	-	-	-	-
Stage 2	1001	1001	-	1202	1202	-	-	-	-	-	-	-
Follow-up Headway	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Capacity-1 Maneuver	32	45	285	32	45	317	677	-	-	725	-	-
Stage 1	225	258	-	293	321	-	-	-	-	-	-	-
Stage 2	293	321	-	225	258	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-		-	-
Mov Capacity-1 Maneuver	19	38	285	28	38	317	677	-	-	725	-	-
Mov Capacity-2 Maneuver	19	38	-	28	38	-	-	-	-	-	-	-
Stage 1	216	227	-	281	308	-	-	-	-	-	-	-
Stage 2	185	308	-	195	227	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	17.8	22.2	0.3	0.8
HCM LOS	C	C		

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	677	-	-	285	317	725	-	-
HCM Lane V/C Ratio	0.04	-	-	0.015	0.343	0.121	-	-
HCM Control Delay (s)	10.54	-	-	17.8	22.2	10.651	-	-
HCM Lane LOS	B			C	C	B		
HCM 95th %tile Q(veh)	0.125	-	-	0.046	1.481	0.413	-	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	0	3	0	951	936	12
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	3	0	1034	1017	13

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2051	1017	1017	0	-	0
Stage 1	1017	-	-	-	-	-
Stage 2	1034	-	-	-	-	-
Follow-up Headway	3.518	3.318	2.218	-	-	-
Pot Capacity-1 Maneuver	61	288	682	-	-	-
Stage 1	349	-	-	-	-	-
Stage 2	343	-	-	-	-	-
Time blocked-Platoon, %				-	-	-
Mov Capacity-1 Maneuver	61	288	682	-	-	-
Mov Capacity-2 Maneuver	61	-	-	-	-	-
Stage 1	349	-	-	-	-	-
Stage 2	343	-	-	-	-	-

Approach	EB		NB		SB	
HCM Control Delay, s	17.6		0		0	
HCM LOS	C					

Minor Lane / Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	682	-	288	-	-
HCM Lane V/C Ratio	-	-	0.011	-	-
HCM Control Delay (s)	0	-	17.6	-	-
HCM Lane LOS	A		C		
HCM 95th %tile Q(veh)	0	-	0.034	-	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↑	↱	↰	↑	↱
Volume (veh/h)	68	46	102	110	43	83	49	800	100	142	752	46
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	190.0	186.3	186.3	190.0	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	1	0	1	1	0	1	1	1	1	1	1
Cap, veh/h	266	65	144	257	87	166	249	938	798	233	991	843
Arrive On Green	0.05	0.13	0.13	0.08	0.15	0.15	0.03	0.50	0.50	0.06	0.53	0.53
Sat Flow, veh/h	1774	516	1145	1774	573	1097	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	74	0	161	120	0	137	53	870	109	154	817	50
Grp Sat Flow(s),veh/h/ln	1774	0	1661	1774	0	1669	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	3.1	0.0	8.1	4.8	0.0	6.5	1.2	37.3	3.1	3.3	31.4	1.3
Cycle Q Clear(g_c), s	3.1	0.0	8.1	4.8	0.0	6.5	1.2	37.3	3.1	3.3	31.4	1.3
Prop In Lane	1.00		0.69	1.00		0.66	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	266	0	208	257	0	253	249	938	798	233	991	843
V/C Ratio(X)	0.28	0.00	0.77	0.47	0.00	0.54	0.21	0.93	0.14	0.66	0.82	0.06
Avail Cap(c_a), veh/h	385	0	290	329	0	292	397	977	830	330	991	843
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.6	0.0	36.3	28.2	0.0	33.6	14.8	19.8	11.3	19.1	16.7	9.7
Incr Delay (d2), s/veh	0.6	0.0	8.2	1.3	0.0	1.8	0.4	14.1	0.1	3.2	5.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	1.4	0.0	3.8	2.1	0.0	2.8	0.5	18.9	1.1	3.5	14.5	0.5
Lane Grp Delay (d), s/veh	31.1	0.0	44.5	29.5	0.0	35.4	15.2	34.0	11.4	22.3	22.5	9.7
Lane Grp LOS	C		D	C		D	B	C	B	C	C	A
Approach Vol, veh/h		235			257			1032			1021	
Approach Delay, s/veh		40.3			32.7			30.6			21.8	
Approach LOS		D			C			C			C	
Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	9.3	15.8		11.5	18.0		7.9	48.2		10.3	50.7	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	10.0	15.0		10.0	15.0		10.0	45.0		10.0	45.0	
Max Q Clear Time (g_c+I1), s	5.1	10.1		6.8	8.5		3.2	39.3		5.3	33.4	
Green Ext Time (p_c), s	0.1	0.7		0.1	0.9		0.0	3.9		0.1	8.2	
Intersection Summary												
HCM 2010 Ctrl Delay			28.2									
HCM 2010 LOS			C									
Notes												

Intersection	
Intersection Delay, s/veh	0.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	6	195	128	10	22	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	212	139	11	24	5

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	150	0	-	0	370	145
Stage 1	-	-	-	-	145	-
Stage 2	-	-	-	-	225	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1431	-	-	-	630	902
Stage 1	-	-	-	-	882	-
Stage 2	-	-	-	-	812	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1431	-	-	-	626	902
Mov Capacity-2 Maneuver	-	-	-	-	626	-
Stage 1	-	-	-	-	882	-
Stage 2	-	-	-	-	807	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	10.7
HCM LOS			B

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1431	-	-	-	664
HCM Lane V/C Ratio	0.005	-	-	-	0.044
HCM Control Delay (s)	7.527	0	-	-	10.7
HCM Lane LOS	A	A			B
HCM 95th %tile Q(veh)	0.014	-	-	-	0.138

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

8: Austin Ave & Alley

Intersection	
Intersection Delay, s/veh	1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	4	178	126	7	23	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	4	193	137	8	25	5

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	145	0	-	0	343	141
Stage 1	-	-	-	-	141	-
Stage 2	-	-	-	-	202	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1437	-	-	-	653	907
Stage 1	-	-	-	-	886	-
Stage 2	-	-	-	-	832	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1437	-	-	-	651	907
Mov Capacity-2 Maneuver	-	-	-	-	651	-
Stage 1	-	-	-	-	886	-
Stage 2	-	-	-	-	830	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	10.5
HCM LOS			B

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1437	-	-	-	686
HCM Lane V/C Ratio	0.003	-	-	-	0.044
HCM Control Delay (s)	7.513	0	-	-	10.5
HCM Lane LOS	A	A			B
HCM 95th %tile Q(veh)	0.009	-	-	-	0.139

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 TWSC
9: Graham Way & Austin Ave

2035 Total
AM Peak

Intersection	
Intersection Delay, s/veh	1.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	149	2	16	101	4	26
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	162	2	17	110	4	28

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	164	0	308	163
Stage 1	-	-	-	-	163	-
Stage 2	-	-	-	-	145	-
Follow-up Headway	-	-	2.218	-	3.518	3.318
Pot Capacity-1 Maneuver	-	-	1414	-	684	882
Stage 1	-	-	-	-	866	-
Stage 2	-	-	-	-	882	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1414	-	675	882
Mov Capacity-2 Maneuver	-	-	-	-	675	-
Stage 1	-	-	-	-	866	-
Stage 2	-	-	-	-	871	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1	9.4
HCM LOS			A

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	847	-	-	1414	-
HCM Lane V/C Ratio	0.038	-	-	0.012	-
HCM Control Delay (s)	9.4	-	-	7.578	0
HCM Lane LOS	A			A	A
HCM 95th %tile Q(veh)	0.12	-	-	0.037	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	1.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	3	127	98	7	24	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	138	107	8	26	9

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	114	0	-	0	255	110
Stage 1	-	-	-	-	110	-
Stage 2	-	-	-	-	145	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1475	-	-	-	734	943
Stage 1	-	-	-	-	915	-
Stage 2	-	-	-	-	882	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1475	-	-	-	733	943
Mov Capacity-2 Maneuver	-	-	-	-	733	-
Stage 1	-	-	-	-	915	-
Stage 2	-	-	-	-	880	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	9.9
HCM LOS			A

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1475	-	-	-	776
HCM Lane V/C Ratio	0.002	-	-	-	0.045
HCM Control Delay (s)	7.446	0	-	-	9.9
HCM Lane LOS	A	A			A
HCM 95th %tile Q(veh)	0.007	-	-	-	0.141

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	0.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	510	11	0	1274	0	18
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	554	12	0	1385	0	20

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	554	0	1246	554
Stage 1	-	-	-	-	554	-
Stage 2	-	-	-	-	692	-
Follow-up Headway	-	-	2.218	-	3.519	3.319
Pot Capacity-1 Maneuver	-	-	1016	-	178	531
Stage 1	-	-	-	-	574	-
Stage 2	-	-	-	-	459	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1016	-	178	531
Mov Capacity-2 Maneuver	-	-	-	-	178	-
Stage 1	-	-	-	-	574	-
Stage 2	-	-	-	-	459	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	12
HCM LOS			B

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	531	-	-	1016	-
HCM Lane V/C Ratio	0.037	-	-	-	-
HCM Control Delay (s)	12	-	-	0	-
HCM Lane LOS	B			A	
HCM 95th %tile Q(veh)	0.115	-	-	0	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 Signalized Intersection Summary
1: North Site Access/Future Access & Erie Pkwy

2035 Total
PM Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰	↱		↰	↱	
Volume (veh/h)	100	1266	56	29	542	101	75	10	15	129	8	125
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	190.0	186.3	186.3	190.0
Lanes	1	2	1	1	2	1	1	1	0	1	1	0
Cap, veh/h	622	2325	988	290	2255	958	214	52	84	326	10	169
Arrive On Green	0.04	0.62	0.62	0.05	1.00	1.00	0.05	0.08	0.08	0.08	0.11	0.11
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	1774	646	1034	1774	93	1505
Grp Volume(v), veh/h	104	1319	58	30	565	105	78	0	26	134	0	138
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1774	0	1680	1774	0	1597
Q Serve(g_s), s	1.8	17.7	1.2	0.5	0.0	0.0	3.4	0.0	1.2	5.6	0.0	7.2
Cycle Q Clear(g_c), s	1.8	17.7	1.2	0.5	0.0	0.0	3.4	0.0	1.2	5.6	0.0	7.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.62	1.00		0.94
Lane Grp Cap(c), veh/h	622	2325	988	290	2255	958	214	0	136	326	0	179
V/C Ratio(X)	0.17	0.57	0.06	0.10	0.25	0.11	0.36	0.00	0.19	0.41	0.00	0.77
Avail Cap(c_a), veh/h	711	2325	988	413	2255	958	284	0	313	341	0	297
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	5.1	9.4	6.3	7.5	0.0	0.0	33.8	0.0	36.8	29.5	0.0	37.1
Incr Delay (d2), s/veh	0.1	1.0	0.1	0.2	0.3	0.2	1.0	0.0	0.7	0.8	0.0	6.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	0.6	7.1	0.4	0.2	0.1	0.1	1.6	0.0	0.6	2.5	0.0	3.3
Lane Grp Delay (d), s/veh	5.2	10.4	6.4	7.6	0.3	0.2	34.8	0.0	37.5	30.3	0.0	43.8
Lane Grp LOS	A	B	A	A	A	A	C		D	C		D
Approach Vol, veh/h		1481			700			104			272	
Approach Delay, s/veh		9.9			0.6			35.5			37.2	
Approach LOS		A			A			D			D	
Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	7.7	57.6		6.0	56.0		8.6	11.0		11.3	13.7	
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Max Green Setting (Gmax), s	8.0	52.0		8.0	52.0		8.0	16.0		8.0	16.0	
Max Q Clear Time (g_c+I1), s	3.8	19.7		2.5	2.0		5.4	3.2		7.6	9.2	
Green Ext Time (p_c), s	0.1	17.5		0.0	21.3		0.0	0.7		0.0	0.4	
Intersection Summary												
HCM 2010 Ctrl Delay			11.3									
HCM 2010 LOS			B									
Notes												

HCM 2010 Signalized Intersection Summary
2: County Line Rd & Erie Pkwy

2035 Total
PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱
Volume (veh/h)	164	922	394	382	331	250	233	416	439	250	484	108
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	2	1	1	2	1	2	2	1	2	2	1
Cap, veh/h	479	1285	546	434	1628	692	311	719	564	329	739	314
Arrive On Green	0.14	0.69	0.69	0.16	0.44	0.44	0.09	0.19	0.19	0.10	0.20	0.20
Sat Flow, veh/h	1774	3725	1583	1774	3725	1583	3442	3725	1583	3442	3725	1583
Grp Volume(v), veh/h	171	960	410	398	345	260	243	433	457	260	504	112
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1583	1721	1863	1583
Q Serve(g_s), s	6.3	16.2	16.4	13.5	5.7	10.9	6.8	10.4	19.0	7.3	12.3	6.0
Cycle Q Clear(g_c), s	6.3	16.2	16.4	13.5	5.7	10.9	6.8	10.4	19.0	7.3	12.3	6.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	479	1285	546	434	1628	692	311	719	564	329	739	314
V/C Ratio(X)	0.36	0.75	0.75	0.92	0.21	0.38	0.78	0.60	0.81	0.79	0.68	0.36
Avail Cap(c_a), veh/h	479	1285	546	505	1628	692	350	719	564	385	757	322
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	17.2	12.5	12.5	22.5	17.2	18.7	43.8	36.3	28.7	43.5	36.6	34.0
Incr Delay (d2), s/veh	0.4	4.0	9.2	20.1	0.3	1.6	9.8	1.4	8.7	9.2	2.4	0.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	2.3	4.7	4.7	6.4	2.5	4.3	3.4	5.0	11.1	3.5	5.9	2.4
Lane Grp Delay (d), s/veh	17.6	16.5	21.7	42.7	17.5	20.2	53.7	37.7	37.4	52.7	39.0	34.7
Lane Grp LOS	B	B	C	D	B	C	D	D	D	D	D	C
Approach Vol, veh/h		1541			1003			1133			876	
Approach Delay, s/veh		18.0			28.2			41.0			42.5	
Approach LOS		B			C			D			D	
Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	12.0	39.0		21.0	48.0		13.9	24.0		14.4	24.5	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	7.0	30.0		20.0	43.0		10.0	19.0		11.0	20.0	
Max Q Clear Time (g_c+I1), s	8.3	18.4		15.5	12.9		8.8	21.0		9.3	14.3	
Green Ext Time (p_c), s	0.0	7.7		0.5	13.6		0.1	0.0		0.2	3.5	
Intersection Summary												
HCM 2010 Ctrl Delay			30.7									
HCM 2010 LOS			C									
Notes												

3: County Line Rd & Northeast RIRO Site Access/Walgreens

Intersection	
Intersection Delay, s/veh	0.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	0	35	0	0	100	0	988	60	0	1181	79
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	-	-	-	-	-	0
Veh in Median Storage, #	-	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	98	98	98	98	98	98	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	36	0	0	102	0	1008	61	0	1205	81

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1709	2274	1205	2244	2244	535	1205	0	0	1069	0	0
Stage 1	1205	1205	-	1039	1039	-	-	-	-	-	-	-
Stage 2	504	1069	-	1205	1205	-	-	-	-	-	-	-
Follow-up Headway	3.519	4.019	3.319	3.519	4.019	3.319	2.218	-	-	2.22	-	-
Pot Capacity-1 Maneuver	65	40	223	26	42	491	579	-	-	648	-	-
Stage 1	224	256	-	247	307	-	-	-	-	-	-	-
Stage 2	519	297	-	224	256	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-		-	-
Mov Capacity-1 Maneuver	51	40	223	22	42	491	579	-	-	648	-	-
Mov Capacity-2 Maneuver	153	144	-	107	146	-	-	-	-	-	-	-
Stage 1	224	256	-	247	307	-	-	-	-	-	-	-
Stage 2	411	297	-	188	256	-	-	-	-	-	-	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	24.2			14.2			0			0		
HCM LOS	C			B								

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	579	-	-	223	491	648	-	-
HCM Lane V/C Ratio	-	-	-	0.16	0.208	-	-	-
HCM Control Delay (s)	0	-	-	24.2	14.2	0	-	-
HCM Lane LOS	A			C	B	A		
HCM 95th %tile Q(veh)	0	-	-	0.559	0.775	0	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	2.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	0	0	23	0	0	135	72	913	75	77	1092	47
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	0	150	-	0	115	-	0
Veh in Median Storage, #	-	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	98	98	98	98	98	98	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	0	23	0	0	138	73	932	77	79	1114	48

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2350	2350	1114	2350	2350	932	1114	0	0	932	0	0
Stage 1	1271	1271	-	1079	1079	-	-	-	-	-	-	-
Stage 2	1079	1079	-	1271	1271	-	-	-	-	-	-	-
Follow-up Headway	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Capacity-1 Maneuver	25	36	253	25	36	323	627	-	-	734	-	-
Stage 1	206	239	-	264	295	-	-	-	-	-	-	-
Stage 2	264	295	-	206	239	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-		-	-
Mov Capacity-1 Maneuver	12	28	253	19	28	323	627	-	-	734	-	-
Mov Capacity-2 Maneuver	12	28	-	19	28	-	-	-	-	-	-	-
Stage 1	182	213	-	233	261	-	-	-	-	-	-	-
Stage 2	134	261	-	167	213	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	20.7	24.2	0.8	0.7
HCM LOS	C	C		

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	627	-	-	253	323	734	-	-
HCM Lane V/C Ratio	0.117	-	-	0.093	0.426	0.107	-	-
HCM Control Delay (s)	11.502	-	-	20.7	24.2	10.492	-	-
HCM Lane LOS	B			C	C	B		
HCM 95th %tile Q(veh)	0.396	-	-	0.304	2.05	0.358	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 TWSC
5: County Line Rd & Southeast RIRO Site Access

2035 Total
PM Peak

Intersection	
Intersection Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	0	19	0	1060	1076	39
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	19	0	1082	1098	40

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2180	1098	1098	0	-	0
Stage 1	1098	-	-	-	-	-
Stage 2	1082	-	-	-	-	-
Follow-up Headway	3.518	3.318	2.218	-	-	-
Pot Capacity-1 Maneuver	51	259	636	-	-	-
Stage 1	319	-	-	-	-	-
Stage 2	325	-	-	-	-	-
Time blocked-Platoon, %				-	-	-
Mov Capacity-1 Maneuver	51	259	636	-	-	-
Mov Capacity-2 Maneuver	51	-	-	-	-	-
Stage 1	319	-	-	-	-	-
Stage 2	325	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	20	0	0
HCM LOS	C		

Minor Lane / Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	636	-	259	-	-
HCM Lane V/C Ratio	-	-	0.075	-	-
HCM Control Delay (s)	0	-	20	-	-
HCM Lane LOS	A		C		
HCM 95th %tile Q(veh)	0	-	0.241	-	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 Signalized Intersection Summary
6: County Line Rd & Austin Ave

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↑	↱	↰	↑	↱
Volume (veh/h)	144	42	83	135	46	119	124	797	125	130	884	82
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	190.0	186.3	186.3	190.0	186.3	186.3	186.3	186.3	186.3	186.3
Lanes	1	1	0	1	1	0	1	1	1	1	1	1
Cap, veh/h	278	76	148	312	60	155	192	928	788	238	931	791
Arrive On Green	0.09	0.13	0.13	0.09	0.13	0.13	0.06	0.50	0.50	0.06	0.50	0.50
Sat Flow, veh/h	1774	565	1103	1774	461	1191	1774	1863	1583	1774	1863	1583
Grp Volume(v), veh/h	150	0	130	141	0	172	129	830	130	135	921	85
Grp Sat Flow(s),veh/h/ln	1774	0	1668	1774	0	1653	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	6.4	0.0	6.6	6.1	0.0	9.1	3.1	36.3	4.0	3.3	44.1	2.6
Cycle Q Clear(g_c), s	6.4	0.0	6.6	6.1	0.0	9.1	3.1	36.3	4.0	3.3	44.1	2.6
Prop In Lane	1.00		0.66	1.00		0.72	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	278	0	224	312	0	215	192	928	788	238	931	791
V/C Ratio(X)	0.54	0.00	0.58	0.45	0.00	0.80	0.67	0.89	0.16	0.57	0.99	0.11
Avail Cap(c_a), veh/h	312	0	278	354	0	275	289	931	791	332	931	791
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.0	0.0	36.6	30.2	0.0	38.0	20.7	20.5	12.4	19.0	22.3	11.9
Incr Delay (d2), s/veh	1.6	0.0	2.4	1.0	0.0	12.2	4.0	11.1	0.1	2.1	26.8	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	2.8	0.0	2.8	2.7	0.0	4.5	3.1	18.1	1.4	1.5	25.6	0.9
Lane Grp Delay (d), s/veh	31.6	0.0	39.0	31.2	0.0	50.2	24.8	31.6	12.5	21.2	49.1	12.0
Lane Grp LOS	C		D	C		D	C	C	B	C	D	B
Approach Vol, veh/h		280			313			1089			1141	
Approach Delay, s/veh		35.0			41.7			28.5			43.0	
Approach LOS		D			D			C			D	
Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	13.3	17.1		12.9	16.7		10.1	49.8		10.2	50.0	
Change Period (Y+Rc), s	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Max Green Setting (Gmax), s	10.0	15.0		10.0	15.0		10.0	45.0		10.0	45.0	
Max Q Clear Time (g_c+I1), s	8.4	8.6		8.1	11.1		5.1	38.3		5.3	46.1	
Green Ext Time (p_c), s	0.1	0.9		0.1	0.6		0.1	5.3		0.1	0.0	
Intersection Summary												
HCM 2010 Ctrl Delay			36.5									
HCM 2010 LOS			D									
Notes												

HCM 2010 TWSC
7: Austin Ave & East Full-Movement Site Access

Intersection	
Intersection Delay, s/veh	3.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	19	153	210	41	115	32
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	166	228	45	125	35

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	273	0	-	0	459	251
Stage 1	-	-	-	-	251	-
Stage 2	-	-	-	-	208	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1290	-	-	-	560	788
Stage 1	-	-	-	-	791	-
Stage 2	-	-	-	-	827	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1290	-	-	-	550	788
Mov Capacity-2 Maneuver	-	-	-	-	550	-
Stage 1	-	-	-	-	791	-
Stage 2	-	-	-	-	812	-

Approach	EB	WB	SB
HCM Control Delay, s	0.9	0	13.4
HCM LOS			B

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1290	-	-	-	589
HCM Lane V/C Ratio	0.016	-	-	-	0.271
HCM Control Delay (s)	7.836	0	-	-	13.4
HCM Lane LOS	A	A			B
HCM 95th %tile Q(veh)	0.049	-	-	-	1.094

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection	
Intersection Delay, s/veh	0.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	14	158	218	25	13	13
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	15	172	237	27	14	14

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	264	0	-	0	453	251
Stage 1	-	-	-	-	251	-
Stage 2	-	-	-	-	202	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1300	-	-	-	565	788
Stage 1	-	-	-	-	791	-
Stage 2	-	-	-	-	832	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1300	-	-	-	558	788
Mov Capacity-2 Maneuver	-	-	-	-	558	-
Stage 1	-	-	-	-	791	-
Stage 2	-	-	-	-	821	-

Approach	EB	WB	SB
HCM Control Delay, s	0.6	0	10.8
HCM LOS			B

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1300	-	-	-	653
HCM Lane V/C Ratio	0.012	-	-	-	0.043
HCM Control Delay (s)	7.802	0	-	-	10.8
HCM Lane LOS	A	A			B
HCM 95th %tile Q(veh)	0.036	-	-	-	0.135

Notes

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Intersection	
Intersection Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	124	7	33	166	2	14
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	135	8	36	180	2	15

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	142	0	391	139
Stage 1	-	-	-	-	139	-
Stage 2	-	-	-	-	252	-
Follow-up Headway	-	-	2.218	-	3.518	3.318
Pot Capacity-1 Maneuver	-	-	1441	-	613	909
Stage 1	-	-	-	-	888	-
Stage 2	-	-	-	-	790	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	1441	-	596	909
Mov Capacity-2 Maneuver	-	-	-	-	596	-
Stage 1	-	-	-	-	888	-
Stage 2	-	-	-	-	768	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.3	9.3
HCM LOS			A

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	853	-	-	1441	-
HCM Lane V/C Ratio	0.02	-	-	0.025	-
HCM Control Delay (s)	9.3	-	-	7.562	0
HCM Lane LOS	A			A	A
HCM 95th %tile Q(veh)	0.062	-	-	0.077	-

Notes

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Intersection	
Intersection Delay, s/veh	0.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	9	116	142	26	15	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	10	126	154	28	16	5

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	183	0	-	0	314	168
Stage 1	-	-	-	-	168	-
Stage 2	-	-	-	-	146	-
Follow-up Headway	2.218	-	-	-	3.518	3.318
Pot Capacity-1 Maneuver	1392	-	-	-	679	876
Stage 1	-	-	-	-	862	-
Stage 2	-	-	-	-	881	-
Time blocked-Platoon, %		-	-	-		
Mov Capacity-1 Maneuver	1392	-	-	-	674	876
Mov Capacity-2 Maneuver	-	-	-	-	674	-
Stage 1	-	-	-	-	862	-
Stage 2	-	-	-	-	874	-

Approach	EB	WB	SB
HCM Control Delay, s	0.5	0	10.2
HCM LOS			B

Minor Lane / Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1392	-	-	-	715
HCM Lane V/C Ratio	0.007	-	-	-	0.03
HCM Control Delay (s)	7.605	0	-	-	10.2
HCM Lane LOS	A	A			B
HCM 95th %tile Q(veh)	0.021	-	-	-	0.094

Notes
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28: North RIRO Site Access & Erie Pkwy

Intersection	
Intersection Delay, s/veh	3.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	1369	42	0	672	0	110
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1426	44	0	700	0	115

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1426	0	1776	1426
Stage 1	-	-	-	-	1426	-
Stage 2	-	-	-	-	350	-
Follow-up Headway	-	-	2.218	-	3.519	3.319
Pot Capacity-1 Maneuver	-	-	477	-	82	165
Stage 1	-	-	-	-	221	-
Stage 2	-	-	-	-	685	-
Time blocked-Platoon, %	-	-		-		
Mov Capacity-1 Maneuver	-	-	477	-	82	165
Mov Capacity-2 Maneuver	-	-	-	-	82	-
Stage 1	-	-	-	-	221	-
Stage 2	-	-	-	-	685	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	65.5
HCM LOS			F

Minor Lane / Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	165	-	-	477	-
HCM Lane V/C Ratio	0.694	-	-	-	-
HCM Control Delay (s)	65.5	-	-	0	-
HCM Lane LOS	F			A	
HCM 95th %tile Q(veh)	4.122	-	-	0	-

Notes
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INCORPORATED

GEOLOGIC AND PRELIMINARY GEOTECHNICAL INVESTIGATION
ERIE PARCEL
SOUTHWEST OF ERIE PARKWAY
AND EAST COUNTY LINE ROAD
ERIE, COLORADO

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Project No. DN47,332-115

September 10, 2014

TABLE OF CONTENTS

SCOPE 1

SUMMARY 1

SITE CONDITIONS 3

PROPOSED DEVELOPMENT 3

PREVIOUS INVESTIGATIONS 4

INVESTIGATION 4

SUBSURFACE CONDITIONS 5
- Interlayered Sand and Clay 5
- Sand 6
- Bedrock 6
- Groundwater 6

GEOLOGIC HAZARDS 7
- Abandoned Underground Coal Mines 7
- Abandoned Mine Entries 9
- Undocumented Fill 13
- Expansive Soil and Bedrock 14
- Seismicity 15
- Radon Gas 16

SITE DEVELOPMENT 16
- Excavation 17
- Site Grading 17
- Sub-Excavation 18
- Existing Fill 19
- Slopes 20
- Underdrain Collection System 20
- Utilities 21
- Pavements 22

BUILDING CONSTRUCTION CONSIDERATIONS 22
- Foundations 23
- Below-Grade Areas 23
- Slab-On-Grade Construction 23
- Surface Drainage 24

RECOMMENDED FUTURE INVESTIGATIONS 25

GEOTECHNICAL RISK 25

LIMITATIONS 26

FIG. 1 – LOCATIONS OF EXPLORATORY BORINGS
FIG. 2 – DEPTH AND ESTIMATED ELEVATION OF BEDROCK SURFACE
FIG. 3 – DEPTH AND ESTIMATED ELEVATION OF GROUNDWATER
FIG. 4 – SUMMARY OF MINE DATA
FIG. 5 – PRELIMINARY RISK DUE TO EXPANSIVE SOIL AND BEDROCK
FIG. 6 – SEWER UNDERDRAIN DETAIL
FIG. 7 – UNDERDRAIN CUTOFF WALL DETAIL
FIG. 8 – CONCEPTUAL UNDERDRAIN SERVICE PROFILE
APPENDIX A – SUMMARY LOGS OF EXPLORATORY BORINGS
APPENDIX B – LABORATORY TEST RESULTS
APPENDIX C – GUIDELINE SITE GRADING SPECIFICATIONS
APPENDIX D – GUIDELINE SITE GRADING SPECIFICATIONS (SUB-EXCAVATION)

SCOPE

This report presents the results of our Geologic and Preliminary Geotechnical Investigation for the 47-acre parcel (Erie Parcel) southwest Erie Parkway and East County Line Road in Erie, Colorado (Fig. 1). The purpose of our investigation was to evaluate the subsurface conditions and review previous mine subsidence reports to assist in planning of site development and residential and commercial construction. The report includes a description of the subsurface conditions encountered in our exploratory borings, descriptions of materials encountered in test pits, identification of geologic hazards, a summary of available mine subsidence data, and discussions of site development and construction as influenced by geologic and geotechnical conditions. The scope was described in our Service Agreement (DN 14-0290) dated June 24, 2014.

This report is based on our understanding of the planned development, subsurface conditions found in exploratory borings and test pits, results of field and laboratory tests, engineering analysis of field and laboratory data, review of previous mine subsidence reports, and our experience with similar projects. The discussions and criteria presented in this report are intended for planning purposes only. Additional investigations will be necessary to design foundations and floor systems, pavements, and other improvements. Further investigation of mine subsidence risk will likely be merited. A brief summary of our conclusions and recommendations follows, with more detailed discussion in the report.

SUMMARY

1. There are geologic hazards that will affect the development of this site. The hazards include abandoned coal mines, abandoned mine entries, undocumented fill, and expansive soil and bedrock. We believe these concerns can be mitigated with proper planning, engineering, design and construction.

2. Subsoils encountered in our borings consisted of about 3 to 24.5 feet of interlayered clay and sand and clean to clayey sand underlain by bedrock. Overburden clay is judged as low swelling and the sand is non-expansive.

Bedrock was encountered deeper than 15 feet in 6 of 9 borings and consisted of low to moderately swelling claystone with thin beds of non-expansive sandstone and lignite. Moderate swelling, shallower claystone was encountered at depths of 3 to 13 feet at the northwest corner and southwest portion of the parcel.

3. Groundwater was encountered in all nine borings at depths ranging from 11 to 27.5 feet below existing grade. Groundwater levels will fluctuate seasonally and may rise in response to precipitation, land-use changes, and landscape irrigation. Groundwater is not expected to impact the construction.

4. Review of available records and documents pertaining to the underlying Marfel and Pinnacle mines indicates that two levels of coal mining occurred within 85 to 136 feet of existing grade. Extraction thickness varied 7 to 14 feet. Mine maps are not known to exist. Additional mine subsidence investigation will likely be required.

5. Exploratory test pits revealed the locations of the Marfel mine entry and Pinnacle shaft. We recommend further investigation of the Marfel mine entry to confirm the entry orientation. Site development planning should avoid construction of structures over the mine entry areas.

6. Based on historical aerial photography and site reconnaissance, we have identified probable areas of undocumented fill (Fig. 5). This fill should be removed and replaced if buildings or roadways are planned in these areas.

7. We believe that use of shallow foundations would be prudent considering the presence of underground coal mines. To allow use of shallow foundations, sub-excavation will likely be necessary in the southwest portion of the site and possibly in the northwest corner. Further investigation will be necessary to define these areas after preliminary grading plans are available. A design-level soils and foundation investigation should be done prior to building design and construction.

8. We advocate use of underdrain systems below sanitary sewer mains to help control groundwater and provide a gravity outlet for basement foundation drains (if basements are planned).

9. Preliminary data suggest that the Town of Erie’s minimum pavement sections will be appropriate. It is unlikely that expansive subgrade treatment will be necessary. A design-level subgrade investigation should be done prior to paving.

10. 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, pavements and flatwork.

SITE CONDITIONS

The 47-acre Erie Parcel is located southwest of Erie Parkway and East County Line Road in Erie, Colorado (Fig. 1 / Photo 1). The site is bordered by a residential subdivision on the west residential/commercial developments on the south, and commercial property on the east. Topography prepared by Rock Creek Surveying, LLC indicates that the ground surface generally slopes to the east with about 50 feet of vertical relief across the parcel. We visited the site on June 12, 2014 to stake boring locations and observe site conditions. The parcel was being used for agricultural purposes and was predominately covered with wheat.

Photo 1 – Google Earth© Aerial Site Photo, October 6, 2013.

PROPOSED DEVELOPMENT

Grading plans are not available. We understand that the site may be developed for mixed-use including single-family residences, townhomes, apartments, and commercial/retail facilities. Single-family residences and townhomes may be one or two-story, wood-framed structures with or without basements. Apartments will likely be multi-story, wood-framed structures. Commercial/Retail structures would likely be one to two-stories without basements. Paved roads and parking lots will provide access. Buried utilities would serve the project.

PREVIOUS INVESTIGATIONS

CTL | Thompson has performed several investigations in the immediate vicinity of the parcel including a Due Diligence Investigation and Geotechnical Investigation (DN43,169-125/145) for the Saint Luke's Orthodox Christian Church to the south. We identified geologic hazards including compressible soil, expansive soil and bedrock, and abandoned underground coal mines and shafts of the McGregor Mine on the church property. We estimated that the subsidence risk is low on the church parcel. We recommended use of footings with minimum dead load or mat foundations after about 5 feet of sub-excavation (to reduce risk related to compressible/swelling soil) below finished floor level. Below grade areas were not planned for the church or auxiliary buildings.

INVESTIGATION

Subsurface conditions were investigated by drilling nine exploratory borings at the locations shown on Fig. 1. The boring locations were selected and staked by our engineers and surveyed by Rock Creek Surveying. Prior to drilling, we contacted the Utility Notification Center of Colorado and local sewer and water districts to clear boring locations for conflicts with buried utilities.

The borings were advanced to depths of 25 to 35 feet using 4-inch diameter, continuous-flight auger and a truck-mounted CME-45 drill rig. Samples of the soil and bedrock were obtained at 5-foot intervals using 2.5-inch diameter (O.D.) modified California barrel samplers driven by a 140-pound hammer falling 30 inches. A representative of CTL | Thompson, Inc. was present during drilling to observe drilling operations, log the soil and bedrock, and obtain samples. Upon completion of drilling, the holes were left open to facilitate delayed groundwater measurements. Groundwater was measured 40 days after drilling. Summary logs of the exploratory borings with results of field penetration resistance tests and a portion of the laboratory data are presented in Appendix A.

Samples were returned to our laboratory where they were examined by our engineers and tests were assigned. Laboratory tests included dry density, moisture content, percent silt and clay-sized particles (passing the No. 200 sieve), Atterberg limits, gradation, swell-consolidation, and water-soluble sulfate concentration. Swell-consolidation tests were performed by wetting the samples under approximate overburden pressures (the weight of the overlying soil). Results of laboratory tests are presented in Appendix B and are summarized in Table B-I.

SUBSURFACE CONDITIONS

Subsoils encountered in our borings consisted of about 3 to 24.5 feet of interlayered sand and clay and clean to clayey sand underlain by bedrock. Bedrock predominately consisted of claystone with thin intermittent beds of sandstone and lignite. Pertinent engineering characteristics of the soil and bedrock are presented in the following paragraphs.

Interlayered Sand and Clay

About 3 to 15 feet of interlayered sand and clay was encountered above bedrock in all borings except TH-7. The interlayered strata predominately consisted of sand with thin seams of clay. Four samples contained 24 to 71 percent clay and silt and exhibited low plasticity. Field penetration tests indicate that the interlayered strata are either medium dense (sand) or medium stiff to stiff (clay). Water-soluble sulfate concentrations of less than 0.01 and 0.05 percent were measured in two samples. Three samples swelled 0.2 to 1.4 percent, one did not swell, and three compressed 0.6 to 0.9 percent when wetted. We judge that the sand is non-expansive and the clay is low swelling.

Sand

About 3 to 12 feet of clean to clayey sand was encountered at variable depths in all 9 borings. Two samples contained 94 and 95 percent sand size particles and exhibited low plasticity. One sample had a water-soluble sulfate concentration of 0.04 percent. One sample did not swell and four compressed 0.1 o 2.4 percent when wetted. The sand is non-expansive.

Bedrock

Bedrock was encountered at depths of 3 to 24.5 feet below existing grade. Estimated surface elevation contours and depths to the bedrock surface are shown on Fig. 2. Bedrock is relatively shallow in the northwest corner and south portion of the parcel and deep in remaining areas. Bedrock predominately consisted of weathered and comparatively unweathered claystone with a few thin beds of sandstone and lignite. Lignite was encountered in TH-3 and 6 at depths of 25 and 28 feet below existing grade. Two samples contained 76 and 85 percent clay and silt size particles and were low to moderately plastic. One sample had a water-soluble sulfate concentration of 0.03 percent. Samples swelled 0.1 to 4.0 percent and did not swell when wetted. We judge that the bedrock is low to moderately swelling.

Groundwater

Groundwater was encountered in TH-4 and TH-9 during drilling at depths of 17 and 18 feet below existing grade. When the holes were checked 40 days after drilling groundwater was measured 11 to 27 feet below existing grade in all nine borings. Figure 3 shows our estimates of the groundwater surface elevations. Groundwater is not anticipated to impact site development or building construction. Groundwater levels will fluctuate seasonally and may rise in response to precipitation, land-use changes, and landscape irrigation.

GEOLOGIC HAZARDS

Geologic hazards were evaluated through review of available mine subsidence reports, historical aerial photography, historical topographic maps, geologic maps, field observations, conditions found in our exploratory borings and test pits, and our experience with similar projects and conditions. The hazards identified are:

- Abandoned Underground Coal Mines,
- Abandoned Mine Entries;
- Undocumented Fill,
- Expansive Soil and Bedrock, and
- Regional Issues of Seismicity and Radioactivity.

The geologic hazards will affect development of this site. We believe the hazards can be mitigated with proper planning, engineering, design and construction.

Abandoned Underground Coal Mines

The presence of abandoned underground coal mines presents risk of ground subsidence. Ground subsidence can induce slight vertical movement, collapse, and/or lateral strain to buildings, pavement, and other improvements.

We reviewed three documents that reference the abandoned underground coal mines on this site that were obtained from the Colorado Geological Survey (CGS) or provided by you including:

- *Preliminary Subsidence and Preliminary Geotechnical Engineering Investigation, ATEC Associates, Project No. 41-74001, April 3, 1987;*

- *Preliminary Mine Subsidence Investigation, Western Environmental and Ecology, Project No. 422-001-01, December 23, 2005; and,*

- *Review Reports and Documents, Abandoned Mine and Subsidence Investigation, Zapata Engineering, Blackhawk, Project No. 5083, October 24, 2007;*

Review of mine subsidence data indicates that the Marfel and Pinnacle mines are located below this property. We understand that very few records were submitted by the mining company after mining was complete. Pertinent information that is not available includes mine surveys (maps) and records of the number of mined levels and depths to the mines. Blackhawk's 2007 document review indicated a discrepancy in the Marfel mine documents. One record pertaining to the Marfel mine reports that the mine is located several miles north in Section 13. The Erie Parcel is located in Section 24. We do not know if this is a numerical error in Section reporting by the mining company or if the record is accurate. As discussed later, mine entries were found on the property during this investigation.

Western Environmental and Ecology (WEE) drilled fifteen deep borings in their 2005 Mine Subsidence Investigation. Their data indicates that two mineable coal seams exist below the property. They reported that the depth to the roof of the upper seam varies from 80 to 116 feet and the depth to the lower seam varies from 101 to 136 feet. The two seams are about 12 feet apart. ATEC's 1987 report indicates that records of the Marfel mine report an average coal thickness of about 14 feet. This record appears to be relatively consistent with the conditions found by WEE who found that each extraction was about 7 feet thick. Data from WEE's 2005 investigation reveal that only the upper level was mined at 3 of 15 boring locations, only the lower level was mined at 4 locations, both levels were mined at 4 locations, and there was no coal extraction at 4 locations. We show the approximate boring locations and summarized data from WEE's studies on Fig. 4.

Using data from WEE's 2005 investigation, bedrock surface elevations estimated during this study, and ground surface elevations provided by Rock Creek Surveying, we have estimated the thickness of bedrock above the original mined level (Fig. 4). Bedrock thickness appears to vary from 71 to 126 feet with the thinnest cover in the northeast portion of the site. WEE comments on the height of collapse above the mine workings in the Boulder-Weld Coal Field and this project which reads as follows: *"..the observed results from the drilling on the site show that collapse is confined to an interval* *of 20 to 40 feet above the workings.”* Based on this observation, estimated bedrock thicknesses, and our experience, we believe that the risk of ground collapse/sinkhole formation due to mine subsidence is low.

WEE performed a lateral strain analysis in their 2005 study. WEE found that the “*worst case theoretical horizontal strains and surface subsidence would be 0.325% and 0.5 feet, respectively.”* WEE stated *“development will allow for construction of buildings with a foundation length of 60 feet or less.”* The width of the extraction is critical to a lateral strain analysis. The actual width of the extraction is not known. WEE assumed a width of 100 feet based on the width of the mapped workings of the nearby Mitchell and Garfield Mines. We believe that additional investigation will be merited to estimate the geographical extent and geometry of mining, evaluate the mine conditions, verify risk of potential mine subsidence, and to determine appropriate remedial actions (if any). The additional investigation may incorporate surface geophysical testing techniques to attempt to delineate the areas and depths of mining. A number of deep verification borings may also be recommended. Our experience suggests that the Town of Erie will likely refer subsidence studies to CGS. It may be beneficial to discuss any proposed investigations with CGS prior to initiation.

Abandoned Mine Entries

Two mine entries to the Marfel and Pinnacle mines are reported on the property by CGS and United States Geological Survey (USGS). Blackhawk concluded that the two government agencies report two different locations for each access point; totaling four possible locations. The United States Bureau of Mines (USBM) records indicate that a slope entry occurred for the Marfel mine. The reported locations of the four possible locations are shown on Fig. 4.

The potential mine entries were investigated using test pits excavated by Don Rice Excavating. All locations were surveyed and staked in the field by Rock Creek Surveying, LLC. The reported location by CGS was immediately adjacent to a soil pile (Photo 2/ Fig. 4).

Photo 2 – Photograph of spoil pile, June 13, 2014.

Test pits at the two reported locations of the Marfel mine entry did not reveal evidence of mining. Excavations of the soil pile indicated that the pile likely originated from a mine entry excavation. A suspicious location was observed northeast of the spoil pile that did not contain vegetation. A test pit at this location (Fig. 4) unearthed evidence of a mine entry. Debris and trash from around the time of mining including bottles, shoes, bed framing, a cow carcass, wagon parts, and other garbage and mining tools were found. At a depth of about 30 feet below existing grade, an apparent sloped entry haulway to the Marfel mine was found (Photo 3). The excavation exposed in-place timber lagging on the haulway wall sides and roof that angled downward to the north-north-east toward the Garfield No. 1 Mine (Photo 3). Collapsed lagging was also observed. The haulway had collapsed up-gradient and below the estimated roof as shown in Photo 3. Soil above the roof did not cave. Safety concerns prevented us from entering the excavation to measure the slope of the lagging. We can provide close-up photographs of the declined entry haulway and lagging upon request. After the excavation was finished, Rock Creek surveyed the location and orientation of the sloped haulway as shown on Fig. 4.

Photo 3 – Photograph of Marfel mine declined access, July 18, 2014.

A sloped mine entry poses risk of ground subsidence and/or lateral strain within some horizontal distance above the haulway. Remediation at the mine access surface will be necessary. We recommend plans avoid placing structures (buildings) within a 100 foot easement outside of the estimated haulway orientation (Fig. 4). Other improvements that can sustain potential ground movement can be planned for this easement. The estimate of the haulway orientation is based on one test pit. We recommend additional investigation to verify and increase confidence of the haulway orientation that may include surface geophysical testing techniques and drilling.

Test pits of the two reported locations of the Pinnacle mine entry did not reveal evidence of mining. An excavation at a suspicious location unearthed the Pinnacle mine entry and revealed deep spoils extending downward. The spoils extended horizontally in an almost perfect circle with a diameter of about 10 feet which indicates that this entry was a vertical shaft (Photo 4). These conditions were encountered consistently to the maximum explored depth of 20 feet.

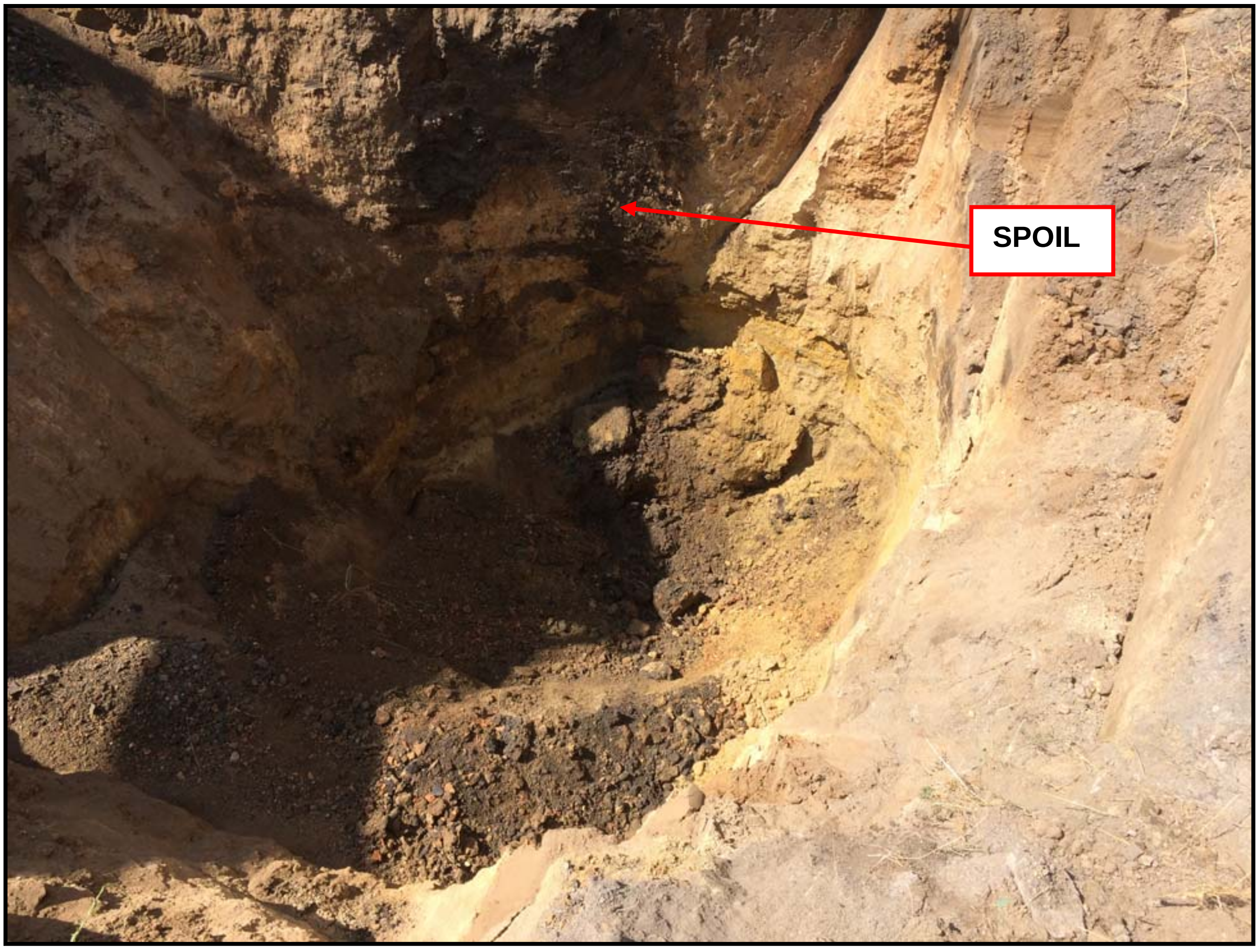

Photo 4 – Photograph of Pinnacle Shaft, July 18, 2014.

The presence of a vertical shaft presents risk of ground subsidence and/or lateral strain. We recommend that the shaft be grouted and capped during site development. We recommend no buildings be planned within 50 feet of the capped shaft. Other improvements that can sustain potential ground movement can be planned for this easement. Table A includes the location data for the shafts/entry points.

TABLE A
MINE SHAFT/ENTRY LOCATION DATA

Shaft/Entry	Northing	Easting
Marfel Slope Entry (depth of 30 feet)	256355.8	124798.8
Pinnacle Shaft	255595.6	125162.8

Due to the lack of records of the Marfel and Pinnacle mines, it is possible that undocumented mine entries or air shafts exist on the property. We did not find any evidence of unmapped mine entries during our site observation. It is possible that after vegetation is stripped, mine spoils will be observed at other locations across the property. We should be present to observe grading and help identify potential mine spoils and potential shaft locations.

Undocumented Fill

Review of historical aerials indicates that the site has been used for agricultural purposes since at least 1993. Very little site activity was apparent prior to the fall/winter of 2002 when Austin Avenue on the south and the residential developments on the west and south were graded (Photo 5). Aerials photos show that access roads were graded on the Erie Parcel during the 2002 site development. We have shown the approximate locations of earthwork visible on aerials on Fig. 5. These locations could contain undocumented fill. We did not find indication of undocumented fill at these locations during our site visits.

Photo 5 – Google Earth© Aerial Site Photo, December 31, 2002.

Aerial photography shows that Erie Parkway was widened during the summer of 2007 (Photo 6). It appears that earthwork was performed on the northern edge of this parcel and an area on the northeast corner was used for construction staging. These locations could contain undocumented fill. We did not observe indication of undocumented fill during our site walk (Fig. 5).

Photo 6 – Google Earth© Aerial Site Photo, July 30, 2007

We do not recommend building structures, roadways, or other improvements over undocumented fill due to potential settlement issues. If fill is present it should be removed and replaced as densely compacted fill. We recommend additional investigation where improvements are planned over these areas.

Mine spoils and buried trash were observed during our test pit exploration in the vicinity of the Marfel mine entry and Pinnacle shaft. Mine spoils and trash below buildings, roadways, or other improvements should be substantially removed.

Expansive Soil and Bedrock

Review of Geologic Maps[1] shows the site soils consist of windblown alluvium (Qes) underlain by bedrock of the Laramie formation (Kl). Typical geologic hazards associated with these geologic units include expansive soil and bedrock and, sometimes, compressible soil. Our investigation data verifies that expansive soil and bedrock are present. Swelling soil and bedrock could heave and damage foundations, slab-on-grade, exterior flatwork, paved roads, and other improvements. Proper engineering of

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[1] "Colton, R.B., and Anderson, L.W., 1977, Preliminary Geologic Map of the Erie Quadrangle, Boulder, Weld, and Adams Counties, Colorado: U.S. Geological Survey, Miscellaneous Field Studies Map MF-882, scale 1:24,000

these structures should be planned to reduce, but not eliminate potential heave and associated distress.

We used the results of swell tests to estimate the post-construction potential heave due to swelling. The estimates are based on 24-foot depth of wetting below existing grade. If extensive cut/fill is planned, we should reevaluate our estimates. Our experience indicates that the heave estimates are conservative and it is unlikely that the full calculated heave will occur. The potential heave estimates are summarized in Table B. These estimates are for heave only and do not include movement due to settlement of undocumented fill and/or mine subsidence.

TABLE B
SUMMARY OF POTENTIAL HEAVE ESTIMATES

Soil Boring	Heave Estimate (inches)	Risk due to Expansive Soil and Bedrock
TH-1	2.2	Low
TH-2	0.6	Low
TH-3	<0.5	Low
TH-4	0.9	Low
TH-5	2.4	Low
TH-6	2.1	Low
TH-7	1.6	Moderate
TH-8	3.3	Moderate
TH-9	1.0	Low

We estimate the risk due to expansive soil and bedrock is predominately low except where moderately swelling shallow claystone was encountered (Fig. 5).We estimated that the risk is moderate where claystone is shallow.

Seismicity

The soil and bedrock are not expected to respond unusually to seismic activity. According to the 2012 International Building Code (IBC, Standard Penetration Resistance method of Section 1613.5.2), and based upon the results of our investigation, we judge the site classifies as Site Class D. The subsurface and groundwater conditions indicate low susceptibility to liquefaction. Only minor damage to relatively new, properly designed and constructed structures would be expected with a major seismic event. Wind loads typically govern dynamic structural design in this area.

Radon Gas

It is normal in the areas east of the Front Range to measure accumulations of radon gas in poorly ventilated spaces that are in contact with soil or bedrock, such as full-depth basements. Radon gas is one of several radioactive products of the natural decay of uranium into stable lead. There is a potential for radon gas accumulation in poorly ventilated spaces. Typical mitigation methods consist of sealing soil gas entry areas and ventilation of below-grade spaces. Radon rarely accumulates to significant levels in above-grade spaces. The only method to accurately evaluate radon concentrations in a closed area is to perform testing after construction. We believe it is prudent to plan contingencies for radon mitigation during design of structures, such as provision for venting of foundation drain systems.

SITE DEVELOPMENT

Geologic hazards that may influence site development and building performance include the presence of abandoned underground coal mines, abandoned mine entries, undocumented fill, and expansive soil and bedrock. These concerns can be mitigated with proper planning, engineering, design and construction. We believe there are no geologic or geotechnical constraints that preclude development. We believe the risk due to expansive soil and bedrock can be reduced by sub-excavation and risk associated with undocumented fill can be reduced by removing and replacing the fill. Additional investigation of the abandoned underground coal mines and entries is recommended to evaluate risk of subsidence and determine appropriate remedial measures (if any). The following sections provide site development recommendations based on available data.

Excavation

We believe the soil and bedrock penetrated by our exploratory borings can be excavated with typical, heavy-duty equipment. We recommend the owner and the contractor become 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 fill and sand will classify as Type C soil and the bedrock as Type A based on OSHA Standards governing excavations published in 29 CFR, Part 1926. Type A soil requires a maximum slope inclination of ¾:1 (horizontal to vertical) and Type C requires 1½:1 for temporary excavations in dry conditions. Saturated soils may require flatter slopes or bracing. Excavation slopes specified by OSHA are dependent upon soil types and groundwater conditions encountered. The contractor's "competent person" should 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 the excavation. A professional engineer should design excavations deeper than 20 feet.

Site Grading

Grading plans are not available. Due to the presence of underground coal mines, the safest site development approach is to limit cuts. The ground surface in areas to be filled should be stripped of vegetation, existing fill and trash, scarified, and moisture conditioned to between optimum and 3 percent above optimum moisture content for clay and within 2 percent of optimum for sand and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698). We anticipate stripping may require cuts of 3 to 6 inches.

The properties of fill will affect the performance of foundations, slabs-on-grade, utilities, pavements, flatwork and other improvements. If import soil is needed, it should ideally consist of soil having a maximum particle size of 3 inches, less than 50 percent passing a No. 200 sieve, a liquid limit less than 30 percent and a plasticity index less than 15 percent. Potential fill materials should be submitted to our office for approval prior to importing to the site.

On-site soils free of vegetation, trash, and deleterious material are suitable for reuse as site grading fill. Fill should be placed in thin loose lifts, moisture conditioned to between optimum and 3 percent above optimum moisture content for clay and within 2 percent of optimum for sand, and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698). The placement and compaction of site grading fill should be observed and density tested by our representative during construction. Guideline grading specifications are presented in Appendix C.

Our experience indicates fill and backfill can settle, even if properly compacted to criteria provide above. Factors that influence the amount of settlement are depth of fill, material type, degree of compaction, amount of wetting and time. The degree of compression of fill under its own weight will likely range from low for granular soils (½ percent or less) to moderate for clay/sand mixtures (1 to 2 percent).

Sub-Excavation

Shallow, moderately swelling bedrock was found in TH-1, TH-7, and TH-8 located in the northwest corner and southwest portions of the parcel. Very long and heavily-reinforced drilled piers and structurally supported basement floors are normally recommended for moderate to high risk sites. Use of shallow foundations is preferable due to potential mine subsidence. In order to allow use of shallow foundations, sub-excavation will likely be necessary in these areas. Additional investigation will be necessary to better define these areas after preliminary grading plans are available. We anticipate sub-excavation to a minimum depth of 10 feet below the lowest foundation excavation level may be merited. The bottom of the sub-excavated area should extend laterally at least 5 feet and preferably 10 feet outside the largest possible foundation footprints to ensure foundations are constructed over moisture-conditioned fill.

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 1 and 4 percent above optimum moisture content with an average test moisture content each day of at least 1.5 percent above optimum. Fill should be 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 excavations as large compaction equipment cannot easily reach these areas. Our representative should observe placement procedures and test compaction of the fill on a “full-time” basis. The swell of the moisture-conditioned fill should be tested after the fill placement. Guideline sub-excavation grading specifications are presented in Appendix D.

If the fill dries excessively prior to construction, it may be necessary to rework the upper drier materials just prior to constructing foundations. We judge the fill should retain adequate moisture for about two years and can check moisture conditions in each excavation as construction progresses, if requested.

Sub-excavation and replacement with low swell fill will likely allow use of footing foundations and enhance performance of slab-on-grade basement floor construction. Sub-excavation will also enhance performance of concrete flatwork (driveways and sidewalks) and pavements, potentially reducing warranty and maintenance costs.

Existing Fill

Undocumented fill was not apparent in our borings; however, we did observe buried trash and debris in one test pit. Historical aerial photography also indicates that undocumented fill could be present at several locations. We have shown potential undocumented fill locations on Fig. 5. The fill should be removed and recompacted as specified in Site Grading.

Slopes

We recommend permanent cut and fill slopes be designed with a maximum grade of 3:1 (horizontal:vertical). Use of 4:1 or flatter slope is better to control erosion. If site constraints (property boundaries and streets) do not permit construction with recommended slopes, we should be contacted to evaluate the subsurface soils and steeper slopes. Slopes greater than 20 feet high should be evaluated on a case-by-case basis. 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 practical after grading to reduce potential for erosion problems. Excavation contractors should evaluate ground conditions and control slopes in accordance with OSHA criteria.

Underdrain Collection System

The use of an underdrain collection system in sanitary sewer main trenches is a common method to provide a gravity outlet for basement foundation drains. The merits of underdrains will depend on proposed grading and the types of structures. If used, the underdrains should consist of 0.75 to 1.5-inch clean, free draining gravel surrounding a perforated PVC pipe (Fig. 7). We believe use of perforated pipe below sanitary sewer mains is the most effective approach to control groundwater. The pipe should have a minimum diameter of 3-inches. The line should consist of smooth, perforated, or slotted rigid PVC pipe placed at a grade of at least 0.5 percent. A positive cutoff (concrete) should be constructed around the sewer pipe and underdrain pipe immediately downstream of the point where the underdrain pipe leaves the sewer trench (Fig. 8). Solid pipe should be used down gradient of this cutoff wall. The underdrains should be designed to discharge to a gravity outfall constructed with a permanent concrete headwall and trash rack. The underdrain should be installed with clean-outs. To reduce the risk of cross-connecting sewer and underdrain services, we recommend using a 4-inch diameter pipe for sewer services and 3-inch diameter pipe for the underdrain services. Where feasible, the underdrain services should be installed deep enough so that the lowest point or the sump pit of the basement foundation drain (if any) can be connected to the underdrain service as a gravity outlet (Fig. 9). For non-walkout basements (if any), the low point of the basement foundation drain may be about 3 feet deeper than the sewer service. For residences with walkout basements (if any), the low point or sump pit of the basement foundation drain will be below the frost stem wall in the rear portion of the basement. The foundation drain in a walkout basement would require a deeper underdrain service for a gravity discharge and may not be practical. For these conditions, we suggest the front portion of the foundation drain be connected to the underdrain and a sump pit used for the rear portion.

Utilities

Water and sewer lines are usually constructed beneath paved roads. Compaction of trench backfill can have a significant effect on the life and serviceability of pavements. Trench backfill should be placed in thin (8 inches or less) loose lifts and moisture conditioned to between optimum and 3 percent above optimum moisture content for clay and claystone, within 2 percent of optimum moisture content for gravel and sand, and compacted to at least 95 percent of maximum dry density (ASTM D 698). The placement and compaction of trench fill and backfill should be observed and tested by our firm during construction.

Our experience indicates use of a self-propelled compactor results in more reliable performance compared to backfill “compacted” by a sheepsfoot wheel attachment on a backhoe or trackhoe. The upper portion of the trenches should be widened to allow the use of a self-propelled compactor. Special attention should be paid to backfill placed adjacent to manholes as we have seen instances where settlement in excess of 2 percent has occurred. Any improvements placed over backfill should be designed to accommodate movement.

Pavements

Pavement subgrade soils will likely consist of interlayered sand and clay or clean to silty sand. We consider the on-site soil as good pavement subgrade. Potential subgrade samples swelled 0.2 and 1.4 percent, did not swell, and compressed 0.1 to 2.4 percent when wetted. We do not anticipate expansive subgrade mitigation. The data suggests that the Town of Erie’s minimum pavement sections will likely be appropriate. We understand that the Town prefers the use of combined a section of hot mix asphalt concrete and aggregate base course. The Town will consider use of full depth hot mix asphalt or Portland cement concrete pavement on a case by case basis. The following minimum pavement sections are specified for combined asphalt and base course and full depth asphalt sections. Erie does not specify minimum Portland cement concrete pavement sections.

TABLE C
SUMMARY OF PRELIMINARY PAVEMENT SECTIONS

Roadway Classification	EDLA	Hot Mix Asphalt Concrete (HMAC) + Aggregate Base Course (ABC)	Full Depth Hot Mix Asphalt Concrete (HMAC)	Portland Cement Concrete Pavement (PCCP)
Local Residential DU > 50	10	4” HMAC + 8" ABC	6.5” HMAC	6” PCCP
Residential Collector	30	4” HMAC + 8" ABC	6.5” HMAC	6” PCCP
Commercial Collector	100	6” HMAC + 9" ABC	8.5" HMAC	6.5" PCCP

A subgrade investigation will be required after roadways are rough cut to grade to design pavements.

BUILDING CONSTRUCTION CONSIDERATIONS

The following discussions are preliminary and are not intended for design or construction. After grading is completed, design-level investigations should be performed on a site specific basis.

Foundations

Our investigation indicated predominately non-expansive sand with seams of low swelling clay and deep bedrock within depths likely to influence the performance of foundations. A few locations of moderately swelling shallow bedrock were also encountered. Abandoned underground coal mines could influence the performance of foundations. A mine subsidence investigation will be necessary to assess this risk. The safest foundation types considering the potential mining are footings, mats, or post-tensioned slab-on-grade. Deep foundation systems anchored in bedrock would more likely to be affected by potential subsidence movement. In order to allow use of shallow foundations, sub-excavation will likely be needed for the southwest portion of the site and possibly the northwest corner. Additional investigation is merited to better identify and delineate areas of sub-excavation.

Below-Grade Areas

Surface water can penetrate relatively permeable loose backfill soils located adjacent to buildings and collect at the bottom of relatively impermeable excavations causing wet or moist conditions. Foundation walls should be designed for lateral earth pressures. Foundation drains should be constructed around the lowest excavation levels. The drains can be connected to a sump pit where water can be removed by pumping if an underdrain is not provided.

Slab-On-Grade Construction

Slab-on-grade basement floors may be considered where low and some moderate swell soils are within the depth of influence and where potential movement is acceptable to the home buyers. Structurally-supported basement floors should be used if the home buyers cannot accept potential movements. Structurally-supported floors should be planned in all non-basement living areas in residences unless post tensioned slab-on-grade floors are used. Use of slab-on-grade floors in commercial/retail buildings should be viable possibly with some over-excavation. 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 (not post-tensioned) from foundation walls, columns and other slab penetrations;
2. Voiding of interior partition walls to allow for conventional slab movement without transferring the movement to the structures;
3. Flexible water and gas connections to allow for slab movement. A flexible plenum above furnaces will be required; and
4. Proper surface grading and foundation drain installation around excavations to reduce water availability to sub-slab and foundation soils.

Surface Drainage

The performance of improvements will be influenced by surface drainage. When developing an overall drainage scheme, consideration should be given to drainage around each building. The ground surface around the buildings should be sloped to provide positive drainage away from the foundations. We recommend a slope of at least 10 percent for the first 10 feet in landscaped areas surrounding single-family residences with basements, where practical. Where possible, drainage swales should slope at least 2 percent; more slope is desirable. Variation from these criteria is acceptable in some areas. For examples, for lots graded to direct drainage from the rear to the front of the lot, it is difficult to achieve the recommended slope at the high point behind the building. We believe it is acceptable to use a slope of about 6 inches in the first 10 feet at this location. For larger townhomes, apartments, and commercial/retail buildings a minimum slope of 5 percent may be used. Roof downspouts and other water collection systems should discharge well beyond the limits of all backfill around structures.

Proper control of surface runoff is also important to control the erosion of surface soils. 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 in such a way to reduce erosion.

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

RECOMMENDED FUTURE INVESTIGATIONS

We recommend the following investigations and services:

1. Investigation will likely be merited to evaluate mine subsidence and we recommend investigation of the mine entry conditions to develop remedial recommendations;
2. Supplemental Preliminary Geotechnical Investigation to delineate areas of sub-excavation and investigate potential areas of undocumented fill
3. Construction testing and observation during site development, grading, and pavement construction.
4. Subgrade investigation and pavement design after grading;
5. Design-level soils investigation(s) after grading; and
6. Foundation installation observations.

GEOTECHNICAL RISK

The concept of risk is an important aspect with any geotechnical evaluation, primarily because the methods used to develop geotechnical recommendations do not comprise an exact science. We never have complete knowledge of subsurface conditions. Our analysis must be tempered with engineering judgment and experience.

Therefore, the recommendations presented in any geotechnical evaluation should not be considered risk-free. Our recommendations represent our judgment of those measures that are necessary to increase the chances that the structures and improvements will perform satisfactorily. It is critical that all recommendations in this report are followed during construction. Owners or property managers must assume responsibility for maintaining structures and use appropriate practices regarding drainage and landscaping. Improvements designed after grading will require additional soil investigation and consultation.

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 that 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 the analysis of the influence of subsurface conditions on the design of the proposed development, please call.

CTL | THOMPSON, INC.

Matthew D. Monteith, E.I.T.
Staff Engineer

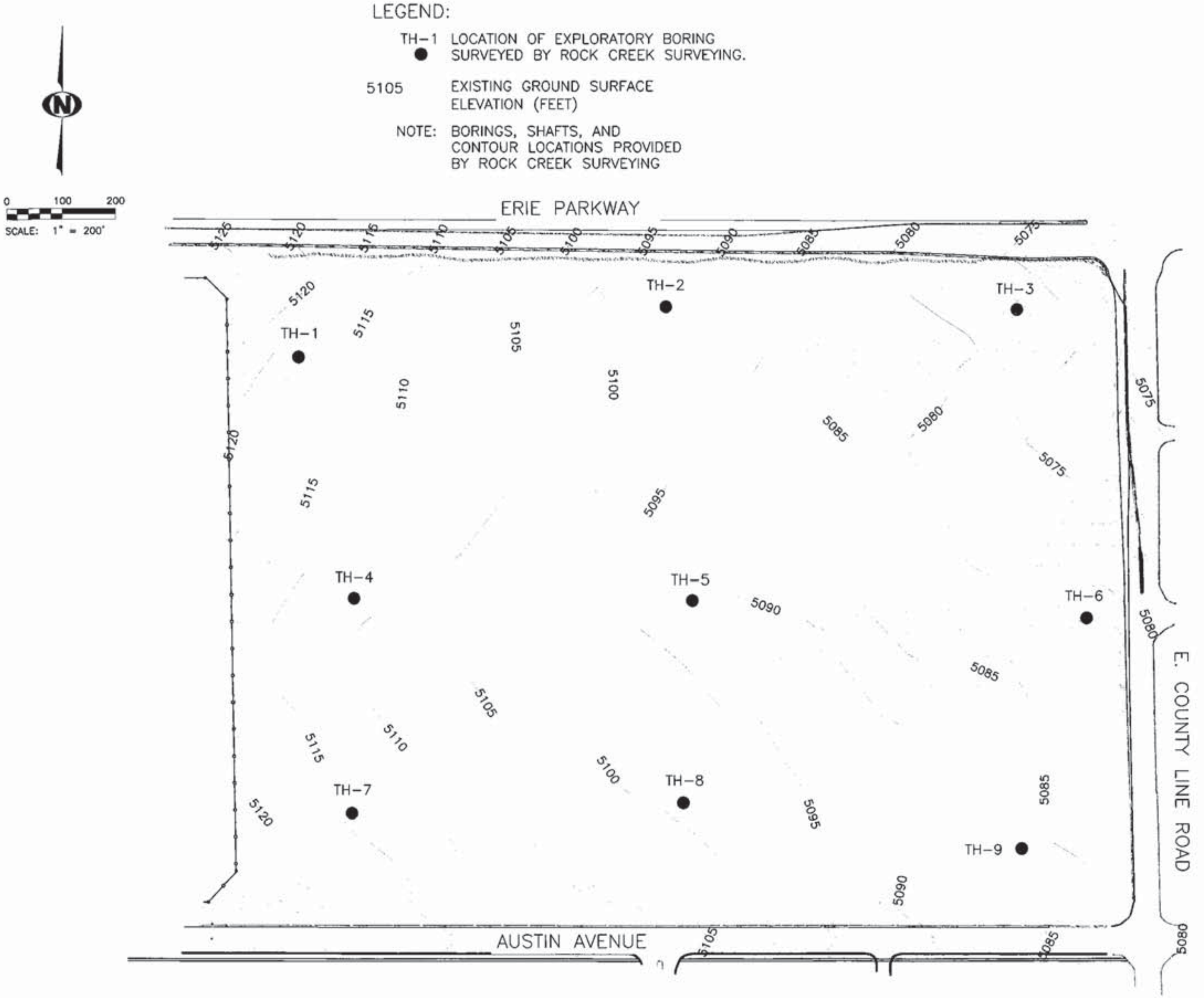
Reviewed by:

20243
5/10/14

Ronald M. McOmber, P.E., D.GE
Chairman & CEO

MDM:RMM/mdm/nt
(3 copies)

Via email: justinrmcs@gmail.com



VICINITY MAP
NOT TO SCALE

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Project No. DN47,332-115

Locations of Exploratory Borings

Fig. 1

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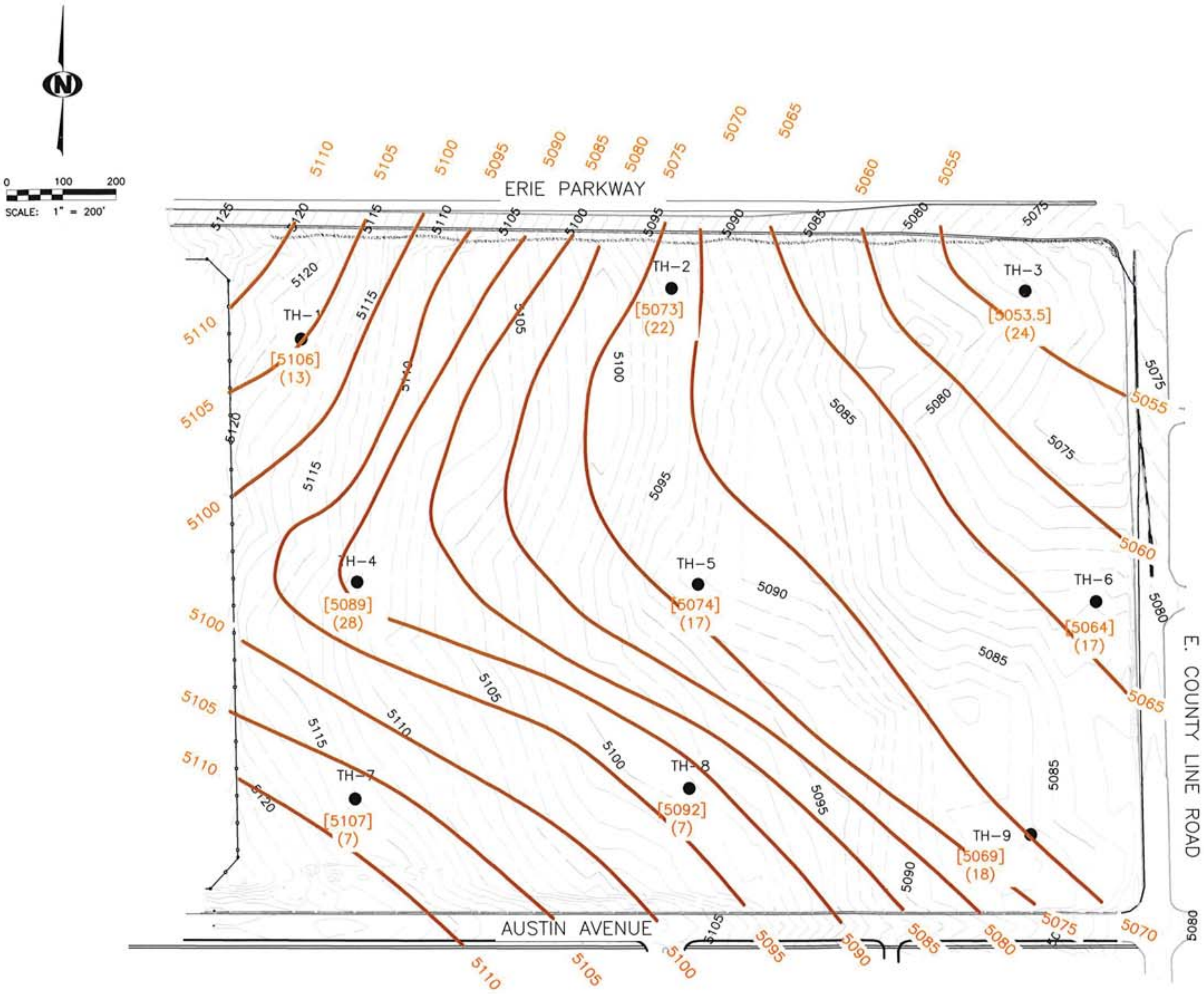

LEGEND:

- TH-1 ● LOCATION OF EXPLORATORY BORING SURVEYED BY ROCK CREEK SURVEYING.
- 5105 —— EXISTING GROUND SURFACE ELEVATION (FEET)
- NOTE: BORINGS, SHAFTS, AND CONTOUR LOCATIONS PROVIDED BY ROCK CREEK SURVEYING
- (17) DEPTH TO BEDROCK BELOW EXISTING GRADE.
- [5055] ELEVATION OF BEDROCK SURFACE
- —— 5110 INDICATES ESTIMATED BEDROCK ELEVATION (FEET)
- NOTE: THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF DRILL HOLE DATA AND MAY NOT REFLECT LOCAL VARIATIONS.

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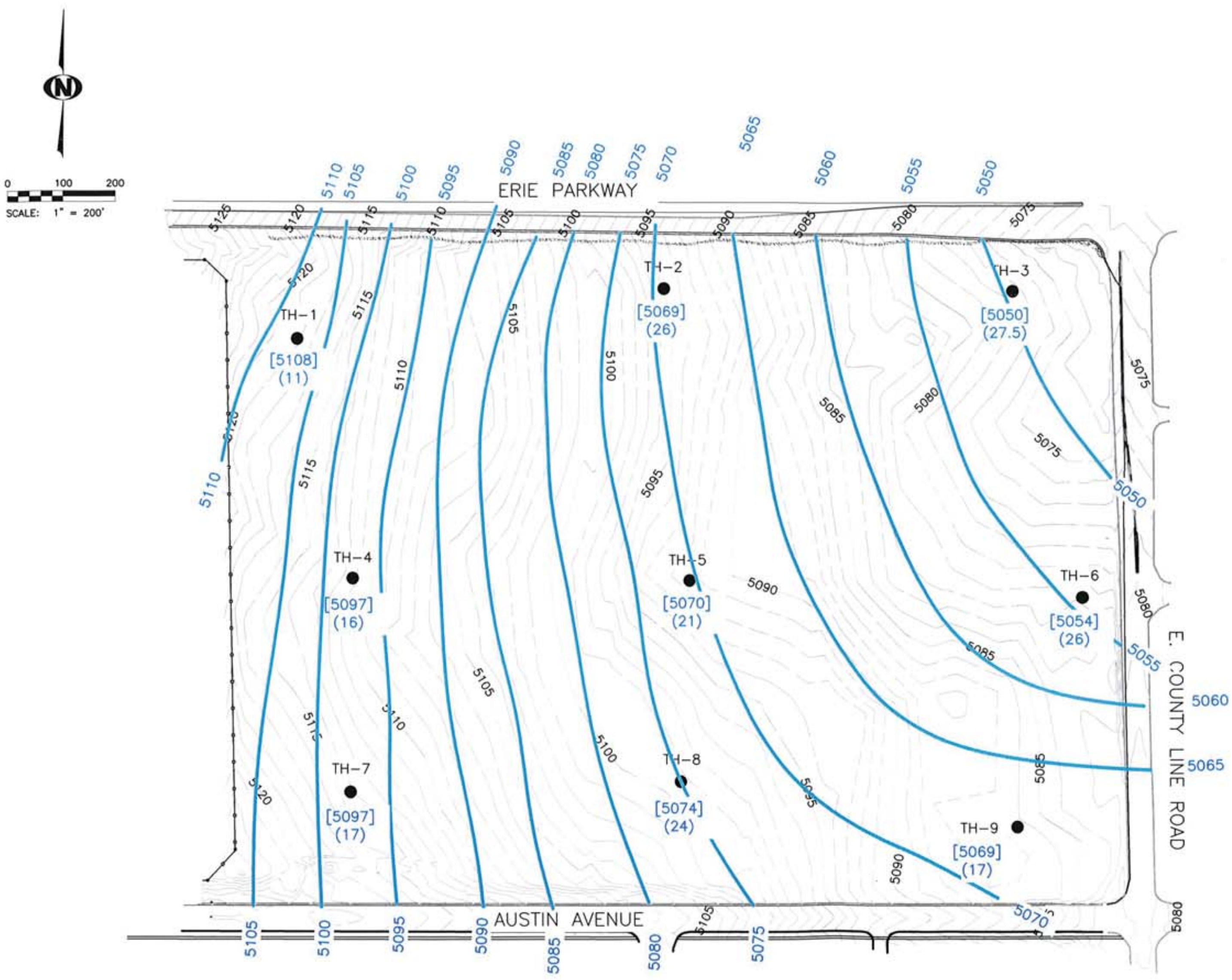
Depth and Estimated Elevation of Bedrock Surface

Fig. 2



LEGEND:

TH-1 ● LOCATION OF EXPLORATORY BORING SURVEYED BY ROCK CREEK SURVEYING.

5105 —— EXISTING GROUND SURFACE ELEVATION (FEET)

NOTE: BORINGS, SHAFTS, AND CONTOUR LOCATIONS PROVIDED BY ROCK CREEK SURVEYING

(17) DEPTH OF GROUNDWATER BELOW EXISTING GRADE.

[5055] ELEVATION OF GROUNDWATER SURFACE

—— 5110 INDICATES ESTIMATED GROUNDWATER ELEVATION (FEET)

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

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Depth and Estimated Elevation of Groundwater

Fig. 3

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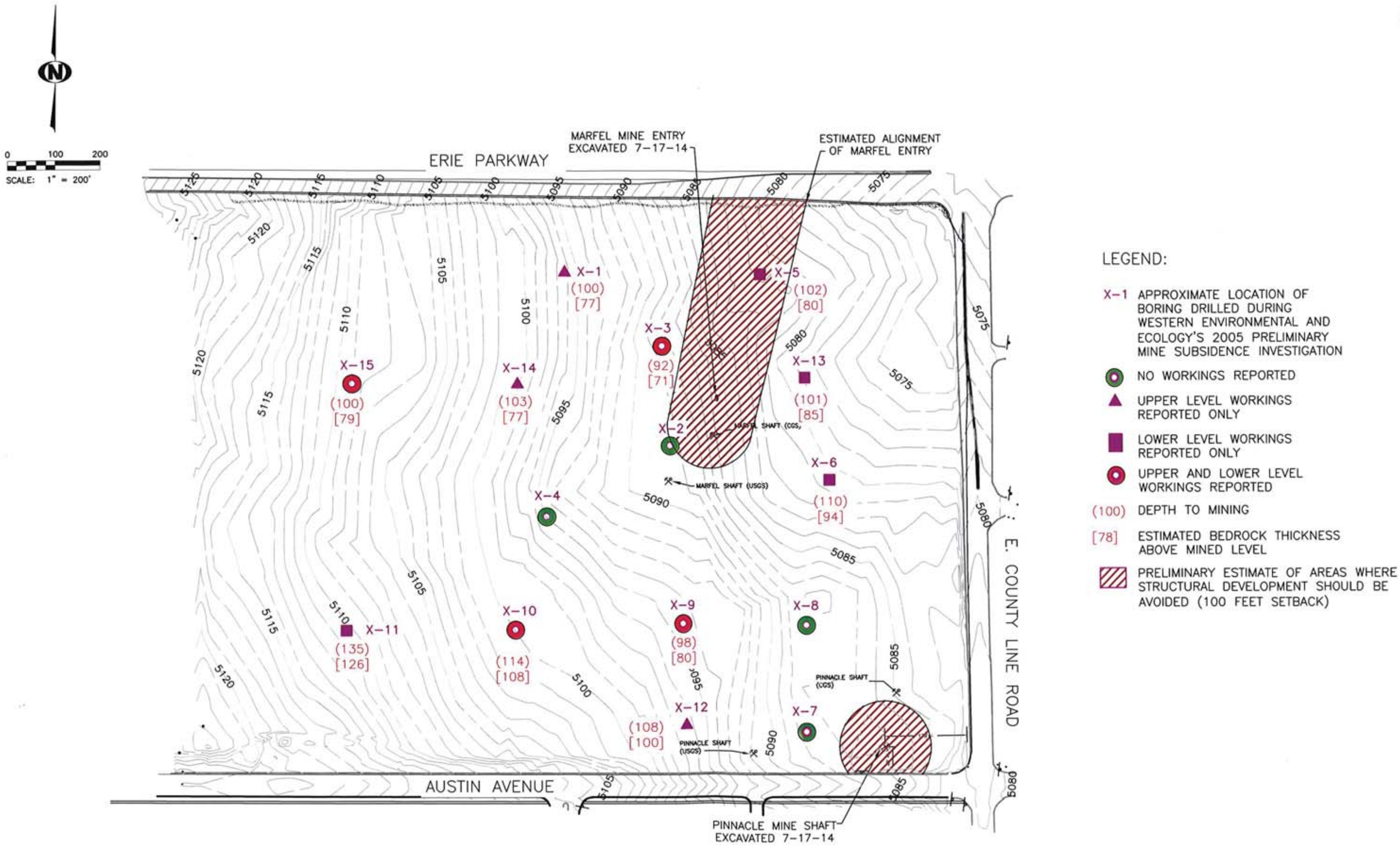

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Summary of Mine Data

Fig. 4

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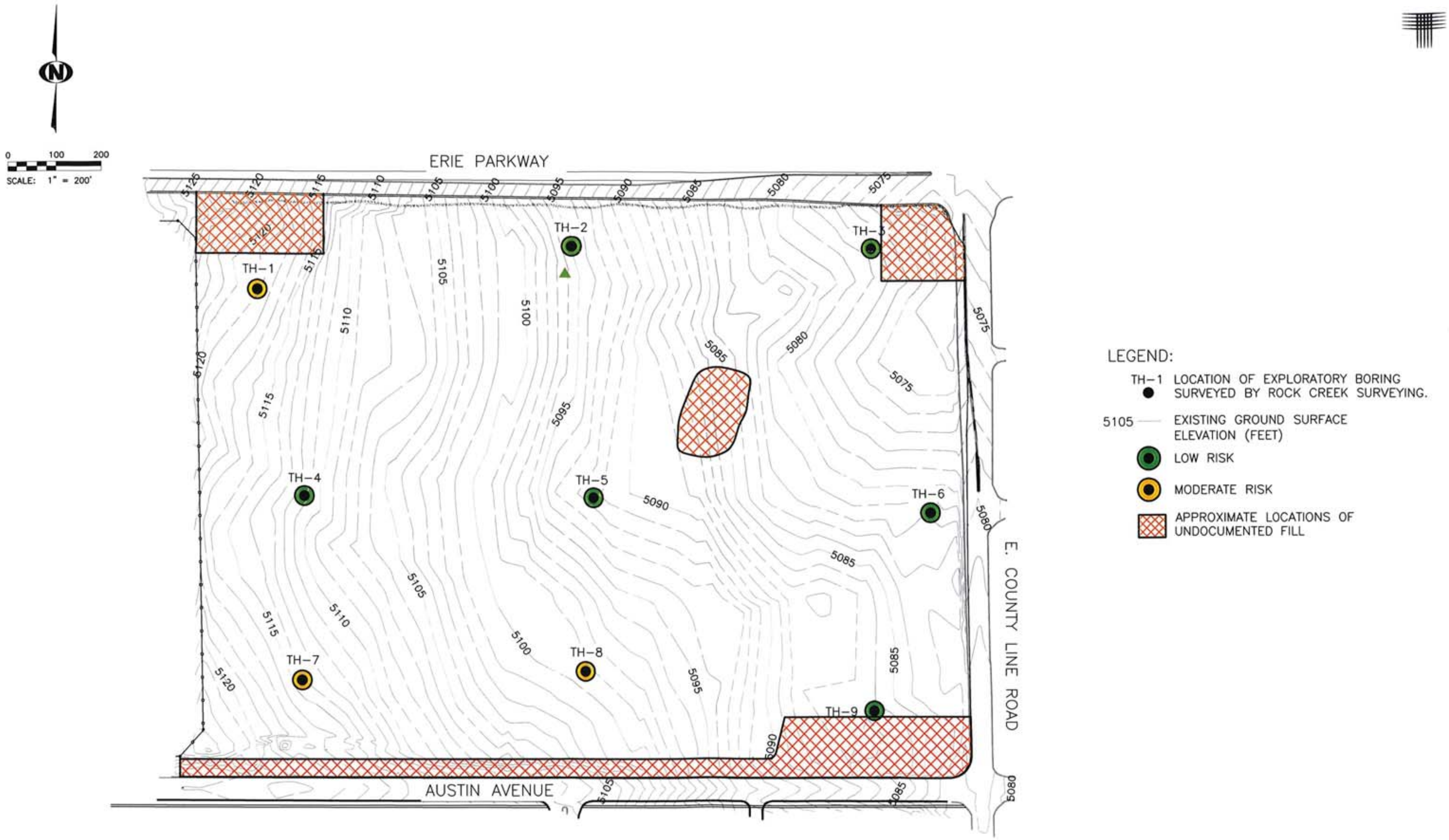

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Preliminary Risk Due to Expansive Soil and Bedrock

Fig. 5

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50-UNDERDRAIN_01

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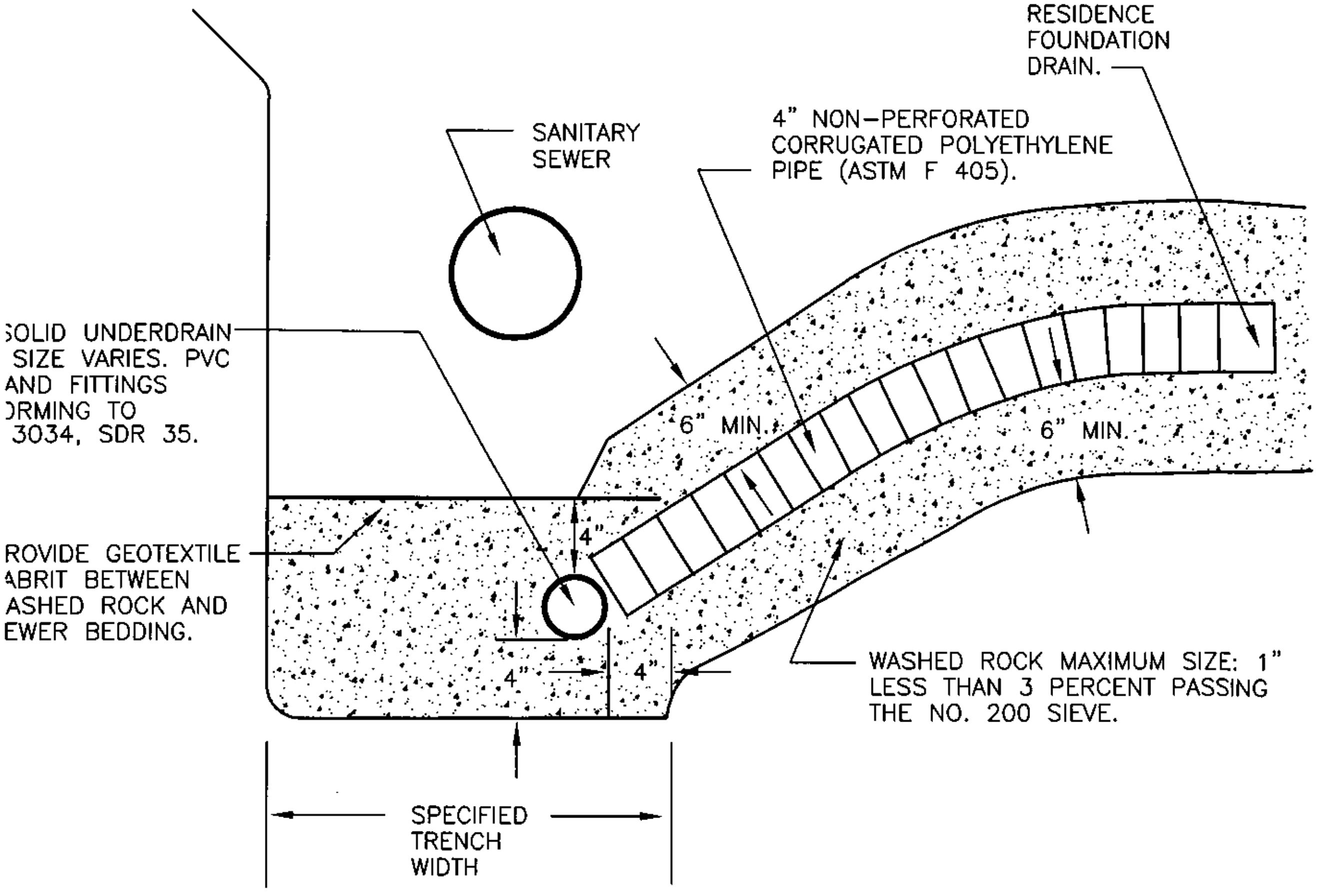

NOTE: NOT TO SCALE.

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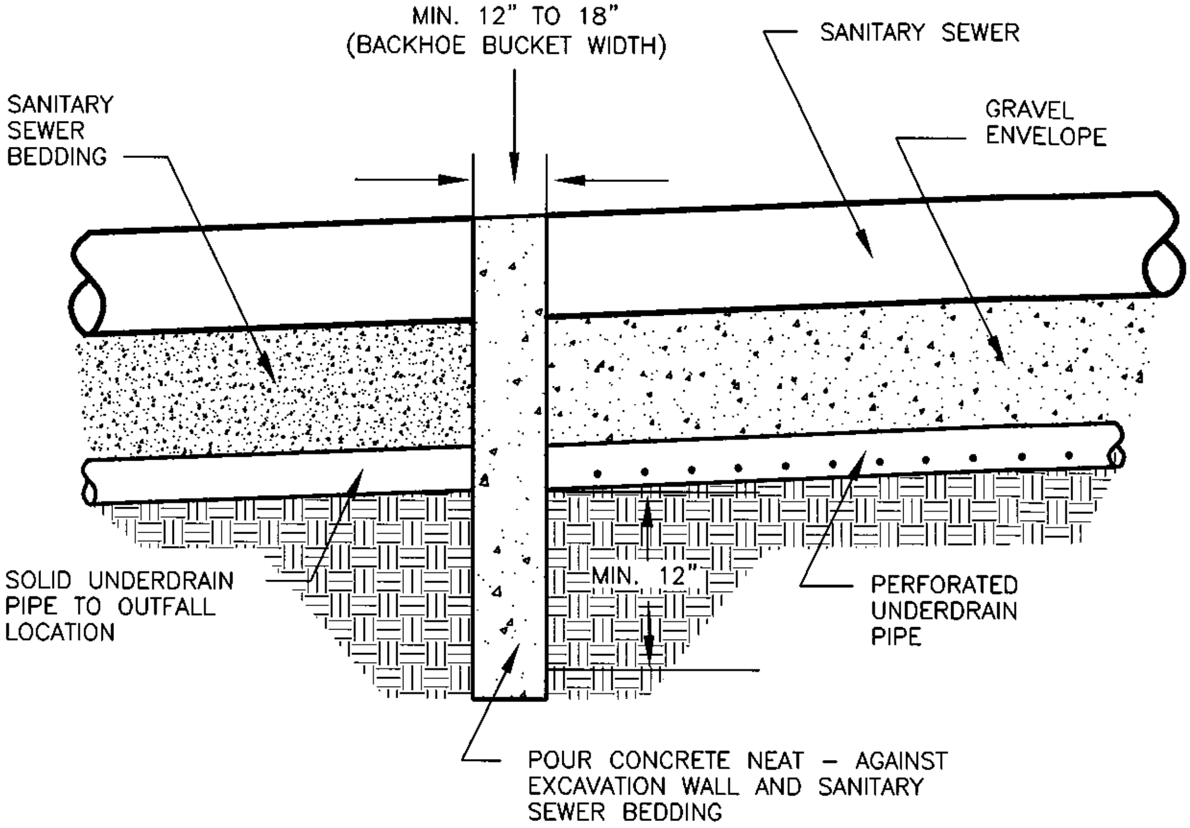
Sewer Underdrain Detail

Fig. 6



NOTE:
THE CONCRETE CUTOFF WALL SHOULD EXTEND INTO THE UNDISTURBED SOILS OUTSIDE THE UNDERDRAIN AND SANITARY SEWER TRENCH A MINIMUM DISTANCE OF 12 INCHES.

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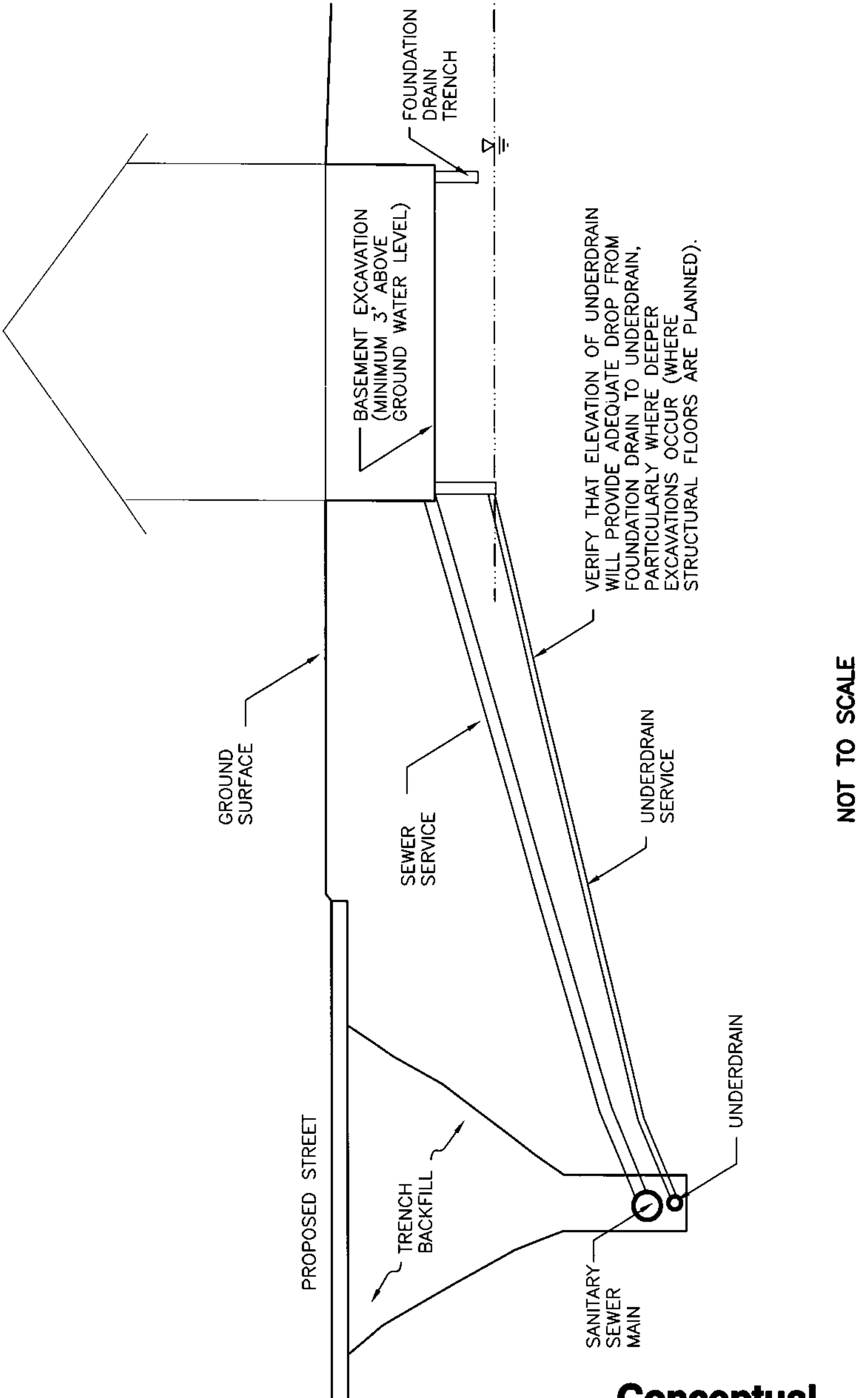
Underdrain Cutoff Wall Detail

Fig. 7



Conceptual Underdrain Service Profile

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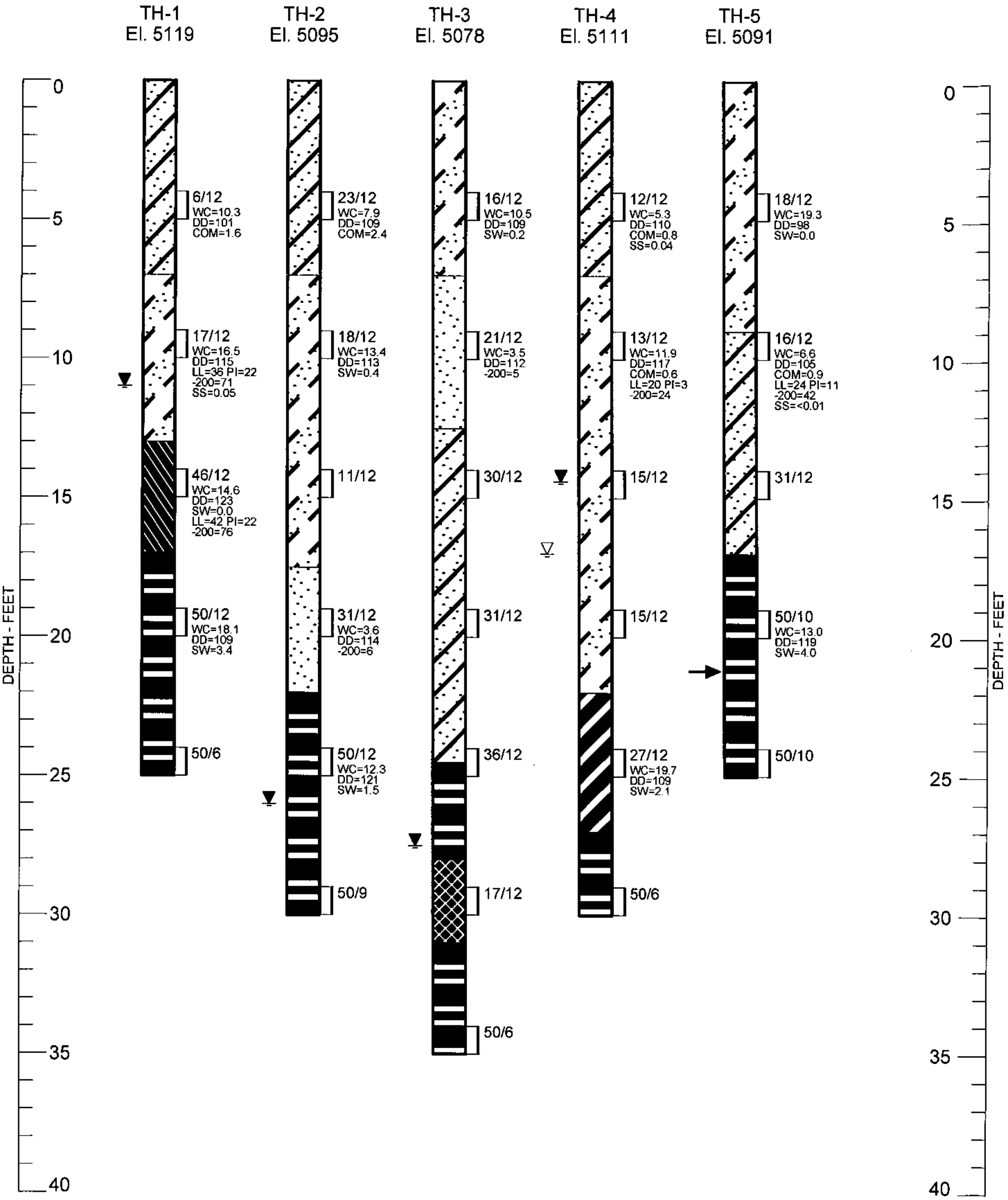
Fig. 8

APPENDIX A

SUMMARY LOGS OF EXPLORATORY BORINGS



SUMMARY LOGS OF EXPLORATORY BORINGS

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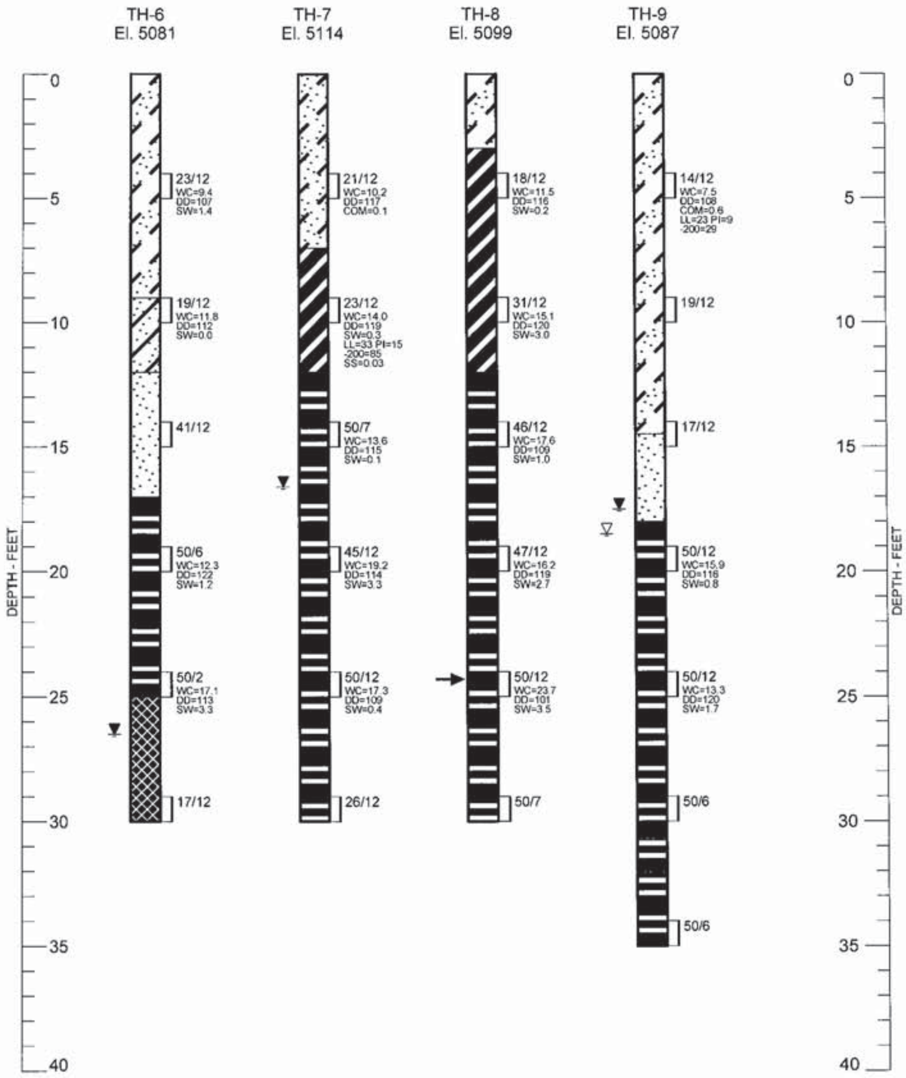


SUMMARY LOGS OF EXPLORATORY BORINGS

LEGEND:

- ▨ SAND, SILTY, LOOSE TO MEDIUM DENSE, MOIST, BROWN (SM).
- ▨ INTERLAYERED CLAY/SAND, MEDIUM DENSE, SLIGHTLY MOIST, BROWN, GRAY (CL OR SC).
- ▨ SAND, SILTY, MEDIUM DENSE, SLIGHTLY MOIST, BROWN, GRAY (SM).
- ▨ SAND, CLAYEY, SAND, SLIGHTLY MOIST, BROWN, GRAY (SC).
- ▨ SAND, CLEAN TO SLIGHTLY SILTY, MEDIUM DENSE, MOIST, BROWN, GRAY (SP, SP-SM).
- ▨ WEATHERED CLAYSTONE, MOIST, BROWN, GRAY.
- ■ BEDROCK, CLAYSTONE, HARD, MOIST, BROWN, GRAY.
- ▩ LIGNITE.
- ⊐ DRIVE SAMPLE. THE SYMBOL 6/12 INDICATES 6 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.
- ▽ WATER LEVEL MEASURED AT TIME OF DRILLING.
- ▼ WATER LEVEL MEASURED AFTER DRILLING ON AUGUST 7, 2014.
- → INDICATES DEPTH WHERE HOLE CAVED.

NOTES:

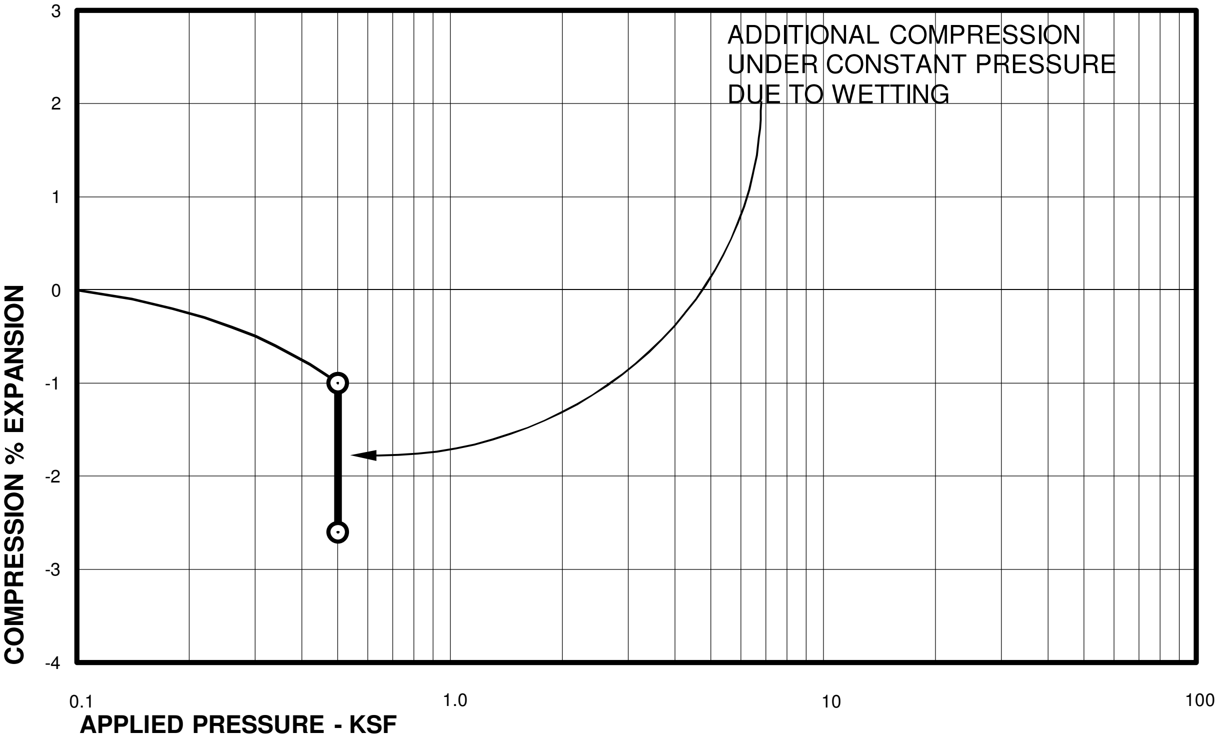
1. THE BORINGS WERE DRILLED ON JUNE 20, 2014 USING 4-INCH DIAMETER, CONTINUOUS-FLIGHT AUGER AND A TRUCK-MOUNTED DRILL RIG.
2. WC - INDICATES MOISTURE CONTENT (%).
   DD - INDICATES DRY DENSITY (PCF).
   SW - INDICATES SWELL WHEN WETTED UNDER APPLIED PRESSURE (%).
   COM- INDICATES COMPRESSION WHEN WETTED UNDER APPLIED PRESSURE (%).
   LL - INDICATES LIQUID LIMIT.
   PI - INDICATES PLASTICITY INDEX.
   -200 - INDICATES PASSING NO. 200 SIEVE (%).
   SS - INDICATES WATER-SOLUBLE SULFATE CONTENT (%).
3. BORING LOCATIONS AND ELEVATIONS WERE DETERMINED BY A REPRESENTATIVE OF OUR FIRM REFERENCING THE TEMPORARY BENCHMARK SHOWN ON FIG. 1.
4. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS AND CONCLUSIONS CONTAINED IN THIS REPORT.

RMCS, INC.
ERIE PARCEL
PROJECT NO. DN47,332-115

FIG. A- 2

APPENDIX B

LABORATORY TEST RESULTS

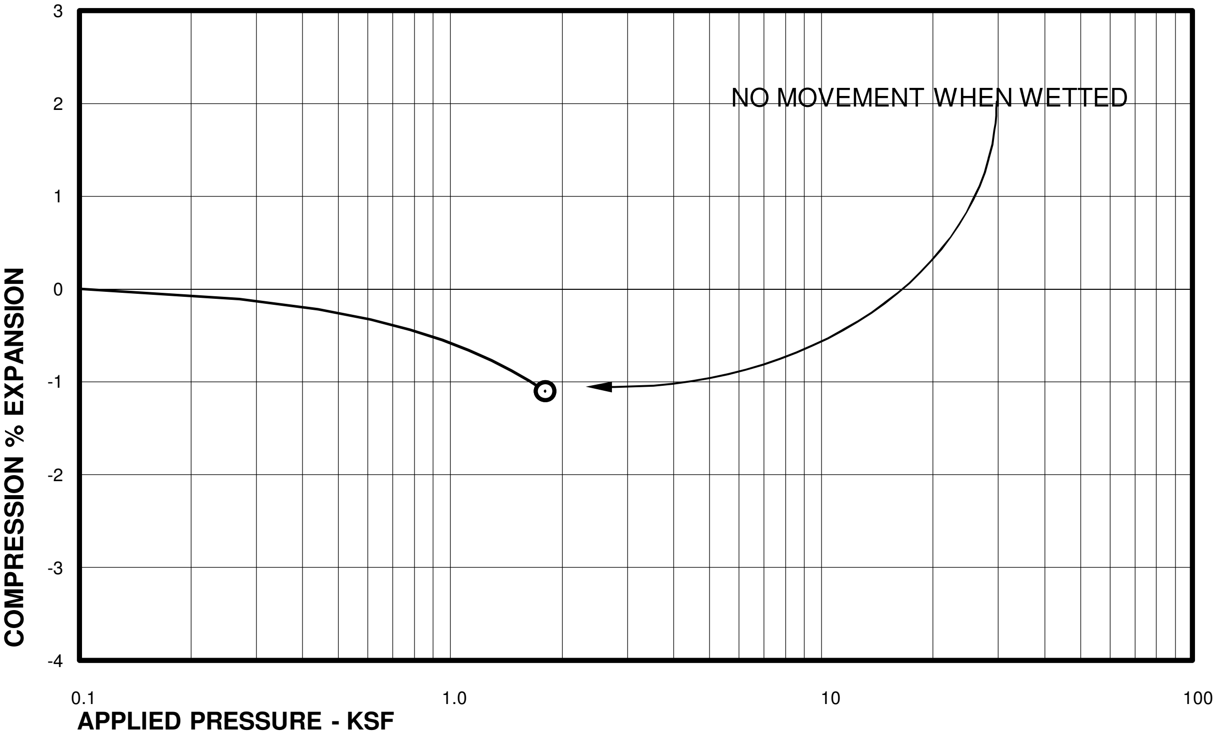


Sample of SAND, SILTY (SM)

From TH-1 AT 4 FEET

DRY UNIT WEIGHT= 101 PCF

MOISTURE CONTENT= 10.3 %



Sample of INTERBEDDED CLAYSTONE/SANDSTONE

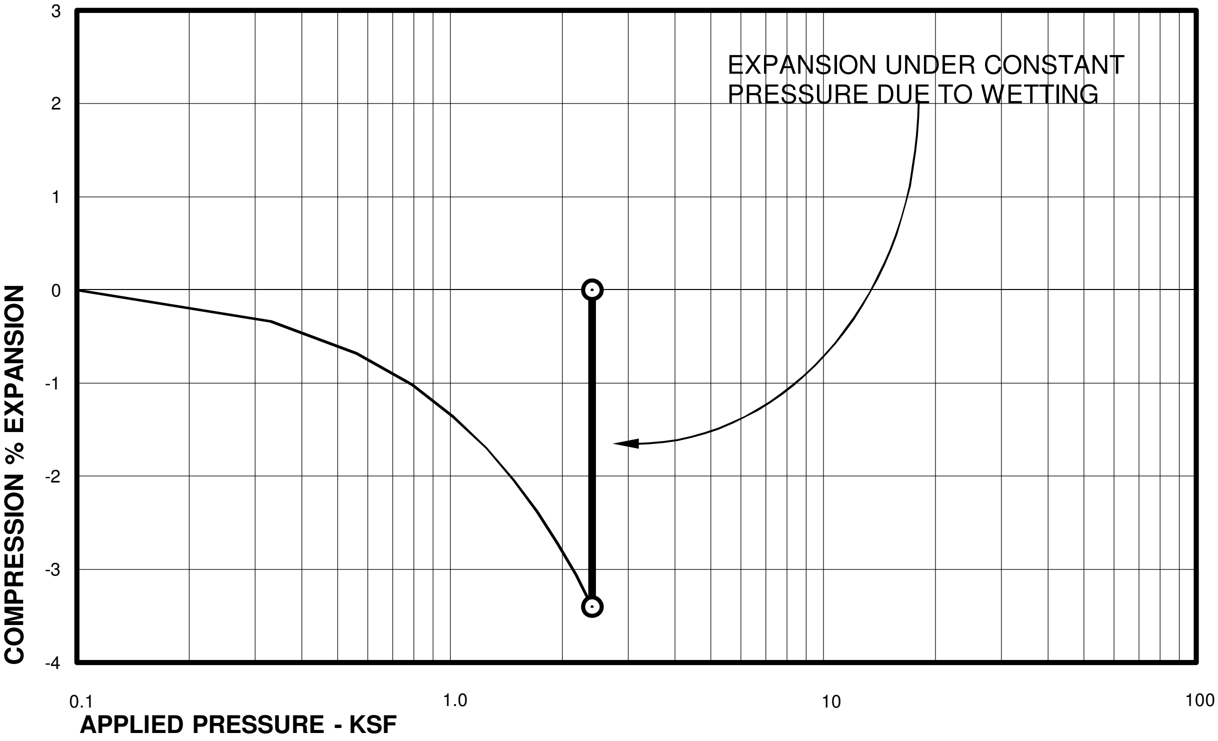
From TH-1 AT 14 FEET

DRY UNIT WEIGHT= 123 PCF

MOISTURE CONTENT= 14.6 %

Swell Consolidation Test Results

FIG. B-1

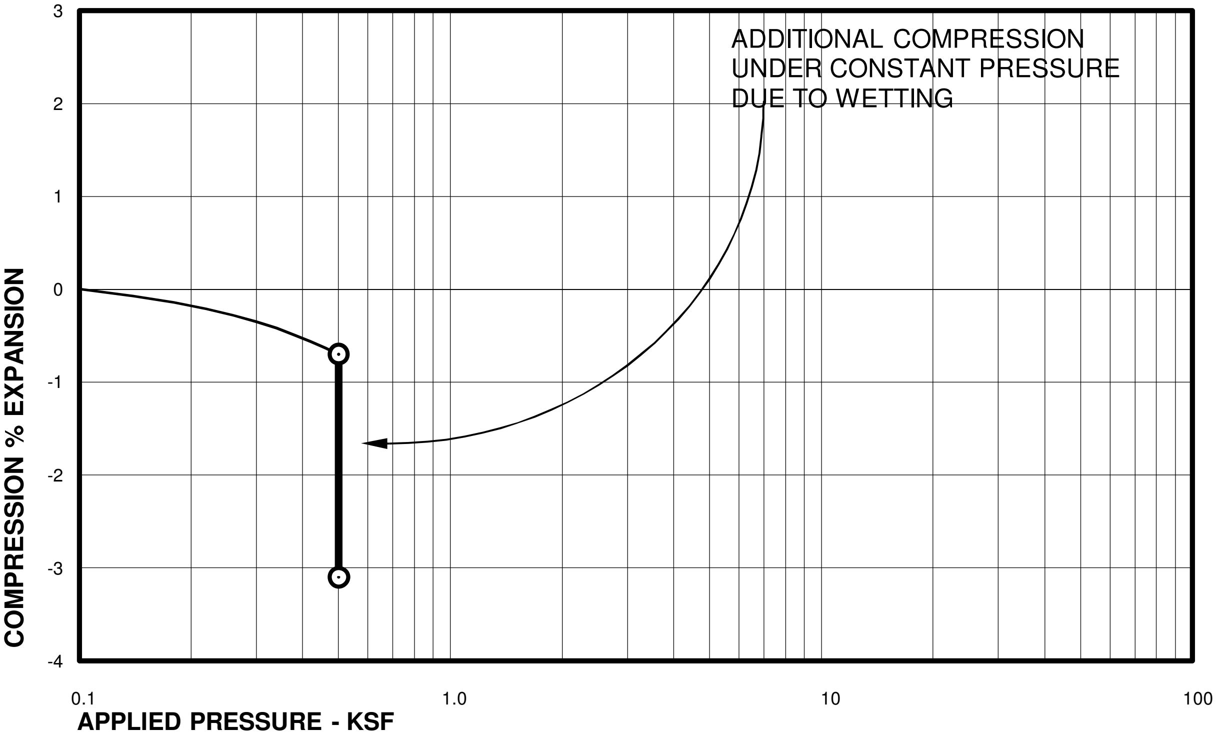


Sample of CLAYSTONE

From TH-1 AT 19 FEET

DRY UNIT WEIGHT= 109 PCF

MOISTURE CONTENT= 18.1 %



Sample of SAND, SILTY (SM)

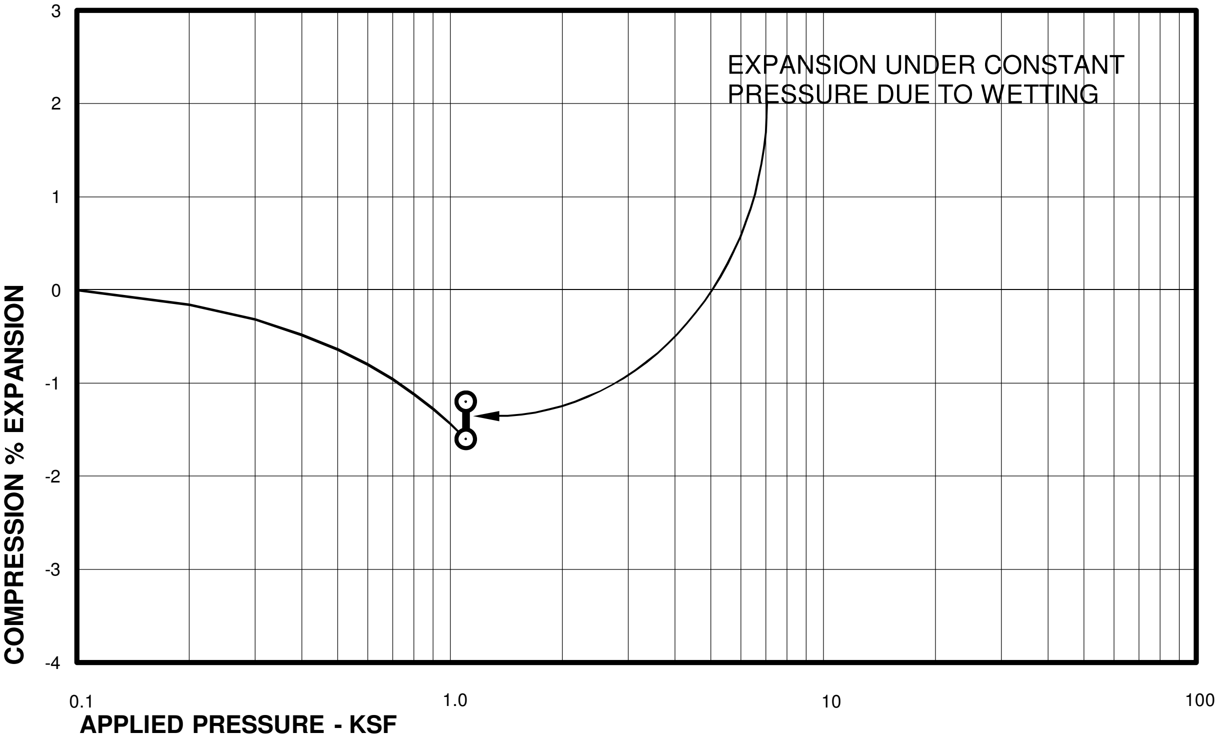
From TH-2 AT 4 FEET

DRY UNIT WEIGHT= 109 PCF

MOISTURE CONTENT= 7.9 %

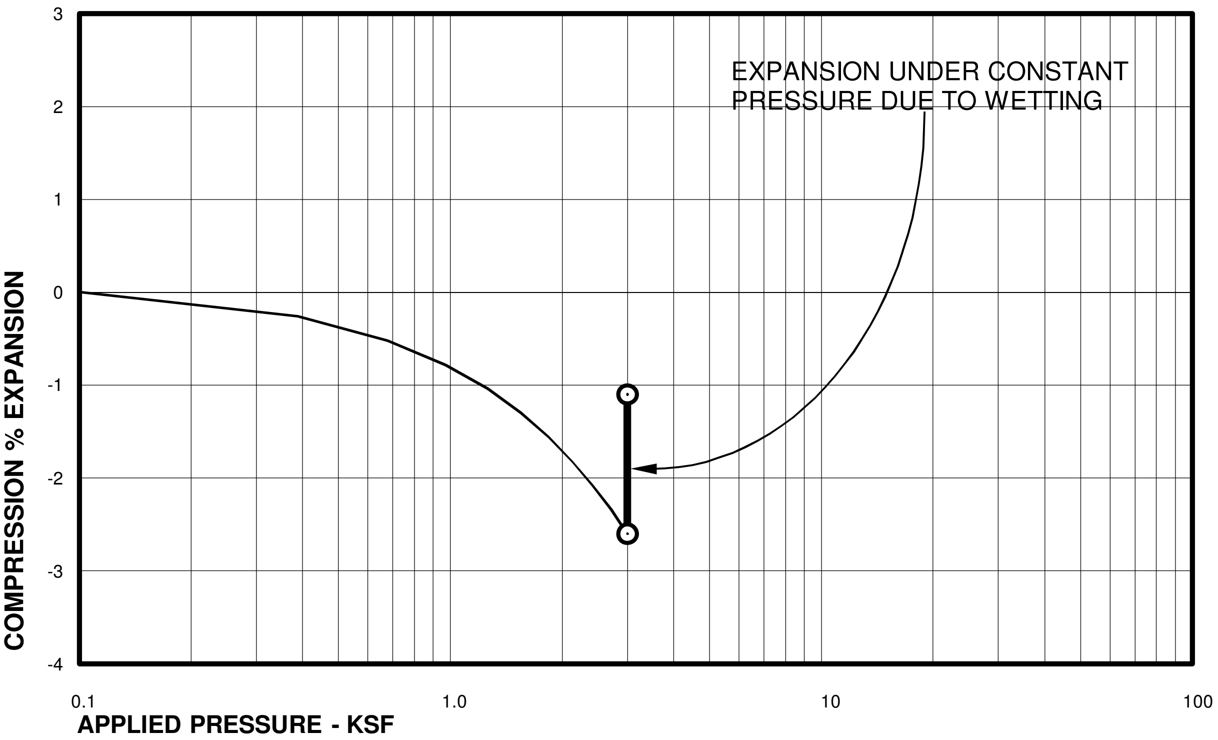
Swell Consolidation Test Results

FIG. B-2



Sample of INTERLAYERED CLAY/SAND
From TH-2 AT 9 FEET

DRY UNIT WEIGHT= 113 PCF
MOISTURE CONTENT= 13.4 %

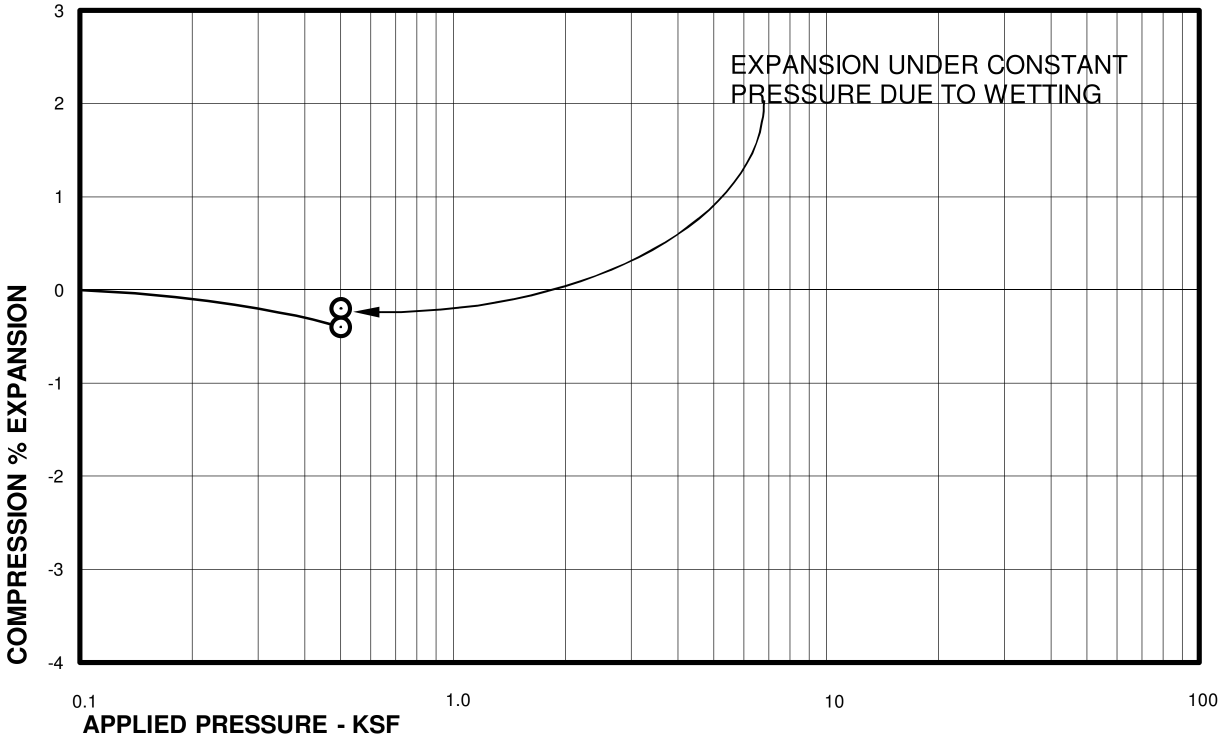


Sample of CLAYSTONE
From TH-2 AT 24 FEET

DRY UNIT WEIGHT= 121 PCF
MOISTURE CONTENT= 12.3 %

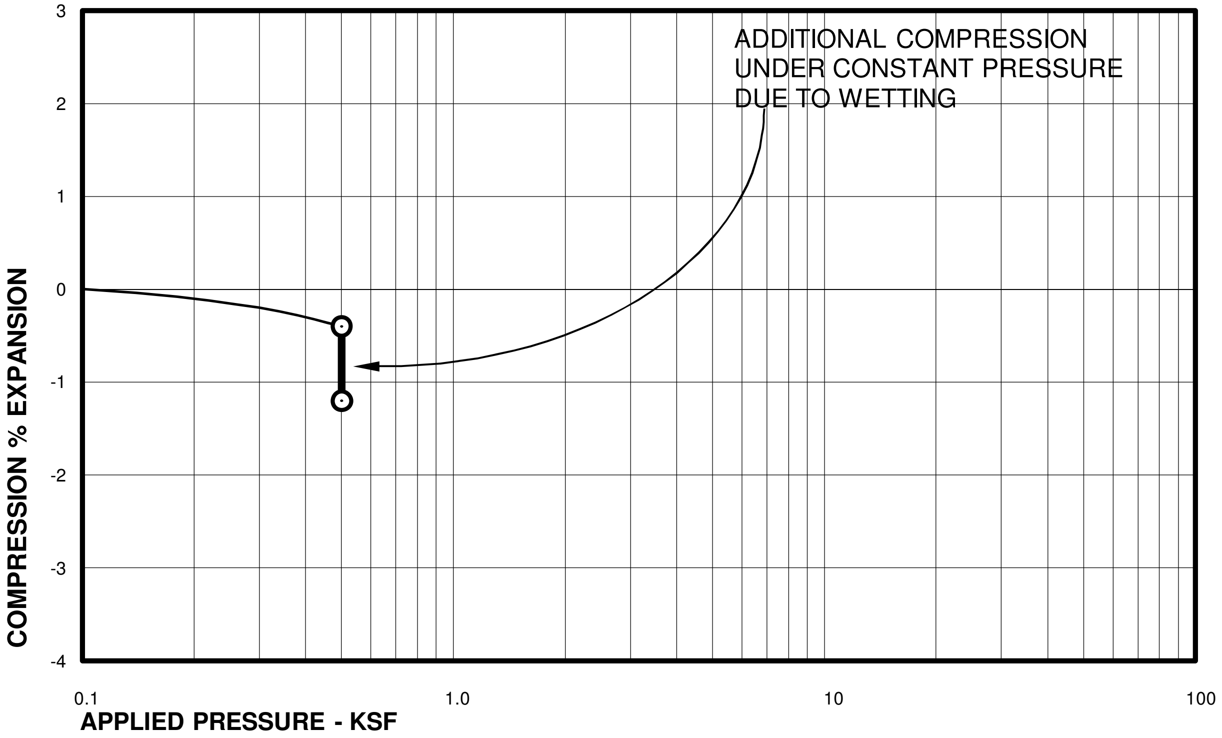
Swell Consolidation Test Results

FIG. B-3



Sample of INTERLAYERED CLAY/SAND
From TH-3 AT 4 FEET

DRY UNIT WEIGHT= 109 PCF
MOISTURE CONTENT= 10.5 %



Sample of SAND, SILTY (SM)
From TH-4 AT 4 FEET

DRY UNIT WEIGHT= 110 PCF
MOISTURE CONTENT= 5.3 %

Swell Consolidation Test Results

FIG. B-4

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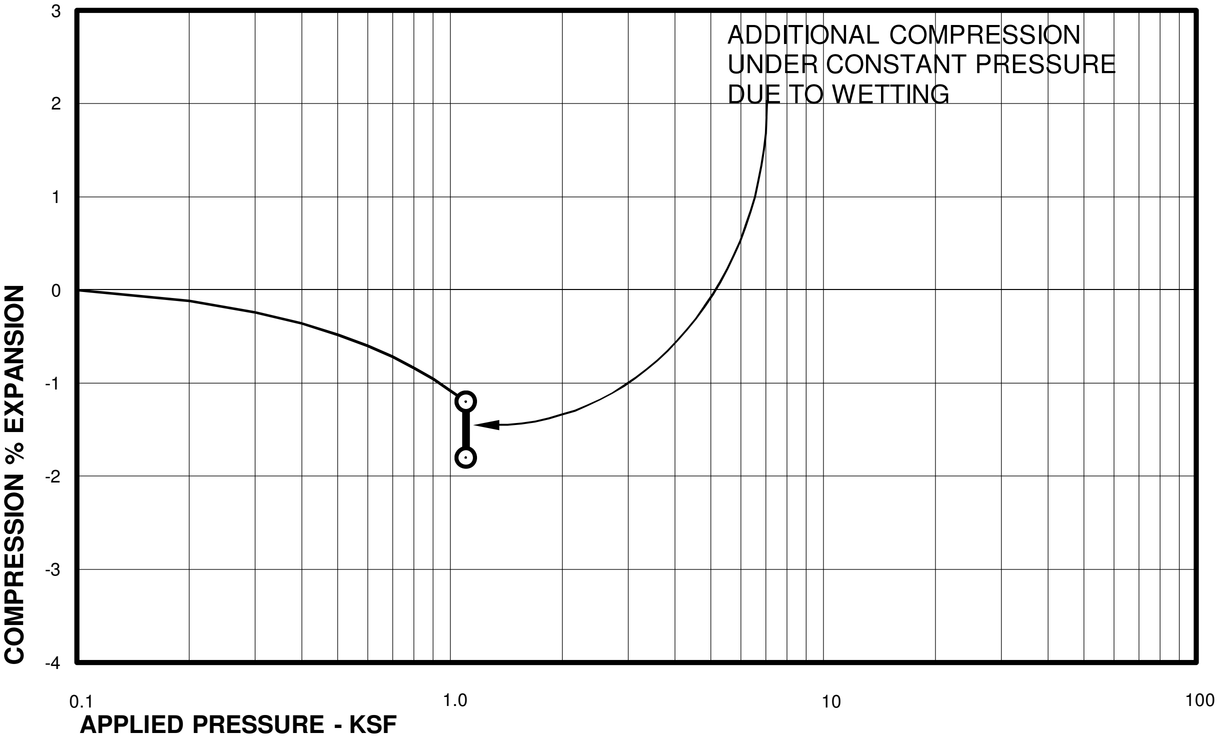
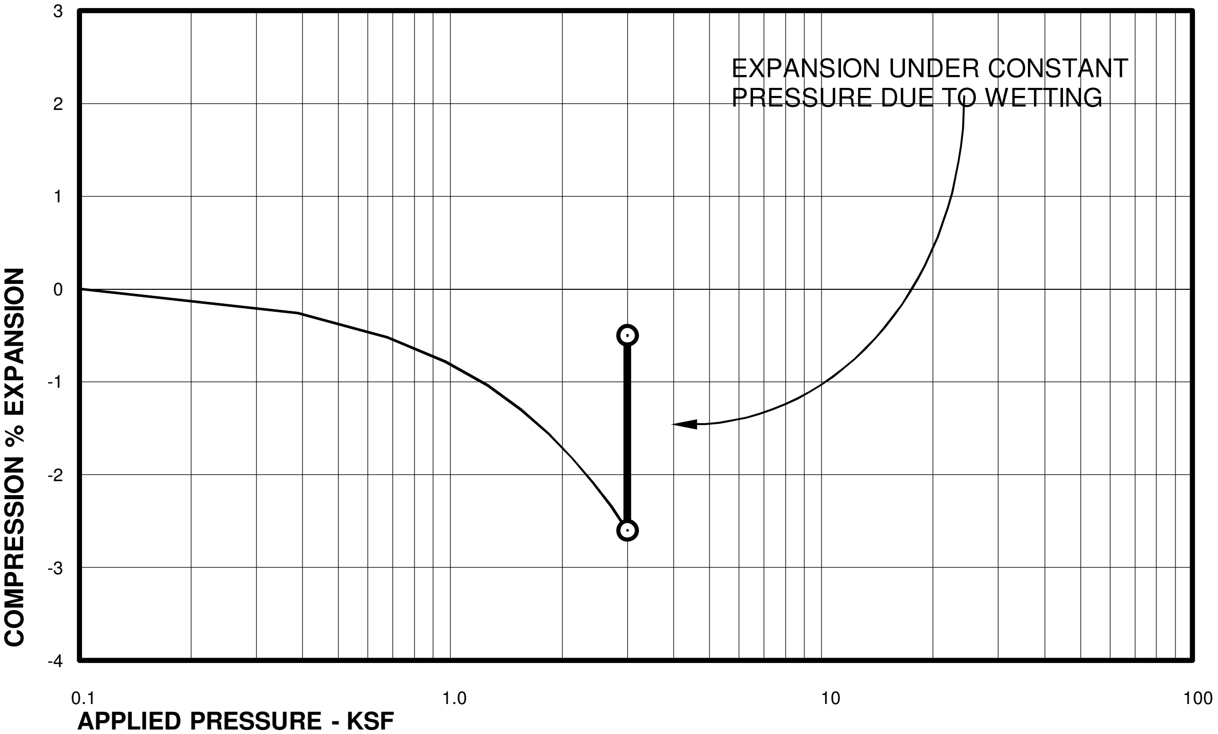


Sample of	INTERLAYERED CLAY/SAND	DRY UNIT WEIGHT=	117	PCF
From	TH-4 AT 9 FEET	MOISTURE CONTENT=	11.9	%



Sample of	WEATHERED CLAYSTONE	DRY UNIT WEIGHT=	109	PCF
From	TH-4 AT 24 FEET	MOISTURE CONTENT=	19.7	%

Swell Consolidation Test Results

FIG. B-5

RMCS, INC.
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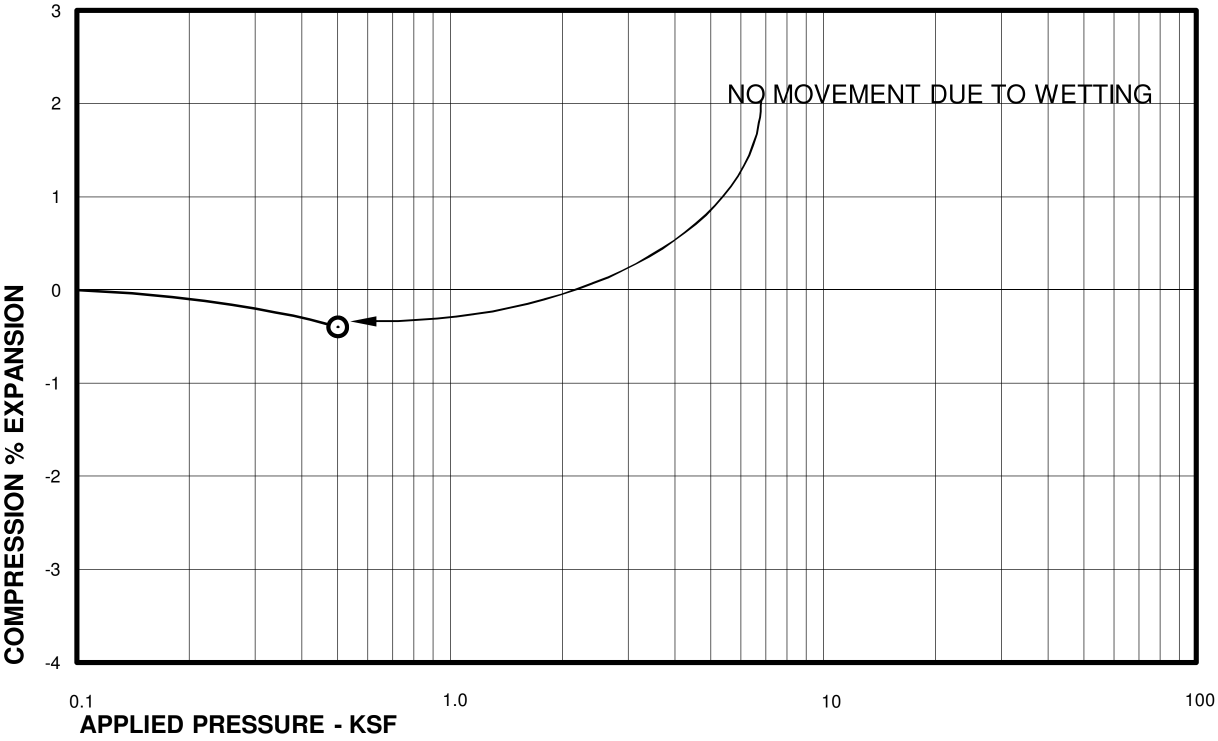
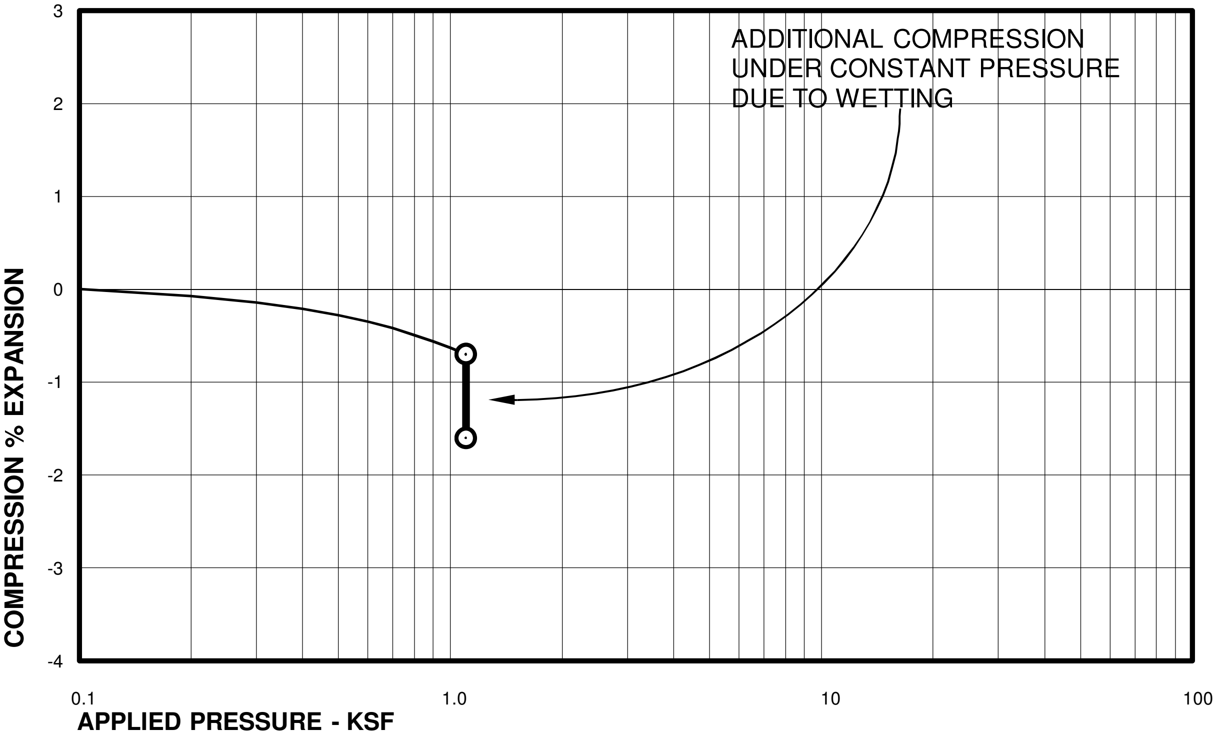
S:\PROJECTS\47300\47332.000\115\2. Reports\R1\dn47332-115-R1-X1(SWELL).xlsm



Sample of INTERLAYERED CLAY/SAND
From TH-5 AT 4 FEET

DRY UNIT WEIGHT= 98 PCF
MOISTURE CONTENT= 19.3 %

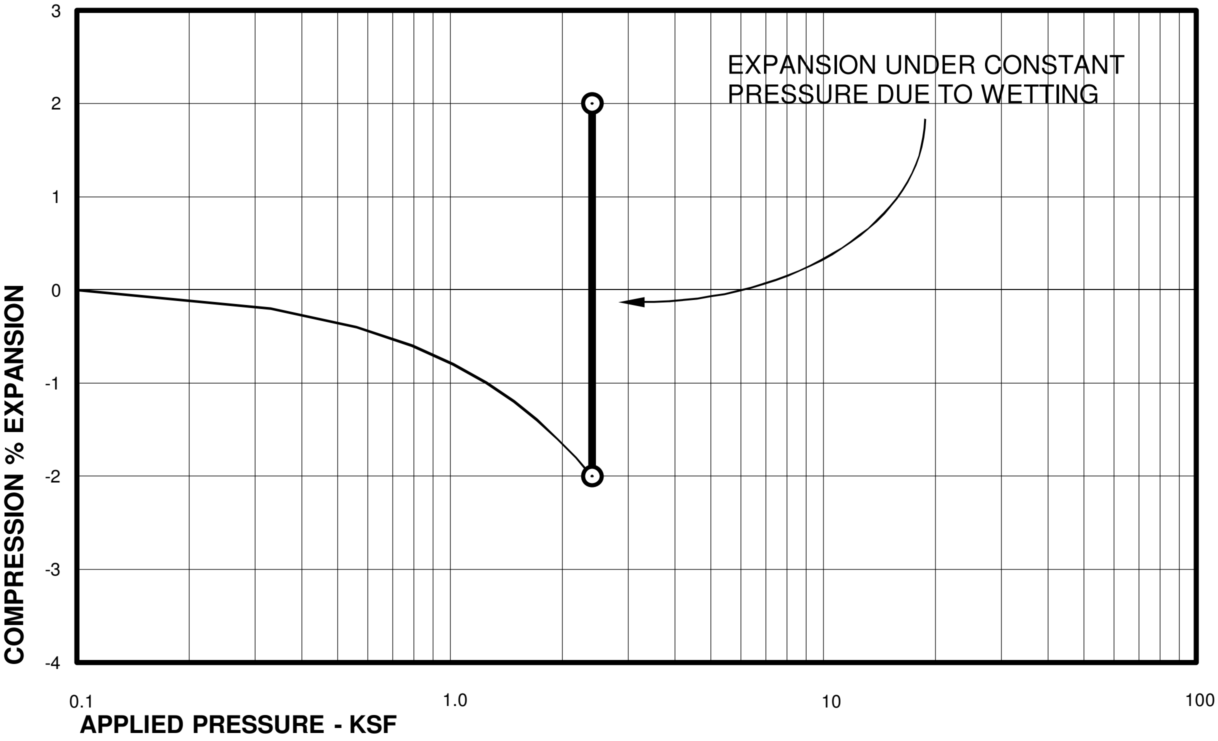


Sample of SAND, SILTY (SM)
From TH-5 AT 9 FEET

DRY UNIT WEIGHT= 105 PCF
MOISTURE CONTENT= 6.6 %

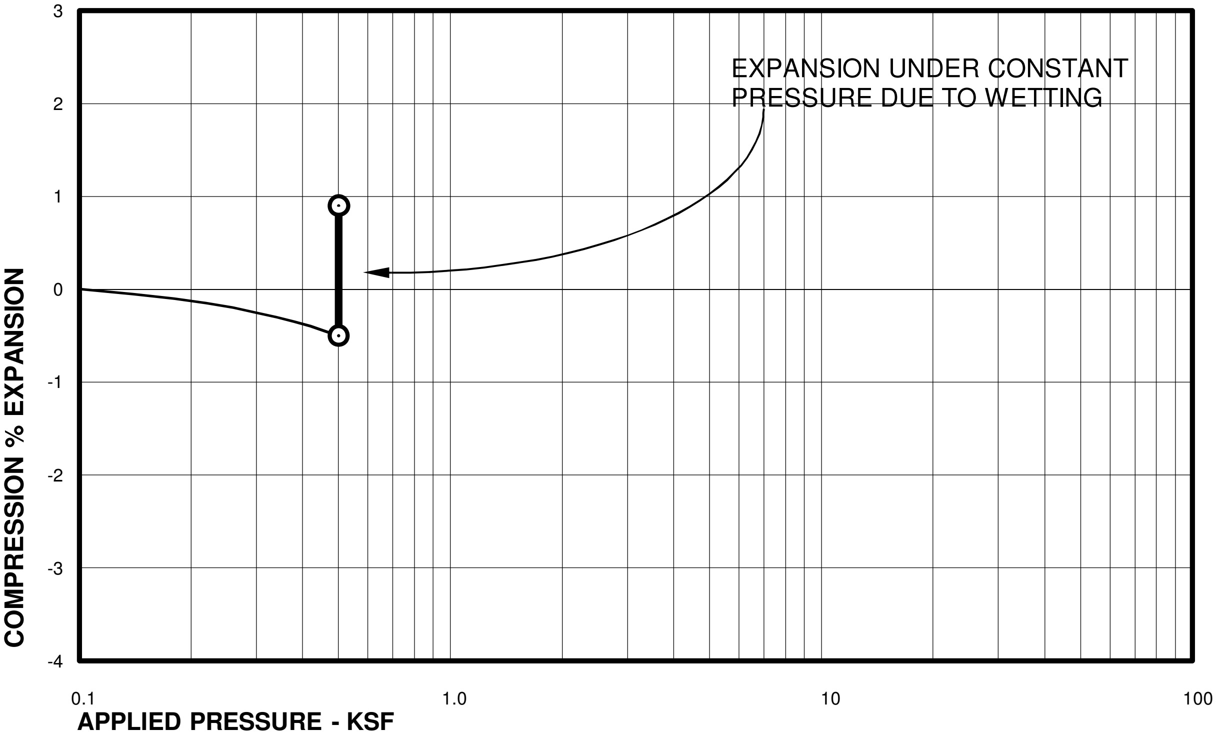
Swell Consolidation Test Results

FIG. B-6



Sample of CLAYSTONE
From TH-5 AT 19 FEET

DRY UNIT WEIGHT= 119 PCF
MOISTURE CONTENT= 13.0 %

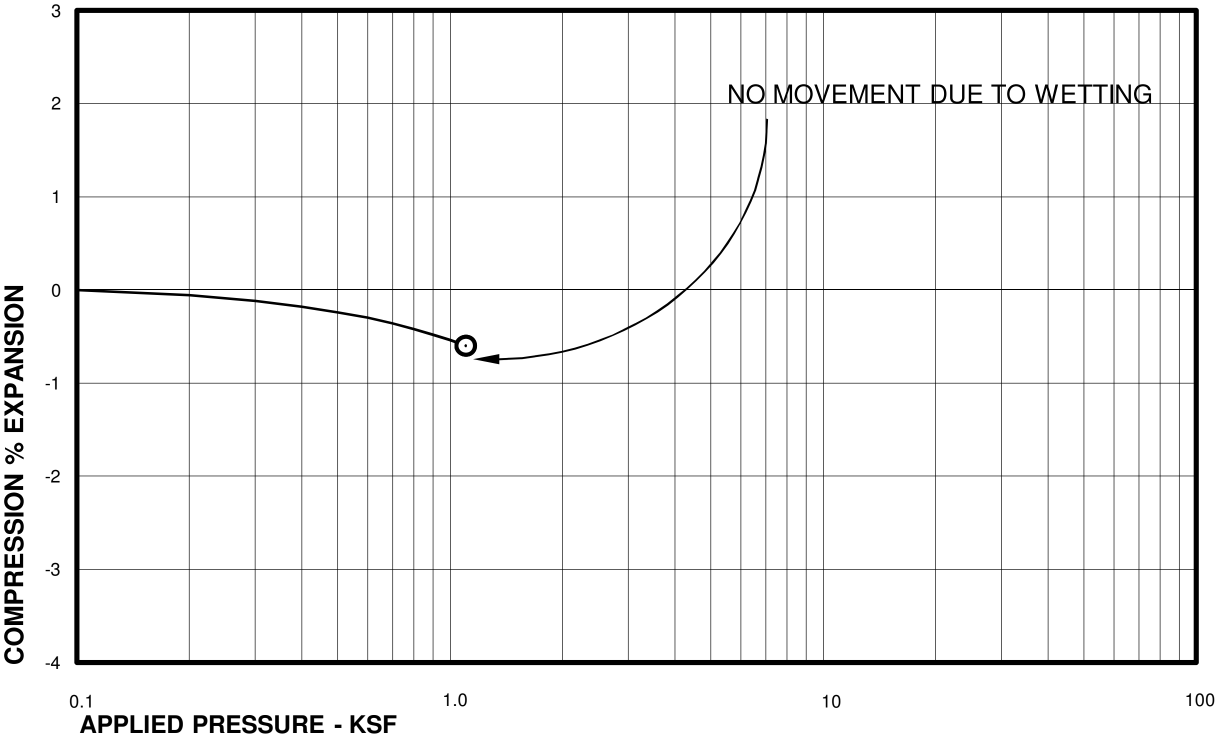


Sample of INTERLAYERED CLAY/SAND
From TH-6 AT 4 FEET

DRY UNIT WEIGHT= 107 PCF
MOISTURE CONTENT= 9.4 %

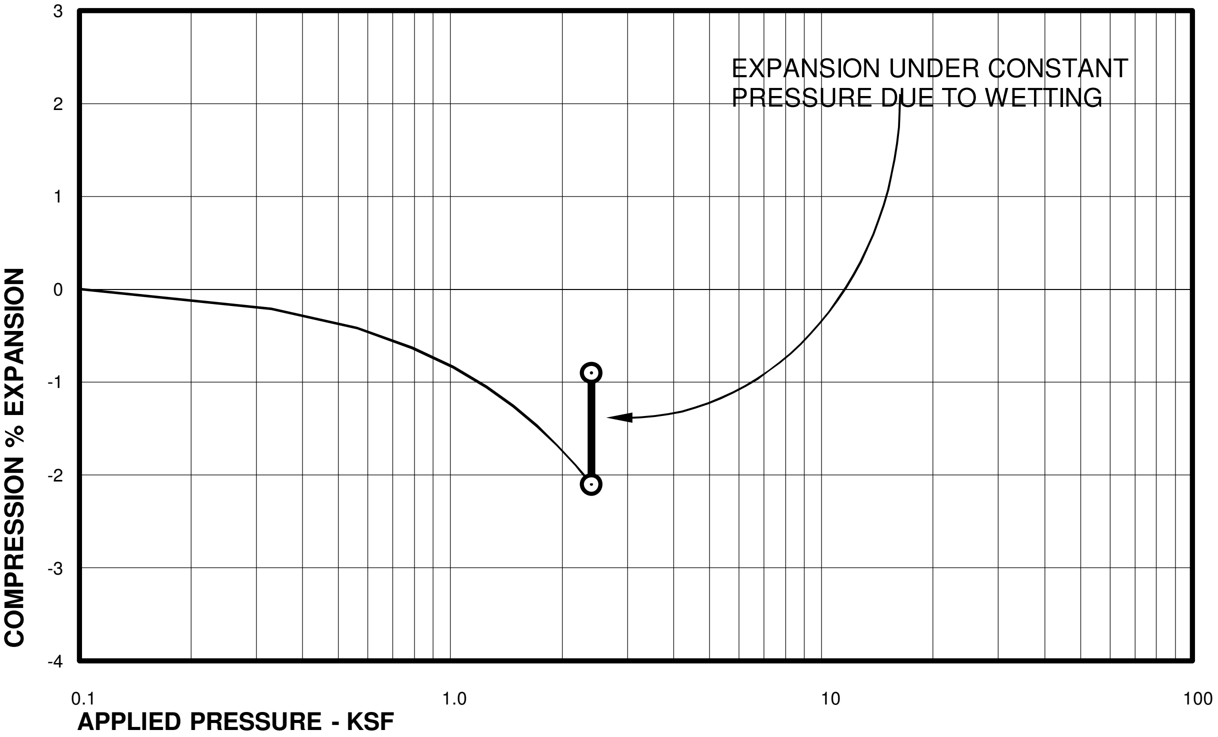
Swell Consolidation Test Results

FIG. B-7



Sample of SAND, SILTY (SM)
From TH-6 AT 9 FEET

DRY UNIT WEIGHT= 112 PCF
MOISTURE CONTENT= 11.8 %

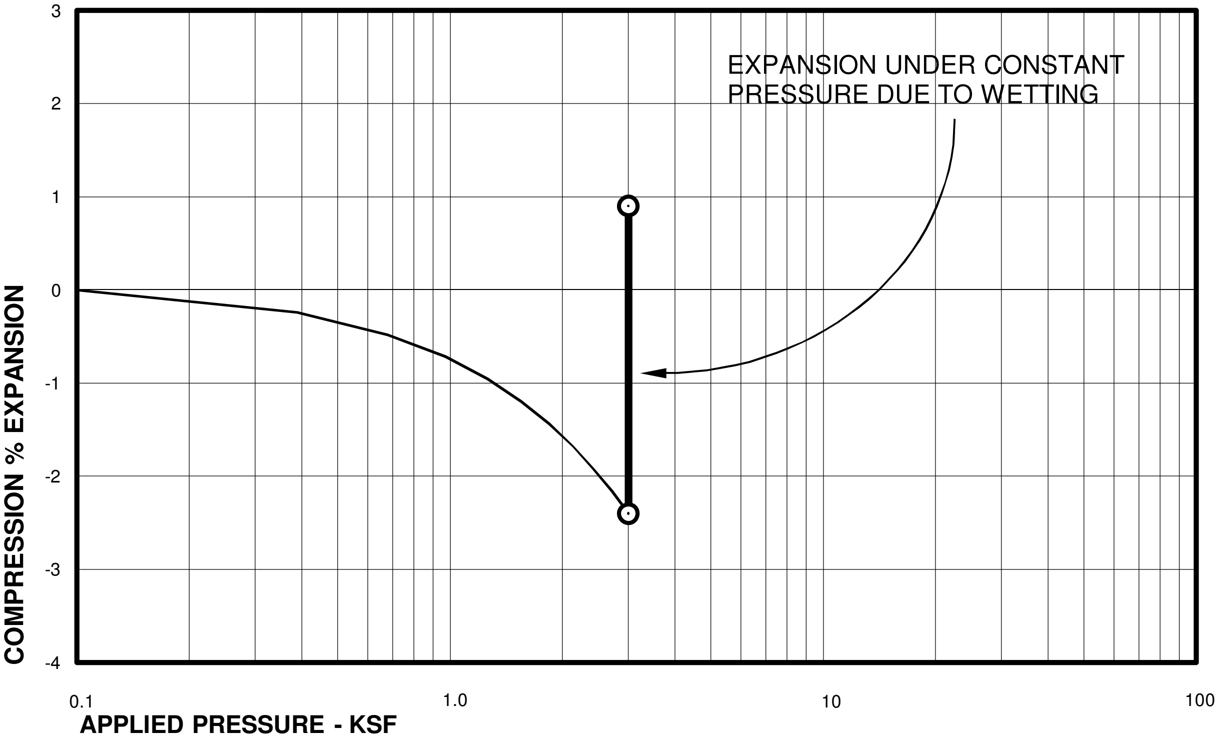


Sample of CLAYSTONE
From TH-6 AT 19 FEET

DRY UNIT WEIGHT= 122 PCF
MOISTURE CONTENT= 12.3 %

Swell Consolidation Test Results

FIG. B-8

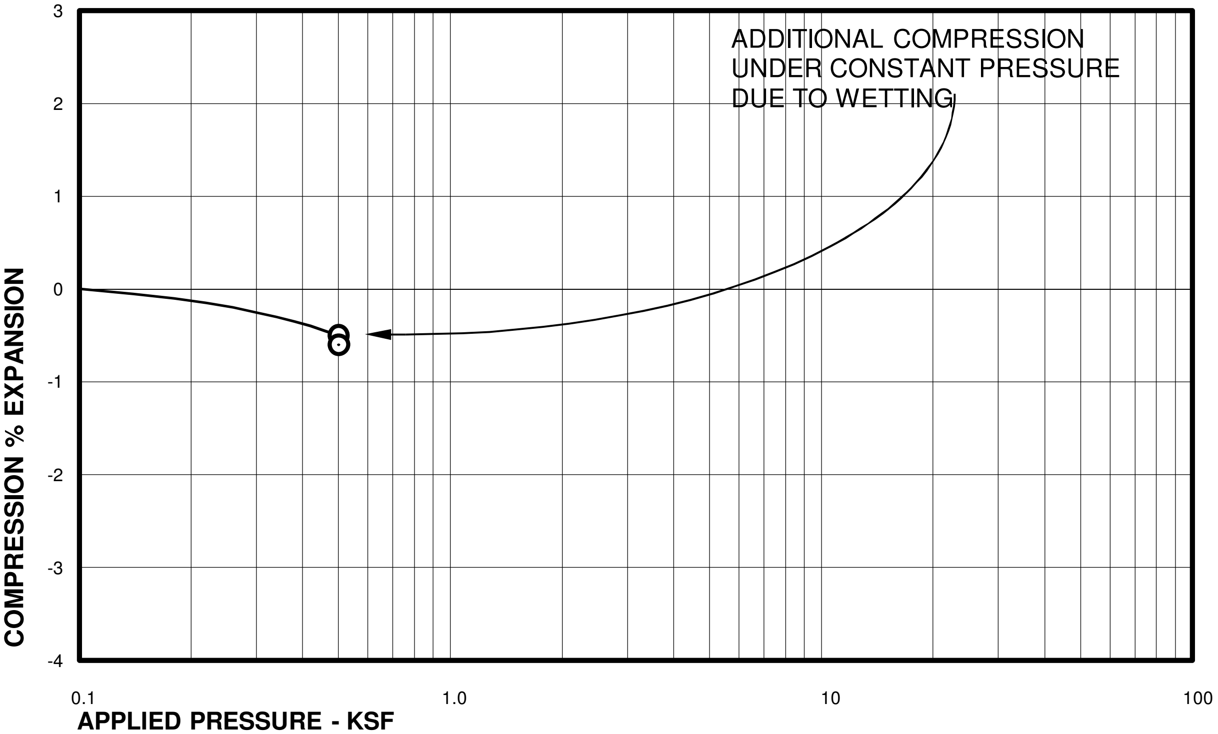


Sample of CLAYSTONE

From TH-6 AT 24 FEET

DRY UNIT WEIGHT= 113 PCF

MOISTURE CONTENT= 17.1 %



Sample of SAND, CLAYEY (SC)

From TH-7 AT 4 FEET

DRY UNIT WEIGHT= 117 PCF

MOISTURE CONTENT= 10.2 %

Swell Consolidation Test Results

FIG. B-9

RMCS, INC.
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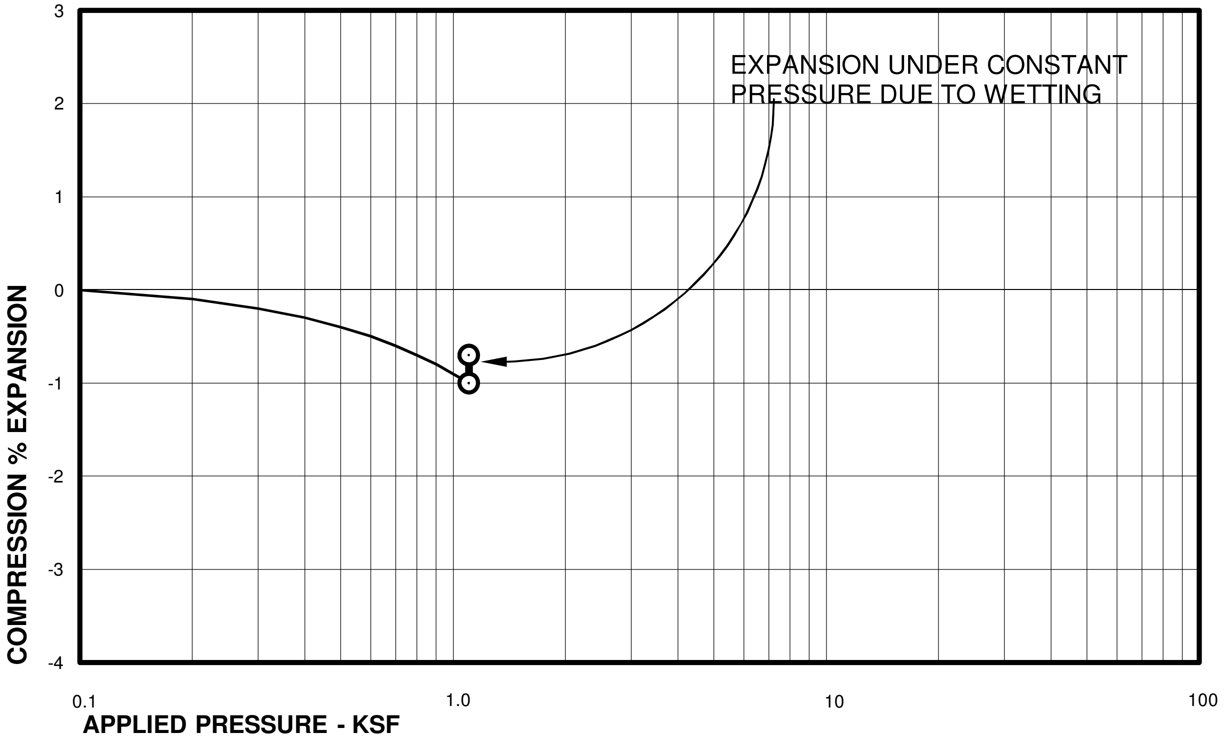
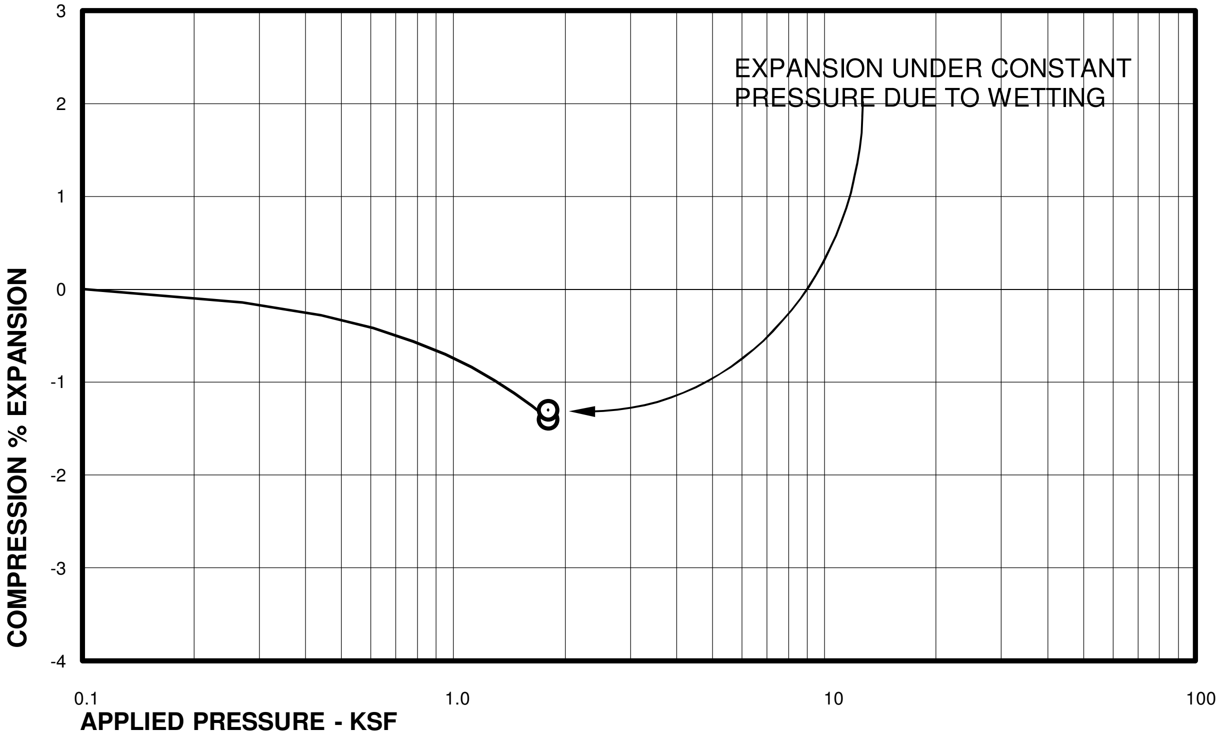


Sample of WEATHERED CLAYSTONE

From TH-7 AT 9 FEET

DRY UNIT WEIGHT= 119 PCF

MOISTURE CONTENT= 14.0 %



Sample of CLAYSTONE

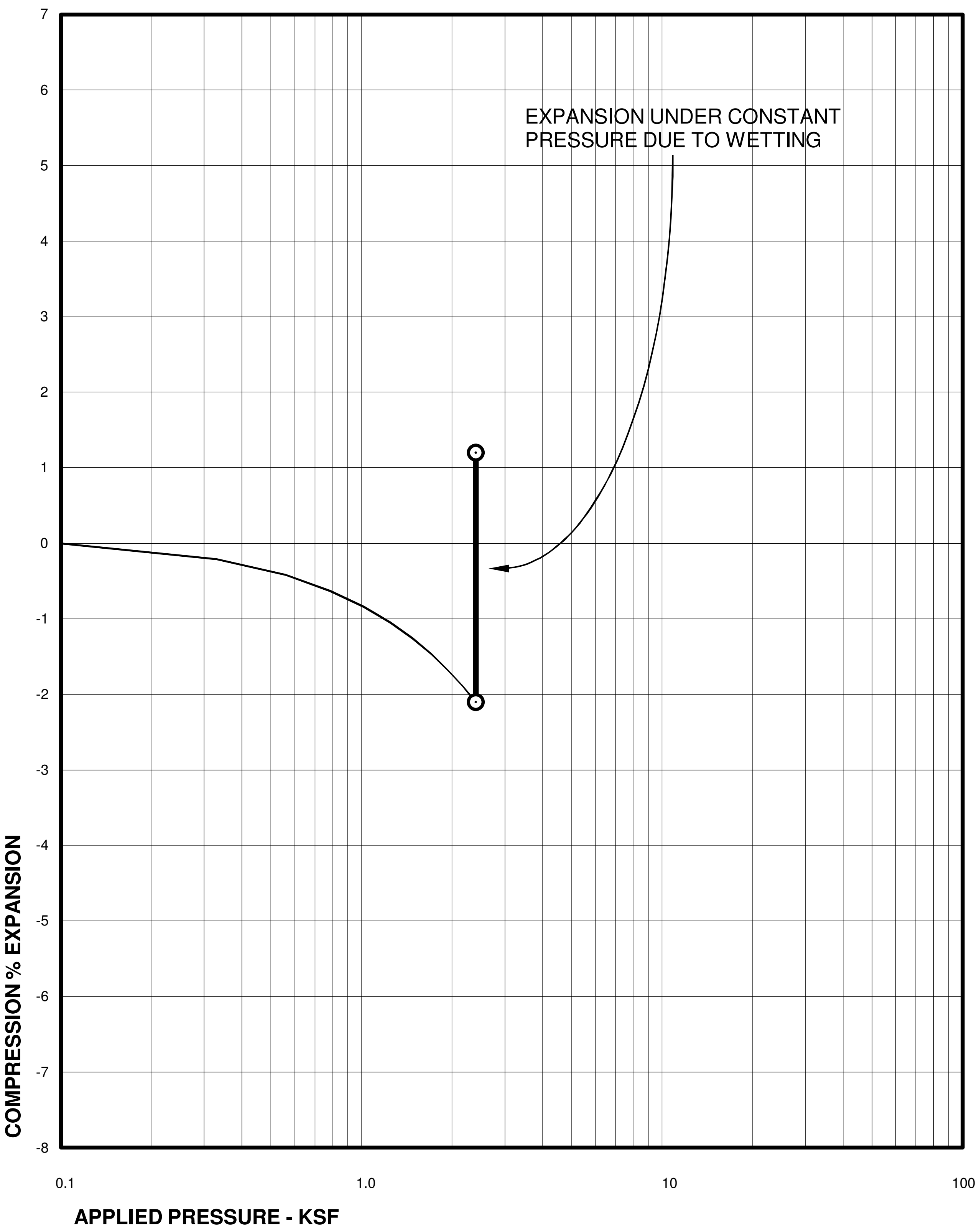
From TH-7 AT 14 FEET

DRY UNIT WEIGHT= 115 PCF

MOISTURE CONTENT= 13.6 %

Swell Consolidation Test Results

FIG. B-10



Sample of CLAYSTONE

From TH-7 AT 19 FEET

DRY UNIT WEIGHT= 114 PCF

MOISTURE CONTENT= 19.2 %

RMCS, INC.
ERIE PARCEL
PROJECT NO. DN46,332-115
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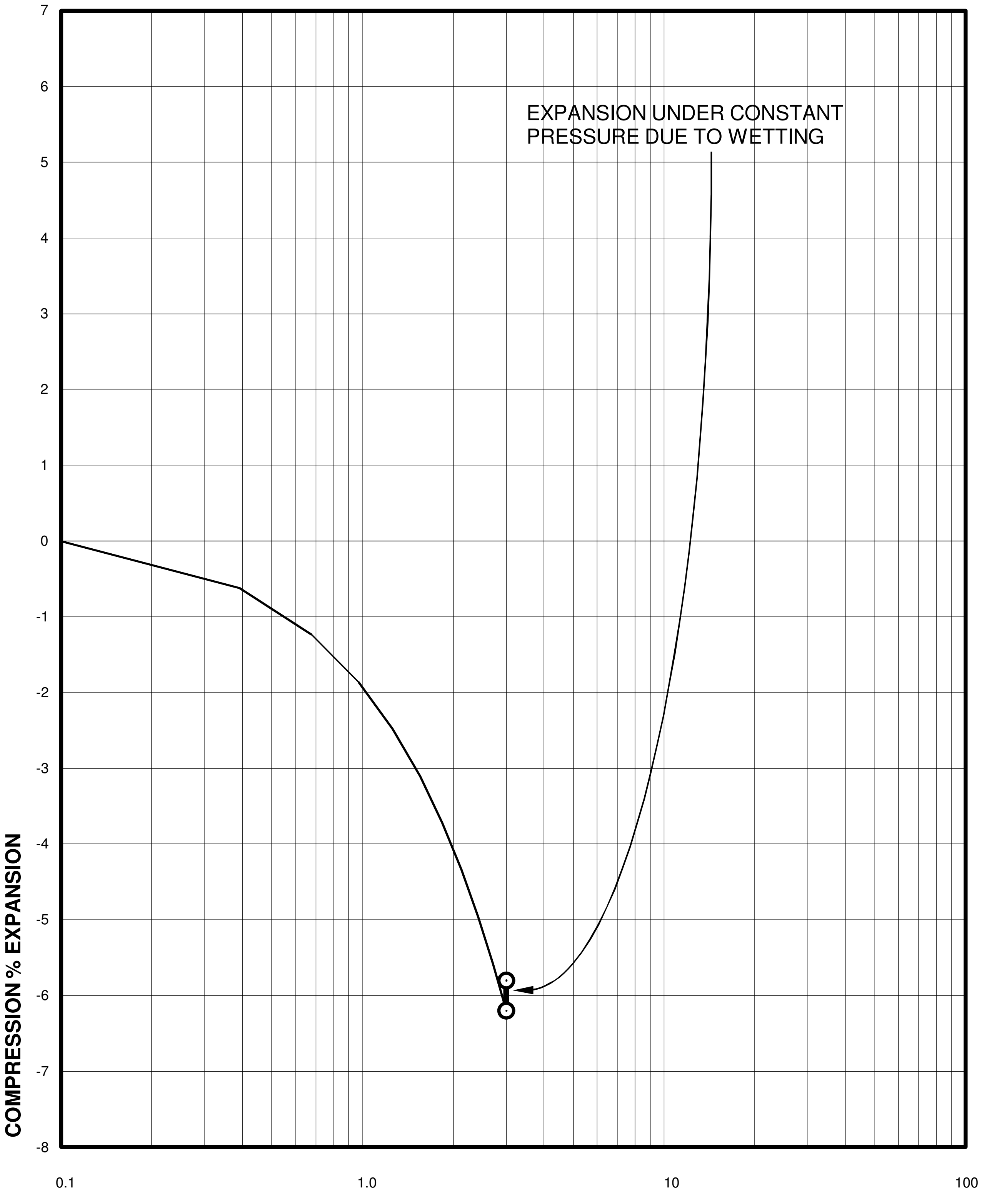
Swell Consolidation Test Results

FIG. B-11



Sample of CLAYSTONE

From TH-7 AT 24 FEET

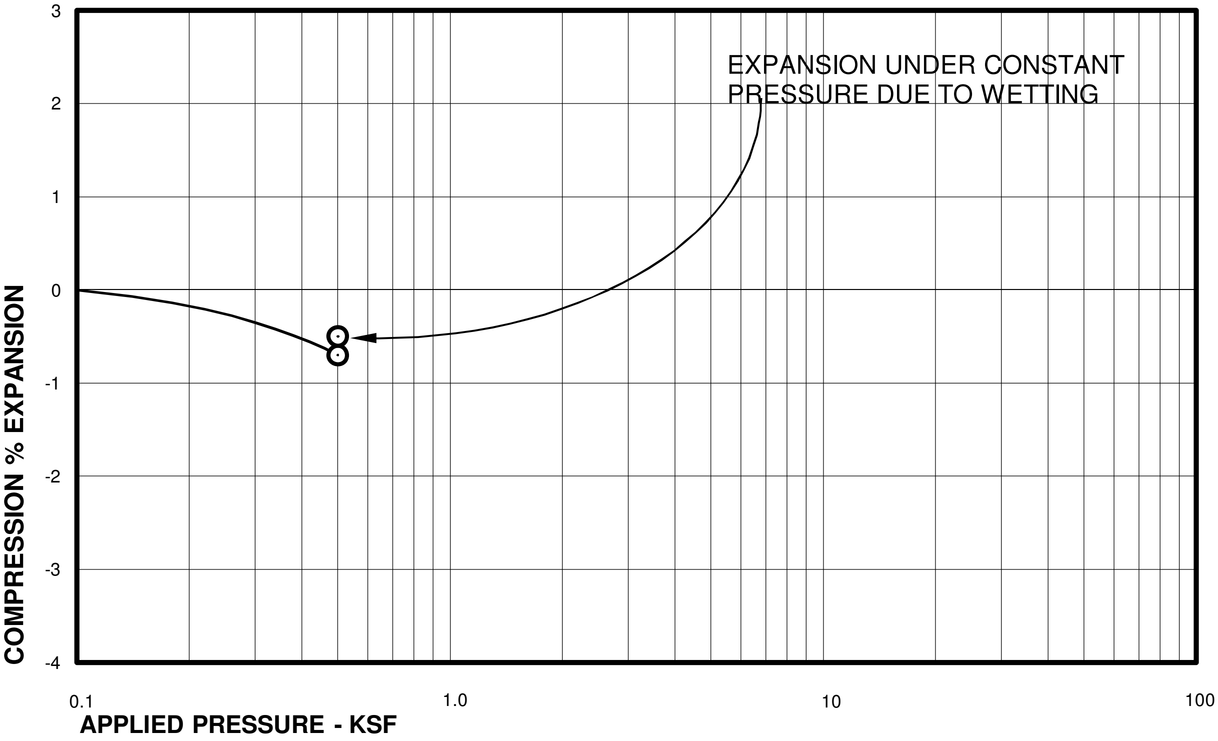
DRY UNIT WEIGHT= 109 PCF

MOISTURE CONTENT= 17.3 %

RMCS, INC.
ERIE PARCEL
PROJECT NO. DN46,332-115
S:\PROJECTS\47300\47332.000\115\2. Reports\R1\dn47332-115-R1-X1(SWELL).xlsm

Swell Consolidation Test Results

FIG. B-12

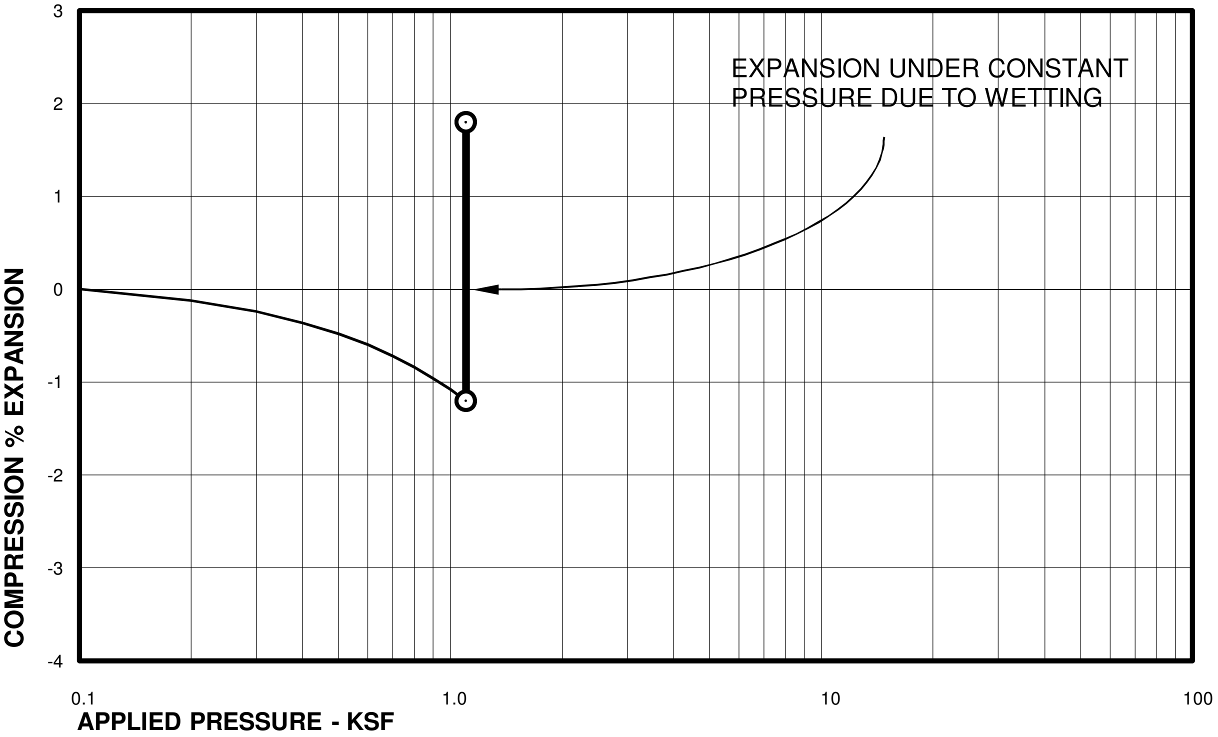


Sample of WEATHERED CLAYSTONE

From TH-8 AT 4 FEET

DRY UNIT WEIGHT= 116 PCF

MOISTURE CONTENT= 11..5 %



Sample of WEATHERED CLAYSTONE

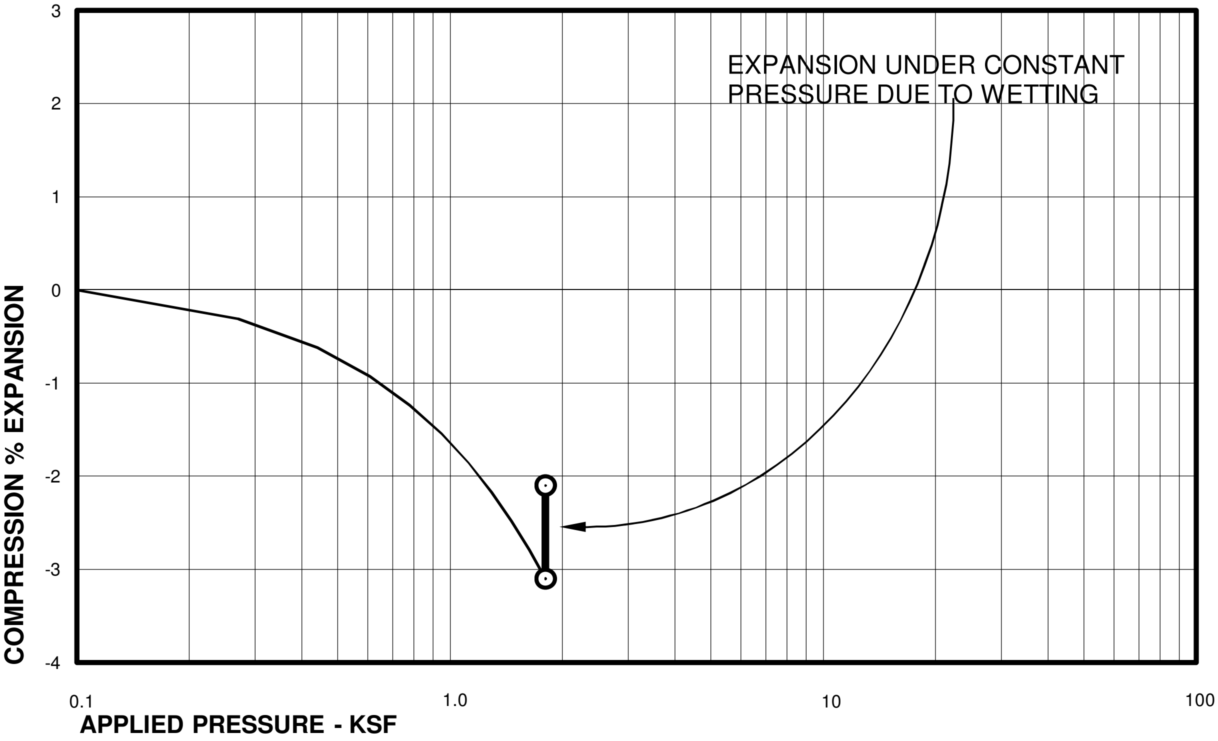
From TH-8 AT 9 FEET

DRY UNIT WEIGHT= 120 PCF

MOISTURE CONTENT= 15.1 %

Swell Consolidation Test Results

FIG. B-13

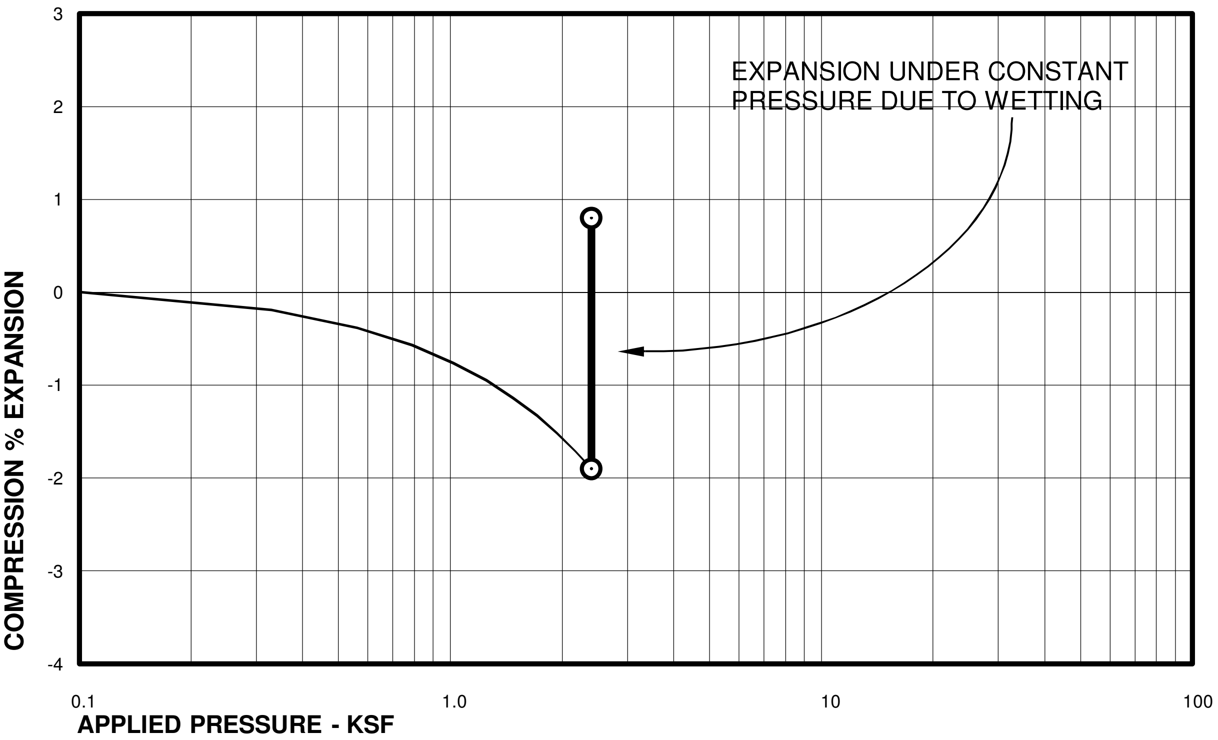


Sample of CLAYSTONE

From TH-8 AT 14 FEET

DRY UNIT WEIGHT= 109 PCF

MOISTURE CONTENT= 17.6 %



Sample of CLAYSTONE

From TH-8 AT 19 FEET

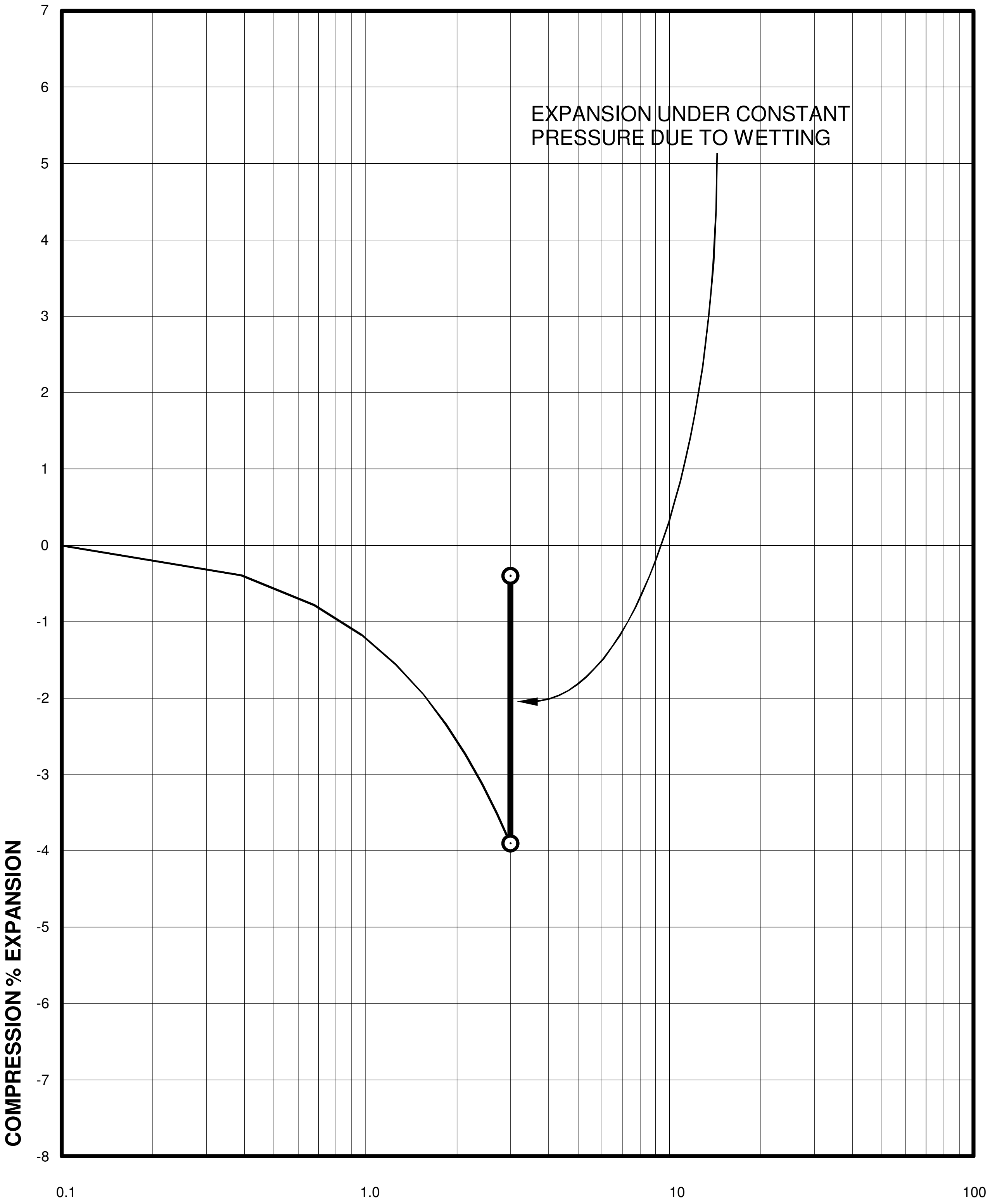
DRY UNIT WEIGHT= 119 PCF

MOISTURE CONTENT= 16.2 %

Swell Consolidation Test Results

FIG. B-14

RMCS, INC.
ERIE PARCEL
PROJECT NO. DN46,332-115
S:\PROJECTS\47300\47332.000\115\2. Reports\R1\dn47332-115-R1-X1(SWELL).xlsm



Sample of CLAYSTONE

From TH-8 AT 24 FEET

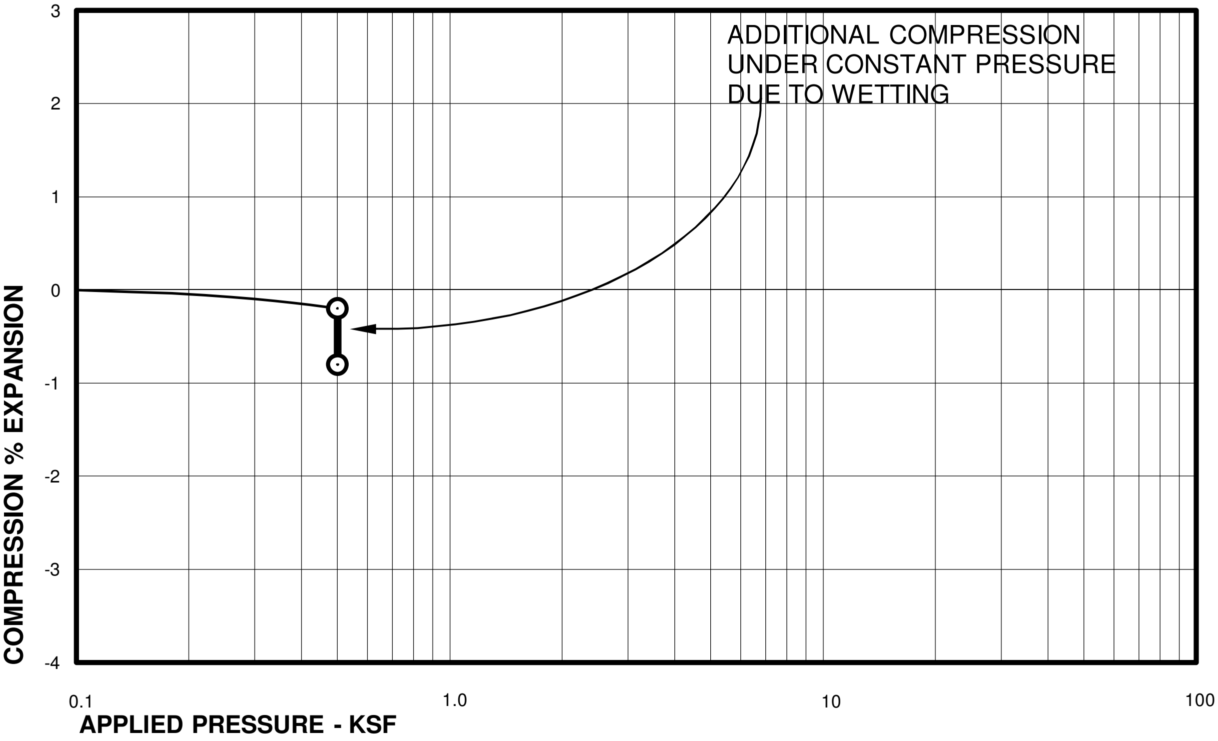
DRY UNIT WEIGHT= 101 PCF

MOISTURE CONTENT= 23.7 %

RMCS, INC.
ERIE PARCEL
PROJECT NO. DN46,332-115
S:\PROJECTS\47300\47332.000\115\2. Reports\R1\dn47332-115-R1-X1(SWELL).xlsm

Swell Consolidation Test Results

FIG. B-15

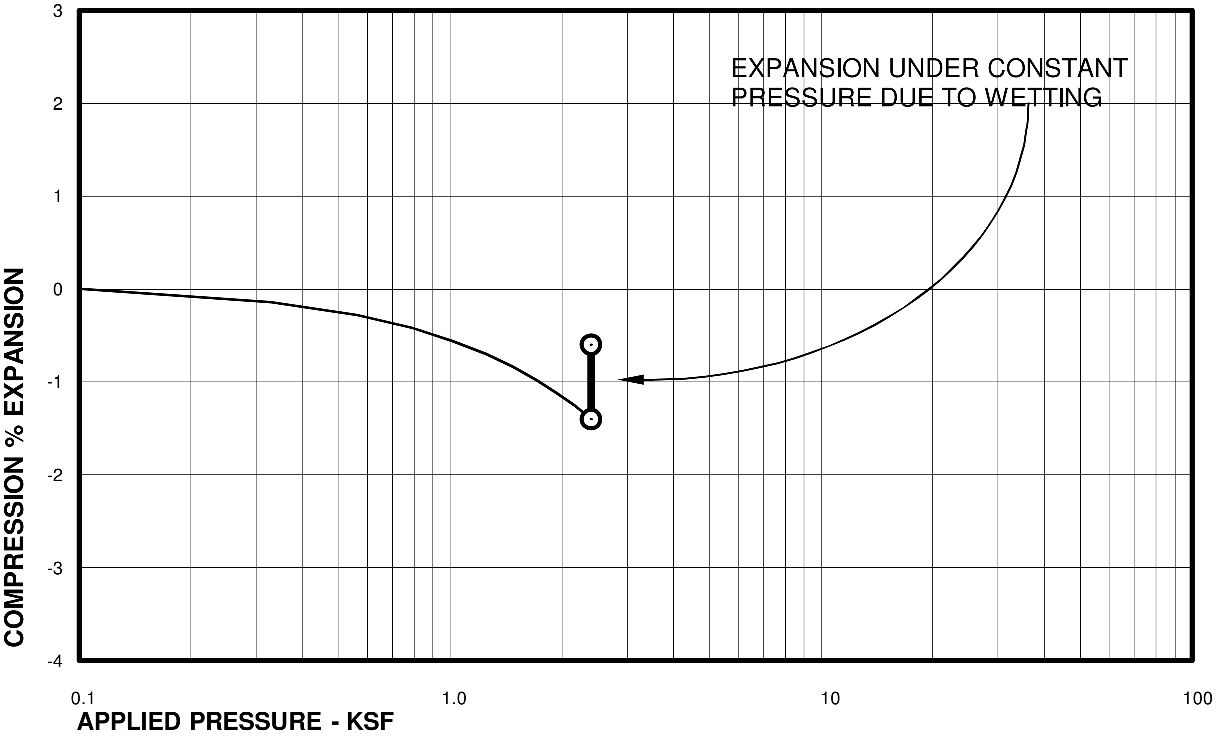


Sample of INTERLAYERED CLAY/SAND

From TH-9 AT 4 FEET

DRY UNIT WEIGHT= 108 PCF

MOISTURE CONTENT= 7.5 %



Sample of CLAYSTONE

From TH-9 AT 19 FEET

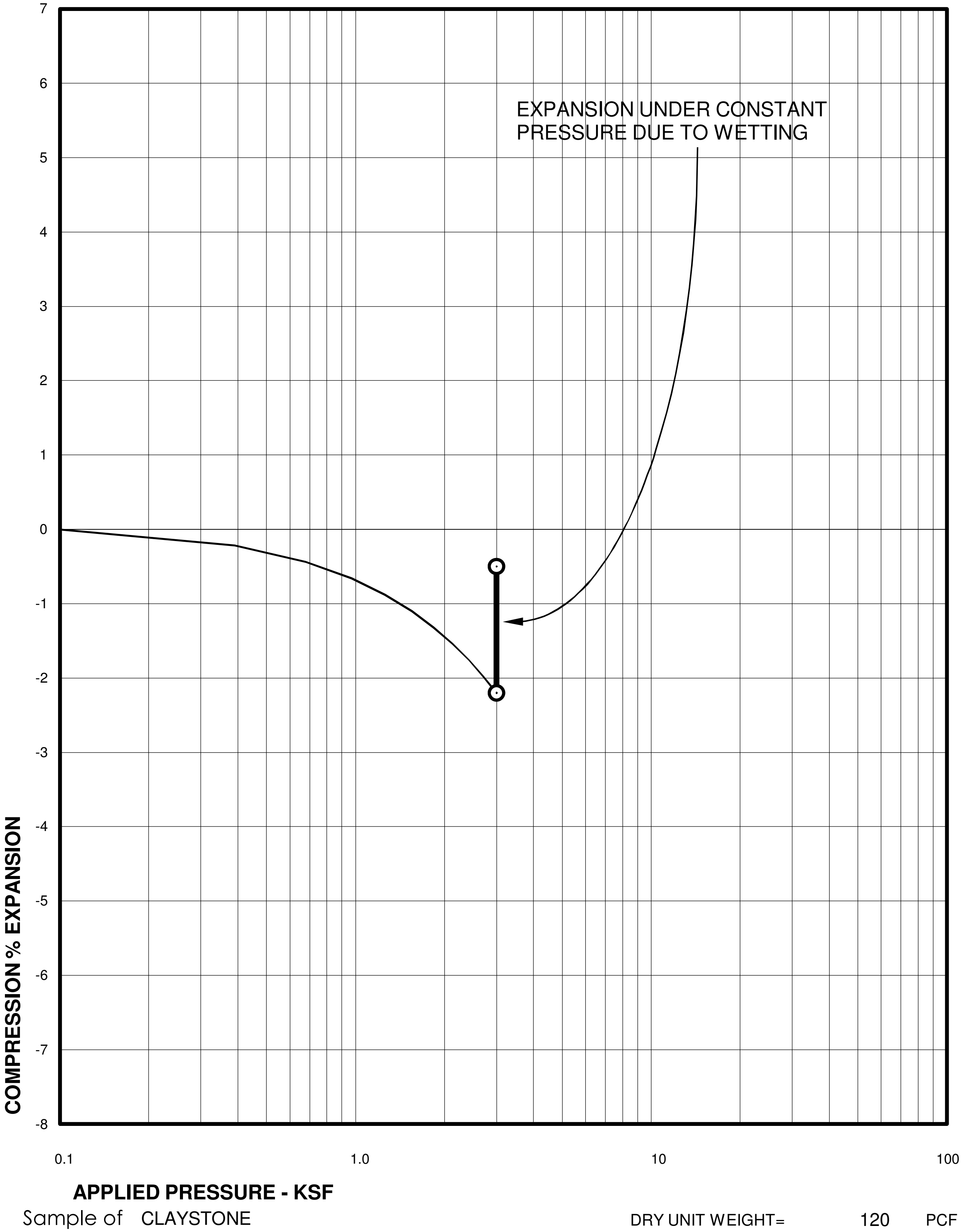
DRY UNIT WEIGHT= 116 PCF

MOISTURE CONTENT= 15.9 %

Swell Consolidation Test Results

FIG. B-16

RMCS, INC.
ERIE PARCEL
PROJECT NO. DN46,332-115
S:\PROJECTS\47300\47332.000\115\2. Reports\R1\dn47332-115-R1-X1(SWELL).xlsm



Sample of CLAYSTONE

From TH-9 AT 24 FEET

DRY UNIT WEIGHT= 120 PCF

MOISTURE CONTENT= 13.3 %

RMCS, INC.
ERIE PARCEL
PROJECT NO. DN46,332-115
S:\PROJECTS\47300\47332.000\115\2. Reports\R1\dn47332-115-R1-X1(SWELL).xlsm

Swell Consolidation Test Results

FIG. B-17

TABLE B - 1

SUMMARY OF LABORATORY TEST RESULTS

BORING	DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL TEST DATA				ATTERBERG LIMITS		SOLUBLE SULFATE CONTENT (%)	PASSING NO. 200 SIEVE (%)	SOIL TYPE
				SWELL (%)	COMPRESSION (%)	APPLIED PRESSURE (psf)	SWELL PRESSURE (psf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)			
TH-1	4	10.3	101		1.6	500						SAND, SILTY (SM)
TH-1	9	16.5	115					36	22	0.05	71	INTERLAYERED CLAY/SAND
TH-1	14	14.6	123	0.0		1,800		42	22		76	CLAYSTONE/SANDSTONE
TH-1	19	18.1	109	3.4		2,400						CLAYSTONE
TH-2	4	7.9	109		2.4	500						SAND, SILTY (SM)
TH-2	9	13.4	113	0.4		1,100						INTERLAYERED CLAY/SAND
TH-2	19	3.6	114								6	SAND, SLIGHTLY SILTY (SP-SM)
TH-2	24	12.3	121	1.5		3,000						CLAYSTONE
TH-3	4	10.5	109	0.2		500						INTERLAYERED CLAY/SAND
TH-3	9	3.5	112								5	SAND, SLIGHTLY SILTY (SP-SM)
TH-4	4	5.3	110		0.8	500				0.04		SAND, SILTY (SM)
TH-4	9	11.9	117		0.6	1,100		20	3		24	INTERLAYERED CLAY/SAND
TH-4	24	19.7	109	2.1		3,000						WEATHERED CLAYSTONE
TH-5	4	19.3	98	0.0		500						INTERLAYERED CLAY/SAND
TH-5	9	6.6	105		0.9	1,100		24	11	<0.01	42	INTERLAYERED CLAY/SAND
TH-5	19	13.0	119	4.0		2,400						CLAYSTONE
TH-6	4	9.4	107	1.4		500						INTERLAYERED CLAY/SAND
TH-6	9	11.8	112	0.0		1,100						INTERLAYERED CLAY/SAND
TH-6	19	12.3	122	1.2		2,400						CLAYSTONE
TH-6	24	17.1	113	3.3		3,000						CLAYSTONE
TH-7	4	10.2	117		0.1	500						SAND, CLAYEY (SC)
TH-7	9	14.0	119	0.3		1,100		33	15	0.03	85	WEATHERED CLAYSTONE
TH-7	14	13.6	115	0.1		1,800						CLAYSTONE
TH-7	19	19.2	114	3.3		2,400						CLAYSTONE
TH-7	24	17.3	109	0.4		3,000						CLAYSTONE
TH-8	4	11.5	116	0.2		500						WEATHERED CLAYSTONE
TH-8	9	15.1	120	3.0		1,100						WEATHERED CLAYSTONE
TH-8	14	17.6	109	1.0		1,800						CLAYSTONE
TH-8	19	16.2	119	2.7		2,400						CLAYSTONE
TH-8	24	23.7	101	3.5		3,000						CLAYSTONE
TH-9	4	7.5	108		0.6	500		23	9		29	INTERLAYERED CLAY/SAND
TH-9	19	15.9	116	0.8		2,400						CLAYSTONE
TH-9	24	13.3	120	1.7		3,000						CLAYSTONE

APPENDIX C

GUIDELINE SITE GRADING SPECIFICATIONS

Erie Parcel
Erie, Colorado

GUIDELINE SITE GRADING SPECIFICATIONS

Erie Parcel, 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 subdivision and/or filing 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, trees, brush and rubbish before excavation or fill placement begins. 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. SCARIFYING AREA TO BE FILLED

Topsoil and vegetable matter shall be substantially removed from the ground surface upon which fill is to be placed. The surface shall then be plowed or scarified to a depth of 8 inches, moisture treated to above optimum moisture content, and compacted until the surface is free from ruts, hummocks or other uneven features, which would prevent uniform compaction by the equipment to be used.

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 to a depth of 8 to 12 inches, brought to the proper moisture content (between optimum and 3 percent above optimum for clay and within 2 percent of optimum for sand) and compacted to not less than 95 percent of maximum density as determined in accordance with ASTM D 698 and 100 percent for the portion of fill deeper than 20 feet below proposed grade (if any). The foundation materials shall be worked, stabilized, or removed and replaced if necessary in accordance with the soils representative's recommendations in preparation for fill.

6. FILL MATERIALS

Fill soils shall be substantially free from vegetable matter or other deleterious substances, and shall not contain rocks having a diameter greater than six (6) inches and claystone pieces larger 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 or imported materials classifying as CL, CH, SC, SM, SW, SP, GP, GC and GM are acceptable. Organic matter and other deleterious materials or debris shall not be used as fill. Concrete can be mixed with the fill provided it is crushed to 6 inches or less in diameter.

7. MOISTURE CONTENT

For fill material classifying as CH, CL or SC, the fill shall be moisture treated to between optimum and 3 percent above optimum moisture content. Soils classifying as SM, SW, SP, GP, GC and GM shall be moisture treated to within 2 percent of optimum moisture content as determined from Proctor compaction tests. 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.

8. 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 to at least 95 percent of the maximum density as determined in accordance with ASTM D 698 and 100 percent for fill deeper than 20 feet below proposed grade. 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 8 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 approved 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 passes to ensure that the required density is obtained.

9. 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 an 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).

10. PLACEMENT OF FILL ON NATURAL SLOPES

Where natural slopes are steeper than 20 percent in grade and the placement of fill is required, cut benches shall be provided 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.

11. 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 below that required, the particular layer or portion shall be reworked until the required density or moisture content has been achieved.

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 Representative indicates that the moisture content and density of previously placed materials are as specified.

13. 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.

14. 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.

15. 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)

Erie Parcel, Erie, Colorado

Note: This guideline is intended for use with sub-excavation. If sub-excavation is not selected, the guidelines in Appendix C should be followed.

GUIDELINE SITE GRADING SPECIFICATIONS
(SUB-EXCAVATION)

Erie Parcel, 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, (1 to 4 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 1 to 4 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 1.5 percent over optimum moisture content.

2. Material represented by samples tested having moisture lower than 1 percent over 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 95 percent of standard Proctor maximum dry density (ASTM D 698).

2. No more than 10 percent of the material represented by the samples tested shall be at dry densities less than 95 percent of standard Proctor maximum dry density (ASTM D 698).

3. Material represented by samples tested having dry density less than 93 percent of standard Proctor maximum dry density (ASTM D 698) will be rejected. Such rejected materials shall be reworked until a dry density equal to or greater than 95 percent of standard Proctor maximum dry density (ASTM D 698) 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.

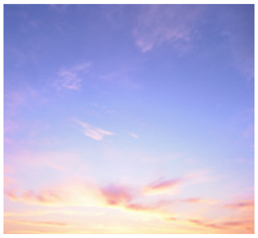
12. SEASONAL LIMITS

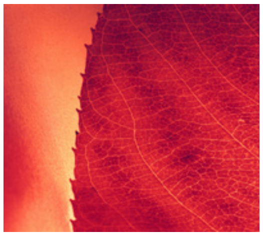
No fill material shall be placed, spread or rolled while it is frozen, thawing, or during unfavorable weather conditions. When work is interrupted by heavy precipitation, fill operations shall not be resumed until the Soils Engineer indicates the moisture content and density of previously placed materials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

letter of existing landscape





people creating spaces

Deborah Bachelder | Senior Planner

Town of Erie | Community Development Department
645 Holbrook Street | P.O. Box 750 | Erie, CO 80516
Phone: 303-926-2775 | Fax: 303-926-2706

RE: Preservation / Vegetative Analysis for the Four Comers Property

Dear Mrs. Bachelder,

Please use this letter as PCS Group's vegetative preservation analysis for the Four Coners property located at the intersection of County Line Road and Erie Parkway.

The property lacks native vegeation due to the use by the previous ownership for agriculture, and has been farmed, plowed and seeded every other year. Several site walks were conducted on the property and it was determined that there is no significant deciduous vegetation or wood plant material on the property. Furthermore, there is no preservation measures that are necessary.

Sincerely,

Paul Shoukas
PCS Group, Inc.
RLA# 416

MINE SUBSIDENCE INVESTIGATION
ERIE PARCEL
A.K.A 4-CORNERS
SOUTHWEST OF ERIE PARKWAY
AND EAST COUNTY LINE ROAD
ERIE, COLORADO

Prepared For:

RMCS, Inc.
21 South Sunset Street
Longmont, Colorado 80503

Attention: Justin McClure

Project No. DN47,332-110

February 10, 2015

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

TABLE OF CONTENTS

SCOPE AND SUMMARY 1
  Conclusions 2

SITE CONDITIONS 4

PROPOSED DEVELOPMENT 5

ABANDONED COAL MINING RECORDS 5
  Mining Methods 6
  Garfield No. 1 Mine 7
  Mitchell Mine 7
  McGregor Mine 8

PREVIOUS INVESTIGATIONS 9
  ATEC and WEE Investigations (1987 and 2005) 9
  Blackhawk Document Review (2007) 10
  CTL|Thompson Preliminary Geotechnical Investigation (2014) 10

MINE SUBSIDENCE INVESTIGATION 11
  Marfel Mine Entry Investigation 12
  Description of Deep Exploratory Borings (Mine Extraction Borings) 13
  Core Boring B-1 16
  Core Borings B-2 16
  Core Boring B-3 16
  Air-Rotary Boring B-4 16
  Air-Rotary Boring B-5 17
  Air-Rotary Boring B-6 17
  Air-Rotary Boring B-7 17
  Air-Rotary Boring B-8 17
  Air-Rotary Boring B-9 17
  Air-Rotary Boring B-10 18
  Material Physical and Strength Properties 18
  Bedrock Physical Characterization and Ground Stability Evaluation 21
  Rock Strength 21
  Rock Quality Designation (RQD) 22
  Overburden Pressure 22
  Mine Time Period Effects 22
  Void Imaging 23

ANALYSIS AND INTERPRETATION OF MIND AREAS 23
  Upper Coal Seam Isopach 23
  Lower Coal Seam Isopach 24

SUBSIDENCE MECHANISM 25
  Caring Subsidence 26
  Trough Subsidence 27
  Shaft Hazards 27

MINE SUBSIDENCE RISK EVALUATION 28
  Mine Geometry 28
  Bulking Factor 28
  Probability of Sinkhole Development 29
  Time Methods 30
  Results of Risk Evaluation 30

RECOMMENDATIONS 31
  Development Considerations over Mined Areas 31
  Shaft Mitigation 31

GEOTECHNICAL RISK 32

LIMITATIONS 32

FIG. 1 – LOCATIONS OF EXPLORATORY BORINGS

FIG. 2 – CLOSE-UP LOCATIONS OF EXPLORATORY SHAFT BORINGS

FIG. 3 – UPPER SEAM ISOPACH MAP

FIG. 4 – LOWER SEAM ISOPACH MAP

FIG. 5 – INTERBURDEN THICKNESS MAP

FIG. 6 – COMPARATIVE RISK OF SUBSIDENCE POTENTIAL

FIG. 7 – PROBABILITY OF SINKHOLE DEVELOPMENT

APPENDIX A – SUMMARY LOGS OF EXPLORATORY BORINGS

APPENDIX B – CORE LOGS AND PHOTOGRAPHS

APPENDIX C – GEOPHYSICAL TEST LOGS

SCOPE AND SUMMARY

This report presents the results of our Mine Subsidence Investigation for the 47-acre Erie Parcel, also known as 4-Corners, southwest of Erie Parkway and East County Line Road in Erie, Colorado (Fig. 1). It is reported that the Marfel and Pinnacle mines underlie this property and entry points to both mines are on the property. The purpose of this investigation is to evaluate the subsurface conditions, estimate the depths where coal mining occurred, confirm the mapped mine access locations, evaluate the risk of subsidence, and provide mitigation concept (if merited) to reduce the likelihood of potential subsidence impacts on site development and construction. This investigation was a team effort performed by CTL | Thompson, Inc. and Kanaan Hanna, who served as a consultant to RMCS. The report includes a descriptions of the site conditions, our understanding of the proposed development, a summary of previous investigations and available mine data, subsurface conditions encountered in our exploratory borings and test pits, and discussions of site development and construction as influenced by the coal mine(s). The scope was described in our Contract Modification No. 2 (DN 14-0290-CM2) dated October 9, 2014 and revised on October 15, 2014.

The field investigation was performed between October 22 and November 5, 2014. A total of ten (10) deep exploratory borings (B-1 to B-10) were drilled, of which three where cored and seven drilled with air rotary. Boring depths varied from 120 to 155 feet. Borehole geophysical logging and void imaging were conducted in support of the exploratory plan.

This report is based on available historical coal mine records, review of previous investigation performed by others, exploratory data collected during this investigation, our subsidence experience in the Boulder-Weld Coal Field, and our understanding of the planned development. The results and findings have led to the following conclusions and recommendations, with more detailed discussion in the report.

Conclusions

1. Historical records indicate that the Marfel and Pinnacle mines and shafts are on this property. Maps of the Marfel and Pinnacle extractions are not available. Mining records show that there are three mines adjacent to the parcel including Garfield No. 1 mine to the north, Mitchell mine to the east, and McGregor mine to the south. A map of the McGregor mine documents a subsidence feature on the south boundary of this site and indicates that mining in the Pinnacle occurred prior to 1894.

2. The Marfel and Pinnacle shafts were found through test pits and borings. The Marfel shaft is 7-feet wide, 12-feet long, and at least 225 feet deep and is backfilled with mine spoil and trash. The Pinnacle shaft is circular with a measured diameter of 10 feet. The depth of the Pinnacle shaft is not known. The Pinnacle shaft backfill consisted of mine spoil. A sloped entry was not found in this investigation.

3. Subsoils encountered in our borings consisted of about 8 to 21 feet of interlayered sand and clay underlain by bedrock of the Laramie formation to the maximum explored depth of 155. The Fox Hills formation was not encountered. Thin rider coal seams were found within the upper 55 feet of most borings. Two mineable coal seams were found. The upper mineable seam depth varied between 80 and 125 feet and was 2.5 to 7 feet thick. The depth to the lower mineable seam varied between 90 and 142 feet and it was 3 to 8 feet thick.

4. Exploratory program: The geotechnical underground exploration, borehole geophysical logging, and void mapping confirmed the presence of two coal seams, referred to as the upper and lower seam, and indicated the following:

    - The upper seam was not mined.

    - The lower seam was mined using a room and pillar mining method.

    - The mine is flooded and contains fine coal/rubble without open void space, as confirmed by the downhole video camera and sonar imaging in boring B-3 and drill observation. The density of the coal/rubble is assumed to be less than 70 pcf. This indicates that the residual subsidence is complete.

5. Bedrock physical characteristics:

- Rock strength – The average rockmass strength of the bedrock claystone/sandstone, based on measured laboratory physical properties, is 2,200 psi. This strength is considerably greater than the overburden pressure, estimated as 100-120 psi.

- Rock Quality Designation (RQD) – RQD values for core in B-1 to B-3 ranged from 50 to 100 percent, which indicates the bedrock quality is good.

- Overburden pressure – Stress calculations indicate that the overburden pressure (vertical and horizontal stress) imposed on the mine workings of the lower seam is static. We conclude that the stresses acting on the mine roof are low and will not adversely affect the bedrock integrity.

- Mine time period effect – Since mining operation ceased more than 100 years ago, residual subsidence has not produced any surface disturbance. The subsidence feature reported on the McGregor mine map was dated 1894.

- Interburden stability – The interburden thickness between the two seams is approximately 12 feet. This is likely too thin to allow for mining in both seams, as reported by ATEC/WEE. We believe that an unstable mine roof/floor would have resulted if multi level mining 12 feet apart occurred. This would have led to major ground control hazards.

- Given the present conditions of the mine workings and the bedrock integrity, we believe the likelihood of any further surface subsidence or ground movement is very low.

6. Mine subsidence risk evaluation:

- Evaluation of subsidence using mine geometry and bulking factor methods indicates that the subsidence risk is very low.

- Probability of sinkhole development – The sinkhole risk evaluation performed for the lower seam using B-1 to B-3 core data indicates that the probability of ground deformation or sinkhole development is less than 5 percent. This is also attributed to the physical characteristics of the bedrock claystone/sandstone materials. Therefore the risk for future subsidence and or sudden sinkhole formation is very lot.

7. Based on analysis of the soil and bedrock conditions, depth of mining, extraction thicknesses, and our geotechnical-mining experience, we judge that the overall risk of future mine subsidence is very low. The subsidence hazard will not preclude the development of this site. Post-tensioned slab-on-grade, spread footings and/or mat foundations are ideal. Basements can be used. Deep foundations should be avoided. Sub-excavation as means to mitigate expansive soil and bedrock and to allow for shallow foundation use will not substantially increase the risk. Wells or other groundwater altering devices should not be used.

   Risk of potential ground subsidence is considered high within the vicinity of the two shafts if they are not mitigated. We recommend that the shafts be mitigated; after which, passive uses should be planned within 42 feet of the Marfel and 40 feet of the Pinnacle shaft centers.

SITE CONDITIONS

The 47-acre Erie Parcel is located south of Erie Parkway and west of East County Line Road in Erie, Colorado (Fig. 1 / Photo 1). The site is bordered by a residential subdivision on the west, residential/commercial developments on the south, and commercial property on the east. The site was formerly used for agricultural purposes and was predominately covered with wheat. Topography prepared by Rock Creek Surveying, LLC indicates that the ground surface generally slopes to the east with about 50 feet of vertical relief across the parcel. We visited the site several times over the course of this investigation and did not observe any surficial evidence of ground surface settlement due to underground coal mining except a spoil pile near the reported location of the Marfel shaft. Surficial subsidence features were not apparent.

Photo 1 – Google Earth© Aerial Site Photo, October 6, 2013.

PROPOSED DEVELOPMENT

We understand that the proposed development is planned as mixed-use including single-family residences, townhomes, apartments, and commercial/retail facilities. Single-family residences and townhomes may be one or two-story, wood-framed structures with or without basements. Apartments will likely be multi-story, wood or metal stud-framed structures. Commercial/Retail structures would likely be one to two-stories without basements. Paved roads and parking lots will provide access. Buried utilities would serve the project.

ABANDONED COAL MINING RECORDS

We reviewed mining records and maps provided by the Colorado Geologic Survey (CGS) and the Division of Reclamation and Mining Safety (DRMS). Review of these records indicates that the property is underlain by abandoned coal mines associated with Marfel and Pinnacle operations (Photo 2). As shown in Photo 2, three mines are reported adjacent to the property: Garfield No. 1 mine to the north, Mitchell mine to the east, and the McGregor mine to the south.

Photo 2 – Google Earth© Aerial Site Photo, October 6, 2014.

Very few records about the Marfel and Pinnacle mines were submitted by the mining companies. Pertinent information that is not available includes mine surveys (maps), records of the number of mined levels, and depths to the extraction. Data pertaining to Marfel and Pinnacle mines and adjacent mines are listed below in Table 1.

TABLE 1
SUMMARY OF MINE RECORDS

Mine	Production Years	Production (tons)	Number of Mined Seams
Mitchell	1883-1891	204,171	1
Pinnacle	Before 1894	--	--
McGregor	1885-1895	85,159	1
Garfield #1	1893-1897	122,711	1
Marfel	1897-1904	14,302	--

Mining Methods

Coal in the Boulder-Weld Coalfield was typically mined during the early 20th century using a room and pillar mining method. To access the coal, slope entries and/or shafts were excavated to the depth of the mineable coal seam and sometimes deeper. Mine shafts were also used to explore the subsurface materials. Air shafts were placed near entry or production shafts and at other locations depending upon the ventilation layout of the mine. Once the slope entry or production shaft reached the mineable coal layer, haulageways (main and submain entries) were excavated (cut) parallel and perpendicular to the strike of the seam. After these entities were constructed, rooms – typically 15 to 20 feet wide and 100 to 300 feet long – were mined with pillars approximately 15 to 40 feet wide between rooms for support. Upon completion of the room and pillar operation, pillars were partially or fully removed using retreat mining techniques. Typically, 15 to 25-foot wide sections of support pillars were removed leaving stump pillars. Maps of the Garfield No. 1, Mitchell, and McGregor mines show that a room and pillar method was used.

Garfield No. 1 Mine

Photo 4 shows a portion of the map of Garfield No. 1 Mine. The southern border of the map correlates to present day Erie Parkway. The pillars for Garfield No. 1 upper seam are mapped as mined out to southern boundary.

Photo 4 – Map of Garfield No. 1 – Upper Seam

Mitchell Mine

Photo 5 shows an 1886 map of the Mitchell Mine. We have no records indicating the depths to the mine. The mine was worked out up to the edge of East County Line Road. A haulageway can be seen extending up to the east edge of County Line Road.

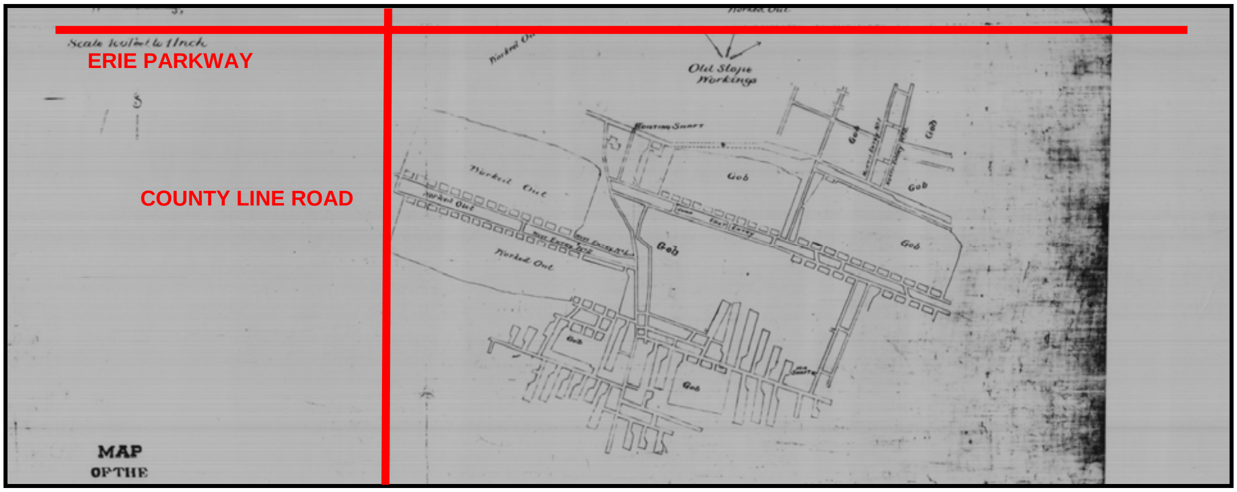


Photo 5 – Map of Mitchell Mine

McGregor Mine

Photo 6 shows an 1894 map of the McGregor Mine. The mine was relatively far south of the project site. Two important features on this map are the reported crevice (subsidence) feature caused by the mine workings associated with Pinnacle operations and boney coal encountered on the north side of the McGregor Mine. Boney coal is a term used for coal that has no mineral value. We assume that the Pinnacle was mined prior to 1885 and the subsidence feature occurred approximately 10 years later.

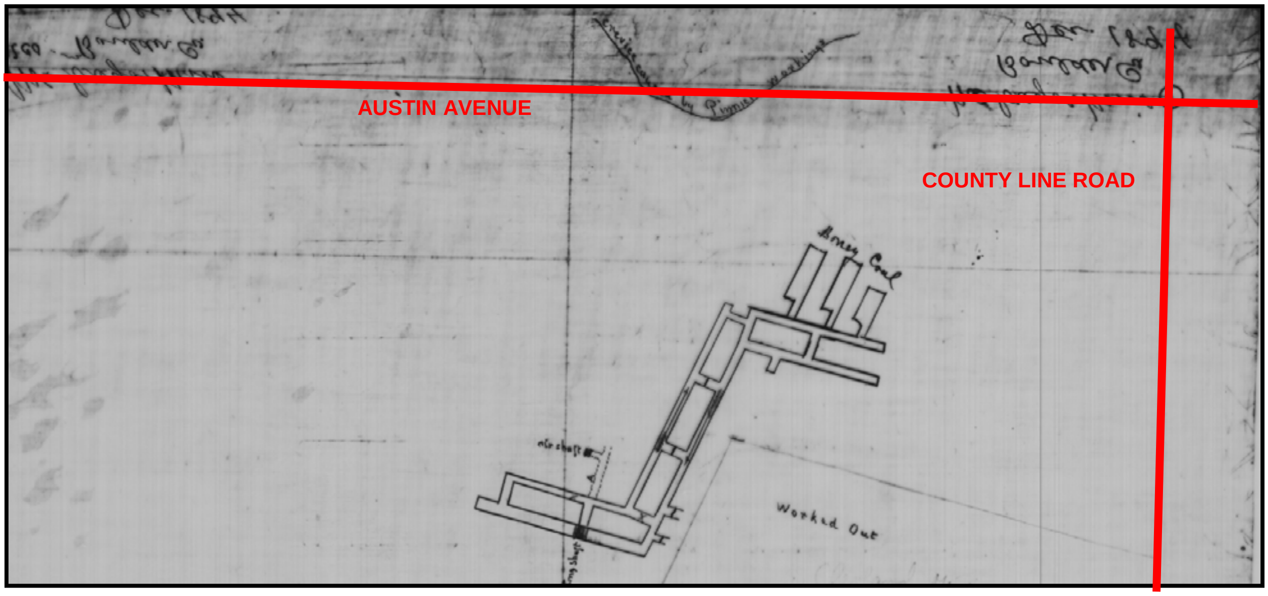


Photo 6 – Map of McGregor Mine

PREVIOUS INVESTIGATIONS

Several previous investigations were performed for this site. We reviewed four documents that were obtained from the CGS or provided by RMCS:

- *Preliminary Subsidence and Preliminary Geotechnical Engineering Investigation, ATEC Associates, Project No. 41-74001, April 3, 1987;*
- *Preliminary Mine Subsidence Investigation, Western Environmental and Ecology, Project No. 422-001-01, December 23, 2005;*
- *Review Reports and Documents, Abandoned Mine and Subsidence Investigation, Zapata Engineering, Blackhawk, Project No. 5083, October 24, 2007; and,*
- *Preliminary Geotechnical Investigation, CTL | Thompson, Project No. DN47,332.000-115, September 10, 2014.*

ATEC and WEE Investigations (1987 and 2005)

ATEC and Western Environmental and Ecology (WEE) advanced a total of 15 deep borings in their 1987 and 2005 investigations. It was reported that two mineable coal seams exist below the property. They reported that the depth to the top of the upper seam varies from 80 to 116 feet and the depth to the lower seam varies from 101 to 136 feet. The two seams are reportedly 12 feet apart (interburden). ATEC's 1987 report indicates that the Marfel mine has an average combined coal thickness of about 14 feet. WEE reported that mining occurred in the upper, lower, and both seams at individual drill locations. An 18-inch thick void was reported at X-13. WEE commented on the height of collapse above the mine workings in the Boulder-Weld Coal Field and this project as follows: *"the observed results from the drilling on the site show that collapse is confined to an interval of 20 to 40 feet above the workings".* The reports include vertical profiles of electrical resistivity, spontaneous potential, caliper, and natural gamma. The profiles and boring descriptions were considered in the development of this report. The approximate locations of the borings from previous investigation have been included in this report (Fig. 1). We have the geophysical data in our files.

Blackhawk Document Review (2007)

Blackhawk's 2007 document review indicated a discrepancy in the Marfel mine documents. One record pertaining to the Marfel mine reports that the mine is located several miles north in Section 13. The Erie Parcel is located in Section 24. We do not know if this is a numerical error in Section reporting by the mining company or if the record is accurate.

CTL | Thompson Preliminary Geotechnical Investigation (2014)

Exploratory test pits were excavated in an effort to locate mapped mine shafts or slope entries. Two mine shafts to the Marfel and Pinnacle mines are reported on the property by CGS and United States Geological Survey (USGS). Blackhawk concluded that the two government agencies report two different locations for each access point; totaling four possible shaft locations. The United States Bureau of Mines (USBM) records indicate that a sloped entry occurred for the Marfel mine. The reported locations of the four possible locations are shown on Fig. 1. All locations were surveyed and staked in the field by Rock Creek Surveying, LLC. The reported Marfel shaft location by CGS was immediately adjacent to a spoil pile (Photo 7).

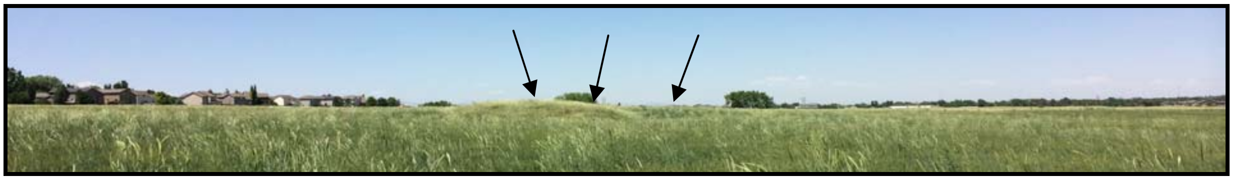


Photo 7 – Photograph of spoil pile, June 13, 2014.

Test pits at the two reported locations of the Marfel mine entry did not reveal evidence of mining. Excavation of the soil pile indicated that the pile likely originated from a mine entry excavation. A suspicious location was observed northeast of the spoil pile that did not contain vegetation. A test pit at this location unearthed evidence of mining. Debris and trash including bottles, shoes, bed framing, a cow carcass, wagon parts, and other garbage and mining tools were found. The excavation exposed in-place timber lagging. We initially suspected that the reported sloped entry to the mine was exposed. A horizontal alignment was approximated in the field and surveyed by Rock Creek. Verification testing (drilling or geophysics) was recommended to evaluate the entry and overlying bedrock properties.

Test pits of the two reported locations of the Pinnacle mine entry did not reveal evidence of mining. An excavation at a suspicious location unearthed the Pinnacle mine entry and revealed spoils extending downward. The spoils extended horizontally in a circle with a diameter of about 10 feet which indicates that this entry was a vertical shaft. These conditions were encountered consistently to the maximum explored depth of 20 feet. Rock Creek surveyed the location.

MINE SUBSIDENCE INVESTIGATION

Based on review of previous mine subsidence investigations, the exposed conditions in our June 2014 test pits, and meetings with CGS, an investigative approach to evaluate the suspected slope entry to the Marfel mine and reported underlying coal extractions was developed by Kanaan Hanna, (as a consultant to RMCS) and Ron McOmber and Matt Monteith of CTL | Thompson. The field investigation began in October, 2014 and consisted of drilling 10 deep exploratory borings (B-1 to B-10). Three borings, B-1 to B-3, were sampled using 3-inch diameter HQ cores and seven borings were advanced using air-rotary drilling. Additionally, we drilled several shallow and deep borings using solid-stem auger to evaluate the location of the suspect sloped entry. We also tested and logged the deep holes for resistivity, gamma, density, and caliper. Downhole video camera and sonar scanning tools were used to attempt to image the conditions of mine workings encountered during drilling. IDS-Colog Group performed the geophysical logging and Zapata provided the imaging tools. Each boring location was surveyed by Rock Creek Surveying, LLC prior to drilling. Precision Sampling of Colorado Springs drilled the borings using a CME750X all-terrain drill rig and a Boart Longyear track-mounted rig. Our representatives observed the drilling and coring operations, logged the subsurface conditions, and obtained core samples. Logs of

Exploratory Borings are presented in Appendix A, Core Logs and Photographs in Appendix B, and Geophysical Test Logs in Appendix C.

The samples were transported to our laboratory where they were examined, classified by our engineers, and test intervals were selected. Advanced Terra Testing Group of Lakewood, Colorado performed 19 unconfined compression tests with Poisson's ratio measurements utilizing ASTM D 7012 Method D. We performed general classification testing and splitting tensile tests utilizing ASTM C 496.

Marfel Mine Entry Investigation

As discussed previously, the USBM reported that the access to the mine was through a sloped entry (haulageway). Our June 2014 test pit investigation led us to believe that this was the case. B-1 was cored at station 1+00 of the suspected slope alignment to: a) verify the presences of the haulageway; b) collect samples for testing; and c) evaluate the subsidence potential above the entry (Fig. 2). B-1 did not indicate the presence of a sloped entry. Several shallow borings were then advanced to further investigate the location of the sloped entry. One boring was drilled at station 0+40 but did not encounter the entry. Two more borings were then offset from 0+40, 5 feet left and 10 feet right of the suspected alignment. Neither indicated the presence of a sloped entry (Figs. 2 and A-1). We then reassessed our opinion of a sloped entry and postulated that the entry could be a vertical shaft.

To investigate the possibility of a shaft, we returned to our 2014 test pit location and drilled seven shallow borings and one deep boring. A vertical shaft was found at station -0+05. The shaft appeared to be rectangular with dimensions of approximately 7-feet, 12-feet and at least 225 feet deep. The boring drilled at station -0+05 was terminated in shaft backfill at a depth of 225 feet. Observation of drill performance leads us to believe that the shaft backfill is very soft to soft. Our 2014 test pits revealed trash within the fill. These holes were not logged with geophysical test equipment. Logs of Exploratory Shaft Borings are shown in Appendix A.

Description of Deep Exploratory Borings (Mine Extraction Borings)

The following descriptions summarize the results of our 10 borings (B-1 to B-10) and do not incorporate descriptions from previous investigations. Subsoils consisted of about 8 to 21 feet of interlayered sand and clay underlain by bedrock of the Laramie formation to the maximum explored depth of 155 feet. The Fox Hills formation was not encountered. Thin, rider coal seams, up to 1.5 feet were found within the upper 55 feet of most borings. Two mineable, upper and lower, coal seams were found. The depth to the upper seam varied between 80 and 125 feet and it was 2.5 to 7 feet thick. The depth to the lower mineable seam varied between 90 and 142 feet and was 3 to 8 feet thick. Table 2 presents the data (B-1 to B-10) from this investigation and information on the coal seam geometry including elevation data and thickness, drilling circulation, and interburden thickness. For the purpose of comparison, the table also includes the boring data from the previous ATEC and WEE studies (X-1 to X-15). The table also includes our opinions of were mining occurred. Pertinent engineering characteristics of the soil and bedrock are described in the following paragraphs.

TABLE 2
SUMMARY OF COAL AND MINE GEOMETERY

BORING	**GROUND SURFACE ELEVATION (FEET)**	**UPPER SEAM**				**LOWER SEAM**				**CIRCULATION LOST (YES/NO)**	**INTERBURDEN THICKNESS (FEET)**
		TOP OF COAL DEPTH (FEET)	**TOP OF COAL ELEVATION (FEET)**	**COAL THICKNESS (FEET)**	**MINED (YES/NO)**	**TOP OF COAL DEPTH (FEET)**	**TOP OF COAL ELEVATION (FEET)**	**COAL THICKNESS (FEET)**	**MINED (YES/NO)**		
WEE 2005 STUDY											
X-1	5096	100	4996	5	NO	--	--	--	YES	YES	--
X-2	5089	99	4990	4	NO	116	4973	5	NO	NO	13
X-3	5088	92	4996	4	NO	106	4982	5	NO	NO	10
X-4	5095	116	4979	5	NO	136	4959	4	NO	NO	15
X-5	5082	80	5002	6	NO	102	4980	4	YES	YES	16
X-6	5080	95	4985	3	NO	110	4970	4	YES	YES	12
X-7	5088	97.5	4990.5	5	NO	115.5	4972.5	4.5	NO	NO	13
X-8	5088	100.5	4987.5	5	NO	118	4970	4	NO	NO	12.5
X-9	5094	98.5	4995.5	4	NO	115	4979	5	NO	YES	12.5
X-10	5100	114	4986	5	NO	130	4970	--	NO	YES	11
X-11	5110	121	4989	5	NO	135	4975	4	NO	NO	9
X-12	5096	108.5	4987.5	5	NO	128.5	4967.5	7	NO	YES	15
X-13	5079	85	4994	4.5	NO	101	4978	5	YES	YES	11.5
X-14	5100	103	4997	4	NO	--	--	--	YES	YES	--
X-15	5109	100	5009	2.5	NO	116	4993	4	YES	YES	13.5
CURRENT INVESTIGATION											
B-1	5087	92	4995	4.5	NO	102	4975	4.5	YES	--	15.5
B-2	5081	96	4985	6	NO	123	4958	3	NO	--	21
B-3	5078	85.5	4992.5	4.5	NO	97	4981	8	YES	--	7
B-4	5078	84	4994	3	NO	90	4988	4	NO	NO	3
B-5	5076	87	4989	4.5	NO	103	4973	4	NO	NO	11.5
B-6	5085	93	4992	5	NO	109	4976	3	YES	NO	11
B-7	5100	125	4975	7	NO	142	4958	7	NO	NO	10
B-8	5116	87	5029	6	NO	--	--	--	NO	NO	--
B-9	5118	80	5038	7	NO	114	5004	3	NO	NO	21
B-10	5086	100	4986	7	NO	119	4967	8	YES	NO	12

Core Boring B-1

Sandy clay was encountered from 0 to 10 feet underlain by silty sand to 21 feet. Bedrock sandstone and claystone with intermittent thin rider coal seams was encountered to a depth of 92 feet. The upper seam was penetrated from 92 to 96 feet. Core recovery of 73 percent and rock quality designation (RQD) of 40 percent was measured in the upper seam. Maximum caliper deflection of 4 inches was measured in the upper seam at 94 feet. The lower seam was penetrated from 102 feet to 106 feet. The core recovery and RQD was zero in the lower seam. *The lower seam was mined*. Total core depth was 115 feet. The geophysical tools could not be lowered past 107 feet.

Core Boring B-2

Interlayered sand and clay was encountered from 0 to 20 feet underlain by bedrock sandstone and claystone with intermittent thin coal seams to a depth of 96 feet. The upper seam was penetrated from 96 to 102 feet. Core recovery of 77 percent and RQD of 47 percent was measured in the upper coal seam. The lower seam was penetrated from 123 to 126 feet. The core recovery was 100 percent and RQD was 40 percent in the lower coal seam. The geophysical tools could not be lowered past 70 feet. *No mining occurred at this location*. Total core depth was 131 feet.

Core Boring B-3

Interlayered sand and clay was encountered from 0 to 19 feet underlain by bedrock sandstone and claystone with intermittent thin coal seams to a depth of 85.5 feet. The upper seam was penetrated from 85.5 to 90 feet. Core recovery of 100 percent and RQD of 58 percent was measured in the upper coal seam. The caliper tool did not deflect in the upper coal seam. The lower seam was penetrated from 97 to 105 feet. The core recovery was 63 percent and RQD was 50 percent in the lower coal seam. A possible void was encountered from 99.5 to 101.5 feet; however, less than 1-inch of caliper deflection was measured in the lower seam. The geophysical tools could not be lowered past 103 feet. Also, the downhole video camera and sonar tools could not be lowered past 99 feet. This indicates that the mine workings are filled with rubble/coal with no evidence of an open void. *The lower seam was mined at this location*. Total core depth was 107 feet.

Air-Rotary Boring B-4

Interlayered sand and clay was encountered from 0 to 22 feet underlain by bedrock sandstone and claystone with intermittent thin coal seams to a depth of 84 feet. The upper seam was penetrated from 84 to 87 feet. The caliper tool did not deflect in the upper coal seam. The lower seam was penetrated from 90 to 94 feet. The caliper tool did not deflect in the lower coal seam. Drilling circulation was not lost. *No mining occurred at this location*. Total drilled depth was 115 feet.

Air-Rotary Boring B-5

Interlayered sand and clay was encountered from 0 to 19 feet underlain by bedrock sandstone and claystone with intermittent thin coal seams to a depth of 87 feet. The upper seam was penetrated from 87 to 91.5 feet. The lower seam was penetrated from 103 to 107 feet. The geophysical tools could not be lowered deeper than 85 feet. Drilling circulation was not lost. Evidence of mining was not apparent during drilling. Total drilled depth was 115 feet.

Air-Rotary Boring B-6

Sandy clay was encountered from 0 to 18 feet underlain by bedrock sandstone and claystone with intermittent thin coal seams to a depth of 93 feet. The upper seam was penetrated from 93 to 98 feet. The lower seam was penetrated from 109 to 112 feet. Drilling circulation was not lost. The geophysical tools could not be lowered deeper than 89 feet due to borehole caving during the PVC casing installation. Drill performance indicates that *mining occurred in the lower coal seam*. Total drilled depth was 125 feet.

Air-Rotary Boring B-7

Interlayered sand and clay was encountered from 0 to 14 feet underlain by bedrock sandstone and claystone with intermittent thin coal seams to a depth of 125 feet. The upper seam was penetrated from 125 to 132 feet. The lower seam was penetrated from 142 to 149 feet. Drilling circulation was not lost. Geophysical tools lowered to a depth of 155 feet. Caliper deflection measurements show *no indication of mining*. Total drilled depth was 155 feet.

Air-Rotary Boring B-8

Interlayered sand and clay was encountered from 0 to 8 feet underlain by bedrock sandstone and claystone with intermittent thin coal seams to a depth of 87 feet. The upper seam was penetrated from 87 to 93 feet. The lower seam was not apparent. Drilling circulation was not lost. Geophysical tools lowered to a depth of 146 feet. Caliper deflection of 2-inches was measured at 134 feet. We believe that this magnitude of deflection was likely created by drilling. *No mining occurred at this location*. Total drilled depth was 155 feet.

Air-Rotary Boring B-9

Sandy clay was encountered from 0 to 13 feet underlain by bedrock sandstone and claystone with intermittent thin coal seams to a depth of 80 feet. The upper seam was penetrated from 80 to 87 feet. The lower seam was penetrated from 114 to 117 feet. Drilling circulation was not lost. Geophysical tools lowered to a depth of 112 feet. *No evidence of mining was observed at this location*. Total drilled depth was 125 feet.

Air-Rotary Boring B-10

Interlayered sand and clay was encountered from 0 to 18 feet underlain by bedrock sandstone and claystone with intermittent thin coal seams to a depth of 100 feet. The upper seam was penetrated from 100 to 107 feet. The lower seam was penetrated from 119 to 127 feet. Drilling circulation was not lost. Geophysical tools lowered to a depth of 110 feet. *Mining was observed in the lower seam.* Total drilled depth was 155 feet.

Material Physical and Strength Properties

Laboratory tests consisted of moisture content, density, gradation, Atterberg limits, unconfined compression, Young’s Modulus, Poission’s Ratio, and splitting tensile strength (Table 3). The following summarizes the results of the tests.

TABLE 3
SUMMARY OF LABORATORY TEST RESULTS

CORE	DEPTH	MOISTURE CONTENT (%)	MOIST DENSITY (pcf)	PASSING NO. 200 SIEVE (%)	ATTERBERG LIMITS		UNCONFINED COMPRESSION TESTS			SPLITTING TENSILE STRENGTH (psi)	SOIL TYPE
					LIQUID LIMIT (%)	PLASTICITY INDEX (%)	COMPRESSIVE STRENGTH (psi)	YOUNG'S MODULUS (x 10^6 psi)	POISSON'S RATIO		
B-1	62	10.7	144	99	51	34	1090	0.17	0.429		CLAYSTONE
B-1	76	10.1	137	77	30	12	4680	0.06	0.141		CLAYSTONE
B-1	86	17.7	133	98			400	0.04	0.374		CLAYSTONE
B-1	87.5		131				80	0.00	0.362		CLAYSTONE
B-1	91		122				180	0.02	0.443		COAL
B-1	98		139				300	0.02	0.135	20	CLAYSTONE AND LIGNITE
B-1	109		138				1800	0.09	0.138		CLAYSTONE/SANDSTONE
B-2	79		139				1330	0.11	0.163		CLAYSTONE
B-2	82		136				40	0.00	0.137		LIGNITE/COAL
B-2	97		79				780	0.03	0.032		COAL
B-2	104.5		142				2080	0.44	0.146	215	CLAYSTONE/SANDSTONE
B-2	108.5		145				1690	0.31	0.073	170	CLAYSTONE/SANDSTONE
B-2	122		142				780	0.14	0.254	260	CLAYSTONE/SANDSTONE
B-2	126.5		146				1740	0.22	0.379		CLAYSTONE/SANDSTONE
B-3	79.5		162				8470	4.05	0.339		SANDSTONE
B-3	81		146				1230	0.13	0.372		CLAYSTONE
B-3	88.5		81				1150	0.23	0.144		COAL
B-3	98		135				90	0.01	0.369	15	LIGNITE/COAL
B-3	105		142				940	0.17	0.308		SANDSTONE/CLAYSTONE

Bedrock primarily consisted of claystone with interbedded sandstone and lens of coal (rider seams) and lignite. Three bedrock samples had 77 to 99 percent clay and silt size particles and exhibited low and moderate plasticity. Moist density varied 133 to 162 pcf. The unconfined compressive strength (UCS) for claystone in six samples varied 400 to 4680 psi, and the UCS for claystone/sandstone varied 780 to 2080 psi in six samples. The UCS for sandstone measured in one sample was 8470 psi. In general, the UCS varied 400 to 8470 psi with an average strength of 2200 psi. Poisson's ratio varied from 0.14 to 0.429. Tensile strength varied 170 to 260 psi in three samples. We judge the claystone and sandstone are comparatively strong and competent.

Coal cores were primarily brown to black, highly fractured, and blocky. Lignite was interbedded in a few cores. Coal moist density varied 79 to 139 pcf. Coal UCS varied 40 to 1150 psi with an average strength of 420 psi. Poisson's ratio varied 0.032 to 0.443. Tensile strengths of 15 and 20 psi were measured in two samples. We judge the coal and lignite are weak.

Bedrock Physical Characterization and Ground Stability Evaluation

The methodology used in our evaluation was quantitatively based on: 1) various rock mass classifications methods (such as Bieniawski 1984 & 1989); 2) core data and physical properties and 3) our practical mining-geotechnical experience, and knowledge of underground mining operations (see reference list at the end of the text).

Rock Strength

The rockmass strength of the bedrock claystone/sandstone varied 700 to 8,470 psi, and was 400 psi in one sample. The average strength was 2,200 psi. The rock strength rating is estimated to be medium strong to strong. This range of rock strength is much greater than the overburden pressure, estimated as 100 – 120 psi (using 1.0-1.2 psi per foot of depth, and an average overburden depth of 100 feet).

Rock Quality Designation (RQD)

The RQD value is another criterion used to classify the bedrock quality. An RQD value of less than 25 indicates very poor rock, 50-75 fair, 75–90 good, and 90-100 excellent. Reviewing B-1, B-2, and B-3 core data (Figs. B-1 to B-6) shows the RQD values ranged from 50 to 100 percent. We judge that the bedrock quality is good.

Overburden Pressure

We believe that the overburden pressure (vertical and horizontal stress), imposed on the mine workings of the lower seam, is static. The following equations were used:

$S_v = 1.0\text{-}1.2\ h$ (psf), or $S_v = \gamma\ h$ and
$S_h = S_v\ (\nu/1\text{-}\nu)$, where
S_v and S_h = vertical and horizontal stress (psf), respectively
h = overburden (vertical) depth (feet)
γ = the unit weight of the rock (pcf)
ν = Poisson's ratio

The value of the Poisson's ratio (ν) for the claystone/sandstone is between 0.2 and 0.35. For a value of Poission's ratio of 0.2, $S_h = 1/4\ S_v$; and if; $\nu = 0.33$, $S_h = 1/2\ S_v$, and if $\nu = 0.44$ to 0.5, $S_h \leq S_v$, and the stress field is hydrostatic. Since no core discing was observed, we can conclude that $S_h < S_v$. Based on this analysis, we believe that the stresses acting on the mine roof are low and will not adversely affect the bedrock integrity.

Mine Time Period Effects

We used the time of mining as a measure of the rock-mass strength. Mining records show that the production years for the Marfel Mine were from 1897 to 1904 and the Pinnacle was mined prior to 1894. Mining ceased more than 100 years ago, and residual subsidence has not produced any appreciable surface deformation. Given the present conditions of the filled mine workings and the bedrock integrity, we do not anticipate any further surface subsidence displacement or ground movement due to subsidence of the mine workings.

Void Imaging

A potential void encountered in core B-3 was investigated using a downhole video camera and sonar scanning tools. The tools were lowered in an attempt to observe the ground conditions and size of the potential void at 99.5 to 101.5 feet. Imaging was very limited and no data could be obtained due to poor groundwater clarity and the fine coal/rubble materials filling the extraction. Based on the unsuccessful void mapping, we conclude that the mine workings are flooded with water, coal, and rubble. No void was apparent.

ANALYSIS AND INTERPRETATION OF MINED AREAS

It is important to understand how and where coal was mined and the depth to the extraction to evaluate the risk of subsidence potential. We reviewed data from historical records, previous investigations, and data from this investigation to evaluate potentially mined areas. We also reviewed top of coal depths and bedrock stratigraphy. We have included Isopach Maps of the upper and lower seams using ground surface elevations and drilled hole data (Figs. 3 and 4). It is our opinion that mining did not occur in both seams; however, if mining did occur in both seams, mining of each seam does not appear to overlap horizontally.

Upper Coal Seam Isopach

A plan showing the elevation of top of coal, coal thickness, and our interpretation of where mining occurred in the upper seam is provided as Fig. 3. We made our own interpretation of the data from previous investigations by ATEC and WEE. Our opinions are sometimes different. For example, we do not believe that mining occurred in the upper seam. ATEC and WEE reported multi-level mining at a few locations. From a ground control point of view, it would be very difficult to mine both levels at the same horizontal level with an interburden thickness of approximately 12 feet without creating major ground hazards.

A potential reason that the multi-level mining was reported was due to multi-level caliper deflection records. We believe that there are two explanations for this. One potential reason is due to erosion of the borehole walls within coal due to the mud rotary drill method. Observation of the coal cores indicates that the coal is highly fractured. Some of the coal cores fell apart when removed from the core barrel. It is possible that coal eroded when drill fluid motion/pressure occurred which would create a void or bed separation. This mechanism could have led to false interpretation of where mining occurred. One way to evaluate this is to review the gamma and resistivity data where caliper deflection is reported. High resistivity and low gamma lead us to believe that coal is present. Comparatively low resistivity and higher gamma would indicate rubble since the coal extractions were found to be water filled.

Another possible explanation for double coal seam deflections is voids created by bulking or subsidence. This mechanism comes into play where mining occurred in the lower seam. After mining, the interburden and overlying upper seam likely bulked or collapsed into the lower extraction creating voids in the upper coal seam. The collapse limit above mines in the Boulder-Weld Coalfield is commonly 20 to 40 feet above the extraction which would intercept the upper coal seam. Testing indicated that the coal is weak. Bulking and/or collapse of the upper coal seam could have contributed to caliper deflections. This mechanism could have led to false interpretation of where mining occurred.

Lower Coal Seam Isopach

A plan showing the depth and elevation of top of coal, coal thickness, and our interpretation of where mining occurred in the lower seam is provided as Fig. 4. As stated previously, we made our own interpretation of the data from previous investigations by ATEC and WEE. We believe that mining occurred at 12 of 25 drill hole locations from this and previous studies. We believe that the coal was extracted using a room and pillar technique. The precise horizontal extents of mining and the degree in which the pillars were removed are impossible to determine due to the lack of mine maps.

Data indicates that the Marfel and Pinnacle shafts were utilized to mine the lower seam. The depth of mining in the vicinity of the Marfel appears to vary between 100 and 116 feet below grade. The depth to mining varies between 115 and 128.5 feet in the vicinity of the Pinnacle shaft.

We used the reported coal quantity of 14302 tons, average coal thickness of 5 feet from this investigation, and average moist coal density from this study of 90 pcf to approximate the square footage of mining recorded in the Marfel. We found that the mining footprint is about 63560 square feet or 1.5 acres which is about 3 percent of this site. If the pillars were left in place, the mining area should approximately double in footprint to about 3 acres or 6 percent of the site area. The computed area is small compared to the span between borings where we believe mining occurred. It appears that most of the coal production was unreported. It is also possible that the Garfield No. 1 mine to the north extended onto the property in the area of X-1, X-14, and X-15 and went unreported/undocumented. We do not know the depth to the Garfield No. 1.

SUBSIDENCE MECHANISMS

When coal is mined underground, stress increases in the soil and bedrock overlying the mined seam due to the loss of vertical support. Eventually the overburden begins to subside into the extraction. The occurrence of subsidence and the mechanisms by which the overburden rock is distressed and displaced depend on the physical properties of the overburden, the geometry of the mine and the extraction thickness. Testing indicates that the overlying bedrock is medium strong to strong. Subsidence may be caused as a result of failure of the mine roof, coal pillars, or mine floor.

Several environmental factors can increase subsidence potential including; land-use changes, vibratory loading, seismic events, and fluctuation of groundwater. When buildings are constructed above a mine, the risk of subsidence may increase due to introduction of new surface loads, excavation of soils resisting subsidence, changes in drainage patterns and increased water percolation from landscape irrigation. Vibrations of construction equipment and ground motion due to earthquakes are also known to accelerate ground subsidence. If water-filled workings are drained, risk of collapse tends to increase due to loss in water pressure support. Field data indicates that the workings encountered below this site are filled with water. If subsidence occurs, features may be observed at the ground surface in the form of caving subsidence, trough subsidence, or settlement of entry/air shaft backfill materials.

Caving Subsidence

Caving of materials overlying comparatively shallow mine workings can produce sinkholes or depressions at the ground surface. Caving occurs as the roof over a mine fails and collapses into the space created by coal extraction. This process continues until the space is either filled with debris, or caving propagates to the surface. Caving is common over room and pillar operations.

The depth to mining is important when estimating whether or not a subsidence feature will reach the surface. The thickness of the extracted layer, presence of groundwater, and the bulking and strength characteristics of the overburden bedrock are also important. The size of the sinkholes caused by caving is controlled by the geometry of the mine and properties of the overburden. The areal extent of surface depressions is largely controlled by the size of the mine extraction. Research has found that sinkholes typically are circular or elliptical in shape and usually not larger than the width of the underlying extraction.

Trough Subsidence

Trough subsidence is caused by sagging of the overburden triggered when large extraction ratios and panel sizes are achieved, both in areas of room and pillar mining and longwall mining. This generally occurs as caving of the roof followed by sagging and bed separation of the overlying strata. Trough-type subsidence is the common mechanism over longwall mines in the United States and Europe. Troughs that develop over partial extractions, such as room and pillar mines, differ greatly from those which occur over longwall mining. Oravecz (1977) found the magnitude of surface subsidence above partial extractions is considerably smaller than subsidence that develops over total extraction mines. The presence of internal barriers and the low width to depth ratios help reduce the magnitude of surface displacement.

Trough subsidence over room and pillar mining will be localized as compared to the area-wide troughs developed by longwall mining. As with sinkholes, the depth and areal extent of troughs will depend on the depth to mining, physical properties of the overburden, and extraction ratios. The shape of depressions will be irregular due to the presence of remnant pillars. Like longwall mining, subsidence over retreat mining should develop rapidly due to recompression of rubble or re-orientation of beds which have sagged.

Shaft Hazards

The subsidence hazard associated with entry and shafts is high because of the potential sudden and significant movement. Although small in area, shafts can be dangerous because of the haphazard way in which they were backfilled. The two shafts on this site were filled with debris including timber, mine waste, and trash. Over a period of time, the debris can loosen and settle, leading to subsidence at the surface. We discovered no documented settlement associated with the Marfel and Pinnecle shafts since the crevice reported on 1894 McGreger mine map.

MINE SUBSIDENCE RISK EVALUATION

We evaluated the risk of subsidence-sinkhole potential considering mine geometry, bulking factor, probability methods, and research conducted in the Boulder-Weld Coalfield.

Mine Geometry

One method of evaluating whether caving subsidence will propagate to the surface can be addressed through the mine geometry. The critical dimensions are the thickness of cover or overburden height (H) and extraction thickness (h). Piggot and Eynon (1977) suggest subsidence will not propagate to the ground surface over room and pillar workings where the overburden to extraction thickness ratio (H/h) exceeds 10. We have defined the overburden thickness as the bedrock thickness only. The soil thickness was neglected due to comparatively low strength to resist caving. Using an extraction thickness of 4 and 5 feet, caving is not expected to propagate through more than about 40 and 50 feet of bedrock, respectively. The actual bedrock thickness (the distance between the soil/bedrock interface and top of the original mine roof) ranges from 77 to 110 feet.

Bulking Factor

Caving of the roof above a mine can continue until the extraction and collapse area is filled with broken and bulked rock or the caving reaches the surface. The height to which caving can occur is based on the coal seam thickness and bulking properties of the collapsed rock. The increase in the volume of the collapsed rock is referred as a “Bulking Factor.” The Bulking Factor is defined as the original extraction height minus any remaining void, divided by the height of the rubble zone above the original mine roof. Typical bulking factors for this coal strata range from 30 to 50 percent (Piggott and Eynon). The data indicates an extraction thickness of 4 to 5 feet and marginally thicker at a few locations. We used a bulking factor of 40 percent and the extraction recorded at each boring in our analysis. The following equation was used in our analysis:

$H = 3h/B$ for conical collapse, where
H = Collapse height above mined coal seam roof.
B = Bulking Factor (0.40)
h = Original extraction thickness (4 to 5 feet)

The calculated average height of potential conical collapse is 28 to 35 feet. We assessed the subsidence risk by computing a factor of safety (FS) by dividing the actual bedrock thickness above the mine by the computed height of potential conical collapse. We typically use a minimum factor of safety of 1.5 to distinguish where risk is low. We consider a factor of safety of less than 1.2 as high. Table 4 summarizes the compacted factor of safety which ranges from 2.0 to 4.0.

TABLE 4
SUMMARY OF POTENTIAL MINE SUBSIDENCE EVALUATION

BORING	DEPTH TO BEDROCK (FEET)	INITIAL BEDROCK THICKNESS ABOVE MINE ROOF (FEET)	EXTRACTION THICKNESS (FEET)	REQUIRED BEDROCK THICKNESS (FEET)	FACTOR OF SAFETY	COMPARATIVE RISK
X-15	15	101	4.0	30.0	3.4	LOW
X-9	20	95	5.0	37.5	2.5	LOW
X-10	20	110	5.0	37.5	2.9	LOW
X-12	25	103.5	7.0	52.5	2.0	LOW
X-5	25	77	4.0	30.0	2.6	LOW
X-6	15	95	4.0	30.0	3.2	LOW
X-13	17	91	4.5	33.8	2.7	LOW
B-1	21	91	4.5	33.8	2.7	LOW
B-3	17	80	5.0	37.5	2.1	LOW
B-6	18	91	3.0	22.5	4.0	LOW

Probability of Sinkhole Development

Figure 7 is a plot derived from case studies showing the probability and expected lateral size of a caved zone reaching a given height, as a function of overburden thickness (Hanna, 2011). This figure assumes a subsidence angle of draw of 19^o and a void size of 7 feet high by 10 feet wide which is typical of historic abandoned room-and-pillar mining. Statistically, angle of draw measured for subsidence in the American West ranges from 12° to 16° (Peng, 1978). The 19° angles of draw used here allows for a margin of safety in sinkhole size estimation.

For comparison purposes, boreholes B-1 to B-3 are plotted along with other boreholes, H1 to H5, obtained from various studies of other sites. For example, the area within borehole H1 at a depth of approximately 30 feet has the highest probability (greater than 100 percent) of forming a sinkhole at the surface (according to this statistical approach, sinkhole formation is a virtual certainty). If and when a sinkhole forms, the edge of the surface settlement could propagate approximately 8 feet (dashed red line) from the edge of the void space. For this site, the mine at B-1 to B-3 occurs at depth of approximately 100 feet which indicated a probability less than 5 percent of forming a sinkhole at the surface. Since the 1904 operation of the Marfel mine and the subsidence occurrence in 1894, no apparent surface settlement or sinkhole formation has been recorded or observed, indicative of stable mine workings at these depths. This is further supported by the physical characteristics of the bedrock claystone/sandstone materials. Therefore, we believe that the risk of future subsidence and/or sudden sinkhole occurrence due to the mine workings is very low or minimal. This does not include areas around the two shafts.

Time Methods

Research in the Boulder-Weld Coalfield indicates that about 95 percent of subsidence occurs within 15 years of mining (Matheson, 1987). This research is consistent with the documented crevice over the Pinnacle mine. Based on the extraction thicknesses of 4 to 5 feet, only 2 to 4-inches of residual subsidence would have occurred after 15 years of the mine closure.

Results of Risk Evaluation

Overall, we judge the potential subsidence risk is very low for this site. Risk is judged high in the vicinity of the shaft locations.

RECOMMENDATIONS

The subsidence hazard will not preclude the development of this site. We found that the risk of potential subsidence is very low over mined areas. Several development aspects should be considered over the mined areas. We judge the risk is high in the vicinity of the shafts. Due to the haphazard way in which shafts were backfilled and the sudden nature in which subsidence develops over shafts, we believe that the two shafts pose a potential safety concern to the public. We recommend that the shafts be mitigated; after which, the immediate shaft areas should be sited for passive uses. We believe that passive uses will be safe after mitigation.

Development Considerations over Mined Areas

Lightly loaded structures that utilize shallow foundations can be planned over mined areas. Shallow foundations ideally consist of post-tensioned slab-on-grade, footings, or mats. Basements and below grade areas can be used. Heavy loaded buildings requiring the use of deep foundations should be avoided. The use of shallow foundations and minimal grading is considered safest to reduce effects of subsidence movement. Our previous preliminary investigation revealed expansive soils and bedrock that may require sub-excavation to allow use of shallow foundations. If necessary, sub-excavation can be utilized without significantly increasing to the subsidence hazard. Groundwater drawdown could trigger subsidence. Wells and/or other mechanical systems that would alter the groundwater level should not be used.

Shaft Mitigation

We judge the subsidence potential is high in the vicinity of the shafts. We recommend that the shafts be mitigated. Several mitigation techniques can be considered, including grouting and construction of reinforced soil or reinforced concrete caps. We can discuss these options with you and design the selected mitigation technique upon request. After mitigation, we believe the shaft areas can be safely used for passive uses such as parks, parking lots, greenways, and associated structures that can tolerate movement. Buildings, roadways, utility corridors, and structures sensitive to movement should not be planned within a 42 foot radius from the Marfel shaft center and 40 foot radius from the Pinnacle shaft center. The “no build’ radii were estimated using depths to the mine roof at each shaft, measured shaft widths, an angle of draw of 16^{o} (Peng, 1978), and a safety factor of 1.2.

GEOTECHNICAL RISK

The concept of risk is an important aspect with any geotechnical evaluation, primarily because the methods used to develop geotechnical recommendations do not comprise an exact science. We never have complete knowledge of subsurface conditions. Our analysis must be tempered with engineering judgment and experience. Therefore, the recommendations presented in any geotechnical evaluation should not be considered risk-free.

LIMITATIONS

Our investigation was planned to obtain information necessary to perform an analysis and evaluation of the subsidence hazard. Our conclusions regarding the risk of future subsidence were based on our investigation and analysis, previous investigation, review of available mine records, previous studies and our experience. There is no method, to our knowledge, of eliminating all risk of subsidence. If additional data become available concerning unreported mining or subsidence features develop at the site, we should be contacted to evaluate the situation.

We believe this investigation was conducted with the level of skill and care ordinarily used by geotechnical and mining engineers practicing in this area at this time. No warranty, express or implied, is made. We appreciate the opportunity to provide service. If we can further explain our opinions and conclusions, please contact us.

CTL | THOMPSON, INC.

Matthew D. Monteith, P.E.
Project Geotechnical Engineer

Kanaan Hanna

Kanaan Hanna
Senior Mining Engineer (Independent)

Reviewed by:

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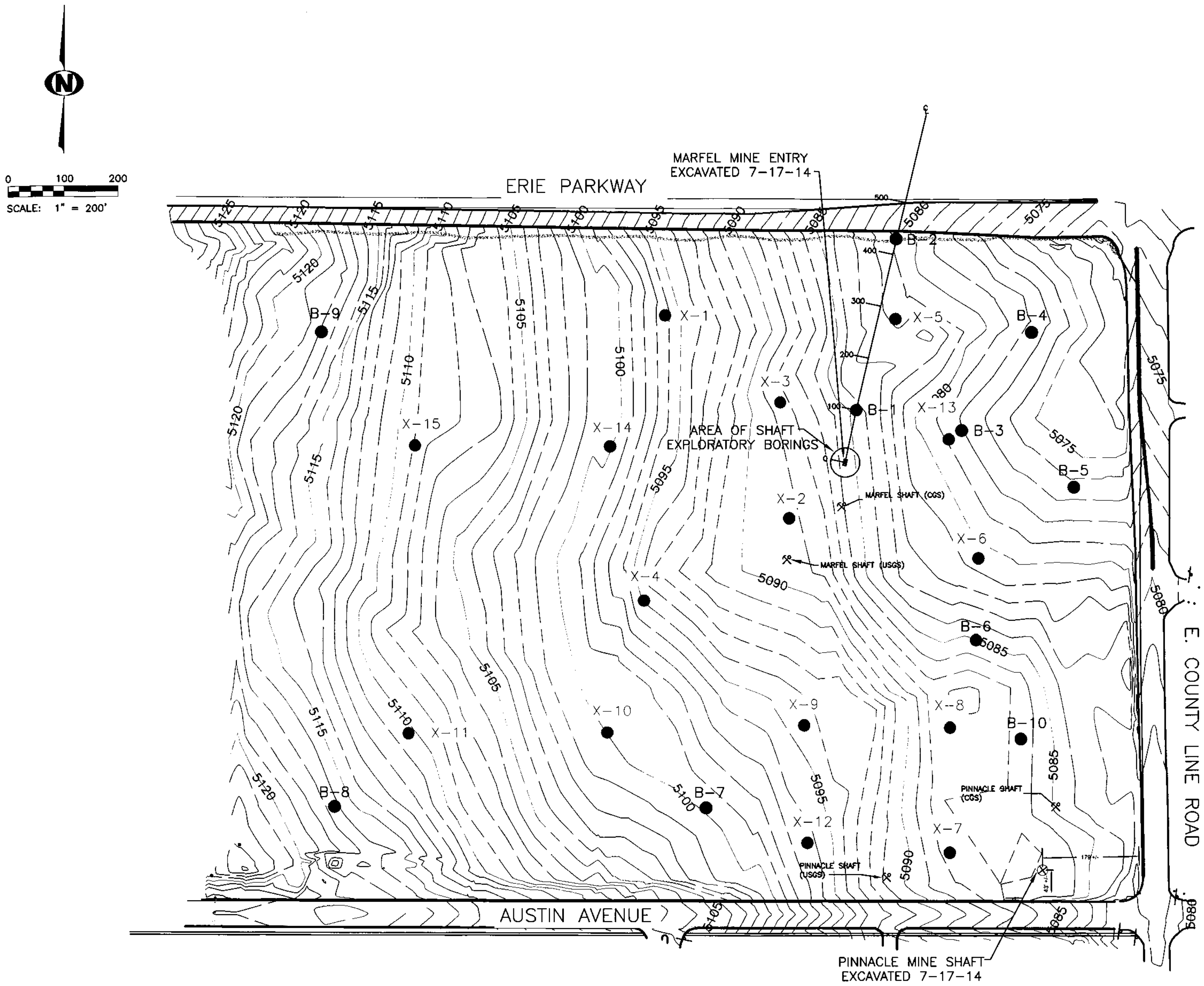

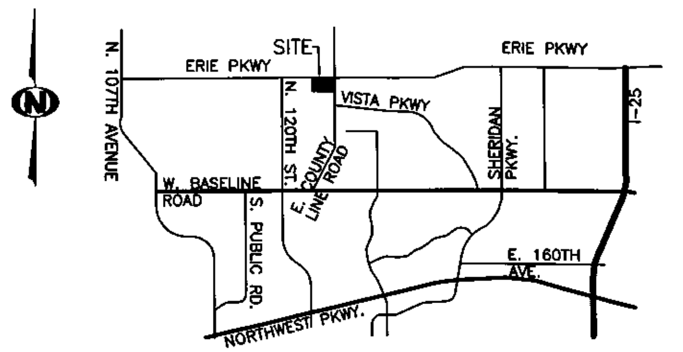

VICINITY MAP
NOT TO SCALE

LEGEND:

B-1 ●	APPROXIMATE LOCATION OF DEEP BORING DRILLED DURING THIS INVESTIGATION
X-1 ●	APPROXIMATE LOCATION OF BORING DRILLED DURING WESTERN ENVIRONMENTAL AND ECOLOGY'S 2005 PRELIMINARY MINE SUBSIDENCE INVESTIGATION

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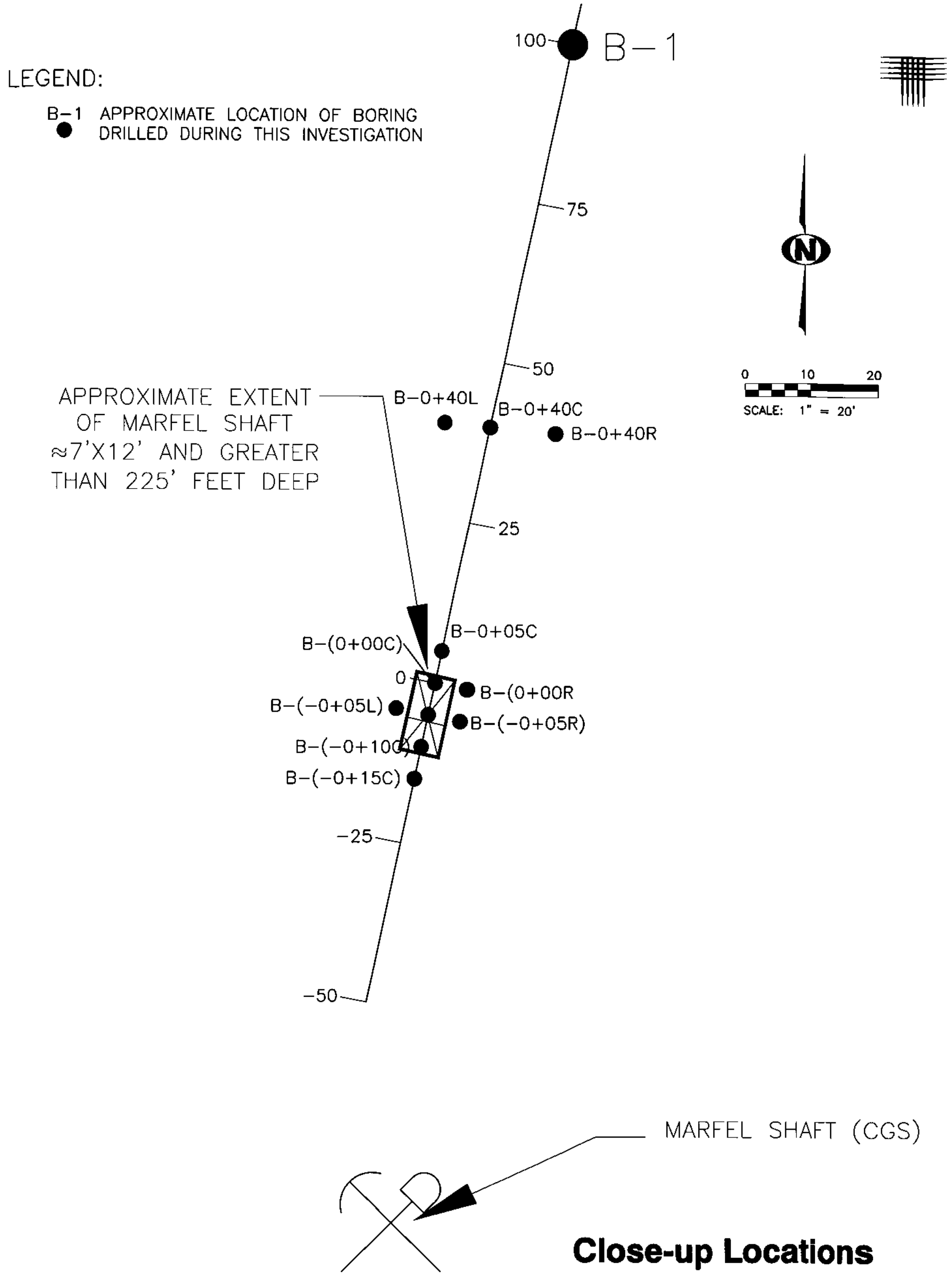
RMCS, INC.
ERIE PARCEL
Project No. DN47,332-110

Locations of Exploratory Mine Borings

Fig. 1



RMCS, INC.
ERIE PARCEL
Project No. DN47,332-110

Close-up Locations of Exploratory Shaft Borings

Fig. 2

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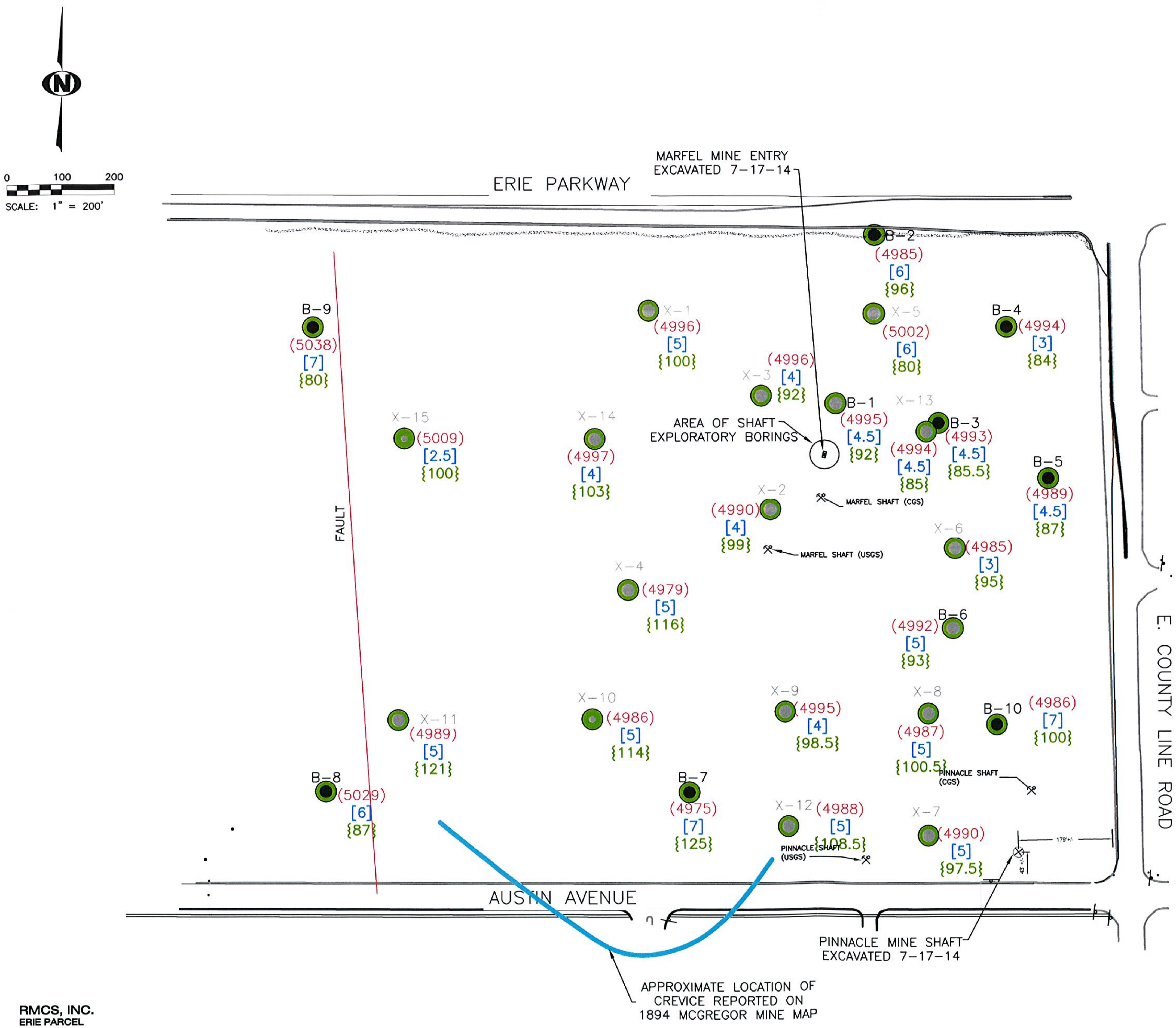

LEGEND:

B-1 ● APPROXIMATE LOCATION OF DEEP BORING DRILLED DURING THIS INVESTIGATION

X-1 ● APPROXIMATE LOCATION OF BORING DRILLED DURING WESTERN ENVIRONMENTAL AND ECOLOGY'S 2005 PRELIMINARY MINE SUBSIDENCE INVESTIGATION

(4996) INDICATES APPROXIMATE ELEVATION OF TOP OF UPPER COAL SEAM

[4] INDICATES APPROXIMATE UPPER COAL SEAM THICKNESS (FEET)

🟢 DATA INDICATES THAT NO MINING OCCURED IN UPPER SEAM

🔴 DATA INDICATES THAT MINING OCCURED IN UPPER SEAM

{117} INDICATES APPROXIMATE DEPTH TO TOP OF UPPER COAL SEAM

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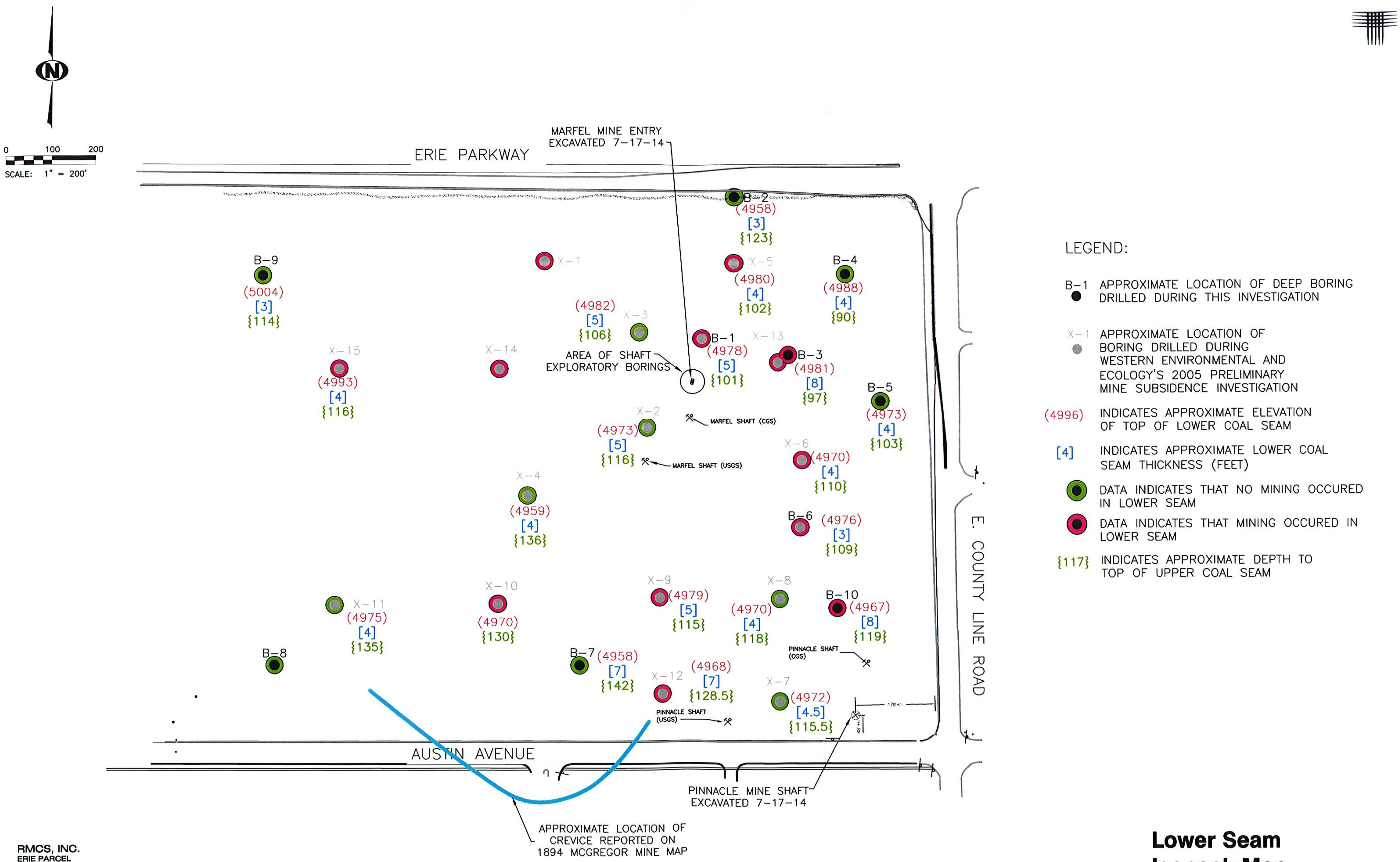
Project No. DN47,332-110

Upper Seam Isopach Map

Fig. 3



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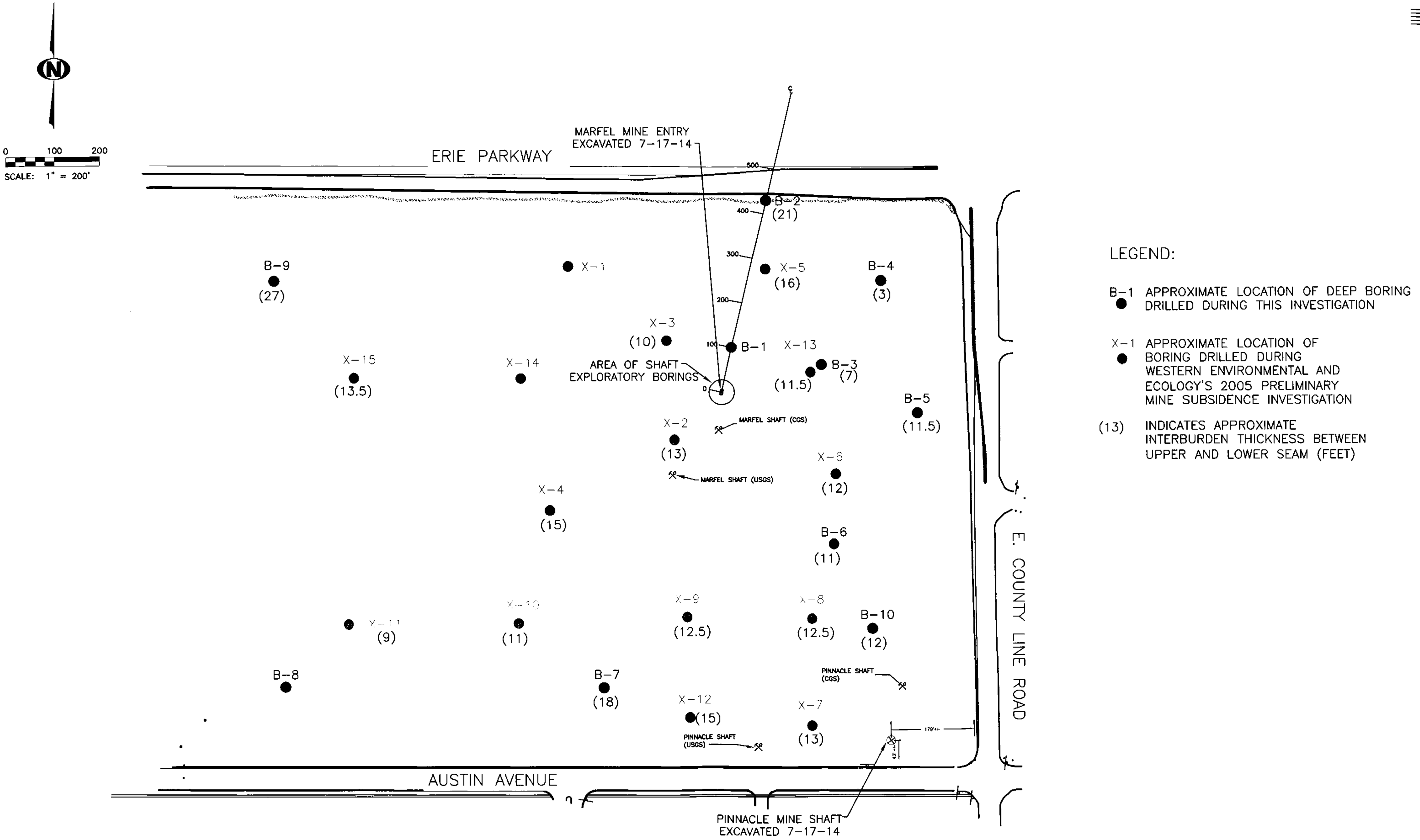
Lower Seam Isopach Map

Fig. 4



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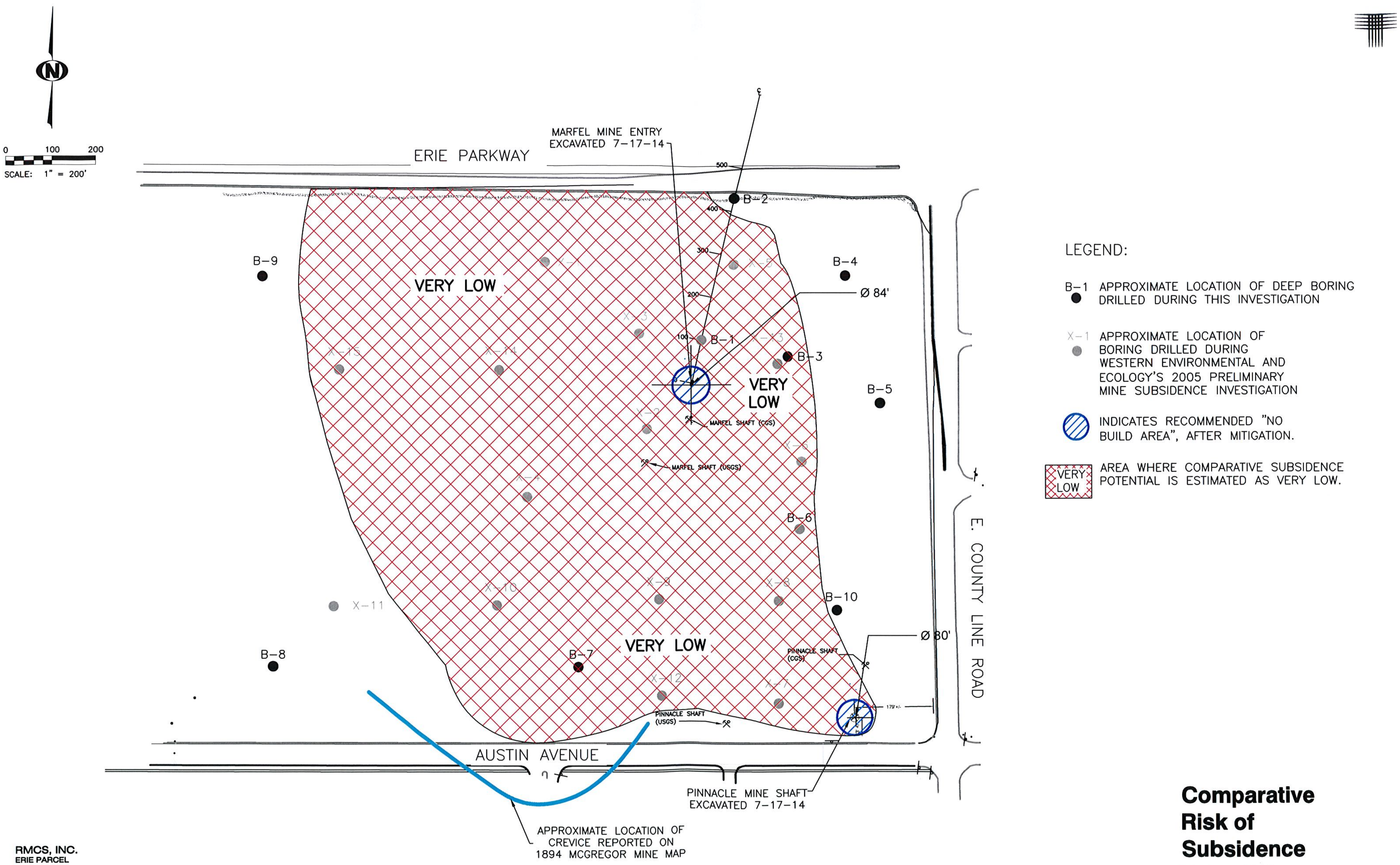
Project No. DN47,332-110

Interburden Thickness Map **Fig. 5**



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Project No. DN47,332-110

Comparative Risk of Subsidence Potential

Fig. 6

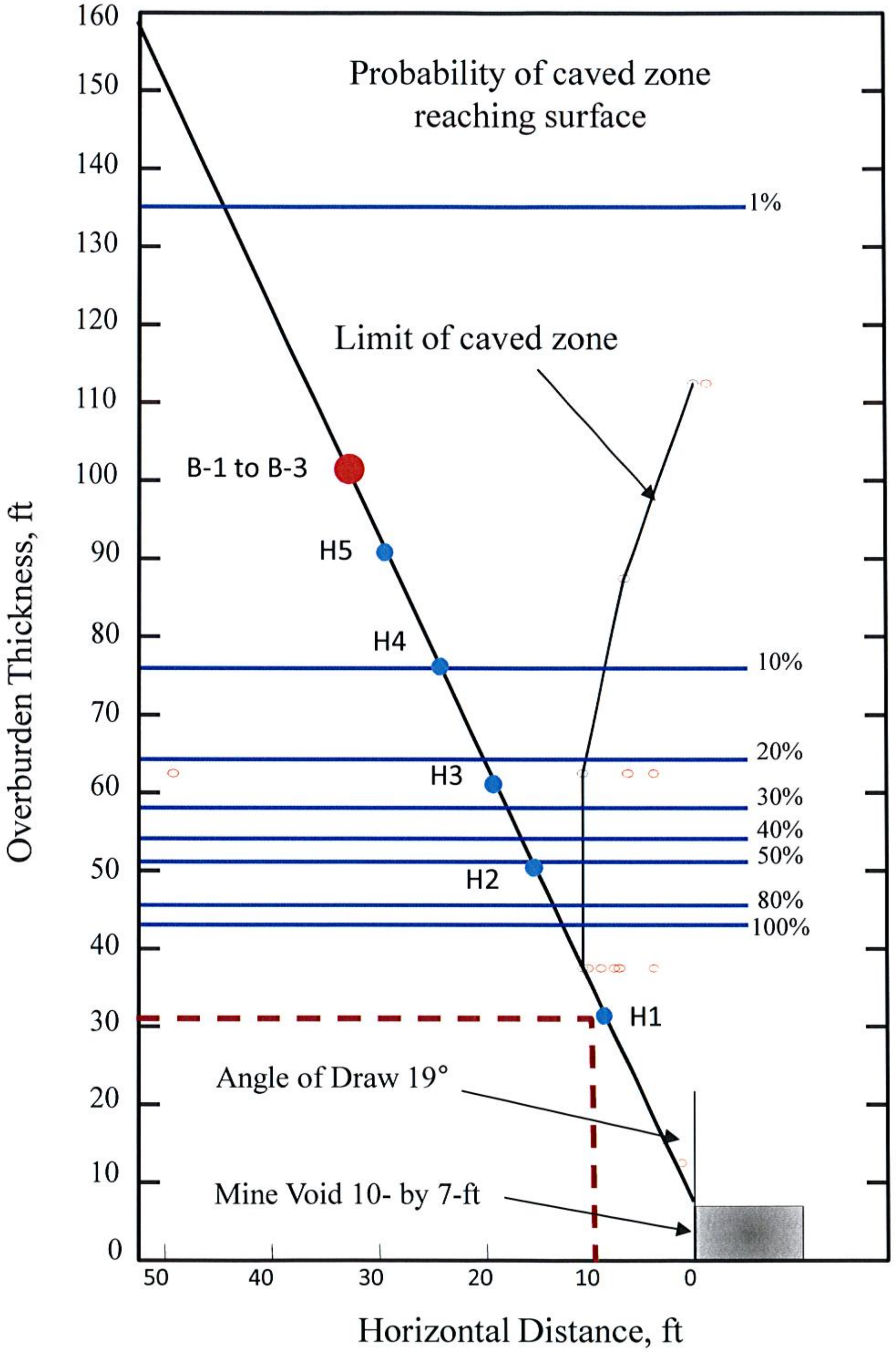
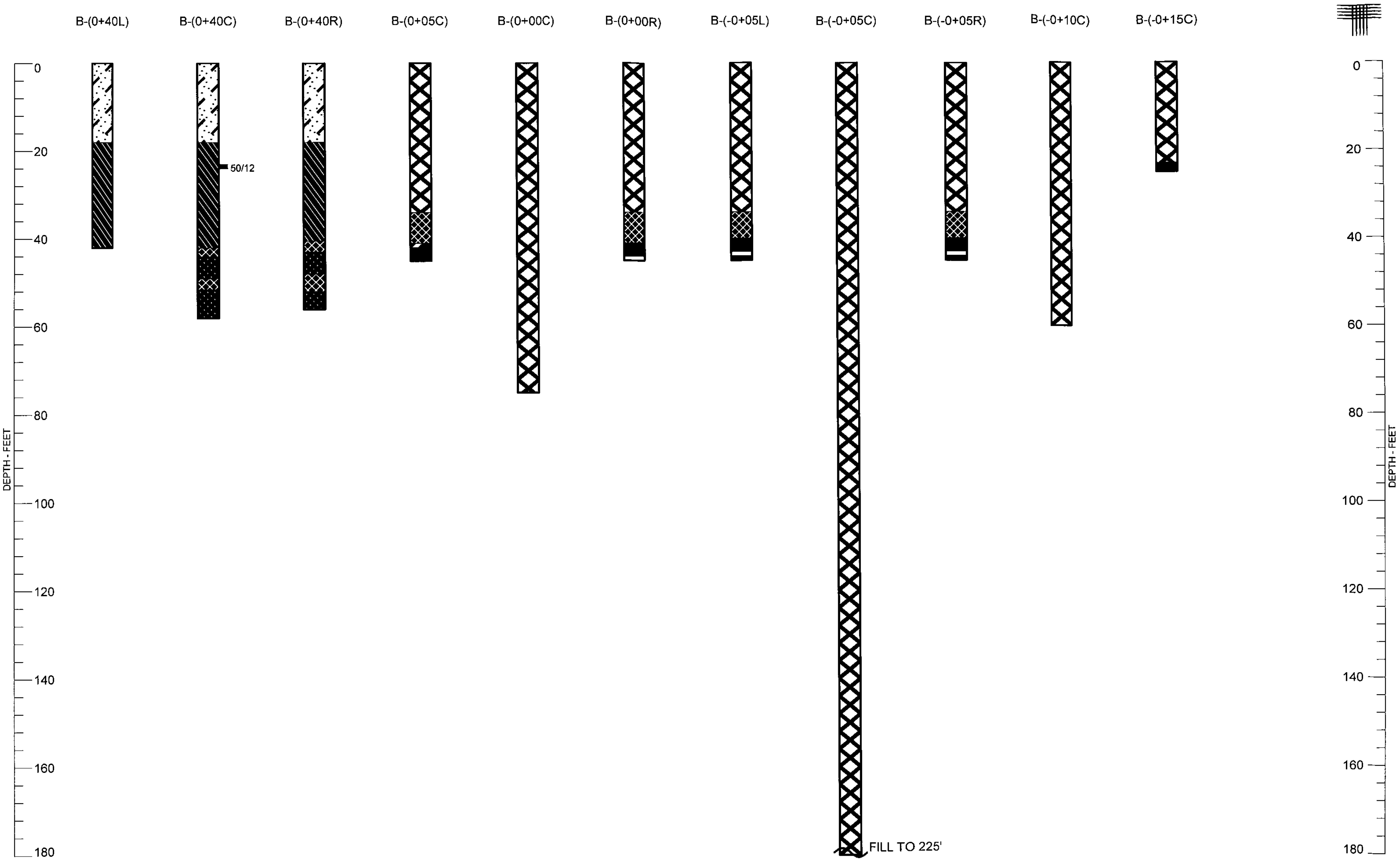


Figure 7: Probability of Sinkhole Development

APPENDIX A

SUMMARY LOGS OF EXPLORATORY BORINGS



SUMMARY LOGS OF EXPLORATORY BORINGS

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FIG. A- 1

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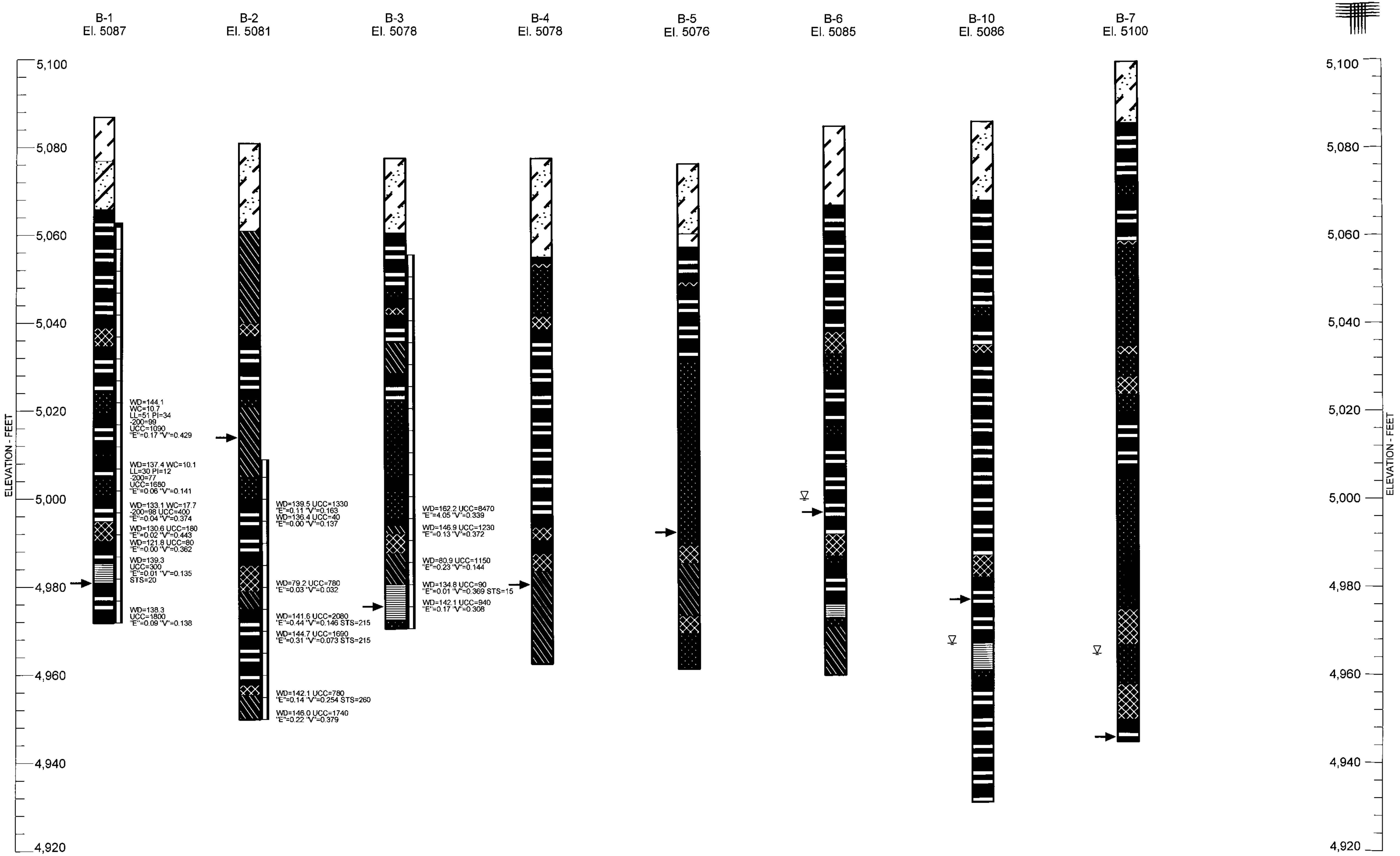
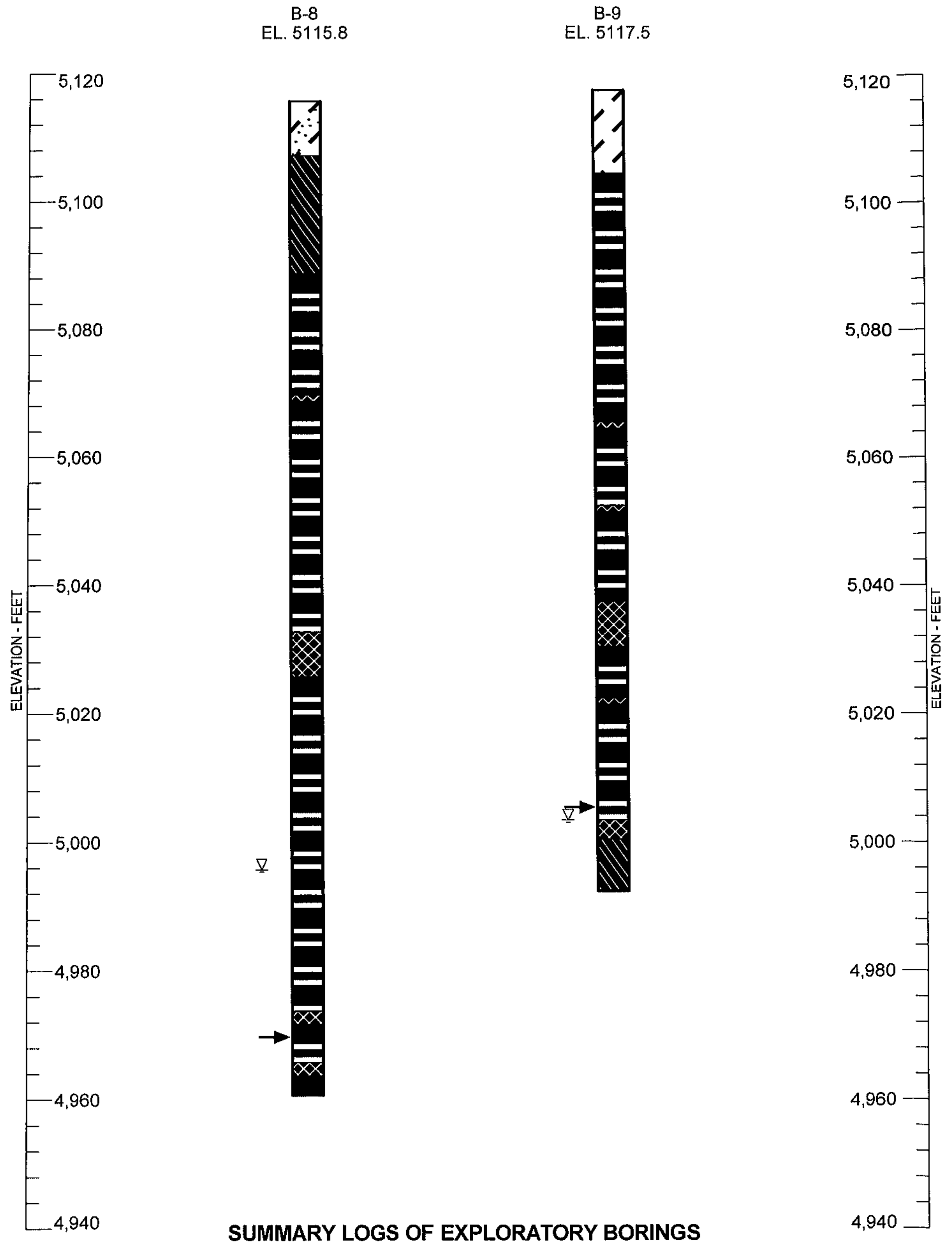


RMCS, INC.
ERIE PARCEL
PROJECT NO. DN47,332-110

SUMMARY LOGS OF EXPLORATORY BORINGS

FIG. A- 2



SUMMARY LOGS OF EXPLORATORY BORINGS

RMCS, INC.
ERIE PARCEL
PROJECT NO. DN47,332-110

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LEGEND:

- ☒ FILL, CLAY, SANDY, MINE SPOILS, WOOD FRAGMENTS, MINING DEBRIS.
- ▧ CLAY, SANDY, MOIST, BROWN (CL).
- ▧ SAND, SILTY, MEDIUM DENSE, MOIST, BROWN (SM).
- ▧ INTERLAYERED CLAY/SAND, MOIST, BROWN, GRAY (CL OR SC).
- ■ BEDROCK, CLAYSTONE, LIGNITE LENSES, HARD, MOIST, BROWN, GRAY.
- ■ BEDROCK, SANDSTONE, CLAYSTONE LENSES, HARD, MOIST, BROWN, TAN.
- ▨ BEDROCK, INTERBEDDED CLAYSTONE/SANDSTONE, LIGNITE LENSES, HARD, MOIST, BROWN, GRAY.
- ▩ COAL, SOME LIGNITE, BROWN, MOIST.
- ▤ RUBBLE.
- CORE SAMPLE.
- DRIVE SAMPLE. THE SYMBOL INDICATES BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.0-INCH O.D. SAMPLER INCHES.
- ∇ INDICATES DEPTH WHERE GROUNDWATER APPEARED IN AIR CIRCULATION.
- → INDICATES DEPTH WHERE HOLE CAVED DURING GEOPHYSICAL TESTING.

NOTES:

1. THE BORINGS WERE DRILLED ON OCTOBER 28, 2014 USING 4-INCH DIAMETER, CONTINUOUS-FLIGHT AUGER AND A TRUCK-MOUNTED DRILL RIG.
2. BORING LOCATIONS AND ELEVATIONS WERE DETERMINED BY A REPRESENTATIVE OF OUR FIRM REFERENCING THE TEMPORARY BENCHMARK SHOWN ON FIG. 1.
3. WC - INDICATES MOISTURE CONTENT (%).
   WD - INDICATES MOIST DENSITY (PCF).
   LL - INDICATES LIQUID LIMIT.
   PI - INDICATES PLASTICITY INDEX.
   -200 - INDICATES PASSING NO. 200 SIEVE (%).
   UC - INDICATES UNCONFINED COMPRESSIVE STRENGTH (PSI).
   E - INDICATES YOUNG'S MODULUS (x10 PSI)
   V - INDICATES POISSON'S RATIO.
   STS - INDICATES SPLITTING TENSILE STRENGTH (PSI).
4. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS AND CONCLUSIONS CONTAINED IN THIS REPORT.

FIG. A- 3

APPENDIX B

CORE LOGS AND PHOTOGRAPHS

PROJECT NODN47,332-110
PROJECT NAME ERIE PARCEL

CTL/THOMPSON, INC. (303) 825-0777
1971 WEST 12TH AVENUE DENVER, COLORADO 80204

BORING NUMBER B-1	BEGIN DRILLING TIME: 10/22/2014	END DRILLING TIME: 10/28/2014
TOP OF HOLE ELEVATION 5086.9	GROUND WATER ELEVATION	DIRECTION OF HOLE VERTICAL
TOTAL DEPTH 115	OVERBURDEN THICKNESS 21	SIZE AND TYPE OF BIT HQ 3.5"OD
DRILLING COMPANY PRECISION	DRILLER TIM/JUAN/STEVEN	DRILL TYPE CME75
ENGINEER MDM		

DEPTH		REMARKS	DRILL TIME (MIN.)	CORE INTERVAL (FEET)	CORE LENGTH (INCHES)	CORE RECOVERY (%)	RQD (%)	LOG	DESCRIPTION
FROM	TO								
0	10								CLAY, SANDY, SILTY, MOIST, BROWN.
10	21								SAND, SILTY, MOIST TO VERY MOIST, LIGHT BROWN, LIGHT YELLOWISH BROWN.
21	23.5		5	2.5	27	90%	55		CLAYSTONE, SLIGHTLY SANDY, SLIGHLTY SILTY, MOIST, LIGHT GRAYISH BROWN, CONTAINS OCCASIONAL LIGNITE.
23.5	26			5	27	45%	55		
26	31		6	5	36	60%	53		
31	36		7	5	60	100%	86		
36	41		6.5	5	59	98%	98		
41	46		5	5	59	98%	75		COAL, BLACK. CLAYSTONE, SLIGHTLY SANDY, LIGHT TO GRAYISH BROWN.
46	51		4.5	5	60	100%	52		LIGNITE, DARK BROWN, VERY MOIST. COAL, INTENSITY FRACTURED, SLIGHTLY SANDY OR SILTY.
51	56		5	5	60	100%	75		CLAYSTONE, MOIST, SLIGHTLY SANDY OR SILTY.
56	61		6	5	60	100%	100		
61	66		8	5	60	100%	53		SANDSTONE, LIGHT GRAY, BROWN, FINE GRAINED.
66	71		6	5	57	95%	52		CLAYSTONE, FRACTURED, GRAY TO GRAYISH BROWN, MOIST, SLIGHTLY SANDY.
71	76		18	5	41	68%	47		CLAYSTONE, FRACTURED, GRAY TO DARK GRAY.
76	81		10	5	48	80%	56		SANDSTONE, SILTY. CLAYSTONE, DARK BROWN, CONTAINED

FIG. B-1

PROJECT NODN47,332-110
PROJECT NAME ERIE PARCEL

CTL/THOMPSON, INC. (303) 825-0777
1971 WEST 12TH AVENUE DENVER, COLORADO 80204

BORING NUMBER B-1	BEGIN DRILLING TIME: 10/22/2014	END DRILLING TIME: 10/28/2014
TOP OF HOLE ELEVATION 5086.9	GROUND WATER ELEVATION	DIRECTION OF HOLE VERTICAL
TOTAL DEPTH 115	OVERBURDEN THICKNESS 21	SIZE AND TYPE OF BIT HQ 3.5"OD
DRILLING COMPANY PRECISION	DRILLER TIM/JUAN/STEVEN	DRILL TYPE CME750
ENGINEER MDM		

DEPTH		REMARKS	DRILL TIME (MIN.)	CORE INTERVAL (FEET)	CORE LENGTH (INCHES)	CORE RECOVERY (%)	RQD (%)	LOG	DESCRIPTION
FROM	TO								
81	86		4	5	37	62%	25		WOOD. SANDSTONE, LIGHT GRAY TO GRAY, FINE GRAINED.
86	91		2	5	42	70%	70		CLAYSTONE, FRACTURED, GRAY TO GRAYISH BROWN, CONTAINS GRAVEL.
91	96		2	5	44	73%	40		COAL/LIGNITE, FRACTURED, DARK GRAY TO BROWN.
96	101		4.5	5	54	90%	87		CLAYSTONE, DARK GRAY, BROWN.
101	106		3	5	15	25%	0		RUBBLE, LIGHT GRAY.
106	111		3.5	5	49	82%	62		CLAYSTONE, DARK GRAY, BROWN. SANDSTONE.
111	115		12	4	48	100%	63		CLAYSTONE, SANDY, FRACTURED, GRAY.

FIG. B-2

PROJECT NODN47,332-110
PROJECT NAME ERIE PARCEL

CTL/THOMPSON, INC. (303) 825-0777
1971 WEST 12TH AVENUE DENVER, COLORADO 80204

BORING NUMBER B-2
BEGIN DRILLING TIME: 10/29/2014
END DRILLING TIME: 11/4/2014
TOP OF HOLE ELEVATION 5081.0
GROUND WATER ELEVATION
DIRECTION OF HOLE VERTICAL
TOTAL DEPTH 131
OVERBURDEN THICKNESS 20
SIZE AND TYPE OF BIT HQ 3.5"OD
DRILLING COMPANY PRECISION
DRILLER TIM/JUAN/STEVEN
DRILL TYPE CME750
ENGINEER MDM

DEPTH FROM	DEPTH TO	REMARKS	DRILL TIME (MIN.)	CORE INTERVAL (FEET)	CORE LENGTH (INCHES)	CORE RECOVERY (%)	RQD (%)	LOG	DESCRIPTION
0	20		4						INTERLAYERED CLAY/SAND, SILTY, MOIST, LIGHT BROWN.
20	27		4						INTERBEDDED CLAYSTONE/SANDSTONE, SLIGHTLY SANDY, BROWN TO GRAY.
27	32		4						
32	37		4						
37	42		3						
42	47		3						COAL, RIDER SEAM
47	52		2						CLAYSTONE, SANDY TO SLIGHTLY SANDY, BROWN, GRAY.
52	57		2						
57	62		7						SANDSTONE, SILTY, MOIST, GRAYISH BROWN.
62	67		3						INTERBEDDED CLAYSTONE/SANDSTONE, SLIGHTLY SANDY TO SANDY, BROWN TO GRAYISH BROWN.
67	72		4						
72	76		4	4	48	100%	50		
76	81		5	5	44	73%	16		SANDSTONE, BROWN, LIGHT GRAY.

FIG. B-3

PROJECT NODN47,332-110
PROJECT NAME ERIE PARCEL

CTL/THOMPSON, INC. (303) 825-0777
1971 WEST 12TH AVENUE DENVER, COLORADO 80204

BORING NUMBER B-2
BEGIN DRILLING TIME: 10/29/2014
END DRILLING TIME: 11/4/2014
TOP OF HOLE ELEVATION 5081.0
GROUND WATER ELEVATION
DIRECTION OF HOLE VERTICAL
TOTAL DEPTH 131
OVERBURDEN THICKNESS 20
SIZE AND TYPE OF BIT HQ 3.5"OD
DRILLING COMPANY PRECISION
DRILLER TIM/JUAN/STEVEN
DRILL TYPE CME750
ENGINEER MDM

DEPTH		REMARKS	DRILL TIME (MIN.)	CORE INTERVAL (FEET)	CORE LENGTH (INCHES)	CORE RECOVERY (%)	RQD (%)	LOG	DESCRIPTION
FROM	TO								
81	86		4	5	42	70%	35		CLAYSTONE, SILTY,LIGHT GRAY TO GRAYISH BROWN, CONTAINS LIGNITE AND COAL LENSES.
86	91		7	5	47	78%	58		
91	96		8	5	47	78%	48		
96	101		7	5	46	77%	47		COAL, FRACTURED, DRILLED SOFTER.
101	106		5	5	57	95%	57		INTERBEDDED CLAYSTONE/SANDSTONE,GRAY TO LIGHT GRAY.
106	111		8	5	60	100%	83		CLAYSTONE, SLIGHTLY SANDY TO SANDY, LIGHT TO DARK GRAY.
111	116		7	5	51	85%	51		
116	121		9	5	60	100%	50		
121	126		7	5	60	100%	40		COAL, DARK BROWN, CHUNKY SOLID.
126	131		5	5	58	97%	70		INTERBEDDED CLAYSTONE/SANDSTONE, LIGHT GRAY.

FIG. B-4

PROJECT NODN47,332-110
PROJECT NAME ERIE PARCEL

CTL/THOMPSON, INC. (303) 825-0777
1971 WEST 12TH AVENUE DENVER, COLORADO 80204

BORING NUMBER B-3	BEGIN DRILLING TIME: 10/28/2014	END DRILLING TIME: 10/29/2014
TOP OF HOLE ELEVATION 5077.6	GROUND WATER ELEVATION	DIRECTION OF HOLE VERTICAL
TOTAL DEPTH 107	OVERBURDEN THICKNESS 17	SIZE AND TYPE OF BIT HQ 3.5"OD
DRILLING COMPANY PRECISION	DRILLER TIM/STEVEN	DRILL TYPE CME750
ENGINEER MDM		

DEPTH FROM	DEPTH TO	REMARKS	DRILL TIME (MIN.)	CORE INTERVAL (FEET)	CORE LENGTH (INCHES)	CORE RECOVERY (%)	RQD (%)	LOG	DESCRIPTION
0	19								INTERLAYERED CLAY/SAND, SILTY, SLIGHTLY GRAVELLY, MOIST, DARK BROWN.
19	22		2	3	18	50%	100		
22	27	DRILL ISSUES PREVENTED CORE RECOVERY	8	5	N/A	N/A	N/A		CLAYSTONE, DARK GRAYISH BROWN.
27	29.5		4	2.5	30	100%	47		
29.5	32		4	2.5	28	93%	67		SANDSTONE, BROWN TO GRAYISH BROWN.
32	37		5	5	60	100%	58		CLAYSTONE, DARK GRAYISH BROWN. COAL, RIDER SEAM, DARK BROWN, WET.
37	42		10	5	60	100%	60		CLAYSTONE, DARK GRAYISH BROWN.
42	47		10	5	60	100%	90		INTERBEDDED CLAYSTONE/SANDSTONE, SILTY, LIGHT GRAY.
47	52		10	5	60	100%	87		
52	57		6	5	60	100%	78		CLAYSTONE, SILTY, DARK GRAY TO GRAY.
57	62		5	5	60	100%	78		
62	67		4.5	5	60	100%	74		SANDSTONE, CLAYEY, FRACTURED, FINE GRAIN, LIGHT GRAY.
67	72		4.5	5	60	100%	70		
72	77		5.75	5	59	98%	74		CLAYSTONE, SANDY, GRAY TO DARK GRAY.
77	82		7.5	5	60	100%	69		SANDSTONE, LIGHT GRAY.

FIG. B-5

PROJECT NODN47,332-110
PROJECT NAME ERIE PARCEL

CTL/THOMPSON, INC. (303) 825-0777
1971 WEST 12TH AVENUE DENVER, COLORADO 80204

BORING NUMBER B-3
BEGIN DRILLING TIME: 10/28/2014
END DRILLING TIME: 10/29/2014
TOP OF HOLE ELEVATION 5077.6
GROUND WATER ELEVATION
DIRECTION OF HOLE VERTICAL
TOTAL DEPTH 107
OVERBURDEN THICKNESS 17
SIZE AND TYPE OF BIT HQ 3.5"OD
DRILLING COMPANY PRECISION
DRILLER TIM/STEVEN
DRILL TYPE CME75
ENGINEER MDM

DEPTH		REMARKS	DRILL TIME (MIN.)	CORE INTERVAL (FEET)	CORE LENGTH (INCHES)	CORE RECOVERY (%)	RQD (%)	LOG	DESCRIPTION
FROM	TO								
82	87		5	5	60	100%	42		CLAYSTONE, CONTAINS COAL AND LIGNITE.
87	92		5	5	60	100%	58		COAL, DARK BROWN INTERBEDDED CLAYSTONE/SANDSTONE, SILTY, DARK GRAY, GRAYISH BROWN.
92	97		10	5	60	100%	53		
97	102		5	5	88	63%	50		RUBBLE
102	107		3.5	5	60	100%	55		INTERBEDDED CLAYSTONE/SANDSTONE, LIGHT GRAY, DARK GRAY, FINE GRAINED.

FIG. B-6

VIEW OF CORE B-1 AT 23.5-26.0

VIEW OF CORE B-1 AT 26.0-31.0

RMCS, INC
ERIE PARCEL
CTL | T PROJECT NO. DN47,332-110

FIG. B-7

VIEW OF CORE B-1 AT 31.0-36.0

VIEW OF CORE B-1 AT 36.0-41.0

VIEW OF CORE B-1 AT 36.0-41.0

VIEW OF CORE B-1 AT 41.0-46.0

VIEW OF CORE B-1 AT 41.0-46.0

VIEW OF CORE B-1 AT 46.0-51.0

VIEW OF CORE B-1 AT 46.0-51.0

VIEW OF CORE B-1 AT 46.0-51.0

VIEW OF CORE B-1 AT 51.0-56.0

VIEW OF CORE B-1 AT 51.0-56.0

FIG. B-12

VIEW OF CORE B-1 AT 56.0-61.0

VIEW OF CORE B-1 AT 56.0-61.0

VIEW OF CORE B-1 AT 56.0-61.0

VIEW OF CORE B-1 AT 61.0-66.0

FIG. B-14

VIEW OF CORE B-1 AT 61.0-66.0

VIEW OF CORE B-1 AT 61.0-66.0

VIEW OF CORE B-1 AT 71.0-76.0

VIEW OF CORE B-1 AT 71.0-76.0

FIG. B-16

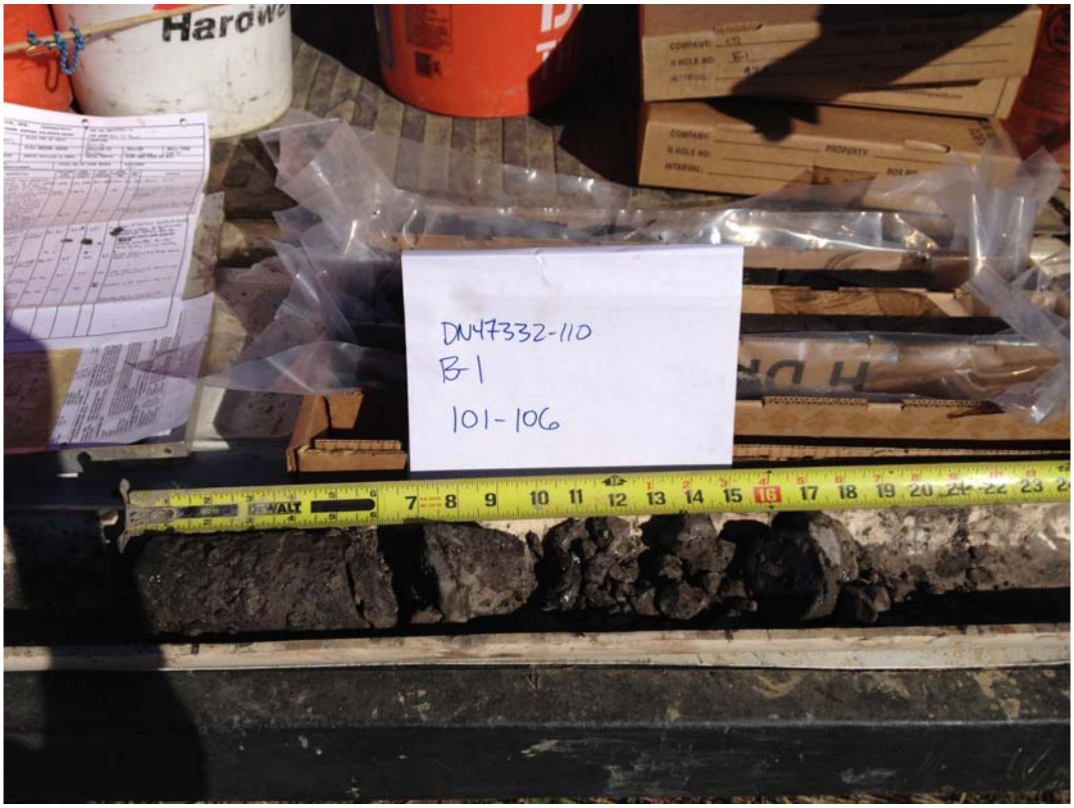
VIEW OF CORE B-1 AT 76.0-81.0

VIEW OF CORE B-1 AT 81.0-86.0

VIEW OF CORE B-1 AT 86.0-91.0

VIEW OF CORE B-1 AT 91.0-96.0

VIEW OF CORE B-1 AT 96.0-101.0



VIEW OF CORE B-1 AT 101.0-106.0

VIEW OF CORE B-1 AT 106.0-111.0

VIEW OF CORE B-1 AT 106.0-111.0

VIEW OF CORE B-2 AT 76.0-81.0

VIEW OF CORE B-2 AT 76.0-81.0

VIEW OF CORE B-2 AT 81.0-86.0

VIEW OF CORE B-2 AT 81.0-86.0

VIEW OF CORE B-2 AT 86.0-91.0

VIEW OF CORE B-2 AT 86.0-91.0

VIEW OF CORE B-2 AT 91.0-96.0

VIEW OF CORE B-2 AT 91.0-96.0

VIEW OF CORE B-2 AT 96.0-101.0

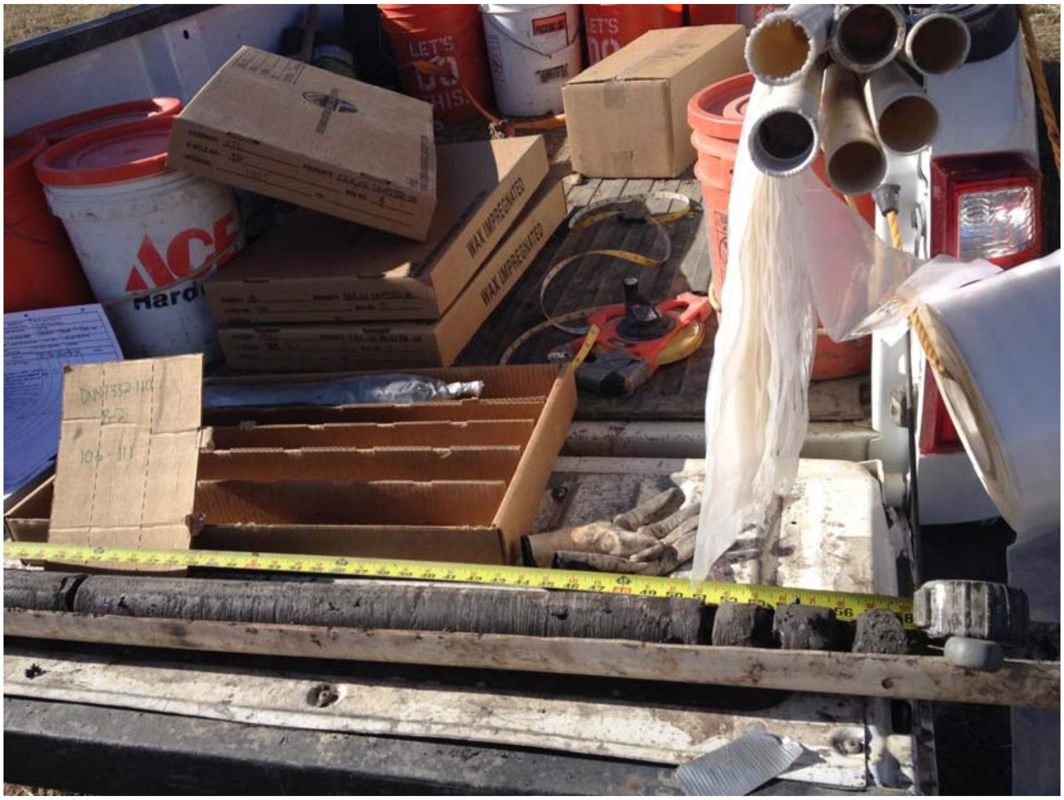
VIEW OF CORE B-2 AT 96.0-101.0

VIEW OF CORE B-2 AT 101.0-106.0

VIEW OF CORE B-2 AT 101.0-106.0

VIEW OF CORE B-2 AT 106.0-111.0

VIEW OF CORE B-2 AT 106.0-111.0



VIEW OF CORE B-2 AT 106.0-111.0

VIEW OF CORE B-2 AT 111.0-116.0

VIEW OF CORE B-2 AT 111.0-116.0

VIEW OF CORE B-2 AT 116.0-121.0

VIEW OF CORE B-2 AT 116.0-121.0

VIEW OF CORE B-2 AT 121.0-126.0

VIEW OF CORE B-2 AT 121.0-126.0

VIEW OF CORE B-2 AT 121.0-126.0

VIEW OF CORE B-3 AT 19.0-22.0

VIEW OF CORE B-3 AT 27.0-29.5

VIEW OF CORE B-3 AT 29.5-32.0

VIEW OF CORE B-3 AT 32.0-37.0

VIEW OF CORE B-3 AT 32.0-37.0

VIEW OF CORE B-3 AT 37.0-42.0

FIG. B-34

VIEW OF CORE B-3 AT 42.0-47.0

VIEW OF CORE B-3 AT 42.0-47.0

VIEW OF CORE B-3 AT 47.0-52.0

VIEW OF CORE B-3 AT 47.0-52.0

VIEW OF CORE B-3 AT 52.0-57.0

VIEW OF CORE B-3 AT 52.0-57.0

FIG. B-37

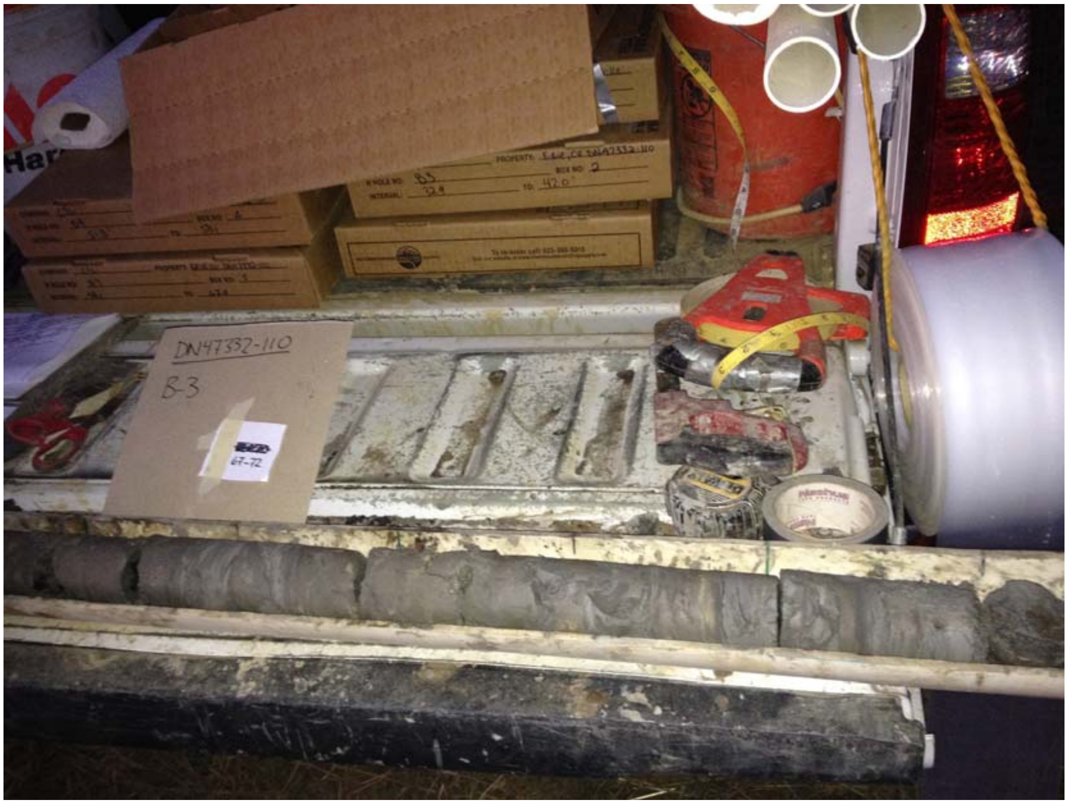
VIEW OF CORE B-3 AT 57.0-62.0

VIEW OF CORE B-3 AT 57.0-62.0

VIEW OF CORE B-3 AT 62.0-67.0

VIEW OF CORE B-3 AT 62.0-67.0

VIEW OF CORE B-3 AT 67.0-72.0



VIEW OF CORE B-3 AT 67.0-72.0

VIEW OF CORE B-3 AT 72.0-77.0

VIEW OF CORE B-3 AT 72.0-77.0

FIG. B-41

VIEW OF CORE B-3 AT 77.0-82.0

VIEW OF CORE B-3 AT 77.0-82.0

VIEW OF CORE B-3 AT 82.0-87.0

VIEW OF CORE B-3 AT 82.0-87.0

VIEW OF CORE B-3 AT 82.0-87.0

VIEW OF CORE B-3 AT 87.0-92.0

VIEW OF CORE B-3 AT 87.0-92.0

VIEW OF CORE B-3 AT 92.0-97.0

VIEW OF CORE B-3 AT 92.0-97.0

VIEW OF CORE B-3 AT 97.0-102.0

FIG. B-46

VIEW OF CORE B-3 AT 97.0-102.0

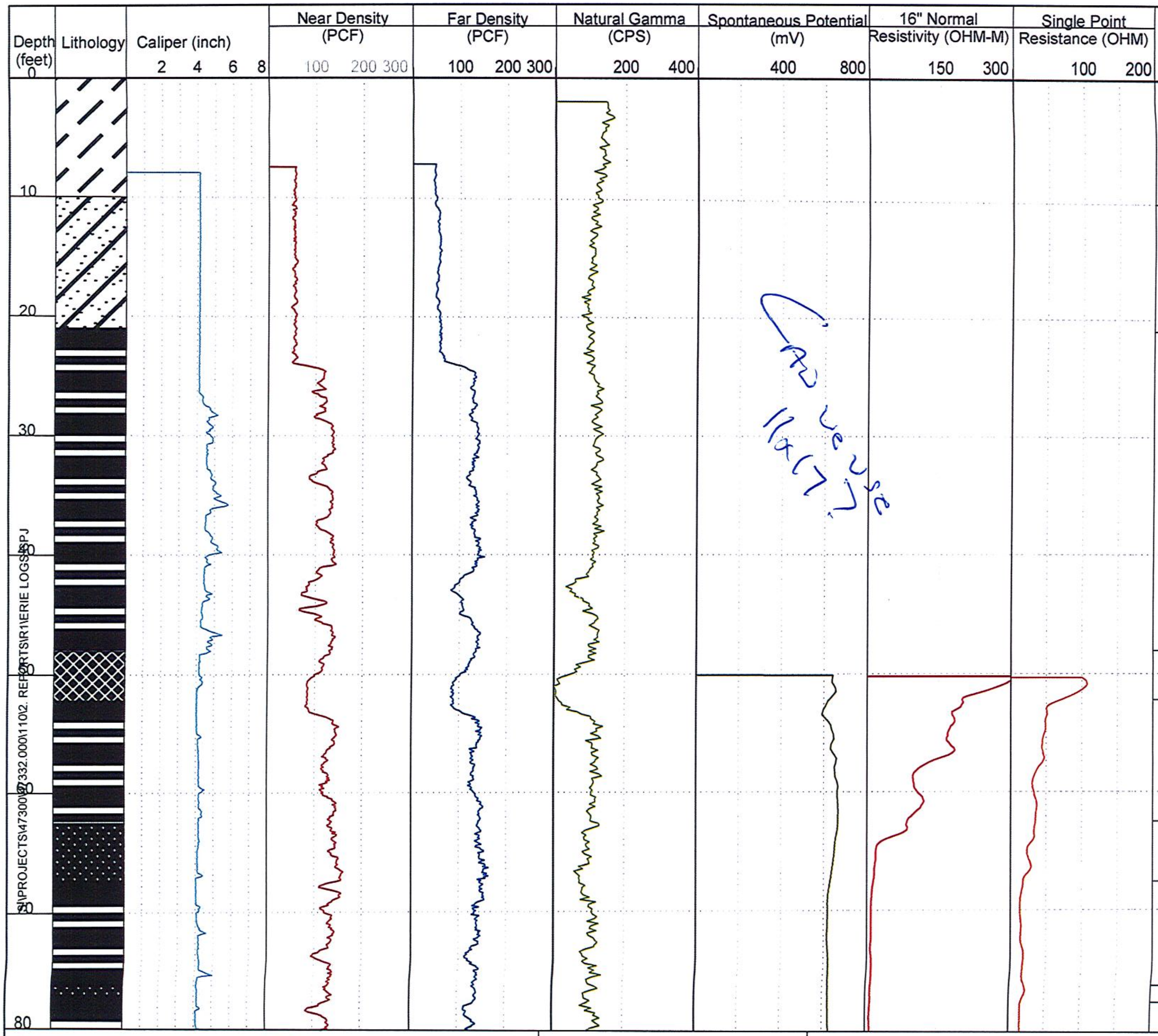
VIEW OF CORE B-3 AT 102.0-107.0

VIEW OF CORE B-3 AT 102.0-107.0

VIEW OF CORE B-3 AT 102.0-107.0

APPENDIX C

GEOPYSICAL TEST LOGS



Can we use 11x17?

Material Description

CLAY, SANDY, SILTY, MOIST, BROWN.

SAND, SILTY, MOIST TO VERY MOIST, LIGHT BROWN, LIGHT YELLOWISH-BROWN.

CLAYSTONE, SLIGHTLY SANDY, SLIGHTLY SILTY, MOIST, LIGHT GRAYISH BROWN, CONTAINS OCCASIONAL LIGNITE.

COAL, BLACK.

CLAYSTONE, SLIGHTLY SANDY, LIGHT TO GRAYISH BROWN.

SANDSTONE, LIGHT GRAY, BROWN, FINE GRAINED.

CLAYSTONE, FRACTURED, GRAY TO GRAYISH BROWN, MOIST, SLIGHTLY SANDY.

SANDSTONE, SILTY.

CLAYSTONE, DARK BROWN,

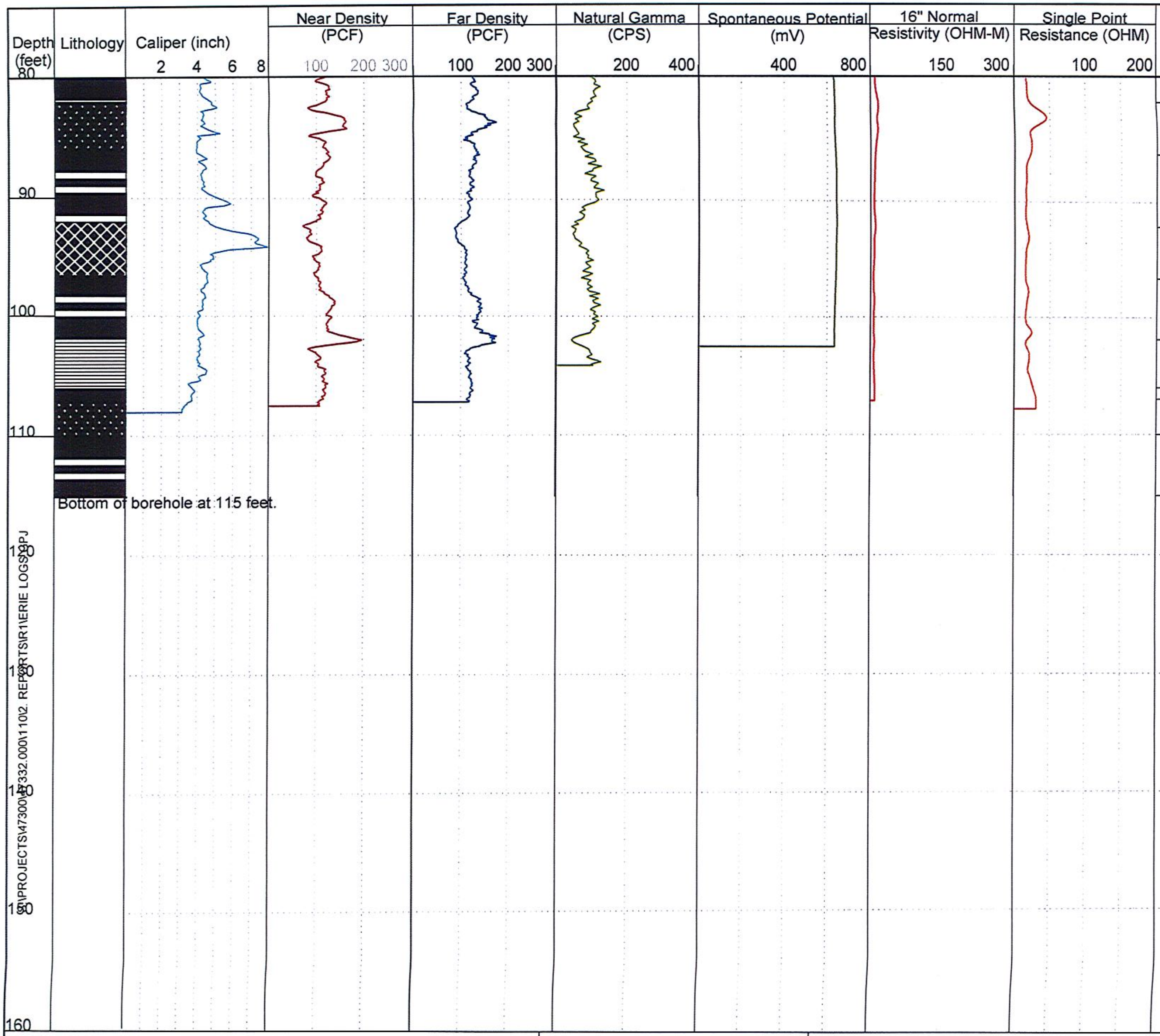
GEOPHYSICAL TEST LOG: B-1

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



Material Description

CONTAINED PERFIED WOOD.

SANDSTONE, LIGHT GRAY TO GRAY, FINE GRAINED.

CLAYSTONE, FRACTURED, GRAY TO GRAYISH BROWN, CONTAINS GRAVEL.

COAL/LIGNITE, FRACTURED, DARK GRAY TO BROWN.

CLAYSTONE, DARK GRAY, BROWN.

RUBBLE, LIGHT GRAY.

CLAYSTONE, DARK GRAY, BROWN.

SANDSTONE.

CLAYSTONE, SANDY, FRACTURED, GRAY.

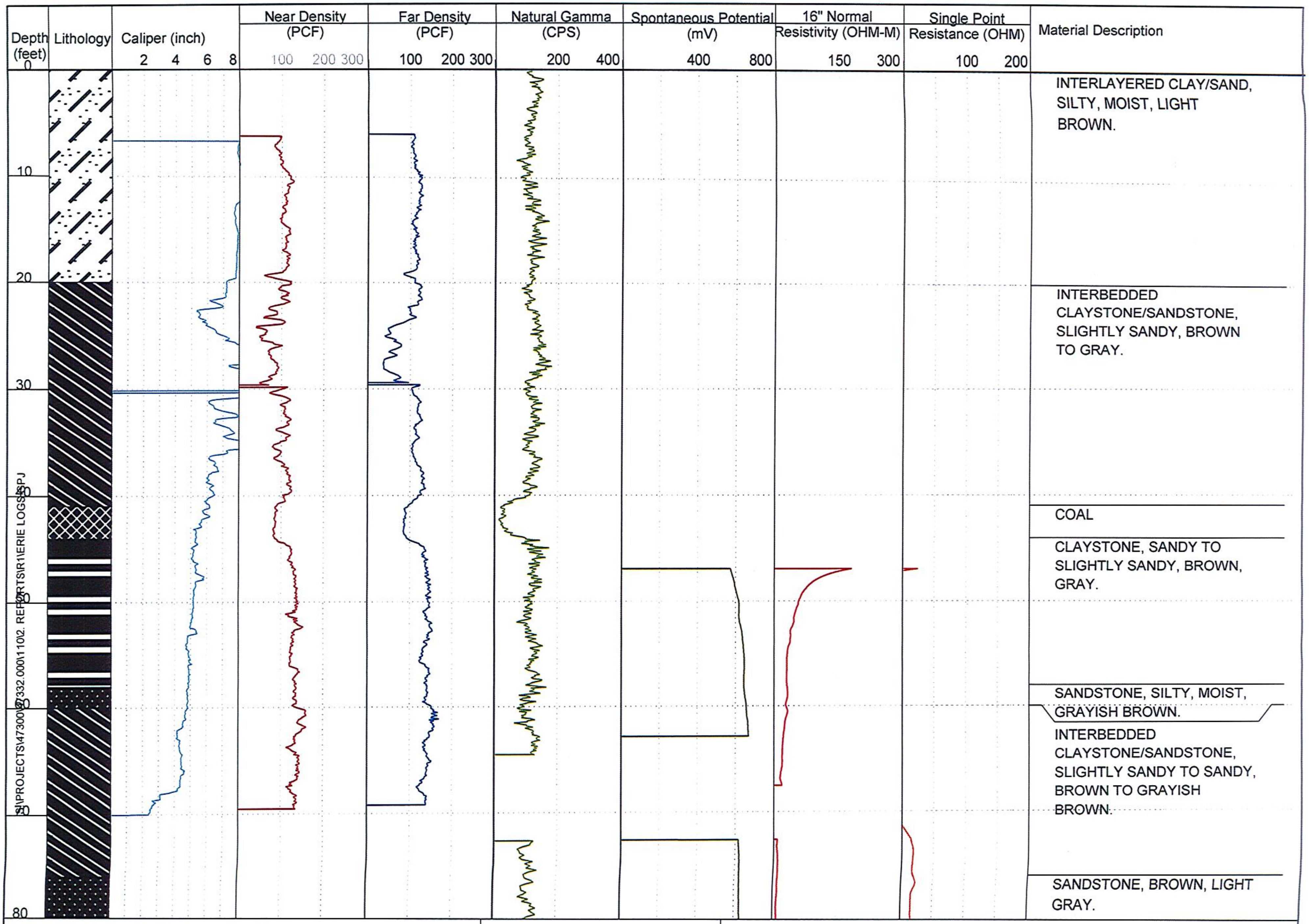
GEOPHYSICAL TEST LOG: B-1

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



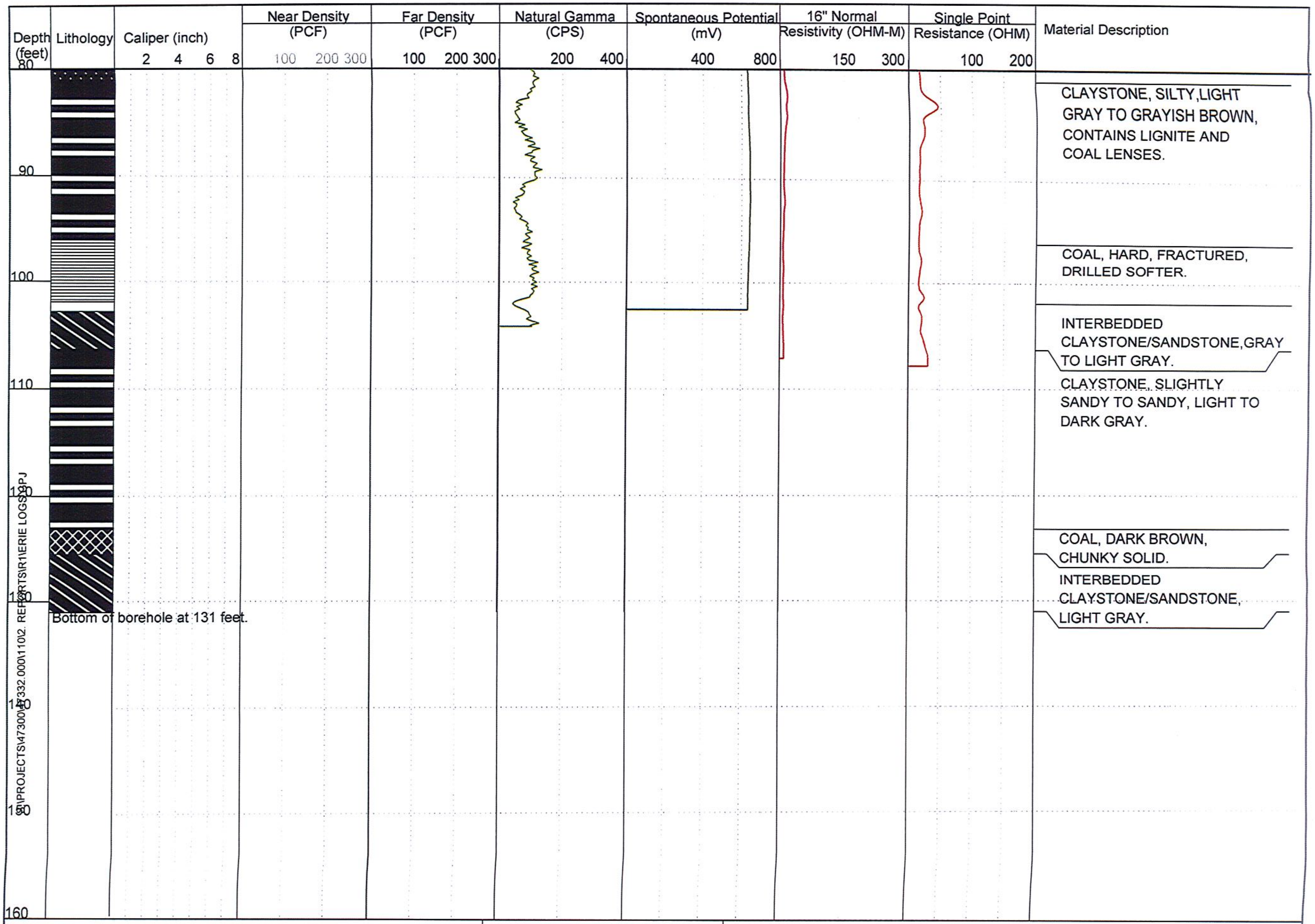
GEOPHYSICAL TEST LOG: B-2

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



CLAYSTONE, SILTY, LIGHT GRAY TO GRAYISH BROWN, CONTAINS LIGNITE AND COAL LENSES.

COAL, HARD, FRACTURED, DRILLED SOFTER.

INTERBEDDED CLAYSTONE/SANDSTONE, GRAY TO LIGHT GRAY.

CLAYSTONE, SLIGHTLY SANDY TO SANDY, LIGHT TO DARK GRAY.

COAL, DARK BROWN, CHUNKY SOLID.

INTERBEDDED CLAYSTONE/SANDSTONE, LIGHT GRAY.

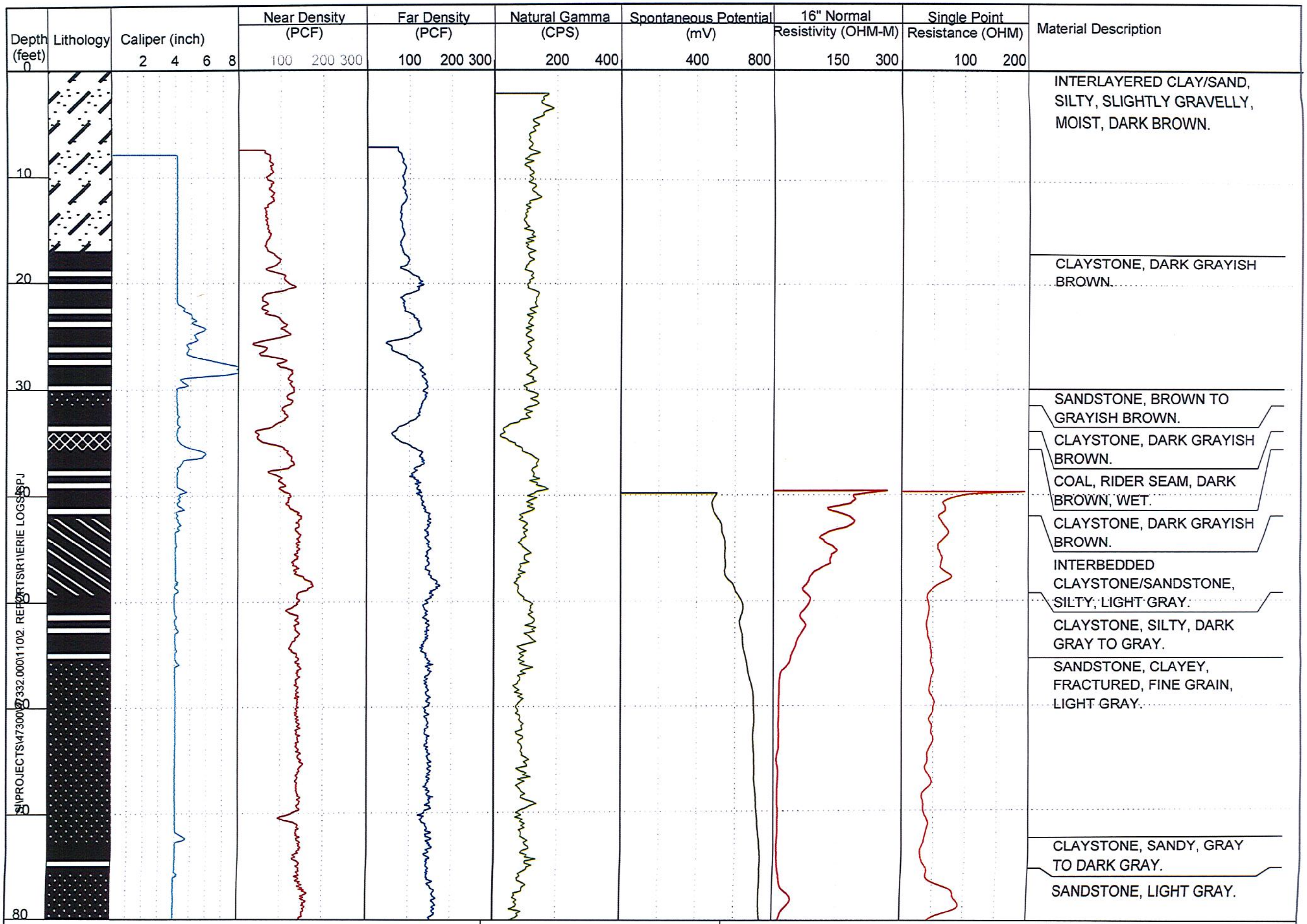
GEOPHYSICAL TEST LOG: B-2

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



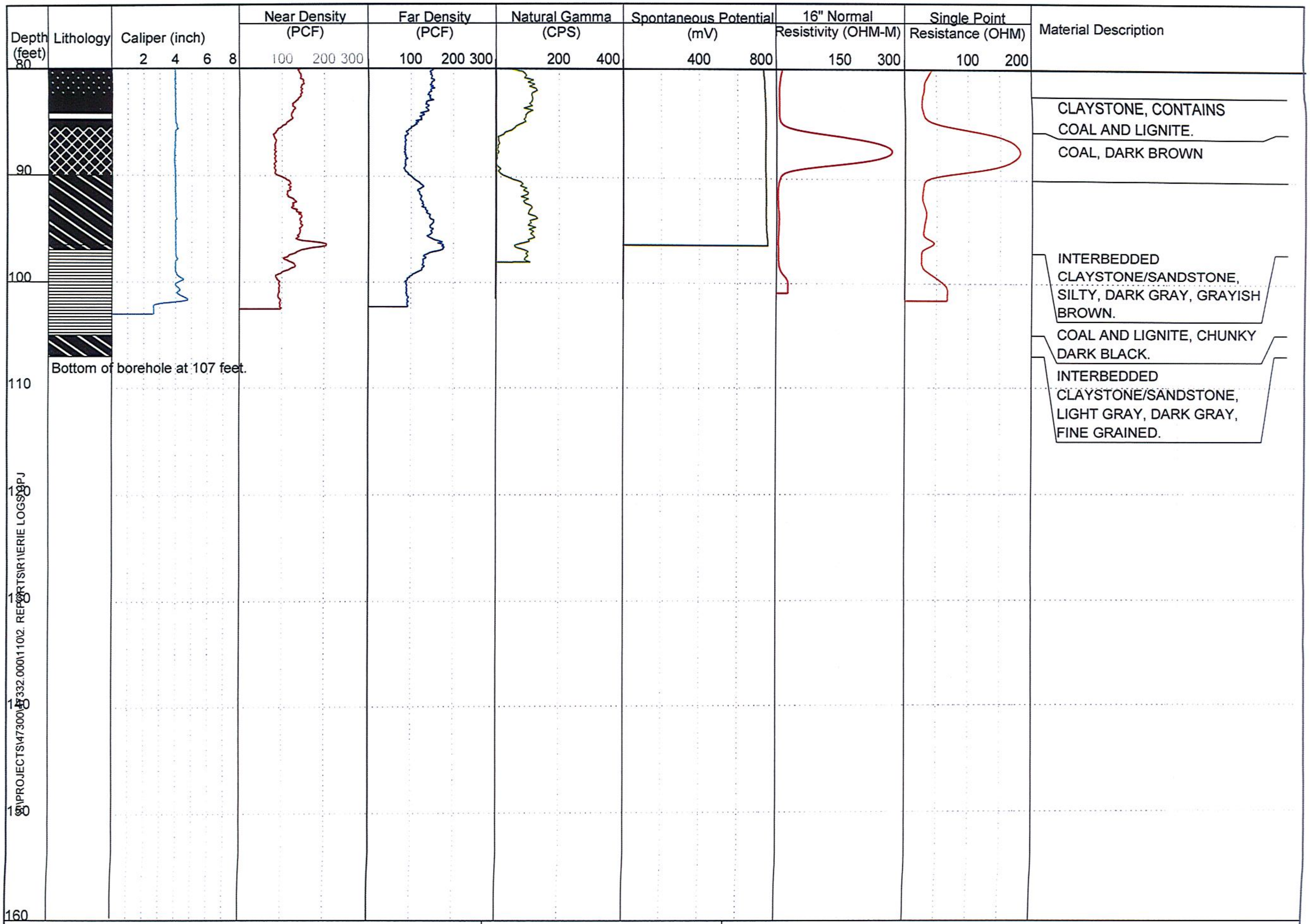
GEOPHYSICAL TEST LOG: B-3

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



CLAYSTONE, CONTAINS COAL AND LIGNITE.

COAL, DARK BROWN

INTERBEDDED CLAYSTONE/SANDSTONE, SILTY, DARK GRAY, GRAYISH BROWN.

COAL AND LIGNITE, CHUNKY DARK BLACK.

INTERBEDDED CLAYSTONE/SANDSTONE, LIGHT GRAY, DARK GRAY, FINE GRAINED.

Bottom of borehole at 107 feet.

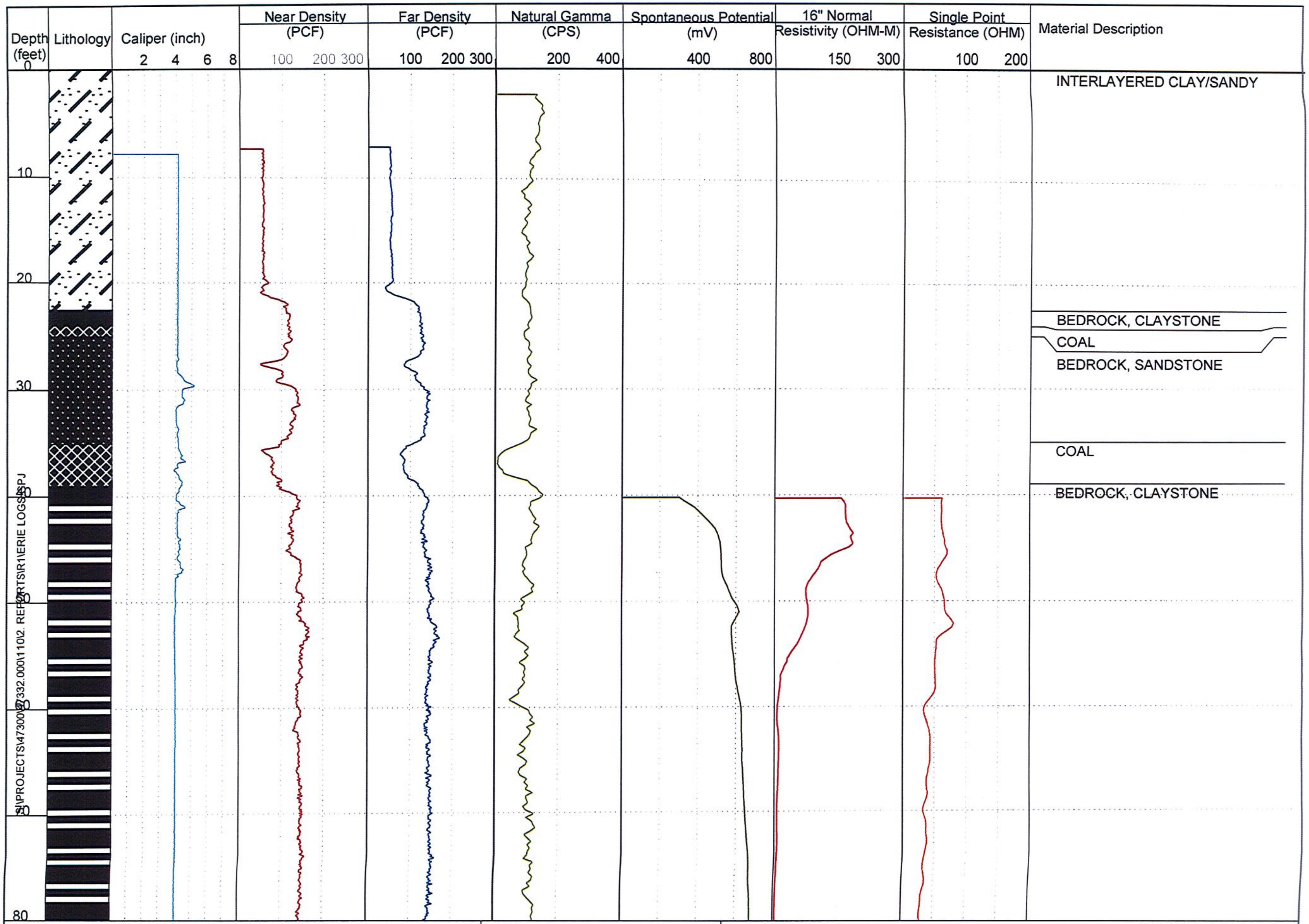
GEOPHYSICAL TEST LOG: B-3

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



GEOPHYSICAL TEST LOG: B-4

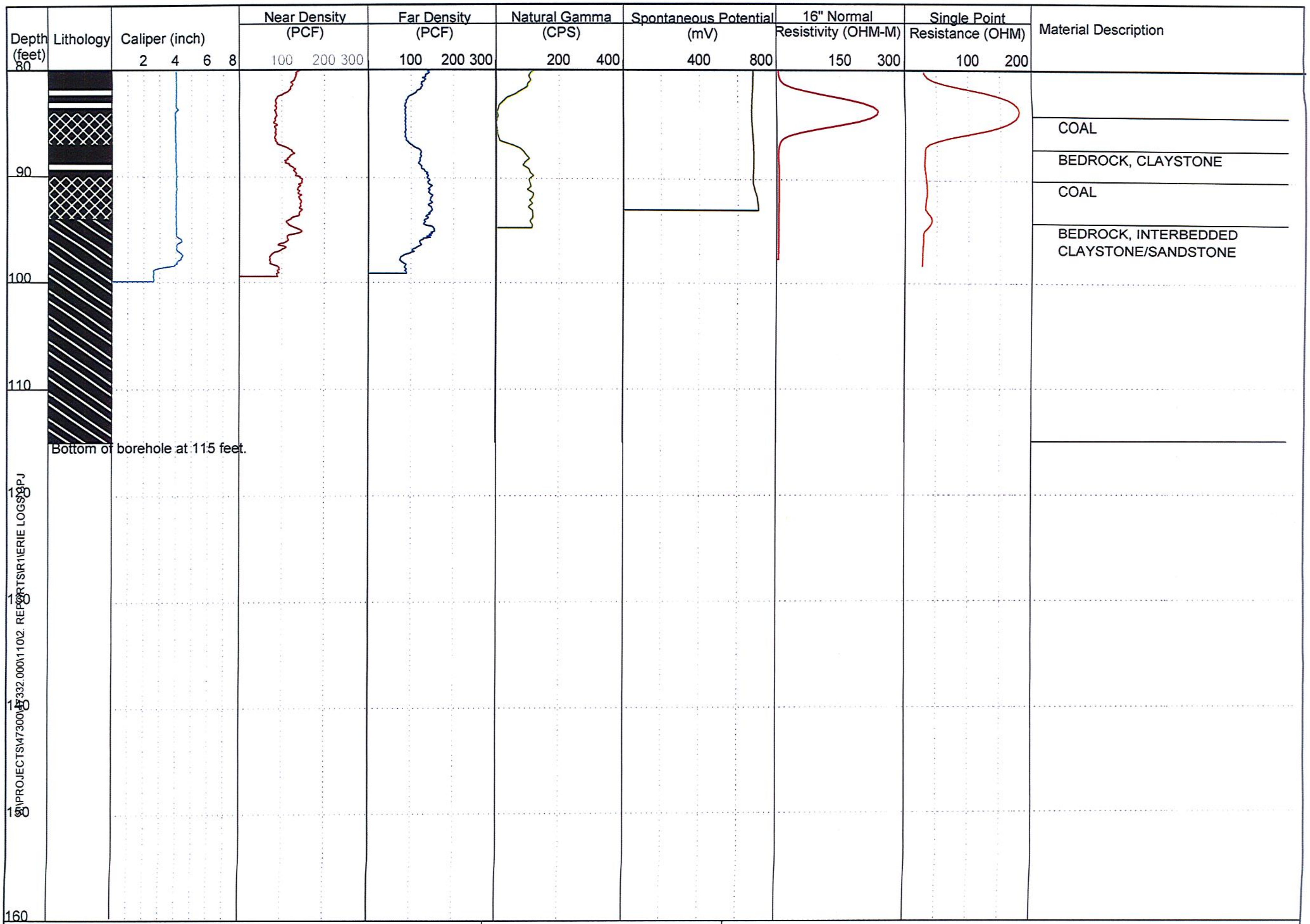
CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110

PAGE 1 OF 2



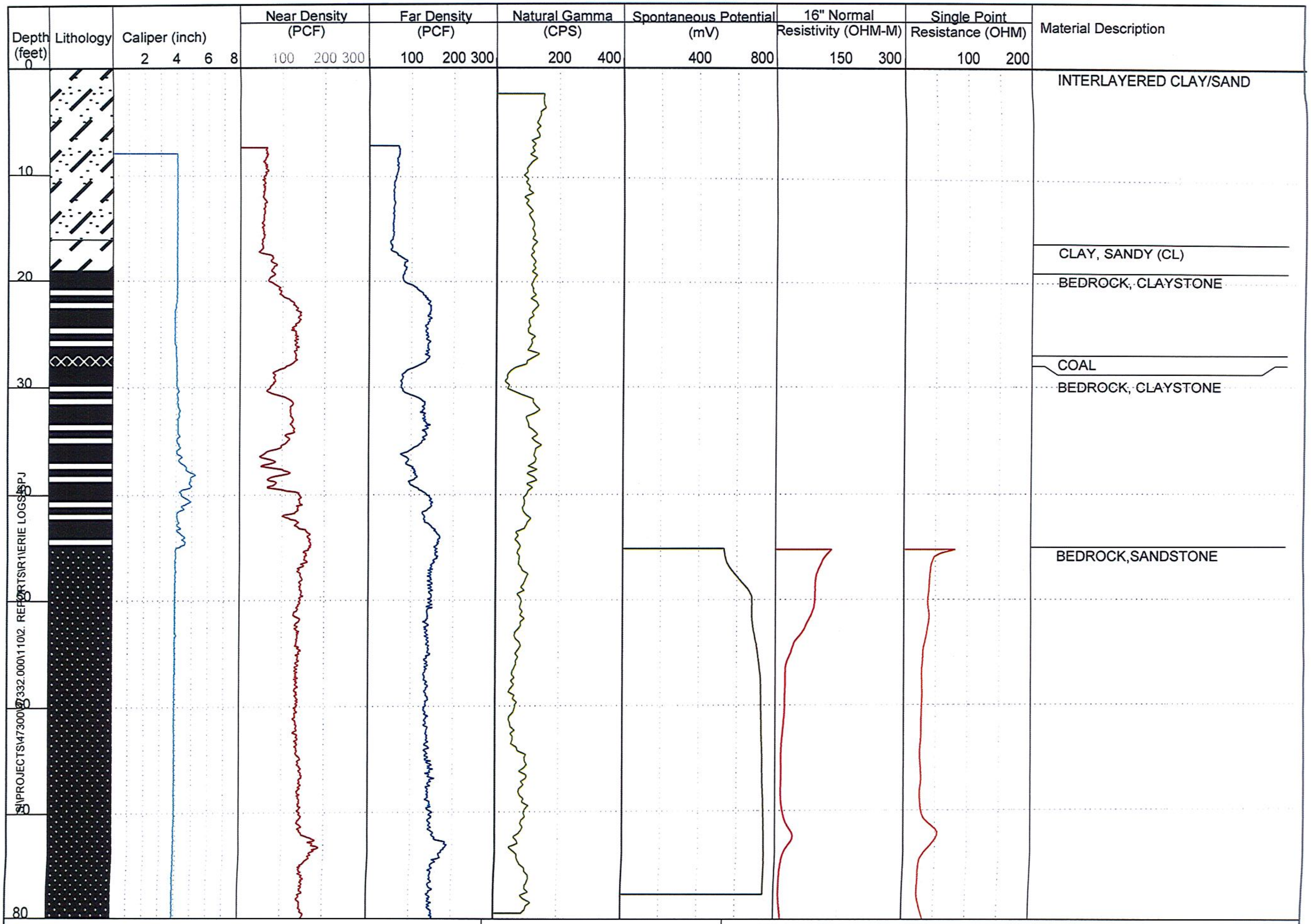
GEOPHYSICAL TEST LOG: B-4

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



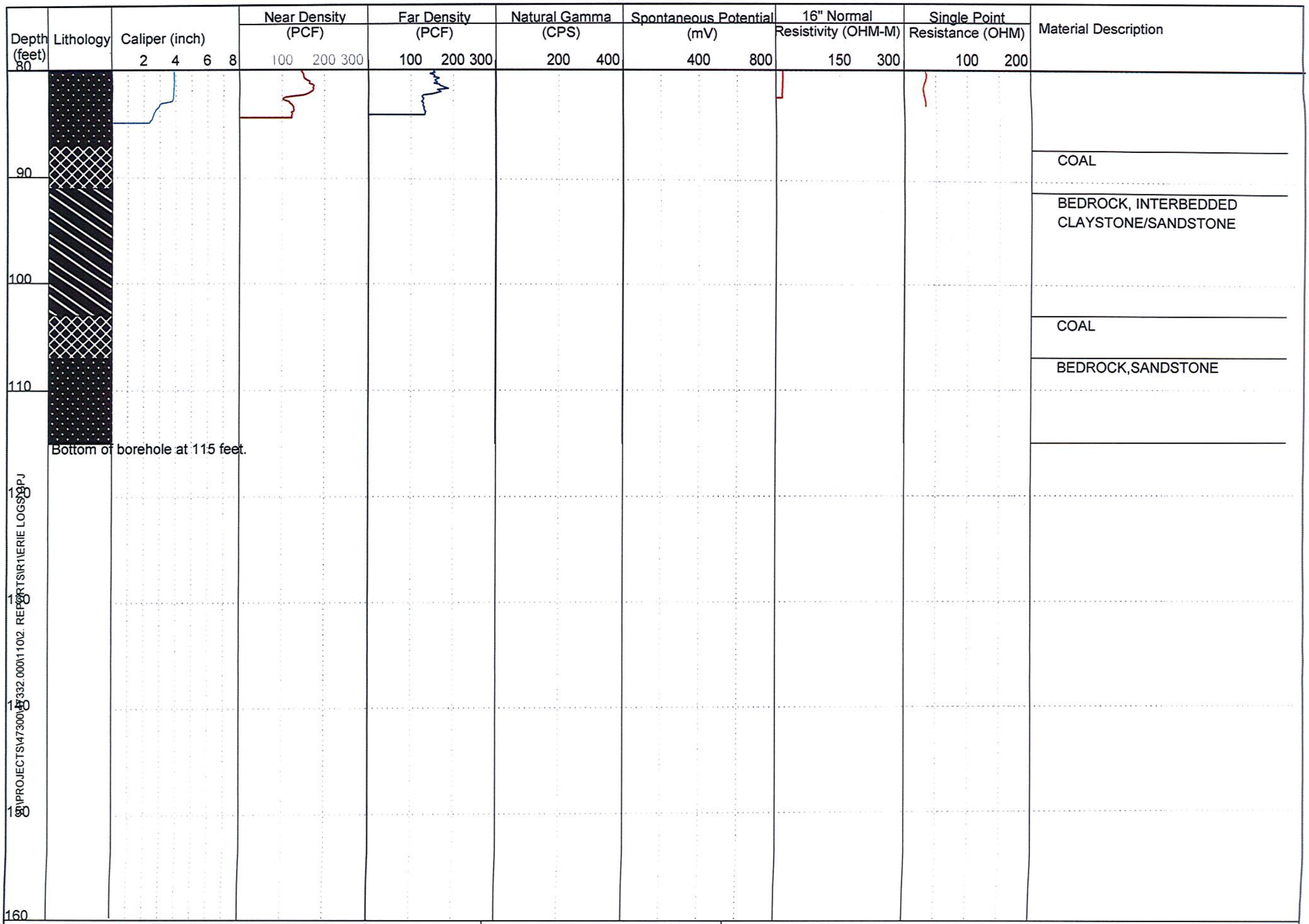
GEOPHYSICAL TEST LOG: B-5
CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110

PAGE 1 OF 2



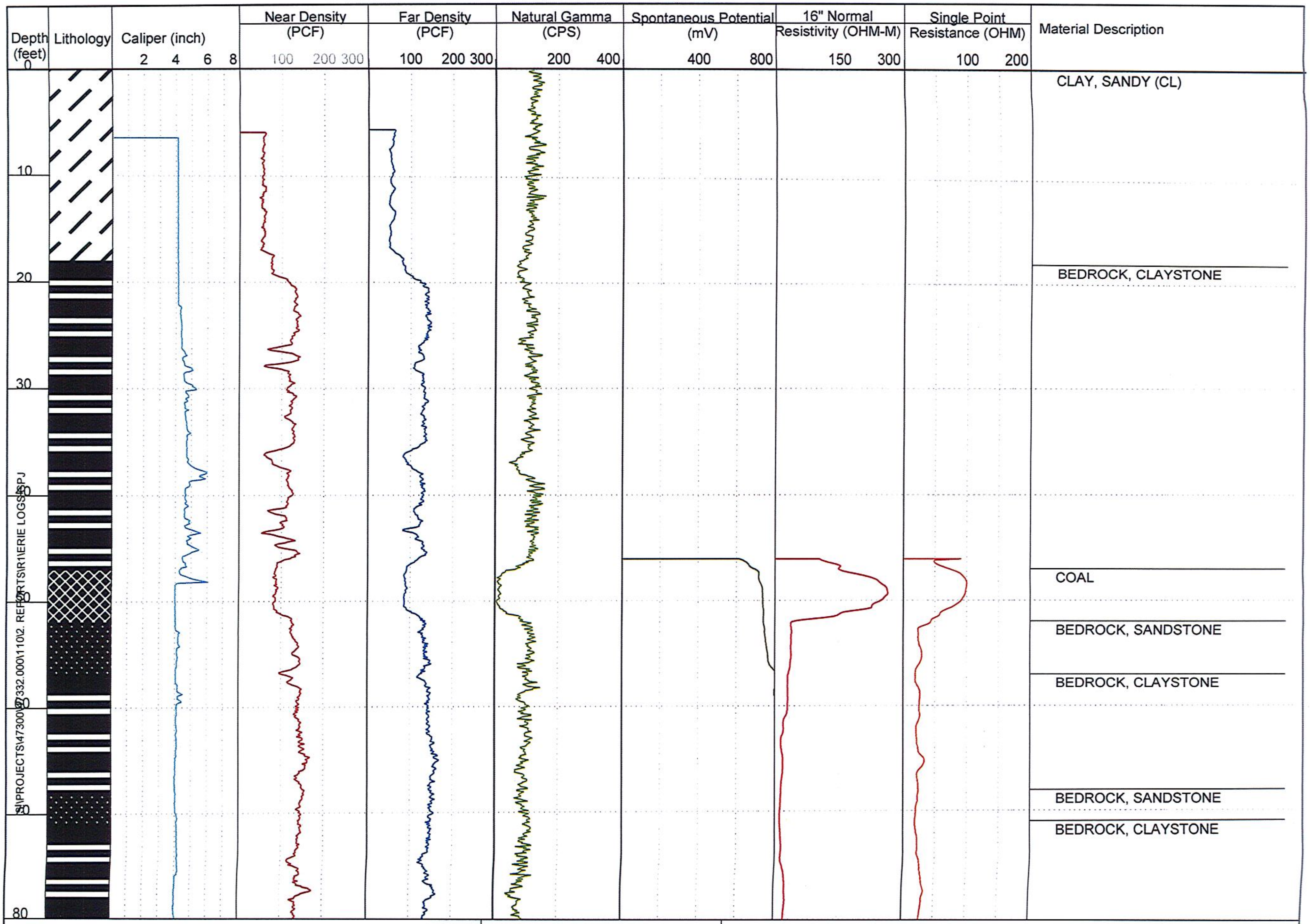
GEOPHYSICAL TEST LOG: B-5

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



GEOPHYSICAL TEST LOG: B-6

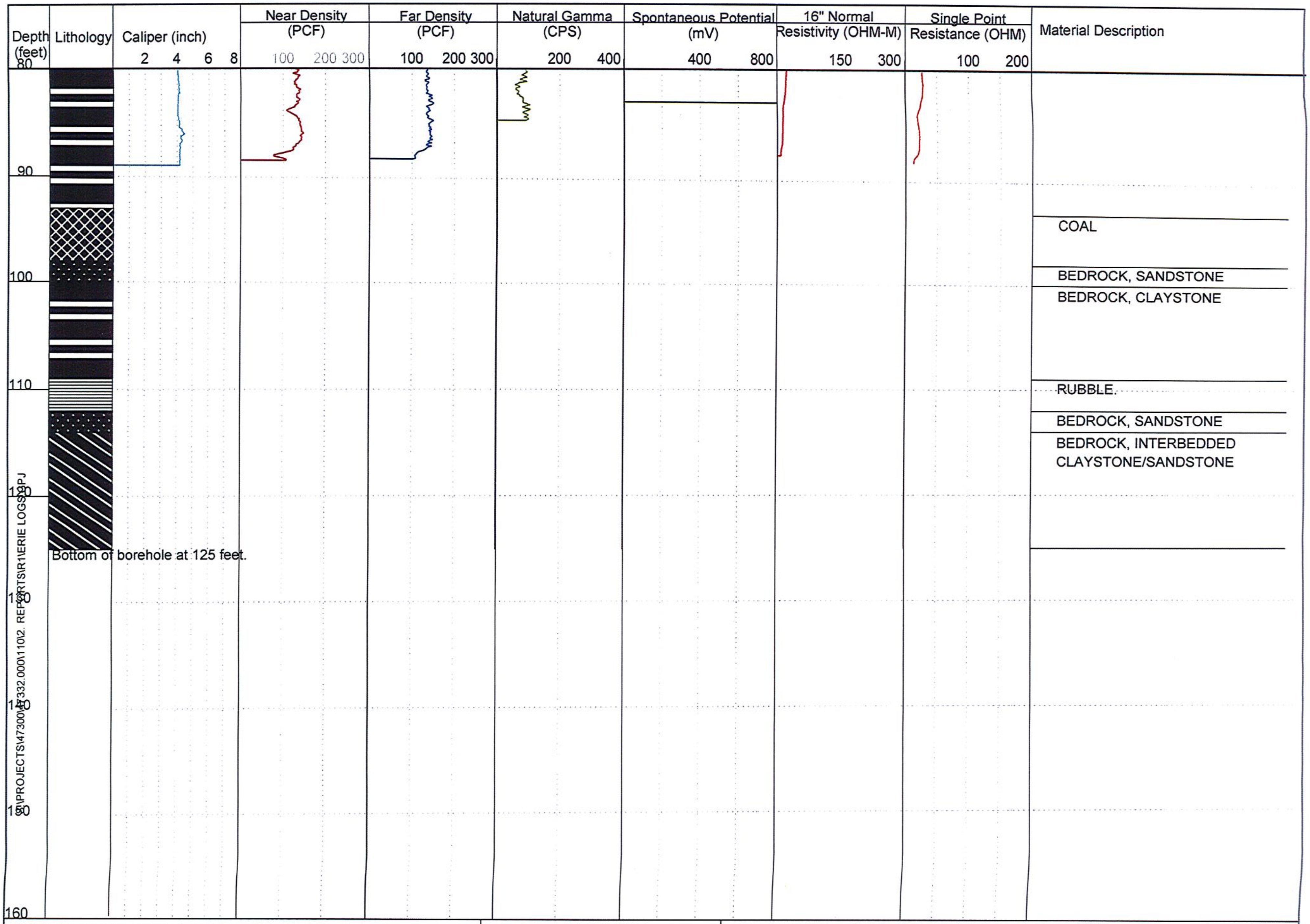
CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110

PAGE 1 OF 2



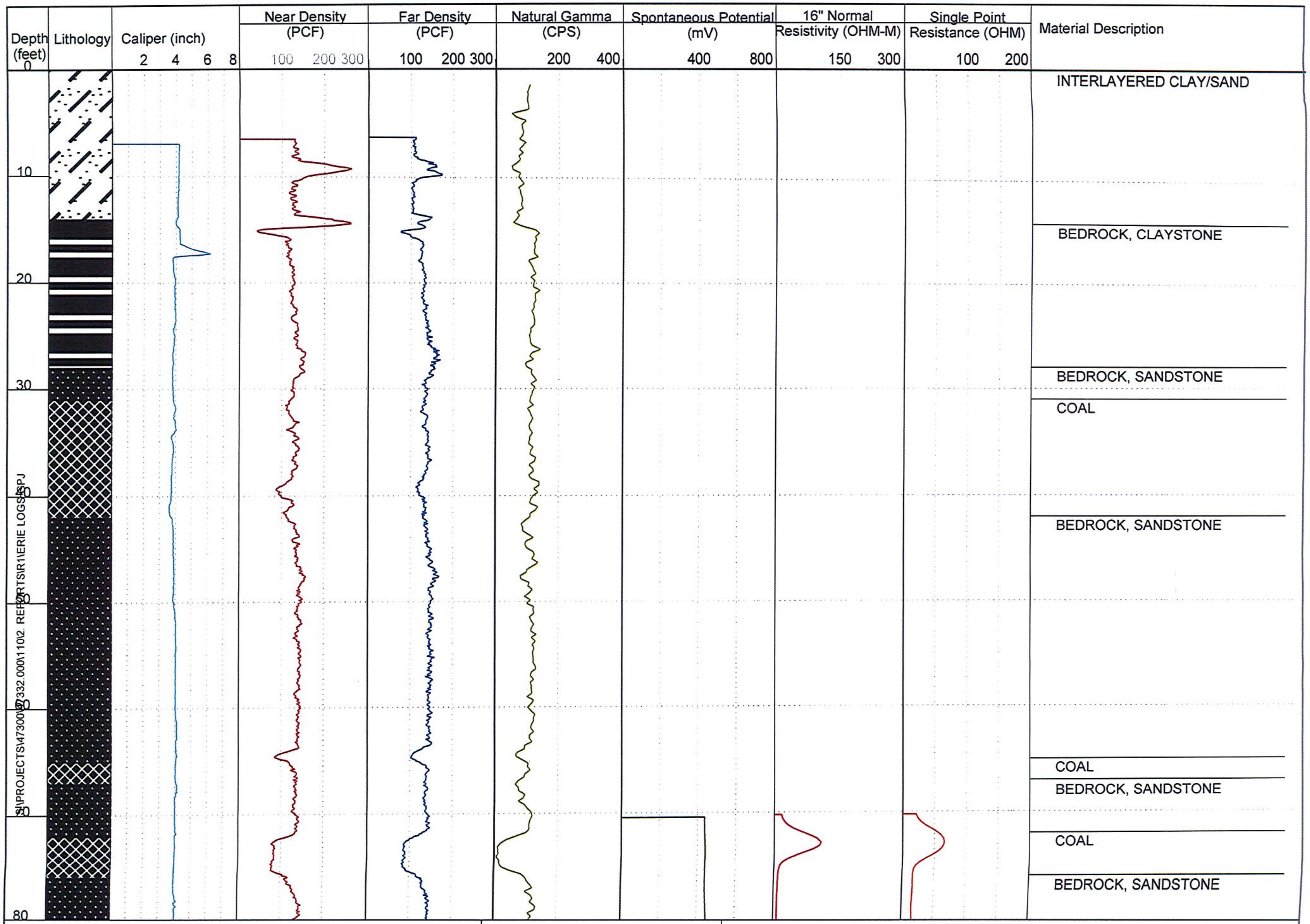
GEOPHYSICAL TEST LOG: B-6

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



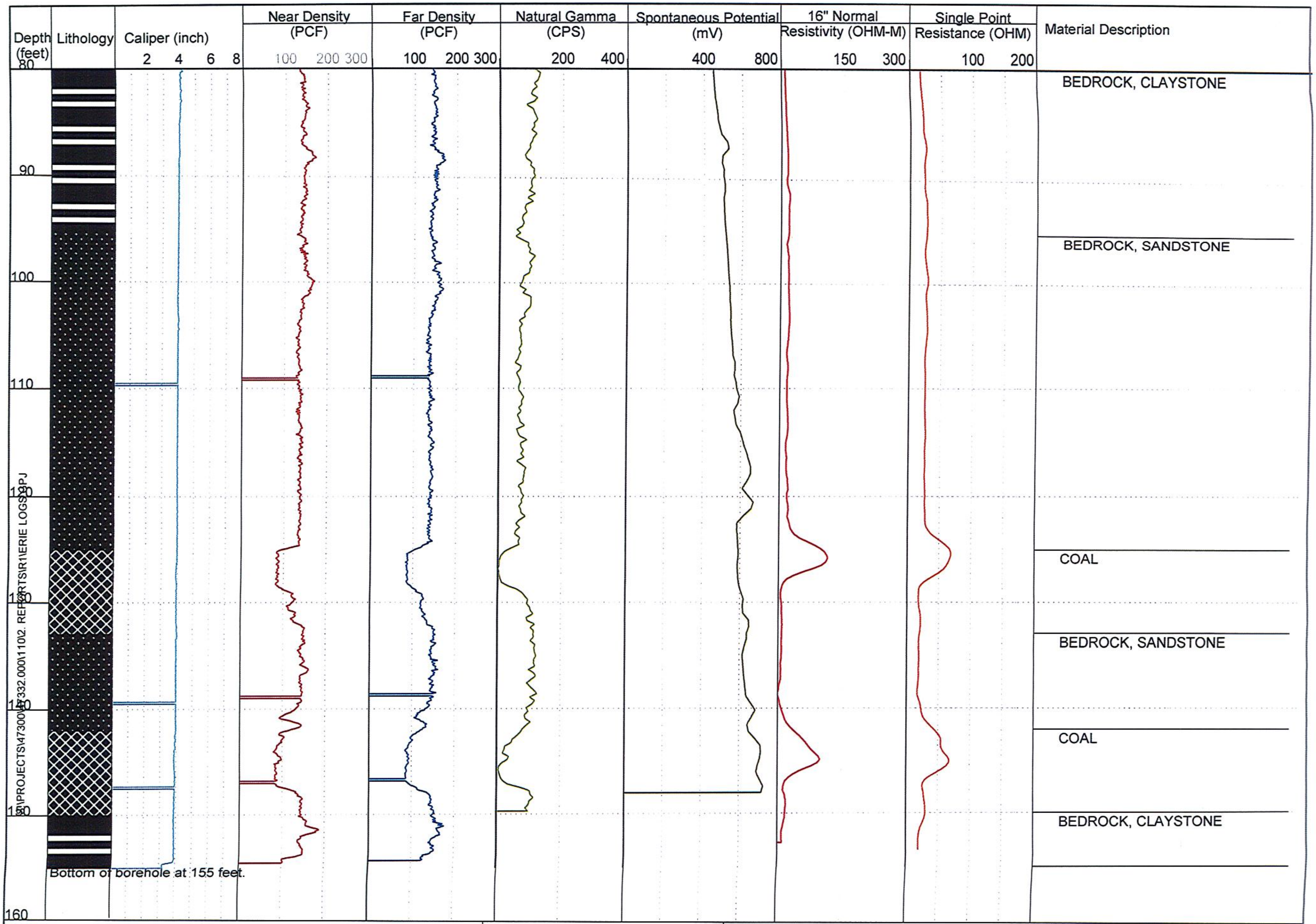
GEOPHYSICAL TEST LOG: B-7

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



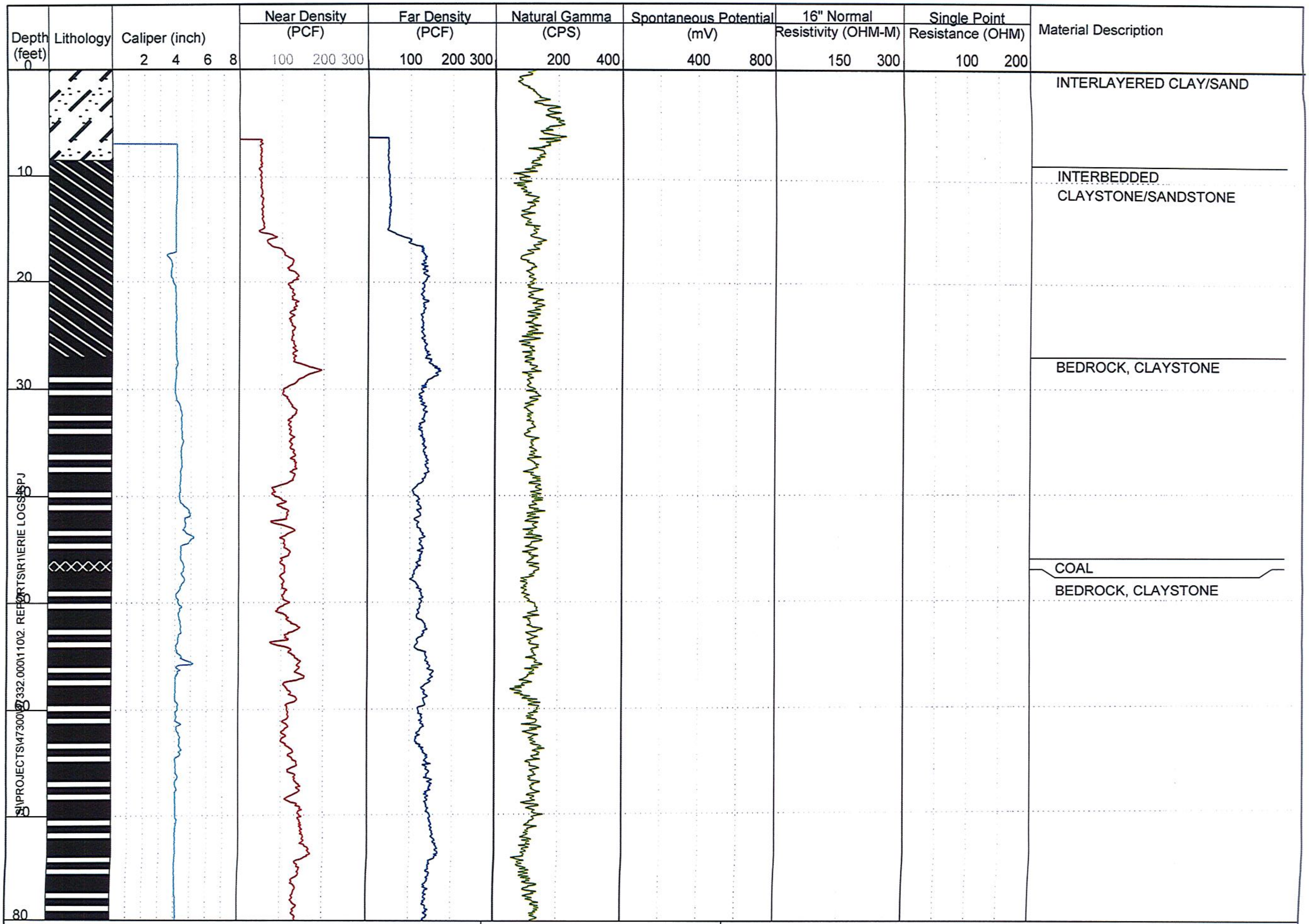
GEOPHYSICAL TEST LOG: B-7

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



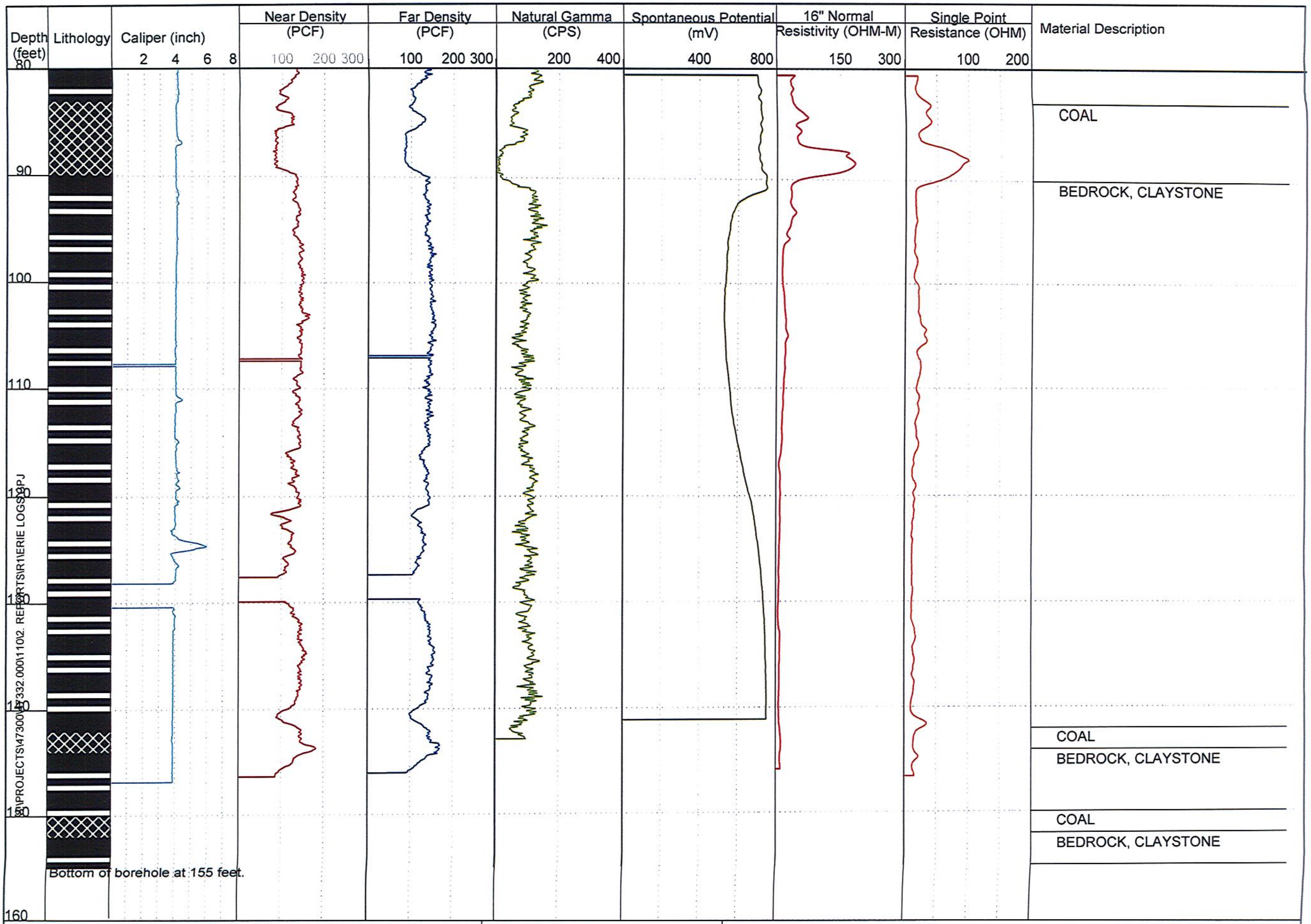
GEOPHYSICAL TEST LOG: B-8

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



GEOPHYSICAL TEST LOG: B-8

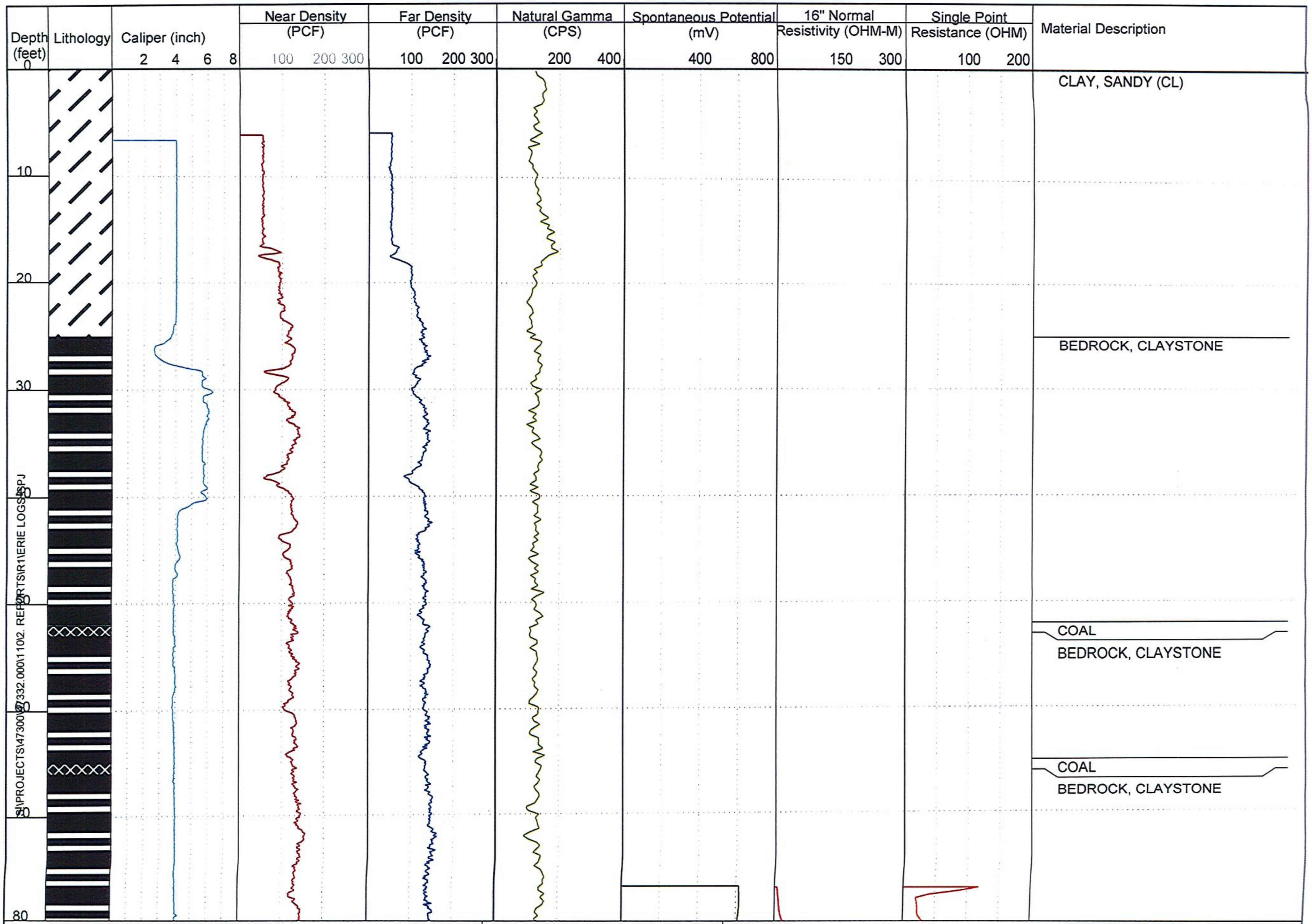
CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:

IDS- COLOG

Erie Parcel

Project No.DN47,332-110



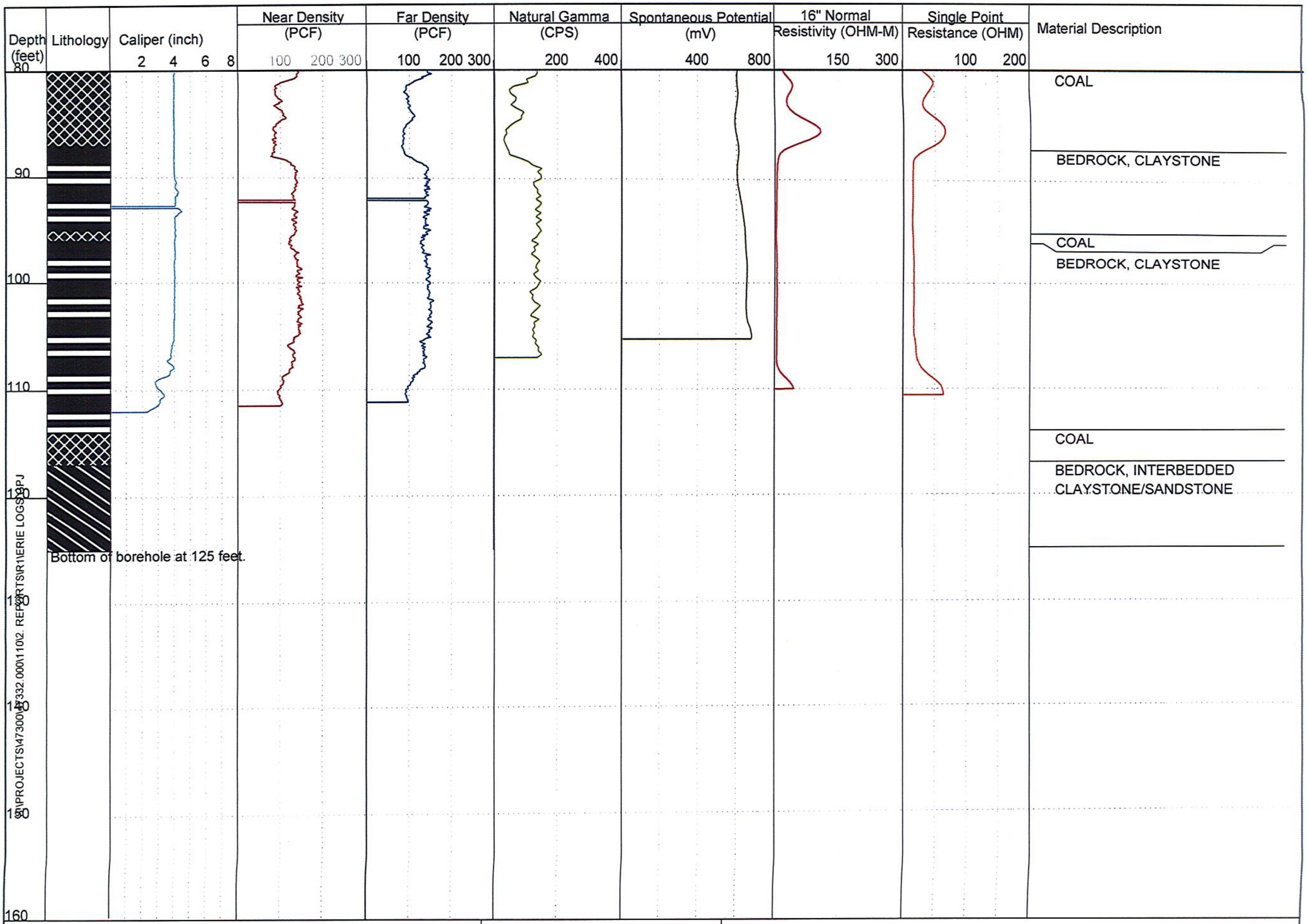
GEOPHYSICAL TEST LOG: B-9

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



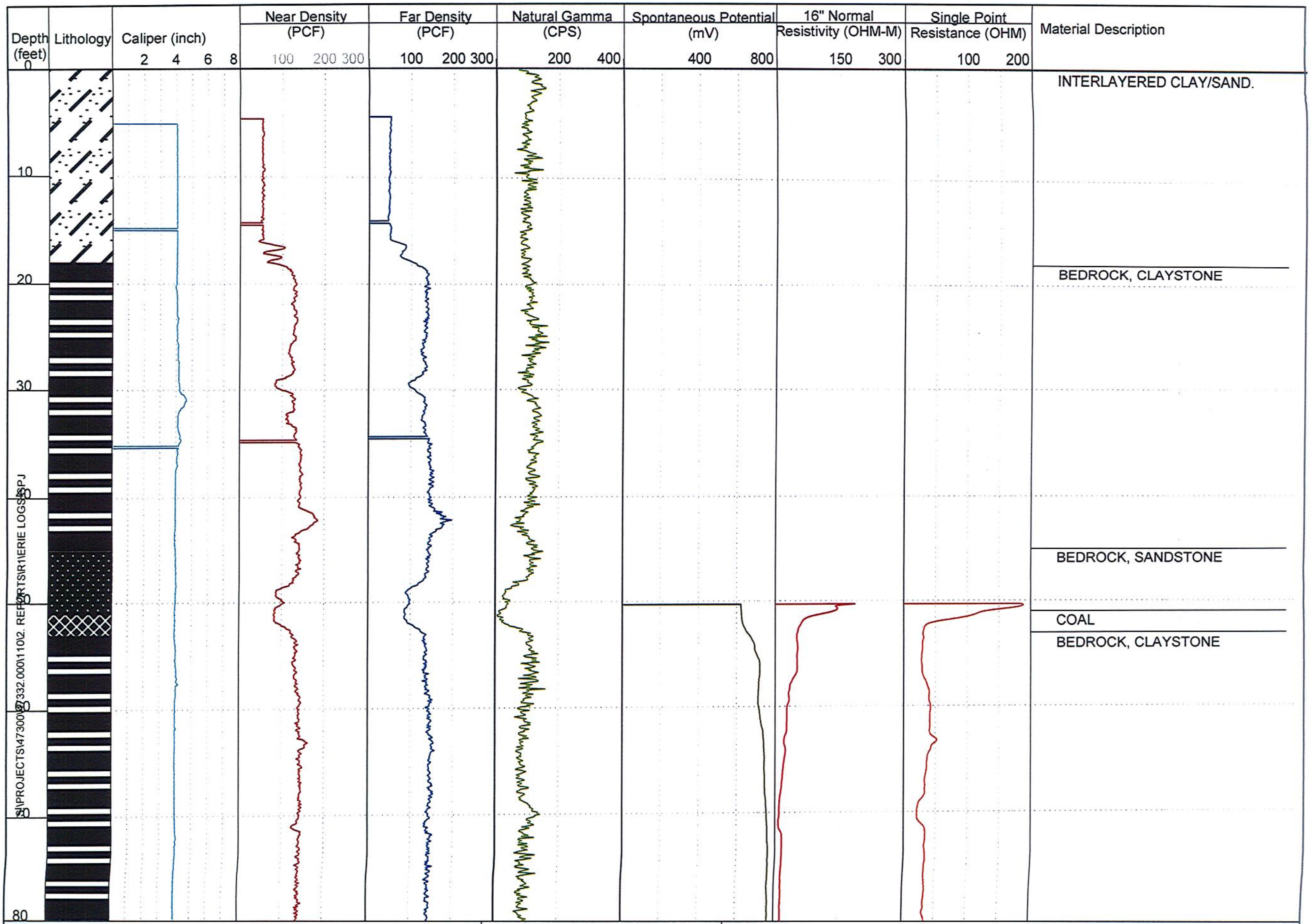
GEOPHYSICAL TEST LOG: B-9

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



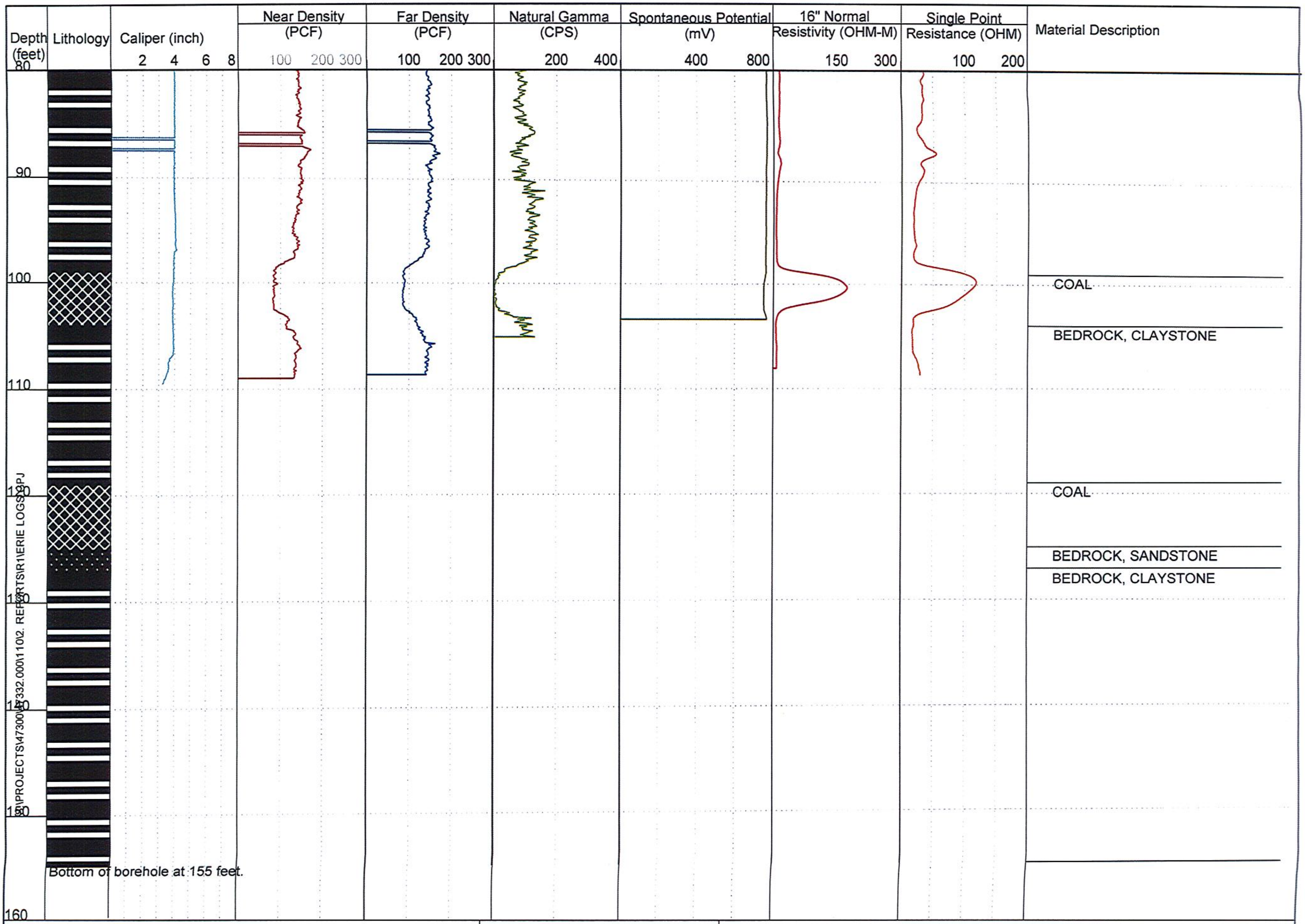
GEOPHYSICAL TEST LOG:B-10

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110



GEOPHYSICAL TEST LOG: B-10

CTL/THOMPSON, INC.
1971 W. 12th Avenue
Denver, CO 80204
Phone: 303-825-0777

GEOPHYSICAL CONTRACTOR:
IDS- COLOG

Erie Parcel

Project No.DN47,332-110

PAGE 2 OF 2

FINAL DRAINAGE REPORT

FOR

Canyon Creek Subdivision
Filing No. 10
Four Corners Commercial Area 1
Erie, Colorado

Prepared for:

Foundry Builders, Inc.
1002 Griffith Street
Louisville, CO. 80027
(720) 524-3620
Contact: Justin McClure

Prepared by:

Kimley-Horn and Associates, Inc.
4582 South Ulster Street, Suite 1500
Denver, Colorado 80237
(303) 228-2300
Contact: Kevin Barney, P.E.

Kimley»Horn

Project #: 094000003

Prepared: September 8, 2017
Revised: January 24, 2018

TABLE OF CONTENTS

TABLE OF CONTENTS **0**

CERTIFICATION **1**

ENGINEERS STATEMENT 1

VICINITY MAP **2**

INTRODUCTION **2**

LOCATION 2
DESCRIPTION OF PROPERTY 3
ADJACENT AREAS 3

DRAINAGE SYSTEM BASINS **4**

MAJOR DRAINAGE BASIN DESCRIPTION 4
SUB-BASINS 4
GENERAL CONCEPT *4*
BASIN A *5*
BASIN B *5*
BASIN C *5*
OFF-SITE AND FUTURE BASINS *6*
BASIN H *6*
DOWNSTREAM SYSTEM 6

DESIGN CRITERIA: **6**

REGULATIONS 6
DEVELOPMENT CRITERIA REFERENCE AND CONSTRAINTS 6
HYDROLOGIC CRITERIA 7
HYDRAULIC CRITERIA 7
ADAPTATIONS FROM CRITERIA 8

DRAINAGE FACILITY DESIGN **8**

CONCLUSIONS **9**

REFERENCES **9**

APPENDICES **10**

APPENDIX A – FIGURES AND SUPPORTING DOCUMENTS
APPENDIX B – HYDROLOGIC CALCULATIONS
APPENDIX C – HYDRAULIC CALCULATIONS
APPENDIX D – DRAINAGE MAPS

CERTIFICATION

ENGINEERS STATEMENT

“This Phase III Drainage Report (plan) for Canyon Creek Subdivision Filing No. 10, Four Corners – Commercial Area 1 was prepared by me (or under my supervision) in accordance with the provisions of Town of Erie Standards and Specifications for Design and Construction, and was designed to comply with the provisions thereof. I understand that the Town of Erie does not, and will not, assume liability for drainage facilities designed by others.”

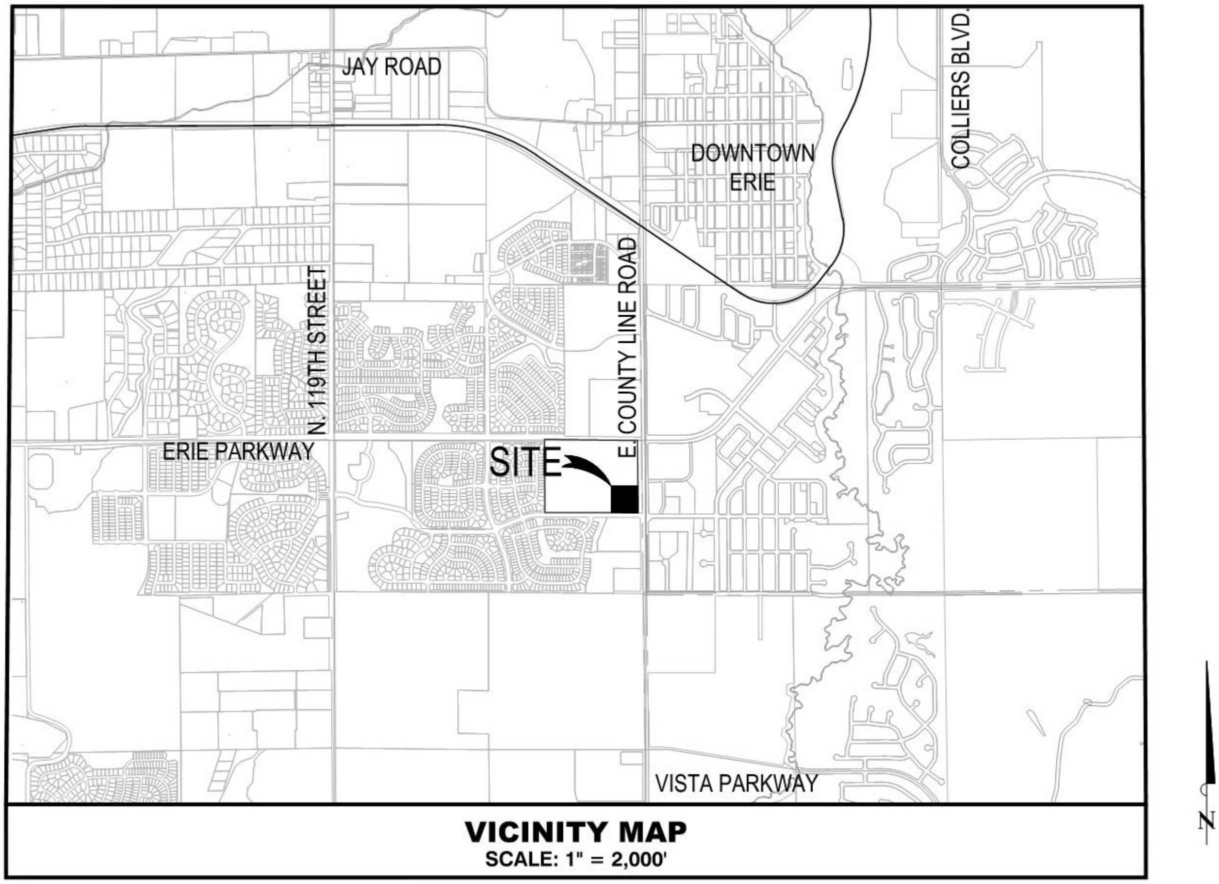
____
By: Kevin P. Barney, P.E.
Licensed Professional Engineer
State of Colorado No. 39719

TOWN ACCEPTANCE

“This report has been reviewed and found to be in general compliance with the *Town of Erie Standards and Specifications for Design and Construction* and other Town requirements. THE ACCURACY AND VALIDITY OF THE ENGINEERING DESIGN, DETAILS, DIMENSIONS, QUANTITIES AND CONCEPTS IN THIS REPORT REMAINS THE SOLE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE APPEAR HEREON.

Accepted by: ______________________________ ________________________
Deputy Public Works Director Date

VICINITY MAP



VICINITY MAP
SCALE: 1" = 2,000'

INTRODUCTION

The purpose of this report is to provide the Town of Erie and the developer the supporting calculations for the final design of the proposed drainage facilities for Canyon Creek Subdivision Filing No. 10, Four Corners Commercial Area 1. The narrative provides a comprehensive description of the project, the hydrologic and hydraulic design methodologies utilized, and a summary of the final design of drainage facilities. The narrative also describes how this development complies with the Town of Erie Outfall Systems Plan (West of Coal Creek), dated January 2014.

LOCATION

Canyon Creek Subdivision Filing No. 10 is located in a portion of the southeast one-quarter of Section 13, and a portion of the southeast one-quarter of Section 13 and a portion of the south one-half Section 24, Township 1 North, Range 69 West of the 6th Principal Meridian, Town of

Erie, Boulder County, Colorado. The overall development consists of approximately 46.61 acres and is bounded on the south by Austin Avenue, on the north by Erie Parkway, on the west by existing Canyon Creek Subdivision Filing No.5, and to the east by the East County Line Road. The tributary area resides in the Erie Commons Reach 1 per the Town of Erie, Outfall Systems Plan (OSP), January 2014. Canyon Creek Subdivision Filing No. 10 is tributary to Reach 1, and ultimately Coal Creek. Canyon Creek Subdivision Filing No. 10, Four Corners Commercial Area 1 will be referred to as the “Site” for the remainder of this report. A Vicinity Map is included on the previous page for reference.

DESCRIPTION OF PROPERTY

The proposed development of the Canyon Creek Subdivision Filing No. 10 will be phased. The first phase of the development, consisting of approximately 3.7 acres within the 46.61 acre property boundary, will be a commercial area at the northwest corner of Austin Avenue and East County Line Road (referred to as “Commercial Area 1”). This first phase includes Lot 1, Lot 2, Pinnacle Boulevard, and the private access drive on the north side. Lot 1 will consist of one commercial building with associated parking areas, drive aisles, and landscaped areas. Lot 2 will not be developed at this time, but is planned to be a future commercial building. The drainage basins that make up the Commercial Area 1 development include Basins A-1 thru A-11, R-1, and R-2. Austin Avenue improvements are also required with this first phase and have been included within this report (Basins B-1 thru B-3). The remaining undeveloped areas are shown as a Tracts A & B on the Canyon Creek Subdivision Filing No. 10 Final Plat (Basins C-1 thru C-3, F-1, and F-2).

As the development continues within the Site, subsequent Phase III Drainage Reports will be submitted with the appropriate planning documents. The Canyon Creek Subdivision Filing No. 10 Underground Water Quality and Detention Facility Construction Plans and Canyon Creek Subdivision Filing No. 10 Overall Phase III report will be submitted by separate document.

On-Site soils consist primarily of sandy loams, as shown on the *Soil Conservation Service Soil Survey of Boulder County maps* (Reference 4) located in Appendix A of this report. Soil classifications with the Site include AcA and MdD. All of the Site soils lie within Hydrologic Soil Groups (HSG) B. Type ‘B’ soils are identified as having medium runoff, moderate infiltration rates and a moderate erosion hazard.

Per Flood Insurance Rate Map for Boulder County, Colorado, Panel 441 of 615 08013C0441J, the site is not within a floodway or floodplain.

There are two mine shafts, Marfel and Pinnacle present on the property. The Pinnacle shaft is located within the Commercial Area developed with this phase. The Pinnacle Shaft has a 40-foot buffer zone from buildings and utilities. A separate Mine Subsidence Investigation has been conducted by CTL Thompson, (Reference 6), and the mine shafts present on the property will be mitigated by separate document before construction.

There are no wetlands areas on this property.

ADJACENT AREAS

The proposed development lies east of the Canyon Creek Subdivision Filing No. 5, which consists of existing, medium-density, residential development. Existing roadway right-of way binds the remaining property edges. Bounding the overall development on the north is Erie Parkway, to the east is East County Line Road and to the south is Austin Avenue.

DRAINAGE SYSTEM BASINS

MAJOR DRAINAGE BASIN DESCRIPTION

The entire Site consists of approximately 46.61 acres and is a single property. Approximately 1.13 acres of the Site is right-of-way for East County Line Road and is dedicated with this plat. The existing land is zoned planned development (PD) and is undeveloped. The Site's existing topography slopes from the southwest corner towards the northeast corner at approximately 2.5%.

The Site is contained within Basin 462 from the OSP (Reference 5) and has a proposed future imperviousness of 79% which correlates to Type B Soil runoff coefficients of 0.74 and 0.85, for the 5-year and 100-year events respectively. Therefore, the final composite imperviousness for the entire Canyon Creek Subdivision Filing No. 10 development will be no greater 79% in accordance with the OSP. Individual basins may be higher due to local basin characteristics, however, the overall composite imperviousness is planned for 79% or less.

As the Overall Site will be constructed in phases, it is anticipated that all sub-basins within the development will be captured and routed to a future underground water quality and detention facility located just south of Erie Parkway and just west of East County Line Road in a future commercial area. This future underground facility is not required for this first phase of the development as a temporary detention and water quality pond (the "Pond") will be utilized.

The storm outfall for the entire development will connect to the existing 42-inch RCP storm sewer that is within the intersection of Erie Parkway and East County Line Road. The Town of Erie is currently preparing East County Line Road Widening Construction Plans that include a proposed inlet near the outfall point of the Site. It is anticipated that this storm outfall will pass through a proposed Type R inlet at the curb return before connecting into the existing 42-inch storm line. From there, flows will be conveyed to Reach 1 of Erie Commons 1 as outlined in the *Town of Erie, Outfall Systems Plan (West of Coal Creek)* (Reference 5).

SUB-BASINS

GENERAL CONCEPT

The tributary area to this Project has been divided into individual drainage basins based on the existing and proposed grading for the site. The drainage basins have been named according to the geographic location that they are tributary to. There are three main drainage basin areas that are described below in more detail. All of the runoff from the on-site drainage basins (Basins A and R) are routed through the development via storm sewer and ultimately discharge into the proposed temporary on-site detention and water quality pond. The future residential lots (Basin C) utilized imperviousness based on conservative land use assumptions to ensure that the proposed drainage system is adequately sized for the development of this Project. The proposed drainage basin locations and layout of the storm sewer is shown on the Proposed Drainage Map included in **Appendix D** of this Report.

BASIN A

Basin A is approximately 3.7 acres and consists of 13 individual drainage basins. Basin A covers the entirety of Commercial Area 1 as well as the portions of Pinnacle Boulevard and the north private access drive that are being constructed during Commercial Area 1 phase of construction. Commercial Area 1 consists of two proposed commercial buildings; Lot 1 is to be constructed during this phase and Lot 2 will be constructed in the future, but the future buildout out Lot 2 is considered in this report. The drainage basins and imperviousness calculations are based on the detailed grading and site layout included in the Commercial Area 1 Construction Plans for this property. The drainage basins are designated as A-1, A-2, etc. Basins R-1 (roof of proposed building on Lot 1) and R-2 (roof of future building on Lot 2) are also contained in Basin A. Basins A-1 through A-8 as well R-1 and R-2 are tributary to the proposed onsite storm sewer system and will be conveyed to the Pond. Basins A-3, A-4, A-5, A-8 and R-1 will be conveyed through storm sewer line B and enter the Pond through a grass swale with trickle channel running from the northwest corner of the site. Basins A-1, A-2, A-6, A-7 and R-2 will be conveyed through storm sewer line A and will discharge at the southeast corner of the Pond. The 5-year and 100-year flows through storm sewer line B are 4.29 cfs and 10.24 cfs respectively. The 5-year and 100-year flows through storm sewer line A are 6.45 cfs and 13.14 cfs respectively. Both storm sewer lines discharge into the Pond through a forebay to disperse the energy and prevent erosion prior to entering the outlet structure.

Basins A-9, A-10 and A-11 are part of the proposed development but will runoff site. The flow from A-9 will enter the future storm inlet at the intersection of E County Line Road and Austin Avenue. The 5-year and 100-year flows from A-9 are 0.03 cfs and 1.03 cfs respectively. The flows from A-10 and A-11 will flow north where they will be captured in the future curb and gutter along E County Line Road. The combined flows from A-10 and A-11 are 0.24 cfs and 1.25 cfs respectively.

BASIN B

Basin B consists of Austin Avenue from E County Line Road to the high point of Austin Avenue. The drainage basins and imperviousness calculations are based on the detailed grading and site layout included in the Austin Avenue Construction Plans for this Project. Austin Avenue has a crown dividing the flows to the south basin B-1 and the north basin B-2. These flows are captured in a curb and gutter and conveyed to the existing catch basins on either side of Austin Avenue just south of Commercial Area 1. The 5-year and 100-year flows of basin B-1 are 3.07 cfs and 7.02 cfs respectively. The 5-year and 100-year flows of basin B-2 are 3.09 cfs and 7.24 cfs respectively. Basin B-3 is the southern half of Austin Avenue east of the existing inlet. This flow will enter the future storm sewer through a storm inlet at the intersection of E County Line Road and Austin Avenue. The 5-year and 100-year flows of basin B-3 are 0.71 cfs and 1.56 cfs respectively.

BASIN C

Basin C is approximately 11.1 acres and consists of the area of future development that will be tributary to the proposed storm sewer system (storm sewer line B) but will remain undeveloped at the time of Commercial Area 1 construction. Basin C consists of drainage basins C-1, C-2 and C-3. The future development of this area will be single family development and an imperviousness of 65% has been used in runoff calculations. The 5-year and 100-year flows from future development in Basin C will be 27.17 cfs and 65.83 cfs respectively. These future developed flows were used when determining the proposed storm sewer design for Commercial Area 1, but were not used to size the Pond. In its undeveloped/existing state, the majority of the runoff from Basin C will be tributary to the North Drainage Swale where it will ultimately be conveyed to the storm outfall for the Site. The 5-year and 100-year undeveloped flows for Basin C are 0.81 cfs and 35.10 cfs, respectively.

OFF-SITE AND FUTURE BASINS

Basins F-1 and F-2 consist of approximately of the remaining 30.7 acres of future development that is analyzed as undeveloped area for the first phase of this project. The flows from F-1 and F-2 will enter the North Drainage Swale, downstream of the Pond. An impervious value of 2% has been used in the runoff calculations. The combined 5-year and 100-year flows for F-1 and F-2 are 1.76 cfs and 76.27 cfs respectively. From the North Drainage Swale, the flows will be conveyed through a proposed storm sewer system into the existing 42-inch storm sewer system within Erie Parkway. Basins OS-1 and OS-2 make up the west half of the existing East County Line Road adjacent to the development. The 5-year and 100-year flows from Basin OS-1 are 4.50 cfs and 8.89 cfs and will flow north and enter the existing storm sewer system within E County Line Road through a future inlet at the intersection with Erie Parkway. The 5-year and 100-year flows from Basin OS-2 are 0.94 cfs and 2.63 cfs respectively, and will flow south along E County Line Road where they will enter the future inlet and the intersection with Austin Avenue.

BASIN H

Basin H consists the back half of 18 existing single family dwellings adjacent to the west side of the overall Project. It consists of approximately 1.27 acres and an impervious value of 45% was used in runoff calculations. The combined 5-year and 100-year flows of Basin H are 2.17 cfs and 6.53 cfs respectively. These flows will enter onto the site through basins F-1 and F2 where they will be conveyed to the North Drainage Swale.

DOWNSTREAM SYSTEM

The Project proposes to maintain existing drainage patterns and flows, and is not anticipated to adversely impact downstream systems. The Project will provide a temporary Pond that has been designed per UDFCD requirements to provide a controlled release that will reduce the 100-year discharge in the developed condition. The discharge from the Pond will be piped into the existing storm sewer system at the southwest corner of the intersection of Erie Parkway and East County Line Road.

DESIGN CRITERIA:

REGULATIONS

A drainage plan is presented for the 5-year (minor-commercial) and 100-year (major) storm events based on the *Town of Erie Storm Drainage Facilities* (Reference 1). The drainage plan for Canyon Creek Subdivision Filing No. 10, Four Corners Commercial Area 1 was based on the Town of Erie requirements (Reference 1), Urban Drainage and Flood Control District (UDFCD) UDSCM (Reference 2), and the *Town of Erie Outfall Systems Plan* (West of Coal Creek) (Reference 5).

DEVELOPMENT CRITERIA REFERENCE AND CONSTRAINTS

The undeveloped lot historically drains to the northeast corner by the intersection of Erie Parkway and East County Line Road. There are no existing drainage or storage facilities on the Site. There is an existing 10-Foot Type R inlet on Erie Parkway at the southwest corner of the intersection of

Erie Parkway and East County Line Road that is connected to the existing storm sewer system within Erie Parkway. The storm outfall for this development will connect to this existing storm sewer system at an existing 42-inch stub located on the south side of the existing storm sewer manhole. There is also a pair of existing, on grade Type R inlets along Austin Avenue that connect to an existing storm sewer system flowing south and will not connect with the storm sewer system on the site. The existing inlet on the north side of Austin Avenue will be removed and upsized to a 15-foot Type R inlet due to the location of the reconstructed curb and gutter. The existing 15-foot Type R inlet on the south side will remain. These two inlets within Austin Avenue will not be utilized for conveyance of developed Site flows from the Overall Site or Commercial Area 1 Site, and the peak flow to these inlets will be equal to or less than existing conditions.

The Town of Erie is currently preparing the East County Line Road Widening Improvements Construction Plans. Coordination between the two projects is ongoing and the proposed roadway improvements are shown on the Construction Plans prepared by JVA, Inc. The widening project proposes to install two inlets directly adjacent to the property line of the Site, one at the southwest corner of Erie Parkway and East County Line Road. The outfall storm sewer for this project will connect to the proposed inlet along County Line Road at the southwest corner of Erie Parkway and East County Line Road intersection. The timing of this inlet construction is still being coordinated between the Developer and Town. If the inlet is not in place at the time needed for Commercial Area 1, then this inlet and the connection to the existing 42-inch storm sewer will be constructed with this project.

Local site constraints include the existing gas lines along the right-of-way of Erie Parkway and East County Line Road. The four existing gas lines along East County Line Road range from 4 to 12-inches in diameter while there is a single 6-inch gas line along Erie Parkway. The storm outfall pipe from the Site will be required to cross under these four gas lines to connect to existing 42-inch storm infrastructure within East County Line Road. Coordination with the gas line owners is ongoing.

HYDROLOGIC CRITERIA

Hydrologic analyses for subsequent reports will be calculated using the Rational Method. Rainfall intensities were taken from the Town’s Manuals (Table 800-2) (Reference 1) IDF equation and are based upon the 1-hour point rainfall depths as identified in Table 1.

Table 1: 1-hr Point Rainfall Depths

Storm Event	1-hr Rainfall Depth (in)
5-yr	1.43
10-yr	1.73
100-yr	2.70

The Rational Method procedures and methodology for the time of concentration and for the computation of peak flow rates follow the Town of Erie and Urban Drainage Criteria outlined in References 1 and 2, respectively.

HYDRAULIC CRITERIA

Street capacities, the sizing of inlets, and the size and layout of the storm sewer system have been analyzed and are reported within this Final Drainage Report utilizing UD-Inlet v4.05 from UDFCD for the current layout of the overall development of the site. The locations and sizes of proposed storm inlets within this commercial area will remain as constructed and are sized for the ultimate Site conditions and future phased development. Runoff from the Commercial Area 1 development and adjacent streets will discharge into a temporary detention pond with water quality control. The pond outfalls into a temporary grass swale that discharges to the 42" storm outfall pipe at the northeast corner of the development. The grass swale for this phase shall be considered a temporary conveyance until the future commercial area storm sewer system north of Commercial Area 1 Site is designed and built. All future storm water capture and conveyance elements will be comprehensively analyzed and sized with previous phased constructed elements within the Final Drainage Report(s). Final Drainage Reports will be submitted consistent with Site phasing and shall analyze interim and final phases, if applicable.

Analysis of curb and gutter street flows are included herein and were calculated using UD Inlet v4.05. Street capacities were calculated using design constraints of 6 inches of ponding (to top back of curb) for minor storms and a maximum of 12-inches of ponding for major storms, which complies with the Town of Erie criteria (Reference 1). Street capacity analyses are included Appendix C of this report.

Type R inlets are being proposed on-site within the parking lots at sump locations and at on-grade locations within the access drive. Additional hydraulic software, FlowMaster v.7.0 by Haestad Methods, has been used for sizing the swales. The sizing of the proposed storm sewer within the development and its connection to future phases has been analyzed in this report using Bentley StormCAD.

ADAPTATIONS FROM CRITERIA

There are no known adaptations from the Town of Erie criteria.

DRAINAGE FACILITY DESIGN

On-site sub-basins will enter a temporary detention and water quality pond via storm sewer that will be constructed with Commercial Area 1. The Pond has been designed utilizing UDFCD spreadsheets and requirements to detain for water quality, excess urban runoff volume (EURV), and the 100-year storm event. The Pond was sized to detain developed flows from Basins A-1 thru A-8, R-1, and R-2. The Pond's outlet structure and emergency overflow will discharge into a grassed swale that runs along the east side of the development. The grassed swale then discharges into a proposed 42-inch storm sewer that routes the peak flows to the existing 42-inch storm sewer outfall in Erie Parkway. The grassed swale was designed to convey 100-year peak flows from the undeveloped areas to the west (Basins C-1 thru C-3, F-1, F-2, H-1, and H-2) as well as the developed basins tributary to the Pond. The Pond and grassed swales have been designed per the Town of Erie Standards and Specifications and UDFCD requirements.

The Pond for Commercial Area 1 will be required to remain in place until the permanent underground detention facility for the overall development is constructed. Since the timing of the permanent system is not known, this Pond has been designed will all of the improvements required for a permanent pond. Concrete forebays, concrete trickle channels, outlet structure, emergency spillway and a maintenance path will all be constructed and maintained with this Pond. The details of these improvements can be found within the Commercial Area 1 Construction Plans. The design of the Pond and outlet structure utilized the UDFCD spreadsheets (UD-

Detention v3.07) and the output from those spreadsheets are included in Appendix C. Maintenance for the Pond shall be in accordance with the UDFCD Volume 3 Manual. A 10-foot wide gravel maintenance path has been included as part of the design to facilitate maintenance of this drainage facility.

CONCLUSIONS

The drainage plan provided in this report complies with the *Town of Erie Storm Drainage Facilities Standards and Specifications* (Reference 1) and the *Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manuals* (Reference 2), and the *Town of Erie Outfall Systems Plan* (Reference 5).

The drainage plan and report depicts the design for the Canyon Creek Subdivision Filing 10. Commercial Area 1 conform to the Town's criteria. The drainage plan attempts to provide protection from flooding to the Site for at least the 100-year storm. Emergency drainage overflows will be provided and detailed within the Commercial Area 1 Construction Documents. The planned improvements will minimize adverse effects on the public and associated infrastructure for the proposed development.

REFERENCES

1. Town of Erie Standards and Specifications for Design and Construction, Town of Erie, January 2017.

2. Urban Storm Drainage Criteria Manuals, Volumes 1-3, Urban Drainage and Flood Control District; Revised January 2016.

3. Flood Insurance Rate Map, Boulder County, Colorado and Incorporated Areas, Panel 441 of 6155, Map Number 08013C0551J, Federal Emergency Management Agency (FEMA), Map Revised December 18, 2012.

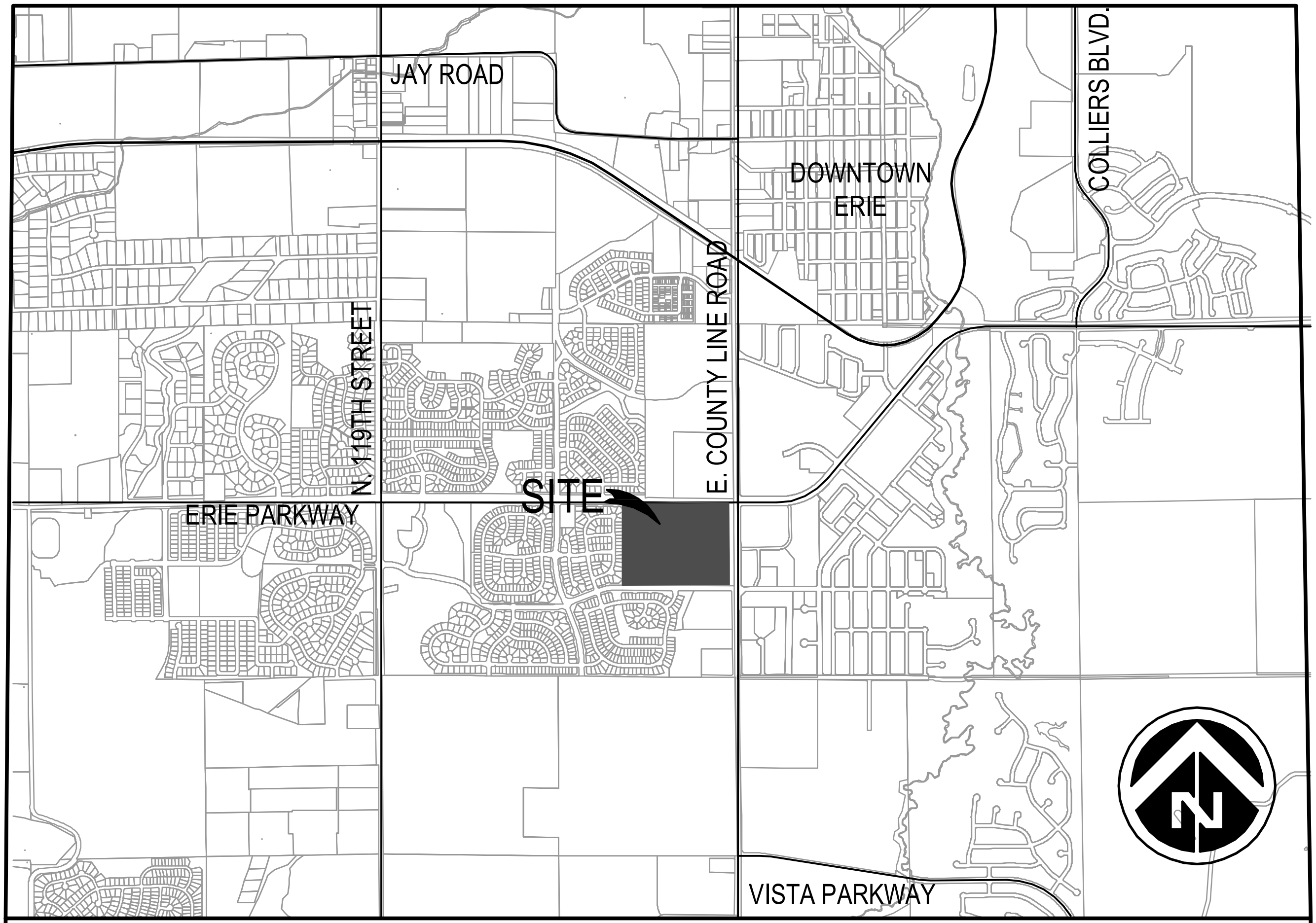
4. Soil Survey of Boulder County Area, Colorado, Natural Resources Conservation Service (NRCS), 1975.

5. Town of Erie, Outfall Systems Plan (West of Coal Creek), RESPEC Consultants & Services, January 2014

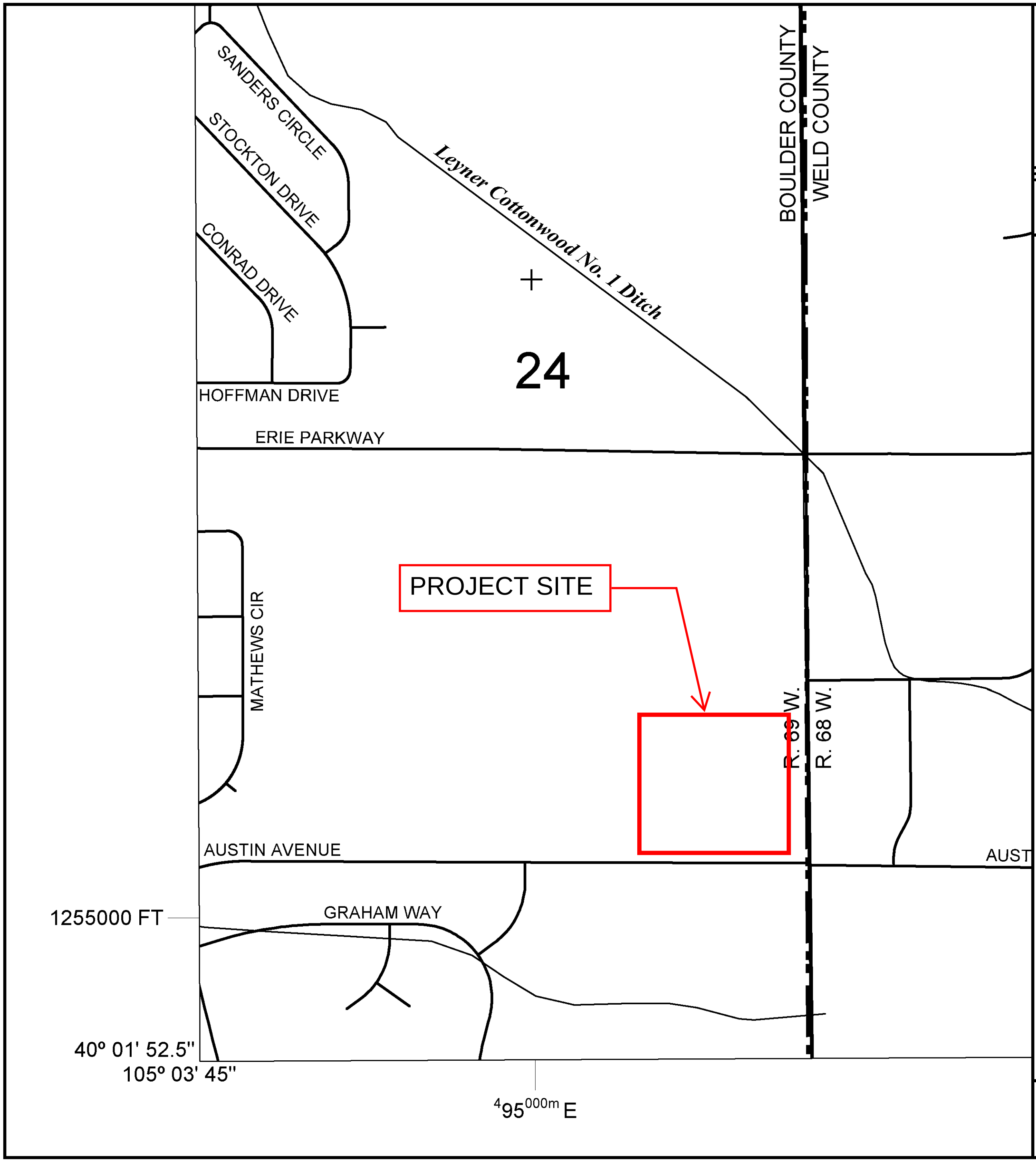
6. Mine Subsidence Investigation, Erie Parcel, aka 4-Corners Southwest of Erie Parkway and East County Line Road, CTL Thompson, February 10, 2015

APPENDICES

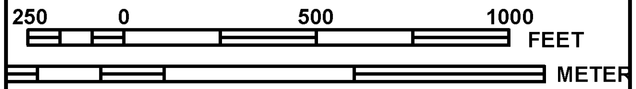
APPENDIX A – FIGURES AND SUPPORTING DOCUMENTS



VICINITY MAP



MAP SCALE 1" = 500'



NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0441J

FIRM
FLOOD INSURANCE RATE MAP
BOULDER COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 441 OF 615

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BOULDER COUNTY	080023	0441	J
ERIE, TOWN OF	080181	0441	J

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

U.S. DEPARTMENT OF HOMELAND SECURITY

MAP NUMBER
08013C0441J

MAP REVISED
DECEMBER 18, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

United States
Department of
Agriculture

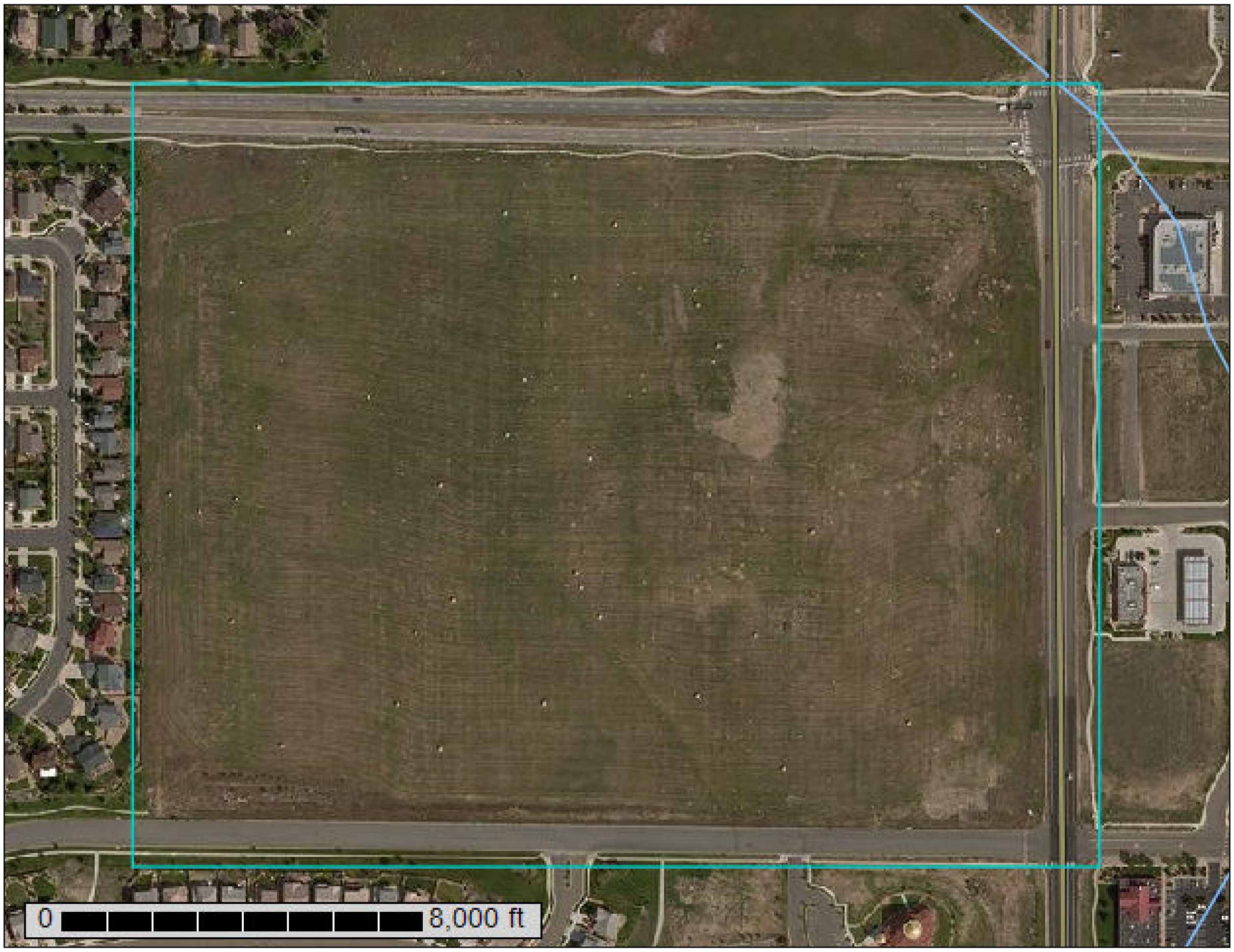
NRCS

Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Boulder County Area, Colorado; and Weld County, Colorado, Southern Part

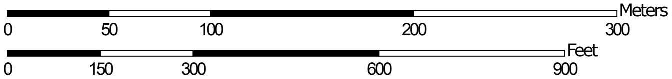
Erie - Four Corners



August 9, 2017

Soil Map

Map Scale: 1:3,720 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boulder County Area, Colorado
Survey Area Data: Version 13, Sep 23, 2016

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 15, Sep 22, 2016

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Map Unit Legend

Boulder County Area, Colorado (CO643)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AcA	Ascalon sandy loam, 0 to 3 percent slopes	18.2	30.7%
AcC	Ascalon sandy loam, 3 to 5 percent slopes	4.0	6.8%
MdD	Manter sandy loam, 3 to 9 percent slopes	33.3	56.3%
Subtotals for Soil Survey Area		**55.4**	**93.7%**
Totals for Area of Interest		**59.1**	**100.0%**

Weld County, Colorado, Southern Part (CO618)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
5	Ascalon sandy loam, 0 to 3 percent slopes	3.7	6.3%
Subtotals for Soil Survey Area		**3.7**	**6.3%**
Totals for Area of Interest		**59.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Boulder County Area, Colorado

AcA—Ascalon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2swl3
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ascalon and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk - 19 to 35 inches: sandy clay loam
C - 35 to 80 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: Sandy Plains (R067BY024CO)
Hydric soil rating: No

Minor Components

Olnest

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy Plains (R067BY024CO)
Hydric soil rating: No

Vona

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy Plains (R067BY024CO)
Hydric soil rating: No

AcC—Ascalon sandy loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2tlnt
Elevation: 3,550 to 5,970 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ascalon and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Interfluves
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam

Bk - 19 to 35 inches: sandy clay loam
C - 35 to 80 inches: sandy loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.1 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: Sandy Plains (R067BY024CO), Sandy (North) Draft (April 2010) (PE 16-20) (R072XA022KS)
Hydric soil rating: No

Minor Components

Stoneham

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy Plains (R067BY002CO), Loamy Upland (North) (PE 16-20) (R072XA015KS)
Hydric soil rating: No

Vona

Percent of map unit: 8 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope, footslope, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy Plains (R067BY024CO), Sandy (North) Draft (April 2010) (PE 16-20) (R072XA022KS)
Hydric soil rating: No

Platner

Percent of map unit: 2 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear

Ecological site: Loamy Plains (R067BY002CO), Loamy Upland (North) (PE 16-20) (R072XA015KS)
Hydric soil rating: No

MdD—Manter sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: jps4
Elevation: 4,900 to 5,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 140 to 155 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Manter and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manter

Setting

Landform: Terraces
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy eolian deposits and/or outwash

Typical profile

H1 - 0 to 5 inches: sandy loam
H2 - 5 to 14 inches: fine sandy loam, sandy loam
H2 - 5 to 14 inches: sandy loam, loamy sand, loamy fine sand
H3 - 14 to 60 inches:
H3 - 14 to 60 inches:
H3 - 14 to 60 inches:

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 18.1 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: Sandy (R067XB026CO)
Hydric soil rating: No

Minor Components

Ascalon

Percent of map unit: 12 percent
Hydric soil rating: No

Otero

Percent of map unit: 3 percent
Hydric soil rating: No

Weld County, Colorado, Southern Part

5—Ascalon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2swl3
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

Ascalon and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk - 19 to 35 inches: sandy clay loam
C - 35 to 80 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: Sandy Plains (R067BY024CO)

Hydric soil rating: No

Minor Components

Olnest

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy Plains (R067BY024CO)
Hydric soil rating: No

Vona

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy Plains (R067BY024CO)
Hydric soil rating: No

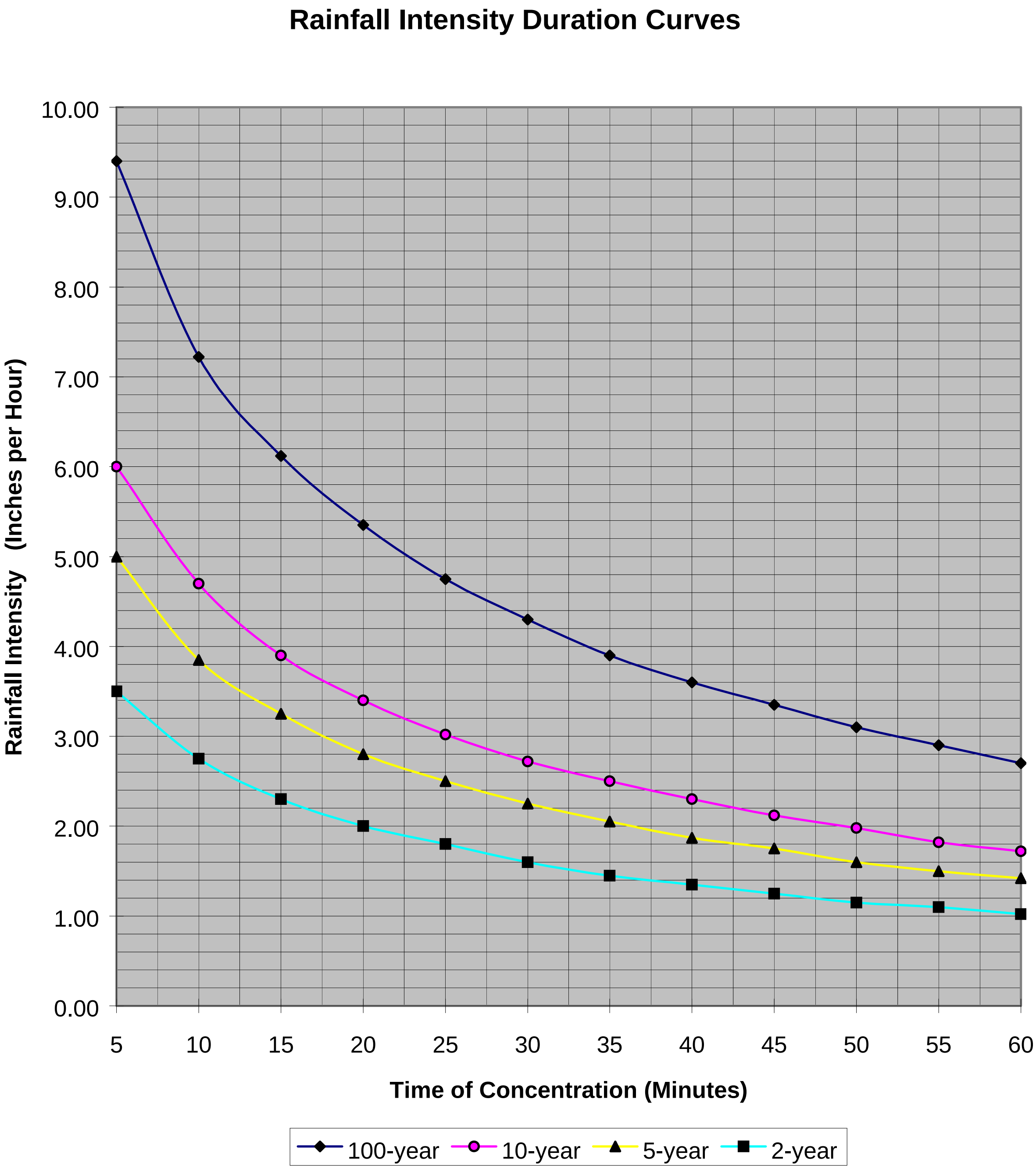
Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential:	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

Table 6-5. Runoff coefficients, *c*

Total or Effective % Imperviousness	**NRCS Hydrologic Soil Group A**					
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
2%	0.02	0.02	0.02	0.02	0.02	0.17
5%	0.04	0.05	0.05	0.05	0.05	0.19
10%	0.09	0.09	0.09	0.09	0.1	0.23
15%	0.13	0.14	0.14	0.14	0.14	0.28
20%	0.18	0.19	0.19	0.19	0.19	0.32
25%	0.22	0.23	0.24	0.24	0.24	0.36
30%	0.27	0.28	0.28	0.28	0.29	0.4
35%	0.31	0.33	0.33	0.33	0.33	0.44
40%	0.36	0.37	0.38	0.38	0.38	0.48
45%	0.4	0.42	0.42	0.42	0.43	0.52
50%	0.45	0.47	0.47	0.47	0.48	0.56
55%	0.49	0.51	0.52	0.52	0.52	0.6
60%	0.53	0.56	0.56	0.57	0.57	0.64
65%	0.58	0.6	0.61	0.61	0.62	0.68
70%	0.62	0.65	0.66	0.66	0.67	0.72
75%	0.67	0.7	0.71	0.71	0.71	0.76
80%	0.71	0.74	0.75	0.76	0.76	0.8
85%	0.76	0.79	0.8	0.8	0.81	0.84
90%	0.8	0.84	0.85	0.85	0.86	0.88
95%	0.85	0.88	0.89	0.9	0.9	0.92
100%	0.89	0.93	0.94	0.94	0.95	0.96
Total or Effective % Imperviousness	**NRCS Hydrologic Soil Group B**					
2%	0.02	0.02	0.14	0.24	0.38	0.46
5%	0.04	0.05	0.17	0.27	0.39	0.48
10%	0.09	0.09	0.21	0.3	0.42	0.5
15%	0.13	0.14	0.25	0.34	0.45	0.53
20%	0.18	0.19	0.29	0.37	0.48	0.55
25%	0.22	0.23	0.33	0.41	0.51	0.58
30%	0.27	0.28	0.37	0.44	0.54	0.6
35%	0.31	0.33	0.41	0.48	0.57	0.63
40%	0.36	0.37	0.45	0.51	0.6	0.65
45%	0.4	0.42	0.49	0.55	0.63	0.67
50%	0.45	0.47	0.53	0.58	0.66	0.7
55%	0.49	0.51	0.57	0.62	0.69	0.72
60%	0.53	0.56	0.61	0.65	0.72	0.75
65%	0.58	0.6	0.65	0.69	0.75	0.77
70%	0.62	0.65	0.69	0.72	0.78	0.8
75%	0.67	0.7	0.73	0.76	0.81	0.82
80%	0.71	0.74	0.77	0.79	0.84	0.85
85%	0.76	0.79	0.81	0.83	0.87	0.87
90%	0.8	0.84	0.85	0.86	0.89	0.9
95%	0.85	0.88	0.89	0.9	0.92	0.92
100%	0.89	0.93	0.94	0.94	0.95	0.94

The rainfall intensities to be used in the computation of runoff using the Rational Method shall be obtained from the Rainfall Intensity Duration Curves for the Town of Erie, included in these STANDARDS AND SPECIFICATIONS.



814.00 Detention

DESIGN STORM RETURN PERIODS

Land Use or Zoning	Design Storm Return Period	
	Initial Storm	Major Storm
Residential	2-year	100-year
Business	5-year	100-year
Public Building Areas	5-year	100-year
Parks, Greenbelts, etc.	2-year	100-year
Open Channels and Drainage ways	10 year	100-year
Detention Facilities	Water Quality and 10 year	100-year

813.03 Runoff Computations, Colorado Urban Hydrograph Procedure (CUHP)

The CUHP method is generally applicable to basins greater than 90 acres. However, the CUHP is required for watershed areas larger than 160-acres. The procedures for the CUHP, as explained in the Urban Storm Drainage Criteria Manual, shall be followed in the preparation of drainage reports and storm drainage facility designs in the Town. The CUHP program requires the input of a design storm, either as a detailed hyetograph or as a 1-hour rainfall depth. The program for the latter using the 2-hour storm distribution recommended in the Urban Storm Drainage Criteria Manual generates a detailed hyetograph distribution. The 1-hour rainfall depths for the Town of Erie are presented in Table 800-2.

Table 800-2
TOWN OF ERIE
ONE-HOUR RAINFALL DEPTH

Design Storm	Rainfall Depth (in.)
2-Year	1.01
5-Year	1.43
10-Year	1.73
50-Year	2.40
100-Year	2.70

The hydrograph from the CUHP program must be routed through any proposed conveyance facility using UDSWM or a similar method.

813.04 Runoff Computations, Rational Method

The Rational Method will be utilized for sizing storm sewers and for determining runoff magnitude from un-sewered areas. The limit of application of the Rational Method is approximately 160 acres. When the drainage basin exceeds 160 acres, the CUHP method shall be used.

The procedures for the Rational Method, as explained in the Urban Storm Drainage Criteria Manual, shall be followed in the preparation of drainage reports in the Town.

Table 800-6
STREET CLASSIFICATION FOR DRAINAGE PURPOSES

Street Classification	Function	Speed/Number of Lanes	Signalization at Intersections	Street Parking
Local	Provide access to residential and industrial areas	Low speed with 2 moving lanes	Stop signs	One or both sides of the street
Collector	Collect and convey traffic between local and arterial streets	Low to moderate speed with 2 or 4 moving lanes	Stop signs or traffic signals	One or both sides of the street
Arterial	Function as primary through traffic conduits in urban areas	Moderate to high speeds with 4 to 6 lanes	Traffic signals (controlled access)	Usually prohibited
Freeway	Provide rapid and efficient transport over long distances	High speed travel with 4 lanes or more	Cloverleaves, access ramps (limited access)	Always prohibited

Both the initial storm runoff and major storm runoff must be considered, and calculations showing such runoff at critical sections will be submitted. The following criteria will apply in the determination of allowable street flow capacities:

A. Street, curb/gutter, walks, crosspans and curb cuts shall conform to all applicable Sections of these STANDARDS AND SPECIFICATIONS.

B. In relation to street capacity for initial storm, pavement encroachment for the initial design storm will not exceed the limitations set forth in Table 800-7:

TABLE 800-7
ALLOWABLE PAVEMENT ENCROACHMENT AND DEPTH OF FLOW FOR INITIAL STORM RUNOFF

Street Classification	Maximum Encroachment*
Local	No curb overtopping; flow may spread to crown of street.
Collector	No curb overtopping; flow spread must leave the equivalent of one 10-foot driving lane clear of water.
Arterials	No curb overtopping; flow spread must leave the equivalent of two 10-foot driving lanes clear of water - one lane in each direction.
Freeways	No encroachment is allowed on any traffic lane.

* Where no curbing exists, encroachment will not extend past property lines.

The storm sewer system will commence at the point where the maximum allowable encroachment occurs.

C. In relation to street capacity for major storm, the allowable depth of flow and inundated area for the major design storm will not exceed the limitations set forth in Table 800-8:

TABLE 800-8
ALLOWABLE DEPTH OF FLOW AND INUNDATED AREA FOR MAJOR STORM RUNOFF

Street Classification	Allowable Depth and Inundated Areas
Local & Collector	Residential dwellings and public, commercial, and industrial buildings should be no less than 12 inches above the 100-year flood at the ground line or lowest water entry of the building. The depth of water over the gutter flow line will not exceed 18 inches and 12 inches for collector streets.
Arterial & Freeway	Residential dwellings and public, commercial, and industrial buildings should be no less than 12 inches above the 100-year flood at the ground line or lowest water entry of the building. The depth of water should not exceed the street crown to allow operation of emergency vehicles. The depth of water over gutter flow line should not exceed twelve (12).inches

Cross street flow: Cross street flow will occur by one of the following methods. One method is runoff which has been flowing in a gutter and then flows across the street to the opposite gutter or inlet. The second case is flow from some external source, such as a drainage way or conduit, which will flow across the crown of the street when the conduit capacity is exceeded. Allowable Cross Street Flow is set forth in Table 800 –9.

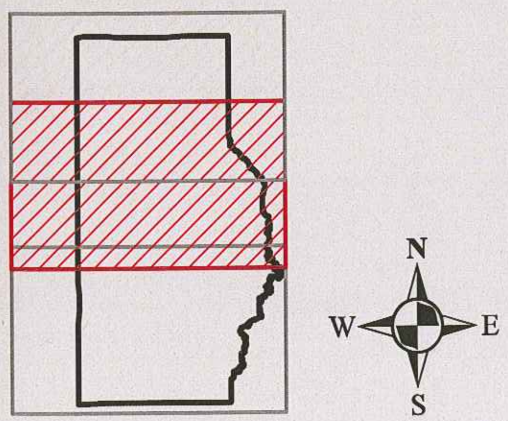
TABLE 800-9

LEGEND

- ☐ Study Area Boundary
- 🟦 Town of Erie
- 🟧 City of Lafayette
- ☐ Subbasin Boundary
- ▬ Major Watershed Boundary
- ▨ Regional Detention Ponds

XXX — Subbain ID
XX — % Impervious (Existing Land Use)
X — % Impervious (Future Land Use)
Area (Acres)

KEY MAP



0 750 1,500 3,000 Feet

1 " = 1,500 FT

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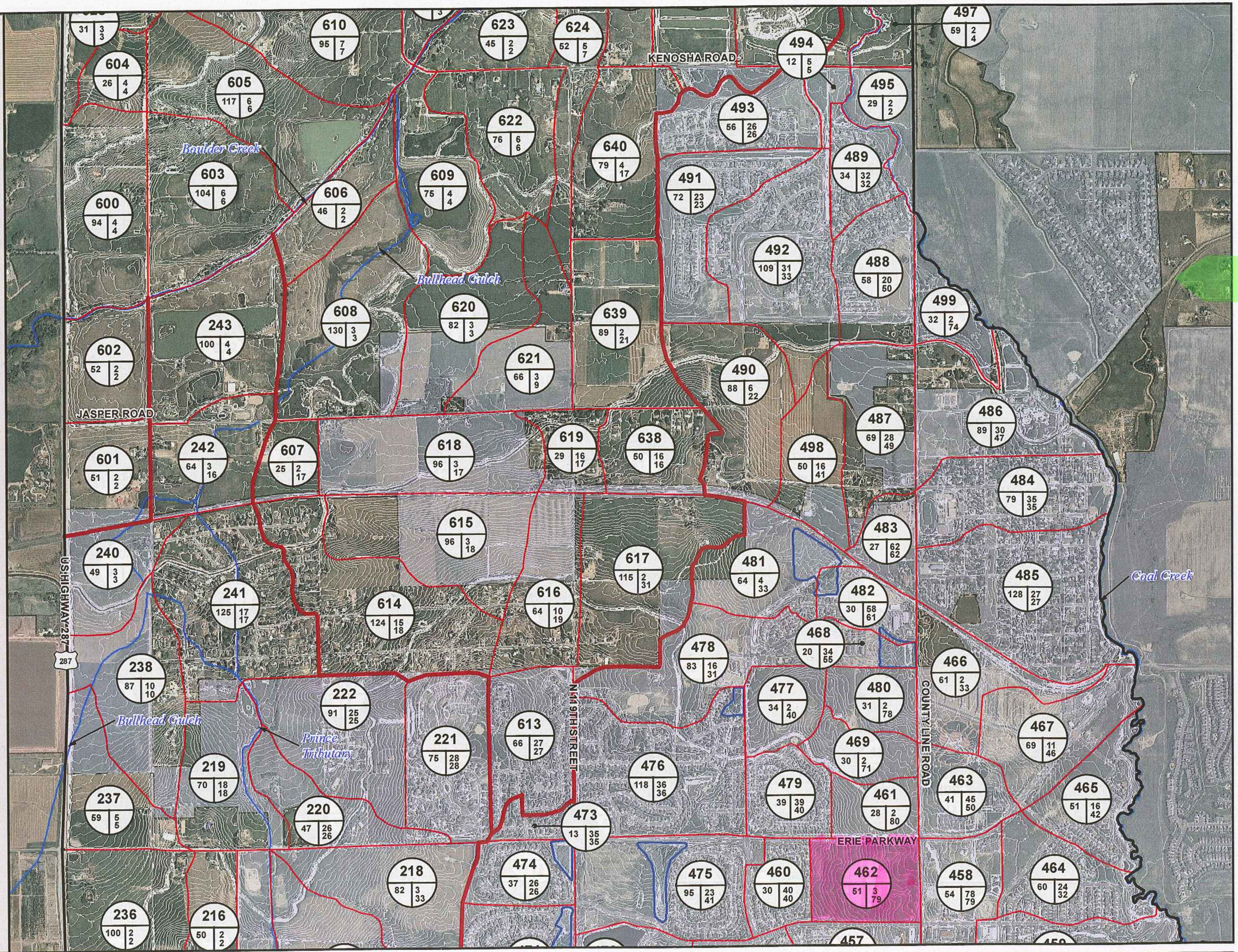


WRC ENGINEERING, INC.	WRC ENGINEERING, INC. 950 SOUTH CHERRY STREET, SUITE 404 DENVER, COLORADO 80246 PHONE: 303-757-8513 FAX: 303-758-3208	TOWN OF ERIE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	TOWN OF ERIE OUTFALL SYSTEMS PLAN (WEST OF COAL CREEK)	SUBBASIN MAP	FIGURE B-3 B4 B3

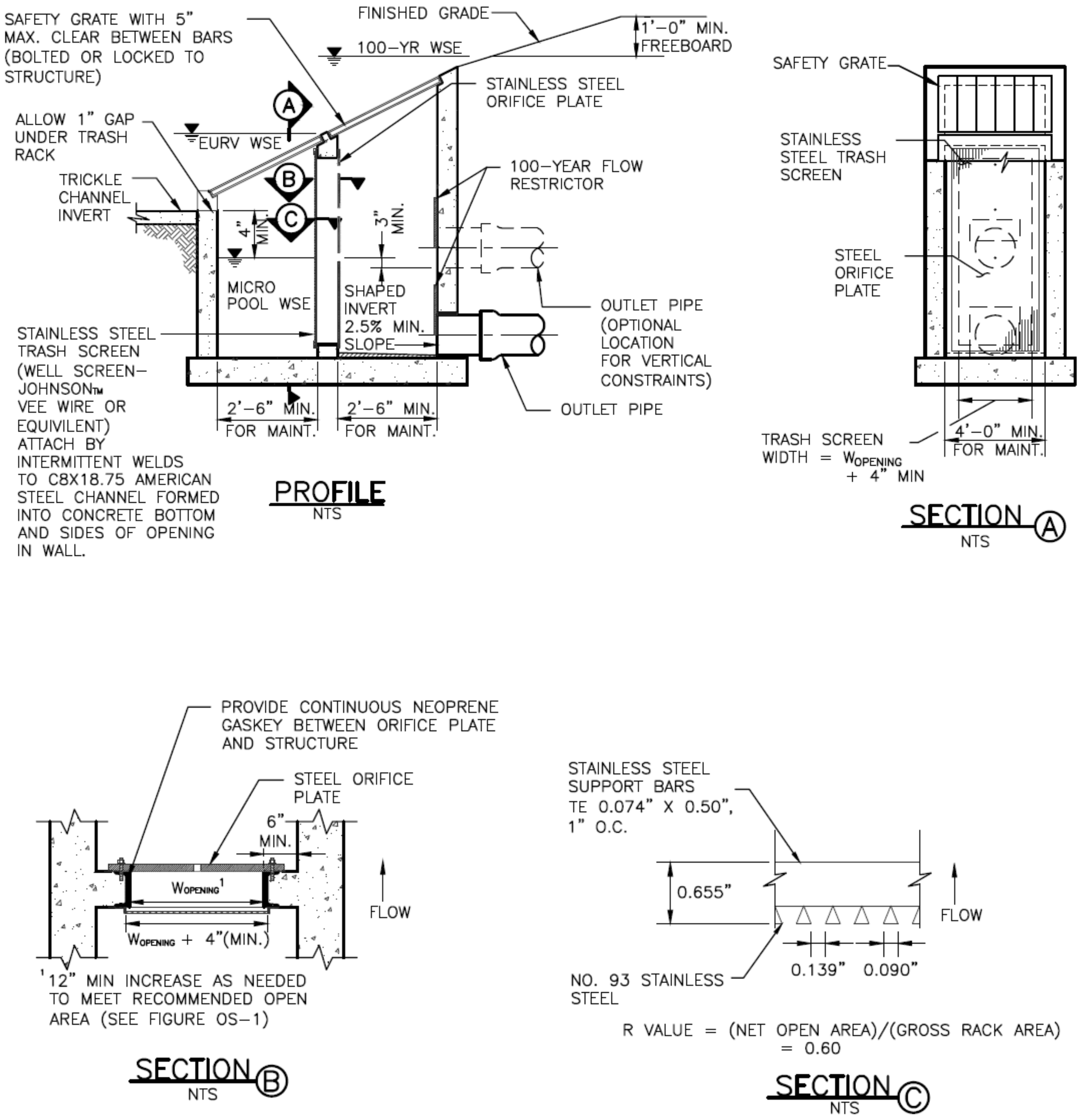


Figure OS-7. Full spectrum detention outlet structure for 5-acre impervious area or less

APPENDIX B – HYDROLOGIC CALCULATIONS

Kimley»Horn

STANDARD FORM SF-1
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

PROJECT NAME: Erie - Commercial 1 - Prop. Conditions
PROJECT NUMBER: 096635000
CALCULATED BY: RDW
CHECKED BY: KPB

DATE: 9/8/2017

LAND USE:	PAVED AREA	DRIVES & WALKS AREA	ROOF AREA	LANDSCAPE AREA	TYPE B SOIL RESIDENTIAL AREA	*OVERALL DEV. BASINS AREA
5-YEAR COEFF.	0.93	0.84	0.84	0.02	0.42	0.60
10-YEAR COEFF.	0.94	0.85	0.85	0.14	0.49	0.65
100-YEAR COEFF.	0.94	0.90	0.90	0.46	0.67	0.77
IMPERVIOUS %	100%	90%	90%	2%	45%	65%

* NOTE: FUTURE BASINS TRIBUTARY TO STORM SYSTEM. BASIN PROPERTIES DERIVED FROM PROPOSED CONDITIONS.
** NOTE: FUTURE BASINS IN UNDEVELOPED CONDITIONS. RUNOFF ASSUMED TO BE TAKEN ON IN NORTH DRAINAGE SWALE.

On-Site Basins

DESIGN BASIN	DESIGN POINT	PAVED AREA (AC)	DRIVES & WALKS AREA (AC)	ROOF AREA (AC)	LANDSCAPE AREA (AC)	RESIDENTIAL AREA (AC)	*OVERALL DEV. BASINS AREA (AC)	TOTAL AREA (AC)	Cc(5)	Cc(10)	Cc(100)	Imp %
A-1	A1	0.417	0.015	0.000	0.034	0.000	0.000	**0.47**	0.86	0.88	0.90	0.93
A-2	A2	0.407	0.070	0.000	0.038	0.000	0.000	**0.52**	0.85	0.87	0.90	0.91
A-3	A3	0.074	0.001	0.000	0.088	0.000	0.000	**0.16**	0.44	0.51	0.68	0.47
A-4	A4	0.104	0.016	0.000	0.047	0.000	0.000	**0.17**	0.67	0.71	0.80	0.72
A-5	A5	0.268	0.058	0.000	0.179	0.000	0.000	**0.51**	0.60	0.65	0.77	0.64
A-6	A6	0.199	0.080	0.000	0.057	0.000	0.000	**0.34**	0.75	0.78	0.85	0.81
A-7	A7	0.070	0.028	0.000	0.039	0.000	0.000	**0.14**	0.65	0.69	0.79	0.70
A-8	A8	0.154	0.043	0.000	0.150	0.000	0.000	**0.35**	0.53	0.58	0.73	0.56
A-9	OS4	0.000	0.001	0.000	0.307	0.000	0.000	**0.31**	0.02	0.14	0.46	0.02
A-10	OS3	0.020	0.009	0.000	0.199	0.000	0.000	**0.23**	0.13	0.24	0.52	0.14
A-11	OS3	0.020	0.008	0.000	0.013	0.000	0.000	**0.04**	0.62	0.67	0.78	0.67
B-1	B1	0.697	0.139	0.000	0.333	0.000	0.000	**1.17**	0.66	0.70	0.80	0.71
B-2	B2	0.725	0.144	0.000	0.403	0.000	0.000	**1.27**	0.63	0.68	0.78	0.68
B-3	B3	0.137	0.022	0.000	0.048	0.000	0.000	**0.21**	0.71	0.74	0.82	0.76
*C-1		0.000	0.000	0.000	0.000	0.000	10.094	**10.09**	0.60	0.65	0.77	0.65
*C-2		0.000	0.000	0.000	0.000	0.000	0.821	**0.82**	0.60	0.65	0.77	0.65
*C-3		0.000	0.000	0.000	0.000	0.000	0.166	**0.17**	0.60	0.65	0.77	0.65
R-1	A4	0.000	0.000	0.259	0.000	0.000	0.000	**0.26**	0.84	0.85	0.90	0.90
R-2	A6	0.000	0.000	0.173	0.000	0.000	0.000	**0.17**	0.84	0.85	0.90	0.90
BASIN		**3.29**	**0.63**	**0.43**	**1.94**	**0.00**	**11.08**	**17.38**	0.61	0.66	0.78	0.66
SUBTOTAL		**19%**	**4%**	**2%**	**11%**	**0%**	**64%**	**100%**				

Off-Site Basins

DESIGN BASIN	DESIGN POINT	PAVED AREA (AC)	DRIVES & WALKS AREA	ROOF AREA (AC)	LANDSCAPE AREA (AC)	RESIDENTIAL AREA (AC)	OVERALL DEV. BASINS AREA (AC)	TOTAL AREA (AC)	Cc(5)	Cc(10)	Cc(100)	Imp %
H-1	F1	0.000	0.000	0.000	0.000	1.085	0.000	**1.08**	0.42	0.49	0.67	0.45
H-2	F2	0.000	0.000	0.000	0.000	0.189	0.000	**0.19**	0.42	0.49	0.67	0.45
F-1	F1	0.000	0.000	0.000	9.908	0.000	0.000	**9.91**	0.02	0.14	0.46	0.02
F-2	F2	0.000	0.000	0.000	20.799	0.000	0.000	**20.80**	0.02	0.14	0.46	0.02
OS-1	OS1	0.654	0.000	0.000	0.961	0.000	0.000	**1.61**	0.39	0.46	0.65	0.42
OS-2	OS2	0.245	0.028	0.000	0.274	0.000	0.000	**0.55**	0.47	0.53	0.70	0.50
**C-1		0.000	0.000	0.000	10.090	0.000	0.000	**10.09**	0.02	0.14	0.46	0.02
**C-2		0.000	0.000	0.000	0.820	0.000	0.000	**0.82**	0.02	0.14	0.46	0.02
**C-3		0.000	0.000	0.000	0.170	0.000	0.000	**0.17**	0.02	0.14	0.46	0.02
BASIN		**0.90**	**0.03**	**0.00**	**43.02**	**1.27**	**0.00**	**45.22**	0.05	0.17	0.48	0.05
SUBTOTAL		**2%**	**0%**	**0%**	**95%**	**3%**	**0%**	**100%**				

Kimley»Horn

STANDARD FORM SF-2
Time of Concentration

PROJECT NAME: Erie - Commercial 1 - Prop. Conditions
PROJECT NUMBER: 096635000
CALCULATED BY: RDW
CHECKED BY: KPB

DATE: 9/8/2017

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)						tc CHECK (URBANIZED BASINS)			FINAL tc		
DESIGN BASIN (1)	AREA Ac (2)	C_5 (3)	LENGTH Ft (4)	SLOPE % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	C_v (9)	Land Surface (10)	VEL fps (11)	T_t Min. (12)	COMP. tc (13)	TOTAL LENGTH (14)	tc=(L/180)+10 Min. (15)	Min.	C10	C100
A-1	0.465	0.86	122	2.1%	3.8	16	0.5%	20.0	Paved Areas	1.4	0.2	4.0	138	10.8	5.0	0.88	0.90
A-2	0.515	0.85	120	2.6%	3.6	15	1.2%	20.0	Paved Areas	2.1	0.1	3.7	135	10.8	5.0	0.87	0.90
A-3	0.163	0.44	23	8.2%	2.9	63	0.5%	20.0	Paved Areas	1.4	0.7	3.6	86	10.5	5.0	0.51	0.68
A-4	0.167	0.67	21	6.2%	2.0	72	0.6%	20.0	Paved Areas	1.5	0.8	2.8	93	10.5	5.0	0.71	0.80
A-5	0.506	0.60	18	1.8%	3.2	325	2.4%	20.0	Paved Areas	3.1	1.7	5.0	343	11.9	5.0	0.65	0.77
A-6	0.336	0.75	60	3.6%	3.2	115	1.2%	20.0	Paved Areas	2.2	0.9	4.1	175	11.0	5.0	0.78	0.85
A-7	0.138	0.65	10	2.0%	2.1	180	1.6%	20.0	Paved Areas	2.5	1.2	3.2	190	11.1	5.0	0.69	0.79
A-8	0.348	0.53	32	8.0%	3.0	317	2.4%	20.0	Paved Areas	3.1	1.7	4.7	349	11.9	5.0	0.58	0.73
A-9	0.309	0.02	63	7.6%	8.0	1	1.0%	7.0	Short Pasture/Lawn	0.7	0.0	8.0	64	10.4	8.0	0.14	0.46
A-10	0.227	0.13	67	7.9%	7.3	1	1.0%	7.0	Short Pasture/Lawn	0.7	0.0	7.3	68	10.4	7.3	0.24	0.52
A-11	0.042	0.62	10	0.4%	3.8	58	0.6%	7.0	Short Pasture/Lawn	0.5	1.8	5.6	68	10.4	5.6	0.67	0.78
B-1	1.170	0.66	33	3.4%	3.1	1,203	2.6%	20.0	Paved Areas	3.2	6.2	9.3	1236	16.9	9.3	0.70	0.80
B-2	1.271	0.63	26	1.4%	3.9	1,203	2.6%	20.0	Paved Areas	3.2	6.2	10.1	1229	16.8	10.1	0.68	0.78
B-3	0.207	0.71	10	5.0%	1.3	187	2.6%	20.0	Paved Areas	3.2	1.0	2.3	197	11.1	5.0	0.74	0.82
*C-1	10.094	0.60							Paved Areas						9.1	0.65	0.77
*C-2	0.821	0.60							Paved Areas						5.0	0.65	0.77
*C-3	0.166	0.60							Paved Areas						5.0	0.65	0.77
R-1	0.259	0.84							Paved Areas						5.0	0.85	0.90
R-2	0.173	0.84							Paved Areas						5.0	0.85	0.90
H-1	1.08	0.42	50	1.0%	8.8	1	1.0%	7.0	Short Pasture/Lawn	0.7	0.0	8.8	51	10.3	8.8	0.49	0.67
H-2	0.19	0.42	50	1.0%	8.8	1	1.0%	7.0	Short Pasture/Lawn	0.7	0.0	8.8	51	10.3	8.8	0.49	0.67
F-1	9.91	0.02	300	4.0%	21.6	1,253	3.0%	7.0	Short Pasture/Lawn	1.2	17.2	38.8	1553	18.6	18.6	0.14	0.46
F-2	20.80	0.02	300	3.7%	22.2	1,454	2.6%	7.0	Short Pasture/Lawn	1.1	21.5	43.6	1754	19.7	19.7	0.14	0.46
OS-1	1.61	0.39	37	1.9%	6.4	980	1.0%	7.0	Short Pasture/Lawn	0.7	23.3	29.7	1017	15.7	15.7	0.46	0.65
OS-2	0.55	0.47	40	2.1%	5.7	225	0.5%	7.0	Short Pasture/Lawn	0.5	7.6	28.0	265	11.5	11.5	0.53	0.70
**C-1	10.09	0.02	300	2.4%	25.6	812	2.4%	7.0	Short Pasture/Lawn	1.1	12.5	12.5	1112	16.2	12.5	0.14	0.46
**C-2	0.82	0.02	182	2.2%	20.5	1	2.2%	7.0	Short Pasture/Lawn	1.0	0.0	0.0	183	11.0	5.0	0.14	0.46
**C-3	0.17	0.02	236	3.3%	20.4	1	3.3%	7.0	Short Pasture/Lawn	1.3	0.0	0.0	237	11.3	5.0	0.14	0.46

$$T_i = \frac{0.395(1.1-C)L^{1/2}}{S^{1/3}}$$

$$T_t = \frac{L}{60V}$$

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: Erie - Commercial 1 - Prop. Conditions
DATE: 9/8/2017
PROJECT NUMBER: 096635000
P_1 (1-Hour Rainfall) = **1.43**
CALCULATED BY: RDW
CHECKED BY: KPB

		DIRECT RUNOFF							**TOTAL RUNOFF**				**STREET**		**PIPE**			**TRAVEL TIME**			**REMARKS**
STORM LINE	**DESIGN POINT**	**DESIGN BASIN**	**AREA (AC)**	**RUNOFF COEFF C5**	**tc (min)**	**C*A(ac)**	**I (in/hr)**	**Q (cfs)**	**tc(max)**	**S(C*A) (ac)**	**I (in/hr)**	**Q (cfs)**	**SLOPE (%)**	**STREET FLOW(cfs**	**DESIGN FLOW(cfs)**	**SLOPE (%)**	**PIPE SIZE (in)**	**LENGTH (ft)**	**VELOCITY**	**tt (min)**	
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**	**(20)**	**(21)**	**(22)**
	A1	A-1	0.47	0.86	5.00	0.40	4.85	1.94													
	A2	A-2	0.52	0.85	5.00	0.44	4.85	2.13													
	A3	A-3	0.16	0.44	5.00	0.07	4.85	0.35													
	A4	A-4	0.17	0.67	5.00	0.11	4.85	0.54													
	A5	A-5	0.51	0.60	5.00	0.30	4.85	1.47													
	A6	A-6	0.34	0.75	5.00	0.25	4.85	1.23													
	A7	A-7	0.14	0.65	5.00	0.09	4.85	0.44													
	A8	A-8	0.35	0.53	5.00	0.18	4.85	0.89													
	OS2	A-9	0.31	0.02	7.99	0.01	4.20	0.03													
	OS1	A-10	0.23	0.13	7.32	0.03	4.33	0.13													
	OS1	A-11	0.04	0.62	5.55	0.03	4.71	0.12													
	B1	B-1	1.17	0.66	9.30	0.77	3.98	3.07													
	B2	B-2	1.27	0.63	10.13	0.80	3.85	3.09													
	B3	B-3	0.21	0.71	5.00	0.15	4.85	0.71													
		*C-1	10.09	0.60	9.10	6.06	4.01	24.29													
		*C-2	0.82	0.60	5.00	0.49	4.85	2.39													
		*C-3	0.17	0.60	5.00	0.10	4.85	0.48													
	A4	R-1	0.26	0.84	5.00	0.22	4.85	1.05													
	A6	R-2	0.17	0.84	5.00	0.15	4.85	0.71													
	*Note that Basins C1 through C3 assume future development conditions in order to size storm sewer appropriately.																				

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: Erie - Commercial 1 - Prop. Conditions

DATE: 9/8/2017

PROJECT NUMBER: 096635000

P_1 (1-Hour Rainfall) = 1.43

CALCULATED BY: RDW

CHECKED BY: KPB

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF C5	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	F1	H-1	1.08	0.42	8.84	0.46	4.05	1.85													
	F2	H-2	0.19	0.42	8.84	0.08	4.05	0.32													
	F1	F-1	9.91	0.02	18.63	0.20	2.92	0.58													
	F1	-	-	-	-	-	-	-	19.74	1.15	2.83	3.25									Combined F-1 + F-2 + H-1 + H-2
	F1	F-2	20.80	0.02	19.74	0.42	2.83	1.18													
	OS1	OS-1	1.61	0.39	15.65	0.63	3.18	2.00													
	OS1	-	-	-	-	-	-	-	15.65	0.68	3.18	2.17									Combined OS-1 + A-10 + A-11
	OS2	OS-2	0.55	0.47	11.47	0.26	3.66	0.94													
	OS2	-	-	-	-	-	-	-	11.47	0.26	3.66	0.96									Combined OS-2 + A-9
		**C-1	10.09	0.02	12.48	0.20	3.53	0.71													
		**C-2	0.82	0.02	5.00	0.02	4.85	0.08													
		**C-3	0.17	0.02	5.00	0.00	4.85	0.02													
	**Note that Basins C1 through C3 assume undeveloped conditions in order to size the temporary drainage swale appropriately.																				

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 10 YEAR EVENT

PROJECT NAME: Erie - Commercial 1 - Prop. Conditions
PROJECT NUMBER: 096635000
CALCULATED BY: RDW
CHECKED BY: KPB

P_1 (1-Hour Rainfall) = 1.73

DATE: 9/8/2017

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
STORM LINE	DESIGN POINT	DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{100}	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCIT Y	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	A1	A-1	0.47	0.88	5.00	0.41	5.87	2.40													
	A2	A-2	0.52	0.87	5.00	0.45	5.87	2.63													
	A3	A-3	0.16	0.51	5.00	0.08	5.87	0.49													
	A4	A-4	0.17	0.71	5.00	0.12	5.87	0.69													
	A5	A-5	0.51	0.65	5.00	0.33	5.87	1.92													
	A6	A-6	0.34	0.78	5.00	0.26	5.87	1.54													
	A7	A-7	0.14	0.69	5.00	0.10	5.87	0.56													
	A8	A-8	0.35	0.58	5.00	0.20	5.87	1.19													
	OS2	A-9	0.31	0.14	7.99	0.04	5.09	0.22													
	OS1	A-10	0.23	0.24	7.32	0.05	5.24	0.28													
	OS1	A-11	0.04	0.67	5.55	0.03	5.70	0.16													
	B1	B-1	1.17	0.70	9.30	0.82	4.81	3.95													
	B2	B-2	1.27	0.68	10.13	0.86	4.66	4.00													
	B3	B-3	0.21	0.74	5.00	0.15	5.87	0.90													
		*C-1	10.09	0.65	9.10	6.56	4.85	31.84													
		*C-2	0.82	0.65	5.00	0.53	5.87	3.13													
		*C-3	0.17	0.65	5.00	0.11	5.87	0.63													
	A4	R-1	0.26	0.85	5.00	0.22	5.87	1.29													
	A6	R-2	0.17	0.85	5.00	0.15	5.87	0.86													
	*Note that Basins C1 through C3 assume future development conditions in order to size storm sewer appropriately.																				

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 10 YEAR EVENT

PROJECT NAME: Erie - Commercial 1 - Prop. Conditions

DATE: 9/8/2017

PROJECT NUMBER: 096635000

P_1 (1-Hour Rainfall) = 1.73

CALCULATED BY: RDW

CHECKED BY: KPB

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
STORM LINE	DESIGN POINT	DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{100}	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	F1	H-1	1.08	0.49	8.84	0.53	4.91	2.61													
	F2	H-2	0.19	0.49	8.84	0.09	4.91	0.45													
	F1	F-1	9.91	0.14	18.63	1.39	3.53	4.90													
	OS1	-	-	-	-	-	-	-	19.74	4.92	3.43	16.87									Combined F-1 + F-2 + H-1 + H-2
	F2	F-2	20.80	0.14	19.74	2.91	3.43	9.98													
	OS1	OS-1	1.61	0.46	15.65	0.75	3.85	2.88													
	OS1	-	-	-	-	-	-	-	15.65	1.36	3.85	5.24									Combined OS-1 + A-10 + A-11
	OS2	OS-2	0.55	0.53	11.47	0.29	4.43	1.29													
	OS2	-	-	-	-	-	-	-	11.47	0.34	4.43	1.49									Combined OS-2 + A-9
		**C-1	10.09	0.14	12.48	1.41	4.27	6.03													
		**C-2	0.82	0.14	5.00	0.11	5.87	0.67													
		**C-3	0.17	0.14	5.00	0.02	5.87	0.14													
	**Note that Basins C1 through C3 assume undeveloped conditions in order to size the temporary drainage swale appropriately.																				

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: Erie - Commercial 1 - Prop. Conditions

DATE: 9/8/2017

PROJECT NUMBER: 096635000

P_1 (1-Hour Rainfall) = 2.7

CALCULATED BY: RDW

CHECKED BY: KPB

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
STORM LINE	DESIGN POINT	DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{100}	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCIT Y	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	A1	A-1	0.47	0.90	5.00	0.42	9.16	3.85													
	A2	A-2	0.52	0.90	5.00	0.46	9.16	4.24													
	A3	A-3	0.16	0.68	5.00	0.11	9.16	1.02													
	A4	A-4	0.17	0.80	5.00	0.13	9.16	1.23													
	A5	A-5	0.51	0.77	5.00	0.39	9.16	3.55													
	A6	A-6	0.34	0.85	5.00	0.29	9.16	2.61													
	A7	A-7	0.14	0.79	5.00	0.11	9.16	1.00													
	A8	A-8	0.35	0.73	5.00	0.25	9.16	2.32													
	OS2	A-9	0.31	0.46	7.99	0.14	7.94	1.13													
	OS1	A-10	0.23	0.52	7.32	0.12	8.18	0.96													
	OS1	A-11	0.04	0.78	5.55	0.03	8.90	0.29													
	B1	B-1	1.17	0.80	9.30	0.93	7.51	7.02													7.02 - 0.60(Q to Carryover to B3) = 6.42
	B2	B-2	1.27	0.78	10.13	1.00	7.27	7.24													7.24 - 0.70(Q to Carryover to OS2) = 6.54
	B3	B-3	0.21	0.82	5.00	0.17	9.16	1.56													
	B3	-	-	-	-	-	-	-	5.00	0.17	9.16	2.14									Combined Basin B-3 + Carryover from B-1
		*C-1	10.09	0.77	9.10	7.77	7.57	58.87													
		*C-2	0.82	0.77	5.00	0.63	9.16	5.79													
		*C-3	0.17	0.77	5.00	0.13	9.16	1.17													
	A4	R-1	0.26	0.90	5.00	0.23	9.16	2.13													
	A6	R-2	0.17	0.90	5.00	0.16	9.16	1.43													
	*Note that Basins C1 through C3 assume future development conditions in order to size storm sewer appropriately.																				

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME:	Erie - Commercial 1 - Prop. Conditions		DATE:	9/8/2017
PROJECT NUMBER:	096635000	**P_1 (1-Hour Rainfall) =** **2.7**		
CALCULATED BY:	RDW			
CHECKED BY:	KPB			

		DIRECT RUNOFF							**TOTAL RUNOFF**				**STREET**		**PIPE**			**TRAVEL TIME**			**REMARKS**
STORM LINE	**DESIGN POINT**	**DESIGN BASIN**	**AREA (AC)**	**RUNOFF COEFF C_{100}**	**tc (min)**	**C*A(ac)**	**I (in/hr)**	**Q (cfs)**	**tc(max)**	**S(C*A) (ac)**	**I (in/hr)**	**Q (cfs)**	**SLOPE (%)**	**STREET FLOW(cfs)**	**DESIGN FLOW(cfs)**	**SLOPE (%)**	**PIPE SIZE (in)**	**LENGTH (ft)**	**VELOCITY**	**tt (min)**	
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**	**(20)**	**(21)**	**(22)**
	F1	H-1	1.08	0.67	8.84	0.73	7.66	5.57													
	F2	H-2	0.19	0.67	8.84	0.13	7.66	0.97													
	F1	F-1	9.91	0.46	18.63	4.56	5.51	25.11													
	OS1	-	-	-	-	-	-	-	19.74	14.98	5.35	80.09									Combined F-1 + F-2 + H-1 + H-2
	F2	F-2	20.80	0.46	19.74	9.57	5.35	51.16													
	OS1	OS-1	1.61	0.65	15.65	1.06	6.01	6.35													
	OS1	-	-	-	-	-	-	-	15.65	1.21	6.01	7.25									Combined OS-1 + A-10 + A-11
	OS2	OS-2	0.55	0.70	11.47	0.38	6.91	2.63													
	OS2	-	-	-	-	-	-	-	11.47	0.52	6.91	4.28									Combined OS-2 + A-9 + Carryover from B-2
		**C-1	10.09	0.46	12.48	4.64	6.66	30.94													
		**C-2	0.82	0.46	5.00	0.38	9.16	3.46													
		**C-3	0.17	0.46	5.00	0.08	9.16	0.70													
	**Note that Basins C1 through C3 assume undeveloped conditions in order to size the temporary drainage swale appropriately.																				

FOUR CORNERS - COMMERCIAL AREA 1

FINAL DRAINAGE PLAN - RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)	
			Q5	Q100
A1	A1	0.47	1.94	3.85
A2	A-2	0.52	2.13	4.24
A3	A-3	0.16	0.35	1.02
A4	A-4, R-1	0.43	1.59	3.36
A5	A-5	0.51	1.47	3.55
A6	A6, R2	0.51	1.93	4.04
A7	A-7	0.14	0.44	1.00
A8	A-8	0.35	0.89	2.32
OS1	A-10, A-11, 0S-1	1.88	2.25	7.60
OS2	A-9, OS-2	0.86	0.97	3.77
B1	B-1	1.17	3.07	7.02
B2	B-2	1.27	3.09	7.24
B3	B-3	0.21	0.71	1.56
	*C-1	10.09	24.29	58.87
	*C-2	0.82	2.39	5.79
	*C-3	0.17	0.48	1.17
F1	H-1, F-1	10.99	2.43	30.68
F2	H-2, F-2	20.99	1.50	52.13

*Note that Basins C1 through C3 assume future development conditions in order to size storm sewer appropriately.

Kimley»Horn

PROJECT NAME: Erie - Commercial 1 - Prop. Conditions DATE: 8/25/2017
PROJECT NUMBER: 096635000
CALCULATED BY: RDW
CHECKED BY: KPB

SOUTH DRAINAGE SWALE - RUNOFF SUMMARY TABLE

TRIBUTARY BASIN	AREA (AC)	RUNOFF COEFFICIENTS		I (%)	PEAK FLOWS (CFS)	
		C5	C100		Q5	Q100
A-3	A-3	0.47	1.94	385%	0.35	1.02
A-4	0.17	0.67	0.80	72%	0.54	1.23
A-5	0.51	0.60	0.77	64%	1.47	3.55
A-8	0.35	0.53	0.73	56%	0.89	2.32
R-1	0.26	0.84	0.90	90%	1.05	2.13
TOTAL RUNOFF ENTERING SOUTH DRAINAGE SWALE =					4.29	10.24

NORTH DRAINAGE SWALE - RUNOFF SUMMARY TABLE

TRIBUTARY BASIN	AREA (AC)	RUNOFF COEFFICIENTS		I (%)	PEAK FLOWS (CFS)	
		C5	C100		Q5	Q100
A-1	0.47	0.86	0.90	93%	1.94	3.85
A-2	0.52	0.85	0.90	91%	2.13	4.24
A-3	0.16	0.44	0.68	47%	0.35	1.02
A-4	0.17	0.67	0.80	72%	0.54	1.23
A-5	0.51	0.60	0.77	64%	1.47	3.55
A-6	0.34	0.75	0.85	81%	1.23	2.61
A-7	0.14	0.65	0.79	70%	0.44	1.00
A-8	0.35	0.53	0.73	56%	0.89	2.32
R-1	0.26	0.84	0.90	90%	1.05	2.13
R-2	0.17	0.84	0.90	90%	0.71	1.43
H-1	1.08	0.42	0.67	45%	1.85	5.57
H-2	0.19	0.42	0.67	45%	0.32	0.97
F-1	9.91	0.02	0.46	2%	0.58	25.11
F-2	20.80	0.02	0.46	2%	1.18	51.16
**C-1	10.09	0.02	0.46	2%	0.71	30.94
**C-2	0.82	0.02	0.46	2%	0.08	3.46
**C-3	0.17	0.02	0.46	2%	0.02	0.70
TOTAL RUNOFF ENTERING SOUTH DRAINAGE SWALE =					15.47	141.28

APPENDIX C – HYDRAULIC CALCULATIONS

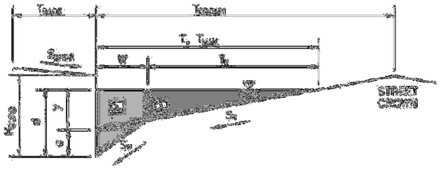
Version 4.05 Released March 2017

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

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

Project: Erie - Four Corners - Commercial 1

Inlet ID: A1 - COMM1



Gutter Geometry (Enter data in the blue cells)

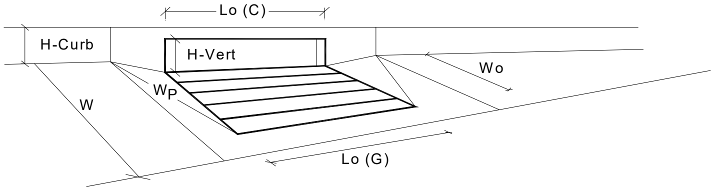
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	9.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.051	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	49.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.015	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	20.0	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

Version 4.05 Released March 2017



Design Information (Input) CDOT Type R Curb Opening ▾		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)	$Q_{PEAK\ REQUIRED}$ =	1.9	3.9	cfs

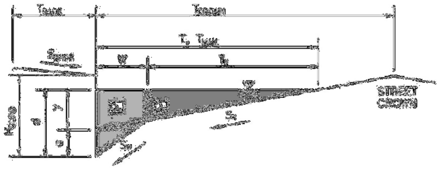
Version 4.05 Released March 2017

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

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

Project: **Erie - Four Corners - Commercial 1**

Inlet ID: **A2- COMM1**



Gutter Geometry (Enter data in the blue cells)

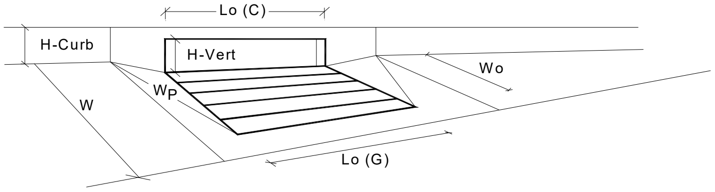
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	16.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.071	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	49.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.013	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	24.0	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

Version 4.05 Released March 2017



Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening ▾	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)		$Q_{PEAK\ REQUIRED}$ =	2.1	4.2	cfs

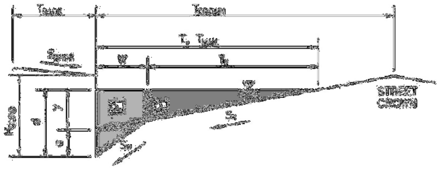
Version 4.05 Released March 2017

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

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

Project: **Erie - Four Corners - Commercial 1**

Inlet ID: **A3 - COMM1**



Gutter Geometry (Enter data in the blue cells)

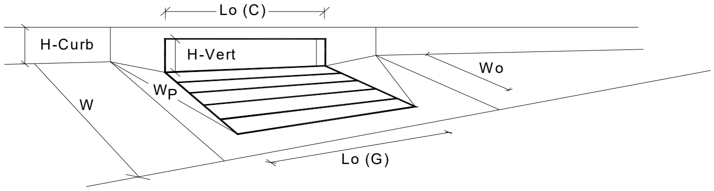
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.114	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	33.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.028	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	23.0	33.0	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

Version 4.05 Released March 2017



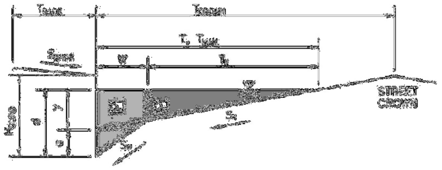
Design Information (Input)		MINOR	MAJOR	
Type of Inlet CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside 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)	$Q_{PEAK\ REQUIRED}$ =	0.4	1.0	cfs

Version 4.05 Released March 2017

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

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

Project: **Erie - Four Corners - Commercial 1**
Inlet ID: **A4 - COMM1**



Gutter Geometry (Enter data in the blue cells)

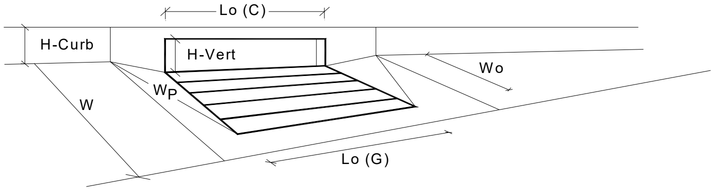
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	19.3	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.201	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	34.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.048	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.5	34.5	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

Version 4.05 Released March 2017



Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	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)		$Q_{PEAK\ REQUIRED}$ =	0.5	1.2	cfs

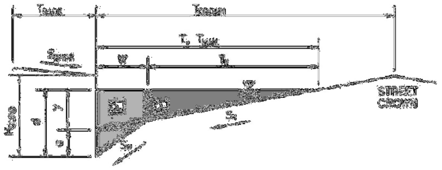
Version 4.05 Released March 2017

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

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

Project: Erie - Four Corners - Commercial 1

Inlet ID: A5 - ST CAPACITY



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.5		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} =	13.0		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 =	0.010		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	13.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.7	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**5.7**	**13.2**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

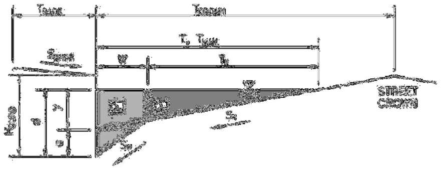
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Version 4.05 Released March 2017

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

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

Project: **Erie - Four Corners - Commercial 1**
Inlet ID: **A5 - COMM1**



Gutter Geometry (Enter data in the blue cells)

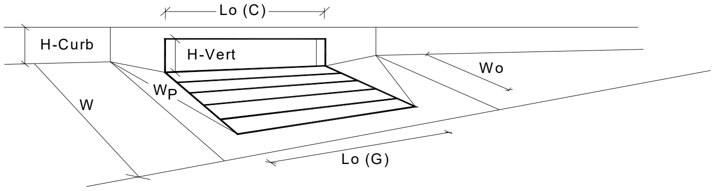
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	19.0	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	9.0	19.0	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

Version 4.05 Released March 2017



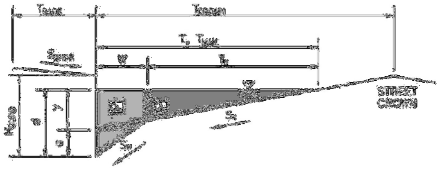
Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	3.7	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} =	0.14	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.47	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 =	**1.5**	**5.4**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor Storm		$Q_{PEAK\ REQUIRED}$ =	1.5	3.6	cfs

Version 4.05 Released March 2017

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

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

Project: **Erie - Four Corners - Commercial 1**
Inlet ID: **A6 - COMM1**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.8	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.170	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} =	12.0	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 =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

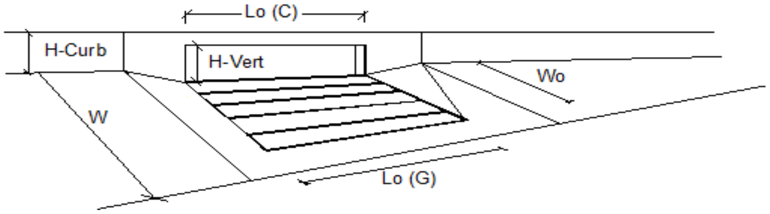
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.7**	**4.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening ▾	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.2**	**2.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**100**	**%**

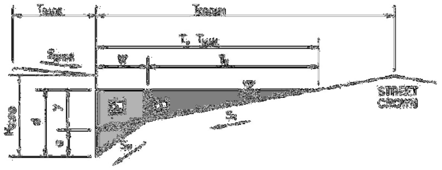
Version 4.05 Released March 2017

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

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

Project: **Erie - Four Corners - Commercial 1**

Inlet ID: **A7 - COMM1**



Gutter Geometry (Enter data in the blue cells)

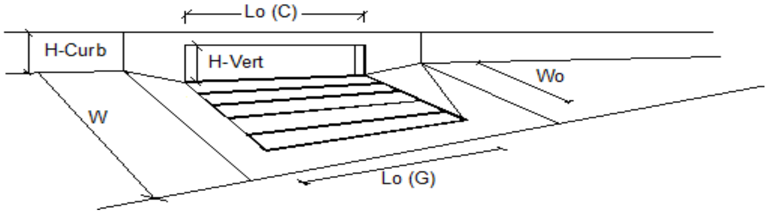
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.5		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0		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 =	0.010		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**4.7**	**4.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.4**	**1.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

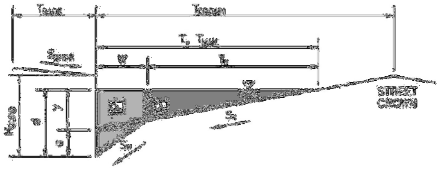
Version 4.05 Released March 2017

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

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

Project: **Erie - Four Corners - Commercial 1**

Inlet ID: **A8 - ST CAPACITY**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.113	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} =	13.0	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 =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	13.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.7	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**5.7**	**13.2**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

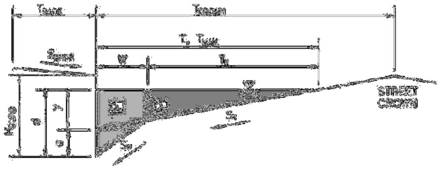
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Version 4.05 Released March 2017

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

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

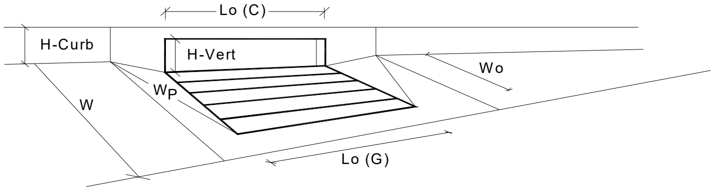
Project: **Erie - Four Corners - Commercial 1**
Inlet ID: **A8 - COMM1**



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.5		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.113		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} =	19.0		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} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	9.0	19.0	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 Allowable Capacity is based on Depth Criterion		Minor Storm	Major Storm	
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



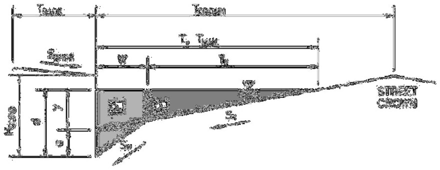
Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	3.7	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} =	0.14	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.47	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 =	**1.5**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	0.9	2.3	cfs

Version 4.05 Released March 2017

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

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

Project: **Erie - Four Corners - Commercial 1**
Inlet ID: **B1 - AUSTIN AVE**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	16.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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 =	0.020	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

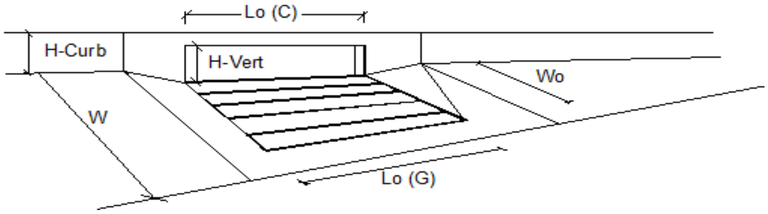
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**3.4**	**13.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening ▾	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**3.1**	**6.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.6**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**92**	**%**

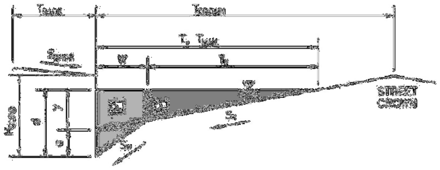
Version 4.05 Released March 2017

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

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

Project: **Erie - Four Corners - Commercial 1**

Inlet ID: **B2 - AUSTIN AVE**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	16.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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 =	0.020	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

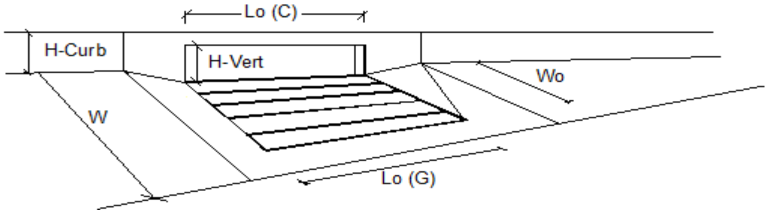
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**3.4**	**13.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017

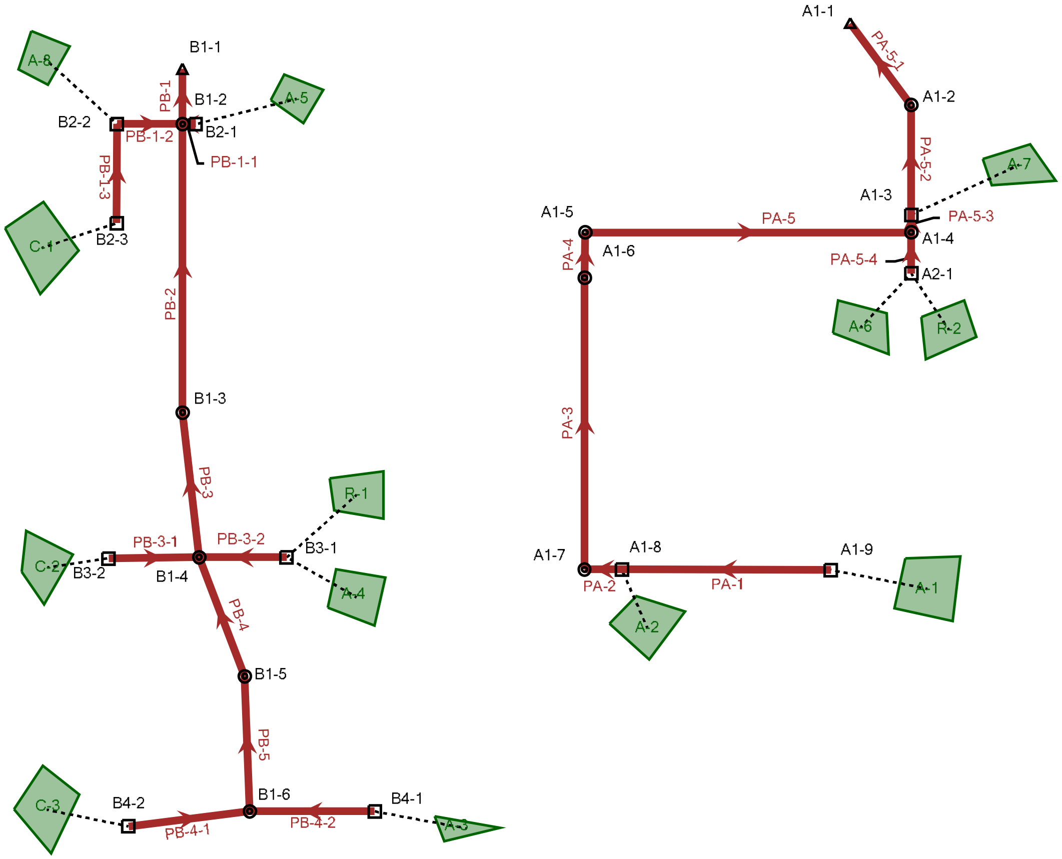


CDOT Type R Curb Opening ▾

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.1**	**6.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**91**	**%**

Scenario: 100-YEAR STORM EVENT



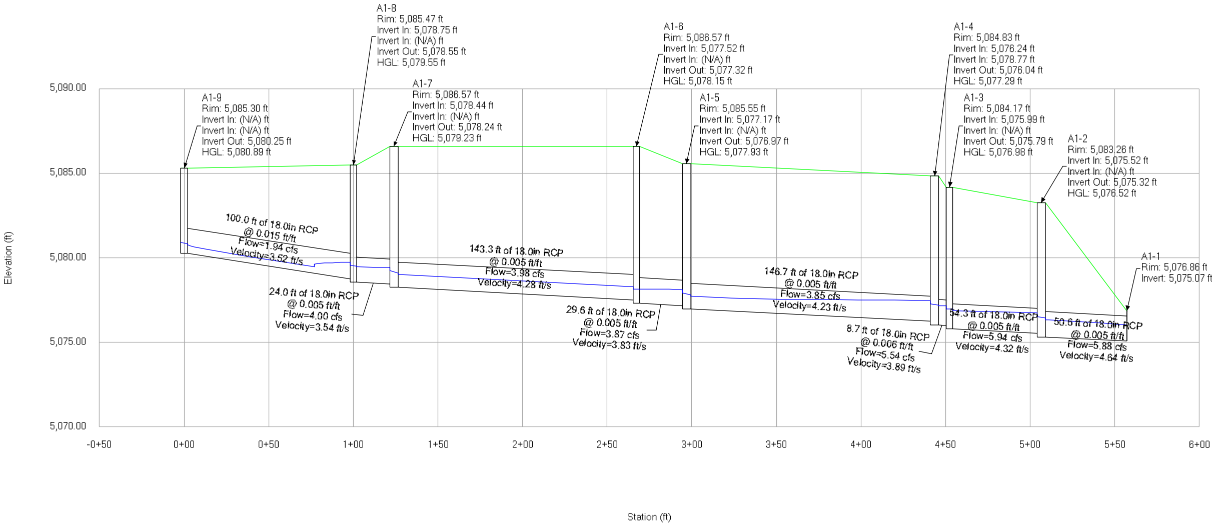
Erie - Commercial 1.stsw
1/18/2018

Bentley Systems, Inc. Haestad Methods Solution Center
27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA
+1-203-755-1666

Profile Report

Engineering Profile - Comm 1 East Main A1 (Erie - Commercial 1.stsw)

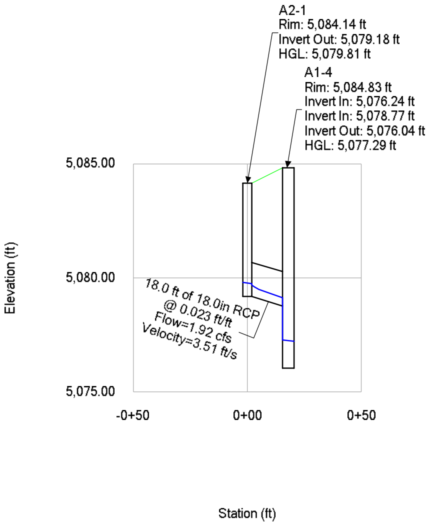
Active Scenario: 5-yr



Profile Report

Engineering Profile - Comm 1 East Lat A2 (Erie - Commercial 1.stsw)

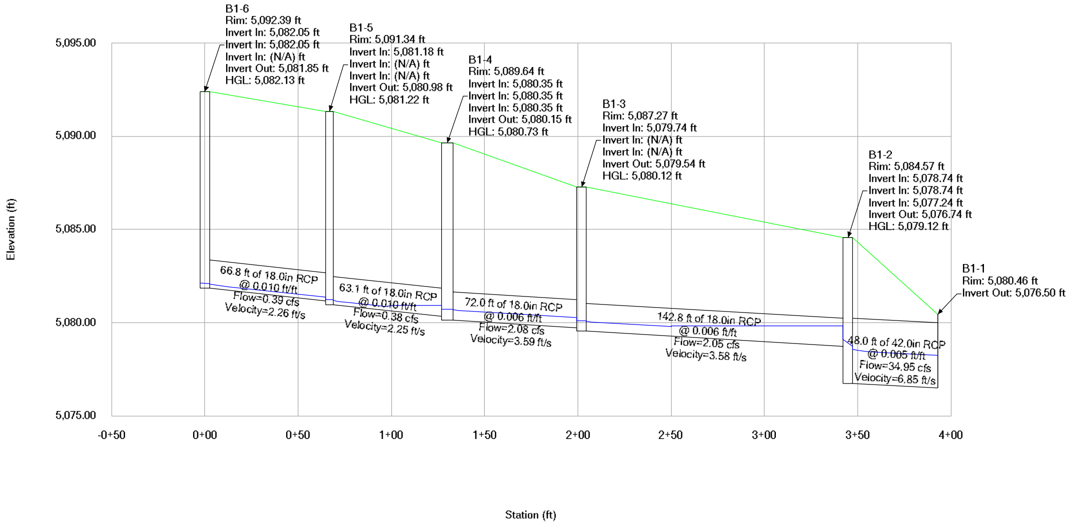
Active Scenario: 5-yr



Profile Report

Engineering Profile - Comm 1 West Main B1 (Erie - Commercial 1.stsw)

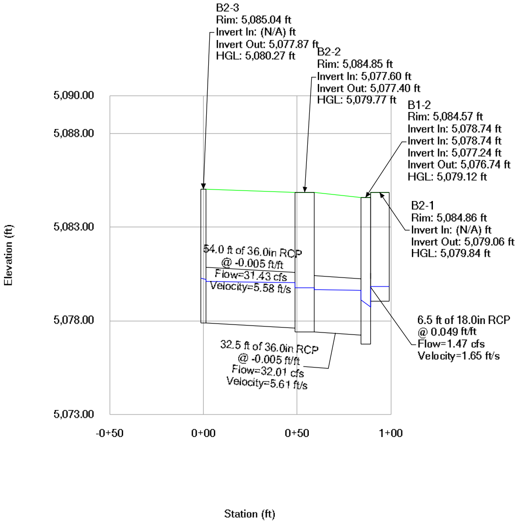
Active Scenario: 5-yr



Profile Report

Engineering Profile - Comm 1 West Lat B2 (Erie - Commercial 1.stsw)

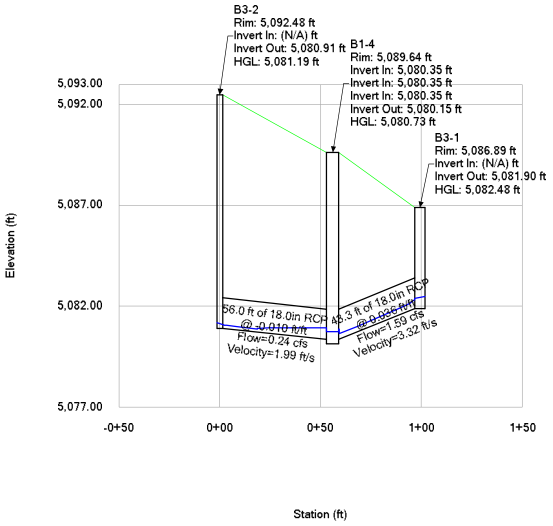
Active Scenario: 5-yr



Profile Report

Engineering Profile - Comm 1 West Lat B3 (Erie - Commercial 1.stsw)

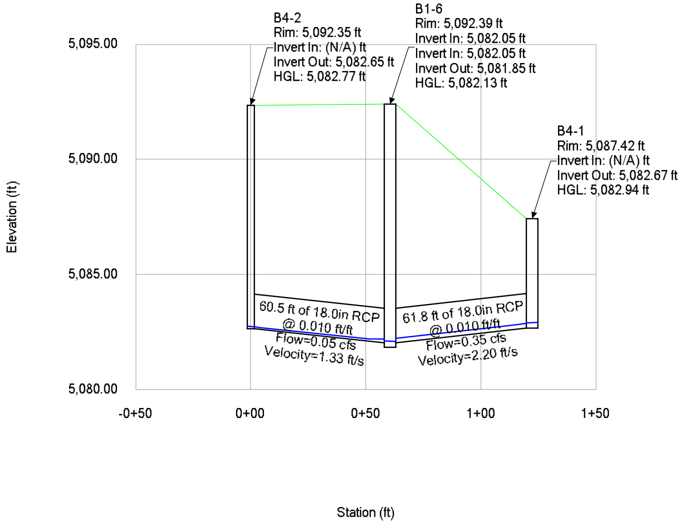
Active Scenario: 5-yr



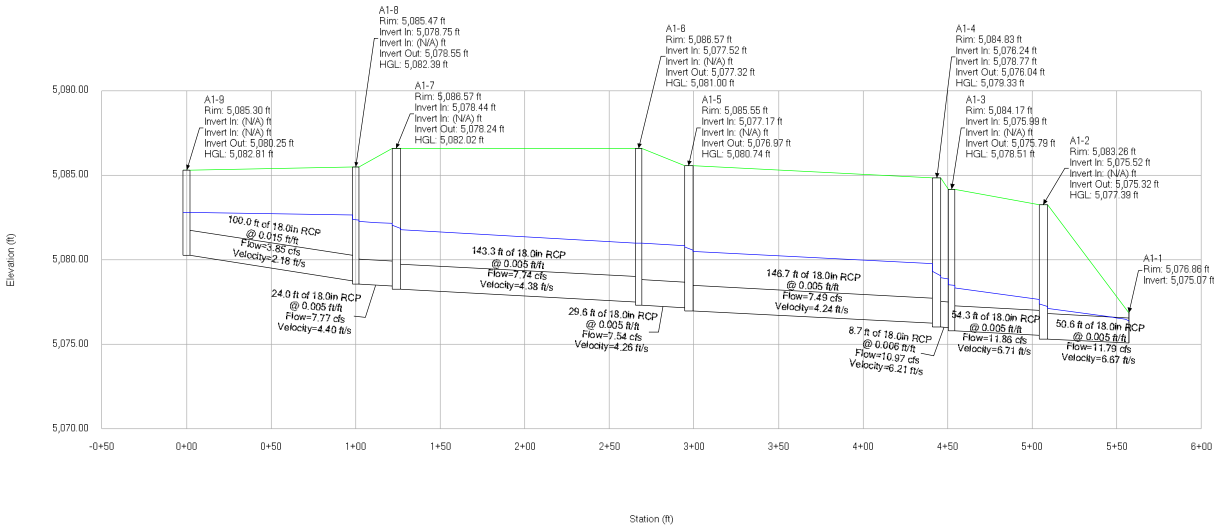
Profile Report

Engineering Profile - Comm 1 West Lat B4 (Erie - Commercial 1.stsw)

Active Scenario: 5-yr



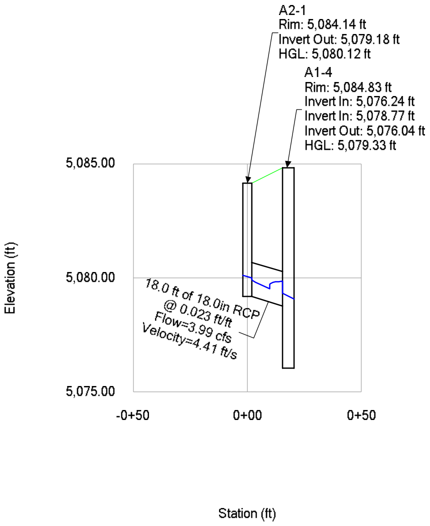
Profile Report
Engineering Profile - Comm 1 East Main A1 (Erie - Commercial 1.stsw)
Active Scenario: 100-YEAR STORM EVENT



Profile Report

Engineering Profile - Comm 1 East Lat A2 (Erie - Commercial 1.stsw)

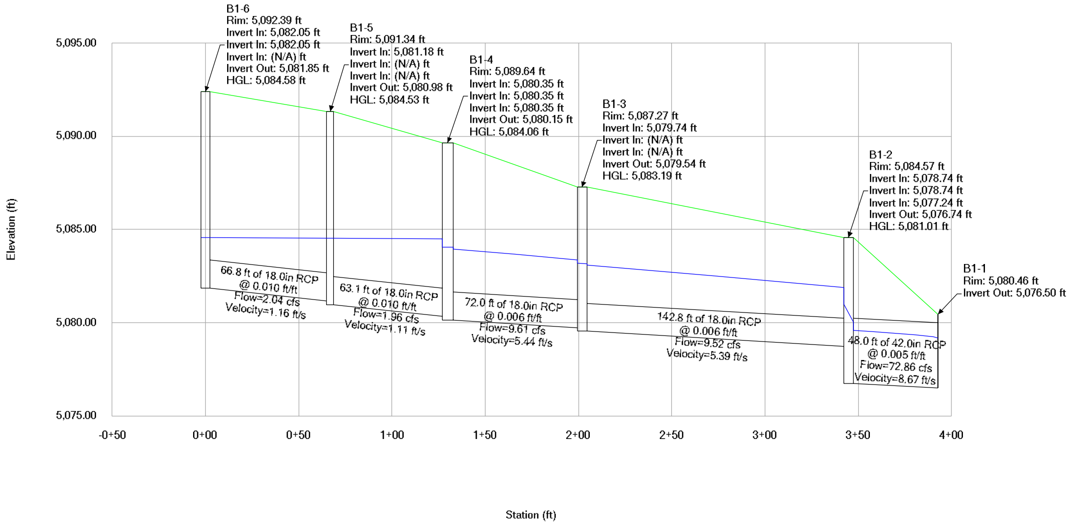
Active Scenario: 100-YEAR STORM EVENT



Profile Report

Engineering Profile - Comm 1 West Main B1 (Erie - Commercial 1.stsw)

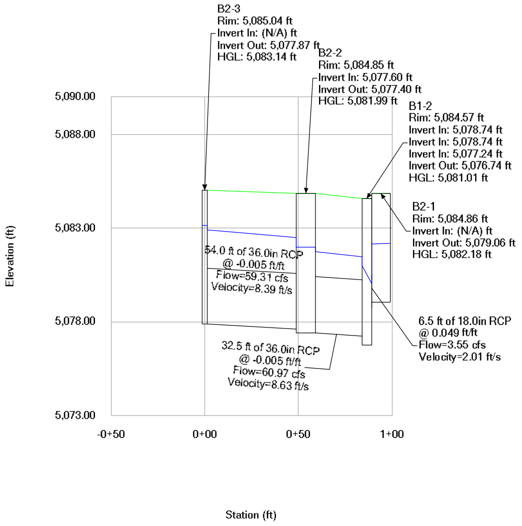
Active Scenario: 100-YEAR STORM EVENT



Profile Report

Engineering Profile - Comm 1 West Lat B2 (Erie - Commercial 1.stsw)

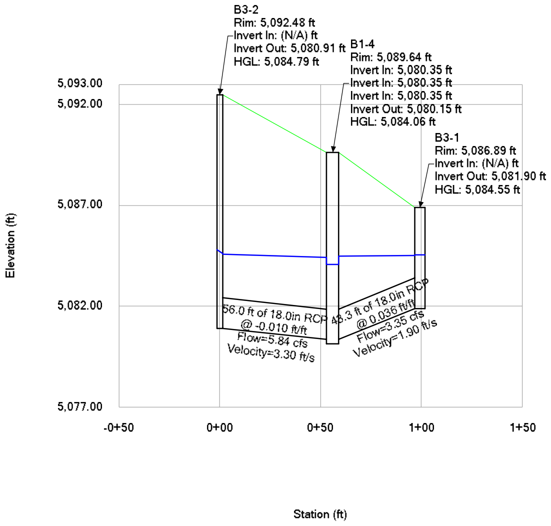
Active Scenario: 100-YEAR STORM EVENT



Profile Report

Engineering Profile - Comm 1 West Lat B3 (Erie - Commercial 1.stsw)

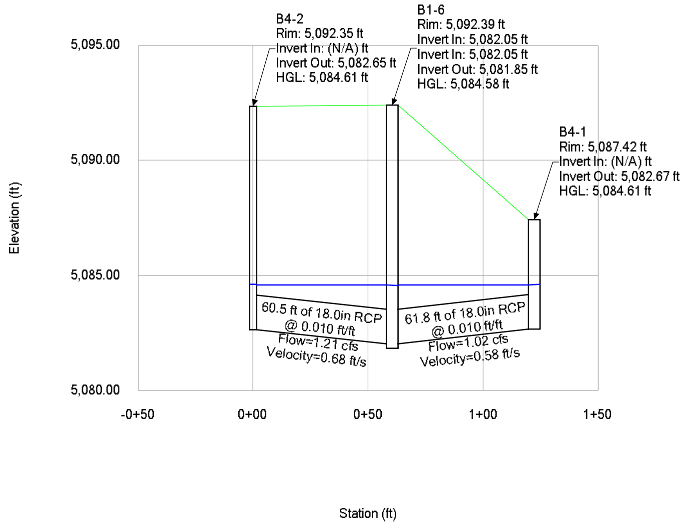
Active Scenario: 100-YEAR STORM EVENT



Profile Report

Engineering Profile - Comm 1 West Lat B4 (Erie - Commercial 1.stsw)

Active Scenario: 100-YEAR STORM EVENT



FlexTable: Catch Basin Table

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
B4-1	5,087.42	5,082.67	1.02	5,084.61	5,084.61
B3-1	5,086.89	5,081.90	3.35	5,084.55	5,084.54
B4-2	5,092.35	5,082.65	1.21	5,084.61	5,084.61
B2-1	5,084.86	5,079.06	3.55	5,082.18	5,082.16
B2-2	5,084.85	5,077.40	60.97	5,081.99	5,081.99
B2-3	5,085.04	5,077.87	59.31	5,083.14	5,083.13
B3-2	5,092.48	5,080.91	5.84	5,084.79	5,084.62
A1-9	5,085.30	5,080.25	3.85	5,082.81	5,082.80
A1-8	5,085.47	5,078.55	7.77	5,082.39	5,082.33
A2-1	5,084.14	5,079.18	3.99	5,080.12	5,080.01
A1-3	5,084.17	5,075.79	11.86	5,078.51	5,078.49

FlexTable: Catchment Table

Label	Outflow Element	Area (User Defined) (acres)	Time of Concentration (min)	Runoff Coefficient (Rational)	Flow (Total Out) (cfs)
A-1	A1-9	0.463	5.000	0.900	3.85
A-2	A1-8	0.510	5.000	0.900	4.24
A-3	B4-1	0.163	5.000	0.680	1.02
A-4	B3-1	0.166	5.000	0.800	1.23
A-5	B2-1	0.500	5.000	0.770	3.55
A-6	A2-1	0.333	5.000	0.850	2.61
A-7	A1-3	0.137	5.000	0.790	1.00
A-8	B2-2	0.345	5.000	0.730	2.32
C-1	B2-3	10.090	9.100	0.770	59.31
C-2	B3-2	0.821	5.000	0.770	5.84
C-3	B4-2	0.170	5.000	0.770	1.21
R-1	B3-1	0.256	5.000	0.900	2.13
R-2	A2-1	0.176	5.400	0.900	1.43

FlexTable: Conduit Table

Label	Start Node	Diameter (in)	Invert (Start) (ft)	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (cfs)	Flow (cfs)	Elevation Ground (Start) (ft)	Cover (Stop) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Cover (Start) (ft)	Velocity (ft/s)
PA-1	A1-9	18.0	5,080.25	5,078.75	103.3	0.015	12.86	3.85	5,085.30	5.22	5,085.47	5,082.65	5,082.78	3.55	2.18
PA-2	A1-8	18.0	5,078.55	5,078.44	18.5	0.005	7.11	7.77	5,085.47	6.63	5,086.57	5,082.14	5,082.27	5.42	4.40
PA-3	A1-7	18.0	5,078.24	5,077.52	144.4	0.005	7.45	7.74	5,086.57	7.55	5,086.57	5,081.00	5,081.78	6.83	4.38
PA-4	A1-6	18.0	5,077.32	5,077.17	22.5	0.005	7.48	7.54	5,086.57	6.88	5,085.55	5,080.85	5,081.00	7.75	4.26
PA-5	A1-5	18.0	5,076.97	5,076.24	161.2	0.005	7.41	7.49	5,085.55	7.09	5,084.83	5,079.76	5,080.51	7.08	4.24
PA-5-1	A1-2	18.0	5,075.32	5,075.07	50.6	0.005	7.39	11.79	5,083.26	0.29	5,076.86	5,076.38	5,077.12	6.44	6.67
PA-5-2	A1-3	18.0	5,075.79	5,075.52	54.3	0.005	7.41	11.86	5,084.17	6.24	5,083.26	5,077.66	5,078.35	6.88	6.71
PA-5-3	A1-4	18.0	5,076.04	5,075.99	8.7	0.006	7.96	10.97	5,084.83	6.68	5,084.17	5,078.85	5,078.94	7.29	6.21
PA-5-4	A2-1	18.0	5,079.18	5,078.77	20.3	0.023	15.85	3.99	5,084.14	4.56	5,084.83	5,079.86	5,079.94	3.46	7.47
PB-1	B1-2	42.0	5,076.74	5,076.50	27.3	0.005	71.14	72.86	5,084.57	0.46	5,080.46	5,079.17	5,079.60	4.33	8.42
PB-1-1	B2-1	18.0	5,079.06	5,078.74	6.5	0.049	23.30	3.55	5,084.86	4.33	5,084.57	5,082.14	5,082.15	4.30	2.01
PB-1-2	B1-2	36.0	5,077.24	5,077.40	32.5	-0.005	46.79	60.97	5,084.57	4.45	5,084.85	5,081.48	5,081.76	4.33	8.63
PB-1-3	B2-2	36.0	5,077.60	5,077.87	49.1	-0.005	47.16	59.31	5,084.85	4.17	5,085.04	5,082.49	5,082.91	4.25	8.39
PB-2	B1-3	18.0	5,079.54	5,078.74	142.8	0.006	7.86	9.52	5,087.27	4.33	5,084.57	5,081.91	5,083.08	6.23	5.39
PB-3	B1-4	18.0	5,080.15	5,079.74	72.0	0.006	7.92	9.61	5,089.64	6.03	5,087.27	5,083.36	5,083.97	7.99	5.44
PB-3-1	B1-4	18.0	5,080.35	5,080.91	44.8	-0.010	10.50	5.84	5,089.64	10.07	5,092.48	5,084.42	5,084.59	7.79	3.30
PB-3-2	B3-1	18.0	5,081.90	5,080.35	43.3	0.036	19.87	3.35	5,086.89	7.79	5,089.64	5,084.48	5,084.53	3.49	1.90
PB-4	B1-5	18.0	5,080.98	5,080.35	63.1	0.010	10.50	1.96	5,091.34	7.79	5,089.64	5,084.51	5,084.53	8.86	1.11
PB-4-1	B4-2	18.0	5,082.65	5,082.05	60.5	0.010	10.46	1.21	5,092.35	8.84	5,092.39	5,084.60	5,084.61	8.20	0.68
PB-4-2	B4-1	18.0	5,082.67	5,082.05	61.8	0.010	10.52	1.02	5,087.42	8.84	5,092.39	5,084.60	5,084.61	3.25	0.58
PB-5	B1-6	18.0	5,081.85	5,081.18	66.8	0.010	10.52	2.04	5,092.39	8.66	5,091.34	5,084.54	5,084.57	9.04	1.16

FlexTable: Manhole Table

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
B1-6	5,092.39	5,081.85	2.04	5,084.58	5,084.57
B1-5	5,091.34	5,080.98	1.96	5,084.53	5,084.53
B1-4	5,089.64	5,080.15	9.61	5,084.06	5,084.06
B1-3	5,087.27	5,079.54	9.52	5,083.19	5,083.17
A1-7	5,086.57	5,078.24	7.74	5,082.02	5,081.84
A1-5	5,085.55	5,076.97	7.49	5,080.74	5,080.56
A1-4	5,084.83	5,076.04	10.97	5,079.33	5,079.06
B1-2	5,084.57	5,076.74	72.86	5,081.01	5,080.04
A1-2	5,083.26	5,075.32	11.79	5,077.39	5,077.25
A1-6	5,086.57	5,077.32	7.54	5,081.00	5,081.00

FlexTable: Outfall Table

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
A1-1	5,076.86	5,075.07	Free Outfall		5,076.38	11.72
B1-1	5,080.46	5,076.50	Free Outfall		5,079.17	72.58

Culvert Calculator Report
Outfall Pipe Sizing - 42" Pipe

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	5,074.00	ft	Headwater Depth/Height	2.56	
Computed Headwater Eleva	5,073.27	ft	Discharge	141.28	cfs
Inlet Control HW Elev.	5,073.27	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	5,071.79	ft	Control Type	Inlet Control	

Grades

Upstream Invert	5,064.30	ft	Downstream Invert	5,063.12	ft
Length	23.70	ft	Constructed Slope	0.050000	ft/ft

Hydraulic Profile

Profile	S2		Depth, Downstream	2.72	ft
Slope Type	Steep		Normal Depth	2.01	ft
Flow Regime	Supercritical		Critical Depth	3.36	ft
Velocity Downstream	17.58	ft/s	Critical Slope	0.017175	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	3.50	ft
Section Size	42 inch		Rise	3.50	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	5,071.79	ft	Upstream Velocity Head	3.44	ft
Ke	0.20		Entrance Loss	0.69	ft

Inlet Control Properties

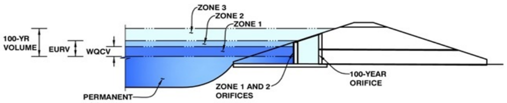
Inlet Control HW Elev.	5,073.27	ft	Flow Control	Submerged	
Inlet Type	Beveled ring, 45° bevels		Area Full	9.6	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	A	
C	0.03000		Equation Form	1	
Y	0.74000				

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: **Erie Four Corners Temporary Drainage Pond**

Basin ID:



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type = **EDB**
Watershed Area = 3.07 acres
Watershed Length = 380 ft
Watershed Slope = 0.028 ft/ft
Watershed Imperviousness = 77.00% percent
Percentage Hydrologic Soil Group A = 0.0% percent
Percentage Hydrologic Soil Group B = 100.0% percent
Percentage Hydrologic Soil Groups C/D = 0.0% percent
Desired WQCV Drain Time = 40.0 hours
Location for 1-hr Rainfall Depths = Erie
Water Quality Capture Volume (WQCV) = 0.079 acre-feet
Excess Urban Runoff Volume (EURV) = 0.262 acre-feet

			Optional User Override 1-hr Precipitation	
2-yr Runoff Volume (P1 = 0.81 in.) =	0.150	acre-feet		inches
5-yr Runoff Volume (P1 = 1.11 in.) =	0.215	acre-feet		inches
10-yr Runoff Volume (P1 = 1.39 in.) =	0.287	acre-feet		inches
25-yr Runoff Volume (P1 = 1.84 in.) =	0.410	acre-feet		inches
50-yr Runoff Volume (P1 = 2.24 in.) =	0.506	acre-feet		inches
100-yr Runoff Volume (P1 = 2.68 in.) =	0.629	acre-feet		inches
500-yr Runoff Volume (P1 = 3.89 in.) =	0.952	acre-feet		inches

Approximate 2-yr Detention Volume = 0.141 acre-feet
Approximate 5-yr Detention Volume = 0.202 acre-feet
Approximate 10-yr Detention Volume = 0.270 acre-feet
Approximate 25-yr Detention Volume = 0.336 acre-feet
Approximate 50-yr Detention Volume = 0.378 acre-feet
Approximate 100-yr Detention Volume = 0.427 acre-feet

Stage-Storage Calculation

Zone 1 Volume (WQCV) = 0.079 acre-feet
Zone 2 Volume (EURV - Zone 1) = 0.182 acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) = 0.165 acre-feet
Total Detention Basin Volume = 0.427 acre-feet
Initial Surcharge Volume (ISV) = user ft^3
Initial Surcharge Depth (ISD) = user ft
Total Available Detention Depth (H_{total}) = user ft
Depth of Trickle Channel (H_{TC}) = user ft
Slope of Trickle Channel (S_{TC}) = user ft/ft
Slopes of Main Basin Sides (S_{main}) = user H:V
Basin Length-to-Width Ratio ($R_{L/W}$) = user

Initial Surcharge Area (A_{ISV}) = user ft^2
Surcharge Volume Length (L_{ISV}) = user ft
Surcharge Volume Width (W_{ISV}) = user ft
Depth of Basin Floor (H_{FLOOR}) = user ft
Length of Basin Floor (L_{FLOOR}) = user ft
Width of Basin Floor (W_{FLOOR}) = user ft
Area of Basin Floor (A_{FLOOR}) = user ft^2
Volume of Basin Floor (V_{FLOOR}) = user ft^3
Depth of Main Basin (H_{MAIN}) = user ft
Length of Main Basin (L_{MAIN}) = user ft
Width of Main Basin (W_{MAIN}) = user ft
Area of Main Basin (A_{MAIN}) = user ft^2
Volume of Main Basin (V_{MAIN}) = user ft^3
Calculated Total Basin Volume (V_{total}) = **user** acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
Trickle Channel Inv (5073.71)	--	0.33	--	--	--	12	0.000	2	0.000
ELEV = 5074.00	--	0.62	--	--	--	39	0.001	9	0.000
	--	1.62	--	--	--	2,327	0.053	1,169	0.027
	--	2.62	--	--	--	7,313	0.168	6,012	0.138
	--	3.62	--	--	--	11,435	0.263	15,386	0.353
	--	4.62	--	--	--	14,744	0.338	28,476	0.654
	--	5.62	--	--	--	18,121	0.416	44,908	1.031
	--	6.62	--	--	--	21,572	0.495	64,755	1.487
ELEV = 5081	--	7.62	--	--	--	25,097	0.576	88,089	2.022
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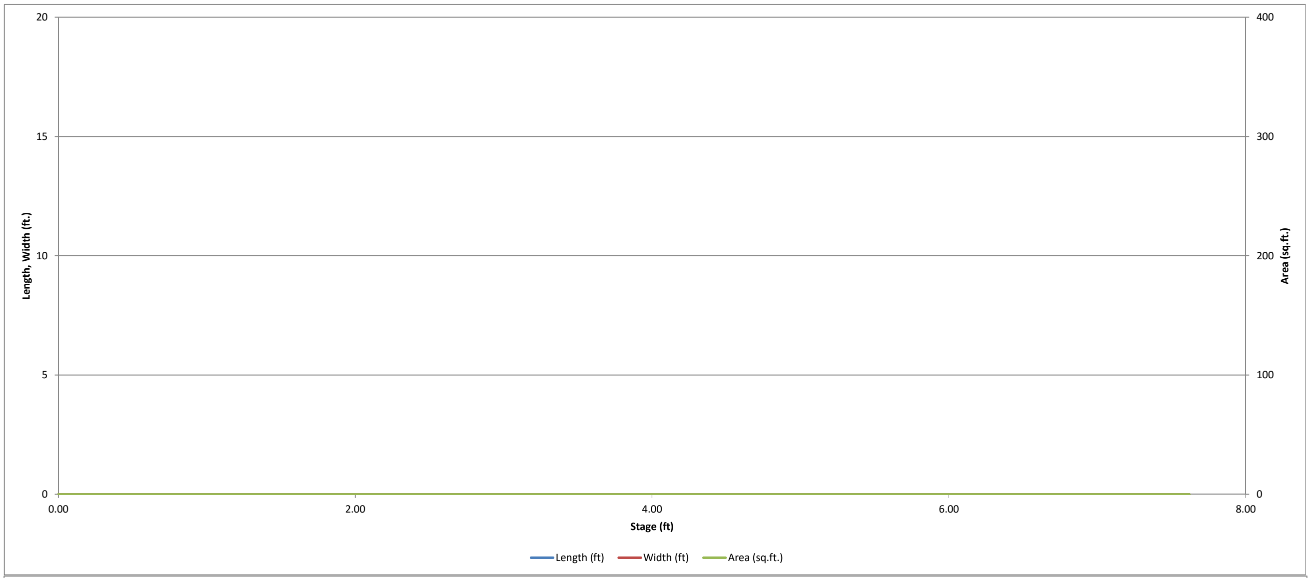
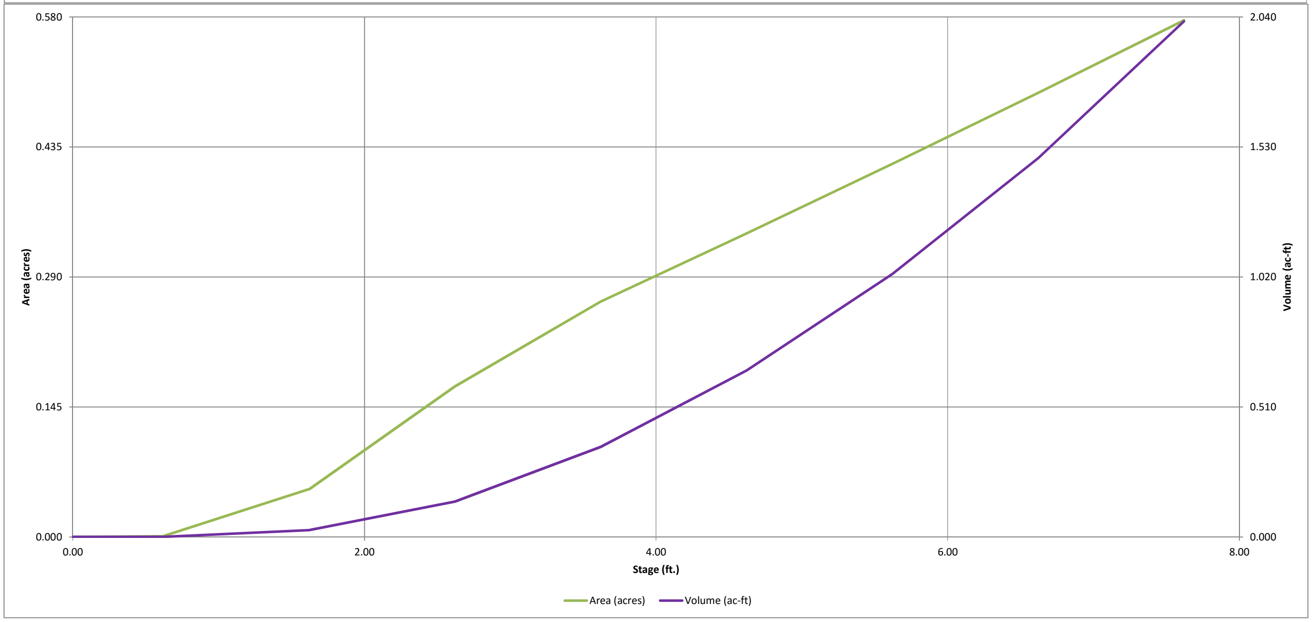
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



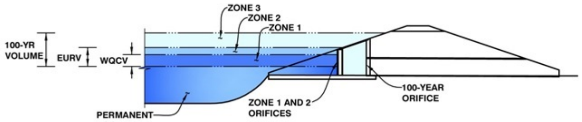


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.22	0.079	Orifice Plate
Zone 2 (EURV)	3.25	0.182	Orifice Plate
Zone 3 (100-year)	3.90	0.165	Weir&Pipe (Restrict)
		0.427	**Total**

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.25	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	13.00	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.08	2.17					
Orifice Area (sq. inches)	0.37	0.37	0.37					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.92	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.98	N/A	feet
Over Flow Weir Slope Length =	3.01	N/A	feet
Grate Open Area / 100-yr Orifice Area =	24.39	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	8.43	N/A	ft^2
Overflow Grate Open Area w/ Debris =	4.21	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	4.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.35	N/A	ft^2
Outlet Orifice Centroid =	0.22	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.05	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.90	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	20.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

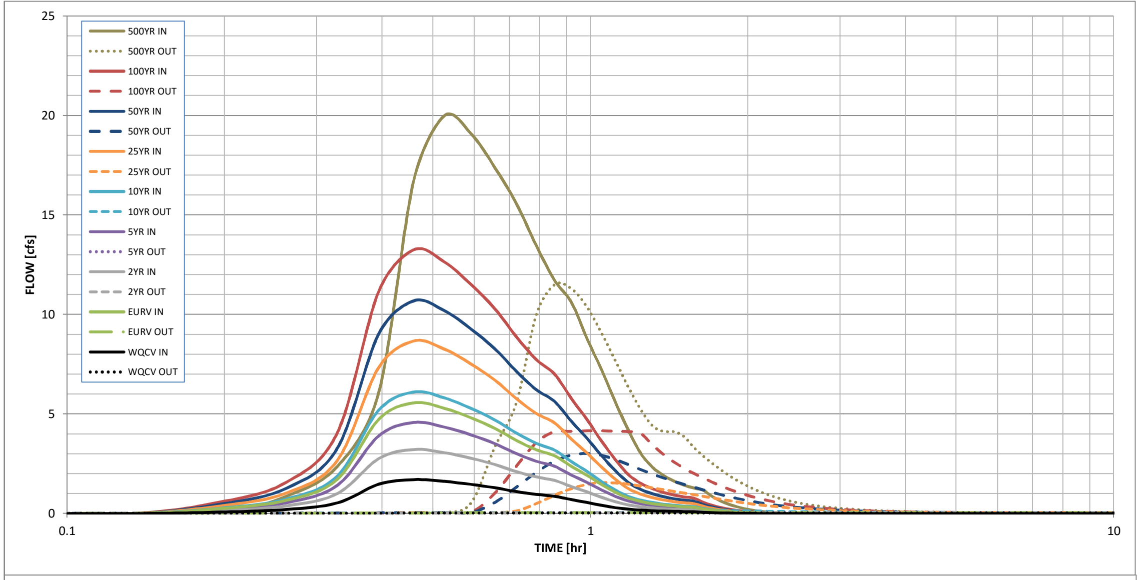
Spillway Design Flow Depth=	0.35	feet
Stage at Top of Freeboard =	5.25	feet
Basin Area at Top of Freeboard =	0.39	acres

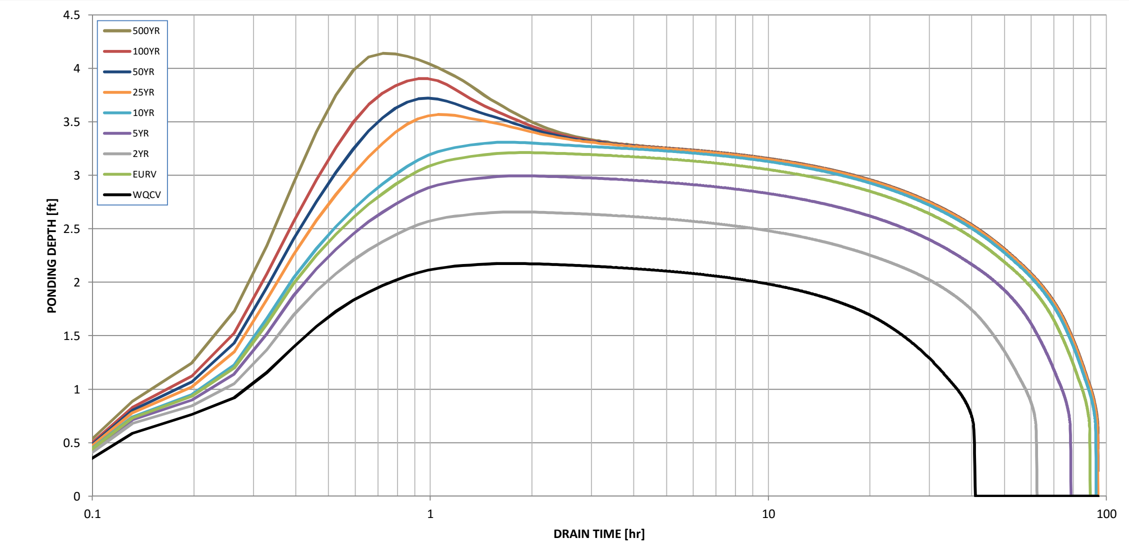
Routed Hydrograph Results

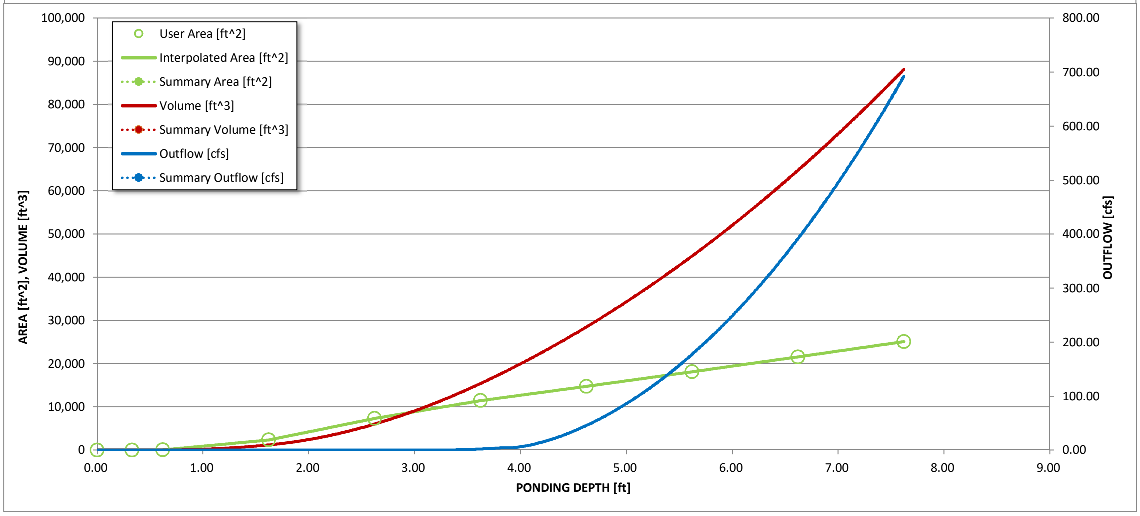
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.81	1.11	1.39	1.84	2.24	2.68	3.89
Calculated Runoff Volume (acre-ft) =	0.079	0.262	0.150	0.215	0.287	0.410	0.506	0.629	0.952
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.079	0.261	0.150	0.214	0.287	0.409	0.506	0.629	0.953
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.22	0.82	1.22	1.73	2.96
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.7	2.5	3.7	5.3	9.1
Peak Inflow Q (cfs) =	1.7	5.6	3.2	4.6	6.1	8.7	10.7	13.3	20.0
Peak Outflow Q (cfs) =	0.0	0.1	0.0	0.0	0.2	1.6	3.0	4.2	11.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.2	0.6	0.8	0.8	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.2	0.3	0.5	0.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	82	58	72	85	84	82	80	75
Time to Drain 99% of Inflow Volume (hours) =	**40**	87	61	76	90	90	89	88	86
Maximum Ponding Depth (ft) =	2.18	3.21	2.66	2.99	3.31	3.57	3.72	3.90	4.14
Area at Maximum Ponding Depth (acres) =	0.12	0.22	0.17	0.20	0.23	0.26	0.27	0.28	0.30
Maximum Volume Stored (acre-ft) =	0.074	0.254	0.143	0.207	0.274	0.338	0.380	0.430	0.497

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Kimley»Horn

Extended Detention Basin (EDB) Calculations

Date 9/8/2017
Prepared By RDW
Checked By KB

		Forebay A		Forebay B	
	Required	Flow: Q_{100} = (cfs)	Release Rate	Flow: Q_{100} = (cfs)	Release Rate
Forebay Release and Configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe configuration	13.14	0.26	10.24	0.20

			Forebay A		Forebay B	
			Required (CF)	Provided (CF)	Required (CF)	Provided (CF)
Minimum Forebay Volume Required	2% of the WQCV	40hr drain time a = 1 I = 0.77 A=3.07	40.25	140.50	30.54	58.00

	Forebay A		Forebay B	
Maximum Forebay Depth	Required	Provided	Required	Provided
	18" Max	6"	18" Max	6"

Trickle Channel Capacity	See calculations on next page.

	Required Area	Provided Area
Micropool	Area ≥ 10ft^2	11.70 ft^2

Forebay Notch Calculations		
$Q = C_o A_o (2gH_o)^{0.5}$		
Q_B	0.26	cfs
Q_C	0.20	cfs
C_o	0.6	
H_o	0.5	ft
g	32.2	ft/s^2
Ab	0.08	ft^2
Ac	0.06	ft^2
Lb	0.05	ft
	0.62	in
Lc	0.04	ft
	0.48	in

Worksheet for North Drainage Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.01100	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	15.00	ft
Discharge	141.28	ft^3/s

Results

Normal Depth	1.43	ft
Flow Area	29.66	ft^2
Wetted Perimeter	26.80	ft
Hydraulic Radius	1.11	ft
Top Width	26.45	ft
Critical Depth	1.25	ft
Critical Slope	0.01815	ft/ft
Velocity	4.76	ft/s
Velocity Head	0.35	ft
Specific Energy	1.78	ft
Froude Number	0.79	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.43	ft
Critical Depth	1.25	ft
Channel Slope	0.01100	ft/ft
Critical Slope	0.01815	ft/ft

Worksheet for South Drainage Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00500	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	10.24	ft³/s

Results

Normal Depth	0.50	ft
Flow Area	6.02	ft²
Wetted Perimeter	14.14	ft
Hydraulic Radius	0.43	ft
Top Width	14.01	ft
Critical Depth	0.31	ft
Critical Slope	0.02764	ft/ft
Velocity	1.70	ft/s
Velocity Head	0.04	ft
Specific Energy	0.55	ft
Froude Number	0.46	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.50	ft
Critical Depth	0.31	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.02764	ft/ft

Rip-Rap Calculation

FES North Swale

.

Applicable Equations:

$L_p = (1/2\tan\Theta)(A_t/Y_t\text{-}D)$	Equation 9-11 per USCDM
$A_t = Q/V$	Equation 9-12 per USDCM
$\Theta = \tan^{-1}(1/(2^*\text{ExpansionFactor}))$	Equation 9-13 per USDCM
$W = 2(L_p\tan\Theta)+D$	Equation 9-14 per USDCM
$T = 2D_{50}$	Equation 9-15 per USDCM

Assumptions

Maximum Major Event Velocity is 7fps for FES outletting into trickle channels

Input parameters:

Description	Variable	Input
Width of the conduit (use diameter for circular conduits),	D:	1.50 ft
HGL Elevation		71.31 ft
Invert Elevation		70.50 ft
Tailwater depth (ft),	Y_t:	0.81 ft
Expansion angle of the culvert flow	Θ:	0.07 radians
Design discharge (cfs)*	Q:	4.20 cfs
Froude Number	F_r	0.47 Subcritical
Unitless Variables for Tables:		
For Figure 9-35	$Q/D^{2.5}$	1.52
For Figure 9-35	Y_t/D	0.54
For Figure 9-38	$Q/D^{1.5}$	2.29
For Figure 9-38	Y_t/D	0.54
Allowable non-eroding velocity in the downstream channel (ft/sec)	V:	5.00 ft/sec
Expansion Factor (Figure 9-35), 1/(2tan(θ))		6.75

Solve for:

Description	Variable	Output
1. Required area of flow at allowable velocity (ft^2)	A_t:	0.84 ft^2
2. Length of Protection	L_p:	-3.13 ft
	L_p < 3D?	Yes
	L_{pmin}:	4.50 ft
3. Width of upstream riprap protection	W:	2.00 ft
4. Rip Rap Type (Figure 9-38)	-	L
5. Rip Rap Size (Figure 8-34)	D_{50}:	9 inches

Rip Rap Summary

Length	L_{pmin}	5.00 ft
Width	W_{min}	2.00 ft
Size	D_{50}	9 inches
Type	-	L -
Thickness	T	18 inches

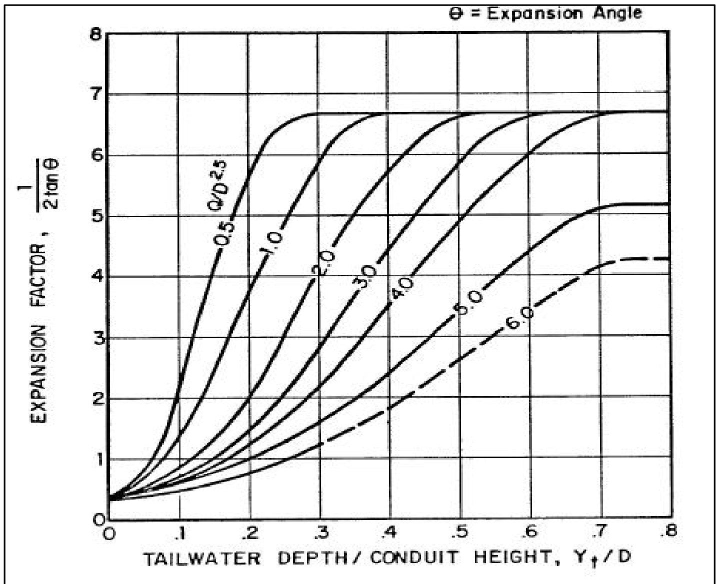
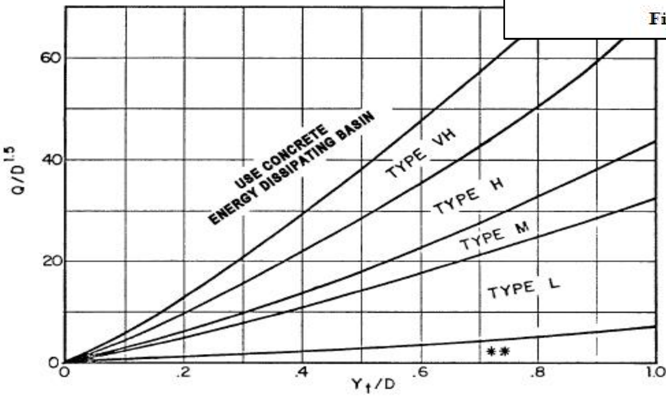
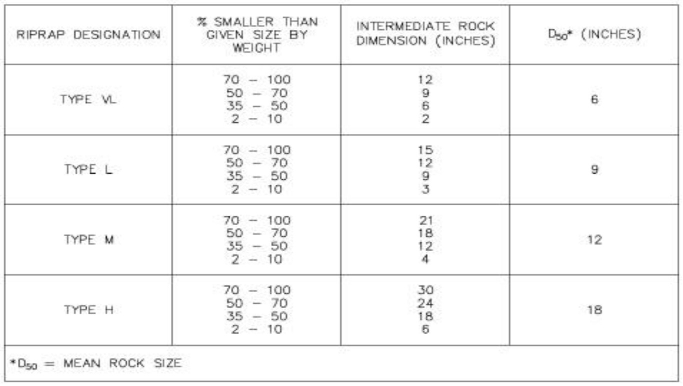


Figure 9-35. Expansion factor for circular conduits



Use D_a instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for $Q/D_{2.5} \leq 6.0$)

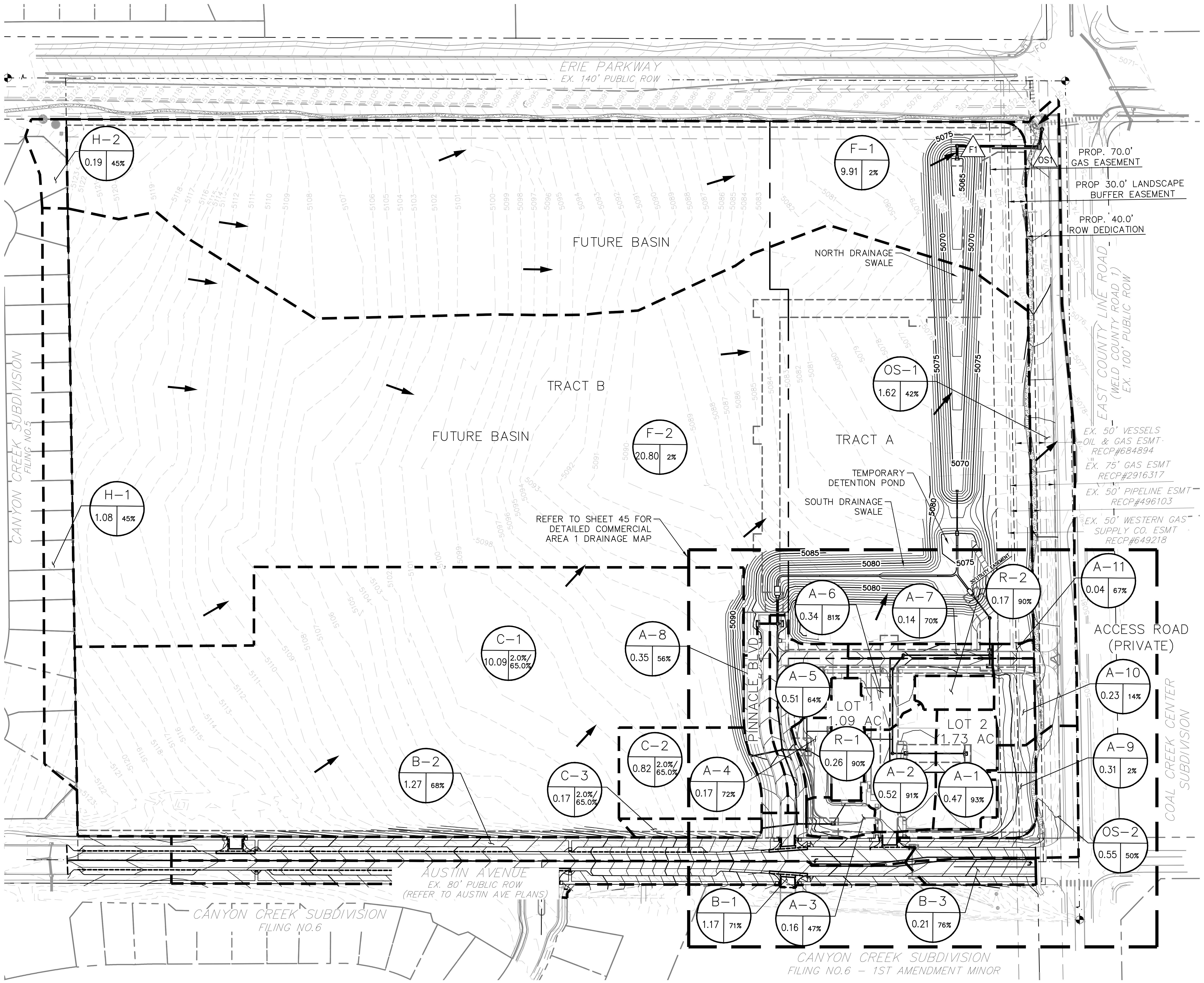


RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D_{50}* (INCHES)
TYPE VL	70 – 100 50 – 70 35 – 50 2 – 10	12 9 6 2	6
TYPE L	70 – 100 50 – 70 35 – 50 2 – 10	15 12 9 3	9
TYPE M	70 – 100 50 – 70 35 – 50 2 – 10	21 18 12 4	12
TYPE H	70 – 100 50 – 70 35 – 50 2 – 10	30 24 18 6	18

*D_{50} = MEAN ROCK SIZE

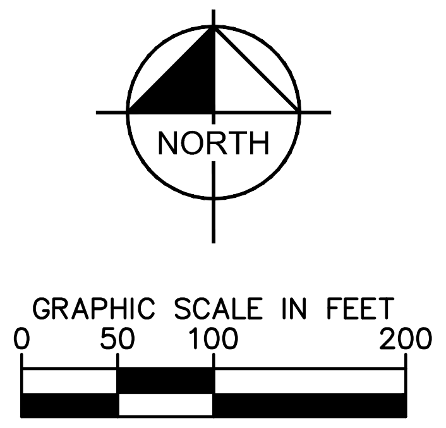
Figure 8-34. Riprap and soil riprap placement and gradation (part 1 of 3)

APPENDIX D – DRAINAGE MAPS



PROPOSED DRAINAGE LEGEND

# / AC | I	# = BASIN DESIGNATION AC = AREA IN ACRES I = % IMPERVIOUSNESS
△ #	# = DESIGN POINT
▬ ▬ ▬	PROPOSED BASIN BOUNDARY
➞	PROPOSED FLOW ARROW
➞	EXISTING FLOW ARROW
---5280---	EXISTING MAJOR CONTOUR
---5278---	EXISTING MINOR CONTOUR
—5280—	PROPOSED MAJOR CONTOUR
—5282—	PROPOSED MINOR CONTOUR
- - - -	EASEMENT LINE



BASIS OF BEARINGS:
THE EAST LINE OF THE SOUTHEAST QUARTER OF SECTION 24, TOWNSHIP 1 NORTH, RANGE 69 WEST OF THE 6TH P.M. IS ASSUMED TO BEAR SOUTH ZERO DEGREES, 59 MINUTES, 04 SECONDS EAST BETWEEN A FOUND 2" ALUMINUM CAP MONUMENT IN RANGE BOX, WITH ILLEGIBLE STAMPING, AT THE NORTHEAST CORNER OF SAID SECTION 24 AND A FOUND 2" ALUMINUM CAP MONUMENT STAMPED LS 14083 AT THE SOUTHEAST CORNER OF SAID SECTION 24.

BENCHMARK:
THE EAST QUARTER CORNER OF SECTION 25, TOWNSHIP 1 NORTH, RANGE 69 WEST OF THE 6TH PRINCIPAL MERIDIAN, A FOUND 2" DIAMETER ALUMINUM CAP MONUMENT IN RANGE BOX AT THE INTERSECTION OF WELD COUNTY ROAD 6 AND WELD COUNTY ROAD 1 (A.K.A. NE COUNTY ROAD) LINE ALSO BEING POINT NUMBER 59 ON THE TOWN OF ERIE CONTROL MAP, PREPARED BY EHRHART GRIFFIN AND ASSOCIATES, REVISION DATED 1/25/04, WITH PUBLISHED ELEVATION OF 5091.99 FEET (NAVD '88 VERTICAL DATUM).

NO.	REVISION	BY	DATE	APPR.
5	FIFTH SUBMITTAL	RDW	1/24/18	KPB
4	FOURTH SUBMITTAL	MPC	9/15/17	DMS
3	THIRD SUBMITTAL (BY J3)		3/17/17	
2	SECOND SUBMITTAL (BY J3)		10/6/16	
1	90% ORIGINAL SUBMITTAL (BY J3)		6/30/16	

Kimley»Horn
4582 South Ulster Street, Suite 1500
Denver, Colorado 80237 (303) 228-2300

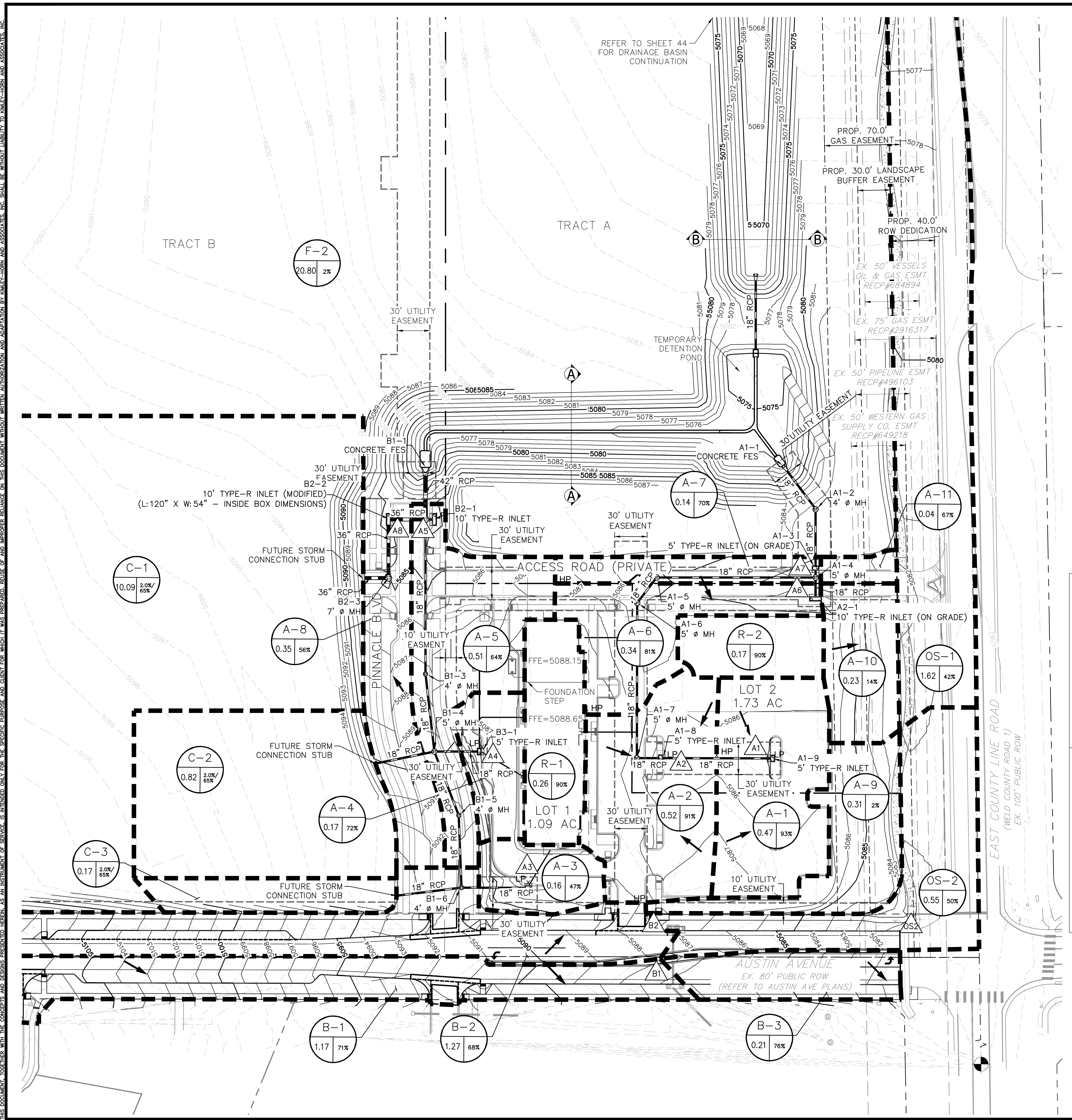
DESIGNED BY: KPB
DRAWN BY: MPC
CHECKED BY: DMS
DATE: 09/15/2017

FOUR CORNERS COMMERCIAL AREA 1
TOWN OF ERIE, COLORADO
OVERALL DRAINAGE MAP
CONSTRUCTION DOCUMENTS

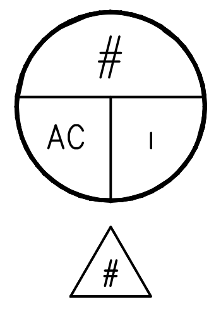
PRELIMINARY
FOR REVIEW ONLY
NOT FOR CONSTRUCTION
Kimley»Horn
Kimley-Horn and Associates, Inc.

PROJECT NO.
096635000

DRAWING NAME
OVERALL DRAINAGE



PROPOSED DRAINAGE LEGEND



= BASIN DESIGNATION

AC = AREA IN ACRES

I = % IMPERVIOUSNESS

= DESIGN POINT

PROPOSED BASIN BOUNDARY

PROPOSED FLOW ARROW

EXISTING FLOW ARROW

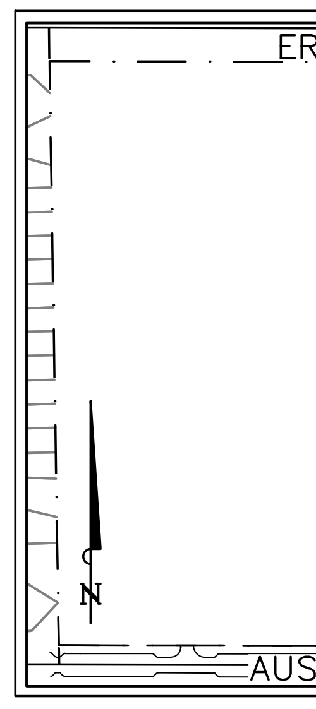
— 5280 — EXISTING MAJOR CONTOUR

- - 5278 - - EXISTING MINOR CONTOUR

—5280— PROPOSED MAJOR CONTOUR

—5282— PROPOSED MINOR CONTOUR

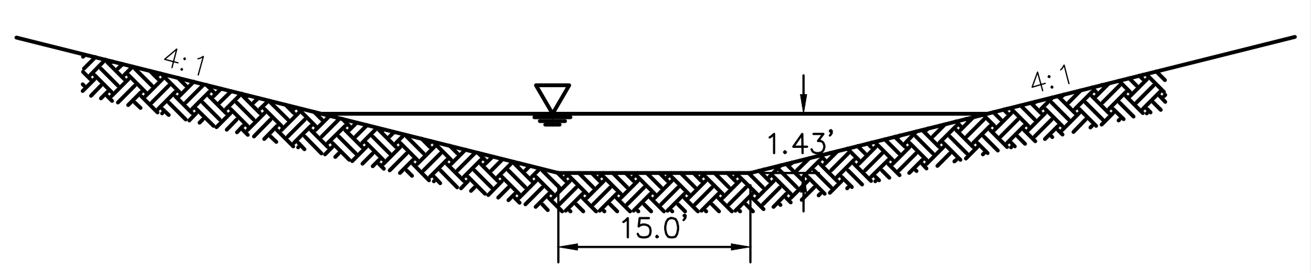
— — — EASEMENT LINE



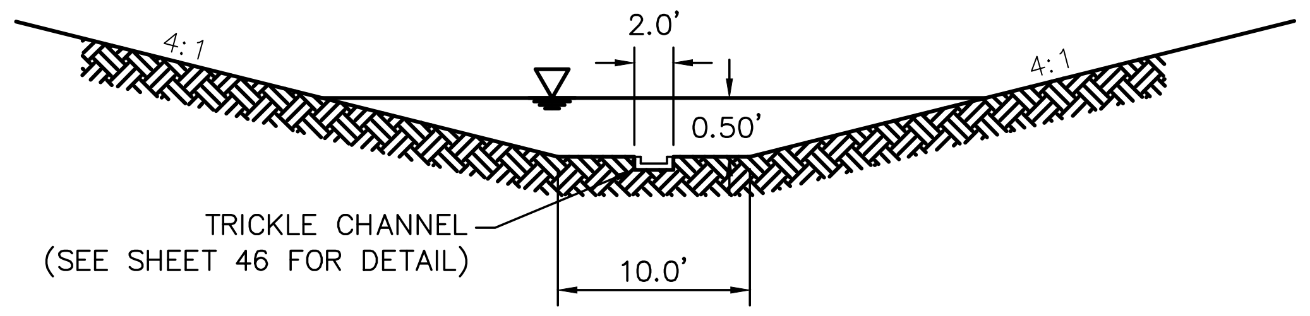
KEY MAP
SCALE: 1"=400'

FOUR CORNERS - COMMERCIAL AREA 1				
FINAL DRAINAGE PLAN - RATIONAL CALCULATIONS SUMMARY				
DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)	
			Q5	Q100
A1	A1	0.47	1.94	3.85
A2	A-2	0.52	2.13	4.24
A3	A-3	0.16	0.35	1.02
A4	A-4, R-1	0.43	1.59	3.36
A5	A-5	0.51	1.47	3.55
A6	A6, R2	0.51	1.93	4.04
A7	A-7	0.14	0.44	1.00
A8	A-8	0.35	0.89	2.32
OS1	A-10, A-11, 0S-1	1.88	2.25	7.60
OS2	A-9, OS-2	0.86	0.97	3.77
B1	B-1	1.17	3.07	7.02
B2	B-2	1.27	3.09	7.24
B3	B-3	0.21	0.71	1.56
	*C-1	10.09	24.29	58.87
	*C-2	0.82	2.39	5.79
	*C-3	0.17	0.48	1.17
F1	H-1, F-1	10.99	2.43	30.68
F2	H-2, F-2	20.99	1.50	52.13

*Note that Basins C1 through C3 assume future development conditions in order to size storm sewer appropriately.



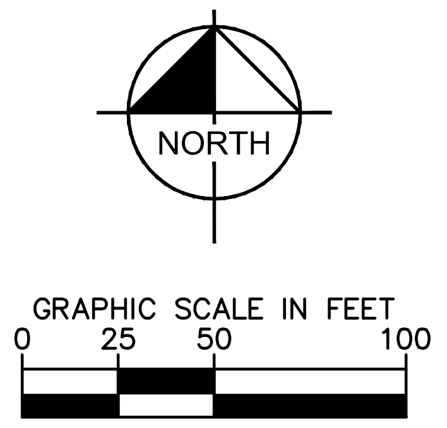
NORTH DRAINAGE SWALE
SECTION B
NTS
Q_{100} = 141.28 CFS
V_{100} = 4.76 FPS
So = 1.10%
d = 1.43 FT
n=0.035
Fr=0.79



SOUTH DRAINAGE SWALE
SECTION A
NTS
Q_{100} = 10.24 CFS
V_{100} = 1.70 FPS
So = 0.5%
d = 0.50 FT
n=0.035
Fr=0.46

BASIS OF BEARINGS:
THE EAST LINE OF THE SOUTHEAST QUARTER OF SECTION 24, TOWNSHIP 1 NORTH, RANGE 69 WEST OF THE 6TH P.M. IS ASSUMED TO BEAR SOUTH ZERO DEGREES, 59 MINUTES, 04 SECONDS EAST BETWEEN A FOUND 2" ALUMINUM CAP MONUMENT IN RANGE BOX, WITH ILLEGIBLE STAMPING, AT THE NORTHEAST CORNER OF SAID SECTION 24 AND A FOUND 2" ALUMINUM CAP MONUMENT STAMPED LS 14083 AT THE SOUTHEAST CORNER OF SAID SECTION 24.

BENCHMARK:
THE EAST QUARTER CORNER OF SECTION 25, TOWNSHIP 1 NORTH, RANGE 69 WEST OF THE 6TH PRINCIPAL MERIDIAN, A FOUND 2" DIAMETER ALUMINUM CAP MONUMENT IN RANGE BOX AT THE INTERSECTION OF WELD COUNTY ROAD 6 AND WELD COUNTY ROAD 1 (A.K.A. NE COUNTY ROAD) LINE ALSO BEING POINT NUMBER 59 ON THE TOWN OF ERIE CONTROL MAP, PREPARED BY EHRHART GRIFFIN AND ASSOCIATES, REVISION DATED 1/25/04, WITH PUBLISHED ELEVATION OF 5091.99 FEET (NAVD '88 VERTICAL DATUM).



NO.	REVISION	BY	DATE	APPR.
5	FIFTH SUBMITTAL	RDW	1/24/18	KPB
4	FOURTH SUBMITTAL	MPC	9/15/17	DMS
3	THIRD SUBMITTAL (BY J3)		3/17/17	
2	SECOND SUBMITTAL (BY J3)		10/6/16	
1	90% ORIGINAL SUBMITTAL (BY J3)		6/30/16	

Kimley»Horn

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DESIGNED BY: KPB
DRAWN BY: MPC
CHECKED BY: DMS
DATE: 09/15/2017

FOUR CORNERS COMMERCIAL AREA 1
TOWN OF ERIE, COLORADO
COMMERCIAL AREA 1 DRAINAGE MAP
CONSTRUCTION DOCUMENTS

PRELIMINARY
FOR REVIEW ONLY
NOT FOR CONSTRUCTION
Kimley»Horn
Kimley-Horn and Associates, Inc.

PROJECT NO.
096635000

DRAWING NAME
COMM 1 DRAINAGE