St.George
Community Development

ITEM 1
Hillside Permit

HILLSIDE REVIEW BOARD AGENDA REPORT: 03/23/2022
CONTINUED HILLSIDE REVIEW BOARD MEETING: 05/25/2022

Commerce Point West Hillside Development Permit (Case No. 2022-HS-005)		
Request:	A Hillside Development Permit to allow disturbance of areas in the 20-30%, 30-40% and 40% and above slope areas. This application is in anticipation of the construction of a new hotel.	
Applicant:	Commerce Point, LC	
Representative:	Austin Atkin	
Location:	Southeast quadrant of the intersection of Auto Mall Drive and Blackridge Drive	
General Plan:	COM (Commercial)	
Existing Zoning:	Highway Commercial (C-2)	
Surrounding Zoning:	North	Planned Development Commercial (PD-C)
	South	Planned Development Commercial (PD-C)
	East	Highway Commercial (C-2)
	West	Planned Development Commercial (PD-C)
Land Area:	Approximately 7.95 acres	



BACKGROUND

This is a request to obtain a hillside permit for the property located on the northeast corner of Auto Mall Drive and Blackridge Drive. The applicants are proposing to build a new commercial development on this property. This property is in the hillside overlay. Section 10-13A-7 of the Zoning Regulations requires that all major development (i.e., cut greater than 4', etc.) on slopes above 20% requires a 'hillside development permit' granted by the City Council upon recommendation from the Hillside Review Board and the Planning Commission.

UPDATE FOR 05/25/2022 MEETING: This item was split into two parts. Part one dealt with the disturbance of the 40% slopes. It was determined that the 40% slopes are non-contiguous and man-made areas, and the Hillside Review Board recommended approval of part one. For part two, the discussion centered around mitigating the cuts and scaring. It was determined by this board that a grading report was needed to address these issues and the meeting was tabled. Please see Exhibit F for the minutes of the 3/23/2022 Hillside Review Board meeting. The applicant has now provided a grading report. Please see Exhibit E for the grading report.

APPLICABLE ORDINANCE(S) *(Selected portions)*

10-13A-1: Density and Disturbance Standards

A. The hillside development overlay zone (HDOZ) limits development densities and provides specific development incentives to transfer underlying zone densities from hillsides (sending areas), to less steep slopes or more safe development areas (receiving areas), within a development.

B. For those portions of a proposed development with natural slopes twenty percent (20%) or less, development density follows the density and development standards in the underlying zone.

C. For those portions of a proposed development with natural slopes from twenty-one percent (21%) to thirty percent (30%), development activity shall not disturb more than thirty percent (30%) of the parcel within this slope category.

D. For those portions of a proposed development with natural slopes from thirty-one percent (31%) to forty percent (40%), development activity shall not disturb more than five percent (5%) of the area within this slope category.

E. A proposed development may not disturb slopes in excess of forty percent (40%).

10-13A-2: Slope and Slope Areas Determined

A. Slope shall be determined for each significant portion of a development parcel.

B. *Procedure:* The applicant shall map the location of the natural slope by using the following procedure:

1. *Preparation of Contour Maps:* The applicant shall submit an accurate, current contour map, prepared and certified by a licensed professional engineer or surveyor, which shows all land contours at intervals no greater than five feet (5'), drawn at a one inch equals one hundred feet (1" = 100') scale maximum.

2. *Verification through Field Surveys:* The city engineer or designee may require the applicant to submit a field survey to verify the accuracy of the contour map.

C. *Determination of Slope Areas:* Using the contour map, natural slopes shall be calculated using points identified as natural slopes of twenty percent (20%), thirty percent (30%), and forty percent (40%), and shall be located on the contour map and connected by a continuous line. That area bounded by said lines and intersecting property lines shall be used for determining project density. Small washes or outcrops, which have slopes distinctly different from surrounding property, and are not part of the contiguous topography, may be excluded from the slope determination.

EXHIBITS PROVIDED

1. Exhibit A – Site Plan/ Grading Plan
   "Exhibit A" in the packet shows the location of the new commercial development and the grading plan with cross sections

2. Exhibit B – Slope Analysis Map
   "Exhibit B" in the packet shows the overall slope analysis for the area to be disturbed.

3. Exhibit C – Drainage Report
   "Exhibit C" – This is the drainage report for this location.

4. Exhibit D – Geotechnical Report
   "Exhibit D" – This is the Geotechnical report for Commerce Point.

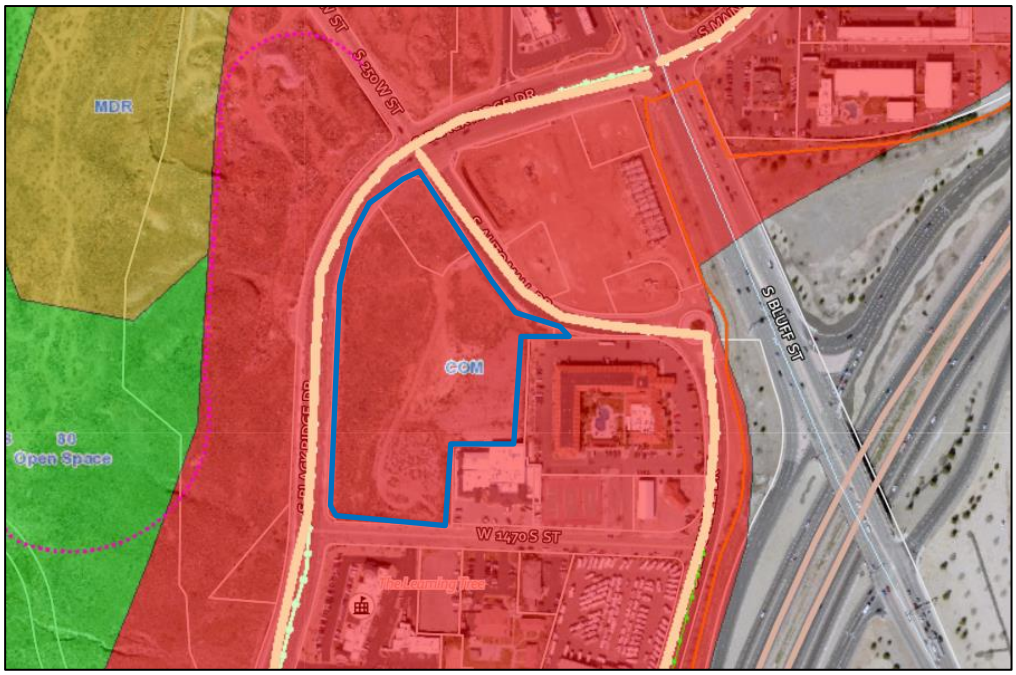
5. Exhibit E – Grading Report
   "Exhibit E" – This is the Grading report for Commerce Point.

6. Exhibit F – Minutes
   "Exhibit F" – These are the minutes from the 3/23/2022 HRB meeting.

RECOMMENDATION

Section 10-13A-8(B)(1) of the "Hillside Review Board Powers and Duties" states that the hillside board can make recommendations to "adopt, modify or reject a proposal" to the Planning Commission (PC).

General Plan - COM



Zoning - C-2

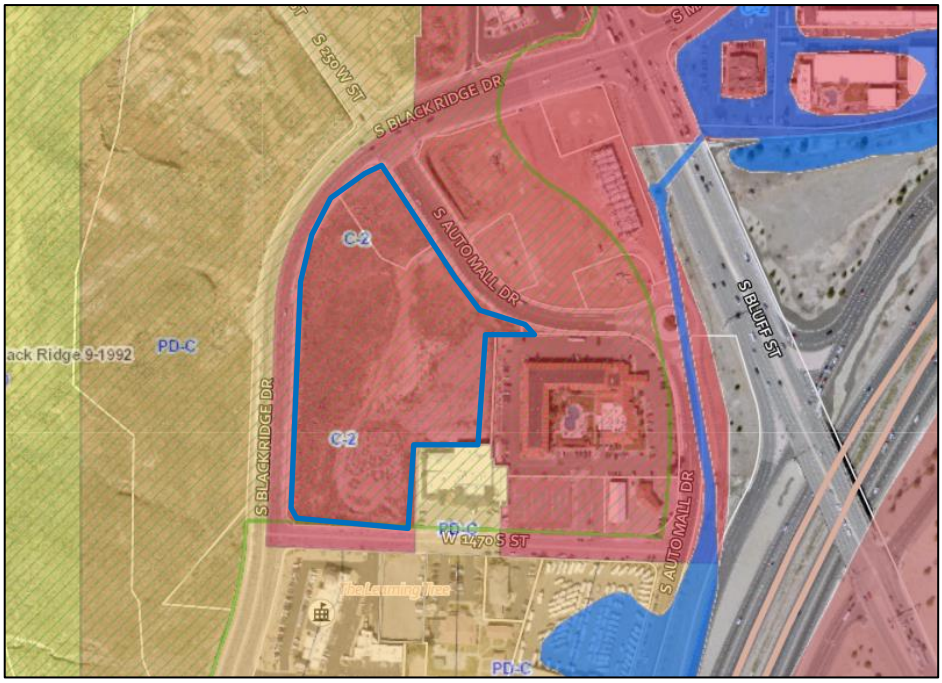
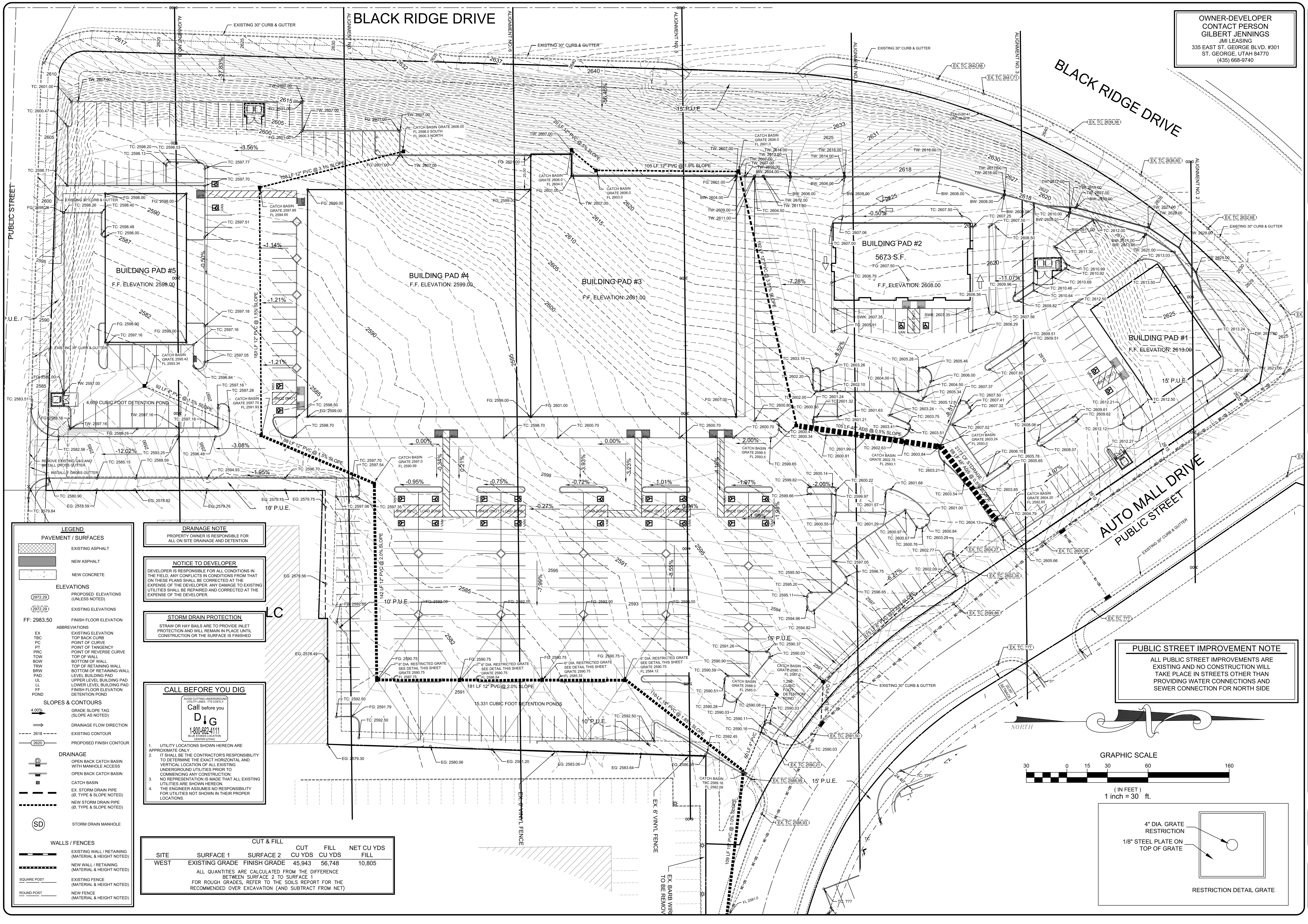


Exhibit A
SITE PLAN/GRADING PLAN



OWNER-DEVELOPER
CONTACT PERSON
GILBERT JENNINGS
JMI LEASING
335 EAST ST. GEORGE BLVD. #301
ST. GEORGE, UTAH 84770
(435) 668-9740

LEGEND

PAVEMENT / SURFACES

- EXISTING ASPHALT
- NEW ASPHALT
- NEW CONCRETE

ELEVATIONS

- (2972.29) PROPOSED ELEVATIONS (UNLESS NOTED)
- (2972.29) EXISTING ELEVATIONS
- FF: 2983.50 FINISH FLOOR ELEVATION

ABBREVIATIONS

EX	EXISTING ELEVATION
TBC	TOP BACK CURB
PC	POINT OF CURVE
PT	POINT OF TANGENCY
PRC	POINT OF REVERSE CURVE
TOW	TOP OF WALL
BOW	BOTTOM OF WALL
TRW	TOP OF RETAINING WALL
BRW	BOTTOM OF RETAINING WALL
PAD	LEVEL BUILDING PAD
UL	UPPER LEVEL BUILDING PAD
LL	LOWER LEVEL BUILDING PAD
FF	FINISH FLOOR ELEVATION
POND	DETENTION POND

SLOPES & CONTOURS

- 4.00% GRADE SLOPE TAG (SLOPE AS NOTED)
- DRAINAGE FLOW DIRECTION
- 2618 EXISTING CONTOUR
- 2620 PROPOSED FINISH CONTOUR

DRAINAGE

- OPEN BACK CATCH BASIN WITH MANHOLE ACCESS
- OPEN BACK CATCH BASIN
- CATCH BASIN
- EX. STORM DRAIN PIPE (Ø, TYPE & SLOPE NOTED)
- NEW STORM DRAIN PIPE (Ø, TYPE & SLOPE NOTED)
- SD STORM DRAIN MANHOLE

WALLS / FENCES

- EXISTING WALL / RETAINING (MATERIAL & HEIGHT NOTED)
- NEW WALL / RETAINING (MATERIAL & HEIGHT NOTED)
- SQUARE POST EXISTING FENCE (MATERIAL & HEIGHT NOTED)
- ROUND POST NEW FENCE (MATERIAL & HEIGHT NOTED)

DRAINAGE NOTE

PROPERTY OWNER IS RESPONSIBLE FOR ALL ON SITE DRAINAGE AND DETENTION

NOTICE TO DEVELOPER

DEVELOPER IS RESPONSIBLE FOR ALL CONDITIONS IN THE FIELD, ANY CONFLICTS IN CONDITIONS FROM THAT ON THESE PLANS SHALL BE CORRECTED AT THE EXPENSE OF THE DEVELOPER. ANY DAMAGE TO EXISTING UTILITIES SHALL BE REPAIRED AND CORRECTED AT THE EXPENSE OF THE DEVELOPER.

STORM DRAIN PROTECTION

STRAW OR HAY BAILS ARE TO PROVIDE INLET PROTECTION AND WILL REMAIN IN PLACE UNTIL CONSTRUCTION OR THE SURFACE IS FINISHED

CALL BEFORE YOU DIG

AVOID CUTTING UNDERGROUND UTILITY LINES. IT'S COSTLY.
Call before you DIG
1-800-662-4111
BLUE STAKES LOCATION CENTER (UTAH)

1. UTILITY LOCATIONS SHOWN HEREON ARE APPROXIMATE ONLY.
2. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE EXACT HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UNDERGROUND UTILITIES PRIOR TO COMMENCING ANY CONSTRUCTION.
3. NO REPRESENTATION IS MADE THAT ALL EXISTING UTILITIES ARE SHOWN HEREON.
4. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR UTILITIES NOT SHOWN IN THEIR PROPER LOCATIONS.

CUT & FILL

SITE	SURFACE 1	SURFACE 2	CUT CU YDS	FILL CU YDS	NET CU YDS FILL
WEST	EXISTING GRADE	FINISH GRADE	45,943	56,748	10,805

ALL QUANTITIES ARE CALCULATED FROM THE DIFFERENCE BETWEEN SURFACE 2 TO SURFACE 1
FOR ROUGH GRADES, REFER TO THE SOILS REPORT FOR THE RECOMMENDED OVER EXCAVATION (AND SUBTRACT FROM NET)

PUBLIC STREET IMPROVEMENT NOTE

ALL PUBLIC STREET IMPROVEMENTS ARE EXISTING AND NO CONSTRUCTION WILL TAKE PLACE IN STREETS OTHER THAN PROVIDING WATER CONNECTIONS AND SEWER CONNECTION FOR NORTH SIDE

GRAPHIC SCALE

30 0 15 30 60 160

(IN FEET)
1 inch = 30 ft.

4" DIA. GRATE RESTRICTION
1/8" STEEL PLATE ON TOP OF GRATE

RESTRICTION DETAIL GRATE

NO.	DATE	BY	APPVD	REVISION DESCRIPTION

STATE OF UTAH
REGISTERED PROFESSIONAL ENGINEER
#153069
LLOYD RIED POPE
1-25-22

1240 EAST 100 SOUTH SUITE 15-B
ST. GEORGE, UTAH 84790
(PHONE) 435-628-1676
(FAX) 435-628-1788
(EMAIL) lrpope@lrpope.com

L. R. POPE ENGINEERING INC.
STRUCTURAL ENGINEERS, CIVIL ENGINEERS & SURVEYORS

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COMMERCE POINT WEST SHOPPING CENTER

ENLARGED GRADING - WEST SIDE

LOCATED IN SECTION 36, T 42 S, R 16 W, SLB&M & IN SECTION 31, T 42 S, R 15 W, SLB&M

DESIGN BY
LRP

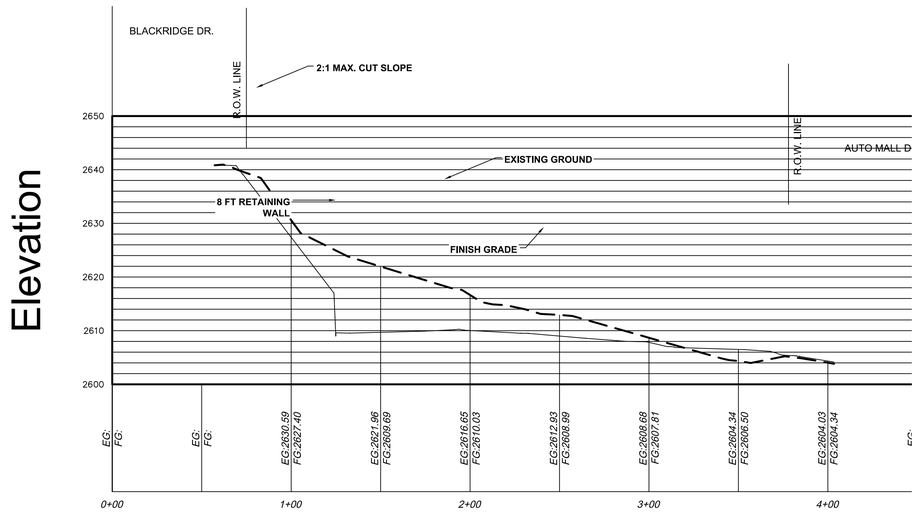
DATE
JUNE 2016

FILE NAME
COMMERCE POINT WEST R16

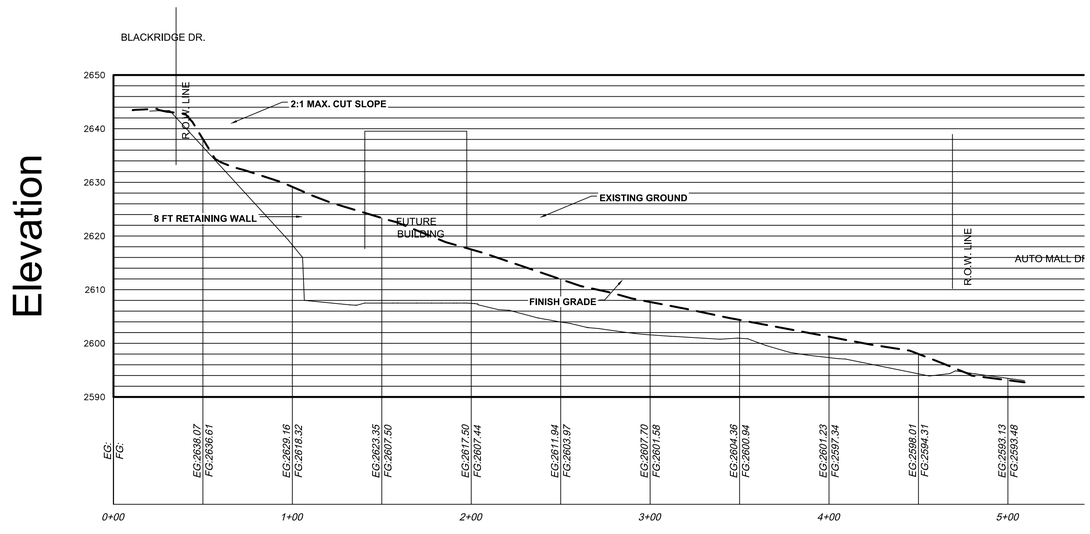
24" x 36"
SCALE 1" = 30'

12" x 18"
SCALE 1" = 60'

SHEET NUMBER
C3.00



CROSS SECTION Alignment - 3



CROSS SECTION Alignment - 4

NO.	DATE	BY	APPVD	REVISION DESCRIPTION

STATE OF UTAH
#154668
LEVI R. POPE
1-25-22
REGISTERED PROFESSIONAL ENGINEER

1245 EAST 180 SOUTH SUITE 1-5-B
ST. GEORGE, UTAH 84790
(PHONE) 435-628-4676
(FAX) 435-628-4677
(EMAIL) lrpope@lrpope.com

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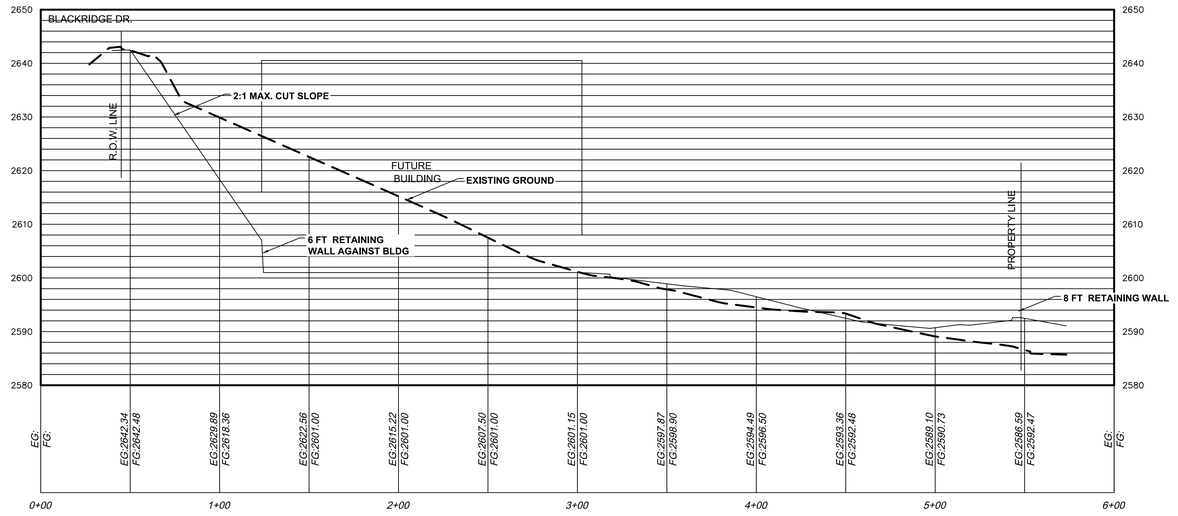
COMMERCE POINT WEST SHOPPING CENTER

CROSS SECTIONS

LOCATED IN SECTION 36, T 42 S, R 16 W, SLB&M & IN SECTION 31, T 42 S, R 15 W, SLB&M

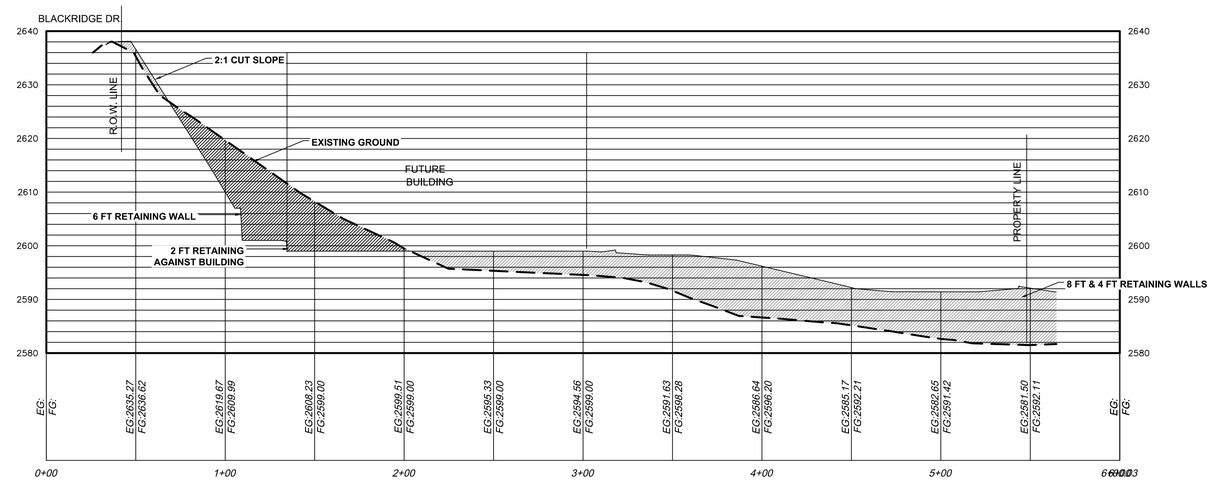
DESIGN BY	LRP
DATE	JUNE 2016
FILE NAME	COMMERCE POINT WEST R1
24" x 36"	SCALE 1" = 40'
12" x 18"	SCALE 1" = 80'
SHEET NUMBER	C6.00

Elevation



CROSS SECTION Alignment - 5

Elevation



CROSS SECTION Alignment - 6

NO.	DATE	BY	APPVD	REVISION DESCRIPTION

STATE OF UTAH
#155068
LLOYD R. POPE
1-25-22
REGISTERED PROFESSIONAL ENGINEER

1240 EAST 100 SOUTH SUITE 15-B
ST. GEORGE, UTAH 84790
(PHONE) 435-628-1976
(FAX) 435-628-1788
(EMAIL) lrpope@lrpope.com

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COMMERCE POINT WEST SHOPPING CENTER

CROSS SECTIONS - PLAN & PROFILE (E, F, G & H)
LOCATED IN SECTION 36, T 42 S, R 16 W, SLB&M & IN SECTION 31, T 42 S, R 15 W, SLB&M

DESIGN BY
LRP

DATE
JUNE 2016

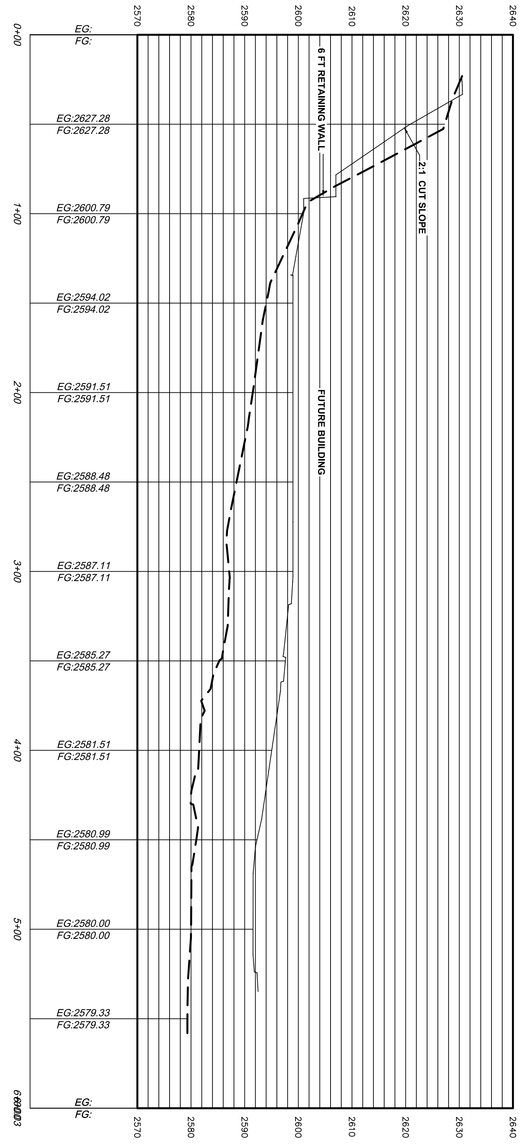
FILE NAME
COMMERCE POINT WEST R16

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SCALE 1" = 40'

12" x 18"
SCALE 1" = 80'

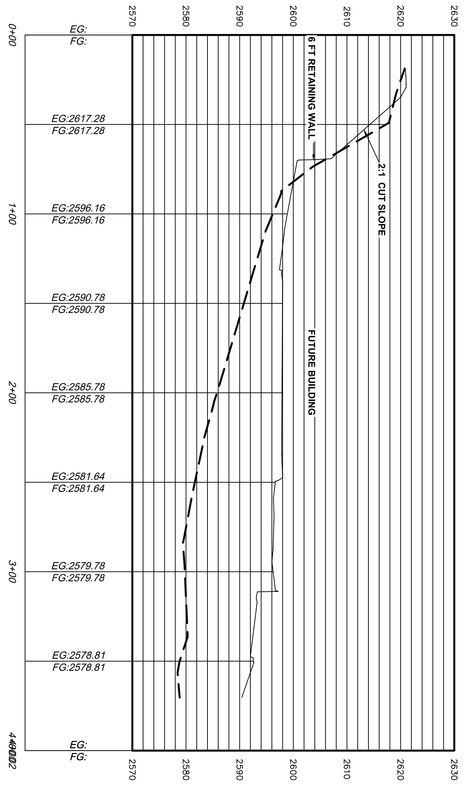
SHEET NUMBER
C6.10

Elevation



CROSS SECTION Alignment - 7

Elevation



CROSS SECTION Alignment - 8

COMMERCE POINT WEST SHOPPING CENTER
CROSS SECTIONS

LOCATED IN SECTION 36, T 42 S, R 16 W, SLB&M & IN SECTION 31, T 42 S, R 15 W, SLB&M

1240 EAST 100 SOUTH SUITE 15-B
ST. GEORGE, UTAH 84790
(PHONE) 435-628-1676
(FAX) 435-628-1788
(EMAIL) lrpope@lrpope.com

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STRUCTURAL ENGINEERS, CIVIL ENGINEERS & SURVEYORS

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LICENSED PROFESSIONAL ENGINEER — #10091097 — LEONARD R. POPE — 12-25-22 — STATE OF UTAH

NO.	DATE	BY	APPVD	REVISION DESCRIPTION

DESIGN BY: LRP
DATE: JUNE 2016
FILE NAME: COMMERCE POINT WEST FS

24" X 36" SCALE 1" = 40"
22" X 17" SCALE 1" = 80"

SHEET NUMBER
C6.20

Exhibit B
Slope Analysis

NORTH

BLACK RIDGE DRIVE

BLACK RIDGE DRIVE

EXISTING 30" CURB & GUTTER

EXISTING 30" CURB & GUTTER

EXISTING 30" CURB & GUTTER

EXISTING 30" CURB & GUTTER

EXISTING 30" CURB & GUTTER

EXISTING 30" CURB & GUTTER

PUBLIC STREET

15' P.U.E.

15' P.U.E.

15' P.U.E.

15' P.U.E.

BUILDING PAD #5

PAD ELEVATION: 2597.00

BUILDING PAD #4

PAD ELEVATION: 2598.00

BUILDING PAD #3

PAD ELEVATION: 2600.00

BUILDING PAD #2

5673 S.F.

BUILDING PAD #1

PAD ELEVATION: 2612.00

25.00'

15.0' RW

REMOVE EXISTING C&G AND INSTALL CROSS GUTTER

INSTALL 1' CROSS GUTTER

6.58' HEIGHT

24-FT CONCRETE RETAINING WALL

8 FT CONCRETE RETAINING WALL

15.17' HEIGHT

16.90' HEIGHT

4' LANDSCAPING

TOWNSHIP LINE

BASIS OF BEARING

S 00°36'38" W 204.48'

10' P.U.E.

EXISTING CMU FENCE

17.03' HEIGHT

EXISTING CMU FENCE ENCROACHMENT

N 87°38'22" W 94.62'

15.34' HEIGHT

10' P.U.E.

TREADSTONE MGMT LLC

SG-5-2-31-334511

6.64'

S 00°31'38" W

5'-6" RW

13.01' HEIGHT

4' LANDSCAPING

6' RW

N 89°24'24" W 93.07'

10' P.U.E.

5'-3" RW

11.3' HEIGHT

13.2' HEIGHT

4' LANDSCAPING

6' RW

S 02°21'39" W 279.68'

6'-6" RW

8.86' HEIGHT

5.5' HEIGHT

EX. 6' VINYL FENCE

EX. 6' VINYL FE

TOWER

HILTON DRIVE

PUBLIC STREET

EXISTING 30" CURB & GUTTER

EXISTING 30" CURB & GUTTER

SEWER MANHOLE

24.40'

15' P.U.E.

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)

1 inch = 30 ft.

Slopes Table

Number	Minimum Slope	Maximum Slope	Area	Color
1	0.00%	19.00%	302659.18	
2	19.00%	29.00%	35559.66	
3	29.00%	40.00%	20664.58	
4	40.00%	100.00%	9439.57	

NO.	DATE	BY	APP'D	REVISION DESCRIPTION

STATE OF UTAH
#155081
LANCE R. POPE
7-2-21
REGISTERED PROFESSIONAL ENGINEER

1246 EAST 100 SOUTH, SUITE 15-B
ST. GEORGE, UTAH 84790
(PHONE) 435-628-1076
(FAX) 435-628-1180
(EMAIL) lrpope@lrpope.com

L. R. POPE ENGINEERING INC.
STRUCTURAL ENGINEERS, CIVIL ENGINEERS & SURVEYORS

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COMMERCE POINT WEST
SHOPPING CENTER
SLOPE ANALYSIS WEST SIDE
LOCATED IN SECTION 36, T 42 S, R 16 W, SLB&M & IN SECTION 31, T 42 S, R 15 W, SLB&M

DESIGN BY
LRP

DATE
MARCH 6, 2016

FILE NAME
COMMERCE POINT WEST

24" x 36"
SCALE 1" = 60'

12" x 18"
SCALE 1" =120'

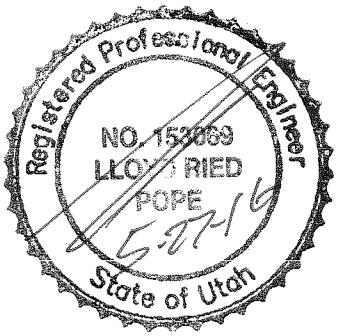
SHEET NUMBER
C1.00

Exhibit C
Drainage Report

DRAINAGE CONTROL PLAN & REPORT
FOR COMMERCE POINT
IN ST. GEORGE, UTAH

May 23, 2016

L.R. POPE ENGINEERING, Inc.
1240 EAST 100 SOUTH #15B
ST. GEORGE, UTAH 84790
435-628-1676



GENERAL DESCRIPTION OF DEVELOPMENT

The project is located on the east and north side of Black Ridge Drive, and on the west side of Bluff Street. For development and reference purposes the project has been divided into three separate parcels, North, East, and West. The North parcel contains 3.67 acres, the East parcel contains 5.36 acres, and the West parcel contains 7.89 acres. The three parcels contain 16.92 acres total.

4.2.2 DESCRIPTION OF PROPERTY

A part of the North parcel has been developed previously for commercial use. The 'Soil Survey of Washington County Area, Utah' classifies the soil conditions as JaB (Junction) and SY (Stony). JaB is described as being fine sandy loam with a hydrologic grouping of 'A'. Stony is described as stony colluvial land with a hydrologic grouping of 'C'.

The East and West parcels do not have any development on them. All three parcels share the same soil conditions.

4.2.3 GENERAL DESCRIPTION OF OFFSITE DRAINAGE

All three parcels are surrounded by streets that divert any offsite storm runoff from entering the parcels.

4.2.4 DESCRIPTION OF ONSITE DRAINAGE

Each parcel will have its own detention for onsite drainage.

The onsite drainage for the North parcel will generally drain easterly into the proposed parking lot and will be collected in a detention pond. The pond will be depressed into the asphalt parking lot and then drain into an existing storm drain in Bluff Street.

The onsite drainage for the East parcel will drain towards the interior of the parcel and be collected into two separate detention ponds. The ponds will be depressed into the asphalt parking lot and then drain into an existing storm drain running parallel to the east property boundary.

The onsite drainage for the West parcel will drain easterly into the proposed parking lot where it will be collected into five separate detention ponds. The ponds will be depressed into the asphalt parking lot and then drain into an existing storm drain in Hilton Drive.

4.2.5 DESCRIPTION OF MASTER PLANNED DRAINAGE FACILITIES

There is an existing 96" storm drain pipe that conveys runoff along Bluff Street and a 36" storm drain pipe that conveys runoff along Hilton Drive.

4.2.6 FEMA FLOODPLAIN BOUNDARIES

The development does not lie within any Zone 'A' 100 year floodplain.

4.2.7 DESCRIPTION OF OTHER DRAINAGE STUDIES AFFECTING SITE

There are no other known drainage studies affecting this site.

4.2.8 DESCRIPTION OF PROPOSED DRAINAGE FACILITIES

The North parcel will have a detention pond installed on the east side of the parcel in the proposed parking lot. The parking lot will be inverted with a catch basin in the center that will convey runoff through a 6" orifice opening into a 8" storm drain that conveys runoff into the existing 72" storm drain that runs along the west side of Bluff Street. The calculated volume of the detention pond as shown is at least 9,220 cu. ft. The drainage calculations indicated that the 7,379 cu. ft. of storage would attenuate the peak runoff to pre-developed conditions for a 100 year storm event.

The East parcel will have two detention ponds installed near the center of the parcel in the proposed parking lot. The parking lot will be inverted with a catch basin in the center of each pond, the southern pond will convey runoff through an 8" orifice opening into a 12" storm drain which will tie into the northern ponds catch basin. The northern pond will have a restricted grate that will convey runoff into an existing 36" storm drain that is running through the parcel. The calculated volume of the detention ponds as shown is at least 19,115 cu. ft. The drainage calculations indicated that the 16,308 cu. ft. of storage would attenuate the peak runoff to pre-developed conditions for a 100 year storm event.

The West parcel will have 4 detention ponds installed on the east side of the parcel in the proposed parking lot and a smaller detention pond on the south side of the parcel in a proposed parking lot. The parking lot for the southern pond will be inverted with a catch basin in the center and will convey water through an 8' orifice opening into a 12" storm drain which will tie into the east ponds. The parking lot for the east ponds will be inverted with a catch basin in the center of each pond that will convey runoff through an restricted grate into a 12" storm drain that conveys runoff into the existing 36" storm drain that runs along the west side Hilton Drive and ties into an existing 96" cmp storm drain along the east side of Hilton Drive parallel to the freeway. The calculated volume of the ponds as shown is at least 22,483 cu. ft. The drainage calculations indicated that the 20,449 cu. ft. of storage would attenuate the peak runoff to pre-developed conditions for a 100 year storm event.

4.2.9 DESCRIPTION OF COMPLIANCE WITH APPLICABLE FLOOD CONTROL REQUIREMENTS AND FEMA REQUIREMENTS

Not applicable.

4.2.10 DESCRIPTION OF DESIGN RUNOFF CALCULATIONS

The rational method was used in calculating surface runoff in this project. The following parameters were used for these calculations.

Assume type 'C' and 'A' soil conditions

North Parcel
Existing conditions:

C = 0.33
Tc = 15 min.

Developed conditions:

C = 0.95
Tc = 15 min.

East Parcel
Existing conditions:

C = 0.01
Tc = 15 min.

Developed conditions:

C = 0.95
Tc = 15 min.

West Parcel
Existing conditions:

C = 0.15
Tc = 15 min.

Developed conditions:

C = 0.95
Tc = 15 min.

Rainfall: 3.60 inches/hr for 15 min. (100 yr.); 2.00 inches/hr for 15 min. (10 yr.)

4.2.11 DESCRIPTION OF DRAINAGE FACILITY DESIGN COMPUTATIONS

The rational method was used in calculating the amount of detention required for the project. The following table shows the amount of storage required for the site:

North Parcel

Detention Basin	100 Year Storm	10 Year Storm
Detention	(7,379 cu.ft.)	(4,099 cu.ft.)

East Parcel

Detention Basin	100 Year Storm	10 Year Storm
Detention	(16,308 cu.ft.)	(9,060 cu.ft.)

West Parcel

Detention Basin	100 Year Storm	10 Year Storm
Detention	(20,449 cu.ft.)	(11,360 cu.ft.)

4.2.12 DESCRIPTION OF ALL EASEMENTS AND RIGHT OF WAYS

No easements or right-of-ways are required at this time.

4.2.13 DESCRIPTION OF FEMA FLOODPLAIN CALCULATIONS

Not applicable.

4.2.14 CONCLUSIONS

The methods used in determining the peak runoff flows and required storm detention for this project are generally accepted engineering practices. It is our professional opinion that the design and recommendations put forth in this report meet the City requirements in controlling a theoretical 100 year storm event. It should be noted that the 100 year storm event is a theoretical storm with a 1% probability of being equaled or exceeded in any given year. It should also be noted that floods equaling or exceeding the 100 year storm event can and do occur. Construction of this development should follow L.R. Pope Engineering, Inc. design and recommendations and any deviation or modification to said development should be approved by L.R. Pope Engineering, Inc., the City of St. George, and the Developer/Owner prior to commencing modification.

APPENDIX 'A'
CALCULATIONS
EXISTING ONSITE DRAINAGE CONDITIONS AND
DEVELOPED ONSITE CONDITIONS

10 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS FOR COMMERCE POINT NORTH

Soil Type = A

Land Use/Cover	Runoff Coefficient, C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	53336	1.22
Apartments/Offices	0.75	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.70	0	
MD Residential: > 6-9 units/acre	0.60	0	
MD Residential: > 4-6 units/acre	0.50	0	
LD Residential: > 3-4 units/acre	0.35	0	
LD Residential: > 2-3 units/acre	0.25	0	
LD Residential: > 1-2 units/acre	0.15	0	
VLD Residential: > 0.5-1 units/acre	0.10	0	
VLD Residential: > 0.2-0.5 units/acre	0.08	0	
VLD Residential: > 0.1-0.5 units/acre	0.05	0	
Urban Lawns/Parks	100.00	0	
Urban Landscaping/Gardens	0.00	0	
Bare/Newly Graded	0.02	106673	2.45
Irrigated Pasture/Agriculture	0.02	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.01	0	
Desert Shrub: < 30-70% Cover	0.01	0	
Desert Shrub: > 70% Cover	0.01	0	
	Total Area =	160009	3.67

Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.330

Time of concentration = 0.25 hours
Recurrence interval = 10 year storm
Intensity, i = 2.000 in/hr

$Q = C_w \cdot i^* A$ = 2.42 CFS

L.R. POPE ENGINEERING 1240 EAST 100 SOUTH # 15B ST. GEORGE, UT 84790 OFFICE: (435) 628-1676 FAX: (435) 628-1788

100 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS FOR COMMERCE POINT NORTH

Soil Type = A

Land Use/Cover	Runoff Coefficient, C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	53336	1.22
Apartments/Offices	0.75	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.70	0	
MD Residential: > 6-9 units/acre	0.60	0	
MD Residential: > 4-6 units/acre	0.50	0	
LD Residential: > 3-4 units/acre	0.35	0	
LD Residential: > 2-3 units/acre	0.25	0	
LD Residential: > 1-2 units/acre	0.15	0	
VLD Residential: > 0.5-1 units/acre	0.10	0	
VLD Residential: > 0.2-0.5 units/acre	0.08	0	
VLD Residential: > 0.1-0.5 units/acre	0.05	0	
Urban Lawns/Parks	100.00	0	
Urban Landscaping/Gardens	0.00	0	
Bare/Newly Graded	0.02	106673	2.45
Irrigated Pasture/Agriculture	0.02	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.01	0	
Desert Shrub: < 30-70% Cover	0.01	0	
Desert Shrub: > 70% Cover	0.01	0	
	Total Area =	160009	3.67

Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.330

Time of concentration = 0.25 hours
Recurrence interval = 100 year storm
Intensity, i = 3.600 in/hr

$Q = C_w \cdot i * A$ = 4.36 CFS

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10 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS FOR COMMERCE POINT NORTH

Soil Type = A

Land Use/Cover	Runoff Coefficient, C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	160009	3.67
Apartments/Offices	0.75	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.70	0	
MD Residential: > 6-9 units/acre	0.60	0	
MD Residential: > 4-6 units/acre	0.50	0	
LD Residential: > 3-4 units/acre	0.35	0	
LD Residential: > 2-3 units/acre	0.25	0	
LD Residential: > 1-2 units/acre	0.15	0	
VLD Residential: > 0.5-1 units/acre	0.10	0	
VLD Residential: > 0.2-0.5 units/acre	0.08	0	
VLD Residential: > 0.1-0.5 units/acre	0.05	0	
Urban Lawns/Parks	100.00	0	
Urban Landscaping/Gardens	0.00	0	
Bare/Newly Graded	0.02	0	
Irrigated Pasture/Agriculture	0.02	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.01	0	
Desert Shrub: < 30-70% Cover	0.01	0	
Desert Shrub: > 70% Cover	0.01	0	
	Total Area =	160009	3.67

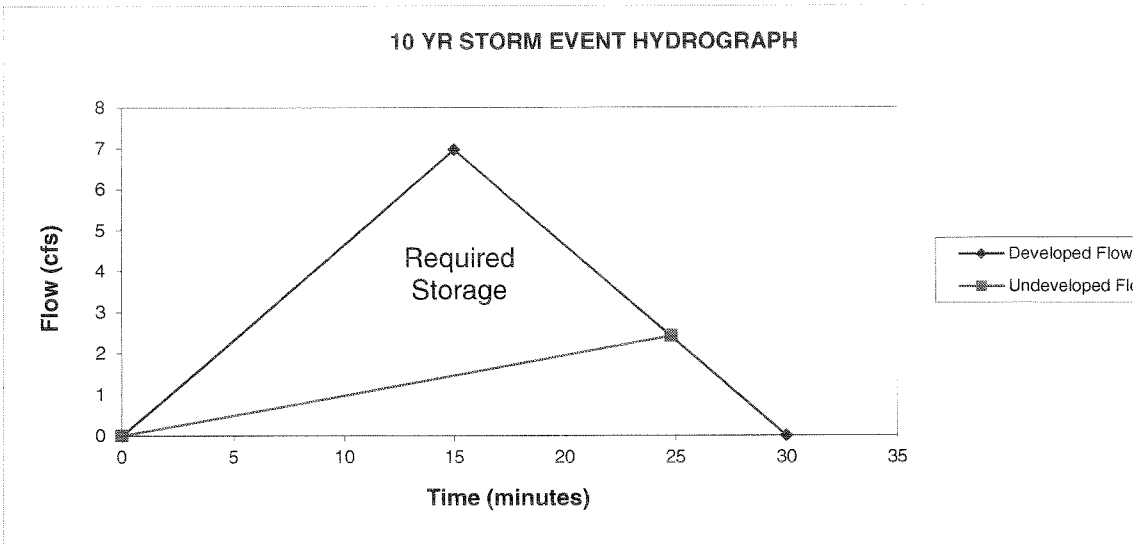
Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.950

Time of concentration = 0.25 hours
Recurrence interval = 10 year storm
Intensity, i = 2.000 in/hr

$Q = C_w \cdot i^* A$ = 6.98 CFS

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GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR PREDEVELOPED CONDITIONS FOR COMMERCE POINT NORTH



	Tc, min	i, in/hr	Q, cfs
Developed peak =	15	2.000	6.98

Return Frequency =	10	**yr**	
Allowable outflow =	2.42	**cfs**	
Peak Inflow =	6.98	**cfs**	
Required Storage =	0.094	**acre-ft** =	4099.417 **ft^3**

Points of intersection
Undeveloped/Developed @ Time = 24.79 **minutes**

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100 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS FOR COMMERCE POINT NORTH

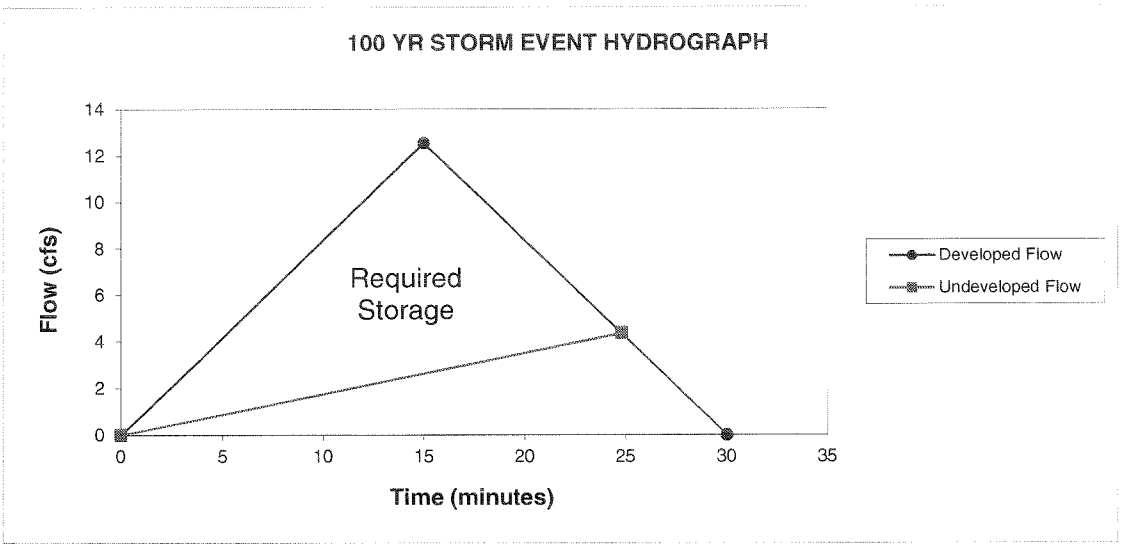
Soil Type = A

Land Use/Cover	Runoff Coefficient, C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	160009	3.67
Apartments/Offices	0.75	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.70	0	
MD Residential: > 6-9 units/acre	0.60	0	
MD Residential: > 4-6 units/acre	0.50	0	
LD Residential: > 3-4 units/acre	0.35	0	
LD Residential: > 2-3 units/acre	0.25	0	
LD Residential: > 1-2 units/acre	0.15	0	
VLD Residential: > 0.5-1 units/acre	0.10	0	
VLD Residential: > 0.2-0.5 units/acre	0.08	0	
VLD Residential: > 0.1-0.5 units/acre	0.05	0	
Urban Lawns/Parks	100.00	0	
Urban Landscaping/Gardens	0.00	0	
Bare/Newly Graded	0.02	0	
Irrigated Pasture/Agriculture	0.02	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.01	0	
Desert Shrub: < 30-70% Cover	0.01	0	
Desert Shrub: > 70% Cover	0.01	0	
	Total Area =	160009	3.67

Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.950

Time of concentration =	0.25	hours
Recurrence interval =	100	year storm
Intensity, i =	3.600	in/hr
$Q = C_w \cdot i^* A$ =	12.56	CFS

GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR DEVELOPED CONDITIONS FOR COMMERCE POINT NORTH



	Tc, min	i, in/hr	Q, cfs
Developed peak =	15	3.600	12.56

Return Frequency =	100	**yr**			
Allowable outflow =	4.36	**cfs**			
Peak Inflow =	12.56	**cfs**			
Required Storage =	0.169	**acre-ft**	**=**	7379	**ft^3**

Points of intersection
Undeveloped/Developed @ Time = 24.79 **minutes**

Detention Study Summary

Frequency Years	Adjusted 'C'	Intensity in/hr	Qpeak cfs	Allowable cfs	Required Storage acre-ft	Required Storage ft^3
10	0.950	2.000	6.98	2.42	0.094	4099
100	0.950	3.600	12.56	4.36	0.169	7379

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10 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS FOR COMMERCE POINT EAST

Soil Type = A

Land Use/Cover	Runoff Coefficient, C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	0	
Apartments/Offices	0.75	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.70	0	
MD Residential: > 6-9 units/acre	0.60	0	
MD Residential: > 4-6 units/acre	0.50	0	
LD Residential: > 3-4 units/acre	0.35	0	
LD Residential: > 2-3 units/acre	0.25	0	
LD Residential: > 1-2 units/acre	0.15	0	
VLD Residential: > 0.5-1 units/acre	0.10	0	
VLD Residential: > 0.2-0.5 units/acre	0.08	0	
VLD Residential: > 0.1-0.5 units/acre	0.05	0	
Urban Lawns/Parks	100.00	0	
Urban Landscaping/Gardens	0.00	0	
Bare/Newly Graded	0.02	0	
Irrigated Pasture/Agriculture	0.02	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.01	233252	5.35
Desert Shrub: < 30-70% Cover	0.01	0	
Desert Shrub: > 70% Cover	0.01	0	
	Total Area =	233252	5.35

Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.010

Time of concentration = 0.25 hours
Recurrence interval = 10 year storm
Intensity, i = 2.000 in/hr

$Q = C_w \cdot i^* A$ = 0.11 CFS

100 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS FOR COMMERCE POINT EAST

Soil Type = A

Land Use/Cover	Runoff Coefficient, C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	0	
Apartments/Offices	0.75	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.70	0	
MD Residential: > 6-9 units/acre	0.60	0	
MD Residential: > 4-6 units/acre	0.50	0	
LD Residential: > 3-4 units/acre	0.35	0	
LD Residential: > 2-3 units/acre	0.25	0	
LD Residential: > 1-2 units/acre	0.15	0	
VLD Residential: > 0.5-1 units/acre	0.10	0	
VLD Residential: > 0.2-0.5 units/acre	0.08	0	
VLD Residential: > 0.1-0.5 units/acre	0.05	0	
Urban Lawns/Parks	100.00	0	
Urban Landscaping/Gardens	0.00	0	
Bare/Newly Graded	0.02	0	
Irrigated Pasture/Agriculture	0.02	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.01	233252	5.35
Desert Shrub: < 30-70% Cover	0.01	0	
Desert Shrub: > 70% Cover	0.01	0	
	Total Area =	233252	5.35

Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.010

Time of concentration =	0.25	hours
Recurrence interval =	100	year storm
Intensity, i =	3.600	in/hr
$Q = C_w \cdot i^* A$ =	0.19	CFS

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10 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS FOR COMMERCE POINT EAST

Soil Type = A

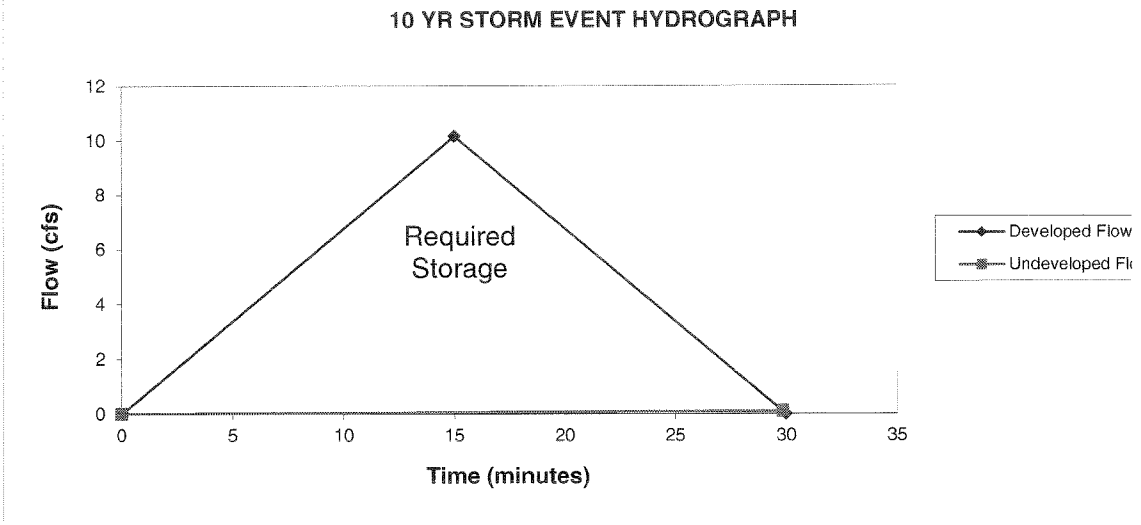
Land Use/Cover	Runoff Coefficient, C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	233252	5.35
Apartments/Offices	0.75	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.70	0	
MD Residential: > 6-9 units/acre	0.60	0	
MD Residential: > 4-6 units/acre	0.50	0	
LD Residential: > 3-4 units/acre	0.35	0	
LD Residential: > 2-3 units/acre	0.25	0	
LD Residential: > 1-2 units/acre	0.15	0	
VLD Residential: > 0.5-1 units/acre	0.10	0	
VLD Residential: > 0.2-0.5 units/acre	0.08	0	
VLD Residential: > 0.1-0.5 units/acre	0.05	0	
Urban Lawns/Parks	100.00	0	
Urban Landscaping/Gardens	0.00	0	
Bare/Newly Graded	0.02	0	
Irrigated Pasture/Agriculture	0.02	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.01	0	
Desert Shrub: < 30-70% Cover	0.01	0	
Desert Shrub: > 70% Cover	0.01	0	
	Total Area =	233252	5.35

Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.950

Time of concentration =	0.25	hours
Recurrence interval =	10	year storm
Intensity, i =	2.000	in/hr
$Q = C_w \cdot i^* A$ =	10.17	CFS

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GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR PREDEVELOPED CONDITIONS FOR COMMERCE POINT EAST



	Tc, min	i, in/hr	Q, cfs
Developed peak =	15	2.000	10.17

Return Frequency =	10	yr	
Allowable outflow =	0.11	cfs	
Peak Inflow =	10.17	cfs	
Required Storage =	0.208	acre-ft	= 9060.202 ft^3

Points of intersection
Undeveloped/Developed @ Time = 29.84 minutes

100 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS FOR COMMERCE POINT EAST

Soil Type = A

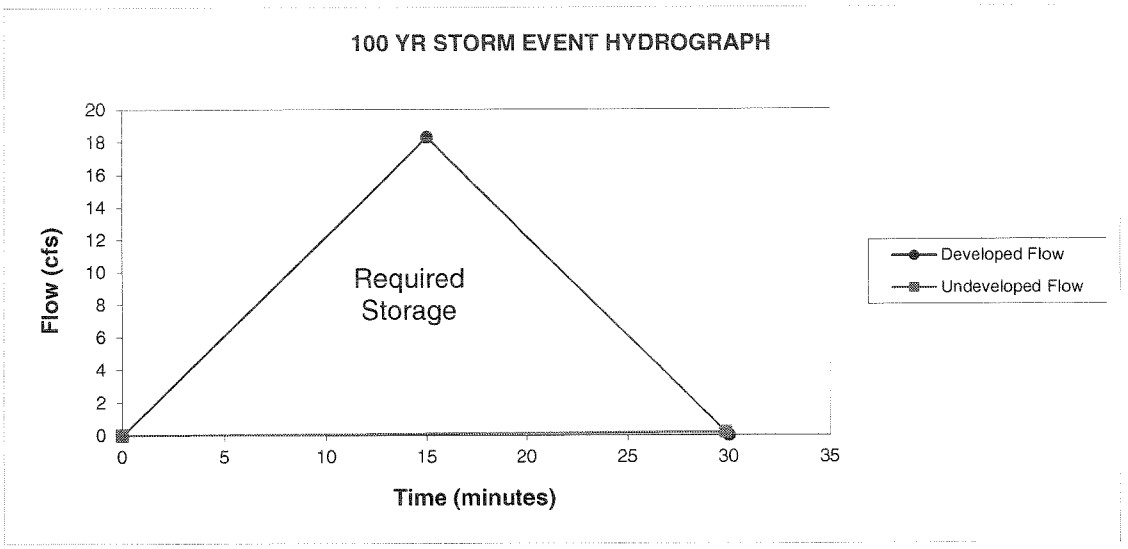
Land Use/Cover	Runoff Coefficient, C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	233252	5.35
Apartments/Offices	0.75	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.70	0	
MD Residential: > 6-9 units/acre	0.60	0	
MD Residential: > 4-6 units/acre	0.50	0	
LD Residential: > 3-4 units/acre	0.35	0	
LD Residential: > 2-3 units/acre	0.25	0	
LD Residential: > 1-2 units/acre	0.15	0	
VLD Residential: > 0.5-1 units/acre	0.10	0	
VLD Residential: > 0.2-0.5 units/acre	0.08	0	
VLD Residential: > 0.1-0.5 units/acre	0.05	0	
Urban Lawns/Parks	100.00	0	
Urban Landscaping/Gardens	0.00	0	
Bare/Newly Graded	0.02	0	
Irrigated Pasture/Agriculture	0.02	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.01	0	
Desert Shrub: < 30-70% Cover	0.01	0	
Desert Shrub: > 70% Cover	0.01	0	
	Total Area =	233252	5.35

Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.950

Time of concentration =	0.25	hours
Recurrence interval =	100	year storm
Intensity, i =	3.600	in/hr
$Q = C_w \cdot i^* A$ =	18.31	CFS

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GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR DEVELOPED CONDITIONS FOR COMMERCE POINT EAST



	Tc, min	i, in/hr	Q, cfs
Developed peak =	15	3.600	18.31

Return Frequency =	100	**yr**		
Allowable outflow =	0.19	**cfs**		
Peak Inflow =	18.31	**cfs**		
Required Storage =	0.374	**acre-ft**	=	16308	**ft^3**

Points of intersection
Undeveloped/Developed @ Time = 29.84 **minutes**

Detention Study Summary

Frequency Years	Adjusted 'C'	Intensity in/hr	Qpeak cfs	Allowable cfs	Required Storage acre-ft	Required Storage ft^3
10	0.950	2.000	10.17	0.11	0.208	9060
100	0.950	3.600	18.31	0.19	0.374	16308

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10 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS FOR COMMERCE POINT WEST

Soil Type = C Land Use/Cover	Runoff Coefficient, C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	0	
Apartments/Offices	0.85	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.80	0	
MD Residential: > 6-9 units/acre	0.70	0	
MD Residential: > 4-6 units/acre	0.60	0	
LD Residential: > 3-4 units/acre	0.45	0	
LD Residential: > 2-3 units/acre	0.35	0	
LD Residential: > 1-2 units/acre	0.25	0	
VLD Residential: > 0.5-1 units/acre	0.20	0	
VLD Residential: > 0.2-0.5 units/acre	0.17	0	
VLD Residential: > 0.1-0.5 units/acre	0.15	0	
Urban Lawns/Parks	0.10	0	
Urban Landscaping/Gardens	0.05	0	
Bare/Newly Graded	0.30	0	
Irrigated Pasture/Agriculture	0.15	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.15	343653	7.89
Desert Shrub: < 30-70% Cover	0.10	0	
Desert Shrub: > 70% Cover	0.05	0	
	Total Area =	343653	7.89

Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.150

Time of concentration =	0.25	**hours**
Recurrence interval =	10	**year storm**
Intensity, i =	2.000	**in/hr**
$Q = C_w \cdot i^* A$ =	2.37	**CFS**

100 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS FOR COMMERCE POINT WEST

Soil Type = C	Runoff Coefficient,		
Land Use/Cover	C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	0	
Apartments/Offices	0.85	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.80	0	
MD Residential: > 6-9 units/acre	0.70	0	
MD Residential: > 4-6 units/acre	0.60	0	
LD Residential: > 3-4 units/acre	0.45	0	
LD Residential: > 2-3 units/acre	0.35	0	
LD Residential: > 1-2 units/acre	0.25	0	
VLD Residential: > 0.5-1 units/acre	0.20	0	
VLD Residential: > 0.2-0.5 units/acre	0.17	0	
VLD Residential: > 0.1-0.5 units/acre	0.15	0	
Urban Lawns/Parks	0.10	0	
Urban Landscaping/Gardens	0.05	0	
Bare/Newly Graded	0.30	0	
Irrigated Pasture/Agriculture	0.15	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.15	343653	7.89
Desert Shrub: < 30-70% Cover	0.10	0	
Desert Shrub: > 70% Cover	0.05	0	
	Total Area =	343653	7.89

Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.150

Time of concentration =	0.25	**hours**
Recurrence interval =	100	**year storm**
Intensity, i =	3.600	**in/hr**
$Q = C_w \cdot i^* A$ =	4.26	**CFS**

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10 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS FOR COMMERCE POINT WEST

Soil Type = C

Land Use/Cover	Runoff Coefficient, C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	343653	7.89
Apartments/Offices	0.85	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.80	0	
MD Residential: > 6-9 units/acre	0.70	0	
MD Residential: > 4-6 units/acre	0.60	0	
LD Residential: > 3-4 units/acre	0.45	0	
LD Residential: > 2-3 units/acre	0.35	0	
LD Residential: > 1-2 units/acre	0.25	0	
VLD Residential: > 0.5-1 units/acre	0.20	0	
VLD Residential: > 0.2-0.5 units/acre	0.17	0	
VLD Residential: > 0.1-0.5 units/acre	0.15	0	
Urban Lawns/Parks	0.10	0	
Urban Landscaping/Gardens	0.05	0	
Bare/Newly Graded	0.30	0	
Irrigated Pasture/Agriculture	0.15	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.15	0	
Desert Shrub: < 30-70% Cover	0.10	0	
Desert Shrub: > 70% Cover	0.05	0	
	Total Area =	343653	7.89

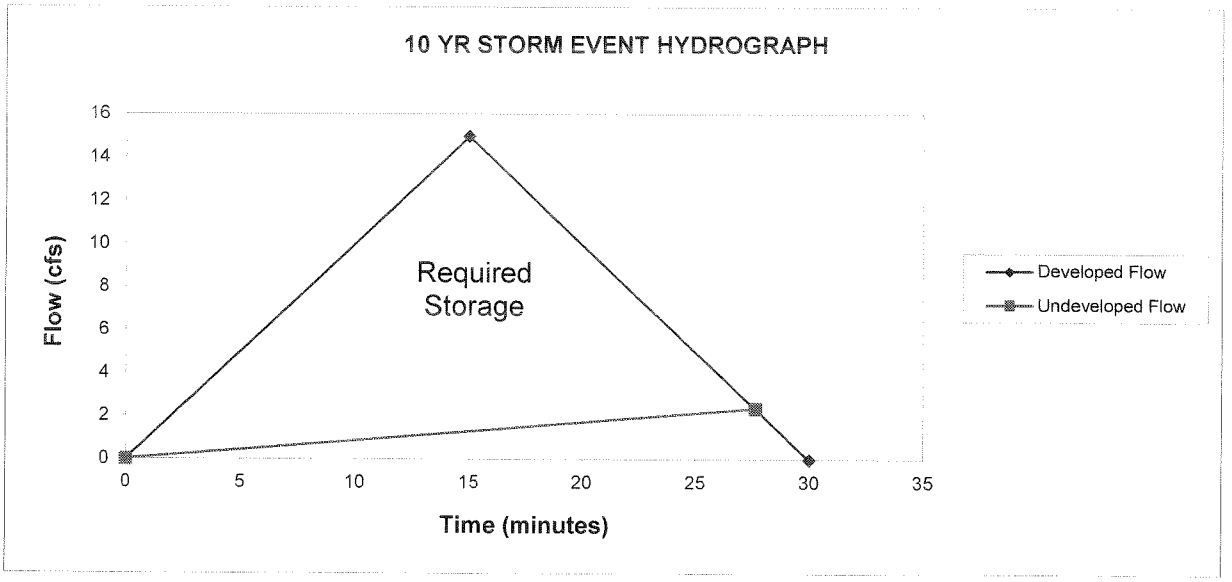
Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.950

Time of concentration = 0.25 hours
Recurrence interval = 10 year storm
Intensity, i = 2.000 in/hr

$Q = C_w * i * A$ = 14.99 CFS

L.R. POPE ENGINEERING 1240 EAST 100 SOUTH # 15B ST. GEORGE, UT 84790 OFFICE: (435) 628-1676 FAX: (435) 628-1788

GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR PREDEVELOPED CONDITIONS FOR COMMERCE POINT WEST



	Tc, min	i, in/hr	Q, cfs
Developed peak =	15	2.000	14.99

Return Frequency =	10	yr	
Allowable outflow =	2.37	cfs	
Peak Inflow =	14.99	cfs	
Required Storage =	0.261	acre-ft	= 11360.43 ft^3

Points of intersection
Undeveloped/Developed @ Time = 27.63 minutes

L.R. POPE ENGINEERING 1240 EAST 100 SOUTH # 15B ST. GEORGE, UT 84790 OFFICE: (435) 628-1676 FAX: (435) 628-1788

100 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS FOR COMMERCE POINT WEST

Soil Type = C

Land Use/Cover	Runoff Coefficient, C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	343653	7.89
Apartments/Offices	0.85	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.80	0	
MD Residential: > 6-9 units/acre	0.70	0	
MD Residential: > 4-6 units/acre	0.60	0	
LD Residential: > 3-4 units/acre	0.45	0	
LD Residential: > 2-3 units/acre	0.35	0	
LD Residential: > 1-2 units/acre	0.25	0	
VLD Residential: > 0.5-1 units/acre	0.20	0	
VLD Residential: > 0.2-0.5 units/acre	0.17	0	
VLD Residential: > 0.1-0.5 units/acre	0.15	0	
Urban Lawns/Parks	0.10	0	
Urban Landscaping/Gardens	0.05	0	
Bare/Newly Graded	0.30	0	
Irrigated Pasture/Agriculture	0.15	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.15	0	
Desert Shrub: < 30-70% Cover	0.10	0	
Desert Shrub: > 70% Cover	0.05	0	
	Total Area =	343653	7.89

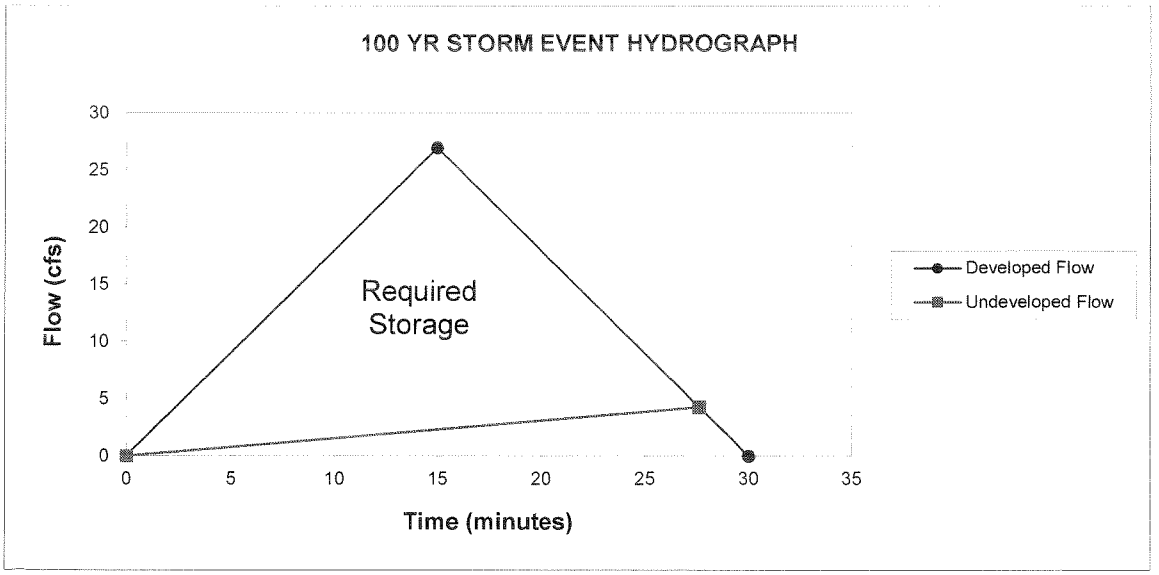
Weighted runoff coefficient, $C_w = \Sigma C_j A_j / \Sigma A_j$ = 0.950

Time of concentration = 0.25 hours
Recurrence interval = 100 year storm
Intensity, i = 3.600 in/hr

$Q = C_w \cdot i^* A$ = 26.98 CFS

L.R. POPE ENGINEERING 1240 EAST 100 SOUTH # 15B ST. GEORGE, UT 84790 OFFICE: (435) 628-1676 FAX: (435) 628-1788

GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR DEVELOPED CONDITIONS FOR COMMERCE POINT WEST



	Tc, min	i, in/hr	Q, cfs
Developed peak =	15	3.600	26.98

Return Frequency =	100	yr		
Allowable outflow =	4.26	cfs		
Peak Inflow =	26.98	cfs		
Required Storage =	0.469	acre-ft	= 20449	ft^3

Points of intersection
Undeveloped/Developed @ Time = 27.63 **minutes**

Detention Study Summary

Frequency Years	Adjusted 'C'	Intensity in/hr	Qpeak cfs	Allowable cfs	Required Storage acre-ft	Required Storage ft^3
10	0.950	2.000	14.99	2.37	0.261	11360
100	0.950	3.600	26.98	4.26	0.469	20449

L.R. POPE ENGINEERING 1240 EAST 100 SOUTH # 15B ST. GEORGE, UT 84790 OFFICE: (435) 628-1676 FAX: (435) 628-1788

APPENDIX 'B'
SOIL MAPS
SOIL DESCRIPTIONS

Washington County Area, Utah

JaB—Junction fine sandy loam, 1 to 2 percent slopes

Map Unit Setting

National map unit symbol: j8f3
Elevation: 2,700 to 3,400 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 57 to 67 degrees F
Frost-free period: 190 to 195 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Junction

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex

Typical profile

H1 - 0 to 2 inches: fine sandy loam
H2 - 2 to 9 inches: fine sandy loam
H3 - 9 to 21 inches: fine sandy loam
H4 - 21 to 32 inches: fine sandy loam
H5 - 32 to 60 inches: fine sandy loam

Properties and qualities

Slope: 1 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very 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: 20 percent
Gypsum, maximum in profile: 7 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A

Ecological site: Desert Loam (Creosotebush) (R030XY110UT)

Minor Components

Pintura
Percent of map unit: 5 percent

Tobler
Percent of map unit: 5 percent

Harrisburg
Percent of map unit: 5 percent

Data Source Information

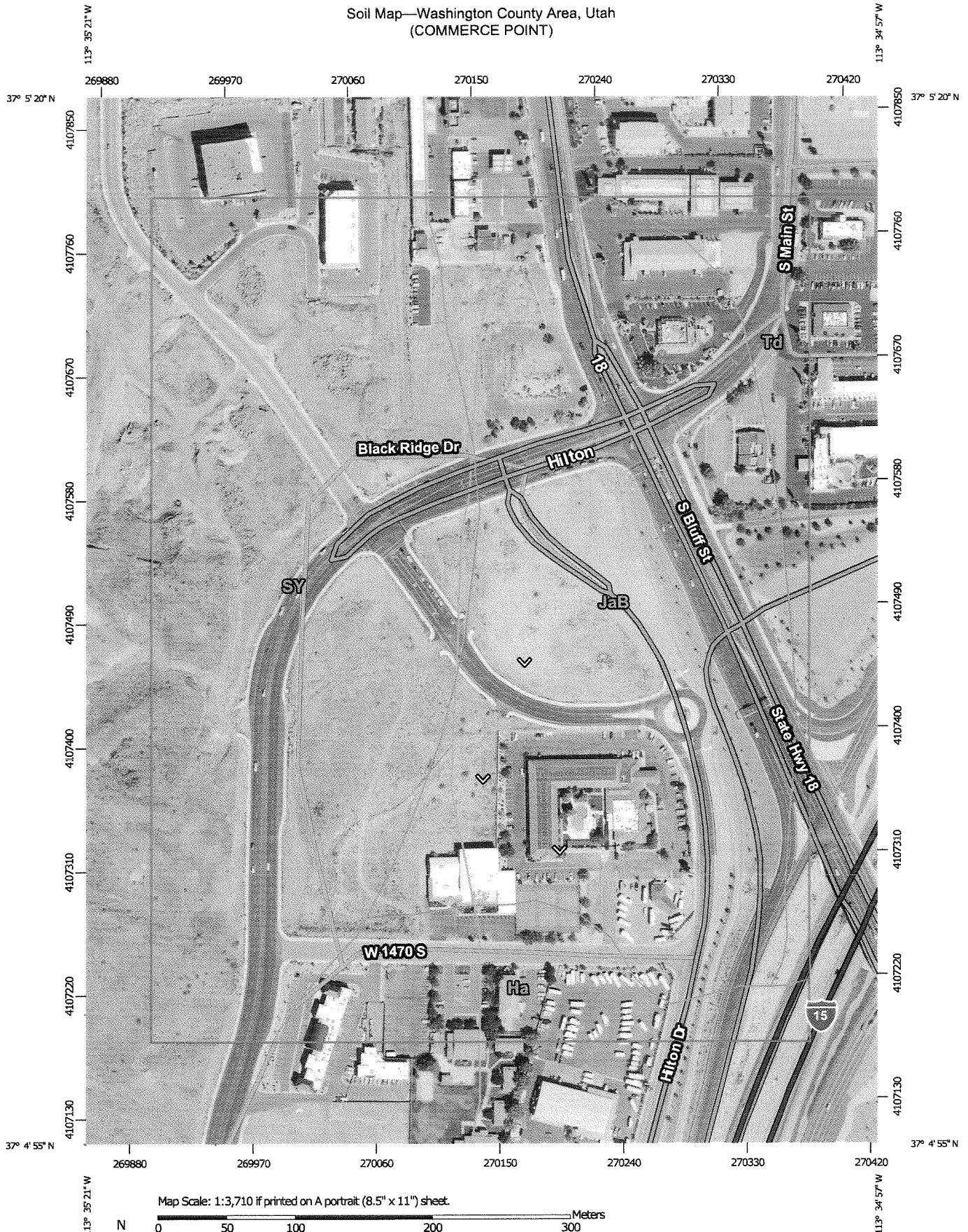
Soil Survey Area: Washington County Area, Utah
Survey Area Data: Version 9, Sep 23, 2015

TABLE 6.--SOIL RESOURCE INTERPRETATIONS--Continued

Map symbol	Soil name	Land capability	Vegetative group	Hydrologic group	Timber management group	Erosion hazard	Frost-heave potential	Degree of limitation for--		
								Road location	Excavation	Dwellings
MsE	Meeks very stony loamy coarse sand, 15 to 30 percent slopes.	VIIs	J	B	3x5	High-----	Moderate-	Severe---	Severe---	Severe.
MsG	Meeks very stony loamy coarse sand, 30 to 60 percent slopes.	VIIs	J	B	4x8	High-----	Moderate-	Severe---	Severe---	Severe.
MtE	Meeks extremely stony loamy coarse sand, 15 to 30 percent slopes.	VIIs	J	B	3x5	High-----	Moderate-	Severe---	Severe---	Severe.
MtG	Meeks extremely stony loamy coarse sand, 30 to 60 percent slopes.	VIIs	J	B	4x8	High-----	Moderate-	Severe---	Severe---	Severe.
MxE	Meiss cobbly loam, 9 to 30 percent slopes.	VIIe	J	D	(1/)	Moderate-	Moderate-	Severe---	Severe---	Severe.
MxF	Meiss cobbly loam, 30 to 50 percent slopes	VIIe	J	D	(1/)	High-----	Moderate-	Severe---	Severe---	Severe.
Px	Pits and dumps----------	VIIIs	J	D	(1/)	Variable-	Variable-	Severe---	Variable-	Severe.
Ra	Rock land----------	VIIIs	J	D	(1/)	Moderate-	Moderate-	Severe---	Severe---	Severe.
RcF	Rock outcrop-Cagwin complex, 30 to 50 percent slopes.	VIIs	J	C	4x8	High-----	Moderate-	Severe---	Severe---	Severe.
RcG	Rock outcrop-Cagwin complex, 50 to 70 percent slopes.	VIIs	J	C	4x8	High-----	Moderate-	Severe---	Severe---	Severe.
RtF	Rock outcrop-Toem complex, 30 to 50 percent slopes.	VIIs	J	C	5x10	High-----	Slight---	Severe---	Severe---	Severe.
RtG	Rock outcrop-Toem complex, 50 to 70 percent slopes.	VIIs	J	C	5x10	High-----	Slight---	Severe---	Severe---	Severe.
Rx	Rock outcrop and Rubble land.	VIIIs	J	D	(1/)	Slight---	Not rated.	Severe---	Severe---	Severe.
ShE	Shakespeare gravelly loam, 9 to 30 percent slopes.	VIe	B	C	3o2	Moderate-	Severe---	Severe---	Moderate-	Severe.
SkF	Shakespeare stony loam, 30 to 50 percent slopes.	VIIe	J	C	3r4	High-----	Severe---	Severe---	Moderate-	Severe.
Sm	Stony colluvial land---	VIIIs	J	C	(1/)	Moderate-	Variable-	Severe---	Severe---	Severe.
TaD	Tahoma stony sandy loam, 2 to 15 percent slopes.	IVe	A	B	2o1	Slight---	Severe---	Moderate-	Slight---	Moderate.
TbD	Tahoma very stony sandy loam, 2 to 15 percent slopes.	VIs	B	B	2o1	Slight---	Severe---	Moderate-	Moderate-	Moderate.
TcB	Tallac gravelly coarse sandy loam, seeped, 0 to 5 percent slopes.	IVe	B	C	3o2	Slight---	Moderate-	Moderate-	Moderate-	Moderate.
TcC	Tallac gravelly coarse sandy loam, seeped, 5 to 9 percent slopes.	IVe	B	C	3o2	Slight---	Moderate-	Moderate-	Moderate-	Moderate.
TdD	Tallac stony coarse sandy loam, 5 to 15 percent slopes.	VIe	B	B	3x5	Slight--	Moderate-	Moderate-	Severe---	Severe.
TeE	Tallac very stony coarse sandy loam, 15 to 30 percent slopes.	VIs	B	B	3x5	Moderate-	Moderate-	Severe---	Severe---	Severe.

Digitized by Google

Soil Map—Washington County Area, Utah
(COMMERCE POINT)



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 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: Washington County Area, Utah
Survey Area Data: Version 9, Sep 23, 2015

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

Date(s) aerial images were photographed: Aug 11, 2010—Nov 3, 2010

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 of map unit boundaries may be evident.

Map Unit Legend

Washington County Area, Utah (UT641)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Ha	Hantz silty clay loam	6.4	8.8%
JaB	Junction fine sandy loam, 1 to 2 percent slopes	31.7	43.5%
SY	Stony colluvial land	30.6	41.8%
Td	Tobler silty clay loam	4.3	5.9%
Totals for Area of Interest		**73.0**	**100.0%**

APPENDIX 'C'
FIGURES AND TABLES FROM
ST. GEORGE HYDROLOGY MANUAL

Table 2-1
Precipitation Depth-Frequency Estimates for St. George, Utah*

Estimated Precipitation Depth (inches)						
Duration	**Annual Exceedance Probability**					
	2-yr	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
5 min	0.15	0.21	0.26	0.34	0.40	0.48
10 min	0..22	0.32	0.40	0.52	0.62	0.73
15 min	0.28	0.40	0.50	0.64	0.76	0.90
30 min	0.37	0.54	0.67	0.86	1.03	1.22
60 min	0.46	0.67	0.83	1.07	1.27	1.51
2 hr	0.54	0.76	0.93	1.18	1.38	1.60
3 hr	0.60	0.83	1.00	1.24	1.43	1.64
6 hr	0.75	1.03	1.22	1.50	1.72	1.96
12 hr	0.91	1.23	1.46	1.76	1.94	2.22
24 hr	1.05	1.42	1.68	2.01	2.26	2.51
2 day	1.15	1.56	1.83	2.19	2.47	2.74
4 day	1.30	1.76	2.06	2.46	2.77	3.07

* From NOAA Atlas 14, 2006 (see Appendix A).

Table 2-6
Rational Method Runoff Coefficients

Land Use/Land Cover Category	Soil Type			
	A	B	C	D
Commercial	0.95	0.95	0.95	0.95
Business / Industrial	0.90	0.90	0.90	0.90
Institutional	0.90	0.90	0.90	0.90
High Density Multi-family Residential	0.70	0.75	0.80	0.85
Medium Density Multi-family Residential	0.60	0.65	0.70	0.75
High Density Single Family Residential	0.50	0.55	0.60	0.65
Medium Density Single Family Residential (Traditional Neighborhood)	0.25	0.30	0.35	0.40
Low Density Single Family Residential	0.15	0.20	0.25	0.30
Very Low Density Single Family Residential	0.08	0.12	0.17	0.22
Urban Lawns/Parks	0.00	0.02	0.10	0.20
Urban Landscaping/Gardens	0.00	0.01	0.05	0.10
Bare Soil: Newly Graded Areas	0.02	0.10	0.30	0.50
Irrigated Pasture/Agriculture	0.02	0.05	0.15	0.25
Wetlands	0.99	0.99	0.99	0.99
Desert Shrub: < 30% ground cover	0.01	0.10	0.15	0.20
Desert Shrub: 30% to 70% ground cover	0.01	0.05	0.10	0.15
Desert Shrub: > 70% ground cover	0.01	0.02	0.05	0.10

Exhibit D
Geotechnical Report

GEOTECHNICAL INVESTIGATION REPORT

COMMERCE POINTE SHOPPING CENTER

St. George, Utah

Submitted to:

JMI Development
Attention: Gilbert Jennings
335 E. St. George Blvd. Suite 301
St. George, Utah 84770

Landmark Project No. 16110

May 6, 2016

LANDMARK
TESTING & ENGINEERING

795 E. FACTORY DRIVE, ST. GEORGE, UT 84790
PHONE: (435) 986-0566 • FAX: (435) 986-0568

GEOTECHNICAL INVESTIGATION REPORT

for

Commerce Pointe Shopping Center

St. George, Utah

Submitted to:

JMI Development
Attn: Gilbert Jennings
335 E. St. George Blvd. Suite 301
St. George, Utah 84770

May 6, 2016

Landmark Testing & Engineering
Landmark Project No. 16110
795 East Factory Drive
St. George, Utah 84790

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COMMERCE POINTE SHOPPING CENTER

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GEOTECHNICAL INVESTIGATION REPORT
COMMERCE POINTE SHOPPING CENTER

FIGURE 1:	VICINITY/LANDSLIDE MAP
FIGURE 2:	SITE PLAN
FIGURES 3-9:	TEST PIT LOGS
FIGURE 10:	UNIFIED SOIL CLASSIFICATION SYSTEM
FIGURES 11-14:	CONSOLIDATION CURVES
FIGURE 15:	LABORATORY TEST SUMMARY

1.0 INTRODUCTION

This report presents the results of Landmark Testing & Engineering's geotechnical investigation for the proposed Commerce Pointe Shopping Center located adjacent to Black Ridge Drive in St George, Utah. We understand that the project will include 10 to 12 building pads with associated parking and site access. Figure 1 is a Vicinity map showing the location of the project relative to surrounding features. A site plan showing the preliminary project layout is shown on Figure 2.

This investigation was completed to assist in developing opinions and recommendations concerning site earthwork, foundation, and pavement design.

2.0 PROPOSED CONSTRUCTION

We understand that proposed construction will consist of a commercial development with 10 to 12 building pads and associated roadways and other infrastructure. Retail pads are expected to range in size from approximately 5,000 to 30,000 square feet. Structural loads have not been provided, however, maximum wall loads are anticipated to be on the order of 2 to 4 kips per lineal foot. Isolated, column loads are expected to range up to 60 kips. Any significant changes to the anticipated loads should be reviewed by Landmark to evaluate the continued applicability of the recommendations contained in this report.

3.0 SITE SETTING

3.1 SURFACE CONDITIONS

The project is located near the toe of the southeast end of the West Black Ridge mesa in St. George, Utah, as shown on Figures 1-3. The site generally slopes downward to the east with an overall elevation change on the order of 60 feet. Black Ridge Drive and Hilton Drive both cross the site. Hilton Drive appears to have been built up near the intersection with Black Ride Drive with embankment fill on the order of 15 feet. Relatively steep slopes were noted near the west side of the site. Vegetation generally consists of sparse to moderate brush, low-lying weeds, grasses, and occasional cactus. Undocumented fill was noted south of Hilton Drive, near the intersection of Hilton and Black Ridge Drives. Fill was also noted in test pit TP-11,

in the vicinity of the hotel that was previously located at the site. Basalt cobbles and boulders are present at the surface throughout much of the site, particularly at the slopes on the western portion of the site.

3.2 SEISMICITY AND FAULTING

Seismicity at the site was determined using the United States Geological Survey, Earthquake Hazards Program website. The following values are presented to assist with seismic design:

- Site Class = D (Stiff Soil) based on the ASCE7 (Table 20.3.1) as referenced in 2012 IBC 1613.3.2.
- Latitude = 37.0851, Longitude = -113.5863

Period (sec)	Sa (g)	Site Class
0.2	0.498 S_S	B
1.0	0.153 S_1	B
0.2	0.466 SD_S	D
1.0	0.223 SD_1	D

(2010 ASCE-7, USGS, U.S. Seismic Design Maps Calculator)

The two major faults in the area, the Washington Fault and the Hurricane Fault Zone are located within approximately 5 miles and 15 miles east of the site, respectively.[1] More recent mapping identifies the St. George Fault as a Quaternary (movement within the last 1,800,000 years) fault and projects the fault trace within approximately 1.5 miles east of the site. The site has also been mapped within a moderate rock-fall hazard area.[2] Although surface rupture at the site is considered unlikely, strong ground motion at the site, rockfall, and instability of slopes at the western portion of the site are possible.

Groundwater was not encountered in any of the test pits. Clay is prevalent throughout much of the site and hard excavating conditions were also noted. Therefore, the liquefaction potential is considered low.

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1 Anderson, R.E., and Christenson, G.E., 1989, Quaternary faults, folds, and selected volcanic features in the Cedar City 1° x 2° quadrangle, Utah: Utah Geological and Mineral Survey Miscellaneous Publication 89-6.

2 William R. Lund, Tyler R. Knudsen, Garrett S. Vice, and Lucan M. Shaw, Geologic Hazards and Adverse Construction Conditions , St. George-Hurricane Metropolitan Area, Washington County, Utah, 2008, Utah Geological Survey Special Study 127.

3.3 SUBSURFACE CONDITIONS

Fourteen (14) test pits were completed throughout the project to characterize subsurface conditions. The approximate test pit locations are shown on Figure 2. Subsurface soils encountered in the test pits are shown on the test pit logs on Figures 3 through 9. A key to the soil descriptions used on the logs is presented on Figure 10. Test pits generally encountered lean to fat clay, with varying amounts of sand and basalt cobbles, throughout the majority of the test pits. Silty sand, silty gravel, and sandy silt were also encountered. Sandstone was encountered in test pit TP-7, which graded hard and practical backhoe refusal was encountered at a depth of 7.0 feet below the existing grade.

Previous geologic mapping by Hayden and Willis[3], 2011, classifies the majority of soils within the site as mixed alluvial and eolian deposits (Qaeo), which consist of moderately to well sorted, clay to sand sized sediment of alluvial origin that locally includes abundant eolian sand and minor gravel. The western portion of the site has been mapped within Holocene to middle Pleistocene aged landslide deposits, with basal detachments in the Petrified Forest Member of the Chinle formation. The Petrified Forest Member appears to underlie the majority of the site.

Due to the very high landslide hazard category, Lund et. al (2008)[4] recommend a detailed engineering geologic and geotechnical-engineering evaluation and predevelopment stabilization for the area included in the western portion of the site. However, landslides involving the Petrified Forest Member are difficult to mitigate. We are aware of recent landslide movement and significant structural damage within 1,000 feet north of the site. An evaluation of the landslide is beyond the scope of this report.

4.0 LABORATORY TESTING

Laboratory tests included mechanical gradation analyses and Atterberg limits to aid in soil classification, swell consolidation tests to assess potential volume change within clays at the site due to saturation, and

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3 Hayden, J.M., and Willis, G.C., Geologic Map of the St. George 7.5' Quadrangle, Washington County, Utah, 2011, Utah Geological Survey Map 251DM.

4 William R. Lund, Tyler R. Knudsen, Garrett S. Vice, and Lucas M. Shaw, Landslide Hazard Map for the St. George-Hurricane Metropolitan Area, Washington County, Utah, 2008, Utah Geological Survey Special Study 127, Plate 4.

soluble sulfate tests to assess the corrosion potential of site soils on concrete. Results of the laboratory tests are shown on the test pit logs on Figures 3 through 9 and on the laboratory summary table on Figure 10.

Published correlations exist between the plasticity index noted in the Atterberg Limits tests and the swell potential[3]. These correlations are shown below.

Swell Potential	Plasticity Index (%)	Direct Measurement (% Swell)
Low	0-15	0-4
Moderate	10-35	4-8
High	20-55	8-12
Critical	35 and above	above 12

Atterberg limits tests had plasticity indices ranging from 18 to 37 and would be expected to experience moderate to high swell if the clay were dry and allowed to become saturated.

There were consolidation tests performed on 4 clay samples at varying depths. The samples were air dried prior to testing and were wetted at 500 psf. Upon wetting, the samples experienced swell from 3.3 to 4.8 percent. Swell curves are shown on Figures 11-14.

Based on an average swell of 4.1 percent, an estimated swell of ½ inch per foot of clay may be expected if the clay underneath the buildings becomes saturated. Assuming 15 feet of clay becomes saturated, a swell of 7.5 inches may be expected. In the parking lot areas, where the confining pressure is lower, a much greater swell would be expected.

[3]Nelson, J.D. and Miller, D.J., 1992 Expansive soils, problem and practice in foundation and pavement engineering: New York, New York, John Wiley & Sons, Inc.

5.0 SITE GRADING AND EARTHWORK

A +17 feet separation between building foundations and the underlying expansive clay is typically sufficient to reduce the potential of saturating the clay due to vertical migration of precipitation or irrigation water through suitable soils into the clay. Lean to fat clay was encountered throughout the majority of the site.

Three options are subsequently presented for building support. These options include:

1. Establishing structures on drilled piers extending below the zone of significant moisture variation (recommended minimum depth of 30 feet below the anticipated footing elevations) and allowing the floor slab to "float" with the understanding that the floor slab will require repair if subsurface soils swell. We recommend a minimum overexcavation of 9.0 feet below floating slabs. Additional overexcavation will provide greater separation and reduce the potential for saturation of the clay.

2. Establishing the structures on drilled piers, including constructing the floors as a suspended structural slab. We recommend a minimum pier depth of 30 feet below the anticipated footing elevations. This option generally gives the best assurance against differential movement due to subsurface moisture variation.

3. Overexcavation of expansive soils and establishing the structures on a mat of improved, relatively impervious soil may be a viable option. Subsequent to overexcavation utilize conventional footings and slab-on-grade construction with a separation between structural elements (i.e. footings and slabs) and underlying clay. A 17 feet separation is typically sufficient to reduce the potential of saturating the clay due to vertical migration of surface water. At a minimum, we recommend an overexcavation depth of 8 feet below footings and floor slabs. Additional overexcavation will provide greater separation and reduce the potential for saturation of the clay. With this option excessive heave is likely if the underlying clay becomes saturated. However, if landscaping can be minimized and strict drainage improvements are implemented throughout the life of the structures, the heave potential can be greatly reduced.

The option chosen will depend on the final product to be constructed, on the degree of risk the owner is willing to accept, cost of repair if required (including lost revenue) and on construction costs for each option. The type of construction will be important in assessing the foundation option. Typically, tilt-up concrete panels are less prone to cracking due to differential movement than is masonry block construction. Additionally, steel buildings provide more flexibility than masonry or tilt-up construction. Other considerations include the amount and type of plumbing beneath the structures and implementation of adjacent landscaping throughout the life of the structures.

Any option will require stringent moisture controls to minimize potential saturation of the clay. Distress of sidewalks, curb/gutter, pavement, and other surface elements will occur if expansive clay beneath these elements becomes saturated. Detailed recommendations for each option are presented.

5.1 DRILLED PIERS WITH FLOATING FLOOR

Piers should be installed a minimum of 30 feet below the anticipated footing elevations. A minimum pier diameter of 8-inches is recommended to allow for insertion of the re-bar cage and to allow adequate concrete cover. We recommend a minimum overexcavation of 9.0 feet in order to establish a non-expansive zone below floating slabs. The overexcavated material should be replaced with structural fill, as outlined below. Cobbles that may impede drilling would likely be removed during overexcavation. Therefore, the overexcavation and replacement should proceed pier installation. Helical piers are not recommended since they will likely not be able to achieve the desired depth. Pier recommendations are as follows:

1. Piers should be designed for a maximum allowable end bearing pressure of 14,000 psf and an allowable skin friction value of 1,100 psf for the portion of pier extending below 8 feet.

2. Piers should be designed and spaced for a minimum deadload pressure of 10,000 psf based on the pier cross-sectional area.

3. Piers should be reinforced the full length to resist tension forces in the event of swelling of adjacent soils. Potential tension forces may be calculated using at least 15 feet of pier length with a skin friction of 1,100 psf. The minimum percent of steel should be 1% of the concrete area. Reinforcement should extend into grade beams and foundation walls.

4. Laterally loaded piers should be at least three diameters apart and may be designed utilizing the parameters in the following table.

Soil Type	Total Unit Weight (pcf)	ε_{50} (in/in)	K value (lb/in^3)	Friction Angle	Cohesion (psf)	Unconfined Compressive Strength (psf)	Modulus of Elasticity (psi)
Granular Fill	130	NA	120	34	NA	NA	2,500
Lean to fat clay	120	0.005	1,000	NA	4,000	8,000	14,000

5. Pier excavations should be carefully cleaned prior to placing concrete. Concrete should be poured into the pier excavations immediately after the excavations are cleaned and inspected. Pumping or tremie methods of concrete placement are recommended to minimize segregation of the concrete. The maximum aggregate size should be less than 1/3 of the clearance between rebar ties. Concrete with a slump of 4 to 6 inches is recommended.

6. A minimum 12-inch continuous void beneath all grade beams and foundations walls supported on piers is recommended to concentrate dead loads and to minimize potential uplift pressures.

7. Pier installation should be observed by competent personnel to assure that adequate bearing is achieved, cleanout is performed, and the re-bar cage is properly placed.

8. Mushrooming or enlargement at the top of piers should be avoided during pier drilling and subsequent construction operations.

9. Concrete should be continuously poured to the bottom of the grade beams such that construction joints are not formed.

10. Ensure that exterior concrete elements are not placed beneath protruding components of the building that may limit free vertical movement of the concrete element.

5.2 DRILLED PIERS WITH A SUSPENDED SLAB

The building perimeter would be installed as previously indicated, however, the floor would consist of a post-tensioned or other structural slab and would also be established on drilled piers. Significant loads would be carried on piers, which may require larger diameters and/or deeper piers. Additional analyses can be performed once exact loads are determined. A minimum 12-inch continuous void beneath all grade beams, suspended slab, and foundations walls supported on piers is recommended to minimize potential uplift pressures due to swell of underlying clay.

With this option excavation would generally be limited to removing material to achieve desired pad elevations, removal of any cobbles that would impede drilling, and to allow for the required void space. Pier design and recommendations would generally follow the parameters previously provided. As with the previous pier option exterior concrete elements should not be placed beneath protruding components of the building that may limit free vertical movement of the concrete elements that are not supported on piers.

5.3 CONVENTIONAL FOUNDATION SYSTEMS

Typically, if there is a +17 feet separation between building foundations and the underlying clay, the potential of saturating the clay due to vertical migration of precipitation or irrigation water through suitable soils into the clay is low. We recommend deep foundation options, as they provide the greatest protection against swell. However, overexcavation and replacement may be a viable option if strict moisture control is implemented and the owner is willing to assume the risk that excessive differential movement will occur if the underlying clay becomes saturated. At a minimum, clays should be overexcavated to allow for a separation of at least 8 feet between the footings and floor slabs and the underlying clay. Overexcavated soils should be replaced with structural fill. Clays underlying the site were generally dry and swell will occur if the clays become saturated. The building type, the owner's risk tolerance, and construction costs should be considered when selecting this option. Strict moisture control recommendations should be followed to minimize the potential for saturation of clays. The following table presents estimates of swell with corresponding overexavation depths.

Overexcavation Depth (ft.)	Potential Swell (in.)
8	4.4
10	3.4
12	2.5
14	1.5
16	0.5
17	0.0

Structural fill should be placed following the recommendations outlined in section 6 of this report. The foundation recommendations presented below should be followed for structurally loaded elements.

1. Foundations established on a minimum of 8.0 feet of imported, structural fill may be designed for a maximum allowable soil bearing pressure of 2,000 pounds per square foot based upon dead load plus long term live load. A one-third increase in allowable bearing pressure may be used for short term transient loads such as wind and seismic events. The bearing capacity may be increased by 500 psf for each additional foot of footing width or depth up to a maximum value of 3,000 psf.

2. The minimum recommended footing width for continuous footings is 24 inches and a minimum width of 24 inches is also recommended for isolated spread footings.

3. Footings should be at established at least 12 inches below the lowest adjacent final grade for confinement purposes.

4. For buildings areas overexcavation, moisture conditioning, and compaction should extend laterally a minimum of 5 feet beyond the building perimeter in each direction. For exterior concrete flatwork and asphalt pavements, the soil preparation should extend laterally a minimum of 2 feet beyond the pavement or flatwork perimeter.

5. Lateral loads imposed on foundations may be resisted by the development of passive earth pressures against the sides of footings and friction between the base of the footing and the supporting soils. In determining the frictional resistance a coefficient of friction of 0.36 should be used between supporting granular soils and foundation concrete. Passive resistance may be calculated using a coefficient of 2.7 and a unit weight of 125 pcf for an equivalent fluid weight of 338 pcf.

6.0 SITE GRADING AND EARTHWORK

6.1 REMOVALS AND SUBGRADE PREPARATION

Preparation of the site for construction should include the removal of existing vegetation, undocumented fill, any debris and other deleterious materials from beneath structurally loaded elements (i.e. conventional footings, slabs-on-grade, parking areas, and concrete flatwork).

We recommend overexcavation of at least 8.0 feet of soils for the conventional footing option and a minimum of 9 feet for drilled piers with a floating floor. Granular on-site soils (silty sand and gravel) are suitable for use as structural fill provided that all organics, oversized material greater than 6-inches in size, and other deleterious materials are removed. However, very little granular material was noted at the site and large quantities of imported structural fill should be anticipated, particularly for the overexcavated building pad option. Excavated clay can be processed and blended with suitable on-site sand or imported structural fill and utilized to backfill the lower portion of excavated areas. Clay should comprise 30% or less of the blended total. For fill consistency and ease of construction, it is recommended that the clay be removed from the site and replaced with low permeable imported fill, as recommended in section 6.2 of this report. Following removal of the clayey material and prior to fill placement, the exposed subgrade should be scarified to a depth of 8-inches, moisture conditioned to at least +4% above the optimum moisture content, and compacted to 90% of the maximum dry density as determined by ASTM D-1557. If dense cobble or

competent claystone or sandstone is encountered in the bottom of the excavation, scarification will not be required. Structural fill can then be placed on the prepared subgrade.

In paved areas and beneath exterior concrete flatwork where near-surface clay is encountered, expansive clay should be removed from within 2.0 feet of pavement and concrete flatwork. Excavated clay can be blended with imported structural fill and utilized to backfill the excavated pavement and flatwork areas. Clay should comprise 30% or less of the blended total. It should be noted that movement will occur if moisture variation occurs in the underlying clays. Additional overexcavation to depths greater than 2.0 feet will provide greater protection against clay expansion.

6.2 FILL PLACEMENT AND COMPACTION

Following removals and subgrade preparation as described above, structural fill should be placed in accordance with the following recommendations. The on-site silty sand and gravel may be stockpiled and used for structural fill, provided cobbles are removed.

Imported structural fill should consist of relatively impervious granular soils that contain 15-30% fines (percent passing the No. 200 sieve) and the fines should have a liquid limit of 30% of less and a plasticity index less than 9. Structural fill should be placed in maximum 8-inch thick loose lifts at a moisture content within 2 percent of the optimum moisture content and compacted to 95% of the maximum dry density as determined by ASTM D-1557. Material not meeting the above requirements may be suitable for use as structural fill at the discretion of the geotechnical engineer. Samples of import material should be submitted to the geotechnical engineer for testing prior to transporting to the site.

Scarified subgrade soils and each eight-inch lift of structural fill material placed at the site should be tested for compliance with the required relative compaction and moisture content prior to proceeding with additional lifts.

7.0 FLOOR SLABS

If the overexcavation and replacement option is chosen, we recommend that floor slabs be established on a pad that has been improved as indicated in sections 5 and 6. If the pier option is chosen, we recommend a minimum of 9 feet of overexcavation.

A minimum four-inch thick layer of free-draining gravel (containing less than 5% fine grained material passing the #200 sieve), should be placed immediately below the floor slabs to help distribute floor loads, break the rise of capillary water, and aid in the concrete curing process. The gravel should be adequately consolidated and placed directly below the floor slab. Alternatively, floor slabs may be established on a minimum of 6-inches of minus 1.5 inch road base.

Concrete placement and curing should meet ACI[4] requirements including following hot weather placement recommendations, when appropriate. A vapor barrier should be placed beneath the slab if a moisture-sensitive floor covering will be installed. The moisture sensitivity of floor finishes, anticipated project conditions and the potential effects of slab curling and cracking should be considered in determining if the barrier should be placed directly beneath the slab or beneath the free-draining gravel (see ACI 302.1R-96 for more information regarding vapor barrier location). If the moisture barrier is installed directly beneath the slab, measures should be taken to minimize excessive slab curl such as reduced joint spacing and use of a low shrinkage (low water-cement ratio) mix.

8.0 LATERAL EARTH PRESSURES

We do not recommend using clay soil for wall backfill. Lateral loads imposed on footings may be resisted by the development of passive earth pressures against the sides of footings and friction between the base of the footing and the supporting soils. Lateral earth pressure values typical of imported structural fill are presented in the following table.

---

[4] American Concrete Institute

Case Evaluated	Soil Type	Value
Active	Granular (import)	37 psf/ft
		55 psf/ft (with seismic)
At-Rest	Granular (import)	57 psf/ft
Passive	Granular (import)	460 psf/ft
		404 psf/ft (with seismic)
Coefficient of friction tan(ϕ x 0.6), where ϕ= 34°	Granular (import)	0.37

The lateral earth pressures presented do not include any safety factors except where the friction angle (ϕ) used to determine the coefficient of friction has been multiplied by 0.6 to account for smooth contact conditions. The pressures also assume horizontal backfill behind the walls and the walls are in a drained condition with no build-up of hydrostatic pressure behind the wall. The additional effects of sloping backfill, surcharge, structural loads and groundwater conditions should be included in calculating lateral earth pressures. Backfill should be placed in accordance with the requirements of structural fill except that backfill in landscape and areas that will not be subject to structural loadings may be reduced to 90% of the maximum dry density as determined by ASTM D-1557.

9.0 CUT AND FILL SLOPES

Development to the north of the site has cut into the toe of the landslide material. Removal of the toe and the introduction of significant moisture due to irrigation has resulted in slope instability in areas north of the site. Substantial cuts have previously been made into the landslide slope during construction of Black Ridge Drive. Existing slopes of the landslide material generally vary from about one vertical to to horizontal (1V:2 H) to one vertical to four horizontal (1V:4H). Significant elevation changes are present at the site and we recommend that overall slope configurations be similar to the existing slopes. We recommend limiting cuts at the site and limiting maximum wall heights to 8.0 feet. Permanent slopes within the clays at the north side of the site should be maintained at one vertical to three horizontal (1V:3H) or flatter. It is recommended

that cut and fill slopes in soil elsewhere at the site be maintained at a slope of one vertical to two horizontal (1V:2H) or flatter unless structurally retained. If structurally retained, retaining structures should be limited to 8 feet and the overall slope should not be steeper than one vertical to two horizontal (1V:2H). Grading of both cut and fill slopes should be such that surface water is directed away from the slopes and not concentrated on slopes or in unprotected channels. All excavations should conform to OSHA standards.

10.0 MOISTURE CONTROL

Wetting of the foundation soils may cause a volume change within the soil and should be prevented both during and after construction. If relatively shallow overexcavation options are selected then measures to minimize potential moisture infiltration such as installation of impervious barriers, extending asphalt or concrete to the perimeter walls, and/or constructing pockets of landscaping that are downgradient of all structures should be considered. Due to the expansive nature of soils at the site, it is recommended that the following general precautions be taken to minimize the potential for soil saturation beneath structural elements.

(1) The ground surface should be graded to drain surface water away from the buildings in all directions. A minimum grade of 5% (IBC 1803.3) in the first 10 feet is recommended. Impervious surfaces such as asphalt or concrete within 10 feet of the building foundations should be sloped a minimum of 2% away from the structures.

(2) Xeriscape (landscaping that eliminates the need for supplemental irrigation of plants) is recommended within 5 feet of the building foundations. Bubblers, although more efficient that sprinkler irrigation, still have a significant potential of introducing excessive water into the ground and saturating foundation soils. Bubblers are not recommended in the 5 feet buffer zone area. Sealed planter boxes should be considered if landscaping is required.

(3) Grass should not be used at this site.

(4) Inadequate compaction of foundation backfill and utility trench backfill provides a conduit for water migration. All utility trenches within the building footprints and extending 5 feet beyond the footprints should be backfilled with structural fill similar to that approved for the foundations. Backfill adjacent to structures should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D-1557 and the minimum slope requirements should be followed. Backfill beneath structures and pavements should be compacted to at least 95% of the maximum dry density.

(5) Consideration should be given to installing rain-gutters and downspouts and discharging collected water well outside of the foundation backfill limits. We recommend that runoff be piped downgradient of all structures to an approved storm-drain system.

(6) Drains within the building should be constructed to allow for movement of the floor slab.

(7) Water from upgradient sources should be channeled around the buildings.

It should be emphasized that final grading and landscaping generally occurs after construction of the structure and observation of these features is outside of normal geotechnical inspection and observation. The developer/owner is responsible to ensure that these surface drainage and moisture control recommendations are followed throughout the life of the structures.

11.0 SOIL CORROSIVITY

Based on laboratory tests, site soils have a water soluble sulfate content of 0.06% and classify as having severe sulfate exposure. We recommend that concrete mixes in contact with site soils be designed in accordance with ACI 318, Section 4.3 for severe sulfate exposure. This includes 4,500 psi concrete and a low water to cement ratio. Sulfate-resistant CMU block is recommended for privacy walls at the project. Buried pipes should be plastic (PVC or HDPE) instead of metal, where possible.

12.0 PAVEMENTS

Design of roadways within the project is based on the procedures outlined in the 1993 Guidelines for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO). For traffic loading we assumed a traffic index of 5.5 for site access roads, which reflects traffic for a roadway classified as a residential collector and a traffic index of 5.0 for parking lots.

For pavement design, the following design parameters have been assumed:

- Pavement Design Life - 20 years
- Subgrade CBR Value - 2 (from lab test)

- Structural Layer Coefficients

  - Asphalt = 0.42

  - Type II = 0.12

Based on design parameters, the following pavement sections are provided.

	Asphalt Thickness (inches)	Type II Base Course (inches)	Subbase (inches)	Scarified and Compacted Subgrade (in)
Access Roads	3.0	8.0	16.0	8.0
Parking Lot	3.0	8.0	10.0*	8.0

*The above recommended parking lot section is based on the CBR value and assumed traffic loading, but does not provide the recommended 2.0 feet of separation between asphalt and underlying clays. The pavement sections listed above are adequate for the anticipated traffic loading. However, saturation of the underlying clays will cause heave that could adversely affect the parking lot. Greater separation between paved surfaces and the underlying clay will decrease the likelihood of differential movement within the pavement section. Pavement maintenance, such as regular crack sealing, will also prolong the life of the pavement section and reduce the potential for subsurface moisture.

Subbase should consist of imported, granular, structural fill meeting St. George City requirements. The upper 8-inches of clayey on-site soils should be scarified to a depth of 8-inches, moisture conditioned to between optimum and 4% above the optimum moisture content, and compacted to 90% of the maximum dry density as determined by ASTM D-1557. Silty or granular subgrade, where encountered, should be moisture conditioned to within 2% of the optimum moisture content and compacted to a minimum of 90% of the maximum dry density as determined by ASTM-D 1557. Compacted subgrade should extend at least two feet beyond the pavement limits. Trafficking upon and compaction of fine-grained, on-site soils will be extremely difficult during periods of wet weather when the subgrade becomes wet. If excessive rutting occurs, a stabilizing geogrid may be required to allow for access by construction vehicles.

Recompacted subbase and base course soils should be compacted to a minimum of 95% of the maximum

dry density (ASTM D-1557). Asphalt should be compacted to at least 96% of the Marshall maximum density. Asphaltic concrete and aggregate base should conform with mix and placement specifications of St. George City. Asphaltic concrete and base should be tested prior to site delivery and during placement for conformance with project specifications.

13.0 FOUNDATION REVIEW AND TESTING

This report has been prepared to assist in preliminary project design and construction. Variations from the conditions portrayed in the exploratory investigations may occur which are sometimes sufficient to require modifications to the design. In order to incorporate recommendations provided into actual field conditions and to confirm that the project specifications are implemented, we recommend that observation and testing be performed during construction to monitor over-excavation, grading, and preparation of soils upon which foundations elements or structural loads may be established.

14.0 LIMITATIONS

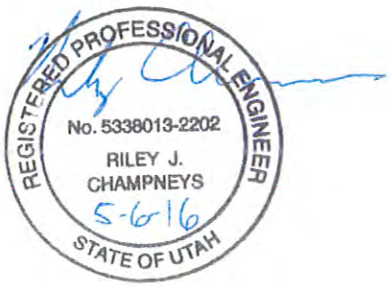
The exploratory data presented in this report were collected to provide geotechnical design recommendations for this project and subsurface site descriptions represent conditions observed at the time and at the locations explored. The investigations may not be indicative of subsurface conditions beyond the investigation location and conditions may change with passage of time. If subsurface conditions are encountered that are significantly different than those reported herein, Landmark should be contacted immediately for the continued applicability of the recommendations. In the event changes to the project are made that differ from those presented in this report, Landmark should be made aware of the changes. Landmark will provide written verification that the recommendations and conclusions remain valid or that modifications are required.

This report has been prepared to assist in project design and construction. We respectfully request the opportunity to review the final design drawings and specifications in order to determine whether the assumptions and recommendations presented herein are applicable to the anticipated designs.

This report is not intended to be used as a bid document. Any information concerning the environmental

conditions of the site is beyond the scope of this geotechnical study. This geotechnical report has been prepared to meet the specific needs of our client and may not be appropriate to satisfy the needs of other users.

LANDMARK TESTING & ENGINEERING

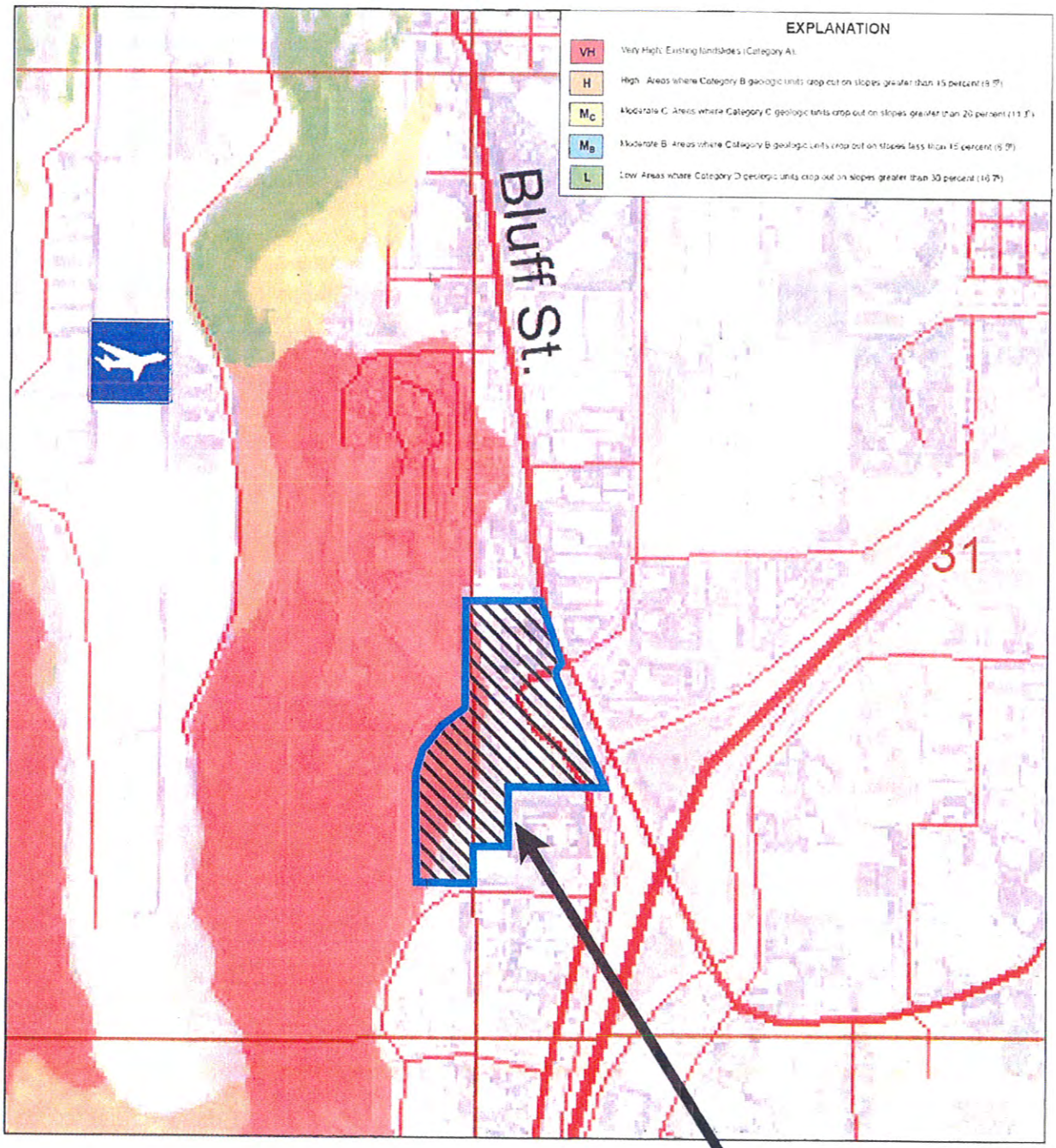


Riley Champneys, P.E.

Reviewed by:

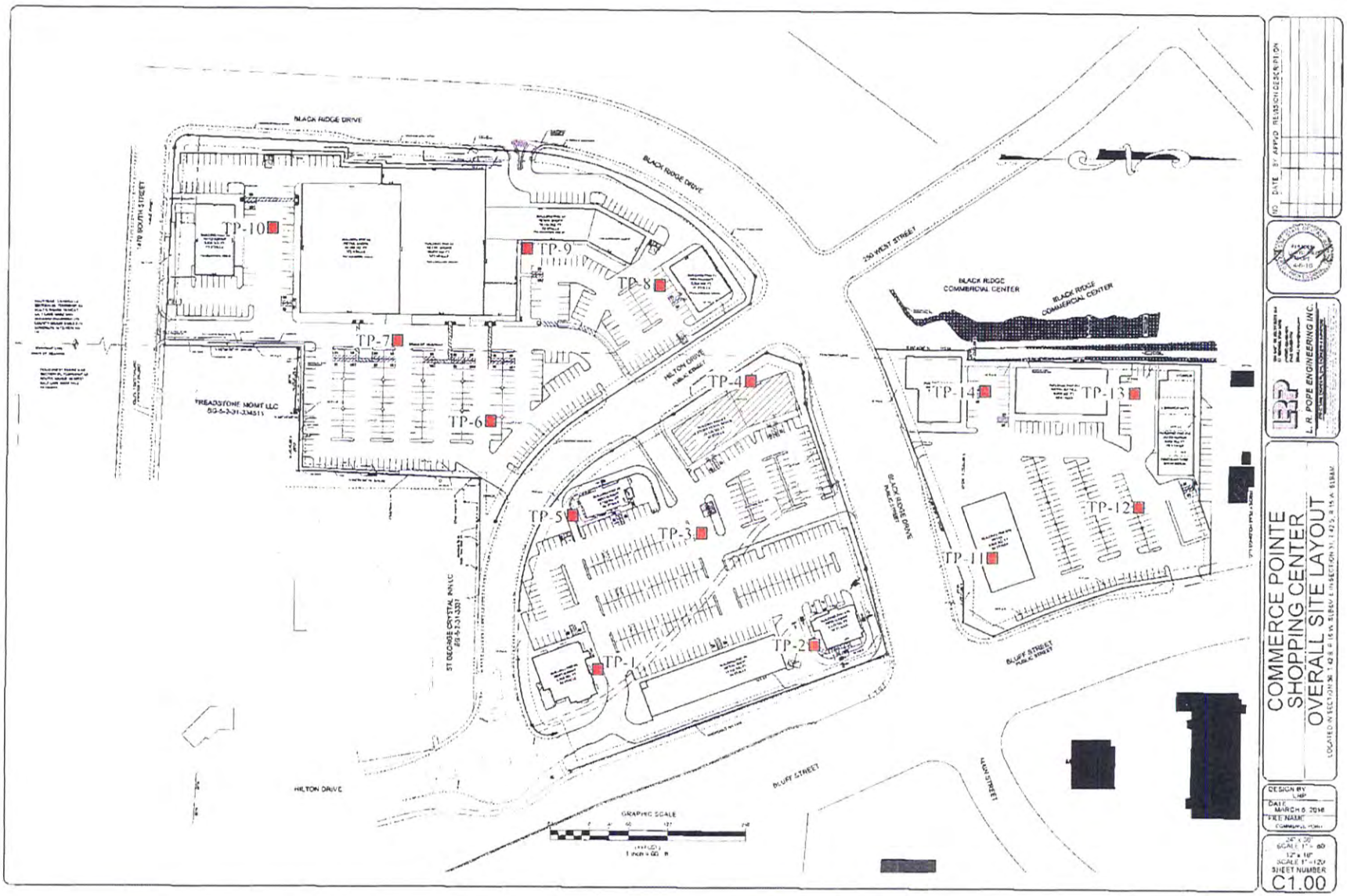
Russell Owens, P.E.

Geotechnical Manager



Adapted from Plate 4 - Landslide-Hazard Map for the St. George -Hurricane Metropolitan Area

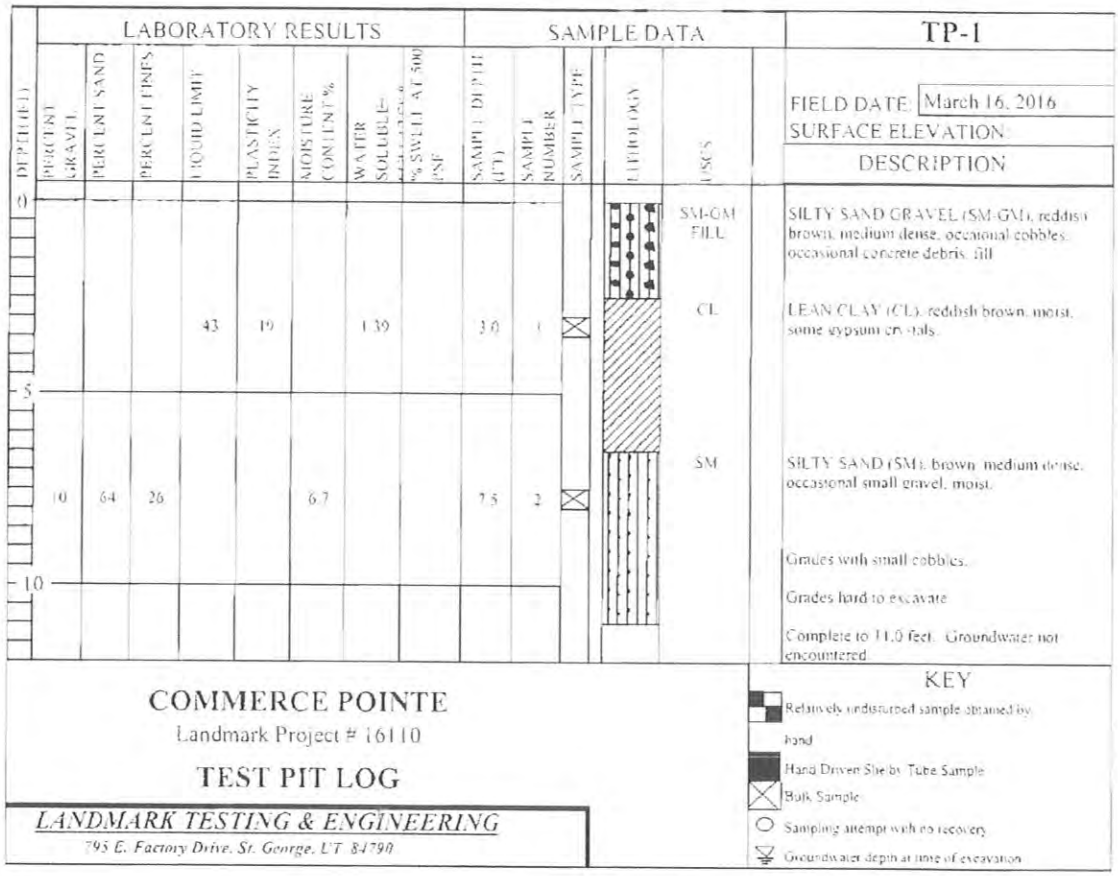
LANDMARK TESTING & ENGINEERING	VICINITY/LANDSLIDE MAP LANDMARK PROJECT 16110	Figure 1



■ Approximate Test Pit Locations

TP-2

LANDMARK TESTING & ENGINEERING	LANDMARK PROJECT 16110 SITE PLAN	FIGURE 2


LABORATORY RESULTS
SAMPLE DATA
TP-1
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
WATER SOLUBLE SULFATES % SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE: March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
SM-GM FILL
SILTY SAND GRAVEL (SM-GM), reddish brown, medium dense, occasional cobbles, occasional concrete debris, fill
43
19
1.39
3.0
1
CL
LEAN CLAY (CL), reddish brown, moist, some gypsum crystals.
10
64
26
6.7
7.5
2
SM
SILTY SAND (SM), brown, medium dense, occasional small gravel, moist.
Grades with small cobbles.
Grades hard to excavate
Complete to 11.0 feet. Groundwater not encountered.
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hand Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

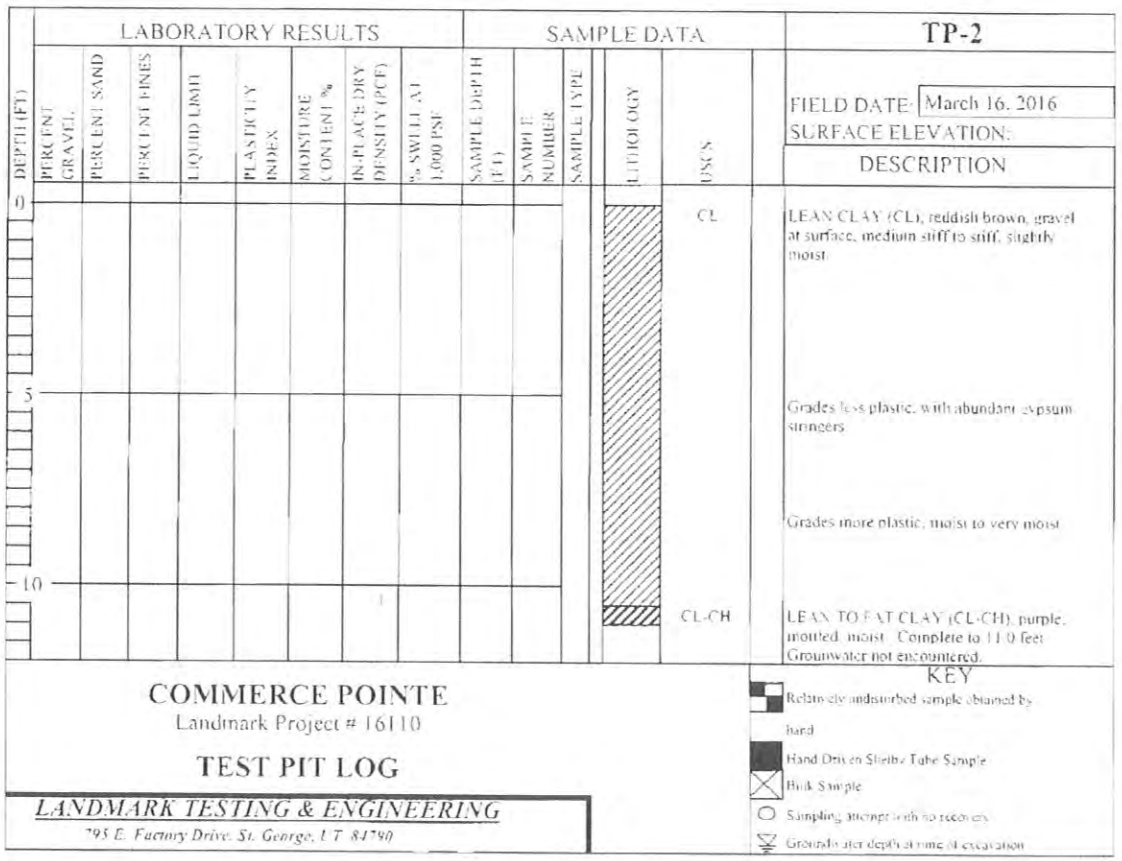
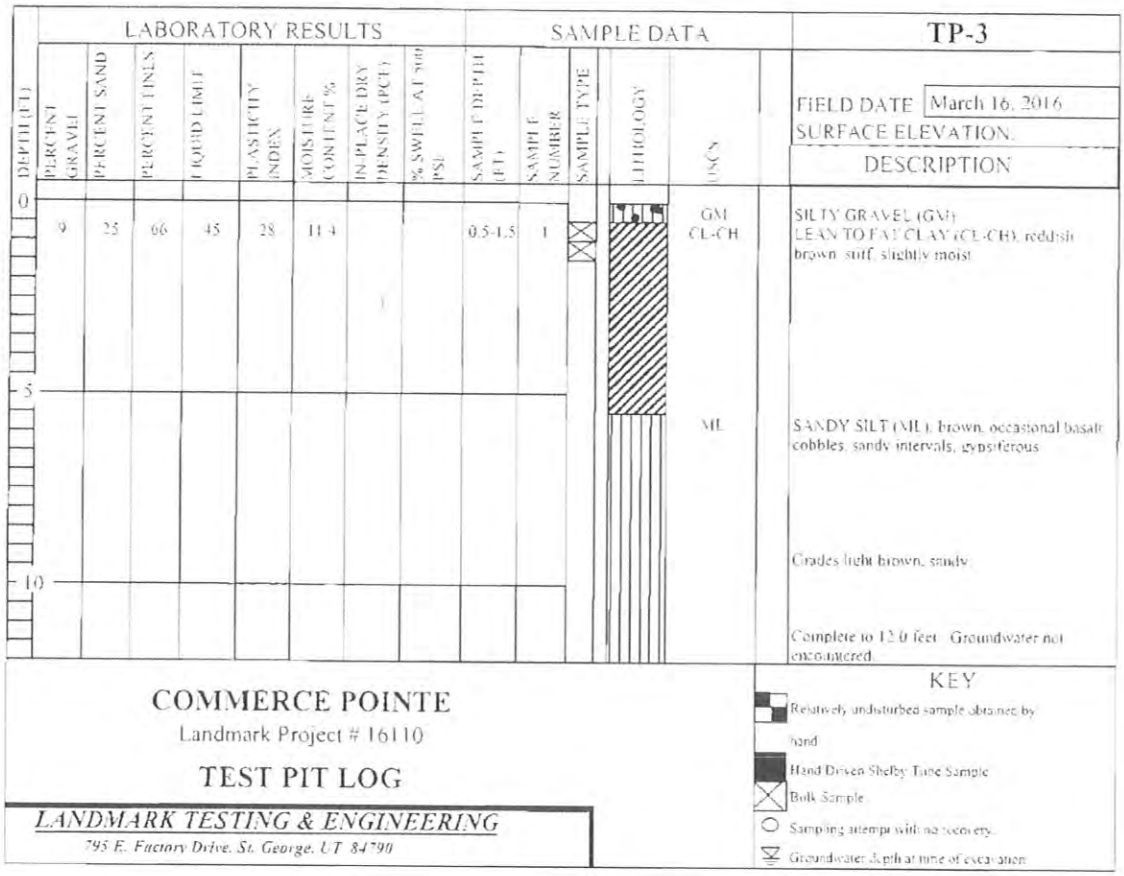

LABORATORY RESULTS
SAMPLE DATA
TP-2
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 1,000 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE: March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
CL
LEAN CLAY (CL), reddish brown, gravel at surface, medium stiff to stiff, slightly moist.
Grades less plastic, with abundant gypsum stringers
Grades more plastic, moist to very moist
CL-CH
LEAN TO FAT CLAY (CL-CH), purple, mottled, moist. Complete to 11.0 feet. Groundwater not encountered.
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hand Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

FIGURE 3


LABORATORY RESULTS
SAMPLE DATA
TP-3
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
9
25
66
45
28
11.4
0.5-1.5
1
GM
CL-CH
SILTY GRAVEL (GM)
LEAN TO FAT CLAY (CL-CH), reddish brown, stiff, slightly moist
5
ML
SANDY SILT (ML), brown, occasional basalt cobbles, sandy intervals, gypsiferous
Grades light brown, sandy
10
Complete to 12.0 feet. Groundwater not encountered.
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hand Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

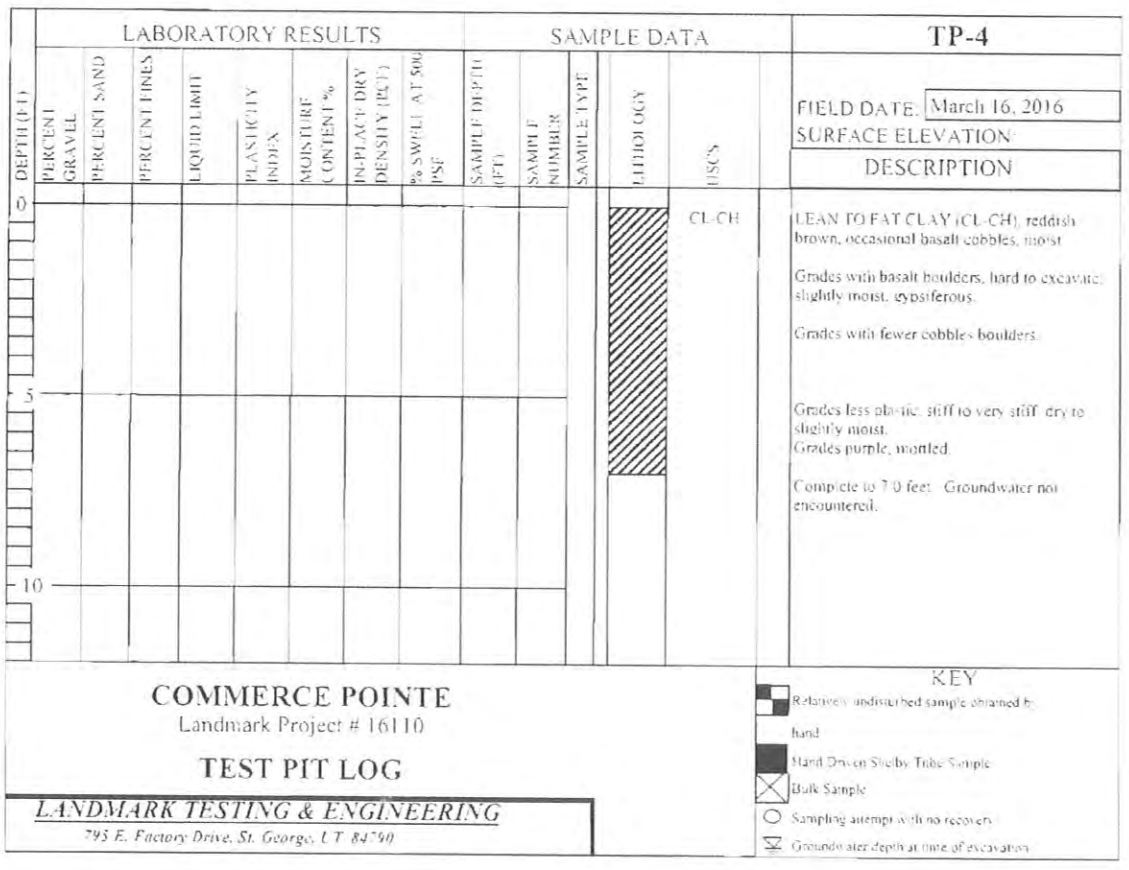
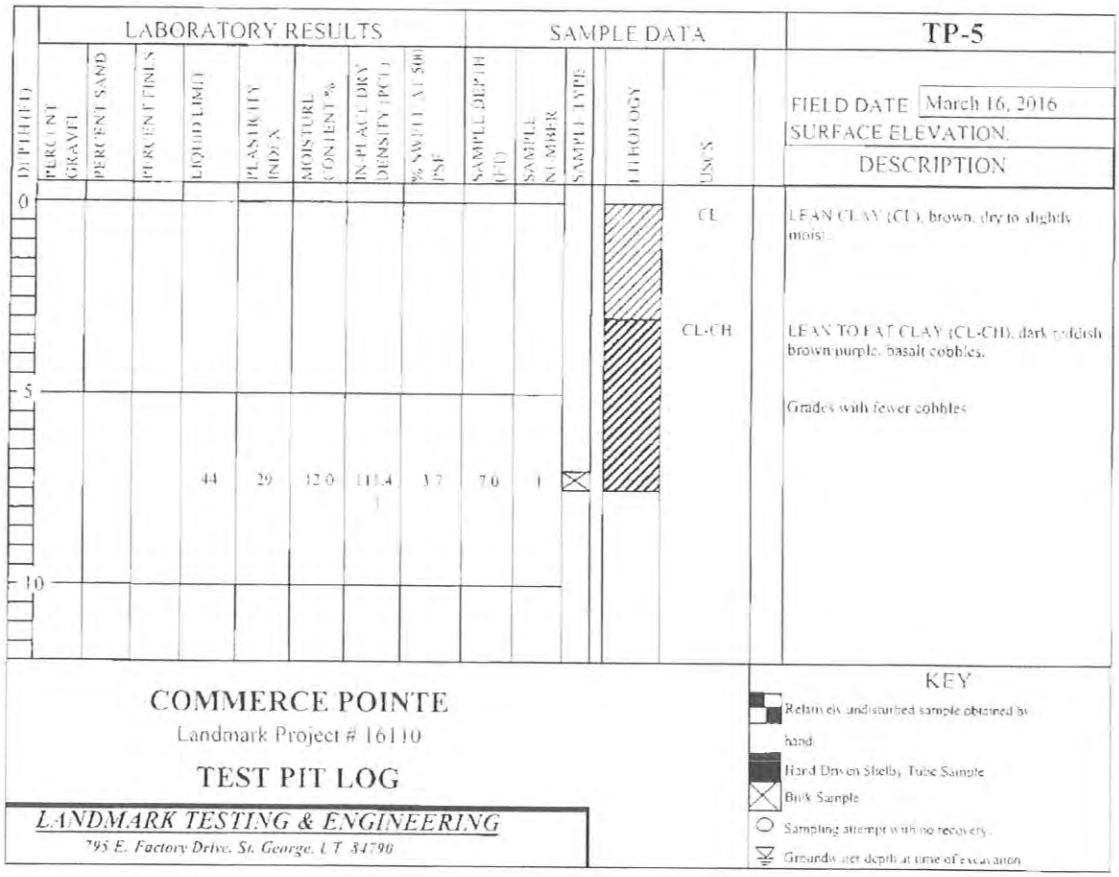

LABORATORY RESULTS
SAMPLE DATA
TP-4
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE: March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
CL-CH
LEAN TO FAT CLAY (CL-CH), reddish brown, occasional basalt cobbles, moist
Grades with basalt boulders, hard to excavate, slightly moist, gypsiferous.
Grades with fewer cobbles/boulders.
5
Grades less plastic, stiff to very stiff, dry to slightly moist.
Grades purple, mottled.
Complete to 7.0 feet. Groundwater not encountered.
10
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hand Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

FIGURE 4


LABORATORY RESULTS
SAMPLE DATA
TP-5
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE: March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
CL
CL-CH
LEAN CLAY (CL), brown, dry to slightly moist.
LEAN TO FAT CLAY (CL-CH), dark reddish brown/purple, basalt cobbles.
Grades with fewer cobbles
44
29
12.0
111.4
3.7
7.0
1
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hard Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

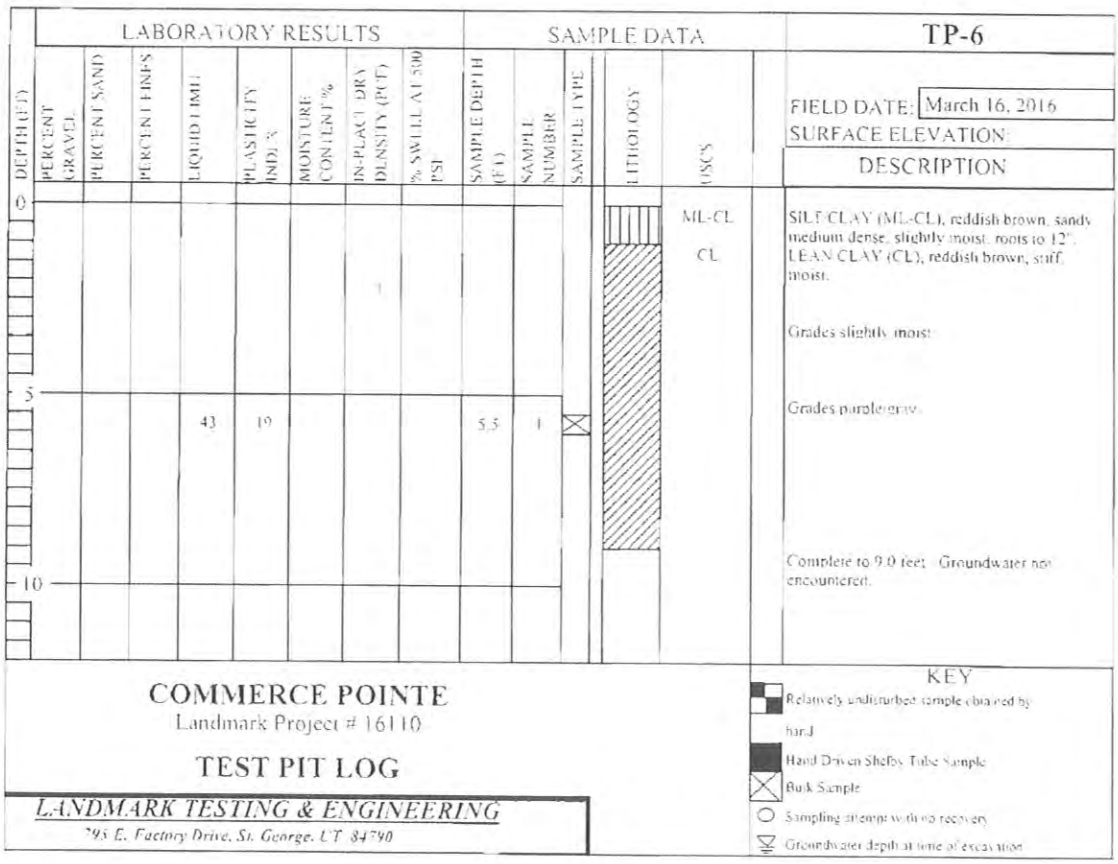
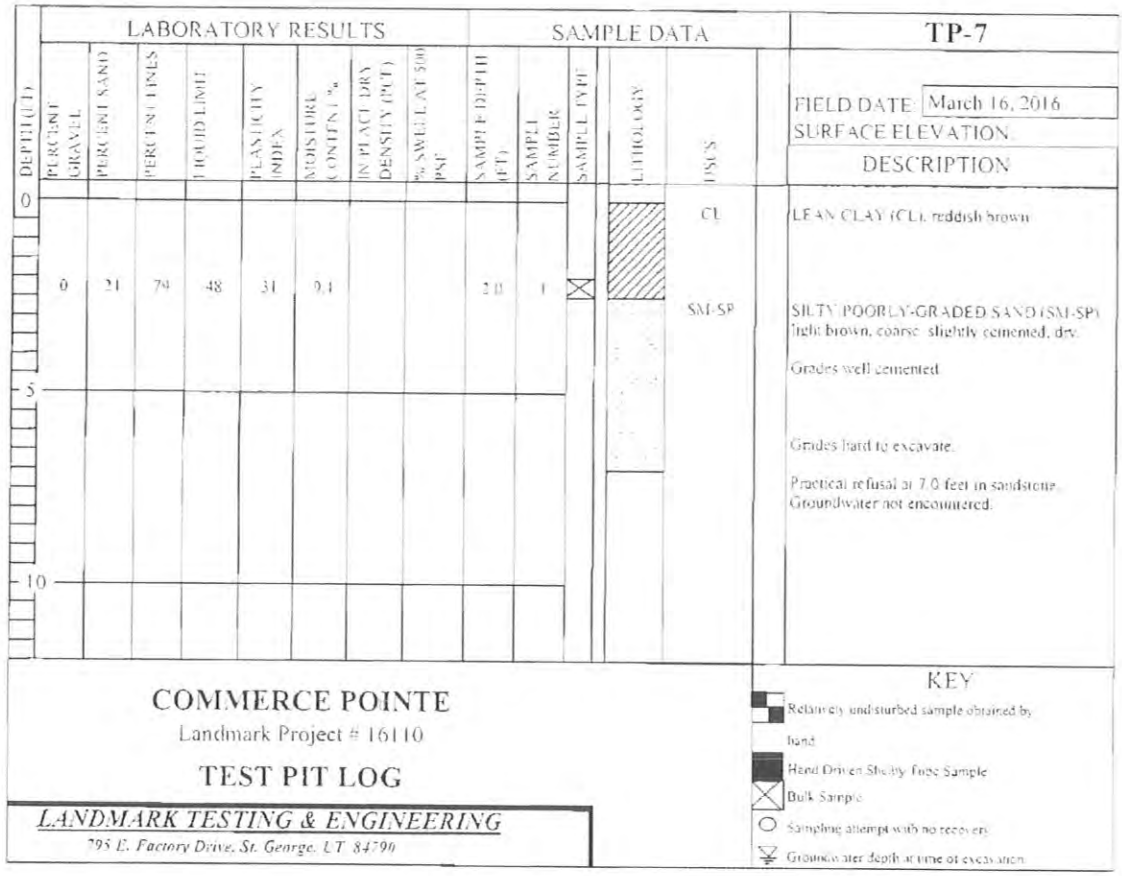

LABORATORY RESULTS
SAMPLE DATA
TP-6
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE: March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
ML-CL
CL
SILT/CLAY (ML-CL), reddish brown, sandy, medium dense, slightly moist, roots to 12".
LEAN CLAY (CL), reddish brown, stiff, moist.
Grades slightly moist
Grades purple/gray
Complete to 9.0 feet. Groundwater not encountered.
43
19
5.5
1
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hard Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

FIGURE 5


LABORATORY RESULTS
SAMPLE DATA
TP-7
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE: March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
0
21
79
48
31
9.1
2.0
1
CL
SM-SP
LEAN CLAY (CL), reddish brown
SILTY POORLY-GRADED SAND (SM-SP), light brown, coarse, slightly cemented, dry.
Grades well cemented.
Grades hard to excavate.
Practical refusal at 7.0 feet in sandstone.
Groundwater not encountered.
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hand Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

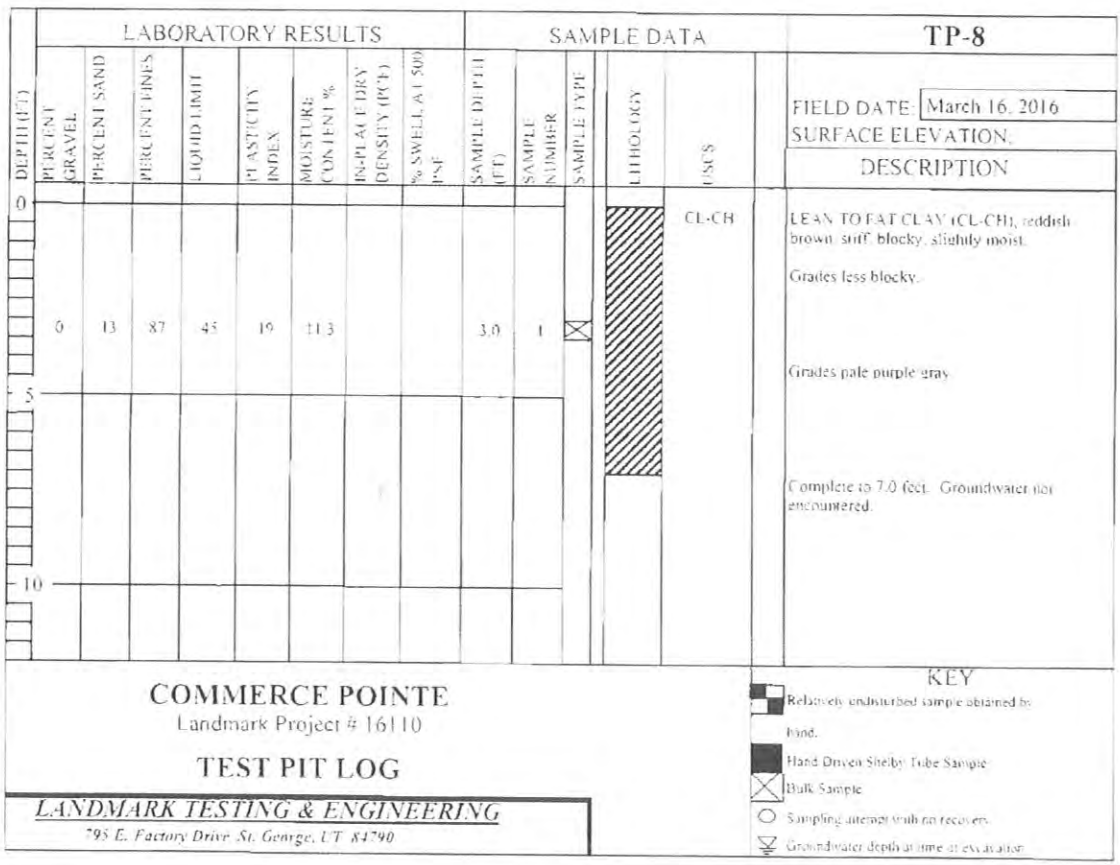
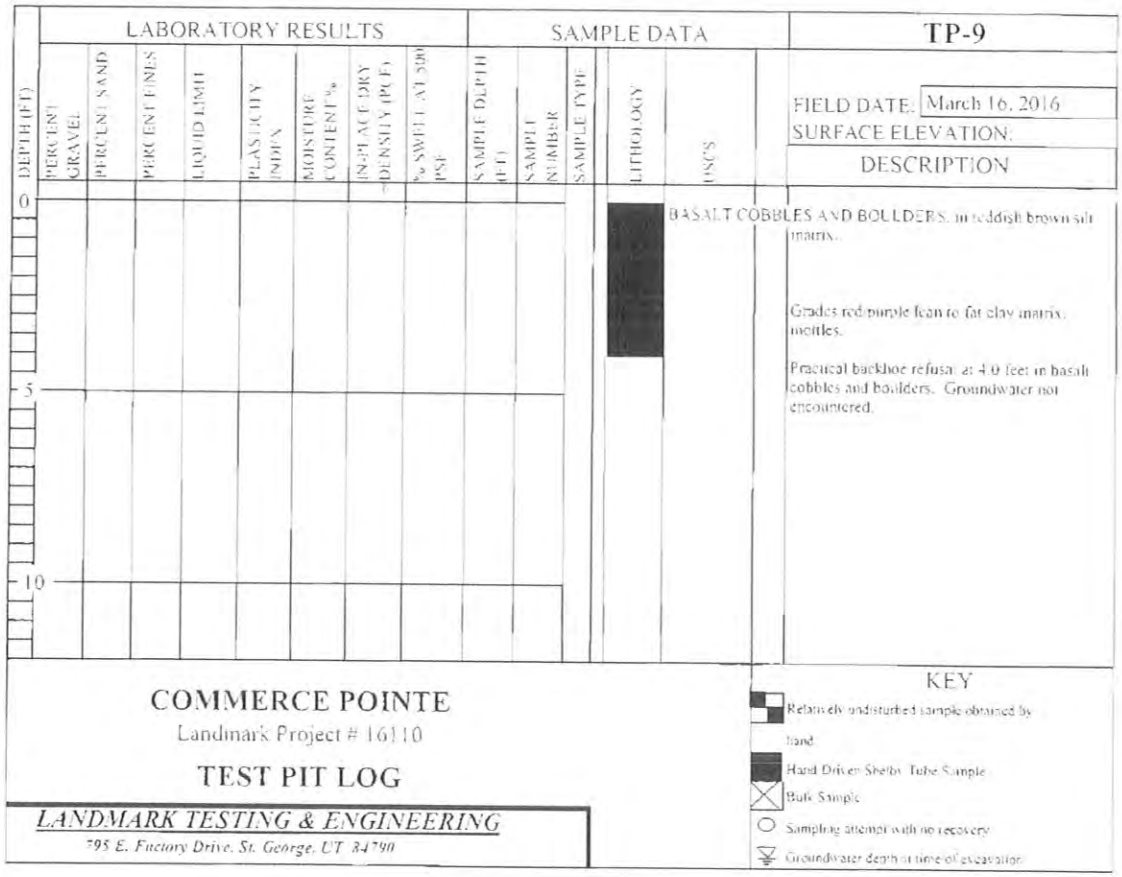

LABORATORY RESULTS
SAMPLE DATA
TP-8
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE: March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
0
13
87
45
19
11.3
3.0
1
CL-CH
LEAN TO FAT CLAY (CL-CH), reddish brown, stiff, blocky, slightly moist.
Grades less blocky.
Grades pale purple gray.
Complete to 7.0 feet. Groundwater not encountered.
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand.
Hand Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

FIGURE 6


LABORATORY RESULTS
SAMPLE DATA
TP-9
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE: March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
BASALT COBBLES AND BOULDERS, in reddish brown silt matrix.
Grades red/purple lean to fat clay matrix; mottles.
Practical backhoe refusal at 4.0 feet in basalt cobbles and boulders. Groundwater not encountered.
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hand Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

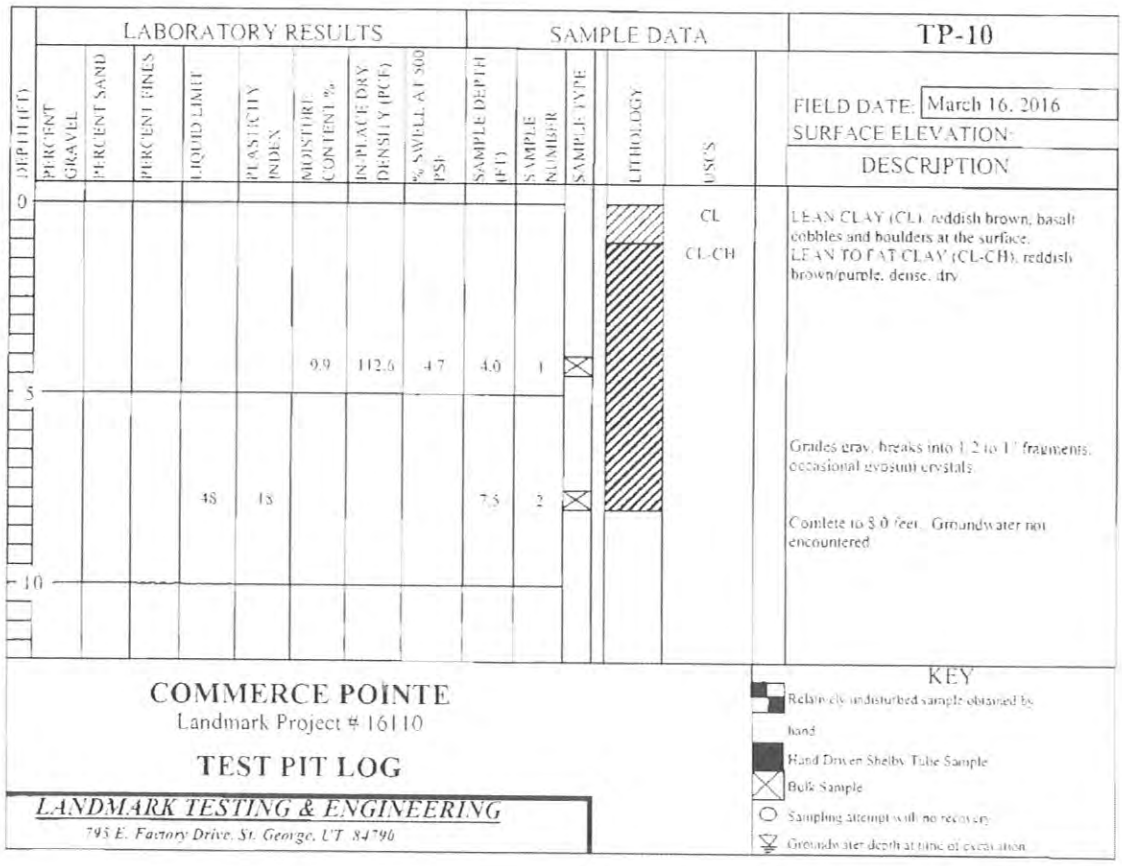
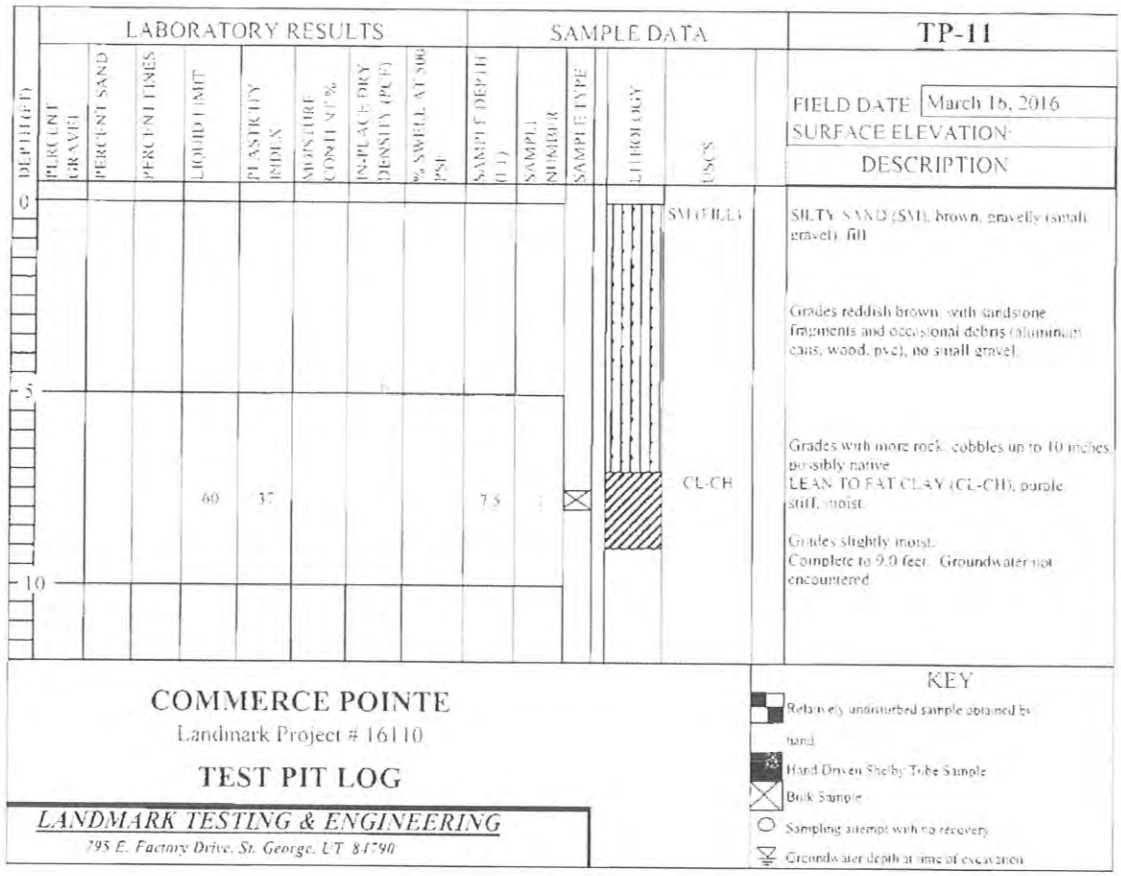

LABORATORY RESULTS
SAMPLE DATA
TP-10
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE: March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
CL
CL-CH
9.9
112.6
4.7
4.0
1
48
18
7.5
2
LEAN CLAY (CL), reddish brown; basalt cobbles and boulders at the surface.
LEAN TO FAT CLAY (CL-CH), reddish brown/purple; dense; dry.
Grades gray; breaks into 1/2 to 1" fragments; occasional gypsum crystals.
Complete to 8.0 feet. Groundwater not encountered.
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hand Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

FIGURE 7


LABORATORY RESULTS
SAMPLE DATA
TP-11
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
60
37
7.5
SM-FILL
CL-CH
SILTY SAND (SM), brown, gravelly (small gravel), fill
Grades reddish brown, with sandstone fragments and occasional debris (aluminum cans, wood, pvc), no small gravel.
Grades with more rock, cobbles up to 10 inches, possibly native
LEAN TO FAT CLAY (CL-CH), purple, stiff, moist.
Grades slightly moist.
Complete to 9.0 feet. Groundwater not encountered.
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hand Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

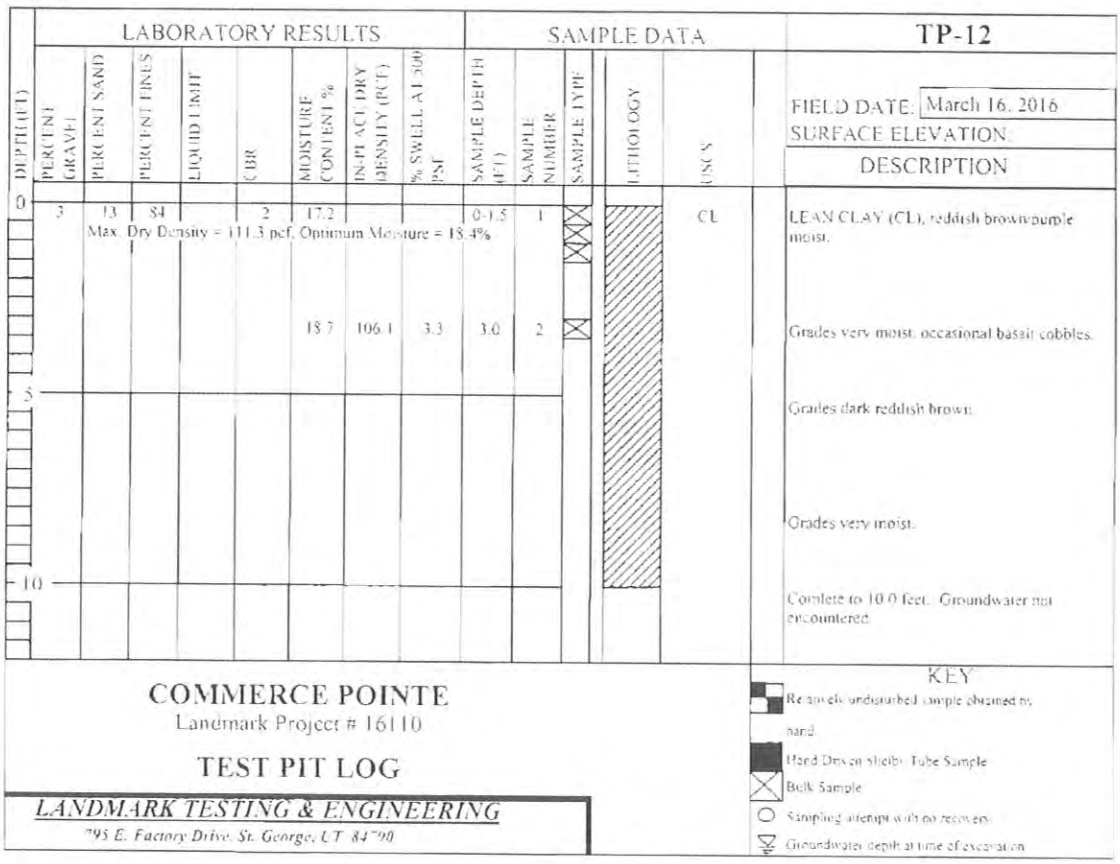
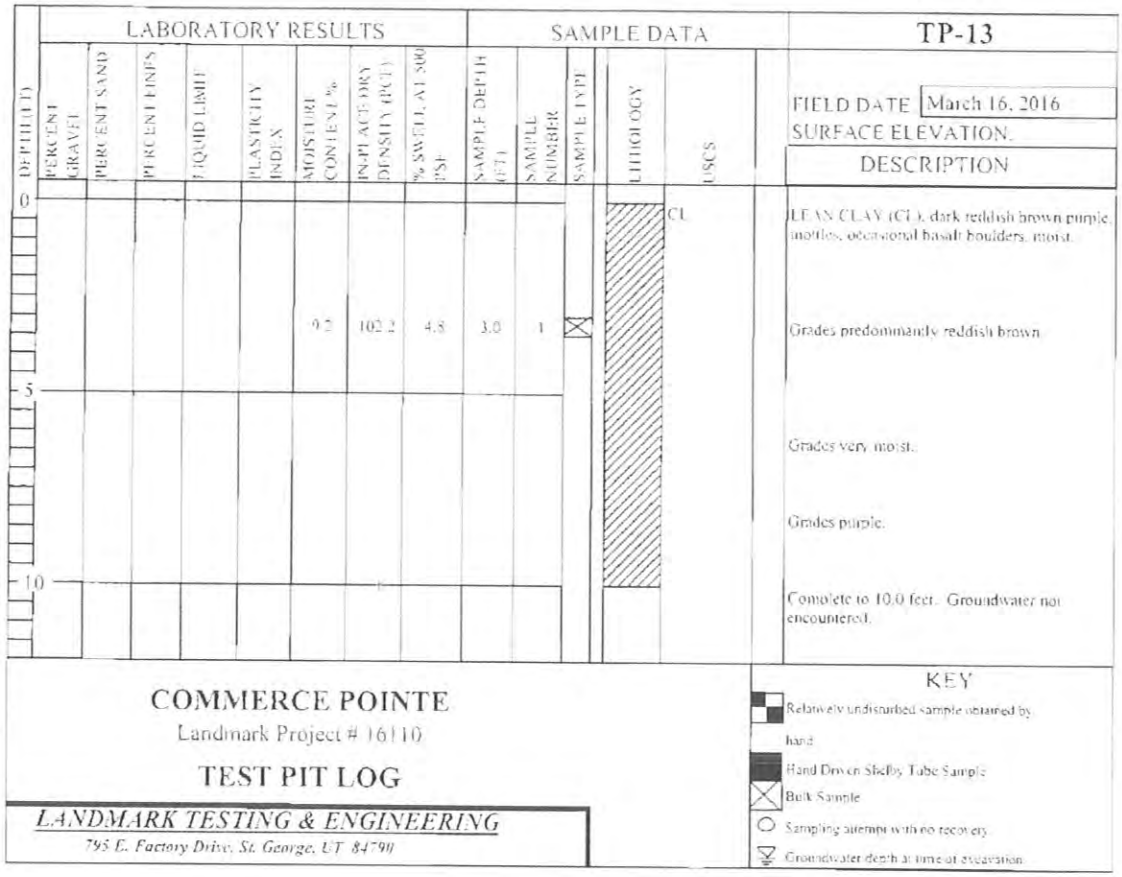

LABORATORY RESULTS
SAMPLE DATA
TP-12
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
CBR
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE: March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
3
13
84
2
17.2
0-1.5
1
CL
Max. Dry Density = 111.3 pcf, Optimum Moisture = 18.4%
18.7
106.1
3.3
3.0
2
LEAN CLAY (CL), reddish brown/purple, moist.
Grades very moist, occasional basalt cobbles.
Grades dark reddish brown.
Grades very moist.
Complete to 10.0 feet. Groundwater not encountered.
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hard Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

FIGURE 8


LABORATORY RESULTS
SAMPLE DATA
TP-13
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
9.2
102.2
4.8
3.0
1
CL
LEAN CLAY (CL), dark reddish brown purple, inorites, occasional basalt boulders, moist.
Grades predominantly reddish brown.
Grades very moist.
Grades purple.
Complete to 10.0 feet. Groundwater not encountered.
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hand Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

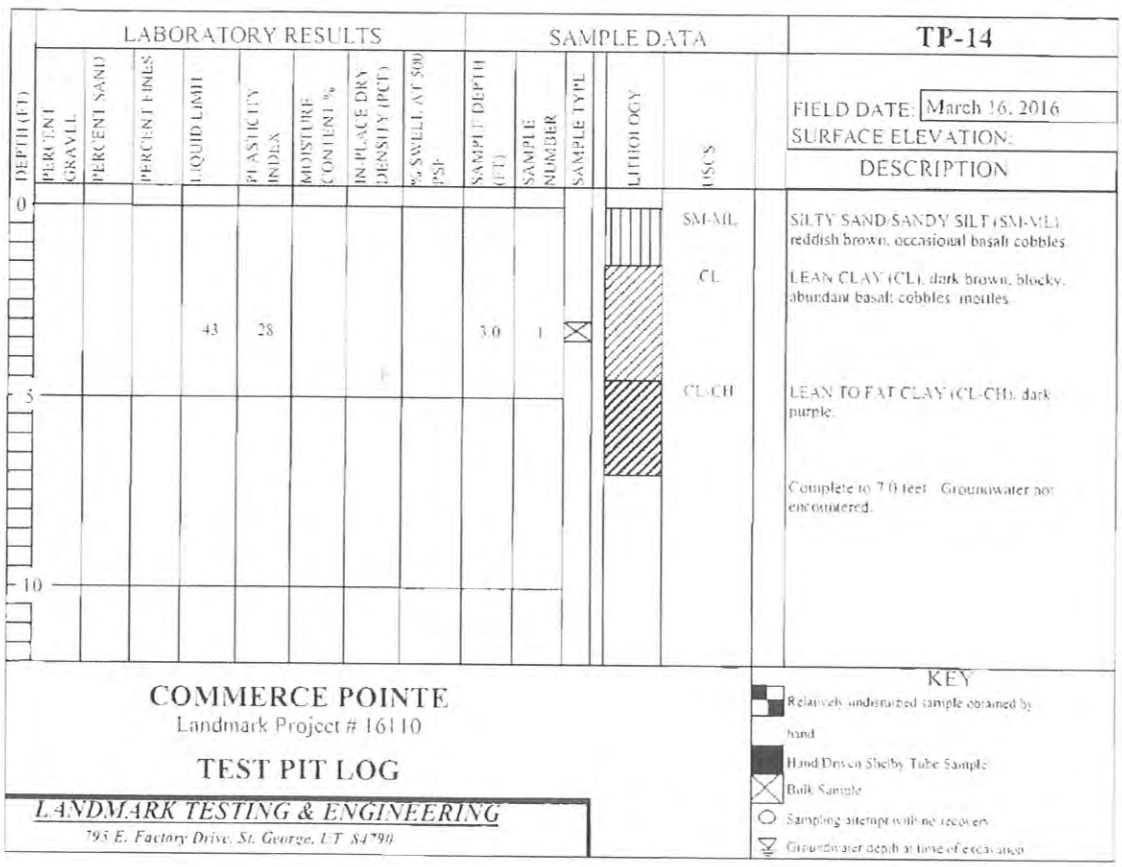

LABORATORY RESULTS
SAMPLE DATA
TP-14
DEPTH (FT)
PERCENT GRAVEL
PERCENT SAND
PERCENT FINES
LIQUID LIMIT
PLASTICITY INDEX
MOISTURE CONTENT %
IN-PLACE DRY DENSITY (PCF)
% SWELL AT 500 PSF
SAMPLE DEPTH (FT)
SAMPLE NUMBER
SAMPLE TYPE
LITHOLOGY
USCS
FIELD DATE: March 16, 2016
SURFACE ELEVATION:
DESCRIPTION
0
5
10
43
28
3.0
1
SM-ML
CL
CL-CH
SILTY SAND/SANDY SILT (SM-ML) reddish brown, occasional basalt cobbles.
LEAN CLAY (CL), dark brown, blocky, abundant basalt cobbles/ inorites.
LEAN TO FAT CLAY (CL-CH), dark purple.
Complete to 7.0 feet. Groundwater not encountered.
COMMERCE POINTE
Landmark Project # 16110
TEST PIT LOG
LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790
KEY
Relatively undisturbed sample obtained by hand
Hand Driven Shelby Tube Sample
Bulk Sample
Sampling attempt with no recovery
Groundwater depth at time of excavation

FIGURE 9

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (More than 1/2 of soil > No.200 sieve size)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size)	GW	Well graded gravels or gravel-sand mixtures little or no fines
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction < No. 4 sieve size)	SW	Well graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than 1/2 of soil < No.200 sieve size)	SILTS & CLAYS Liquid Limit <50	ML	Inorganic silts and very fine sands, rock flour, silty fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandys clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit >50	MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

GRAIN SIZE CHART		
CLASSIFICATION	RANGE OF GRAIN SIZE	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL	3" to No.4	76.2 to 4.76
Coarse	3" to ¾"	76.2 to 19.1
Fine	¾" to No.4	19.1 to 4.76
SAND	No.4 to No.200	4.76 to 0.074
Coarse	No.4 to No.10	4.76 to 2.00
Medium	No.10 to No.40	2.00 to 0.420
Fine	No.40 to No.200	0.420 to 0.074
SILT & CLAY	Below No.200	Below 0.074

Hardness of Rock	
Descriptive Term	Characteristics
Moderately Hard	Can be scratched with a knife with light to moderate pressure; breaks with moderate hammer blow
Hard	Can be scratched with a knife with difficulty; can be broken with heavy hammer blow
Very Hard	Cannot be scratched with a knife; can only be broken with repeated heavy hammer blows.

LANDMARK TESTING & ENGINEERING

SOIL CLASSIFICATION

FIGURE 10

LANDMARK TESTING AND ENGINEERING

COLLAPSE/SWELL CURVE

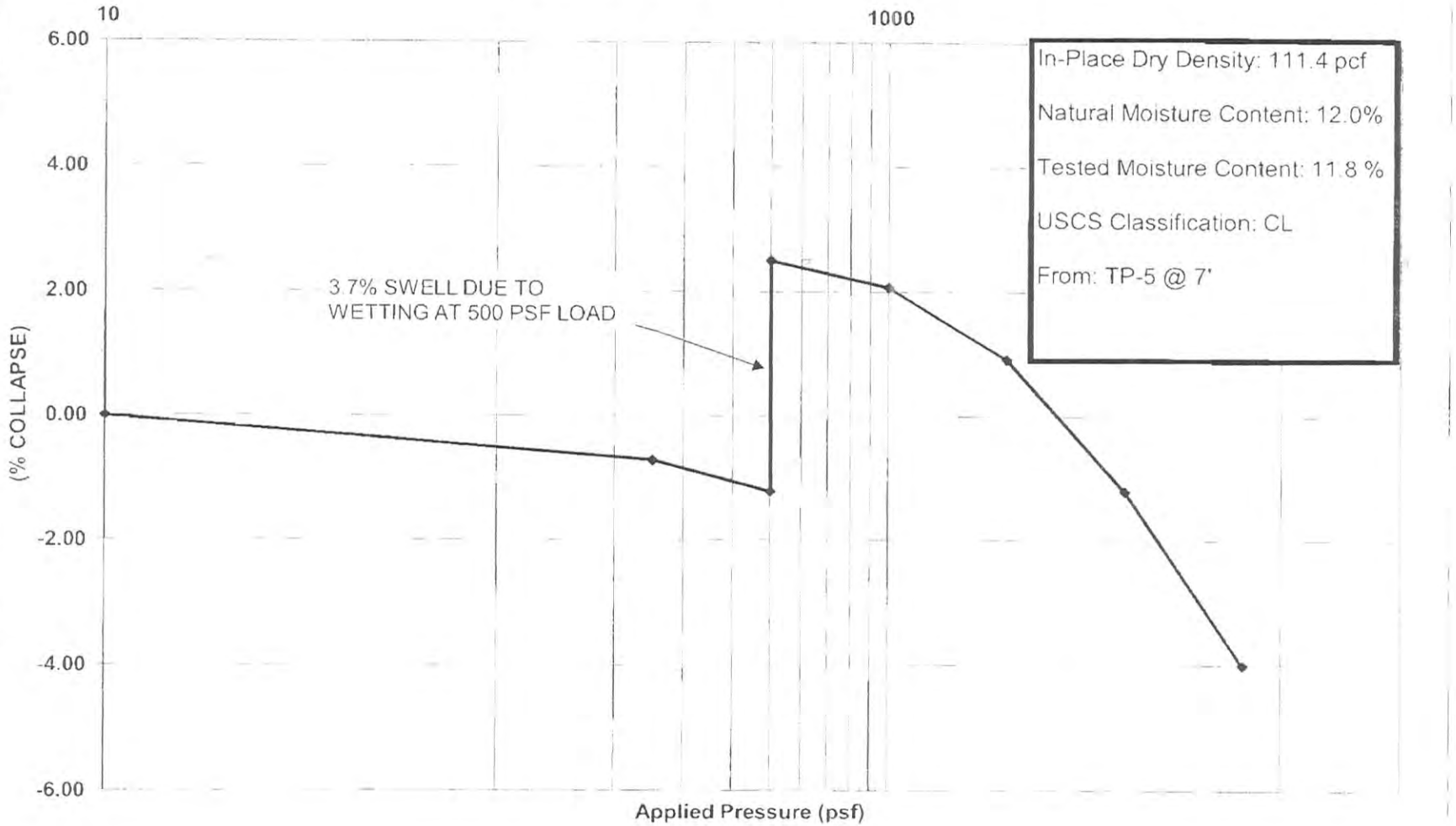


FIGURE 11

LANDMARK TESTING AND ENGINEERING

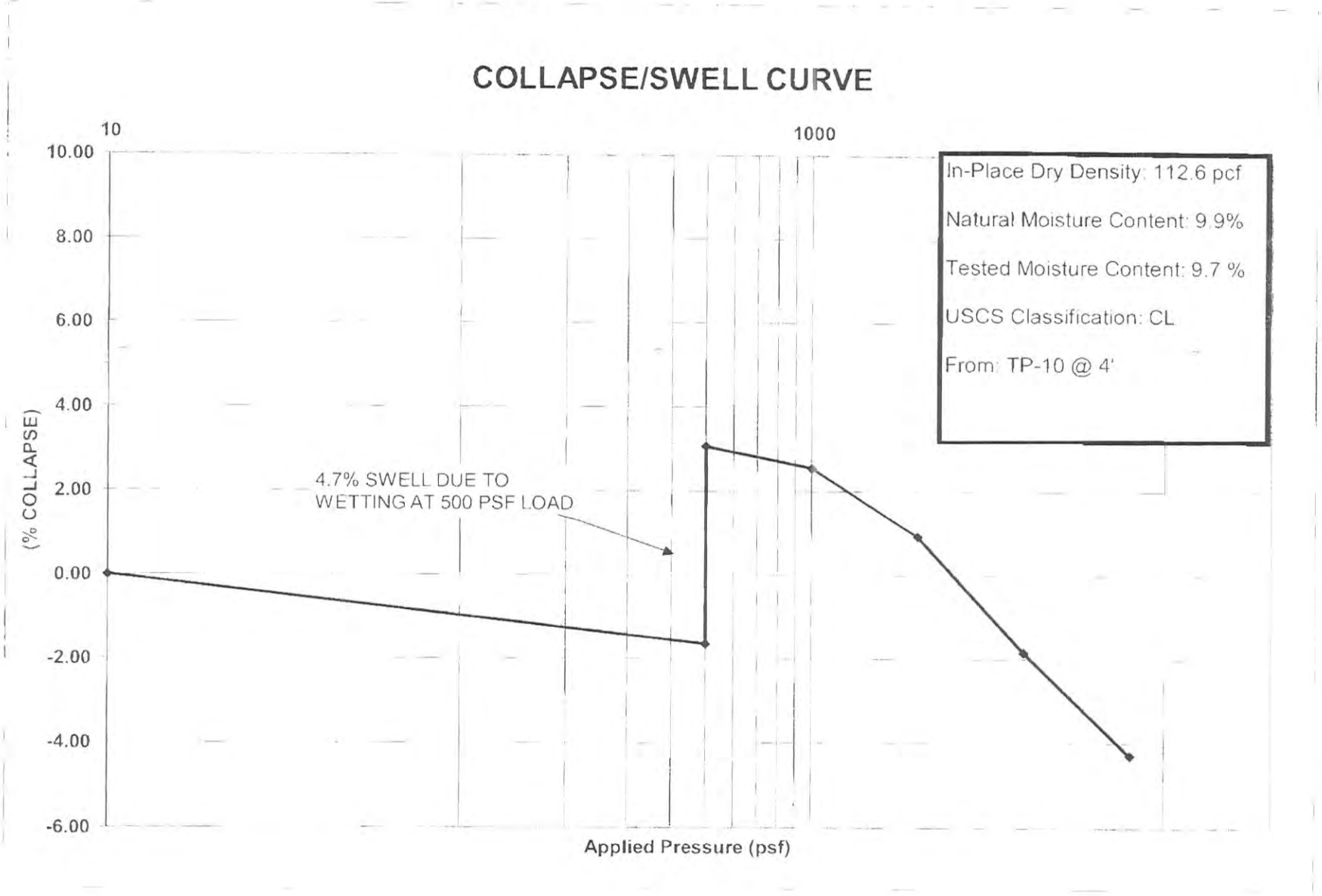


FIGURE 12

LANDMARK TESTING AND ENGINEERING

COLLAPSE/SWELL CURVE

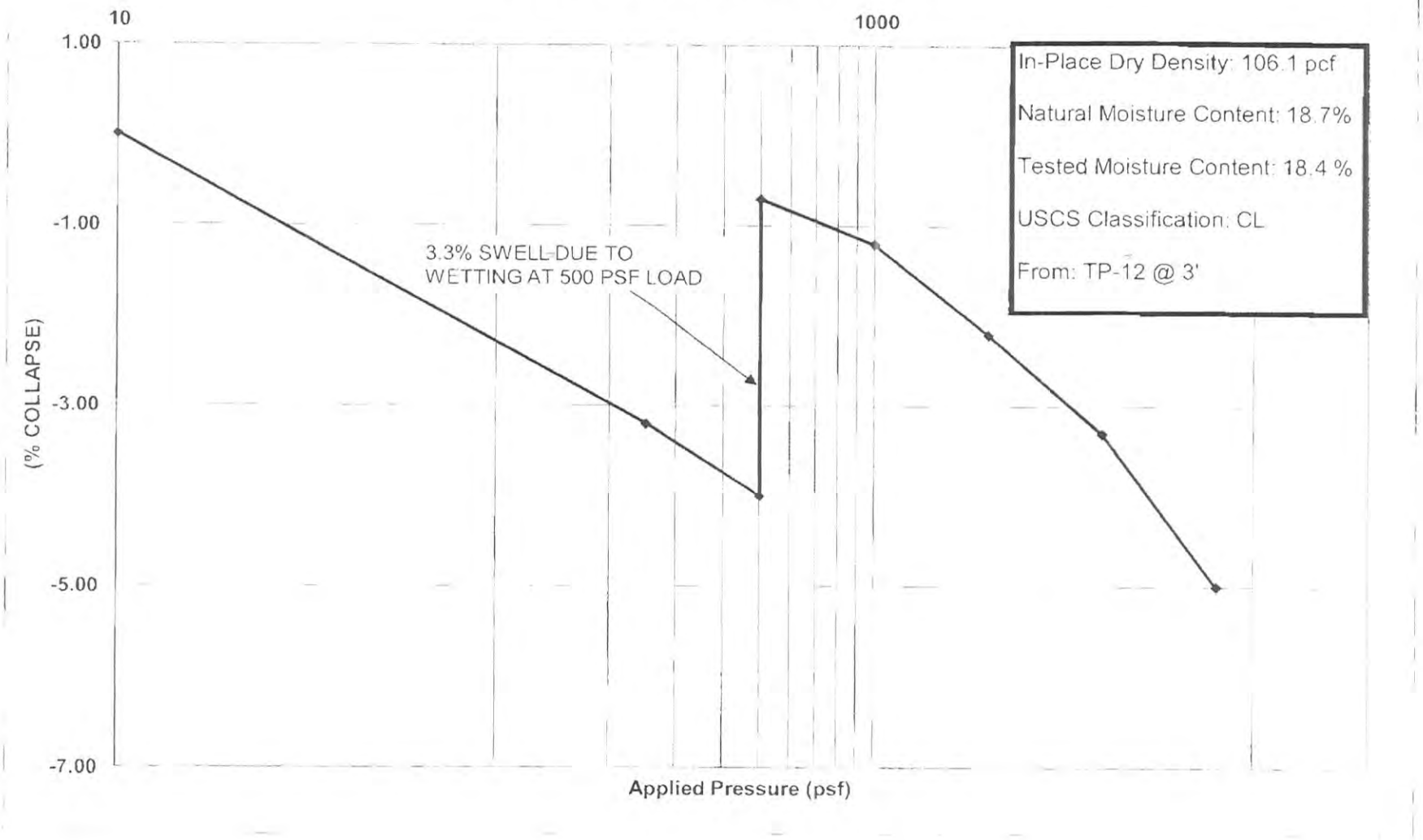


FIGURE 13

LANDMARK TESTING AND ENGINEERING

COLLAPSE/SWELL CURVE

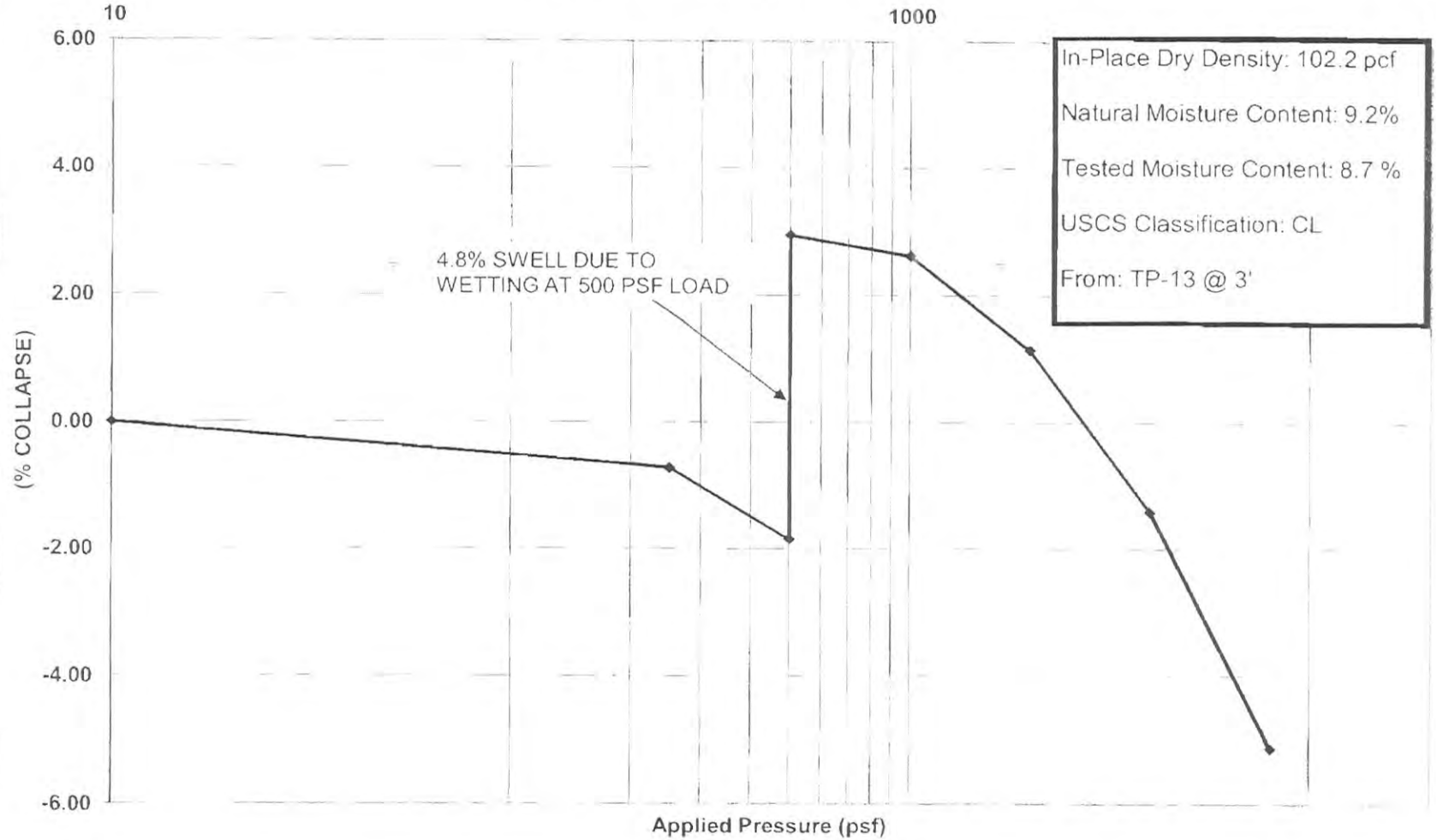


FIGURE 14

TABLE 1
LABORATORY TEST SUMMARY

Project: Commerce Pointe Shopping Center Project No. 16110
Client: JMI Development

BORING/ TEST PIT NO.	DEPTH BELOW GROUND SURFACE (ft.)	MOISTURE CONTENT (%)	IN-PLACE DRY DENSITY (PCF)	% SWELL at 500 psf	MAX. DRY DENSITY (PCF)	OPTIMUM MOISTURE (%)	CBR (%)	WATER SOLUBLE SULFATES (%)	ATTERBERG LIMITS		MECHANICAL ANALYSIS			USCS GROUP SYMBOL
									LIQUID LIMIT (%)	PLASTICITY INDEX (%)	GRAVEL (%)	SAND (%)	SILT & CLAY (%)	
TP-1	3.0							1.39	43	19				CL
	7.5	6.7									10	64	26	SM
TP-3	0.5-1.5	11.4							45	28	9	25	66	CL
TP-5	7.0	12.0	111.4	3.7					44	29				CL
TP-6	5.5								43	19				CL
TP-7	2.0	9.1							48	31	0	21	79	CL
TP-8	3.0	11.3							45	19	0	13	87	CL
TP-10	4.0	9.9	112.6	4.7										CL
	7.5								48	18				ML
TP-11	7.5								60	37				CH
TP-12	0-1.5	17.2			111.3	18.4	2.0				3	13	84	CL
	3.0	18.7	106.1	3.3										CL
TP-13	3.0	9.2	102.2	4.8										CL
TP-14	3.0								43	28				CL

Figure 15

Exhibit E
Grading Report

GRADING RECOMMENDATIONS
- REVISED -

For

COMMERCE POINTE SHOPPING CENTER - WEST PHASE
BUILDING PADS 1 THROUGH 4
SOUTHWEST CORNER OF BLACK RIDGE DRIVE AND HILTON DRIVE
ST. GEORGE, UTAH

Prepared for:

MR. STEVE JENNINGS
JENNINGS MANAGEMENT, INC.
335 EAST ST. GEORGE BLVD., SUITE 301
ST. GEORGE, UT 84770

Prepared by:

GEOTECHNICAL TESTING SERVICES, INC.
1509 SOUTH 270 EAST, SUITE 8
ST. GEORGE, UT 84790
TELEPHONE (435) 628-9536
FAX (435) 628-9589

GTS PROJECT NUMBER 18535

APRIL 20, 2022

Geotechnical Testing Services Inc.

REGISTERED PROFESSIONAL ENGINEER
#344111
CHRISTOPHER D. VOLKSEN
4/21/2022
STATE OF UTAH

Christopher D. Volksen, P.E.
President

GEOTECHNICAL TESTING SERVICES, INC.
735 East Tabernacle Street; St. George, UT 84770
(435) 628-9536 admin@gtsstg.com

April 20, 2022

Mr. Steve Jennings
Jennings Management, Inc.
335 East St. George Blvd., Suite 301
St. George, UT 84770

Subject: Grading Recommendations - Revised
Proposed Commerce Pointe Shopping Center - West Phase
Southwest Corner of Black Ridge Drive and
Hilton Drive
St. George, Utah
GTS Project Number 18535

Dear Mr. Jennings:

We have revised our grading recommendation for the proposed west phase of the Commerce Pointe Shopping Center that will include the rough grading of Building Pads 1, 2, 3 and 4 to be located at the above noted address. A Grading Recommendations report, GTS Project Number 18535, dated March 10, 2020 was prepared for this site; however, the St. George City hillside committee asked that the report be revised to reflect the newest grading plan prepared for the subdivision. Details of our findings and recommendations, along with the supporting field and laboratory data, are presented in the attached report.

To investigate the subsurface soils, 5, 15.3 to 30.3-foot deep test holes were drilled and 3, 8- to 20-foot deep test pits were excavated near the proposed building sites. The subsurface soils encountered generally consisted of clayey and silty sand (SC and SM) and sandy clays (CL) over claystone and sandstone bedrock. Groundwater was not encountered in our test holes at the time of our investigation.

The building pads can be constructed and cut slopes can be excavated on the site to rough grade as proposed on the grading plan.

We appreciate the opportunity to be of service to you on this project. Please call us if you have any questions or need additional information.

Very truly yours,
GEOTECHNICAL TESTING SERVICES, INC.

CHRISTOPHER D. VOLKSEN, P.E.
President

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APPENDIX A: FIELD EXPLORATION, VICINITY MAP, SITE PLAN, AND LOG OF TEST HOLES AND TEST PITS

APPENDIX B: LABORATORY TEST PROCEDURES AND RESULTS

APPENDIX C: RETAINING WALL DESIGN

INTRODUCTION

This report presents the results of our investigation to determine the grading recommendations conducted for the West Phase of the proposed Commerce Pointe Shopping Center to be constructed at the southwest corner of Black Ridge Drive and Hilton Drive in St. George, Utah. The general location of the site is shown on the Vicinity Map presented in Appendix A, Figure A-1.

The purpose of our investigation was to characterize the subsurface soil and groundwater conditions within the site, to provide recommendations for the rough grading of the site, recommendations and the design of retaining walls, and other design and construction considerations influenced by the subsurface conditions. It should be noted that the purpose of our report is not to provide geotechnical recommendations for the building pads at this time; geotechnical recommendations will be provide at a later date once tenants have been decided on and the exact building type and purpose has been determined.

We have previously conducted a Geotechnical Investigation for the adjoining North Phase of the Commerce Pointe Shopping Center which was reported under our Project Number 18535, dated July 28, 2017 and the Southeast Phase which was reported under our Project Number 18535, dated December 6, 2018. We have also reviewed a Geotechnical Investigation Report performed by Landmark Testing and Engineering, Project Number 16110, dated May 6, 2016; the subject parcel was included as part of that report. We also reviewed the Geotechnical Engineering Study prepared for the Proposed Maverick Country Store performed by CMT Engineering Laboratories, Project Number 9661, dated May 17, 2017. The proposed Maverick Country Store is located within the Commerce Point Shopping Center but is located in the North Phase.

As part of determining the stability analysis for the site, we published our Summary of Slope Stability Analysis for the western facing slope, GTS Project Number 18535, dated March 22, 2022.

The investigation included site reconnaissance, subsurface exploration and soil sampling, laboratory testing, engineering analysis, client consultation, and preparation of this report. The information found in the above referenced reports was also used to develop the recommendations found in this report.

PROPOSED DEVELOPMENT

We understand that the proposed development will include 4 to 5 building pads as shown on Figure A-2. The owner of the property indicated that Building Pad 5 might not be constructed, a decision on this building will be made at a later date. It is our understanding that the owner wishes to rough grade the site which will include installing retaining walls along the east side of the property line, leveling the pads to within a couple of feet of finished grade, and bringing the parking lot up to approximate subgrade elevations. The purpose of rough grading the site is to help potential tenants see the conceptual layout of the shopping center. The buildings pads will be on the order of 9,500 to 50,000 square feet in overall size. Building pad elevations along with the anticipated cut and fill can be found in Table 1.

TABLE 1
Proposed Building Pad Elevations

Building Pad Number	Proposed Pad Elevation (ft)	Minimum Cut Under Building* (ft)	Maximum Fill Under Building** (ft)
1	2613	17	-1
2	2608	16	-11
3	2601	27	6
4	2599	13	13
5	2598	-6	18

* A negative number indicates that the building is entirely on fill and the number indicates the minimum amount of fill that the building rests on.

** A negative number indicates that the building is entirely on cut and the number indicates the minimum amount of cut that the building rests on.

As part of the site grading, driveway and parking lot areas will be developed between the building pads. We were provided a grading plan for the project, "Commerce Point West Shopping Center - Enlarged Grading - West Side" by L.R. Pope Engineering, Inc., plan dated June 2016, stamped dated April, 19, 2022. Fills along the eastern portion of the site will be on the order of 12

to 14 feet. Retaining walls will be constructed along the eastern property line to bring the site up to the proposed grades. Cut slopes on the order of 2:1 will be made along the western side of the property. The proposed buildings will have 6- to 10-foot high retaining wall(s) at the west side of the buildings, however, these retaining walls will not be constructed at this time.

SITE CONDITIONS

At the time of our investigation, the site was vacant of any structure. The site generally consists of raw ground with the exception of some end dumped fill material that was recently placed as part of grading operations on other phases of the Commerce Pointe development. Sections or an abandoned concrete lined irrigation canal runs diagonally across the center of the site at a rough elevation of 2590 feet. The ground surface along the site generally slopes down to the southeast with an elevation drop of about 60 feet. The eastern portion of the site slopes up to the west with angles of about 21:1 (horizontal:vertical). The western portions of the site slopes up to the west with angle of about 4.5:1. Surface drainage appears to be fair. The ground surface is covered with basalt boulders and cobbles where not covered with end-dumped soil. The site is bound by Black Ridge Drive to the north and west, by Hilton Drive and the Crystal Inn Motel to the east, and by Crystal Inn and 1450 South Street to the south.

GEOLOGIC CONDITIONS

The proposed development lies within the St. George Basin, which is a complex geological region consisting of alluvial and lava flows, bedrock out-croppings, and wind blown deposits. The St. George Basin is bound by the Hurricane Cliff to the east, the Beaver Dam Mountains to the west, Pine Valley Mountain to the north, and extends south into Arizona. The Virgin River flows westerly through the basin, and is the primary drainage for the region.

Three prominent faults, with suspected Quaternary displacement, trend generally north-south along the western, central, and eastern portions of the St. George Basin. These are the Grand Wash Fault, Washington Fault, and the Hurricane Faults, respectively. Of these, the Hurricane Fault is the most active, and lies to the east about 15 miles to the east of the site. The Gunlock Fault lies approximately 11 miles to the west. The Washington Fault lies about 5 miles to the east. The

location of the faults with respect to the site is not anticipated to impact the development. We did not observe any surface faulting/rupturing within the subdivision during our field investigation nor during any subsequent visits.

The Utah Geological Survey's web site was accessed and reviewed on April 20, 2022 (https://geology.utah.gov/apps/integeomap/#). The following geologic members were shown on the map:

Qaeo: Older alluvial and eolian deposits. Moderately sorted gravel, sand, and silt deposited in small channels and on alluvial flats, and well-sorted, fine- to medium-grained, reddish-brown eolian sand locally reworked by alluvial processes; younger deposits (Qae) form active depositional surfaces, whereas older deposits (Qaeo) typically form incised, inactive surfaces; as much as about 20 feet (6 m) thick.

QMS: Landslide deposits. Poorly sorted, clay- to boulder-size, locally derived material deposited by rotational and translational landslide movement; characterized by hummocky topography and small ponds, numerous internal scarps, and chaotic bedding attitudes; basal slip surfaces most commonly form in the Shnabkaib Member of the Moenkopi Formation, the Petrified Forest Member of the Chinle Formation, the Co-op Creek Limestone Member of the Carmel Formation, the Dakota Formation, and the upper unit of the Straight Cliffs Formation, and the slides incorporate these and overlying map units; the Petrified Forest Member and Dakota Formation especially form large, complex mass movements; undivided as to inferred age because new research shows that even landslides with subdued morphology (suggesting that they are older, weathered, and may have not experienced large-scale movement recently) may continue to exhibit slow creep or are capable of renewed movement if stability thresholds are exceeded (Ashland, 2003); generally several tens of feet thick, but some deposits may exceed 200 feet (60 m) thick.

The soils encountered in our subsurface investigation correlated fairly well the Geology Map. The slide deposits were relatively thin and the bedrock below the slide deposits was part of the Chinle Formation, but again the slide deposits were only a few feet thick and may be alluvial deposits from the western slopes. There is a known landslide located just east of the site; however, our investigation did not reveal evidence of the landslide debris.

SUBSURFACE SOIL CONDITIONS

To investigate the subsurface soils, five15.5- to 30-foot deep test holes were drilled and three 8- to 20-foot deep test pits were excavated across the site as shown on Figures A-2 and A-3. The subsurface soils encountered generally consisted of layers of loose to dense silty and clayey silty and clayey sand (SM and SC) and soft to hard, medium plastic, sandy clay (CL), over slightly weathered, hard, sandstone and claystone to the maximum depth of exploration, 30 feet. The clays and claystone are part of the Chinle formation which is locally known as "Blue Clay". Groundwater was not encountered in our test holes at the time of our investigation.

A detailed description of the conditions encountered in each of the test hole and test pit locations are presented on our Log of Test Holes and Log of Test Pits included in Appendix A, please refer to Figures A-4 through A-11. Figure A-12 is the key to symbols and abbreviations used on the Log of Test Holes and Log of Test Pits.

ANALYSIS AND CONCLUSIONS

The purpose of our investigation was to provide recommendations for the rough grading of the site for the leveling of the building pads and parking lot areas. We are not providing recommendations for pad preparations for building support, those recommendations will be provided in a separate report prepared at a later date.

Swell-consolidation tests performed on the clay indicated that it is expansive. Samples tested swelled between 0.1 and 4.3 percent when saturated at a constant load of either 1,000 pounds per square foot (psf). The tests indicate swell pressures ranging between1,100 and greater than 8,000 psf. Atterberg Limits test results performed on the clay indicate Liquid Limits ranging between 28 and 53 with a Plastic Index ranging between 15 and 34, respectively. One sample of the clay collapsed 1.1 percent when saturated under a constant load of 1,000 psf.

Typically, founding buildings on expansive soils is not recommended because the buildings will most likely move. It has been our experience that providing a 15-foot separation distance between the expansive clay and the building foundation has provided adequate protection for the

structures. As an alternative, supporting the building on a deep foundation system can also provide adequate protection for the structure.

As part of the review comments from the St. George Hillside Committee, they asked about excavating a 15-foot deep excavation adjacent to the proposed 2:1 cut slopes. Excavating the entire building at one time would, most likely, cause a failure of the adjacent hillside. Limiting the length of the excavation along the slope to 20 to 40 feet should allow the slope to remain stable. The exact length/size of the excavation will need to be determined at the time of grading.

Please see Appendix B, Figures B-1 through B-5 for swell-consolidation test results, Figure B-6 for Atterberg Limits test results, and Figure B-7 for gradation test results. Table B-I is a summary of laboratory test results.

SITE PREPARATION AND GRADING

The site should be grubbed from all vegetation which should be hauled away from the site. The boulders that cover the majority of the ground surface should be removed from areas to be graded. The boulders can either hauled from the site or saved to be used to build rock retaining walls, used in landscape areas, or can be mixed in with the structural fill (please refer to the structural fill sections of this report). Due to the fact that the purpose of the grading of the site is to bring the site to proposed grades and not to prepare the building pads for support of the proposed building, the following recommendations should be followed.

Before placing structural fill on the site, the parking lot areas should be over-excavated at least 2 feet below proposed subgrades or 12 inches below existing grade, whichever is greater. Structural fill placed under any of the building areas may be placed on recompacted subgrades. After over-excavation and prior to structural fill placement, the exposed subgrades should be scarified a minimum of 12 inches, moisture conditioned to within 2 to 4 percent over optimum, and recompacted to a firm non-yielding surface.

The building pads may be cut to grade. The exposed surface should be scarified 12 inches, moisture conditioned and compacted to a firm non-yielding surface. Over-excavation is not necessary on the building pads.

The excavations should be backfilled with structural fill up to required grades. Excavation into the claystone and sandstone is expected to be relatively hard and heavy-duty excavation equipment is expected to be required in the deeper cut areas that are greater than 20 feet. Heavy-duty excavation equipment is considered to be a CAT-330 or larger.

Structural fill should be placed up to required grades in 8-inch maximum loose lifts, at the moisture content optimum for compaction, and compacted to at least 93 percent modified Proctor (ASTM D1557-00) maximum dry density at a moisture content between 2 and 4 percent over optimum.

The on-site material excavated from the cut areas may be used as structural fill in the parking lot areas as long as it mixed 3:1 (3 parts native with 1 part imported) with non-expansive imported material. The material that was end-dumped on site may also be used as structural fill in the parking lot as long as it is mixed 3:1 with non-expansive imported material. Imported structural fill should consist of material free of organics, high plastic clay, and other deleterious materials. All imported fill should be approved by GTS prior to its delivery to the site. In general, imported fill should contain not less than 20 percent fines (material passing the No. 200 sieve, based on the minus 3/4-inch fraction), should be well graded, and should have a maximum particle size of 6 inches. The Plasticity Index of the fines should not exceed 15 and the Liquid Limit should not exceed 25.

Cut slopes along the west side of the development can be cut to a slope of 2:1. The slopes should be covered with rip-rap to prevent erosion. Measures should be taken to prevent excess storm water from flowing over the slopes. A Landscape Plan was being developed and was not provided for our review at the time this report was published.

Utility trenches should be backfilled with structural fill. Backfill material should be placed in lift thicknesses appropriate to the type of compaction equipment utilized and compacted to a minimum degree of compaction of 90 percent of the modified Proctor maximum dry density (ASTM D1557-00) by mechanical means in landscape areas. In pavement areas, that portion of the trench backfill within the pavement section should conform to the material and compaction requirements of the adjacent pavement section.

All site grading and fill operations should be observed by a representative from GTS, to determine the adequacy of site preparation, the suitability of fill materials, and compliance with compaction requirements.

FOUNDATION RECOMMENDATIONS

Individual foundation recommendations will be given once the type of building construction is determined.

PAVEMENT DESIGN RECOMMENDATIONS

In areas where a flexible pavement (asphalt) is specified, we recommend a pavement section consisting of 3 inches of asphaltic concrete and 8 inches of high quality base material. This assumes that the subgrade below the base consists of 2 feet of structural fill. The upper 12 inches should consist of imported structural fill.

If a rigid pavement (concrete) is specified, according to the Portland Cement Association publication Building Quality Concrete Parking Areas, 6 inches of concrete will be sufficient for passenger vehicle and occasional commercial type truck traffic. Any concrete pavement should meet the following specifications: 4,500 psi minimum compressive strength, 6 sack mix, 5 percent air entrainment, and 4-inch maximum slump. Control joint spacing should not exceed 10 feet by 10 feet. Rigid pavement should be supported on 2 feet of structural fill. The upper 12 inches should consist of imported structural fill.

RETAINING WALLS

The retaining walls should be designed to resist lateral earth pressures imposed by the surrounding soils and to resist surcharge loads. For static design the surrounding soils may be assumed to act as a fluid with an equivalent unit weight of 65 pcf if the walls are free to rotate at the top. This assume that the native soil mixture will be used as backfill. If imported material is used as backfill within 10 feet of the back of the wall, than soil may be assumed to act as a fluid with an equivalent unit weight of 40 pcf. In addition, these walls should be designed to resist a uniform

lateral pressure acting on the full height of the wall equal to 50 percent of the surcharge loads (material storage, traffic, etc.) adjacent to the wall. Our recommendations assume that the ground behind the wall is level for a minimum distance of 12 feet and that a drainage system is installed behind the wall to prevent hydrostatic pressure buildup on the wall. Regardless of the material used for wall backfill, a perforated pipe should be placed behind the walls to serve as a drainage medium. The pipe should be surrounded by a minimum fo 10 inches of free draining gravel that is wrapped with filter fabric to prevent soil intrusion. If the ground surface is not level for a minimum distance of 12 feet behind the wall, than an equivalent fluid pressure of 85 pcf should be used for the design of the wall.

The retaining wall footings should be supported on a minimum of 2 feet of structural fill compacted to at least 95 percent the Modified Proctor maximum dry density. Footings may be proportioned for an allowable soils bearing pressure of up to 1,800 psf for sustained loads and up to 2,200 psf under the toe at full movement. If imported structural fill is used for the two feet of structural fill than the bearing pressure may be increased to 2,200 psf for sustained loads and up to 2,800 psf under the toe at full movement.

We understand that segmented concrete block walls might be used to replace the cast-in-place retaining walls located along the east side of the development. Design of the walls are provided in Appendix C.

SURFACE DRAINAGE

To prevent saturation of soils under and around the building pads, adequate surface drainage must be maintained during the course of construction and after construction has been completed. The pads should be graded to prevent water from running across and collecting on the pads. Pads should be sealed by rolling the top of the pad with either a smooth drum or pneumatic tire roller. The parking lot areas should be graded to a storm drain system, water should not be allowed to puddle on site.

CONSTRUCTION INSPECTION

A representative from Geotechnical Testing Services, Inc. should be on site periodically during construction to provide the following services:

- Compaction testing and observations during grading operations to insure that the recommendations found in this report are properly followed including but not limited to: adequacy of the site preparation, the suitability of fill material, and compliance with compaction requirements.
- Observation of subgrade(s) to possible identify old fill areas, lateral drains, and other backfilled areas that may underlie the site.
- Concrete testing and observations of off site elements as required by City of George.

PLANS AND SPECIFICATIONS REVIEW

We recommend that one of our engineers review the geotechnical aspects of the project's specifications and plans prior to submission for bids. This review allows us to check if these documents reflect the intent of our recommendations. In addition, we could possibly identify contractual provisions that present the owner with an elevated risk of geotechnically related construction "extras."

LIMITATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from 5 test holes drilled and 3 test pits excavated within the proposed development as indicated on the Site Plan, Figure A-2 and A-3. This report does not reflect any variations which may occur beyond the limits of the test holes and test pits. The nature and extent of variations may not become evident until the course of construction and are sometimes sufficient to necessitate changes in the designs; thus, it is important that we observe subsurface materials exposed in the excavations to take advantage of all opportunities to recognize differing conditions which would affect the performance of the facility being planned.

This report has been prepared in order to assist the engineer in the design of this project. In the event that any changes are planned in the design, location or grades as outlined in this report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or approved in writing by Geotechnical Testing Services, Inc. We also recommend that final plans and specifications be reviewed by our office to evaluate whether our recommendations were properly understood and implemented.

This report should be available to prospective contractors for information on technical data only as interpreted from the test holes and test pits and not as a warranty of subsurface conditions.

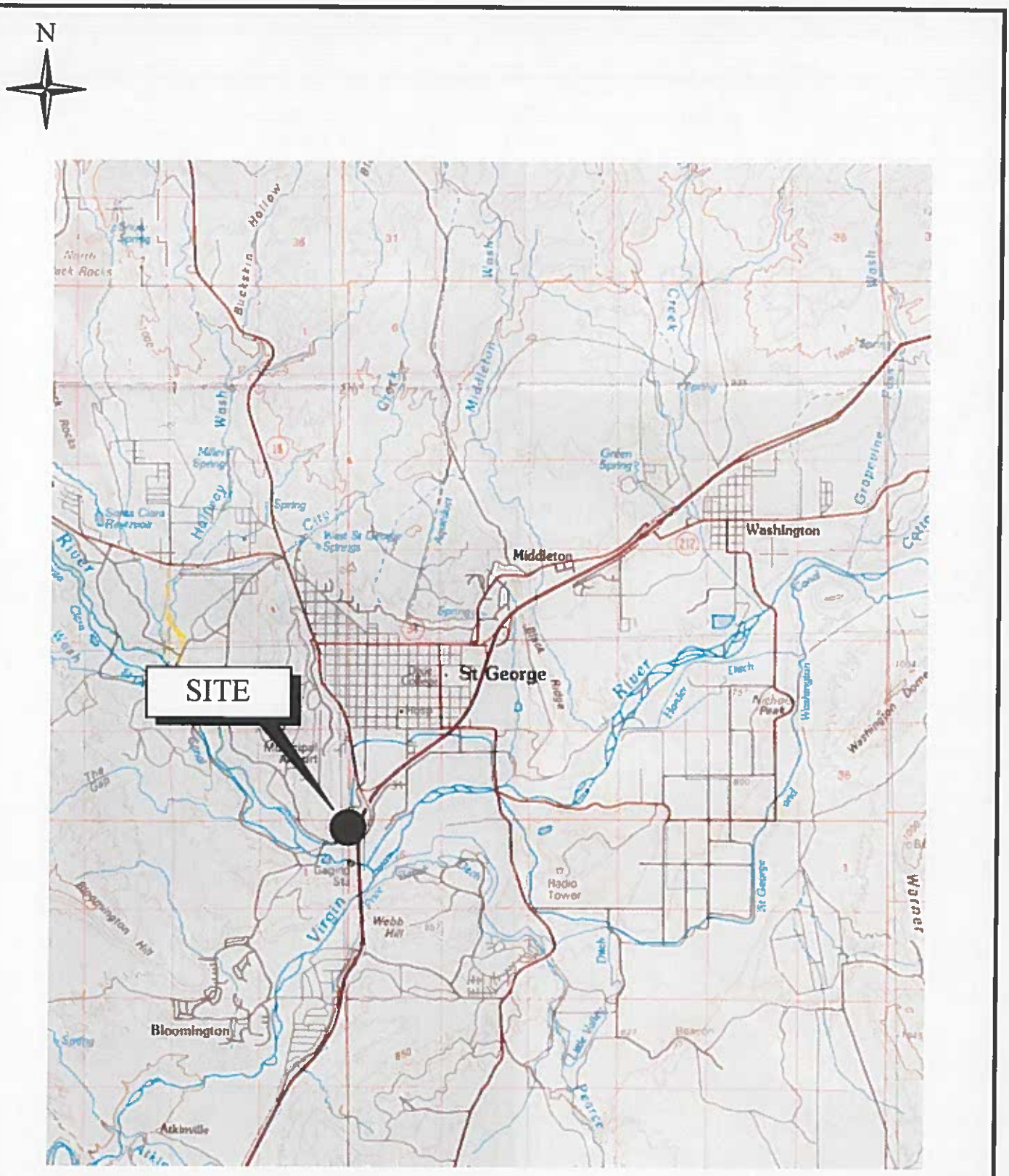
APPENDIX A

FIELD EXPLORATION, VICINITY MAP, SITE PLAN
AND LOG OF TEST HOLES AND TEST PITS

Figure A-1	Vicinity Map
Figures A-2 and A-3	Site Plan
Figures A-4 and A-11	Log of Test Holes and Test Pits
Figure A-12	Key to Test Holes and Test Pits

FIELD EXPLORATION

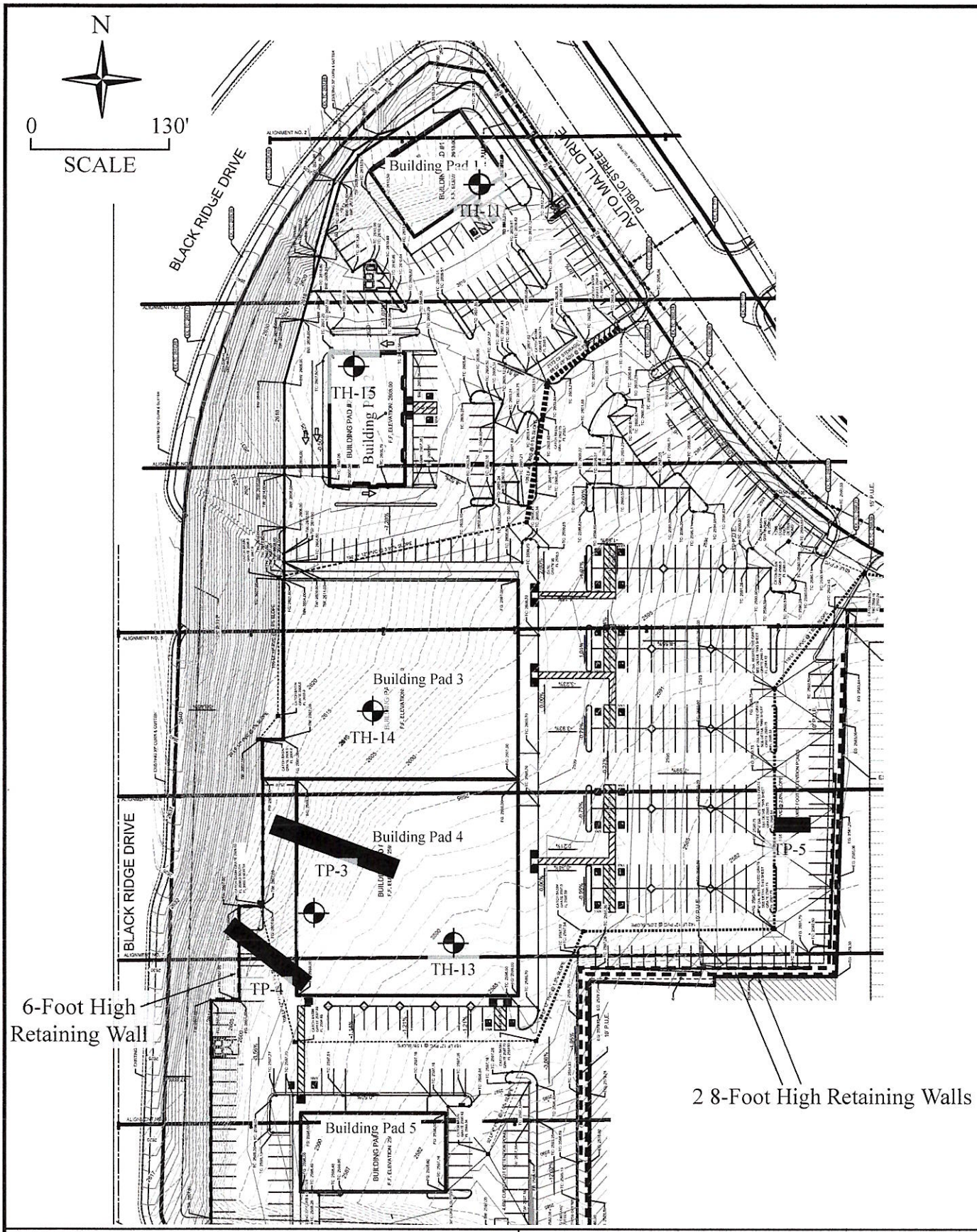
Our field exploration consisted of the excavation, logging, and sampling of five (5) 15.3- to30.3-foot deep test holes and three (3), 8- to 20-foot deep test pits. The locations of the test holes and test pits with respect to the property limits is shown on the Site Plans, Figures A-2 and A-3. The test holes were drilled with a truck-mounted hollow-stem auger. Disturbed and undisturbed samples were taken at selected intervals, sealed and returned to our laboratory for classification and testing. Samples were retrieved from the test hole with a Modified-California type (inside diameter 1.94 inches, outside diameter 2.5 inches) sampler driven with a 140 pound hammer falling 30 inches. Blow counts shown on the logs have been modified to represent a Standard Penetration test values, as per ASTM D1586. The test pits were excavated with a track mounted excavator. A continuous log of the subsurface conditions as encountered in the test holes and test pits was kept by Mr. Carson Gardner, Mr. Christopher Dutson, and Mr. Christopher Volksen, of our office, and supervised the drilling, excavation, and sampling operations. Drilling services were provided by Geotechnical Drilling Services, LLC. of St. George, Utah. Excavation services were provided by the client.



Engineering Consulting Testing	VICINITY MAP

Client: JMI - Jennings Management Incorporated
Project: Commerce Pointe Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A-1



GTS
Geotechnical Testing Services Inc.

Engineering

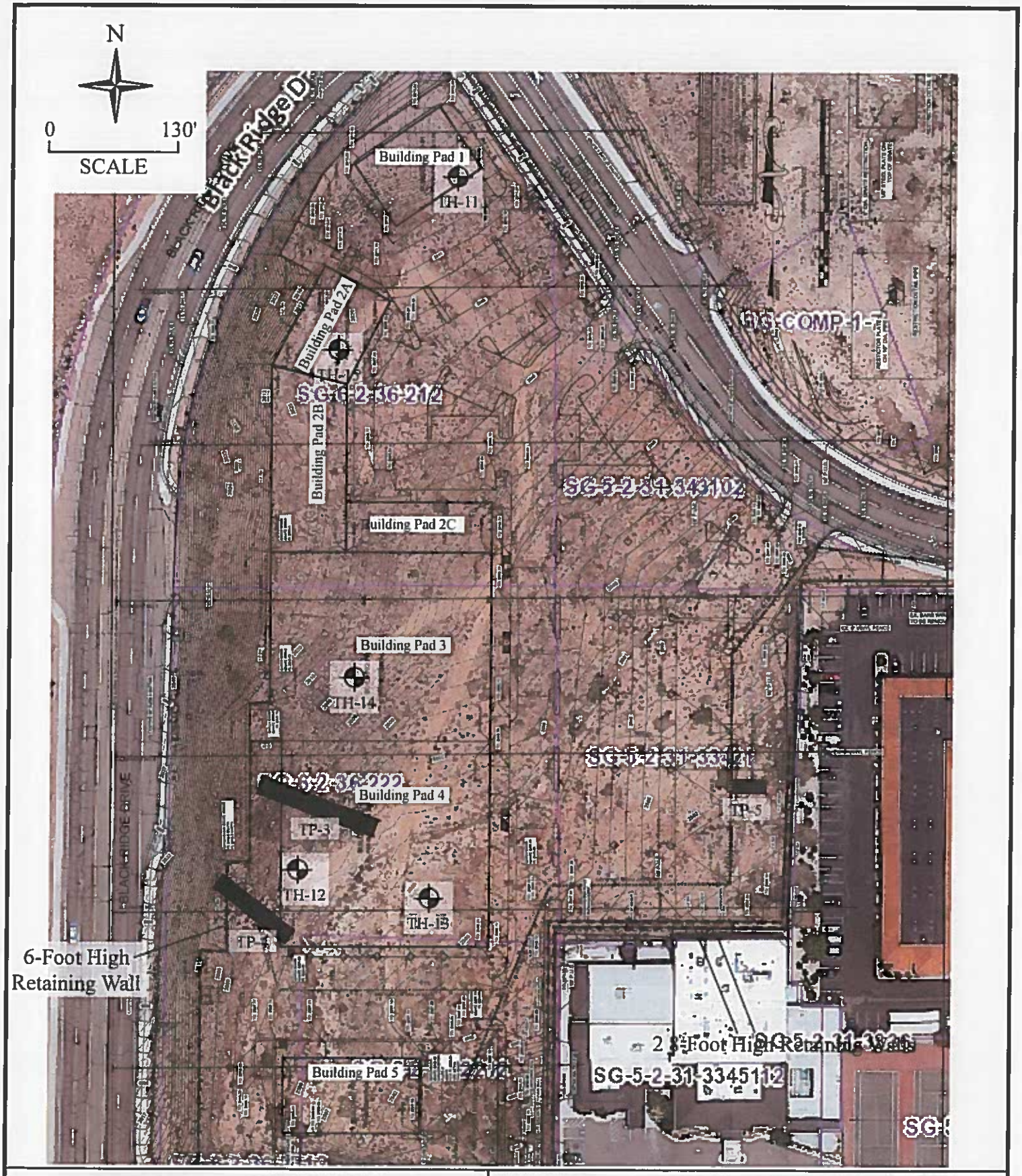
Consulting

Testing

SITE PLAN

Client: JMI - Jennings Management Incorporated
Project: Commerce Pointe Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A-2



Engineering *Consulting* *Testing*	***SITE PLAN***

Client: JMI - Jennings Management Incorporated
Project: Commerce Pointe Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A-3

LOG OF TEST HOLE NUMBER TH-11

TYPE BORING: LOCATION:

DEPTH, FT.	SYMBOL	SAMPLES	BLOWS PER FOOT	SOIL DESCRIPTION	% PASSING #200 SIEVE	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	UNIT DRY WT. LB./CU FT.	SHEAR STRENGTH IN TSF ○ HAND PEN ● UNC CMP 0.5 1.0 1.5 PL WC LL 20 40 60	OTHER TESTS
				SURF. ELEV.:							
			82	CLAY (CL), sandy, gravelly, cobbley, soft to hard with depth, slightly moist, dark red.							
5			47	CLAY (CH), some sand, stiff to very stiff, moist, high plastic, calcium veins, dusky red (10R3/3).							
			50/ 4"	CLAYSTONE: moderately to slightly weathered, sandy, hard, moist, gypsum veins, reddish brown.							
10			50/ 5"								
15			50/ 6"								
			50/ 5"	CLAYSTONE: slightly weathered, some sand, hard, moist, dusky red.							
20											
25			50/ 6"								
30											

GTS Geotechnical Testing Services Inc.

Engineering Consulting Testing

COMPLETION DEPTH: 25.5 FEET DEPTH TO WATER: FEET
DATE: 8/3/17-6/12/17 DATE:

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A - 4

GTS TEST HOLE FIGURE A 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20

LOG OF TEST HOLE NUMBER TH-12

TYPE BORING: LOCATION:

DEPTH, FT.	SYMBOL	SAMPLES	BLOWS PER FOOT	SOIL DESCRIPTION	% PASSING #200 SIEVE	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	UNIT DRY WT. LB./CU FT.	SHEAR STRENGTH IN TSF ○ HAND PEN ● UNC CMP 0.5 1.0 1.5 PL WC LL 20 40 60	OTHER TESTS
				SURF. ELEV.:							
				SAND (SM), silty, gavelly, occasional cobbles, loose, slightly moist, yellowish brown.							
			50/ 5"	SAND (SC), some clay, very dense, dry to slightly moist, moderately to strongly cemented, pale brown.							
5			50/ 3"								
			55/ 5"								
10			50/ 6"								
				CLAY (CL), sandy, hard, slightly moist, medium plastic, dusky red and greenish gray.							
15			50/ 5"								
20			50/ 5.5"								
25											
30											

GTS TEST HOLE FIGURE A 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20

Geotechnical Testing Services Inc.

Engineering Consulting Testing

COMPLETION DEPTH: 21.0 FEET DEPTH TO WATER: FEET
DATE: 8/4/17-6/12/17 DATE:

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A - 5

LOG OF TEST HOLE NUMBER TH-13

TYPE BORING: LOCATION:

DEPTH, FT.	SYMBOL	SAMPLES	BLOWS PER FOOT	SOIL DESCRIPTION	% PASSING #200 SIEVE	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	UNIT DRY WT. LB./CU FT.	SHEAR STRENGTH IN TSF ○ HAND PEN ● UNC CMP 0.5 1.0 1.5 PL WC LL 20 40 60	OTHER TESTS
				SURF. ELEV.:							
				SAND (SM), silty, gavelly, occasional cobbles, loose, slightly moist, yellowish brown.							
			50/ 6"	SAND (SC), clayey, very dense, slightly moist, red brown mottled gray.							
5			91/ 11"	CLAY (CL), sandy, hard, slightly moist, medium plastic, dusky red and greenish gray.							
			50/ 5"								
10			50/ 5"								
15			50/ 4"								
20											
25											
30											

GTS TEST HOLE FIGURE A 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20

GTS Geotechnical Testing Services Inc.

Engineering Consulting Testing

COMPLETION DEPTH: 15.3 FEET DEPTH TO WATER: FEET
DATE: 8/4/17-6/12/17 DATE:

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A - 6

LOG OF TEST HOLE NUMBER TH-14

TYPE BORING: LOCATION:

DEPTH, FT.	SYMBOL	SAMPLES	BLOWS PER FOOT	SOIL DESCRIPTION	% PASSING #200 SIEVE	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	UNIT DRY WT. LB./CU FT.	SHEAR STRENGTH IN TSF ○ HAND PEN ● UNC CMP 0.5 1.0 1.5 PL WC LL 20 40 60	OTHER TESTS
				SURF. ELEV.:							
				SAND (SM), silty, gavelly, occasional cobbles, loose, slightly moist, yellowish brown.							
				CLAY (CL), sandy, some cobbles, hard, slightly moist, weak red mottled whitish.							
5			42								
			56								
			63								
10											
			65								
15			50/ 3"	SANDSTONE, some clay content							
20			50/ 3"								
				Refusal in Sandstone							
25											
30											

GTS TEST HOLE FIGURE A 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20

GTS Geotechnical Testing Services Inc.

Engineering Consulting Testing

COMPLETION DEPTH: 23.0 FEET DEPTH TO WATER: FEET
DATE: 8/4/17-6/15/17 DATE:

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A - 7

LOG OF TEST HOLE NUMBER TH-15

TYPE BORING: LOCATION:

DEPTH, FT.	SYMBOL	SAMPLES	BLOWS PER FOOT	SOIL DESCRIPTION	% PASSING #200 SIEVE	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	UNIT DRY WT. LB./CU FT.	SHEAR STRENGTH IN TSF (O HAND PEN ● UNC CMP; 0.5 1.0 1.5; PL WC LL; 20 40 60)	OTHER TESTS
				SURF. ELEV.:							
				CLAY (CL), sandy, gravelly, basalt cobbles and boulders, medium stiff, slightly moist, reddish brown.							
				CLAYSTONE: moderately weathered, sandy, hard, moist, gypsum veins, reddish brown.							
5			76					7.6	113	X	0.9% Swell @ 1.0 ksf
10			50/ 5"								2.0% Swell @ 1.0 ksf????
				CLAYSTONE: slightly weathered, some sand, hard, moist, greenish gray.							
15			55/ 6"					13.4	103	X	3.5% Swell @ 1.0 ksf
20			50/ 3"					11.6	108	X	4.6% Swell @ 1.0 ksf
25			50/ 3"								
30			50/ 3"								

GTS TEST HOLE FIGURE A 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20

Geotechnical Testing Services Inc.

Engineering Consulting Testing

COMPLETION DEPTH: 30.3 FEET DEPTH TO WATER: FEET
DATE: 8/22/17-6/15/17 DATE:

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A - 8

LOG OF TEST PIT TP-03

TRENCHING EQUIPMENT: LOCATION:

DEPTH, FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	% PASSING #200 SIEVE	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	UNIT DRY WT. LB./CU FT.	SHEAR STRENGTH IN TSF ○ HAND PEN ● UNC CMP (0.5 1.0 1.5) PL WC LL (20 40 60)	OTHER TESTS
			SURF. ELEV.:							
			COBBLES, boulders infilled with CLAY (CL), sandy, very dusky red.	8.1			1.1			Non-Plastic
5		G	CLAY (CL-CH), sandy, some gravel, stiff, slightly moist, medium plastic, dusky red (2.5YR3/2). Sheared and mixed up. No slide plane.							
			SANDSTONE	37.2	28	12	5.9			
10										
15										
20										
25										
30										

GTS Geotechnical Testing Services Inc.

Engineering Consulting Testing

COMPLETION DEPTH: 8.0 FEET DEPTH TO WATER: FEET
DATE: 11/2/16-11/2/16 DATE:

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A - 9

GTS_TEST_PIT 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20

LOG OF TEST PIT TP-04

TRENCHING EQUIPMENT: LOCATION:

DEPTH, FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	% PASSING #200 SIEVE	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	UNIT DRY WT. LB./CU FT.	SHEAR STRENGTH IN TSF ○ HAND PEN ● UNC CMP (0.5, 1.0, 1.5) PL WC LL (20, 40, 60)	OTHER TESTS
			SURF. ELEV.:							
			COBBLES, boulders.							
5										
			CLAY (CL), sandy, gravelly, alluvial deposit, dusky red (2.5YR3/2).							
10			SANDSTONE, highly to moderately weathered, dusky red (2.5YR3/2).	39.8	50	19	13.7			
15										
			SANDSTONE, fresh.							
20										
25										
30										

GTS Geotechnical Testing Services Inc.

Engineering Consulting Testing

COMPLETION DEPTH: 20.0 FEET DEPTH TO WATER: FEET
DATE: 11/2/16-11/2/16 DATE:

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A - 10

GTS_TEST_PIT 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20

LOG OF TEST PIT TP-05

TRENCHING EQUIPMENT: LOCATION:

DEPTH, FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	% PASSING #200 SIEVE	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT	UNIT DRY WT. LB./CU FT.	SHEAR STRENGTH IN TSF ○ HAND PEN ● UNC CMP (0.5 1.0 1.5) PL WC LL (20 40 60)	OTHER TESTS
			SURF. ELEV.:							
			TOPSOIL: CLAY (CL), sandy. Organics in upper 5 inches.							
5			CLAY (CL-CH), medium plastic, blue clay.	78.0	47	31	11.2	96		1.1% Collapse @ 1.0 ksf
				90.4	47 53	29 34	11.9	102		0.1% Swell @ 1.0 ksf
10										
15										
20										
25										
30										

GTS_TEST_PIT 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20

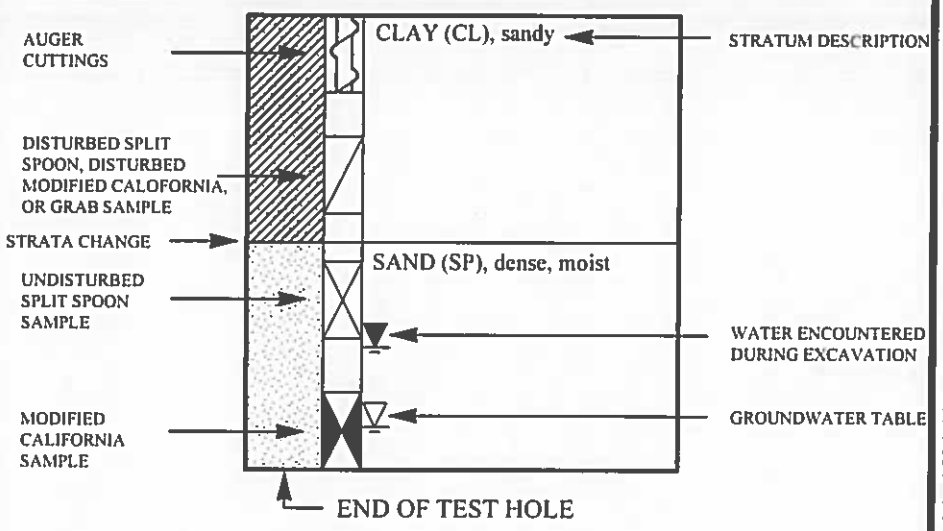
GTS Geotechnical Testing Services Inc.

Engineering Consulting Testing

COMPLETION DEPTH: 8.0 FEET DEPTH TO WATER: FEET
DATE: 11/2/16-11/2/16 DATE:

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A - 11



RELATIVE DENSITY (SAND & SILT)

	BLOWS/FOOT
VERY LOOSE	<4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	>50

CONSISTENCY (CLAY)

	SHEAR STRENGTH (psf)	BLOWS /FOOT
VERY SOFT	<250	<2
SOFT	250 - 500	2 - 4
MED. STIFF	500 - 1000	4 - 8
STIFF	1000 - 2000	9 - 15
VERY STIFF	2000 - 4000	16 - 30
HARD	>4000	>30

FILL MAN MADE
CONCRETE
ASPHALT
TOPSOIL
ORGANIC SILT (OL)
CLAY PLASTIC (CH)
CLAY (CL)
(CL-ML)
SILT PLASTIC (MH)
SILT (ML)
SAND WELL GRADED (SW)
SAND POORLY GRADED (SP)
SAND CLAYEY (SC)
SAND SILTY (SM)
SAND (SW-SC)
SAND (SW-SM)
SAND (SP-SC)
SAND (SP-SM)
SAND (SC-SM)
GRAVEL WELL GRADED (GW)
GRAVEL POORLY GRADED (GP)
GRAVEL CLAYEY (GC)
GRAVEL SILTY (GM)
GRAVEL (GW-GC)
GRAVEL (GW-GM)
GRAVEL (GP-GC)
GRAVEL (GP-GM)
GRAVEL (GC-GM)
CLAY-STONE
SILT-STONE
SAND-STONE
VOL-CANICS
ASH
CLAY-STONE WEATH.
SILT-STONE WEATH.
SAND-STONE WEATH.
GRANITICS
BASALT
CALICHE
BOULDERS AND COBBLES
REFUSAL

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NONPLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE

phi - ANGLE OF INTERNAL FRICTION
C - COHESION (PSF)
p - HAND PENETROMETER (TSF)

NOTES:

1. The soils have been classified in accordance with the Unified Soil Classification System.
2. Strata change lines represent the approximate boundary between soil and rock types, in-situ the transition may be gradual.
3. Test Hole 11 through 15 were drilled during the first week of August 2017. Test Pits 3,4, and 5 were excavated on November 2 2016. All test holes were drilled with a truck mounted hollow stem auger operated by Geotechnical Drilling Services, L.L.C. of St. George, Utah. Test Pits were excavated by Quality Excavation with a Volvo EC 360B track mounted excavator which was provided by the Client
4. Groundwater was not encountered in our test holes or test pits.

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KEY TO TEST HOLES

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure A - 12

GTS KEY TH 18535 - COMMERCE POINT - WEST PHASE.GPJ 3/10/20

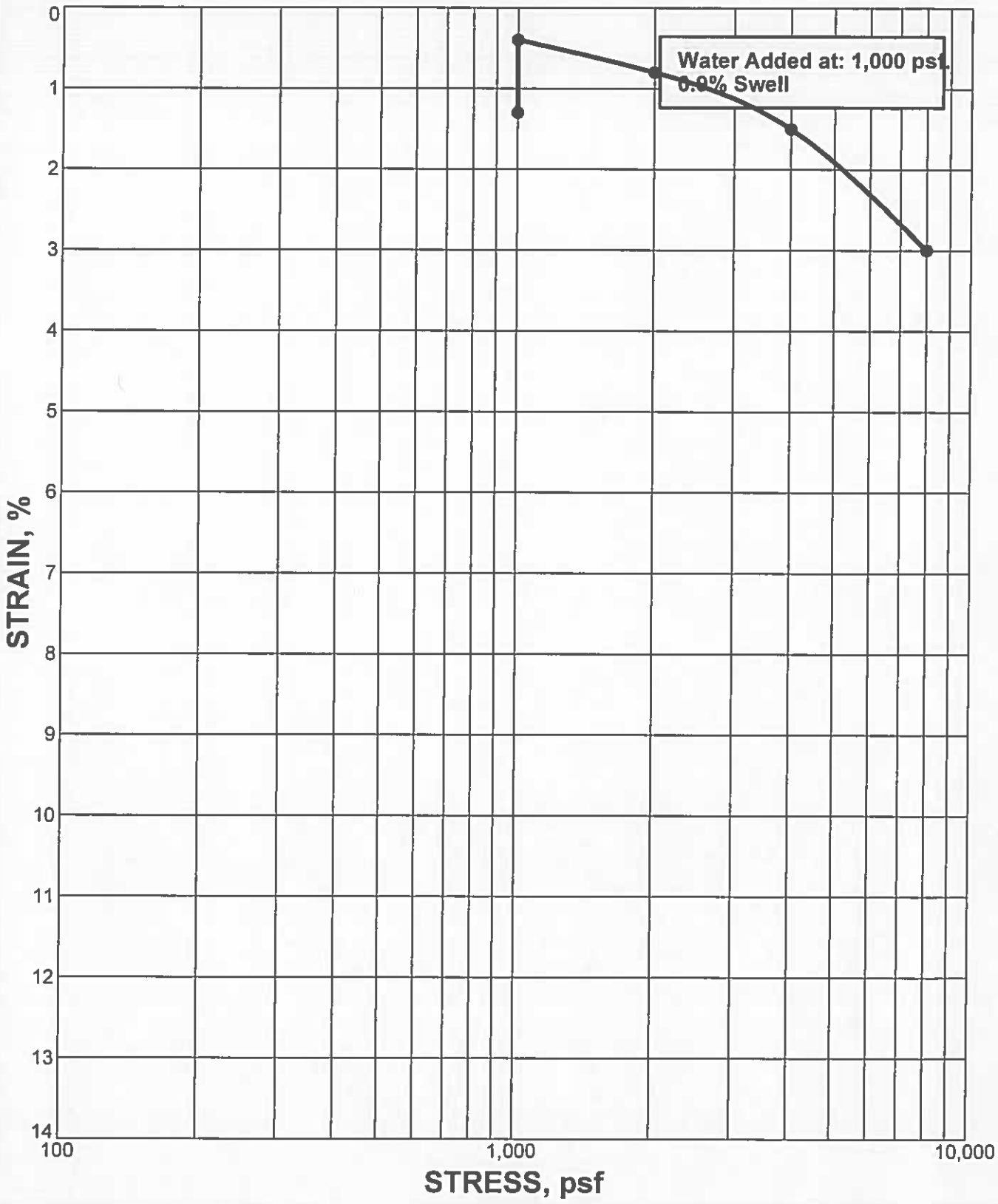
APPENDIX B

LABORATORY TEST PROCEDURES AND RESULTS

Figures B-1 thru B-5	Swell-Consolidation Test Results
Figure B-6	Atterberg Limits Test Results
Figures B-7	Gradation Test Results
Table B-I	Summary of Laboratory Test Results

LABORATORY TESTING PROCEDURES

The soil samples obtained from the test holes were identified in the laboratory to confirm field classification. Laboratory tests conducted included in-situ swell-consolidation, gradation analysis, Atterberg limits, and natural moisture content and dry density. All tests were conducted in accordance with ASTM standards.



Specimen Identification		Classification	γ_d	MC%	LL	PI
● TH-15 6.2		CLAYSTONE	112.9	7.6		

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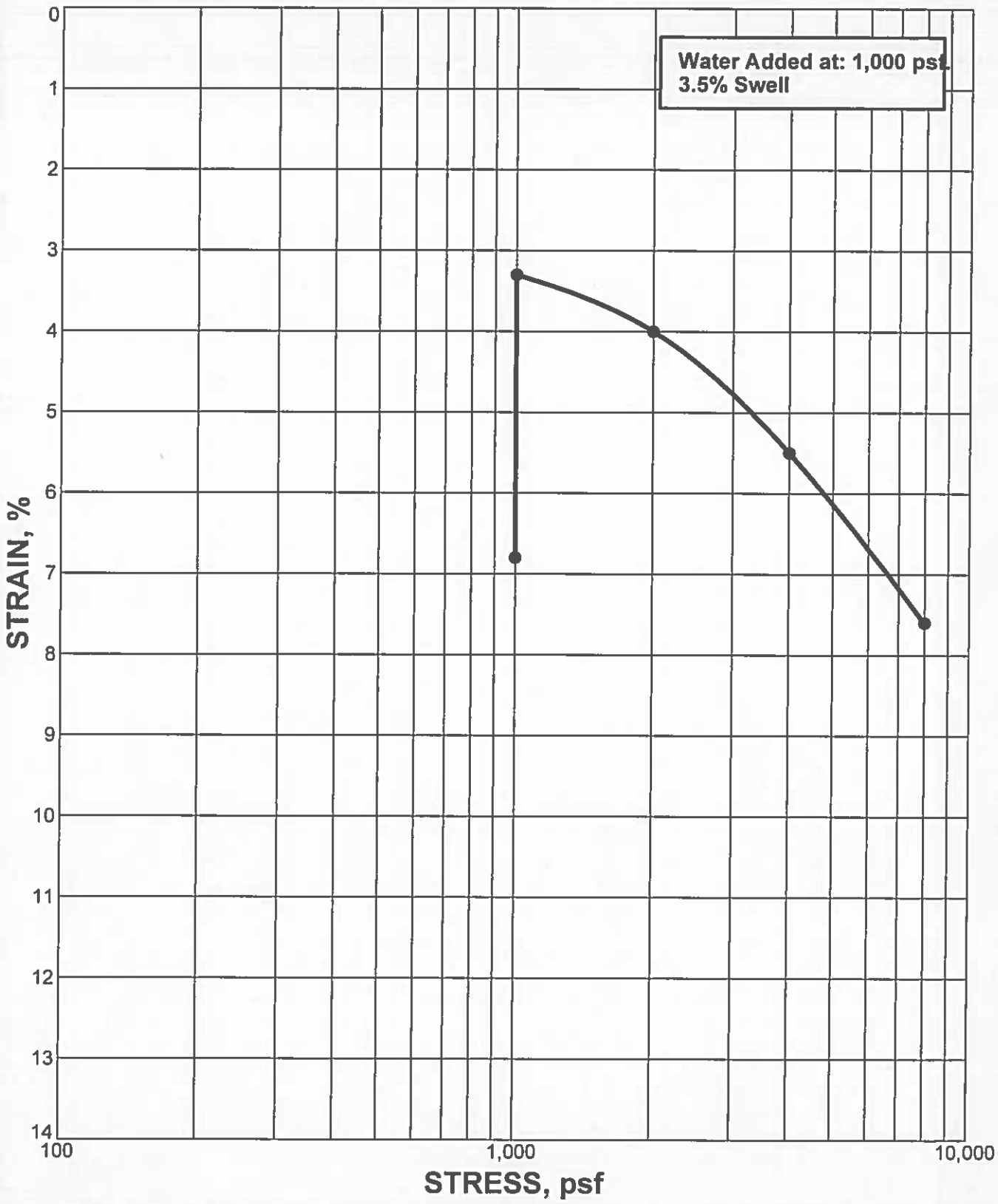
Geotechnical Testing Services Inc.

CONSOLIDATION TEST

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure B - 1

US CONSOL STRAIN 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20



Specimen Identification		Classification	γ_d	MC%	LL	PI
● TH-15	15.2	CLAYSTONE	102.7	13.4		

GTS Geotechnical Testing Services Inc.

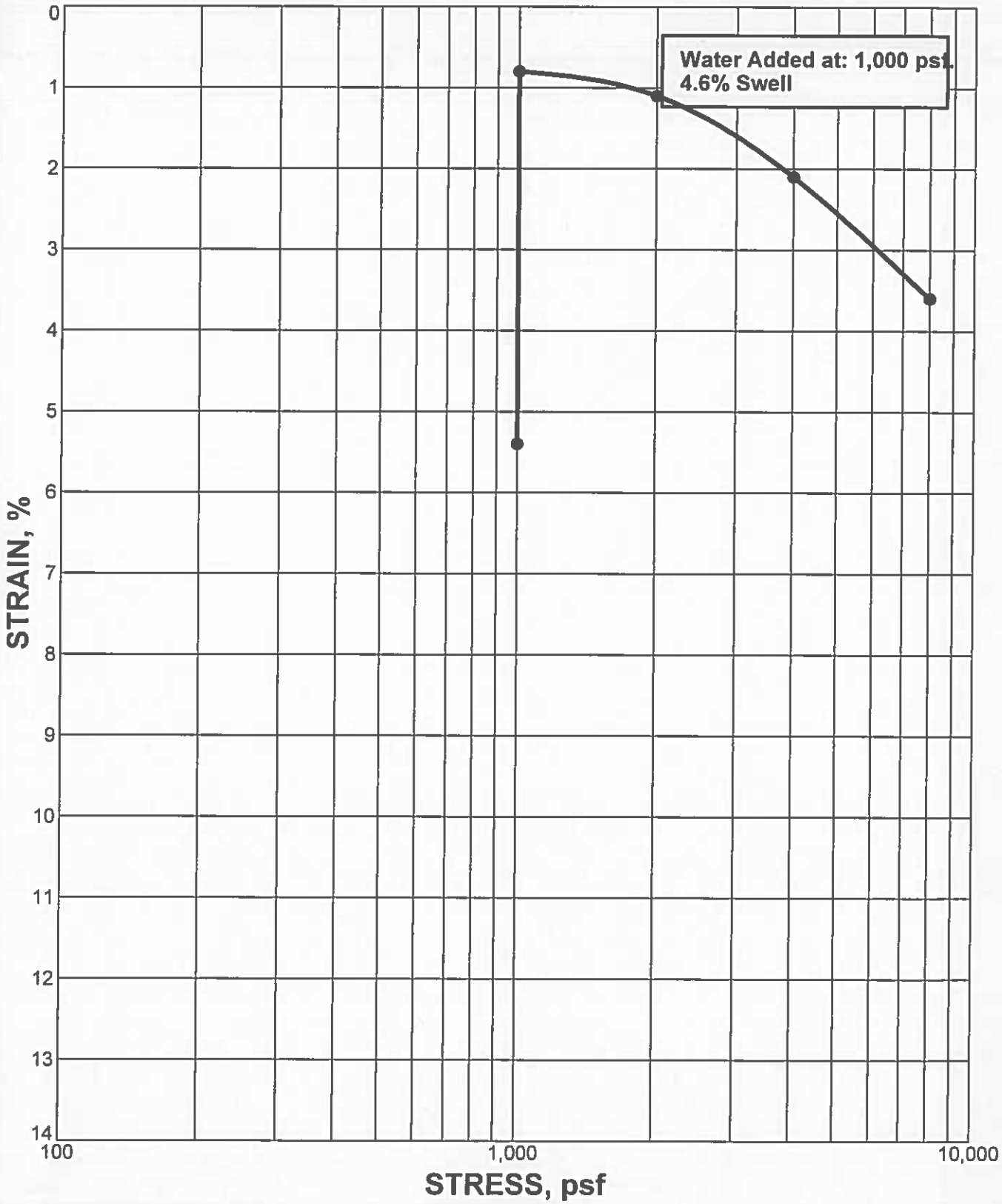
Engineering Consulting Testing

CONSOLIDATION TEST

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure B - 2

US CONSOL STRAIN 18535 - COMMERCE POINT - WEST PHASE GPJ GTS_CORP GDT 3/10/20



Specimen Identification		Classification	γ_d	MC%	LL	PI
● TH-15	20.7	CLAYSTONE	108.1	11.6		

Geotechnical Testing Services Inc.

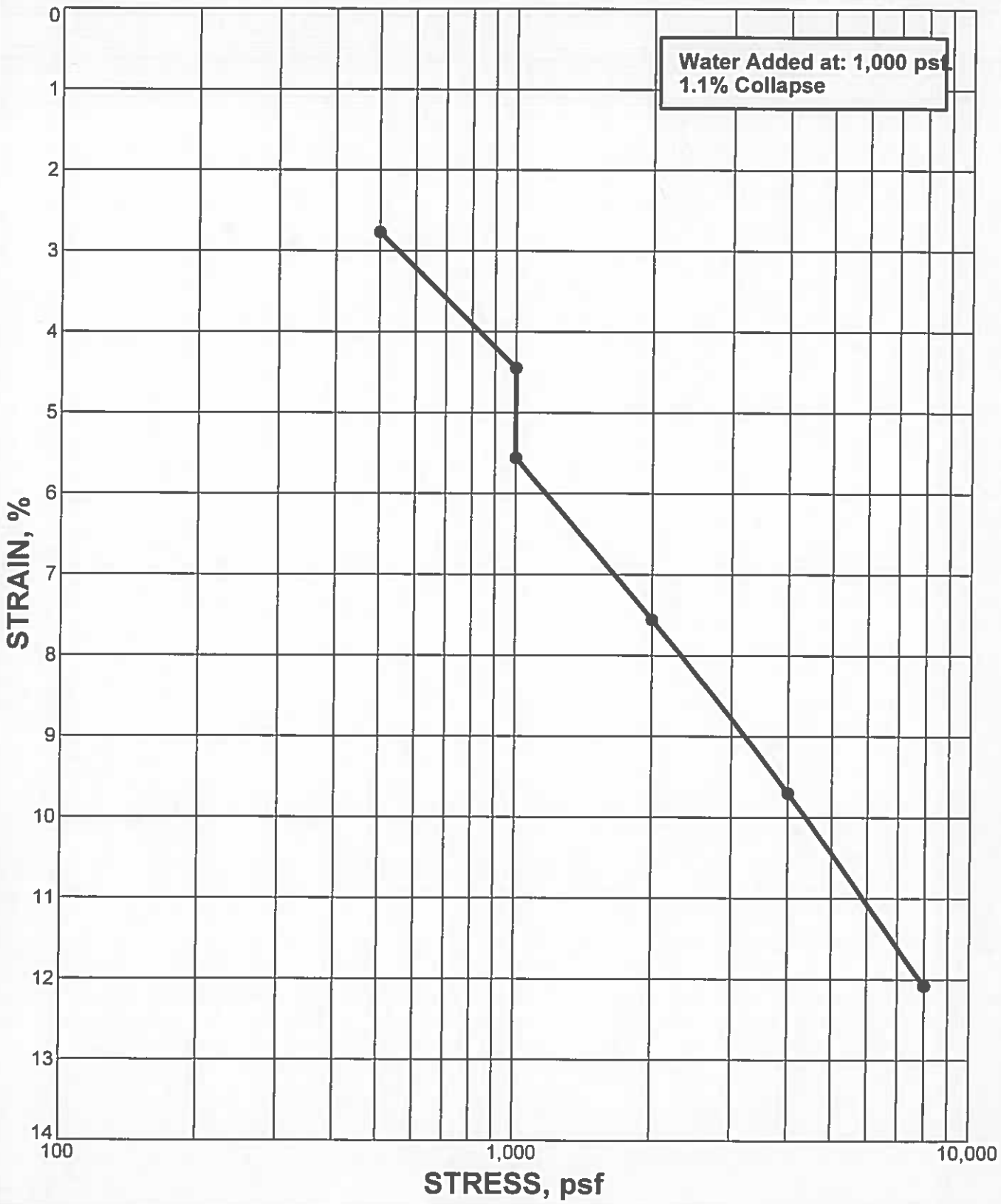
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CONSOLIDATION TEST

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure B - 3

US_CONSOL_STRAIN 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20



Specimen Identification		Classification	γ_d	MC%	LL	PI
● TP-05	4.0	CLAY (CL)	96.3	11.2	47	31

Geotechnical Testing Services Inc.

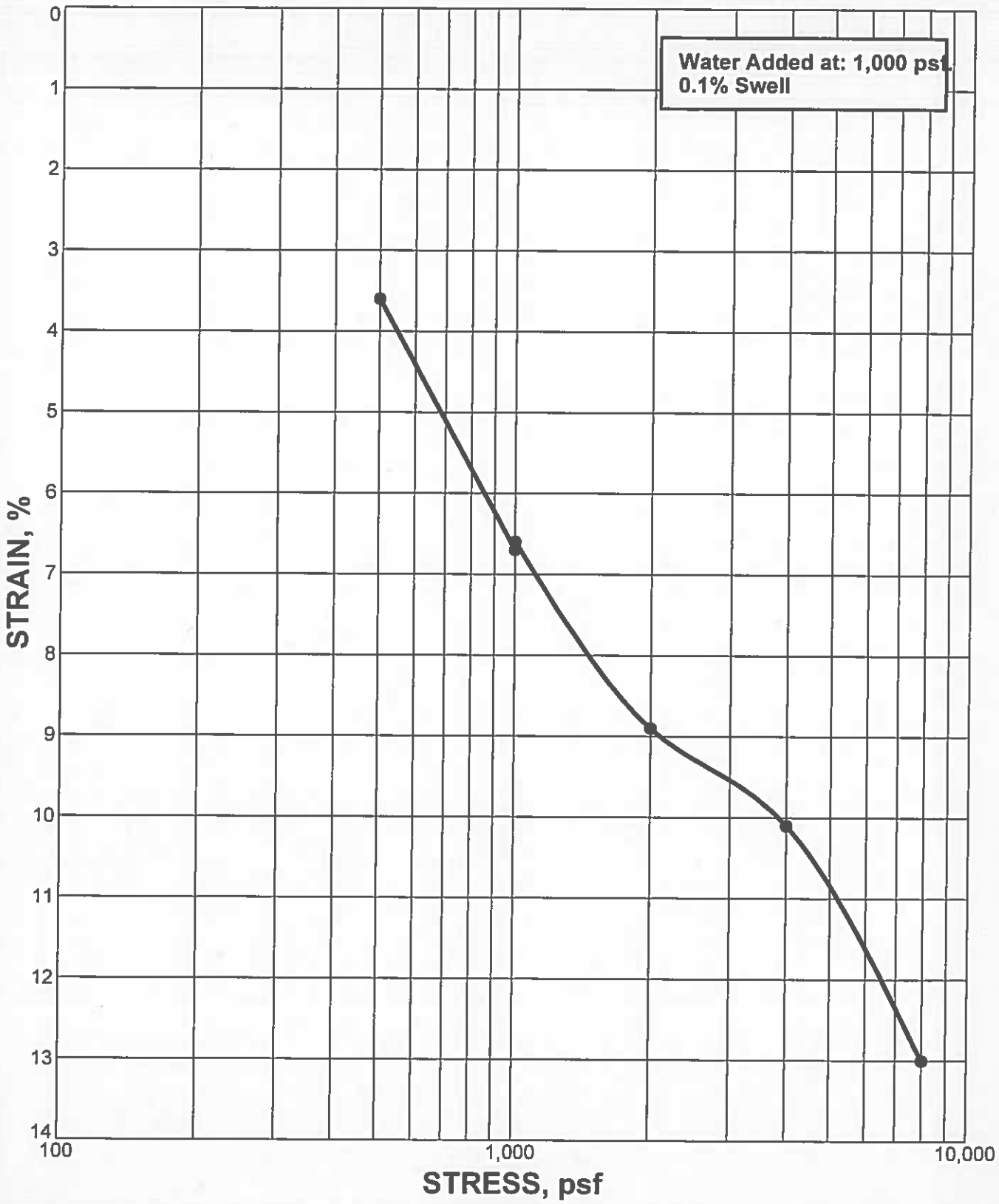
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CONSOLIDATION TEST

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure B - 4

US_CONSOL_STRAIN_18535 - COMMERCE POINT - WEST PHASE.GPJ_GTS_CORP.GDT_3/10/20



Specimen Identification		Classification	γ_d	MC%	LL	PI
● TP-05	7.0	CLAY (CH)	101.7	11.9	47	29

Geotechnical Testing Services Inc.

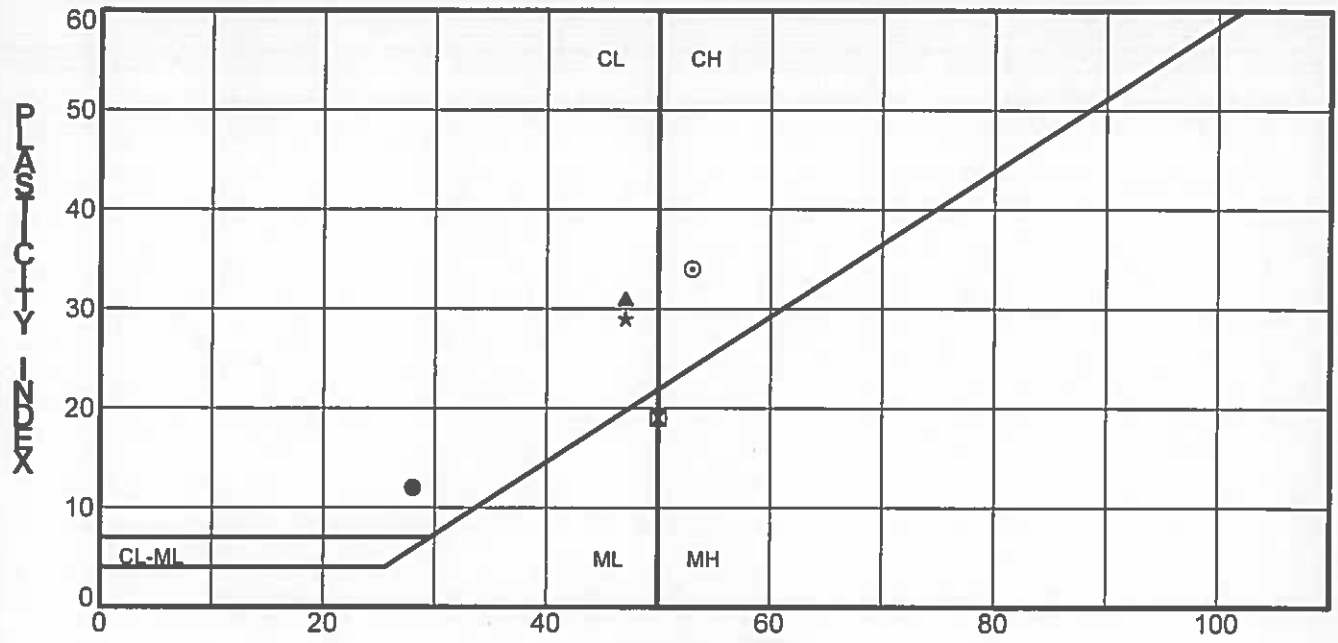
Engineering Consulting Testing

CONSOLIDATION TEST

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure B - 5

US_CONSOL_STRAIN 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20



	Specimen Identification		LL	PL	PI	Fines	Classification
●	TP-03	7.0	28	16	12	37	
⊠	TP-04	12.0	50	31	19	40	
▲	TP-05	4.0	47	16	31	78	CLAY (CL)
★	TP-05	7.0	47	18	29	90	CLAY (CH)
⊙	TP-05	7.5	53	19	34		CLAY (CL)

GTS Geotechnical Testing Services Inc.

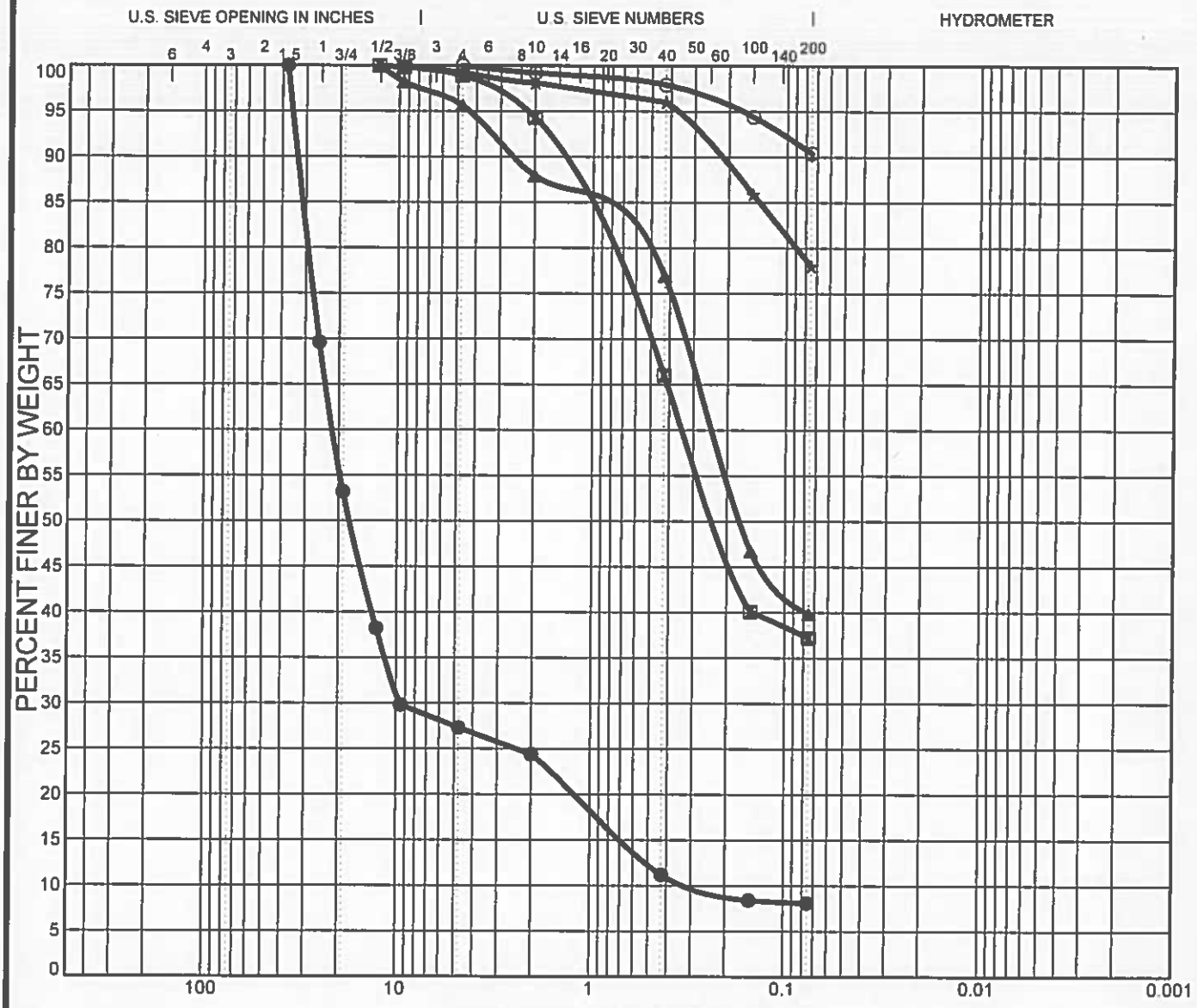
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ATTERBERG LIMITS' RESULTS

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure B - 6

US ATTERBERG LIMITS 18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	TP-03	2.0					15.70	78.79
⊠	TP-03	7.0		28	16	12		
▲	TP-04	12.0		50	31	19		
★	TP-05	4.0	CLAY (CL)	47	16	31		
⊙	TP-05	7.0	CLAY (CH)	47	18	29		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-03	2.0	37.5	21.43	9.566	0.272	72.7	19.2	8.1	
⊠	TP-03	7.0	12.7	0.334			1.1	61.7	37.2	
▲	TP-04	12.0	12.7	0.237			4.4	55.8	39.8	
★	TP-05	4.0	9.5				0.8	21.2	78.0	
⊙	TP-05	7.0	4.75				0.0	9.6	90.4	

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GRAIN SIZE DISTRIBUTION

Client: JMI - Jennings Management Incorporated
Project: Commerce Point Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535

Figure B - 7

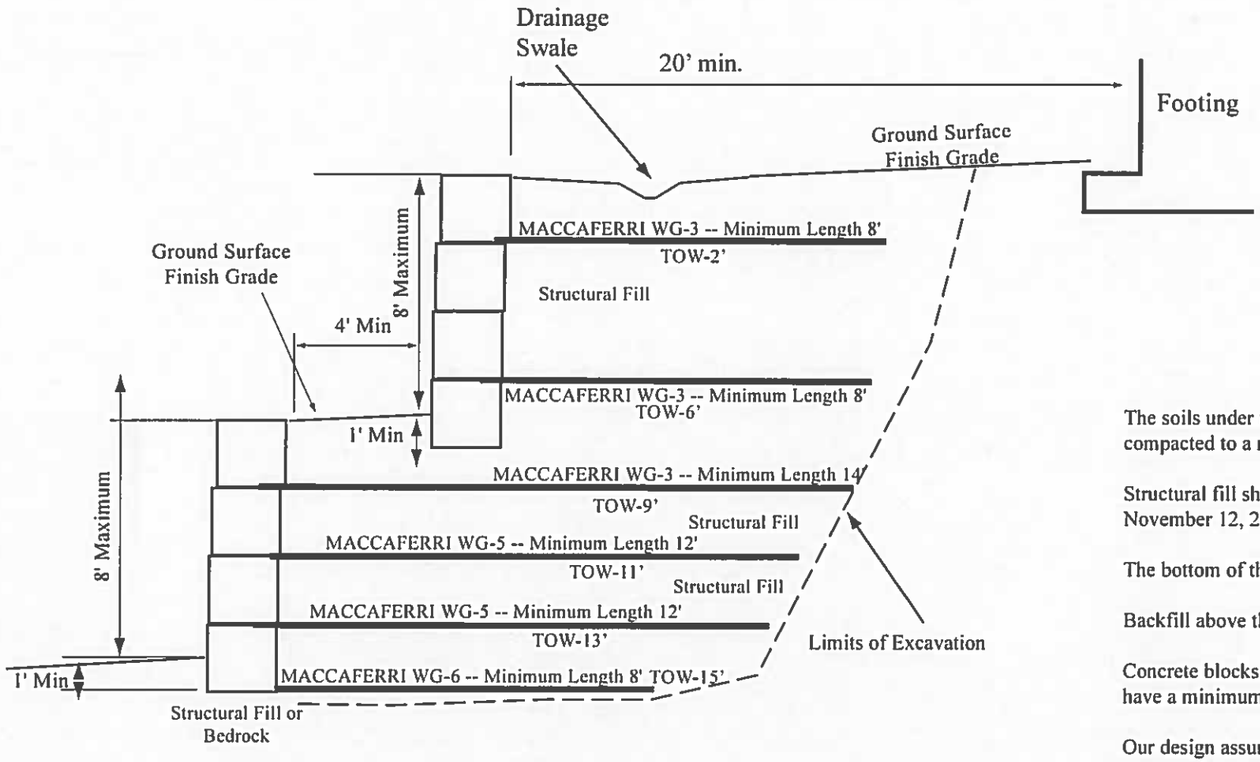
US_GRAIN_SIZE_18535 - COMMERCE POINT - WEST PHASE.GPJ GTS_CORP.GDT 3/10/20

TABLE B-I
Summary of Laboratory Test Results

TEST HOLE NO.	DEPTH (FT.)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	GRAIN SIZE DISTRIBUTION (%)			ATTERBERG LIMITS		SWELL-CONSOLIDATION			SOIL TYPE
				GRAVEL > #4	SAND	SILT/ CLAY < #200	LIQUID LIMIT	PLASTIC INDEX	SWELL (%)	COLLAPSE (%)	PRESS (ksf)	
TH-15	6.17	7.6	112.9						0.9		1.0	CLAYSTONE
TH-15	15.17	13.4	102.7						3.5		1.0	CLAYSTONE
TH-15	20.67	11.6	108.1						4.6		1.0	CLAYSTONE
TP-03	2.0	1.1		72.7	19.2	8.1		NP				SANDSTONE
TP-03	7.0	5.9		1.1	61.7	37.2	28	12				SAND (SC), clayey
TP-04	12.0	13.7					50	19				SILTSTONE
TP-05	4.0			0.8	21.2	78.0	46	31				CLAY (CL), sandy
TP-05	4.5	11.2	96.3							1.1	1.0	CLAY (CL), sandy
TP-05	7.0	11.9	101.7	0.0	9.6	90.4	47	29	0.1		1.0	CLAY (CL), sandy
TP-05	7.5						53	34				CLAY (CH), sandy

APPENDIX C

RETAINING WALL DESIGN



STACKED CONCRETE BLOCK FACED RETAINING
WALL CROSS SECTION

The soils under the bottom coarse of walls should consist of a minimum of 1 foot of structural fill, compacted to a minimum of 95 percent of the modified Proctor (ASTM D1557-00) dry density, or bedrock.

Structural fill should consist of material specified in the Geotechnical Investigation, GTS Project Number 18535, dated November 12, 2019.

The bottom of the course of the walls should be embedded into the subgrade a minimum of 1 foot.

Backfill above the wall should not be sloped greater than 4 : 1 (Horizontal : Vertical).

Concrete blocks used in the construction of the wall should consist of commerically prepared concrete block. The concrete should have a minimum 28-day compressive strength of 4,500 psi, and be air-entrained. Type V cement should be used.

Our design assumes that there is a mechanical/physical connection between the blocks to prevent them from sliding apart.

The wall batter should not be steeper than 1 : 4 (horizontal : vertical).

Grid reinforcement is required, and should be placed as shown in the cross-section detail.

Grid reinforcement should be placed in between the blocks a minimum of 6 inches and should be placed between the mechanical/ physical connection.

A drainage swale should be constructed across the top of the wall to prevent water from flowing over the top of the wall. The wall backfill should not be allowed to become saturated. Saturation of the backfill could cause movement of the wall.

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SITE PLAN

Client: JMI - Jennings Management Incorporated
Project: Commerce Pointe Shopping Center - West Side
Location: SW Corner Black Ridge Drive and Hilton Drive
Number: 18535 **Figure C-1**

Exhibit F
Minutes from the 3/23/2022 HRB Meeting

NOTICE OF MEETING
HILLSIDE REVIEW BOARD
CITY OF ST. GEORGE
WASHINGTON COUNTY, UTAH

Public Notice

Notice is hereby given that the Hillside Review Board of the City of St. George, Washington County, Utah, will hold meetings at the referenced site on **Wednesday, March 23, 2022,** commencing on-site at approximately 8:30 a.m.

PRESENT:
Dave Black
Jeff Mathis
James Dotson
Russ Owens

EXCUSED:
James Sullivan

CITY STAFF:
Assistant Public Works Director, Wes Jenkins
Planner III, Dan Boles
Planner III, Carol Davidson
Development Office Supervisor, Brenda Hatch

Dave Black nominated Jeff Mathis to be the Pro-tem Chair.
James Dotson Seconded
AYES
Dave Black
James Dotson
Russ Owens
Motion Carries

Jeff Mathis called the meeting to order at 8:30 am.

1. Consider a request for a hillside development permit at the Commerce Point Development. The applicant is proposing to construct in the area shown on the slope map labeled 20-30%, 30-40% and 40% and above. The property is located at Southeast quadrant of the intersection of Auto Mall Drive and Blackridge Drive. The property is currently zoned Highway Commercial (C-2). The applicant is Commerce Point, LC. Case No. 2022-HS-005. (*See 'Meeting Place' exhibit below*).

   Wes Jenkins – There are some areas here on the analysis map, the dark red is the 40% then the other is the 30 to 40%. Their proposal is to disturb all of this area over here. The question is, has it already been disturbed, is it consistent or should they not be disturbing the 40% and make sure they comply with the 30-40%. The way I understand it is their proposal is to disturb all of this with the argument that it is not consistent with the

topography that is around it and it is really disturbed material from the construction of Blackridge Drive.

Dave Black – I might make a suggestion that we break this up into at least 2 parts. And that we talk about that first and then we vote on that and decide on that. And then we can look at the overall plans and address that separately.

Jeff Mathis – It appears to me those 40% slopes are coming off the fills for the road, aren't they?

Dave Black – I would agree that mostly that is the case. Personally, I don't see any issues with disturbing the areas that they have planned, and I think we've made similar motions in the past, what do we call that? Non-contiguous?

James Dotson – Or man-made even.

Dave Black – Yes, so they are man-made slopes, they are non-contiguous slopes and so I don't see an issue of disturbing those.

Russ Owens – I agree, I don't see anything.

MOTION: Jeff Mathis made a motion that we approve the areas on the packet that are shown to be disturbing over the 40% slopes, they are non-contiguous areas and man-made areas. We recommend they be allowed to affect those areas.
SECOND: Dave Black
AYES (4)
Dave Black
Jeff Mathis
James Dotson
Russ Owens
NAYS (0)
Motion carries.

Dave Black – The second part is that in the plans they have submitted to us, they have indicated the cut slopes are 40 ft high against Blackridge Drive. That in itself goes against the hillside ordinance. The question I have is how do you mitigate that? That will leave a big scar, are there plans to address the cut slope? Is it going to be decorative rock? Stacked rock, is it going to be just left disturbed? How would plan to mitigate the scars left behind?

Austin Akin – It's in our scope to landscape or otherwise improve everything up the hill that we can. We're not going to leave a big scar. Chris and I have talked about it a little bit and it would be a good idea to stack rock up. We are more than happy to make sure it looks nice.

Jeff Mathis – So you're not going to use that access?

Austin Akin – It is just too steep, that was before I was around, but it seems like a pretty mutual decision not to use that access. We just have the one major road that comes through here.

Russ Owens – In the technical report that we were given to review it talks about minimal cuts with 3:1 slopes and kind of keeping the overall slopes to what it is now, that seems to have not been followed in a lot of this. I know the City is requiring a landslide study, which I guess this is the result of that. So, we haven't had time to review that at all. I think that will be a big issue out here, not only visually but with stability but also with landslide so I would think that needs to be addressed.

Dave Black – I would think that if the Landmark report is not going to be used, that there needs to be a separate updated report from GTS that addresses stable cut and fill slopes and retaining walls and there are expansive soils at this site, maybe revisit the recommendations for foundations.

Discussion continued on what reports will be used.

Dave Black – I don't know that we have enough information for us to review right now and give approval. We probably need to get with GTS and give them the opportunity to tell us what's in their report and any issues or concerns that they have seen.

Chris Volksen – Geotechnical Testing Services did a grading plan for this, and unfortunately our grading report for this portion of this development was not included in the packet. It did address slopes in there.

Wes Jenkins – So it's different than this?

Chris Volksen – Yes, it's a grading report. The purpose of the grading report was just to prepare rough pads.

Austin Akin – So we could go in and do mass grading because we don't know exactly what we are going to build.

Chris Volksen – It's a grading report, so there is a difference between a grading report and a geotechnical report. Once the buildings are established, once they have a tenant, once they know exactly everything with the building then we will do the geotechnical investigation. The intention was to basically to make the site look good so a tenant could come look at it and say that's a nice site we want to be here.

Wes Jenkins – Would your grading report address what Dave is talking about, the cuts and stabilizing those and all of that?

Chris Volksen – Yes, and so we have done some follow up which is what I just gave you here, after we had a 3rd party review with the City on the proposed cuts and the overall stability of the slopes. There was very little affect a .006 affect on the overall slope. What we will do is look at the grading report and I think it addresses slopes in there, it's just been a year since we've done it. It addresses the slopes and the drainage on the slopes and landscape on the slopes. Then we would do a geotechnical investigation for each structure as they are going to be done.

Dave Black – I do think we need to a portion of it now until we receive the report and then if anybody had any comments or anything they wanted to address we could do that in the next meeting.

Wes Jenkins – But you are saying you've done that report, it just wasn't in here?

Chris Volksen – Yes, and if it needs to be updated, I'll update it.

Russ Owens – So can you do a grading study not knowing what they are going to build here? Are you just going to say these buildings have to fit this pad?

Austin Akin – Yes, with the grading that we have planned it's going to narrow what we can do a bit, but it's not setting in stone.

Dave Black – So if you were to grade it now, you would use this plan and have the cut slopes that are on the drawing and then it would be mass graded.

Austin Akin – So the things we would be committing to would be the buildings will be here, the underground utilities here, the driveways here.

Jeff Mathis – So you are going utilities and surface improvements?

Austin Akin – Yes, we would like to. As much as we can.

Russ Owens – So if you did rough grading and it took 3 or 4 years for a client to come in then what would you do with the site?

Austin Akin – We would make sure it was maintained properly.

Chris Volksen – So I know that some of the discussion was that there is going to be a retaining wall along the backside over there, they are not planning on putting that in right now, they are just going to grade that down and just leave the slope.

Dave Black – So that could be a concern. Say you leave a cut slope for 4 years and it sits there.

Wes Jenkins – It has to be treated as a permanent slope, you can't say that it is temporary because the problem is say they sell it off to someone else, they need to understand that it is permanent.

Dave Black – So the landscaping would that go in now?

Wes Jenkins – Not the landscaping but the slope and the treatment of it would need to be dealt with at the initial phase.

Discussion on what the slope would look like and how it should be treated.

Wes Jenkins – From a City standpoint we would require it to be in permanent condition when they walk away from here. So, whatever that slope is, it would have to be in a condition that it could remain in forever.

Dave Black – I understand that, but we would also want the slope dressing on it to mitigate the exposed cut.

Wes Jenkins – Yes it would need to be treated so that the erosion is addressed, and the slope stability is addressed, all of that would have to happen. As far as landscaping around the buildings it won't have to be in.

Jeff Mathis – I think that is understood, what we are concerned about are these 40 ft cuts. It sounds like it's going to be phased, mass grading and so forth anyway.

Austin Akin – We are not planning on this sitting for 3-5 years.

Wes Jenkins – So I'm assuming with your mass grading you are going to come in and pad it out, parking lots established and everything?

Austin Akin – Yes. We are happy to address the cut slope stuff, we can get with Chris and talk about it. I know we don't have any intention of putting water in there, not even for landscaping or anything like that.

Dave Black – Do you have maybe a tall building that could hide something like that, or will they all be single story?

Austin Akin – The ones in the front, we're not doing any retaining. The idea is that yes, we have taller, bigger buildings back here. If you look on the drawings there will be bigger buildings where we are doing the retaining.

Dave Black – So when you come back, that might be part of your mitigation strategy. Address the slope and put taller buildings.

Discussion on how taller buildings will block the cut slope from the road and what type of treatment can be done to the slope.

MOTION: Dave Black made a motion that we table the rest of it. SECOND: Jeff Mathis AYES (4) Dave Black Jeff Mathis James Dotson Russ Owens NAYS (0) Motion carries.

2. Consider a request to amend the hillside overlay map by adding approximately 23 acres to the existing Middleton Ridge hillside overlay area. The property is generally located

north of Red Hills Drive and Middleton Drive and approximately 2200-2300 East. The applicant is the City of St. George. Case No. 2022-HS-009.

Wes Jenkins – We are wanting to revise the hillside overlay zone. If you look on the packet, the hillside overlay zone does not come into this area here on top. For some reason they left out this area right here. The proposal is to amend the hillside overlay zone to incorporate this parcel into the hillside overlay zone.

Jeff Mathis – In essence it would come down to the frontage road and then all the way along St. George City's boundary behind here.

Wes Jenkins – Yes.

Jeff Mathis – Is there a reason that you didn't stop at this road, and you took it clear out to there?

Wes Jenkins – I think we took it to the property lines.

Russ Owens – Have you got a development that is looking at building on this? Is that going to impact their overall scheme of things?

Wes Jenkins – Years ago they submitted an application, and it was for a water park, basically they stayed off of that and the slides came off a pole, so there was no disturbance. I'm not even sure if they have submitted anything. Some of their discussion now is to take the slides and put them up on the slope and disturb the slope. So, we got into that, and the City felt like that was a prominent enough hillside feature that it should be protected because it falls within the slope categories. So that is kind of the question, is it a prominent feature that you would like to protect?

MOTION: Dave Black made a motion that we recommend approval for the addition of the area indicated in the packet.
Jeff Mathis – I have one more discussion item, they had a grading permit they had all their things in place, right? So, are we doing something that going to change what was?
Wes Jenkins – No because whatever they had before has now lapsed.
Jeff Mathis – So at that point they were going to put things on poles and now you've heard discussion they want to come in and put things on the slopes.
Wes Jenkins – Yes and that alerted us to A. this is a prominent feature and should be protected because it's not in the hillside. We always though it was in the hillside. We were caught off guard.
Russ Owens – Say they want to go up there with a landing pad, walk up there and come down?
Wes Jenkins – They would have to go through the hillside, if they wanted to disturb it they would have to do a slope analysis and would have to go through that process and see if there are portions of it that could actually be disturbed. We just want to make bring it in to make it part of the hillside review.
SECOND: James Dotson
AYES (4)
Dave Black
Jeff Mathis

James Dotson
Russ Owens
NAYS (0)
Motion carries.

3. Consider approval of the meeting minutes from February 23, 2022.

MOTION: Dave Black made a motion to approve the minutes from the February 23, 2002, meeting.
SECOND: James Dotson
AYES (4)
Dave Black
Jeff Mathis
James Dotson
Russ Owens
NAYS (0)
Motion carries.

Jeff Mathis made a motion to adjourn.