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, January 24, 2024,** commencing on-site at approximately 9:00 a.m.

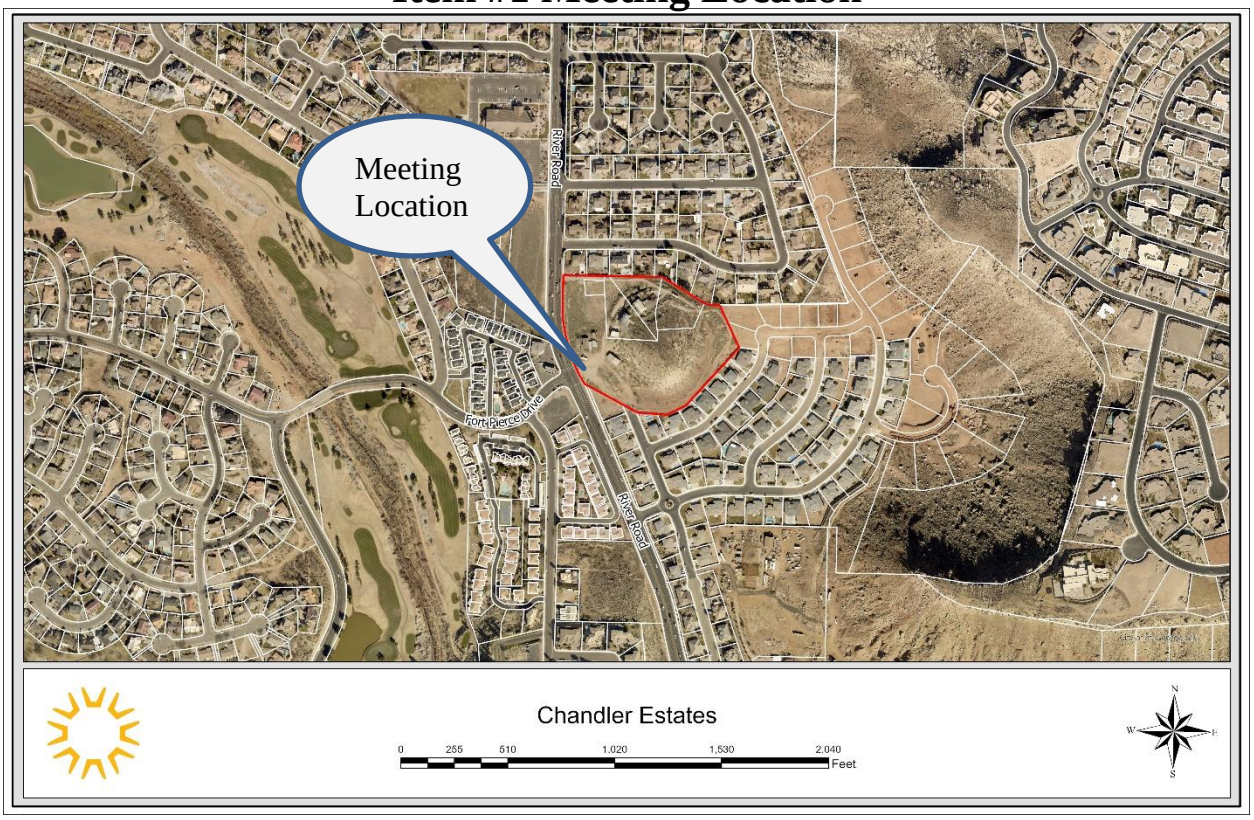
The estimated site times are in bold. The agenda for the meeting is as follows:

1. Consider a request for a hillside development permit in the hillside overlay zone and in areas exceeding 20% slope for single and two family homes located at approximately 1923 South River Road (see map below). The property is approximately 9.49 acres. **Meeting time is approximately 9:00 am, River Road across from Fort Pierce Drive.**
2. Consider a request for a hillside development permit in the hillside overlay zone and in areas exceeding 20% slope for an office, ropes course and restaurant pad at approximately 2000 South Riverside Drive (see map below). The property is just under 5 acres. **Meeting time is approximately 9:45 am, on the south-east side of Riverside Drive across from the Foremaster & Riverside Drives intersection.**

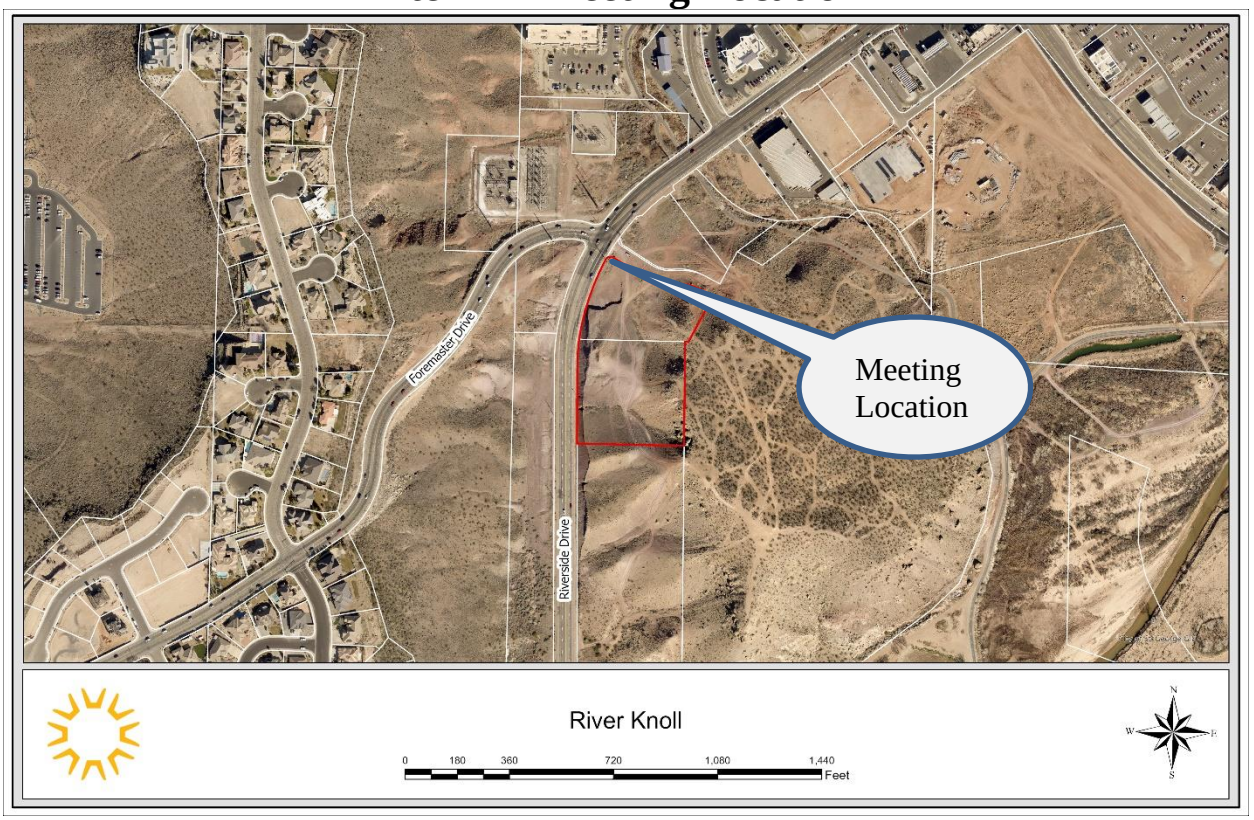
Brenda Hatch
Development Office Supervisor

Reasonable Accommodation: The City of St. George will make efforts to provide reasonable accommodations to disabled members of the public in accessing City programs. Please contact the City Human Resources Office at (435) 627-4674 at least 24 hours in advance if you have special needs.

Item #1 Meeting Location



Item #2 Meeting Location

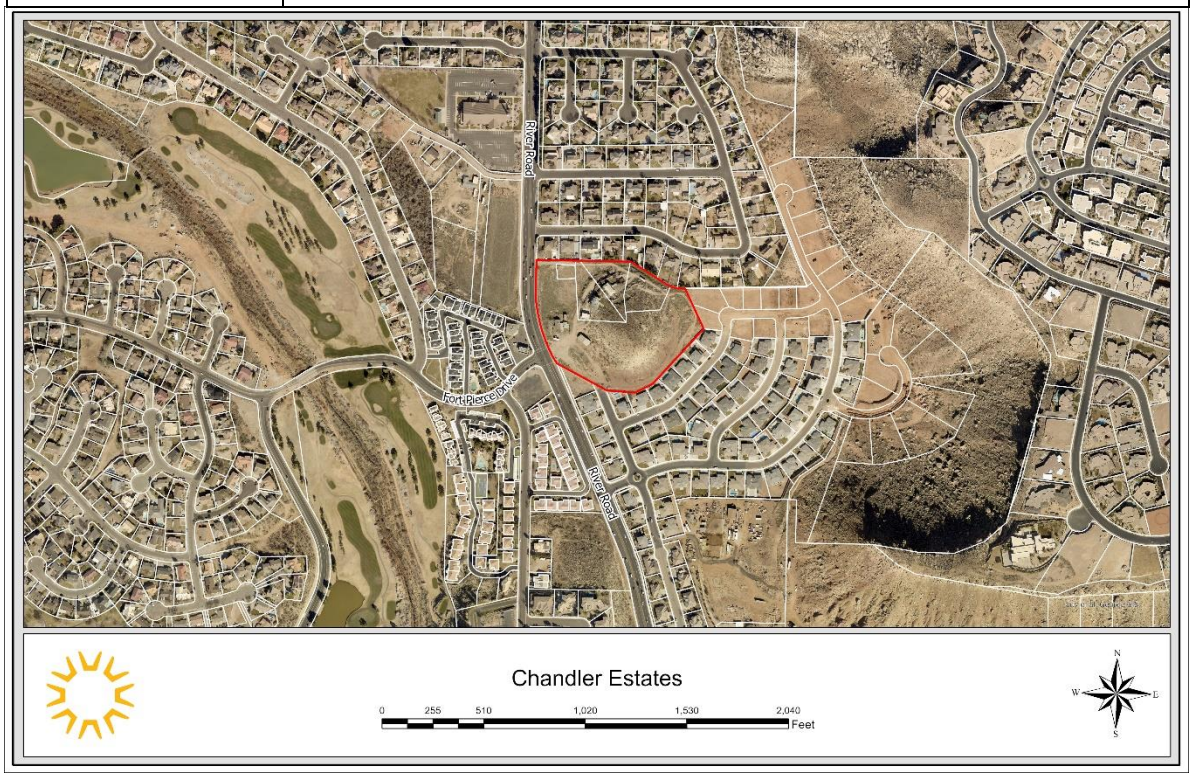


St.George
Community Development

ITEM 1
Hillside Permit

HILLSIDE REVIEW BOARD AGENDA REPORT: **11/29/2023**

Chandler Heights Hillside Development Permit (Case No. 2023-HS-010)		
Request:	Hillside Development Permit to allow disturbance of areas in the 20-30%, 30-40% and 40% and above slope areas. This application is a required in order to develop the property into single family homes.	
Applicant:	Park Bench Partners, PLLC	
Representative:	Bob Hermandson	
Location:	Approximately 1923 S River Road	
General Plan:	LDR (Low Density Residential)	
Existing Zoning:	R-1-10 (Single Family Residential 10,000 sq ft lots)	
Surrounding Zoning:	North	R-1-10 (Single Family Residential 10,000 sq ft lots)
	South	R-1-10 (Single Family Residential 10,000 sq ft lots)
	East	R-1-10 (Single Family Residential 10,000 sq ft lots)
	West	R-1-10 (Single Family Residential 10,000 sq ft lots), C-3 (General Commercial)
Land Area:	9.49 Acres	



BACKGROUND

In 2013, the Hillside Review Board (HRB) examined an application that would allow the removal of the hill that makes up the subject property. The HRB did determine that the hillside itself was not significant and supported its removal, but was concerned that if approved, it would be removed entirely, in a reasonable amount of time, and not partially remain as a scarred eyesore to the community. At the time the hillside permit was initially approved by the City Council, in December 2015, only phase one of Cottom Cove to the east and south of the subject property had been approved and a handful of homes had been constructed. Due to inaction on the part of the applicant, time lapsed, and the approvals of the hillside permit are null and void.

Initially, the applicant applied for a hillside permit requesting to remove the hill as before. After an initial HRB meeting in November of 2023, the applicant decided to revise the concept of the proposed development. In the currently proposed layout, the hill, which was previously proposed to be removed, will stay in place. This current layout depicts the homes (single family and duplex) at the rear of the hill, fairly secluded from River Road. A zone change to PD-R along with a plat would be required after this hillside step.

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 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 – Cut/Fill Map
   "Exhibit A" in the packet shows the Cut/Fill Map.

2. Exhibit B – Grading Plan
   "Exhibit B" in the packet is the Grading Plan

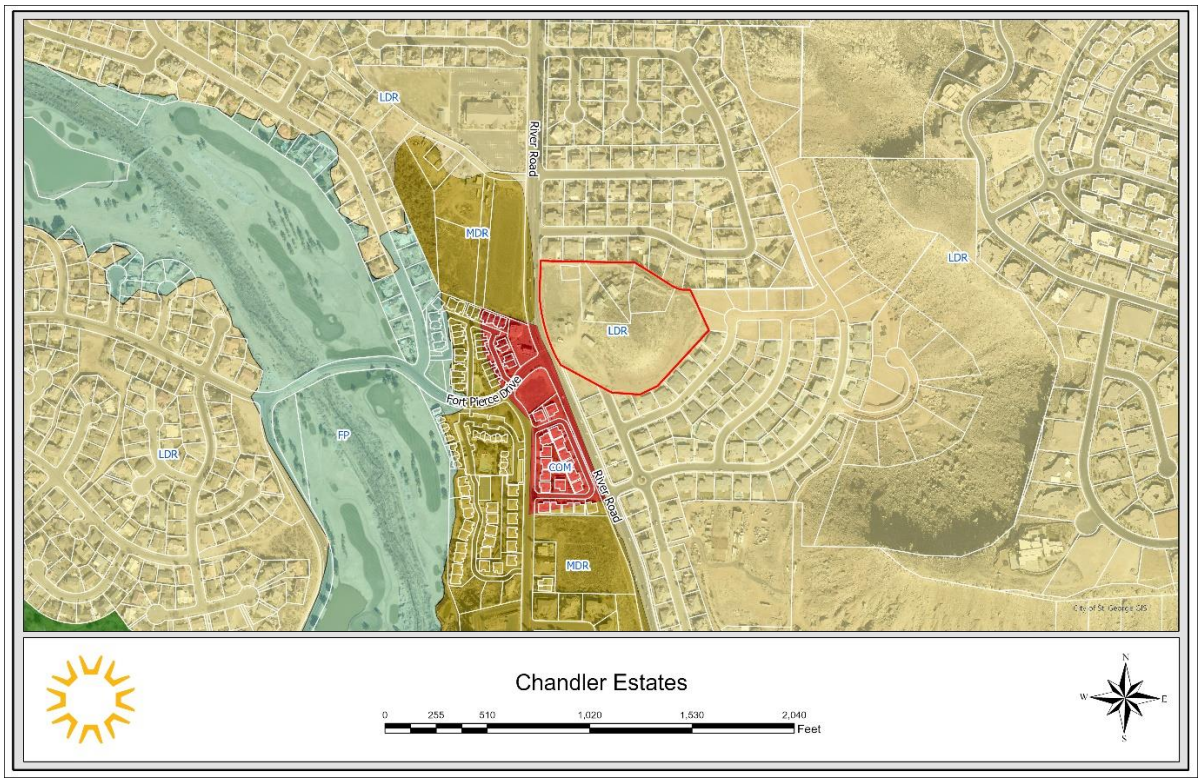
3. Exhibit C – Slope Analysis
   "Exhibit C" in the packet is an analysis of the slope.

4. Exhibit D – November 6, 2023 AGEC Letter
   "Exhibit E" in the packet is a letter provided by AGEC

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 – LDR - Low Density Residential



Zoning – R-1-10-(Single Family Residential 10,000 sq ft lots)

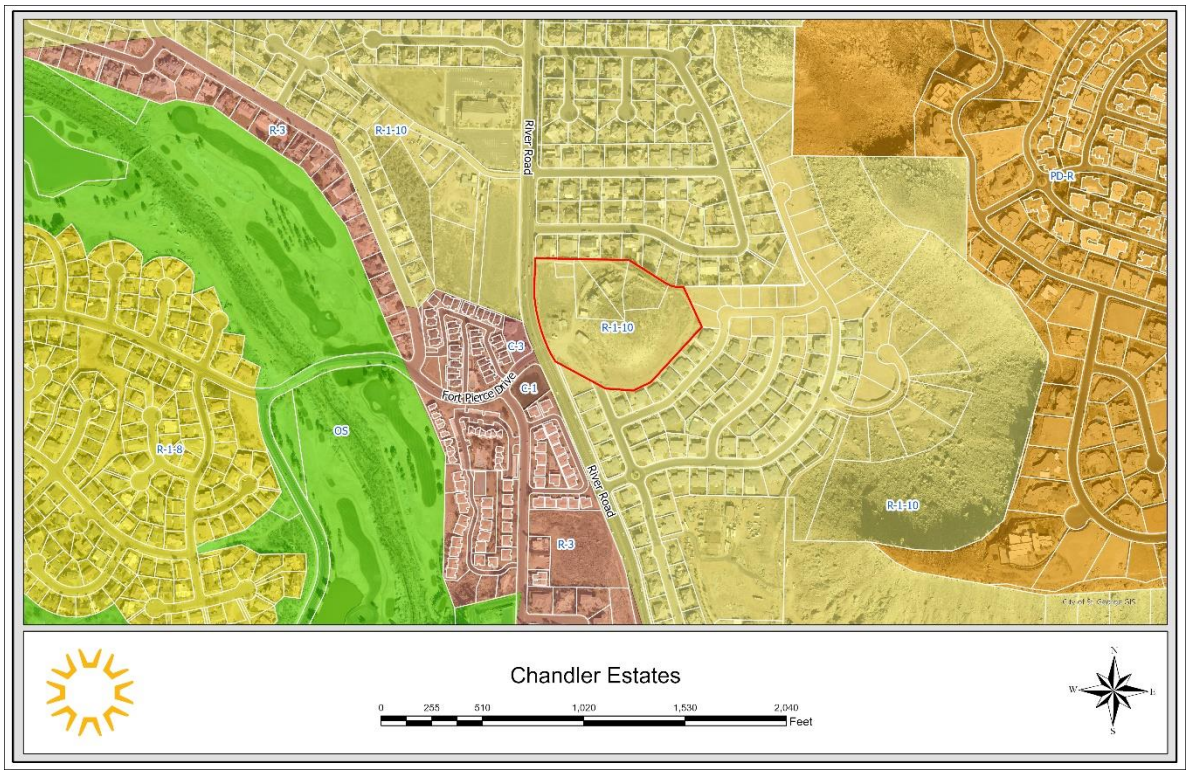
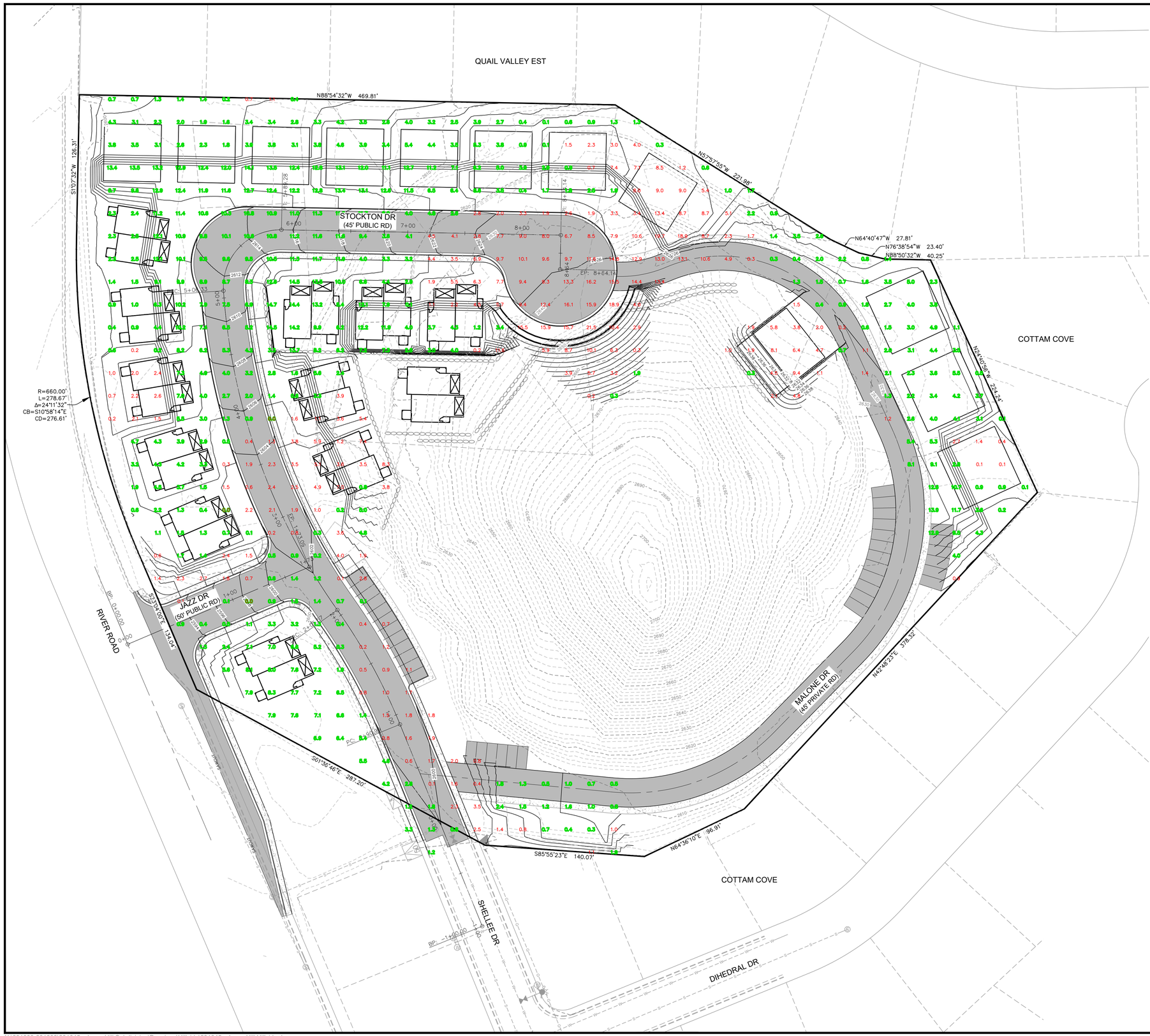


EXHIBIT A
Cut/Fill Map



EARTHWORK QUANTITIES

CUT	18,125 CY
FILL	32,201 CY
NET IMPORT	14,076 CY
MAX CUT	16.1 FT
MAX FILL	14.4 FT

No.5567007
WILLIAM F. MEYER, OR
01/03/2024

No.	Date	By	Revision

BUSH & GUDGELL, INC.
Engineers - Planners - Surveyors
205 East Tabernacle Suite #4
St. George, Utah 84770
Phone (435) 673-2337 / Fax (435) 673-3161
www.bushandgudgell.com

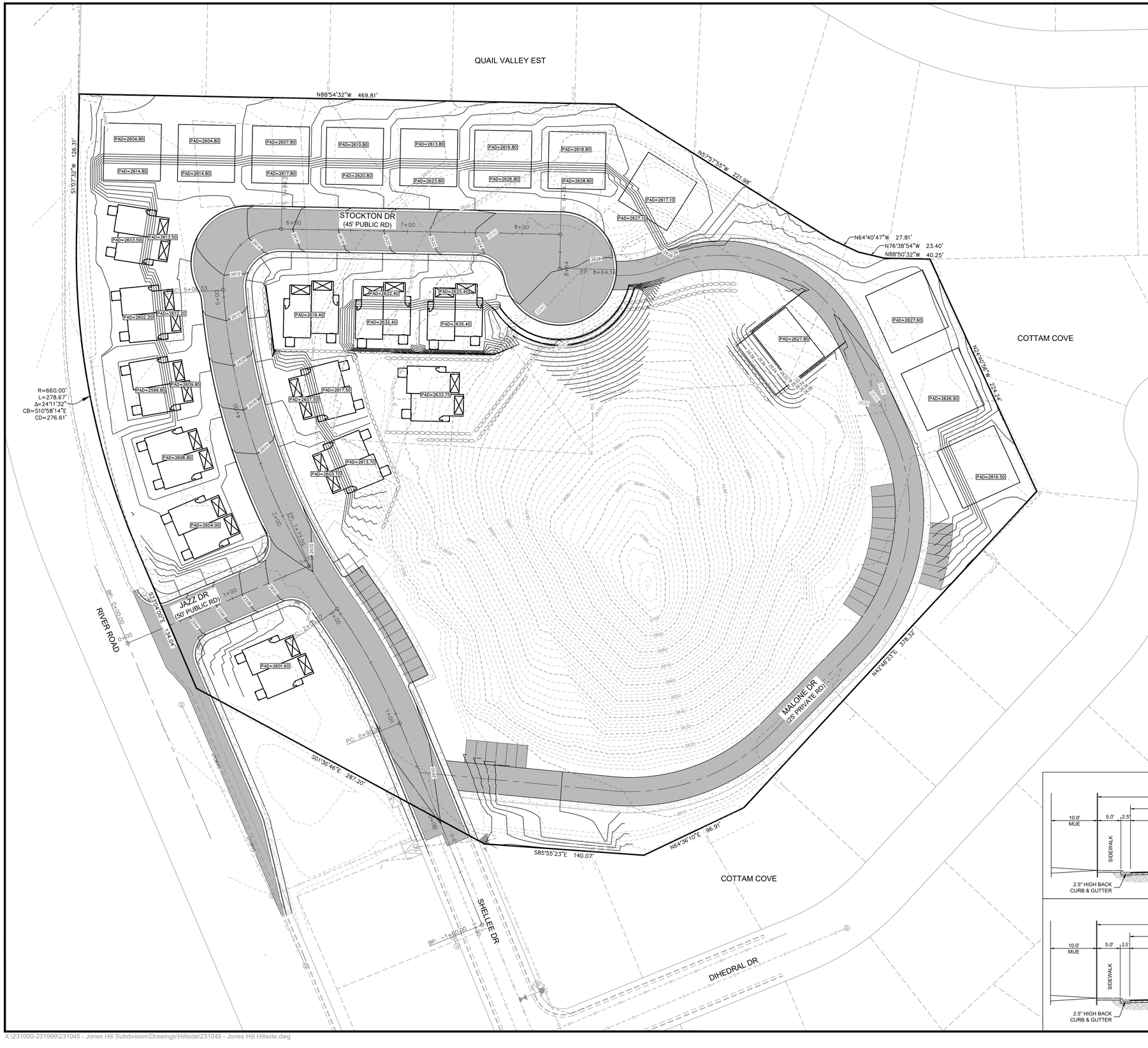
DATE: JAN 2023
DRAWN: CBW
APPROVED: WFM
SCALE: 1" = 40'
JOB NO.: 231045

CUT FILL MAP
CHANDLER HEIGHTS
LOCATED IN ST GEORGE, UTAH

SHEET 3 OF 3 SHEETS
FILE: HILLSIDE

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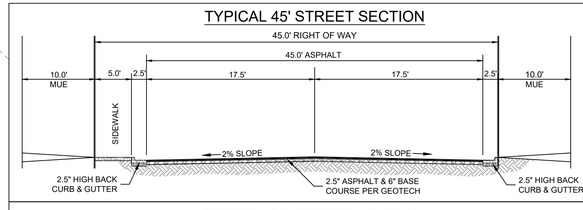
EXHIBIT B
Grading Plan Map



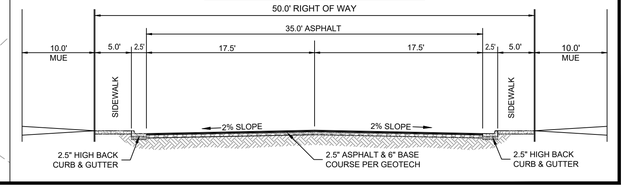
LEGEND

- RIGHT-OF-WAY LINE
- PROPOSED CURB & GUTTER
- EXISTING CURB & GUTTER
- PROPOSED STACKED ROCK RETAINING WALL
- DRAINAGE CHANNEL FLOW LINE
- EXISTING LOT LINE
- PROPOSED ASPHALT
- PROPOSED CONCRETE
- 20.00% - 29.99% SLOPE
- 30.00% - 39.99% SLOPE
- 40.00% - 99.99% SLOPE
- EXISTING GROUND CONTOUR
- FINISH GROUND CONTOUR
- DRAINAGE FLOW
- PAD= 00.0 — FINISH PAD ELEVATION
- LOCATION ELEVATION — SPOT ELEVATION
- SD — STORM DRAIN
- (S) — SINGLE CURB INLET PER CITY STD. DETAIL 205
- (D) — DOUBLE CURB INLET PER CITY STD. DETAIL 205
- LOT LINE
- STORM DRAIN MAN HOLE

TYPICAL 45' STREET SECTION



TYPICAL 50' STREET SECTION



No.5567007
WILLIAM F. MEYER, OR
01/03/2024
STATE OF UTAH

No	Date	By	Revision

BUSH & GUDGELL, INC.
Engineers - Planners - Surveyors
205 East Tabernacle Suite #4
St. George, Utah 84770
Phone (435) 673-2337 / Fax (435) 673-3161
www.bushandgudgell.com

DATE: JAN 2023
DRAWN: CBW
APPROVED: WFM
SCALE: 1" = 40'
JOB NO.: 231045

GRADING PLAN
CHANDLER HEIGHTS
LOCATED IN ST GEORGE, UTAH

SHEET 2 OF 3 SHEETS
FILE: HILLSIDE

X:\231000-231999\231045 - Jones Hill Subdivision\Drawings\Hillside\231045 - Jones Hill Hillside.dwg

EXHIBIT C
Slope Analysis

QUAIL VALLEY EST

COTTAM COVE

PARKBENCH PARTNERS PLLC SG-5-3-5-1210

PARKBENCH PARTNERS PLLC SG-5-3-5-1213

PARKBENCH PARTNERS PLLC SG-5-3-5-1212

PARKBENCH PARTNERS PLLC SG-5-3-5-1214

PARKBENCH PARTNERS PLLC SG-5-3-5-1211

N88°54'32"W 469.81'

S1°07'32"W 126.31'

R=660.00'
L=278.67'
Δ=24°11'32"
CB=S10°58'14"E
CD=276.61'

N57°57'55"W 221.98'

N64°40'47"W 27.81'

N76°38'54"W 23.40'

N88°50'32"W 40.25'

N24°40'56"W 224.24'

N42°45'23"E 378.32'

N64°36'10"E 95.91'

S85°55'23"E 140.07'

S61°36'46"E 287.20'

S23°04'00"E 134.04'

RIVER ROAD

SHELLEE DR

DIHEDRAL DR

LEGEND

- RIGHT-OF-WAY LINE
- PROPOSED CURB & GUTTER
- EXISTING CURB & GUTTER
- PROPOSED STACKED ROCK RETAINING WALL
- DRAINAGE CHANNEL FLOW LINE
- EXISTING LOT LINE
- PROPOSED ASPHALT
- PROPOSED CONCRETE
- 20.00% - 29.99% SLOPE
- 30.00% - 39.99% SLOPE
- 40.00% - 99.99% SLOPE

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.

PROFESSIONAL ENGINEER
No.5567007
WILLIAM F. MEYER, OR
01/03/2024
STATE OF UTAH

No	Date	By	Revision

BUSH & GUDGELL, INC.
Engineers - Planners - Surveyors
205 East Tabernacle Suite #4
St. George, Utah 84770
Phone (435) 673-2337 / Fax (435) 673-3161
www.bushandgudgell.com

DATE: JAN 2023
DRAWN: CBW
APPROVED: WFM
SCALE: 1" = 40'
JOB NO.: 231045

HILLSIDE MAP

CHANDLER HEIGHTS
LOCATED IN ST GEORGE, UTAH

SHEET 1 OF 3 SHEETS

FILE: HILLSIDE

X:\231000-231999\231045 - Jones Hill Subdivision\Drawings\Hillside\231045 - Jones Hill Hillside.dwg

EXHIBIT D
AGEC Letter

AGEC
Applied GeoTech

November 6, 2023

Parkbench Partners, PLLC
193 North Park Ave.
Washington, Utah 84780

Attn: Lori Killpack

Subject: Geologic Review and Hillside Evaluation
East of Intersection of Ft. Pierce Dr. and River Road
St. George, Utah
AGEC Project No. 2232112

Applied Geotechnical Engineering Consultants, Inc. (AGEC) was requested to evaluate the property for the proposed grading and to determine the potential for geologic hazards at the site.

AGEC previously has provided geotechnical consultation with regards to the suitability of the property for use as borrow or aggregate materials. In addition, AGEC has provided consultation previously for the site to a previously planned development. AGEC provided a geotechnical and hillside study for the Cottom Cove development to the south and east of the property. The information from these studies was evaluated in preparation of this report.

SCOPE OF WORK

The references for these studies are listed below:

- Hillside Review, Geologic Hazard Assessment and Geotechnical Study, by AGEC, Project No. 2121027, dated December 14, 2012.
- Material Suitability Report, Jones Hills (same property), AGEC Project No. 2200296, dated February 4, 2020.
- Rock wall Designs and Material Evaluation, AGEC Project No. 2180256, March 6, 2018.

AGEC has also reviewed the proposed grading plan prepared by Bush & Gudgell Engineering, Inc. provided on November 6, 2023.

The geologic conditions at the site were evaluated using the Geologic Map for the St. George Quadrangle Utah Geological Survey (UGS) Map 251, dated 2011, by Hayden and Willis. The geologic hazard map, by Lund etal, dated 2008 was also utilized in our literature review.

SITE CONDITIONS

The site is located east of River Road across from the intersection of Ft. Peirce Drive and River Road. The site consists of a large knoll that is approximately 100 feet in height. The hill peaks with a small knoll at the top. There are existing residences to the east, south and north. The western and northwestern portion of the property is a slope to flat area along River Road where existing debris, farm equiment and small storage sheds exist. There are also several exsting structures on the northwest side of the property. An aerial map of the property is shown below (Figure 1).



Figure 1, site location map

GEOLOGIC CONDITIONS

Based on our review of the literature along with our site visit, the upper approxmately 50 to 70 feet of the knoll consists of sandstone and is underlain by interlayered sitstone and fine grained sandstone. The contact zone between members is dipping down to the northeast. The majority of the hillside will be the yellowish brown sandstone (Upper Sandstone). The geologic mapping is shown below:

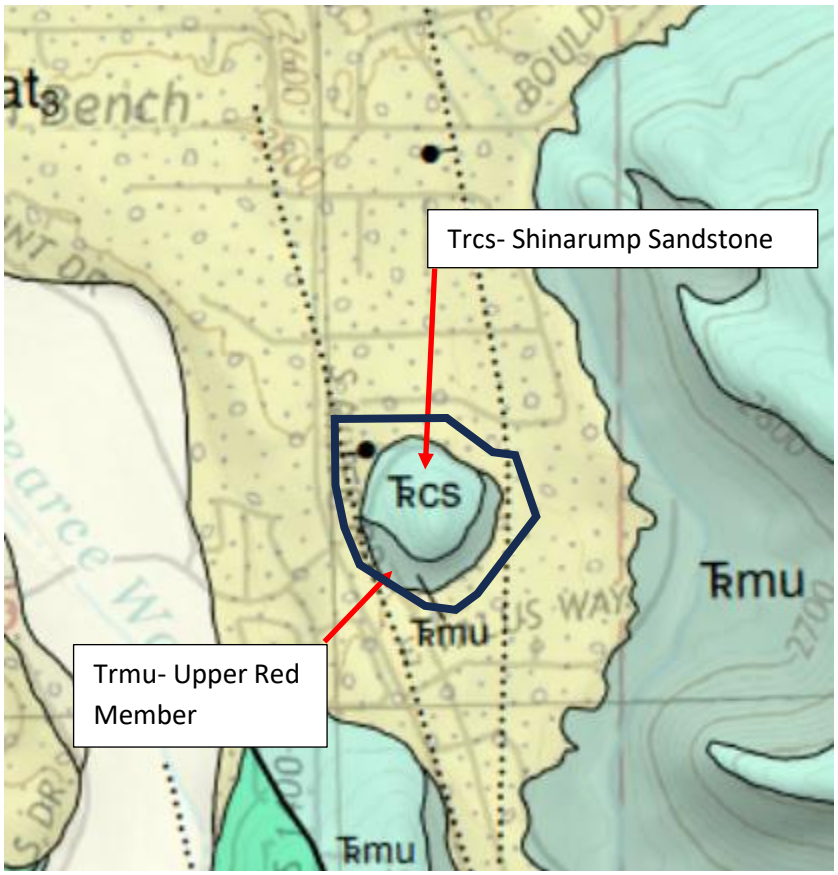


Figure 2, Geologic Map, St. George Quadrangle UGS Map 251, 2011, Hayen and Willis.

Each of the rock material types are described below:

Trcs- Shinarump Sandstone: The upper sandstone is the light brown to yellowish material shown in the photos below and is the Shinarump Member of the Peterified Forest Formation. This material is moderately hard to hard and will require blasting to excavate.

Trmu Upper Red Member: The lower sandstone/siltstone material that is red in color is the Upper Red Member of the Moenkopi Formation. It is moderately hard, but typically can be excavated without blasting. It will require heavy duty excavation equipment to remove. The photo (photo No. 1) below illustrates the two types of materials at the site.

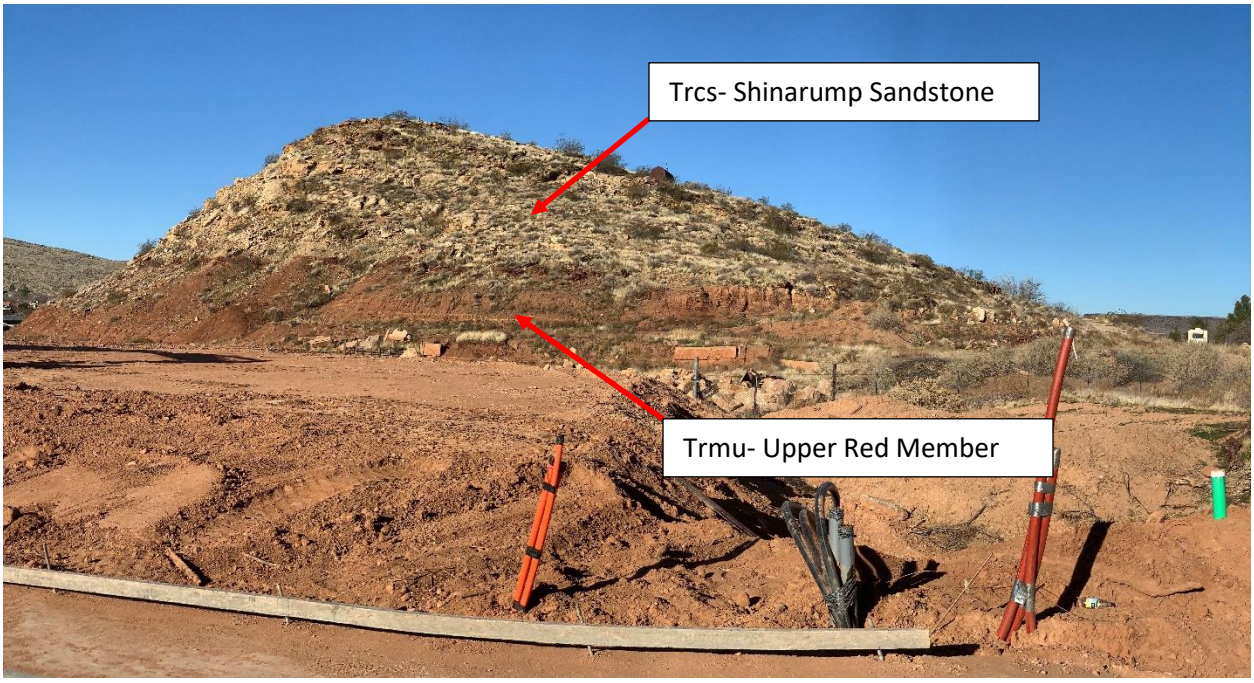


Photo No. 1 – view of Jones Hill looking west to slightly NW.

GEOLOGIC HAZARDS

AGEC has reviewed the potential geologic hazards at the site. The following were identified as a concern:

- Hard Rock – will be excavated/blasted and removed.
- Rock Fall - will be excavated/blasted and removed.
- Earthquake/Fault - The St. George Fault is mapped by Christenson and Dean (1983), Lund and others (2008). Based on the mapping the inferred or concealed location of the fault extends in a north-south direction along both sides of the knoll as shown in the map below, Figure 3. Based on the

mapping, a site specific surface fault rupture study is not recommended unless a critical structure such as a medical facility or school is planned. The planned use of the site being single family residential, it is not required. In addition, our conversations with Utah Geological Survey (UGS) professional geologists, indicate the ST. George Fault is not considered active and is not a restriction in the area of development.

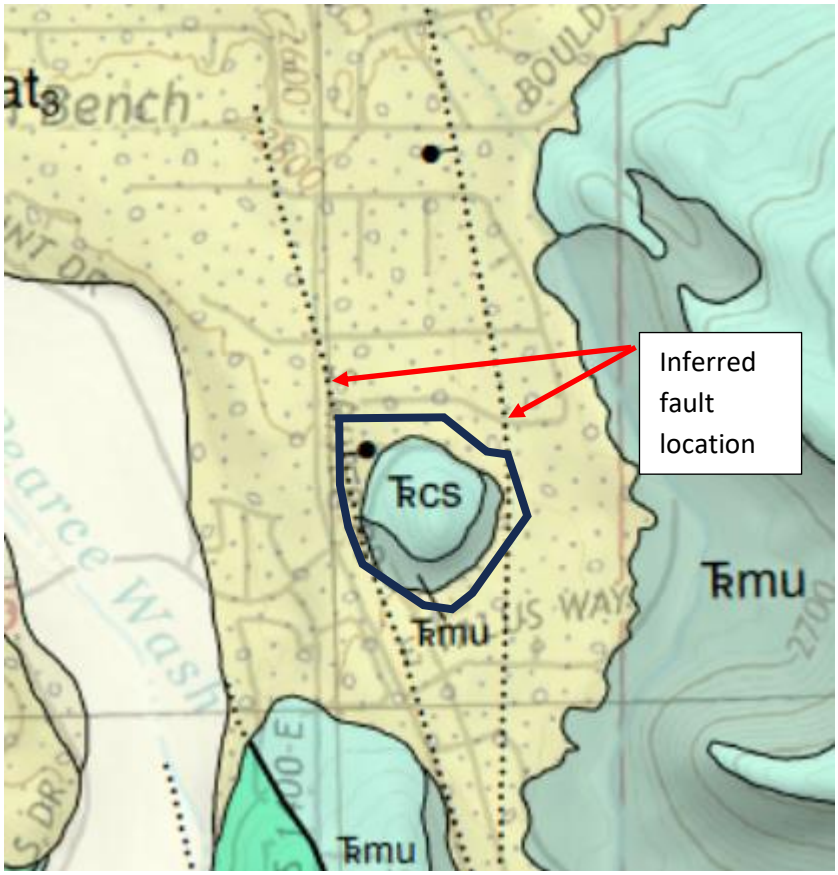


Figure 3, Geologic Map with inferred fault location on both sides of the knoll.

PROPOSED GRADING/DEVELOPMENT

We understand that is it proposed to remove the hill and export as structural fill materials for various projects. The grading will require upwards of a 100 foot cut and a few feet of fill, exporting on the order of 268,000 cubic yards and filling on site approximately 10,000 cubic yards. AGEC has reviewed the grading plan prepared by Bush & Gudgell Engineering, Inc. The plan shows 42 lots will be subdivided as shown on the cut-fill map shown below.



Figure 4, cut-fill map of the proposed grading, showing 42 lots, prepared by B&G.

CONCLUSIONS

The site is suitable for the proposed future residential development. Following removal of the materials and prior to placing fills on the northwest portion of the site, AGEC should verify the conditions exposed at that time.

The site may be used as structural fill materials. Our experience in the area has shown the upper sandstone (Shinarump Sandstone) it is suitable for rock stacking and makes suitable structural fill. It will likely require processing to provide a suitable size for use as fill. Depending on the blasting technique used, the material may need to be screened or crushed. Our experience has also shown that this material meets the requirements for Type I, but is marginal to meet the requirements for Type II (basecourse) for St. George

City requirements. We anticipate increase in volume of 15-20 percent percent depending on the final in-place use of the material.

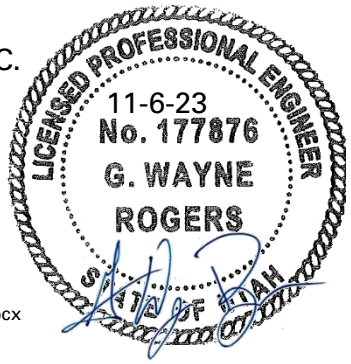
The lower bedrock (Upper Red Member) will also be suitable for use as structural fill. It can be processed to the appropriate size typically with steel tracking or sheeps foot compaction. There are layers within this zone that may be hard and require additional effort to break down to suitable size for a compacted fill material. The material is not suitable for rock stacking material.

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the geologic review and our observations of the site conditions and our experience in the area. Variations in the subsurface conditions may not become evident until excavation is conducted. If the subsurface conditions are found to be significantly different from those described above, we should be notified to reevaluate our recommendations.

If you have any questions or if we can be of further service, please call.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



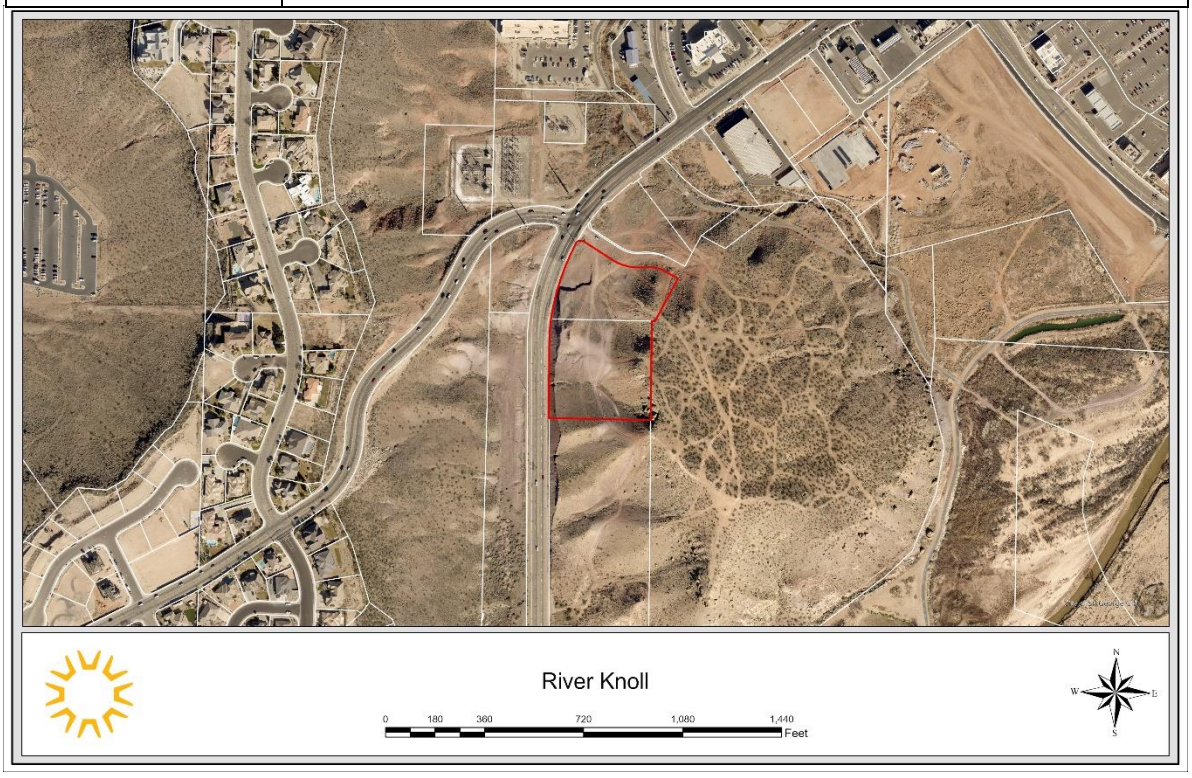
G. Wayne Rogers, P.E.
P:\2023 Project Files\2232100\2232112 - GT - Chandler Heights\Hillside Letter-Chandler Heights.docx

St.George
Community Development

ITEM 2
Hillside Permit

HILLSIDE REVIEW BOARD AGENDA REPORT: **01/24/2024**

River Knoll Hillside Development Permit (Case No. 2024-HS-001)		
Request:	Hillside Development Permit to allow disturbance of areas in the 20-30%, 30-40% and 40% and above slope areas. This application is a required in order to develop the property into a commercial use.	
Applicant:	Aspen Grove LLC/ John Hendlemen	
Representative:	Eric McFadden	
Location:	Approximately 2000 S Riverside Drive	
General Plan:	COM (Commercial)	
Existing Zoning:	C-3 (General Commercial)	
Surrounding Zoning:	North	C-3 (General Commercial)
	South	PD-R (Planned Development Residential)
	East	RE-20 (20,000 ft² residential lots), OS (Open Space)
	West	PD-C (Planned Development Commercial)
Land Area:	4.99 Acres	



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 – Slope Analysis Map
   "Exhibit A" in the packet shows the Slope Analysis Map.

2. Exhibit B – Site Plan
   "Exhibit B" in the packet is the proposed site plan.

3. Exhibit C – Ropes Course Details
   "Exhibit C" in the packet are images of the proposed ropes course.

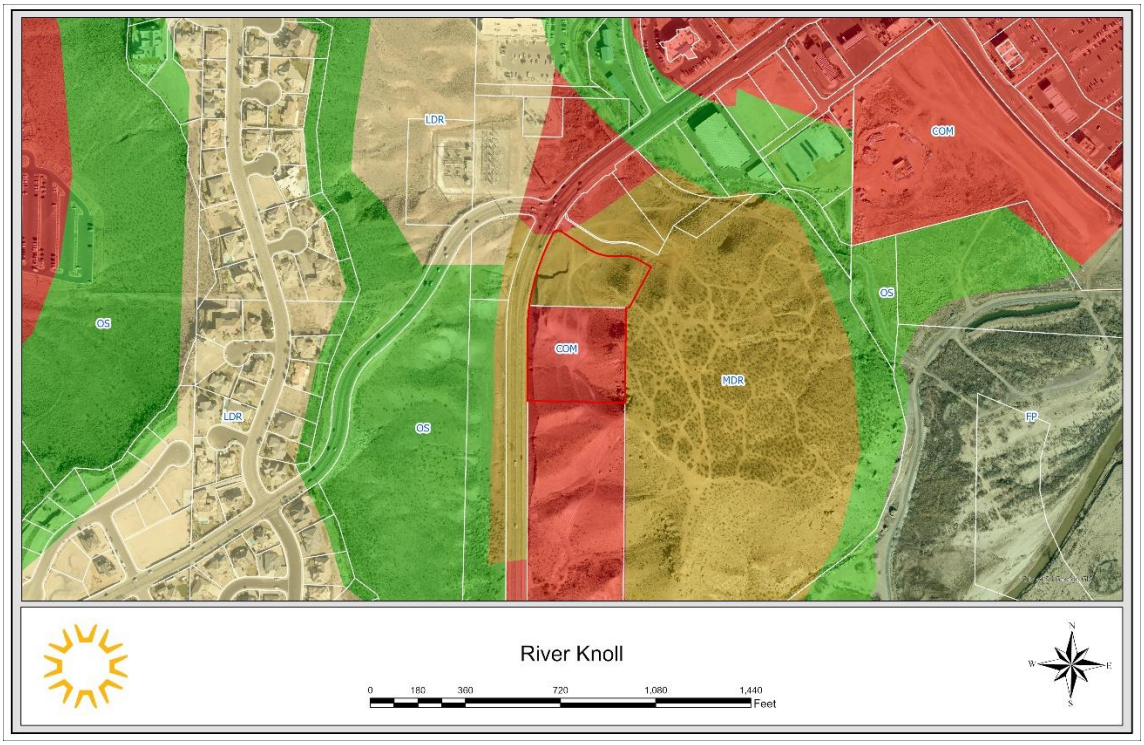
4. Exhibit D – Geotechnical Report
   "Exhibit D" in the packet is the geotechnical report by Landmark.

5. Exhibit E – Drainage Control Plan
   "Exhibit E" in the packet is a drainage plan produced by Premier Design

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 - Commercial



Zoning – R-1-10-(Single Family Residential 10,000 sq ft lots)

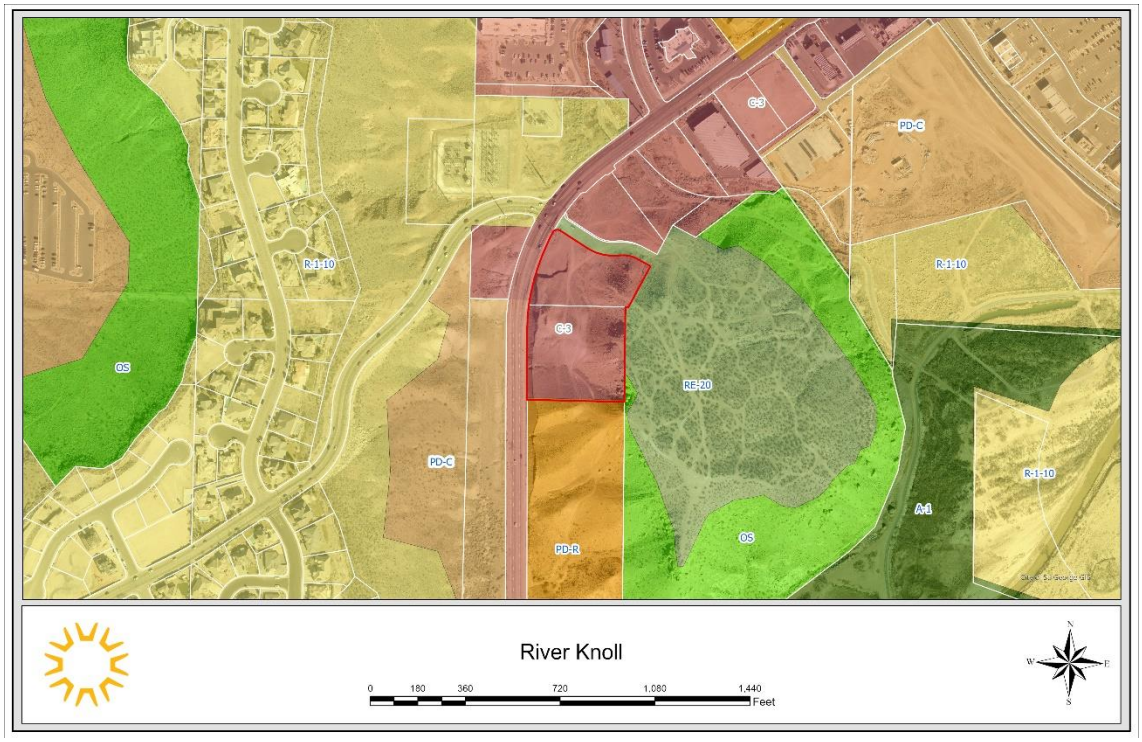
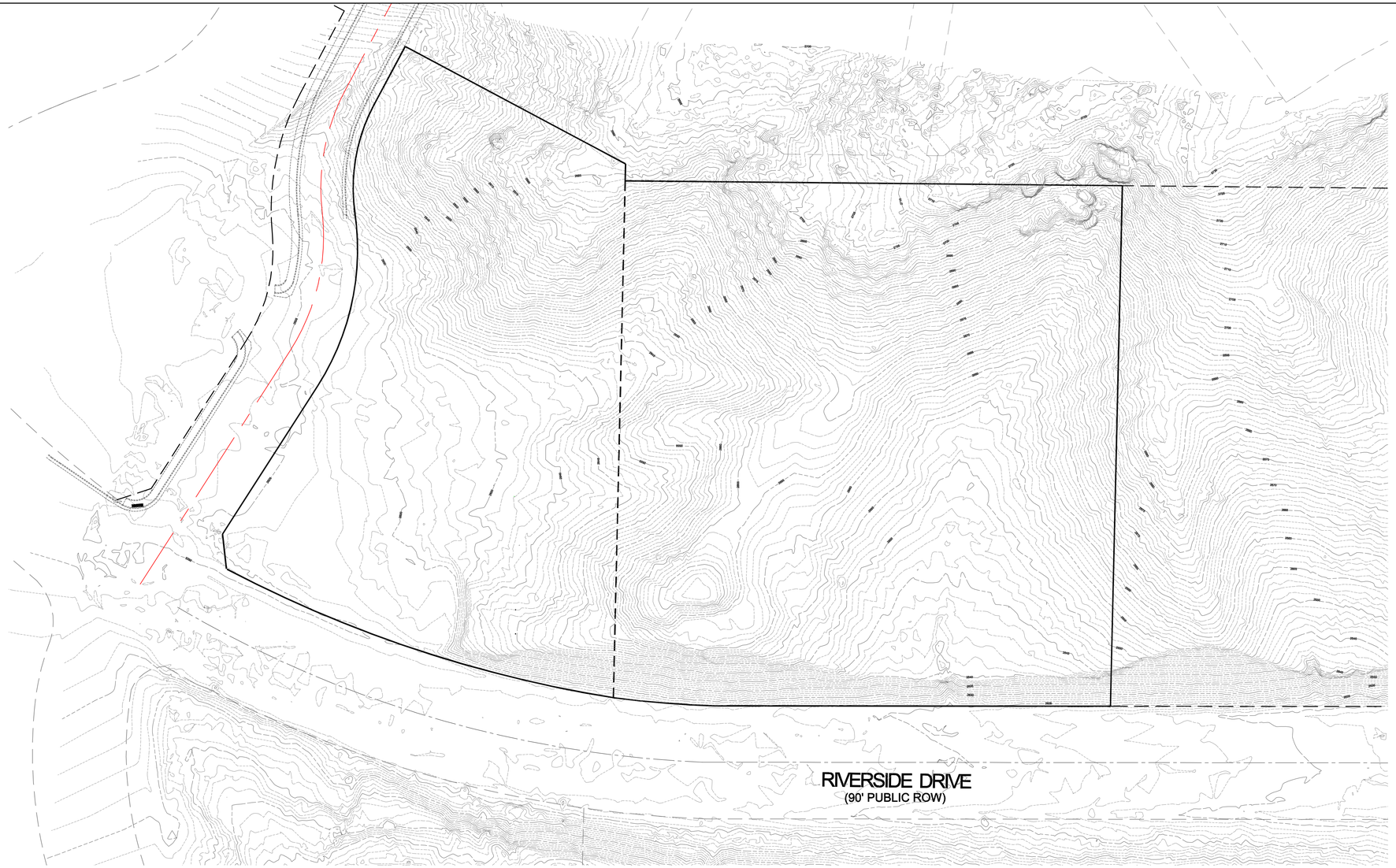


EXHIBIT A
Slope Analysis Map



PROPERTY INFO

PROPERTY ADDRESS = PARCEL # SG-5-2-28-235 & 3 ACRES SOUTH
RIVERSIDE DRIVE
ST.GEORGE, UTAH 84770

OWNER / DEVELOPER:

ASPENS GROVE LLC
30 N GOULD ST, SUITE R
SHERIDAN, WY 82801
PHONE: (801) 628-7147

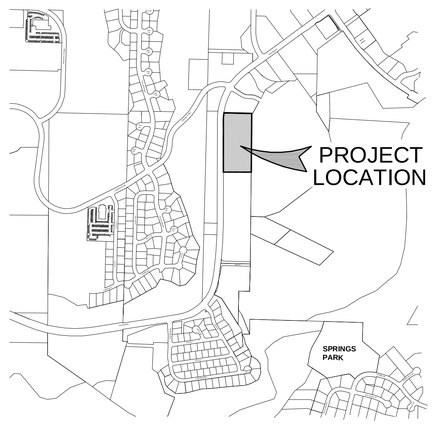
GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

LEGEND

2661 EXISTING 1' CONTOUR
2670 EXISTING 5' CONTOUR
PROPERTY LINE



VICINITY MAP

DATE:	12/13/2023
DRAWN BY:	E.A.M.
CHECKED BY:	M.R.F.
CLIENT:	AGLLC

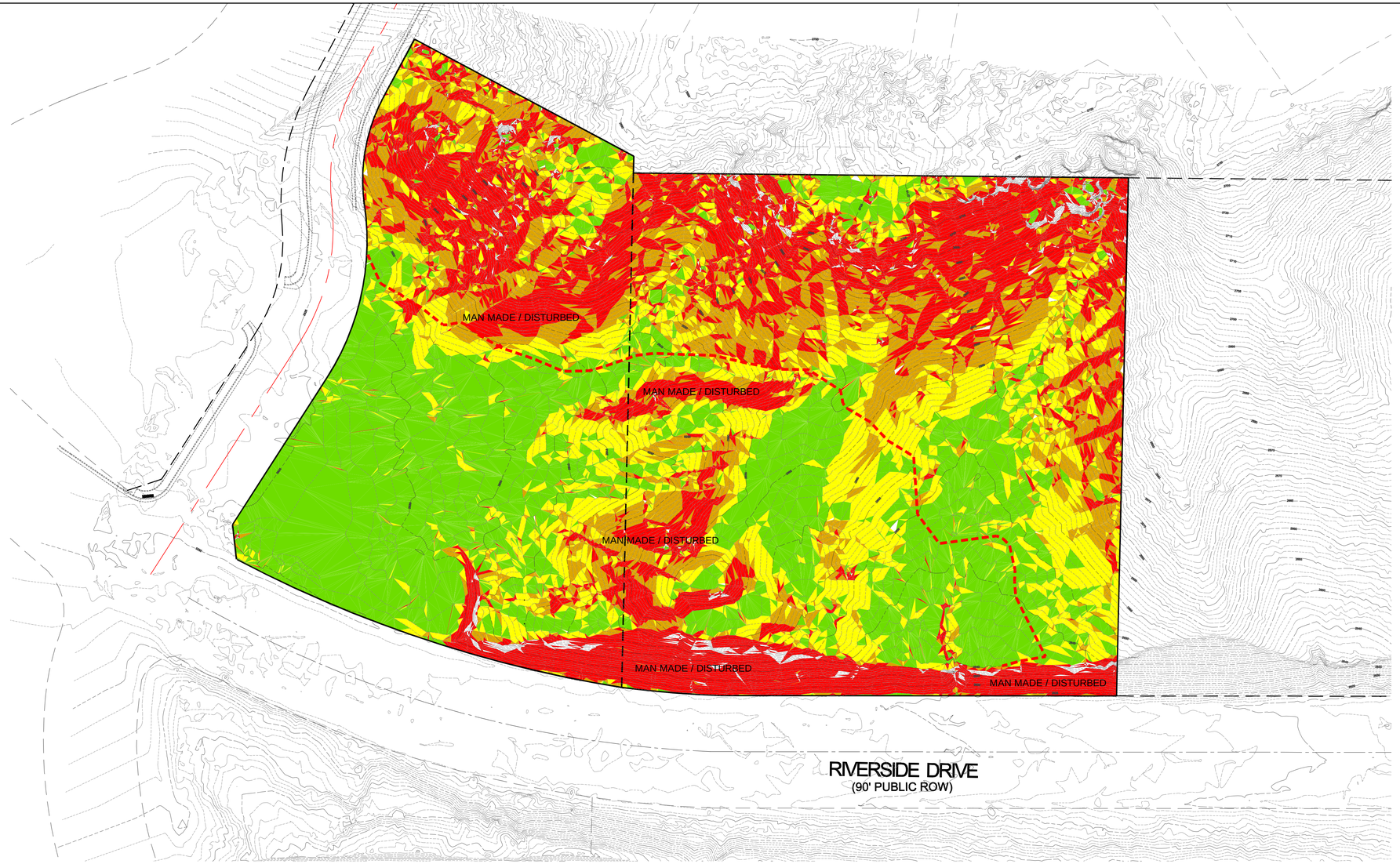
SCALE: 1" = 40'

TOPOGRAPHY MAP
PARCEL SG-5-2-28-325 & 3 ACRES SOUTH
ASPENS GROVE LLC
ST.GEORGE, UTAH 84770

PREMIER Design & Engineering
75 EAST 100 NORTH IVINS, UTAH 84738 (435) 319-2267

PROFESSIONAL ENGINEER
12/13/2023
License No. 323886
Marc R. Fonger
STATE OF UTAH

SHEET
TM



SLOPE LEGEND

Color	Range Beg.	Range End	Percent	Area
	0.00	19.99	35.4	76,958
	20.00	29.99	20.2	43,896
	30.00	39.99	17.1	37,095
	40.00	100.00	27.3	59,427

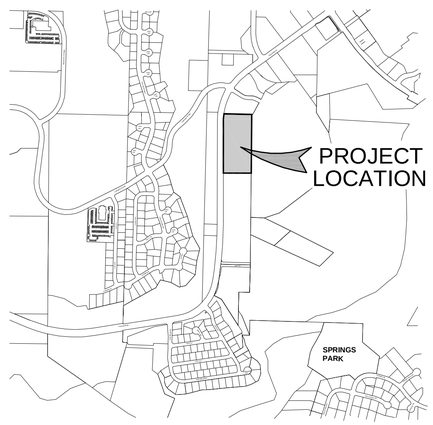
GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

LEGEND

2661 EXISTING 1' CONTOUR
2670 EXISTING 5' CONTOUR
PROPERTY LINE
LIMITS OF EXCAVATION



VICINITY MAP

DATE: 12/13/2023
DRAWN BY: E.A.M.
CHECKED BY: M.R.F.
CLIENT: AGLLC

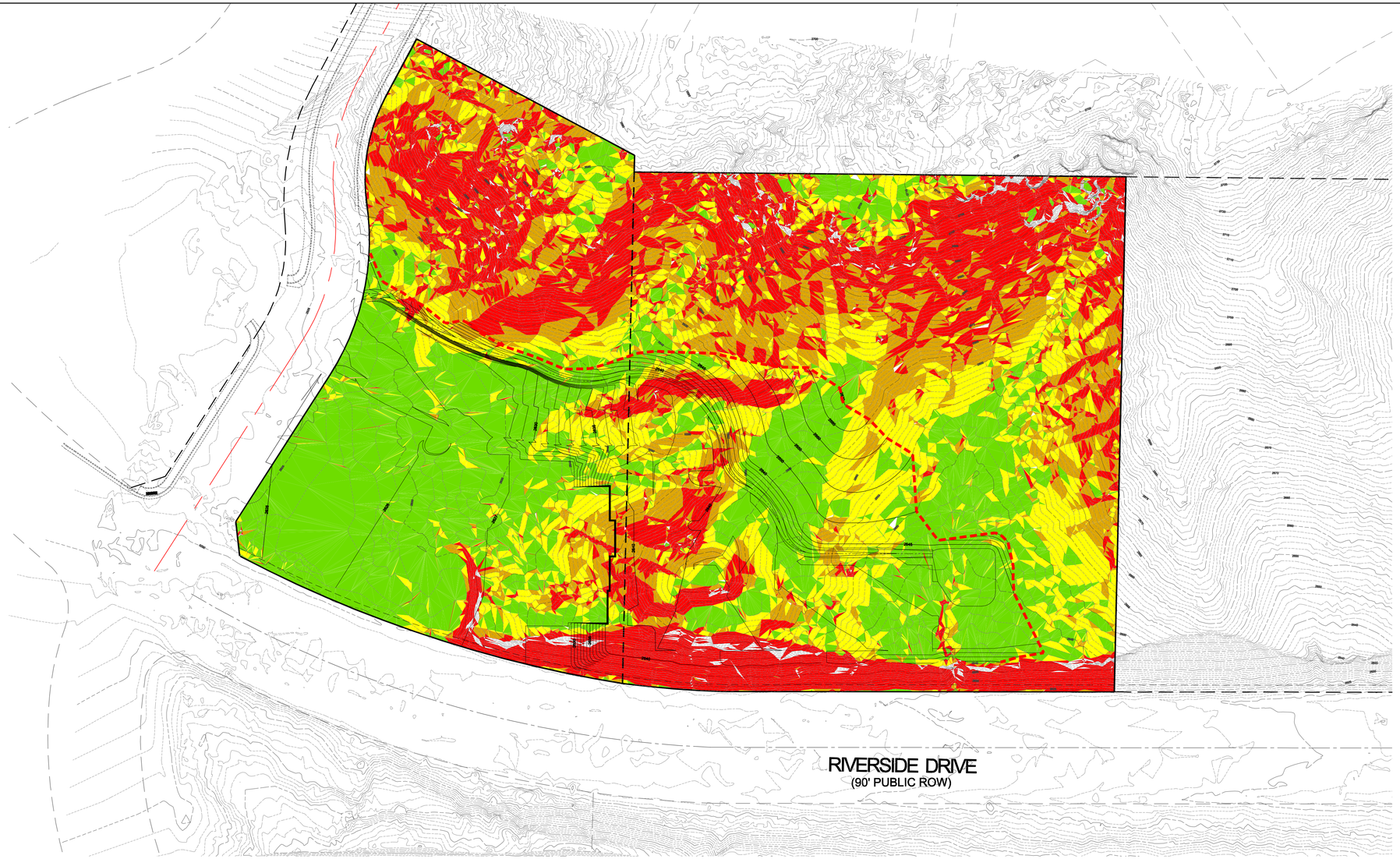
SCALE: 1" = 40'

SLOPE MAP
PARCEL SG-5-2-28-325 & 3 ACRES SOUTH
ASPENS GROVE LLC
ST.GEORGE, UTAH 84770

PREMIER Design & Engineering
75 EAST 100 NORTH IVINS, UTAH 84738 (435) 313-2267

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12/13/2023
License No. 323806
Marc R. Fonger
STATE OF UTAH

SHEET
SM



EARTHWORK QUANTITIES

31,390	(C) CU. YD. CUT
192	(F) CU. YD. FILL
31,198	(C) CU. YD. NET CUT

CUT AND FILL VOLUMES SHOWN ARE BASED ON DIGITAL TERRAIN MODELING COMPUTATIONS. VOLUMES SHOWN ARE COMPACTED IN PLACE VOLUMES AND DO NOT REFLECT EXPANSION AND SHRINKAGE CONDITIONS EXPERIENCED DURING CONSTRUCTION. THESE VOLUMES ARE SHOWN AS REFERENCE ONLY.

THE CONTRACTOR SHALL BE RESPONSIBLE TO EVALUATE THE ONSITE SOILS, REVIEW THE GEOTECHNICAL INVESTIGATION AND DETERMINE THE ANTICIPATED EARTHWORK FOR THIS PROJECT.

THESE VOLUMES ARE GENERATED TO THE FINISHED GRADE OF THE SITE

SLOPE LEGEND

Color	Range Beg.	Range End	Percent	Area
	0.00	19.99	35.4	76,958
	20.00	29.99	20.2	43,896
	30.00	39.99	17.1	37,095
	40.00	100.00	27.3	59,427

GRAPHIC SCALE

40 0 20 40 80 160

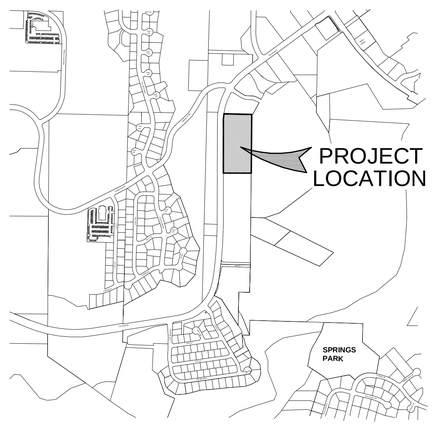
(IN FEET)
1 inch = 40 ft.

SITE DATA

TOTAL SITE AREA = 217,376 SQ.FT. / 4.99 ACRES (100%)
DISTURBED GRADED AREA = 102,938 SQ.FT. / 2.36 ACRES (47.4%)
UNDISTURBED AREA = 114,438 SQ.FT. / 2.82 ACRES (52.6%)

LEGEND

- 2661 — EXISTING 1' CONTOUR
- 2670 — EXISTING 5' CONTOUR
- 2669 — PROPOSED 1' CONTOUR
- 2670 — PROPOSED 5' CONTOUR
- PROPERTY LINE
- LIMITS OF EXCAVATION



VICINITY MAP

DATE:	12/13/2023
DRAWN BY:	E.A.M.
CHECKED BY:	M.R.F.
CLIENT:	AGLLC

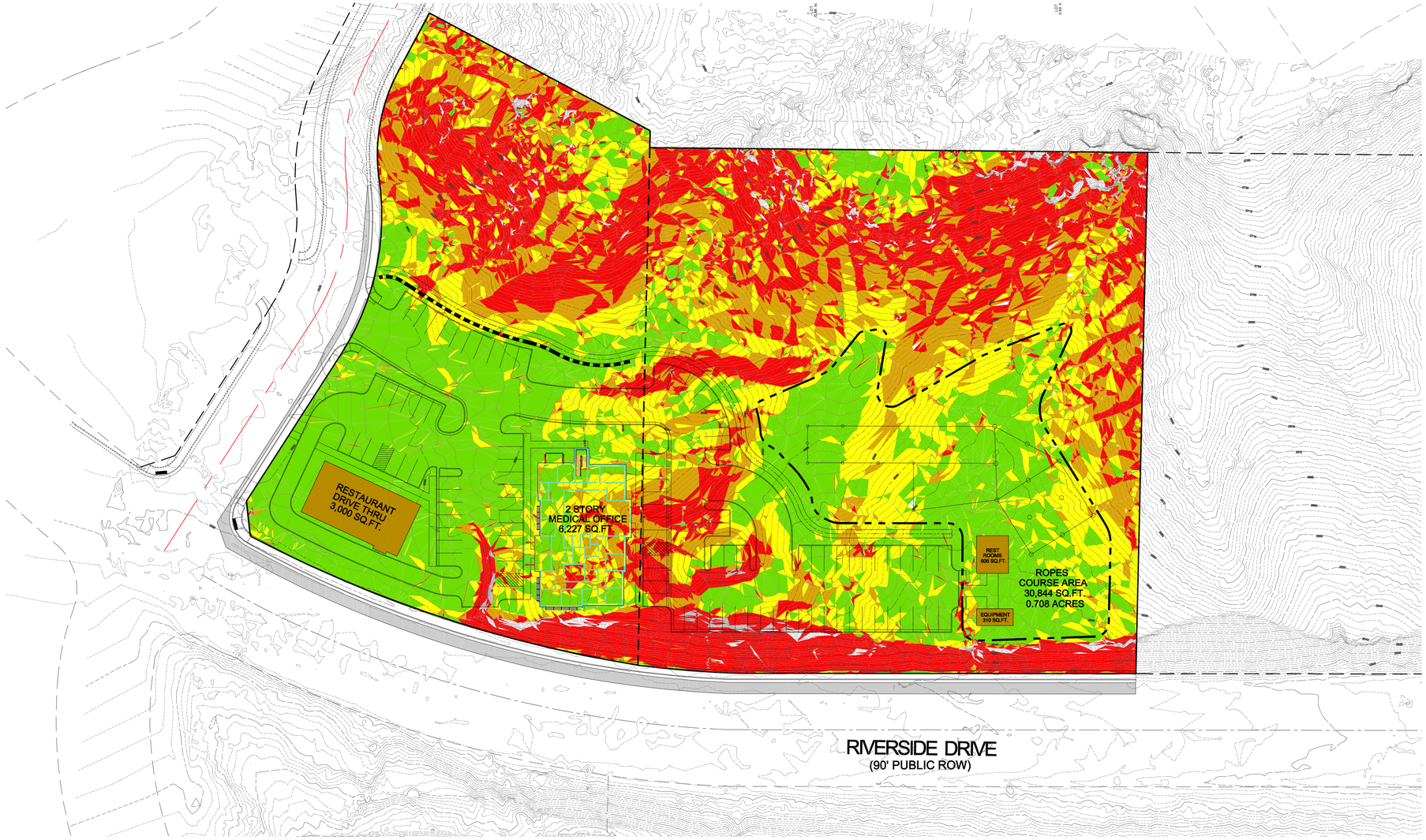
SCALE: 1" = 40'

MASS GRADING PLAN
PARCEL SG-5-2-28-325 & 3 ACRES SOUTH
ASPENS GROVE LLC
ST.GEORGE, UTAH 84770

PREMIER Design & Engineering
75 EAST 100 NORTH IVINS, UTAH 84738 (435) 313-2267

PROFESSIONAL ENGINEER
12/13/2023
License No. 323806
Marc R. Fonger
STATE OF UTAH

SHEET
MG



LEGEND

- 2661 EXISTING 1' CONTOUR
- 2670 EXISTING 5' CONTOUR
- PROPERTY LINE
- BUILDING AREA
- ASPHALT AREA
- ROPES COURSE AREA

SITE DATA

TOTAL SITE AREA = 217,376 SQ.FT. / 4.99 ACRES (100%)
UNDISTURBED AREA = 114,438 SQ.FT. / 2.82 ACRES (52.6%)
BUILDING FOOTPRINT AREA = 10,142 SQ.FT. / 0.23 ACRES (4.7%)
PARKING LOT & SIDEWALK AREA = 46,417 SQ.FT. / 1.06 ACRES (21.4%)
ROPES COURSE AREA = 30,844 SQ.FT. / 0.70 ACRES (14.2%)
LANDSCAPED AREA = 15,535 SQ.FT. / 0.35 ACRES (7.1%)

PARKING CALCULATIONS:

RESTAURANT AREA = 1/100 SQ.FT. (DINING AREA)
RESTAURANT AREA = 1/250 SQ.FT. (KITCHEN AREA)

OFFICE AREA = 1/250 SQ.FT.

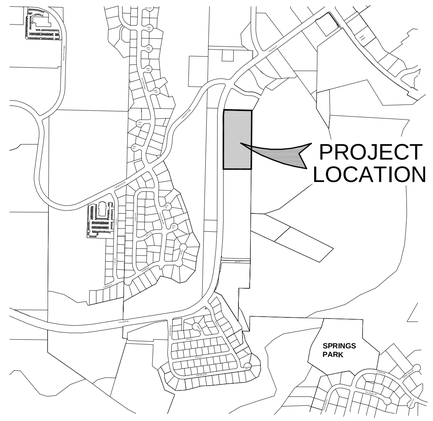
ROPES COURSE AREA = 1/1200 SQ.FT.

RESTAURANT AREA = 1700 SQ.FT. (DINING AREA) = 1700/100 = 17
RESTAURANT AREA = 1300 SQ.FT. (KITCHEN AREA) = 1300/250 = 5
PARKING REQ'D = 22

OFFICE AREA = 12,454 SQ.FT.= 12,454/250 = 50
PARKING REQ'D = 50

ROPES COURSE AREA = 30,844 SQ.FT.= 30,844/1200 = 26
PARKING REQ'D = 26

TOTAL PARKING REQ'D = 98
TOTAL PARKING PROVIDED = 99



VICINITY MAP

DATE: 12/13/2023
DRAWN BY: E.A.M.
CHECKED BY: M.R.F.
CLIENT: AGLLC

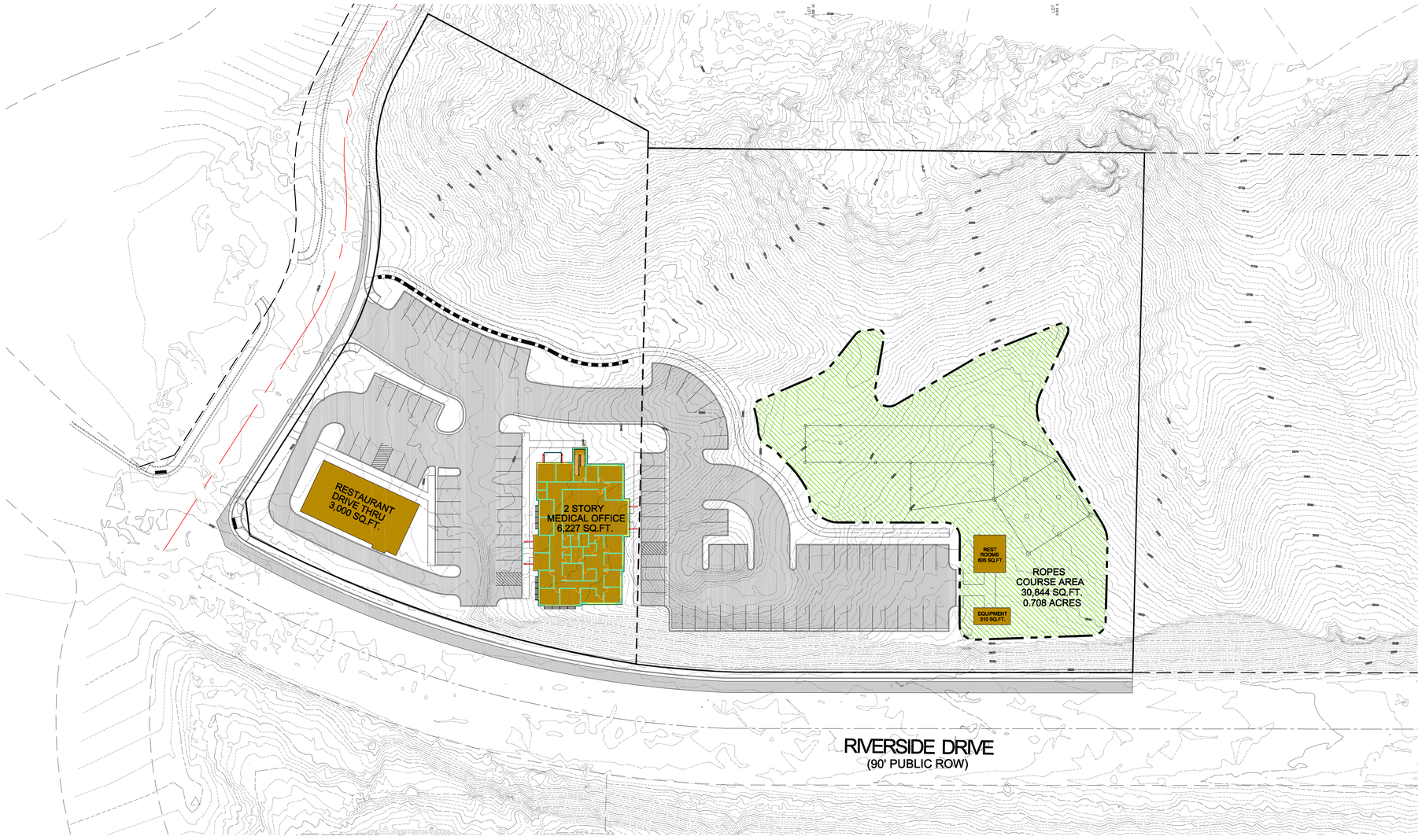
SCALE: 1" = 40'

CONCEPTUAL LAYOUT
PARCEL SG-5-2-28-325 & 3 ACRES SOUTH
ASPENS GROVE LLC
ST.GEORGE, UTAH 84770

PREMIER Design & Engineering
75 EAST 100 NORTH IVINS, UTAH 84738 (435) 313-2267

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12/13/2023
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Marc R. Fonger
STATE OF UTAH

SHEET
C



LEGEND

- EXISTING 1' CONTOUR (2661)
- EXISTING 5' CONTOUR (2670)
- PROPERTY LINE
- BUILDING AREA
- ASPHALT AREA
- ROPES COURSE AREA

SITE DATA

TOTAL SITE AREA = 217,376 SQ.FT. / 4.99 ACRES (100%)
UNDISTURBED AREA = 114,438 SQ.FT. / 2.82 ACRES (52.6%)
BUILDING FOOTPRINT AREA = 10,142 SQ.FT. / 0.23 ACRES (4.7%)
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ROPES COURSE AREA = 30,844 SQ.FT. / 0.70 ACRES (14.2%)
LANDSCAPED AREA = 15,535 SQ.FT. / 0.35 ACRES (7.1%)

PARKING CALCULATIONS:

RESTAURANT AREA = 1/100 SQ.FT. (DINING AREA)
RESTAURANT AREA = 1/250 SQ.FT. (KITCHEN AREA)

OFFICE AREA = 1/250 SQ.FT.

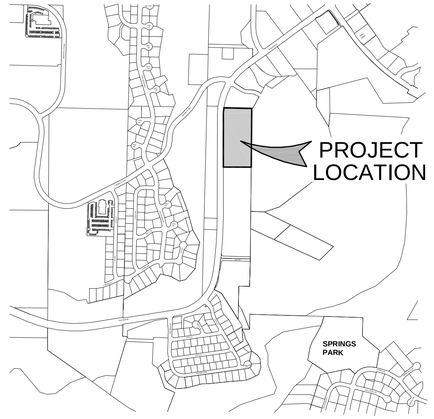
ROPES COURSE AREA = 1/1200 SQ.FT.

RESTAURANT AREA = 1700 SQ.FT. (DINING AREA) = 1700/100 = 17
RESTAURANT AREA = 1300 SQ.FT. (KITCHEN AREA) = 1300/250 = 5
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OFFICE AREA = 12,454 SQ.FT.= 12,454/250 = 50
PARKING REQ'D = 50

ROPES COURSE AREA = 30,844 SQ.FT.= 30,844/1200 = 26
PARKING REQ'D = 26

TOTAL PARKING REQ'D = 98
TOTAL PARKING PROVIDED = 99



VICINITY MAP

DATE: 12/13/2023
DRAWN BY: E.A.M.
CHECKED BY: M.R.F.
CLIENT: AGLLC

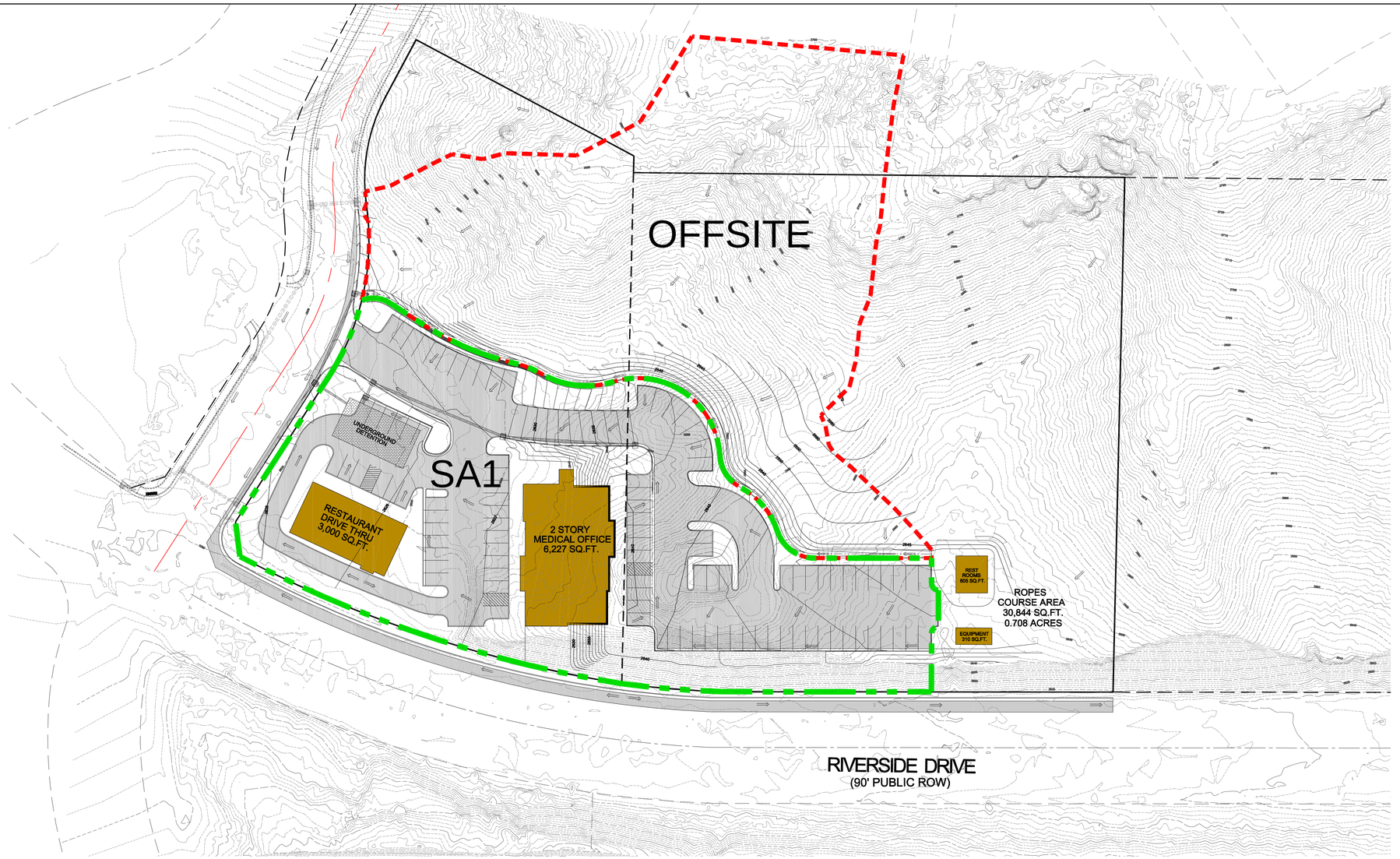
SCALE: 1" = 40'

CONCEPTUAL LAYOUT
PARCEL SG-5-2-28-325 & 3 ACRES SOUTH
ASPENS GROVE LLC
ST.GEORGE, UTAH 84770

PREMIER Design & Engineering
75 EAST 100 NORTH IVINS, UTAH 84738 (435) 313-2267

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12/13/2023
License No. 323806
Marc R. Fonger
Marc R. Fonger
STATE OF UTAH

SHEET
C



GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)

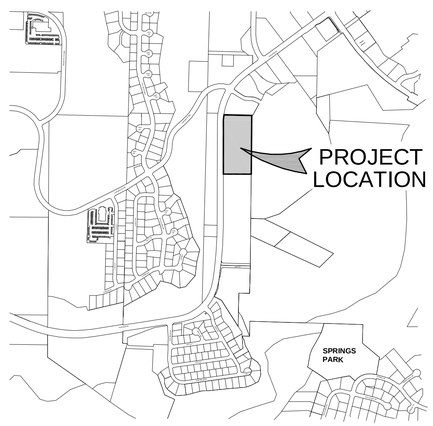
1 inch = 40 ft.

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PARKING LOT & SIDEWALK AREA = 46,417 SQ.FT. / 1.06 ACRES (21.4%)
ROPES COURSE AREA = 30,844 SQ.FT. / 0.70 ACRES (14.2%)
LANDSCAPED AREA = 15,535 SQ.FT. / 0.35 ACRES (7.1%)

LEGEND

- 2661 — EXISTING 1' CONTOUR
- 2670 — EXISTING 5' CONTOUR
- 2669 — PROPOSED 1' CONTOUR
- 2670 — PROPOSED 5' CONTOUR
- PROPERTY LINE
- ⇐ DIRECTION OF FLOW
- SA1
- OFF-SITE DRAINAGE AREA (HILLSIDE)



VICINITY MAP

DATE:	12/13/2023
DRAWN BY:	E.A.M.
CHECKED BY:	M.R.F.
CLIENT:	AGLLC

SCALE: 1" = 40'

DRAINAGE PLAN

PARCEL SG-5-2-28-325 & 3 ACRES SOUTH

ASPENS GROVE LLC

ST.GEORGE, UTAH 84770

PREMIER Design & Engineering
75 EAST 100 NORTH IVINS, UTAH 84738 (435) 313-2267

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12/13/2023
License No. 323806
Marc R. Fonger
STATE OF UTAH

SHEET

DP

TYPICAL PLANT LEGEND

PISTACHE CHINENSIS 'RED PUSH'
RED PUSH PISTACHE

QUERCUS VIRINIANA
SOUTHERN LIVE OAK

PINUS ELDARICA
MONDEL PINE

CHILOPSIS LINEARIS
DESERT WILLOW

LAGERSTROEMIA INDICA
MULTI STEM CRAPE MYRTLE

LOW WATER USAGE DESERT
PLANT MATERIAL



RIVER KNOLL COMMERCIAL MASTER PLAN

N.T.S.

EXHIBIT B
Proposed Site Plan

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PARKING SCHEDULE

STALL TYPE	AMOUNT



A1 AS101 ARCHITECTURAL SITE PLAN
1" = 30'-0"

#	REV. DESCRIPTION	REV. DATE

MARK	ISSUE DESCRIPTION	ISS. DATE

BETTER BALANCE OFFICE
FOREMASTER DR
ST GEORGE, UT 84770

beecherwalker
Architecture/Interiors
o. 801.438.9500 3115 EAST LION LANE #200
f. 801.438.9501 HOLLADAY, UTAH 84121
BEECHERWALKER.COM

PROJECT NUMBER
Project Number

DWN BY	CHKD BY
Author	Checker

Project Status

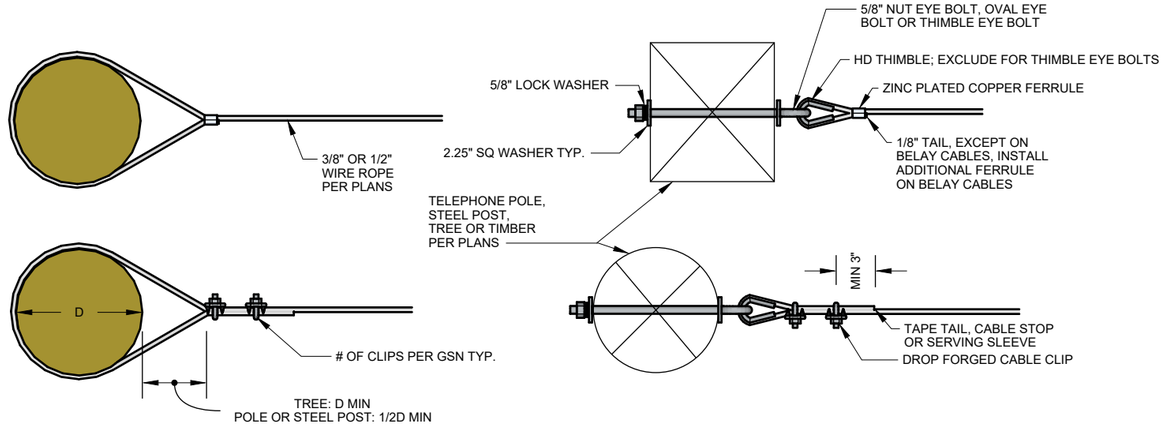
ARCHITECTURAL SITE PLAN

DRAWING NUMBER

AS101

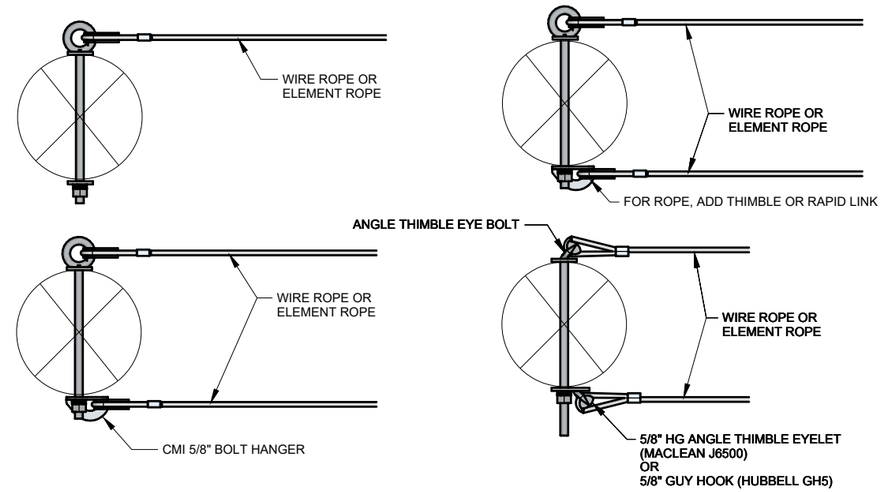
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EXHIBIT C
Ropes Course Details



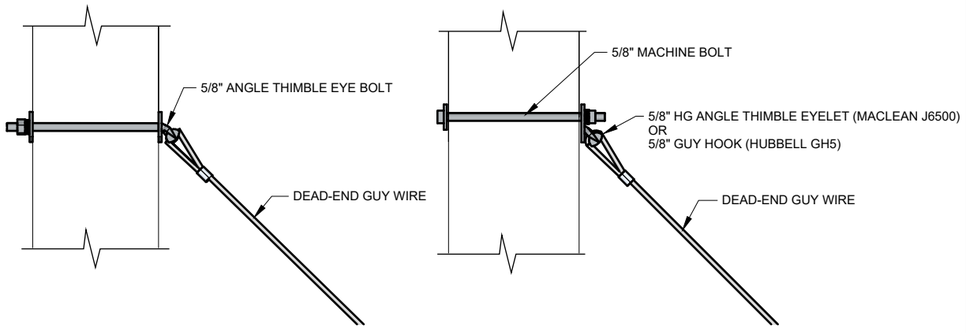
NOTE: ALL CONNECTIONS MUST BE RATED FOR 5,000 LBS

101 BELAY TERMINATIONS
Scale: 1" : 1'

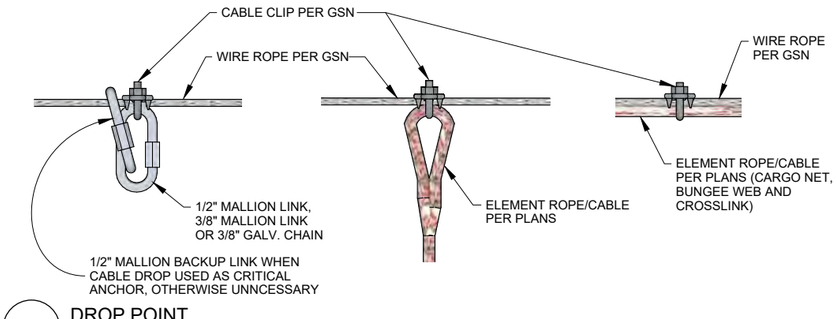


102 FOOT CABLE & ELEMENT TERMINATIONS
Scale: 1" : 1'

*TERMAINTIONS FROM 101 - BELAY TERMINATIONS, 103 - DEAD-END TERMINATIONS

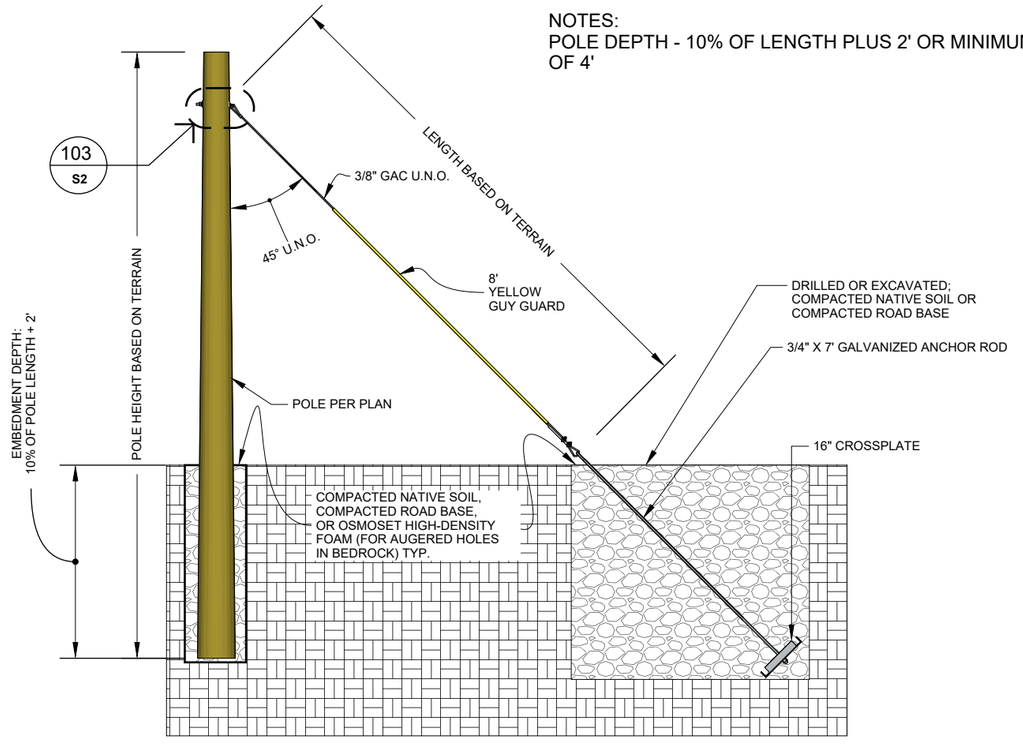


103 DEAD-END GUY TERMINATIONS
Scale: 1" : 1'



104 DROP POINT
Scale: 1 1/2 " : 1'

NOTE: SEE PLANS FOR POLE LENGTHS



105 DEAD-END GUY
Scale: 1/4" : 1'

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

PROJECT
Ropes Of St. George
Coordinates:
37.09558003061237,
-113.54170637005664

PROJECT NO.
ROH01

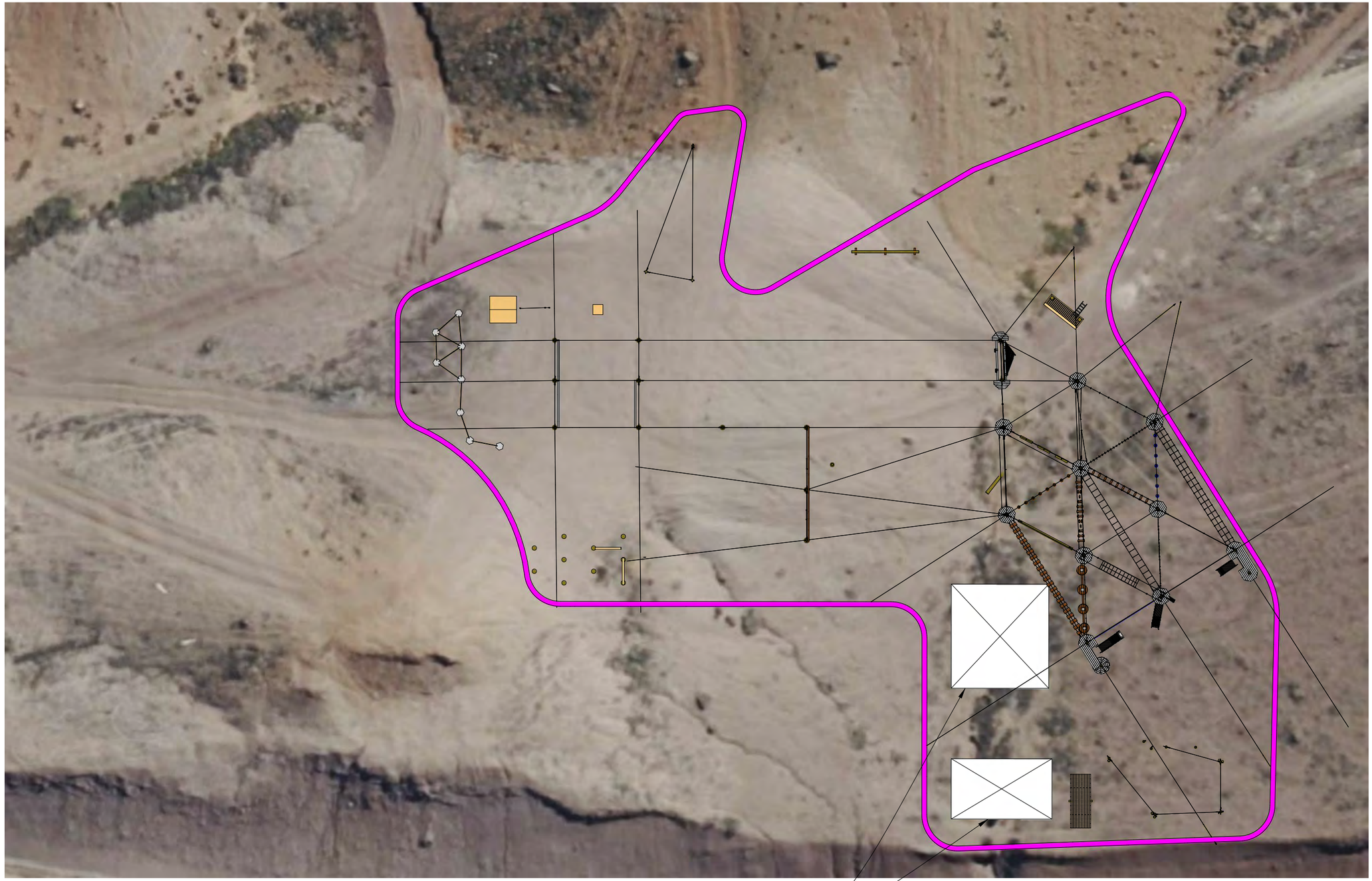
ISSUE
2023

DRAWN BY
BH

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

TERMINATIONS, CONNECTIONS, & GUY WIRE DETAILS

S1.2



A SITE OVERVIEW
Scale: 1" : 30'

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

PROJECT
Ropes Of St. George
Coordinates:
37.09558003061237,
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PROJECT NO.
ROH01

ISSUE
2023

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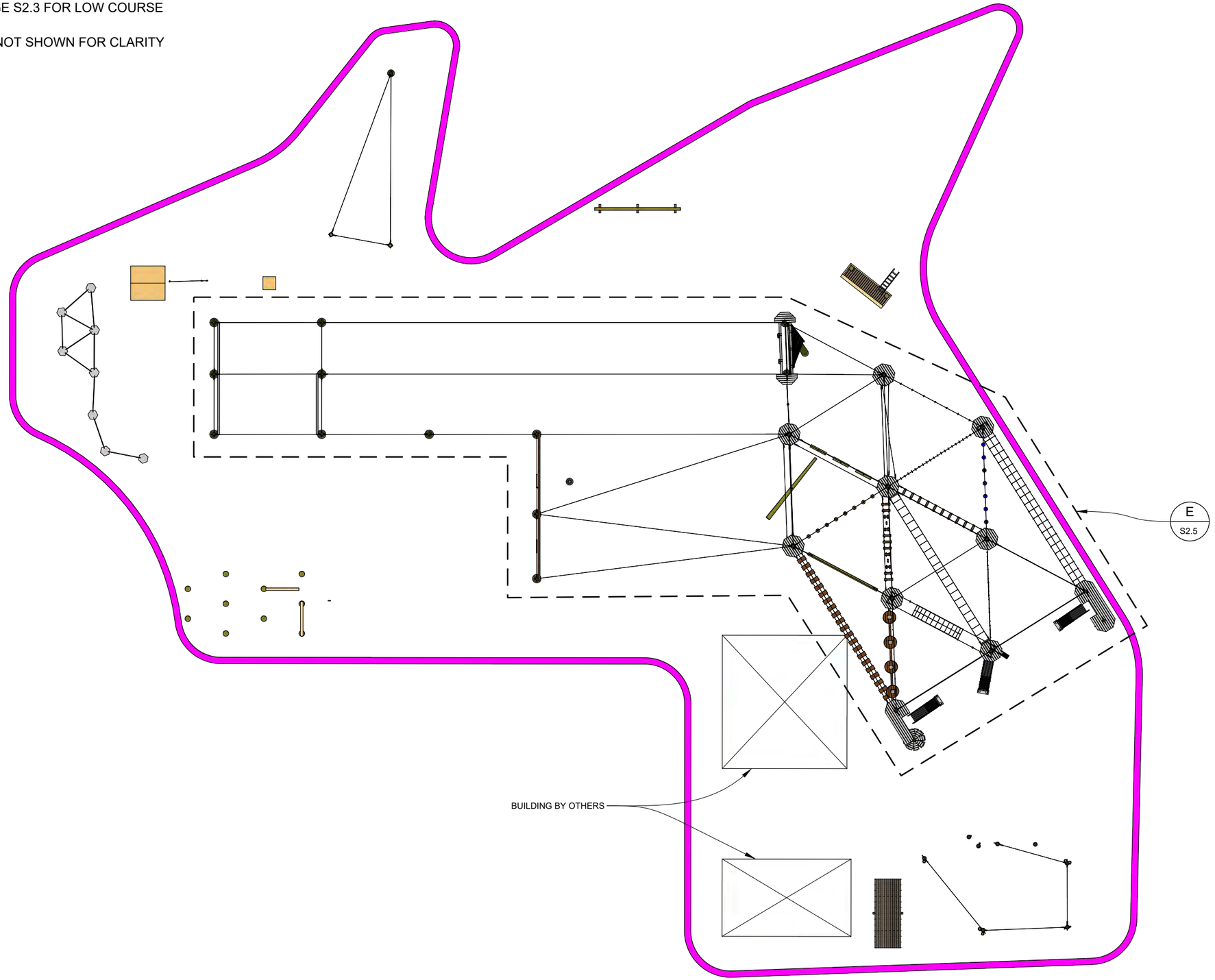
PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

SITE OVERVIEW

S2.1

NOTE: PAGE INCLUDES BOTH HIGH AND LOW COURSES; SEE PAGE S2.3 FOR LOW COURSE

NOTE: GUY WIRES NOT SHOWN FOR CLARITY



B SITE LAYOUT
Not to Scale

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

PROJECT
Ropes Of St. George
Coordinates:
37.09558003061237,
-113.54170637005664

PROJECT NO.
ROH01

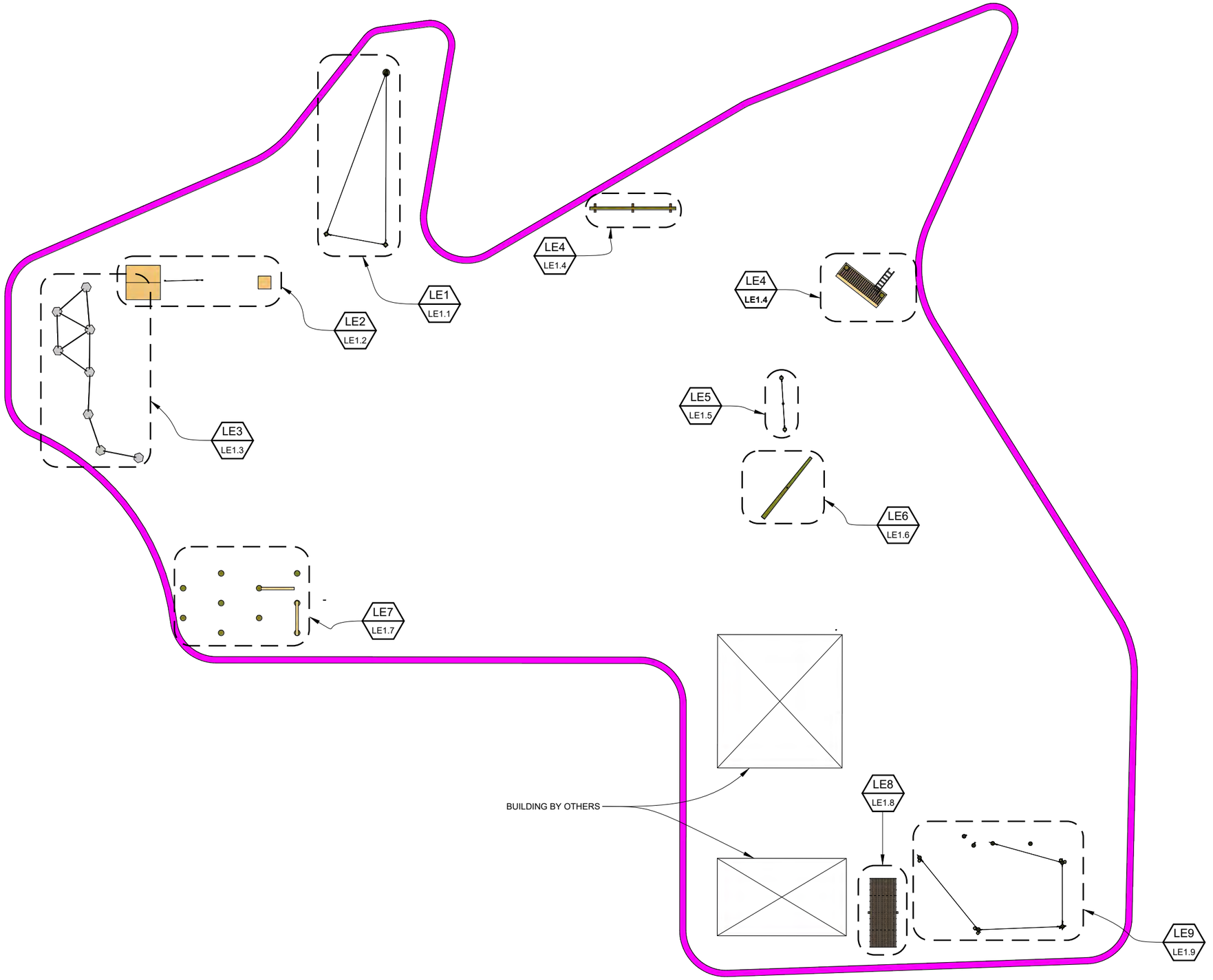
ISSUE
2023

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PRELIMINARY DRAWING
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ROPES COURSE
PLAN VIEW

S2.2



C LOW COURSE
Not to Scale

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

PROJECT
Ropes Of St. George
Coordinates:
37.09558003061237,
-113.54170637005664

PROJECT NO.
ROH01

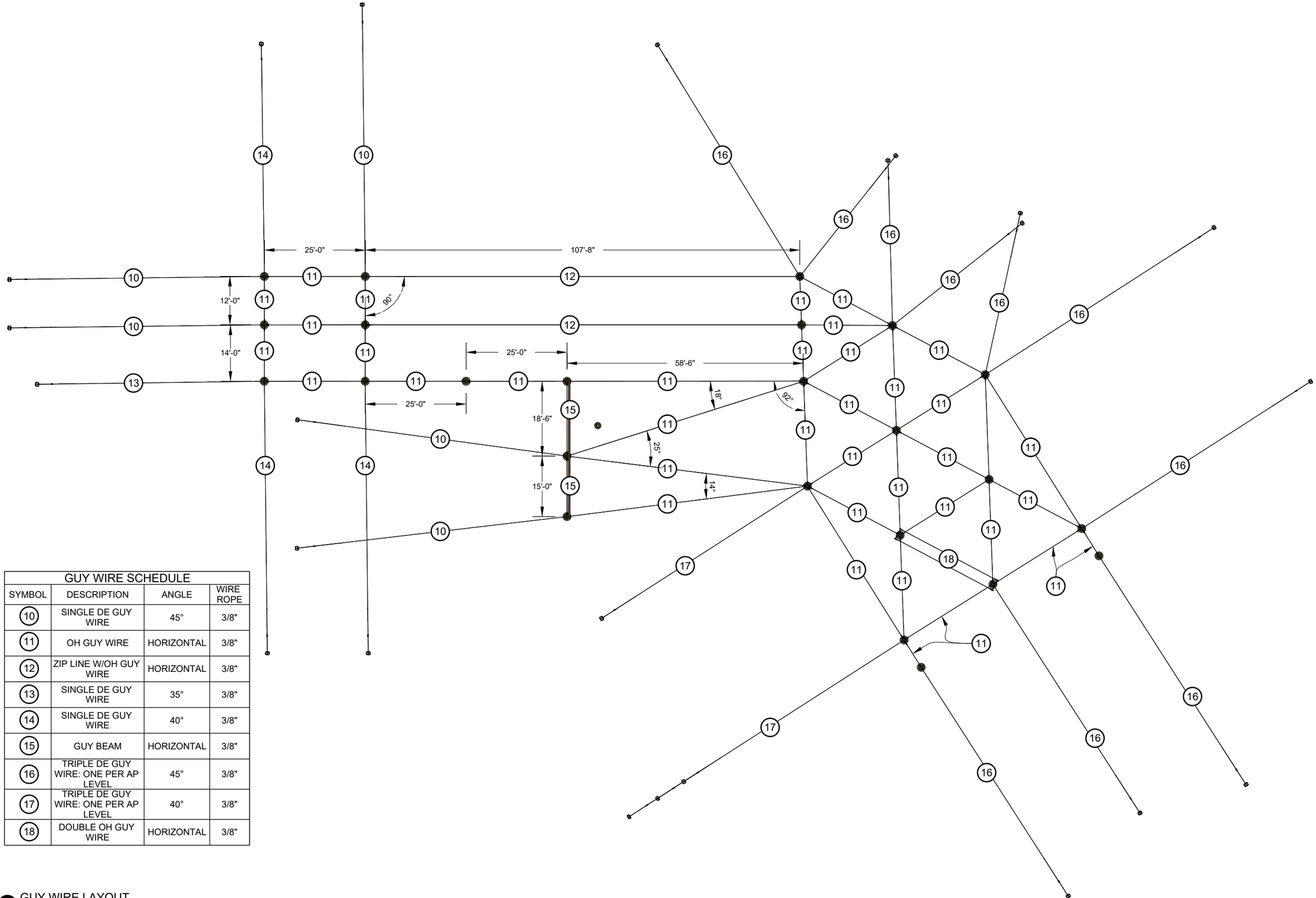
ISSUE
2023

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BH

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NOT FOR CONSTRUCTION

LOW COURSE

S2.3



GUY WIRE SCHEDULE			
SYMBOL	DESCRIPTION	ANGLE	WIRE ROPE
10	SINGLE DE GUY WIRE	45°	3/8"
11	OH GUY WIRE	HORIZONTAL	3/8"
12	ZIP LINE W/OH GUY WIRE	HORIZONTAL	3/8"
13	SINGLE DE GUY WIRE	35°	3/8"
14	SINGLE DE GUY WIRE	40°	3/8"
15	GUY BEAM	HORIZONTAL	3/8"
16	TRIPLE DE GUY WIRE: ONE PER AP LEVEL	45°	3/8"
17	TRIPLE DE GUY WIRE: ONE PER AP LEVEL	40°	3/8"
18	DOUBLE OH GUY WIRE	HORIZONTAL	3/8"

D GUY WIRE LAYOUT
Not to Scale

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

PROJECT
Ropes Of St. George
Coordinates:
37.09558003061237,
-113.54170637005664

PROJECT NO.
ROH01

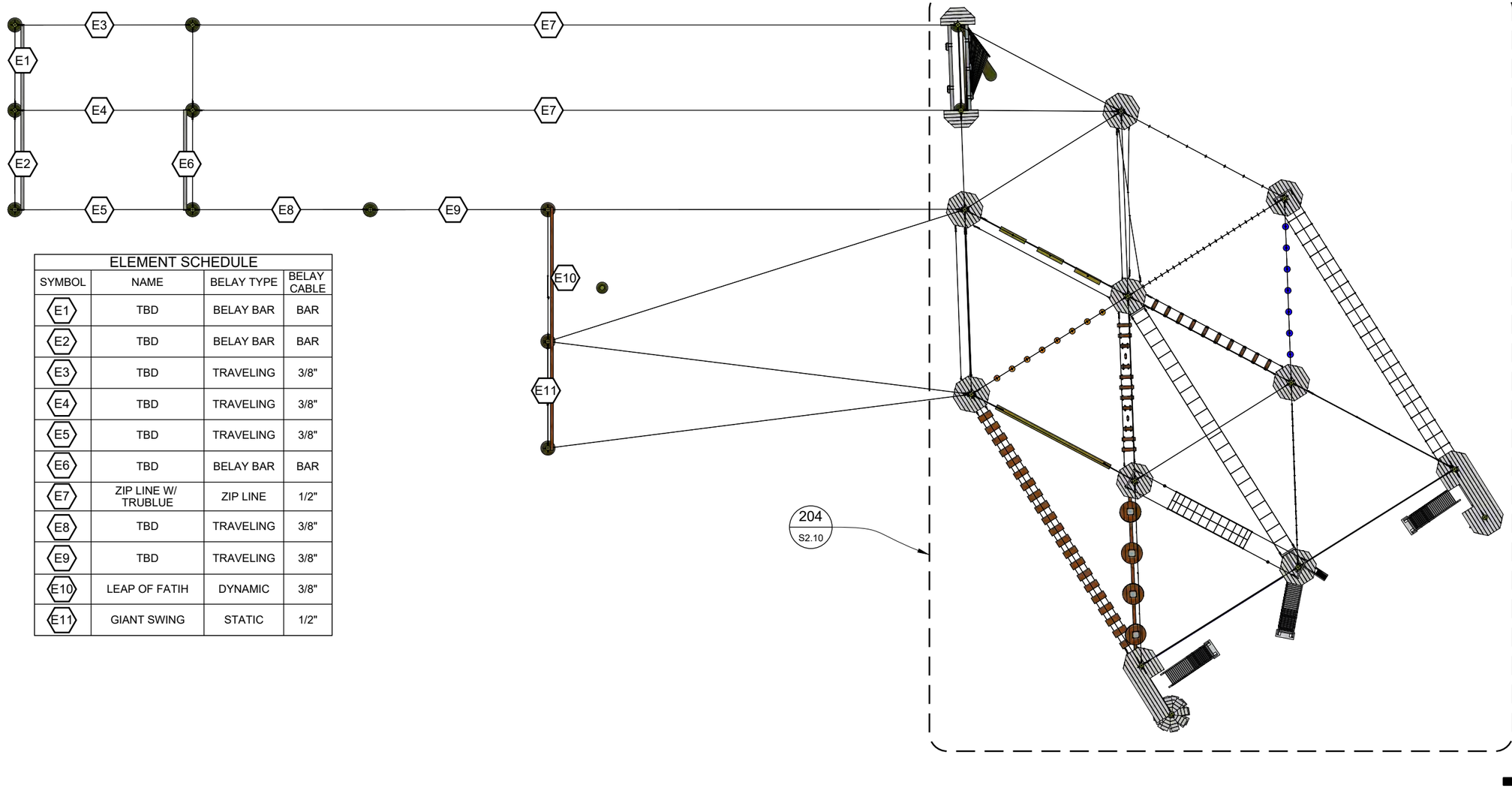
ISSUE
2023

DRAWN BY
BH

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

GUY WIRE LAYOUT

S2.4



ELEMENT SCHEDULE			
SYMBOL	NAME	BELAY TYPE	BELAY CABLE
E1	TBD	BELAY BAR	BAR
E2	TBD	BELAY BAR	BAR
E3	TBD	TRAVELING	3/8"
E4	TBD	TRAVELING	3/8"
E5	TBD	TRAVELING	3/8"
E6	TBD	BELAY BAR	BAR
E7	ZIP LINE W/ TRUBLUE	ZIP LINE	1/2"
E8	TBD	TRAVELING	3/8"
E9	TBD	TRAVELING	3/8"
E10	LEAP OF FATIH	DYNAMIC	3/8"
E11	GIANT SWING	STATIC	1/2"

E HIGH COURSE
Scale: 1/16" : 1'

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

PROJECT
Ropes Of St. George
Coordinates:
37.09558003061237,
-113.54170637005664

PROJECT NO.
ROH01

ISSUE
2023

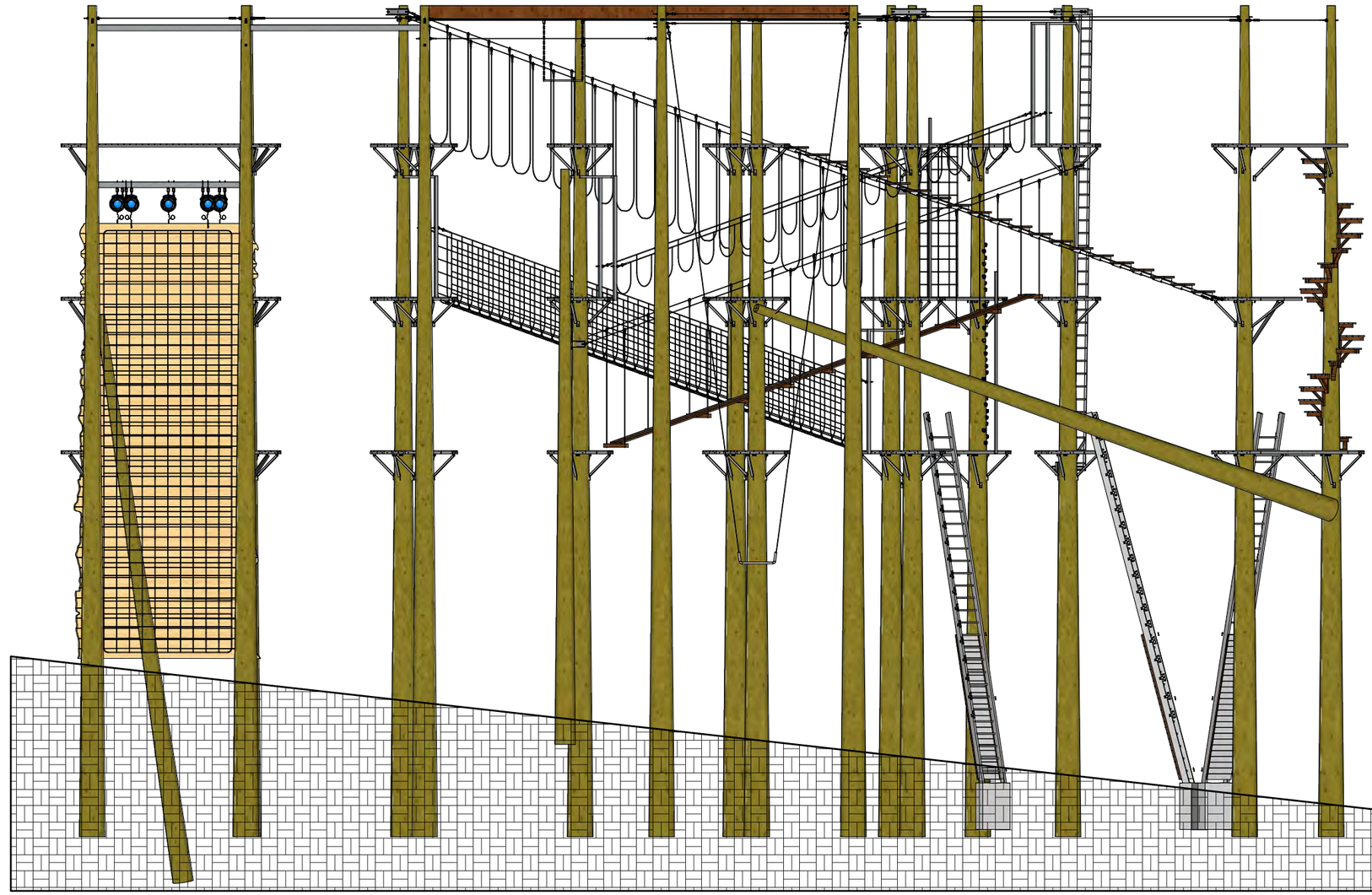
DRAWN BY
BH

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

HIGH COURSE

S2.5

NOTE: HORIZONTAL ELEMENTS NOT SHOWN FOR CLARITY



200 NORTH ELEVATION
Scale: 1" : 10'

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

PROJECT
Ropes Of St. George
Coordinates:
37.09558003061237,
-113.54170637005664

PROJECT NO.
ROH01

ISSUE
2023

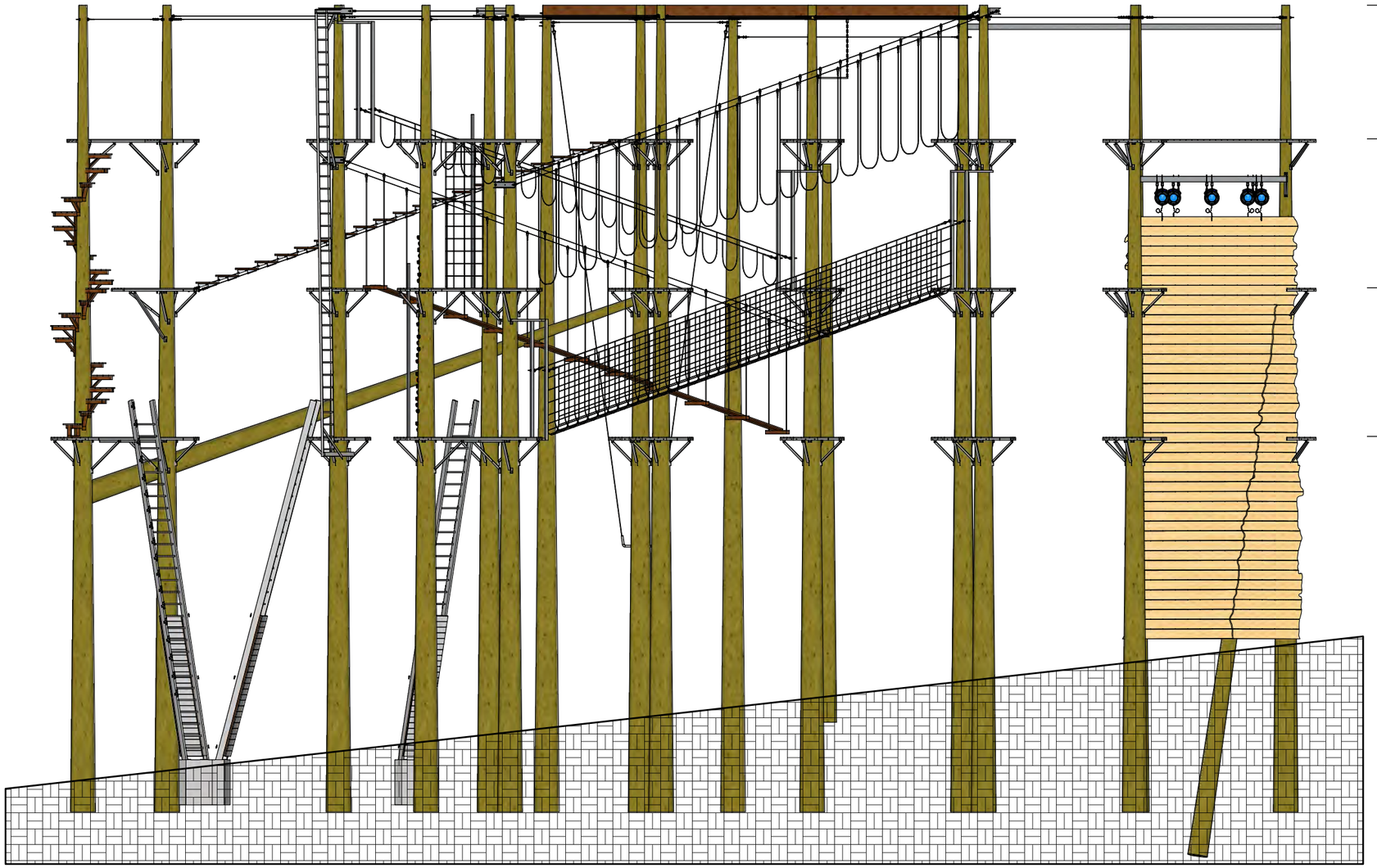
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BH

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

NORTH ELEVATION

S2.6

NOTE: HORIZONTAL ELEMENTS NOT SHOWN FOR CLARITY



201 SOUTH ELEVATION
Scale: 1" : 10'

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

PROJECT
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ROH01

ISSUE
2023

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BH

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

SOUTH ELEVATION

S2.7

NOTE: HORIZONTAL ELEMENTS NOT SHOWN FOR CLARITY

2715'-0"
TOP OF HILLSIDE

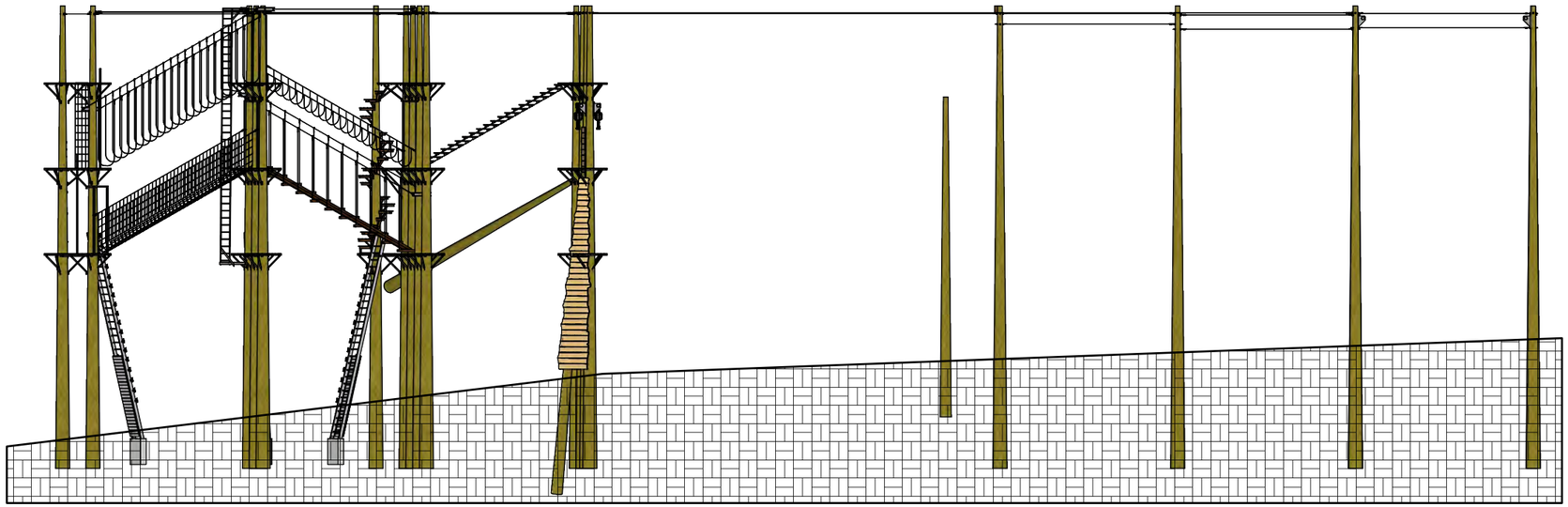
2701'-10"
TOP OF POLE

2697'-0"
LEVEL 3

2685'-0"
LEVEL 2

2673'-0"
LEVEL 1

2647'-0"
GROUND LEVEL



202 EAST ELEVATION
Scale: 1" : 20'

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
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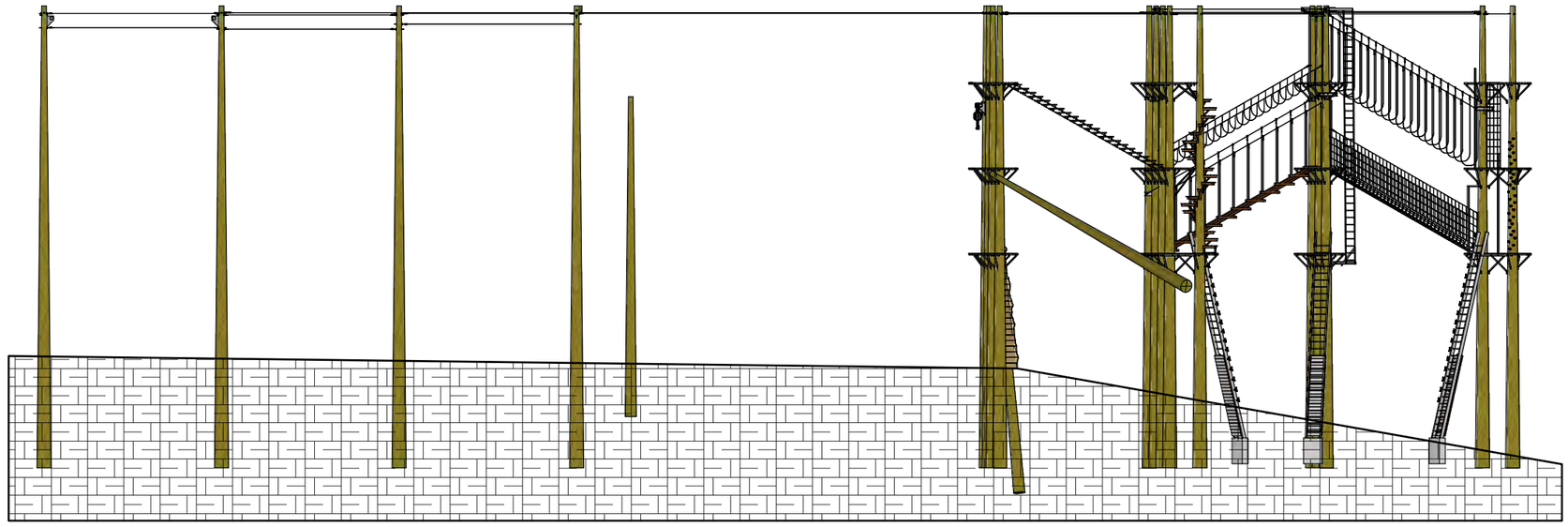
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PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

EAST ELEVATION

S2.8

NOTE: HORIZONTAL ELEMENTS NOT SHOWN FOR CLARITY



203 WEST ELEVATION
Scale: 1" : 20'

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

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2023

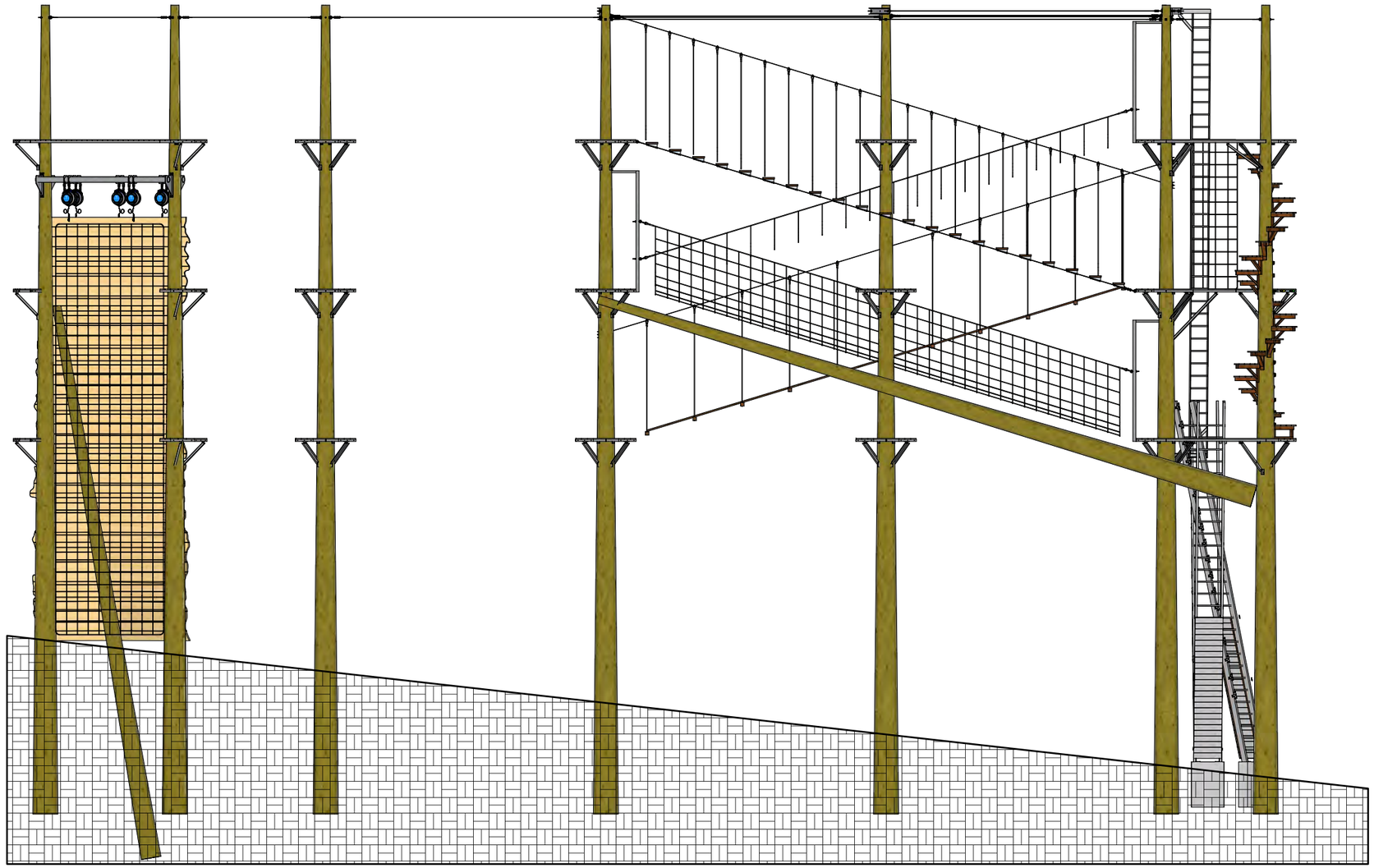
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BH

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

WEST ELEVATION

S2.9

NOTE: HORIZONTAL ELEMENTS NOT SHOWN FOR CLARITY



205 ADVENTURE PARK
NORTH ELEVATION
Scale: 1" : 10'

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

PROJECT
Ropes Of St. George
Coordinates:
37.09558003061237,
-113.54170637005664

PROJECT NO.
ROH01

ISSUE
2023

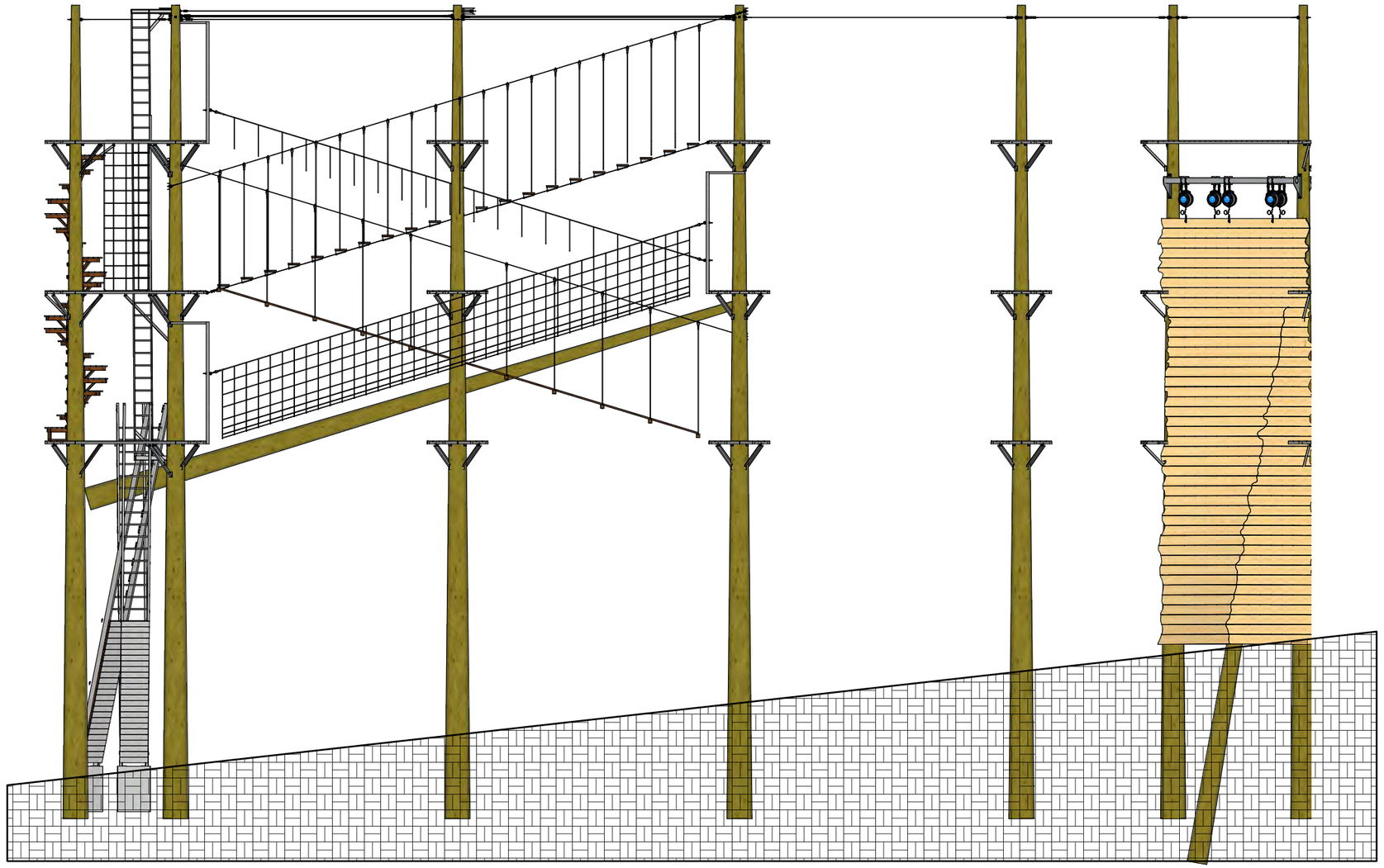
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PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

ADVENTURE PARK
NORTH ELEVATION

S2.11

NOTE: HORIZONTAL ELEMENTS NOT SHOWN FOR CLARITY



206 ADVENTURE PARK
SOUTH ELEVATION
Scale: 1" : 10'

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

PROJECT
Ropes Of St. George
Coordinates:
37.09558003061237,
-113.54170637005664

PROJECT NO.
ROH01

ISSUE
2023

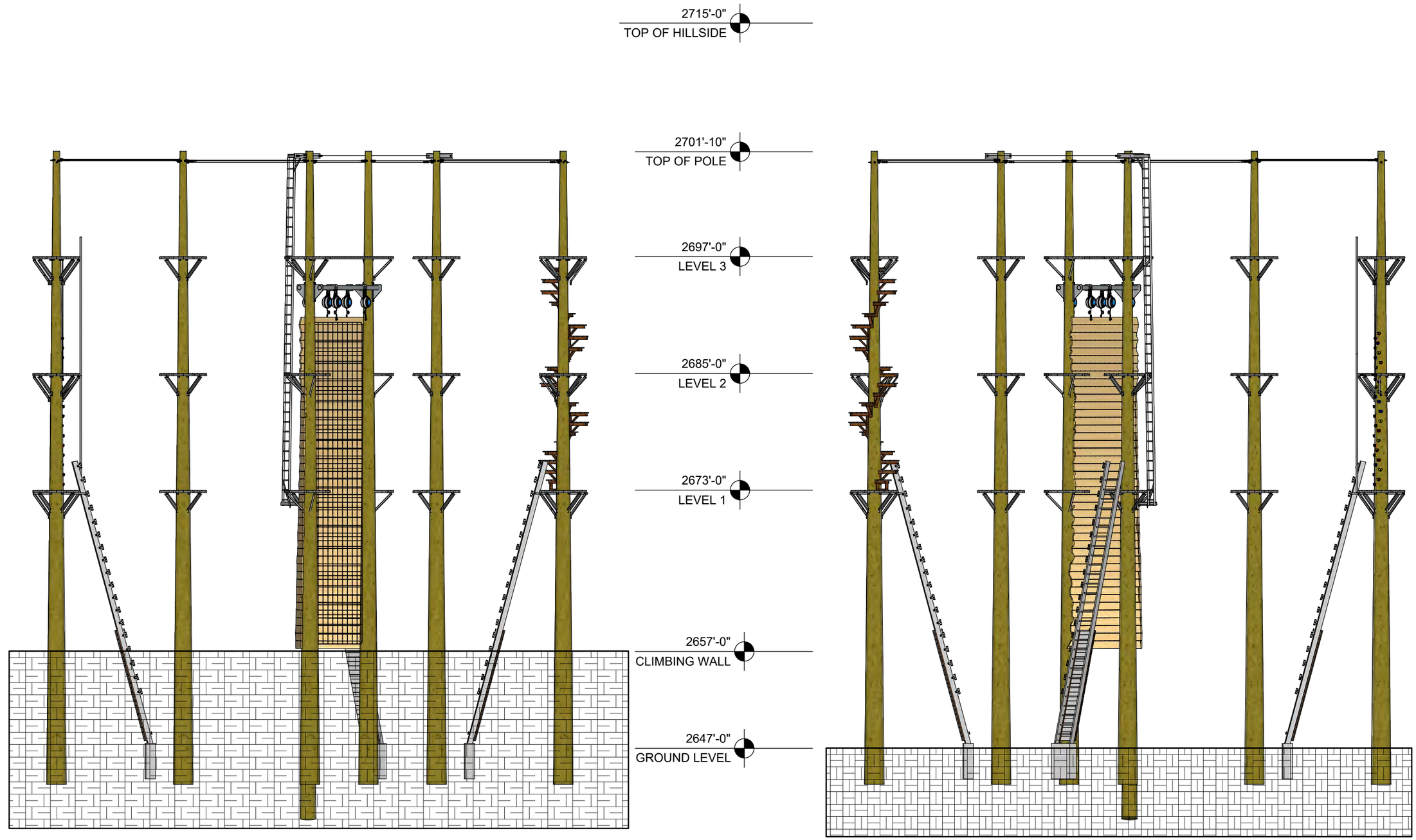
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PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

ADVENTURE PARK
SOUTH ELEVATION

S2.12

NOTE: HORIZONTAL ELEMENTS NOT SHOWN FOR CLARITY



207 ADVENTURE PARK
EAST ELEVATION
Scale: 1" : 10'

208 ADVENTURE PARK
WEST ELEVATION
Scale: 1" : 10'

Helix Construction
94 W Center St
Ephraim, UT 84627
Tel: 801.252.5027

CLIENT
John Hendleman
3466 S Walnut Canyon Dr
St. George, UT 84790

PROJECT
Ropes Of St. George
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PROJECT NO.
ROH01

ISSUE
2023

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PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

ADVENTURE PARK
EAST & WEST ELEVATIONS

S2.13

EXHIBIT D
Geotechnical Report

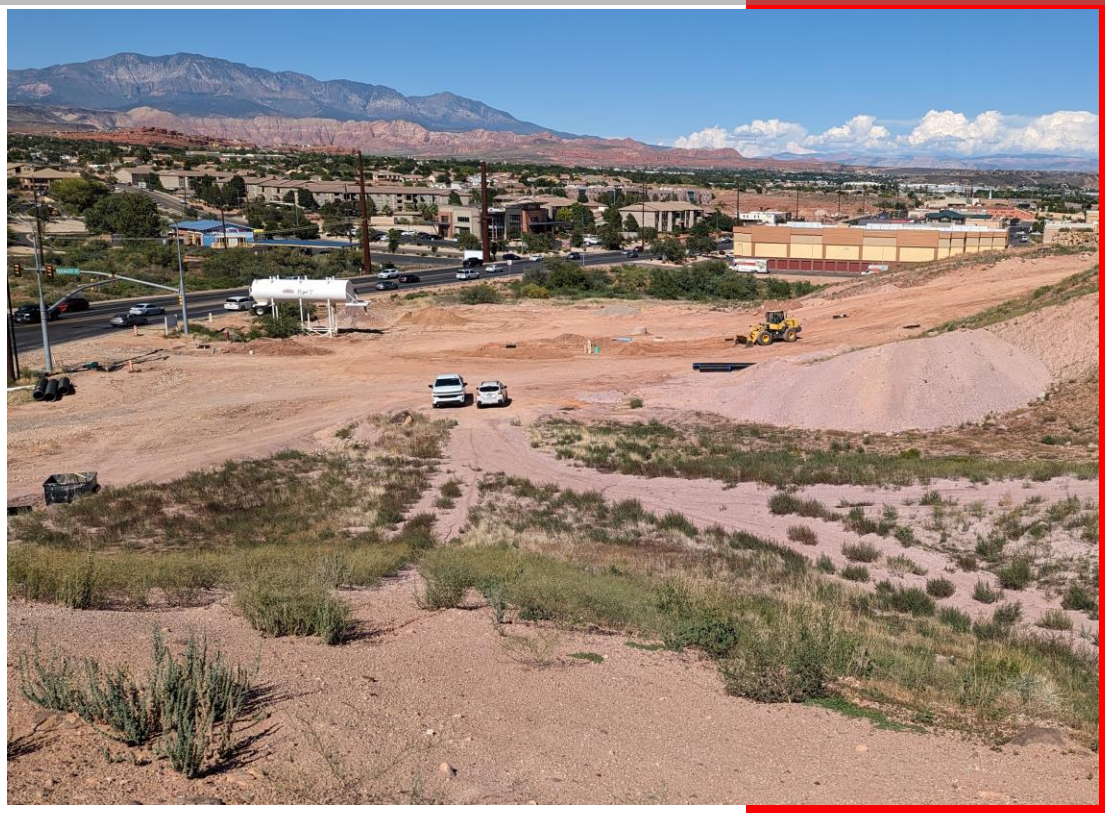
GEOTECHNICAL INVESTIGATION REPORT

Prepared for:

Aspens Grove, LLC
Attn: John Hendleman
3466 South Walnut Canyon Drive
St. George, Utah 84790

October 5, 2023

Riverside Drive Thru and Medical Center



Prepared by:

795 East Factory Drive
St. George, UT 84790

Landmark Project No: 230521

October 5, 2023

Aspens Grove, LLC
Attn: John Hendleman
3466 South Walnut Canyon Drive
St. George, Utah 84790

Subject: Geotechnical Recommendation Report
Riverside Drive Thru and Medical Office
St. George, Utah
Landmark Project No.: 230521

Reference: Preliminary Geotechnical Engineering Report, Caliber Collision, St. George, Utah
PSI Project No.: 07061856, Dated September 8, 2022

John,

As requested, we have completed our site visit, report review, and soils analysis for the above-mentioned project. Our geotechnical recommendations are presented in this report. The referenced geotechnical investigation report was completed for proposed construction consisting of a single story (13,000 sf) structure and associated parking areas and drive lanes. The new proposed construction will consist of a single-story drive thru (3,000 sf) and a two-story medical office building (12,000 sf) with associated asphalt paved parking and drive lanes.

The field investigation completed for the referenced report consisted of the completion of 8-borings to depths ranging from 5 to 50 feet below the existing ground surface. A summary of the findings and recommendations from the referenced report are provided in Sections 3.0 and 4.0 of this report. Site grading and general earthwork recommendations are detailed in Section 5.0 of this report. Foundation recommendations are found in Section 6.0 of this report.

Landmark has great interest in providing materials testing and special inspection services during the construction phase of this project. If you advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Please feel free to contact our office at (435) 986-0566 if you have any questions.

Sincerely,

LANDMARK TESTING AND ENGINEERING



Steven Wells, P.E.
Geotechnical Manager

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RIVERSIDE DRIVE THRU AND MEDICAL OFFICE
ST. GEORGE, UTAH

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GEOTECHNICAL RECOMMENDATIONS REPORT
RIVERSIDE DRIVE THRU AND MEDICAL OFFICE
ST. GEORGE, UTAH

FIGURE 1:	**VICINITY MAP**
FIGURE 2:	**SITE MAP**

1.0 INTRODUCTION

This report presents the results of Landmark Testing & Engineering's geotechnical recommendations for proposed drive thru and medical office building in St. George, Utah based on the Geotechnical Investigation Report from PSI (Project No.: 07061856). The referenced report was completed for a proposed 13,000 sf single story commercial structure.

Figure 1 is a Vicinity Map showing the project location relative to surrounding features. Figure 2 is a Site Map showing the proposed project site and the approximate locations of the borings completed for the referenced investigation report.

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

2.0 PROPOSED CONSTRUCTION

We understand the proposed construction will consist of single-story drive thru and two-story commercial building with associated asphalt and concrete paved driveways and parking stalls. We understand the commercial structures will be wood framed with a slab-on-grade supported on conventional spread footings. Structural loads were not provided at the time of this report; however, we anticipate walls loads to be on the order of 1,500 to 2,500 pounds per lineal foot and column loads to be on the order of 40 kips.

A traffic index of 5.5 is assumed for most of the parking and driveway areas that will accommodate a moderate to high volume of passenger cars to light truck traffic. Additionally, a traffic index of 7.0 is assumed for areas accommodating heavy truck traffic. Any significant changes to the anticipated development 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 site is located along the east side of Riverside Drive to the south of the intersection with Foremaster Drive in St. George, Utah.

The drive thru is on undeveloped land in the northern portion of the parcel. This portion of the parcel is roughly level and at the same elevation as the street to the west. Based on conversations with the Cicil Engineer, the anticipated finished floor elevation (FFE) of the drive thru is 2627.

The medical building portion of the parcel is located on a slope to the south of the drive thru that is approximately 15 feet higher than the drive thru area. The building pad area currently slopes down to the north at an approximate slope of 25 percent. There is a cut between the two proposed structures approximately 10 feet in height. We understand that the medial building will have an FFE of 2628. We understand that the southern wall will retain the cut to the south.

Permanent slopes in the clay and claystone will need to be sloped as subsequently outlined or structurally retained. The design of a retaining wall system is beyond the scope of this report but can be provided upon request.

To the east of the project site, the land slopes up to the north. The lots to the east are separated from the project site by rockery retaining walls.

3.2 GEOLOGIC SETTING

The soils on the project site are mapped by the Utah Geological Survey as being located on the following formations:

JTRm: Moenave Formation (Lower Jurassic to Upper Triassic) -- Consists of two undivided members: Whitmore Point Member (Lower Jurassic): pale-red-purple, greenish-gray, and blackish-red mudstone and claystone, lesser moderate-reddish-brown, fine-grained sandstone and siltstone, and uncommon dark-yellowish-orange micaceous siltstone

The Moenave Formation is mapped as located to the immediate east of the project site and is underlain by the Petrified Forest Member, which is the formation upon which the project site is located.

TRcp: Petrified Forest Member (Upper Triassic) -- Varicolored, typically gray to purple mudstone, claystone, and siltstone, lesser white to yellow-brown sandstone and pebbly sandstone, and minor chert and nodular limestone

The Petrified Forest Member consists of lean to fat clays and is known to be moderately to highly expansive. The clays tested in the referenced report were shown to be expansive. Therefore, the soils encountered in the borings are consistent with geologic mapping.

3.3 SEISMICITY

Seismicity at the site was determined using the Structural Engineers Association (SEA), OSHPD Seismic Design Maps website. The following values are presented to assist with seismic design.

- Latitude = 37.09678° North, Longitude = 113.54167° West
- Site Class = C, Very Dense Soil and Soft Rock, based on ASCE 7 (Table 20.3.1) as referenced in 2018 IBC 1613.3.2

Period (sec)	Sa (g)	Site Class
0.2	S_S = 0.527	B / C
1.0	S_1 = 0.171	B / C
0.2	S_{DS} = 0.453	C
1.0	S_{D1} = 0.171	C

As per section 20.1 of ASCE 7-16, “The soil shall be classified in accordance with Table 20.3-1 and section 20.3 based on the upper 100 feet of the site profile.” However, section 20.1 continues,

"Where site specific data are not available to a depth of 100 feet, appropriate soil properties are permitted to be estimated by the registered design professional preparing the soil investigation report based on known geologic conditions." Based on our engineering experience in the area, mapped geology and the soils encountered in the borings and blowcounts of the soils in the borings, it is the opinion of Landmark Testing and Engineering that the soils on site classify as Seismic Site Class C.

3.4 GEOLOGIC HAZARDS

Fault Rupture

The trace of the Washington Fault is located approximately 2.5 miles east of the site and the Hurricane fault is located approximately 13.0 miles east of the site. Higgins and Willis, indicate that the Hurricane and Washington faults displace late Quaternary sediments and are considered active.[1] Strong ground motion associated with movement along the Hurricane, Washington or other faults associated with the Intermountain Seismic Belt is possible, however, the potential for surface fault rupture is considered low.

Liquefaction

Liquefaction is the sudden loss of shear strength in the soil due to the build-up of excess pore water pressure.[2] This can occur when the soil is subjected to intense shaking such as during a seismic event. The soils that are most susceptible to liquefaction are loose, saturated sandy soils with a low fines content (material passing the #200 sieve).

Soils encountered in the borings predominantly consisted of very stiff to hard clay and claystone. Clayey soils are typically not susceptible to liquefaction. Groundwater was not encountered in the borings during the investigation. Therefore, we believe the liquefaction potential is low. A liquefaction study is beyond the scope of this report.

Expansive Soils

The project site is mapped as being located in an area classified as Highly Susceptible Rock, consisting of "Bedrock units that have high shrink/swell susceptibility. These units contain an abundance of expansive clay minerals and are commonly associated with expansive rock problems within the mapped areas. Landslides mapped within these units are also included."[3]

Landslide

The project site is mapped as being located in an area classified as Highly Susceptible to Landslide Potential, consisting of, "high landslide susceptibility, includes mapped landslides and highly landslide-prone geologic units that crop out on slopes at or above a determined critical angle."

1 Higgins, J.M. and Willis, G.C., 1995, Interim Geologic Map of the St. George Quadrangle, Washington County, Utah; Utah Geological Survey Open-File Report 323
2 Coduto, Donald P. (1999), Geotechnical Engineering: Principles and Practices, Prentice Hall, Upper Saddle River, NJ
3 Utah Geologic Hazards Portal, https://geology.utah.gov/apps/jay/tests/hazards/, Retrieved October 5, 2023

4.0 INVESTIGATION

4.1 FIELD INVESTIGATION

To investigate the subsurface soil conditions for the referenced report PSI completed 8 borings to depths ranging from 5 to 50 feet below the existing ground surface. Borings is the referenced report area labeled SB-1 through SB-8. Borings SB-1, SB-4, and SB-8 were drilled adjacent to the proposed buildings. Boring SB-7 was completed in what is now going to be the parking lot. Borings SB-2, SB-3, SB-5, and SB-6 were drilled to the east and south of the proposed construction for this report.

Soils encountered in borings SB-1, SB-4, and SB-7 consisted of 1 to 5 feet of fat clay underlain by claystone. The claystone was encountered at the ground surface in boring SB-8. The claystone extended to the bottom of the borings.

A detailed description of the subsurface soils encountered in the borings is presented in the referenced report provided by PSI.

4.2 LABORATORY TESTING

Laboratory testing completed for the referenced report consisted of moisture content tests, mechanical sieve analyses and Atterberg Limits tests to aid in soil classification, one dimensional consolidation/swell tests to aid in excavation recommendations.

The surficial clays and underlying claystone were shown to be highly plastic and classified as fat clay with Liquid Limits ranging from 58 to 69 percent.

The samples were shown to have moisture contents of 5 to 23 percent with an average moisture content of 13 percent.

A total of seven swell tests were performed on samples from the borings. The samples swelled 2.7 to 16.7 percent when saturated under loads of 250, 500, 750, and 1,000 psf, depending on the anticipated surcharge values. This shows that the soils are moderately to highly expansive. The swell pressure of the samples ranged from 4,000 to 17,300 psf, which is higher than the anticipated loads of the structures.

4.3 CONCLUSIONS

Soils encountered in the borings completed for the referenced report consisted of moderately to highly expansive clays and claystone to the maximum depth of the explorations. The clays encountered are locally known as “blue clay” and are highly expansive. These clays will swell and heave all structures that provide a load less than the measured swell pressure when they become wet.

The swell pressures of the clay sampled ranged from 4,000 to 17,300 psf. The allowable bearing capacity of clay, as per 2021 IBC Table 1806.2 is 1,500 psf, which is less than the measured swell pressure. Therefore, we anticipate that the proposed buildings will heave if the underlying clays become wet.

Standard construction practices in the area for mitigating the heave potential of the clays include excavations to a depth where water is not expected to penetrate, or establishing the structures on deep foundations.

We anticipate that significant cuts on the order of 15 to 20 feet will need to be completed in the Medical Office building portion of the project site. We understand that the southern wall of the medical office building will retain the cut in clay and claystone to the south.

General earthwork and foundation recommendations are outlined in Sections 5.0 and 6.0 of this report.

5.0 SITE GRADING AND EARTHWORK

5.1 GENERAL GRADING

Initial site grading should consist of clearing and grubbing any vegetation and construction debris on site. We anticipate roots will be minimal.

Following clearing and grubbing of the project site we understand that the building pad area of the medical office building will be excavated to the approximate elevation of the drive thru building.

The soils encountered in each of the borings down to the maximum depth explored consisted of expansive clays and claystone. We recommend one of two options to mitigate the potential heaving of the clay and claystone.

One option is to excavate the clay and claystone down to a depth of 17 feet below the footing elevations. The other option is to establish the structures on deep foundations. Recommendations for both options are outlined below.

Deep Excavation

If the excavation option is chosen, we recommend that the building pad areas be excavated a minimum of 17 feet below the footing elevations. The excavated clays and claystone are not suitable for use as structural fill and should be removed from the site. Once the excavations are completed, the soil in the bottom of the excavation should be compacted to a firm and unyielding surface.

The clays and claystone are stiff to hard, but we anticipate that they will be excavatable with standard construction equipment. There is a possibility that specialized construction equipment such as a single tooth ripper may be required to excavate isolated layers of claystone.

Imported granular structural fill will be required to bring the building pads up to the desired elevations. The imported, granular, structural fill should be placed according to structural fill recommendations as subsequently outlined.

Deep Foundations

If the deep foundations option is chosen, we recommend that the building pad areas be excavated to a depth sufficient to allow for a void space of at least 6 inches between the ground surface and grade beams.

We recommend that micro piles be used for the deep foundations. Helical piers will not likely reach the desired depth before reaching the maximum torque of the piles. Deep foundation recommendations are outlined in Section 6.2 of this report.

Landmark does not determine the location of the over-excavation, deep foundations, or the location of the structures to be constructed. The builder is responsible to ensure that the building footprint is entirely within the over-excavated and recompacted building pad or entirely on the installed deep foundations.

Pavement

Prior to construction of the pavement sections, we recommend that the pavement sections be excavated to allow for a minimum of 1 foot of imported fill to be placed between the pavement section and the subgrade. The excavated clay should be removed from the project site.

5.2 FILL PLACEMENT AND COMPACTION

All fill to be placed for support of footings and slabs-on-grade should be considered structural fill. All footings and floor slabs on-grade should be underlain by imported, granular structural fill. Imported, granular structural fill should be non-expansive and free of organics and all deleterious materials. Soils used for granular, imported, structural fill should meet the following specifications and preferably would classify as gravel.

GRADATION	PERCENT PASSING
3- inch	100
1.5-inch	80-100
No. 200 sieve	10-25
ATTERBERG LIMITS	
Liquid Limit	30 or less
Plasticity Index	9 or less

Material not meeting the above requirements may be suitable for use as structural fill at the discretion of the geotechnical engineer. Samples of structural fill should be submitted for testing prior to being transported to the site.

Any on-site soils used as structural fill or imported structural fill should be compacted to the following specifications.

FILL PLACEMENT AND COMPACTION	
Maximum lift thickness	8-inch (loose)
Minimum compaction	95% ASTM D-1557
Compacted Moisture Content	within 2% of optimum

Compaction of structural fill should be completed with equipment suitable for the conditions encountered in the field such that compaction requirements are met, including those areas that may be inaccessible to large rolling compactors. All structural fill should be evenly spread on a horizontal plane in eight-inch loose lifts. 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.

5.3 LIGHTLY LOADED ELEMENTS

Exterior concrete slabs on grade (sidewalks, curbs, gutters, and misc.) should be established on a minimum of 6-inches of imported, granular structural fill underlain by 8-inches of scarified and recompacted on-site soils. Sidewalks and curbs and gutters within the public right of way will need to be underlain by approved road base as per St. George City Standards.

Structural fill, including road base, should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D-1557.

5.4 CUT AND FILL SLOPES

We anticipate that permanent cuts and fill across the drive thru building pad area will be minimal. We anticipate that the medical office building pad area will be cut approximately 15 to 20 feet. It is recommended that permanent cut or fill slopes in on-site clays be maintained at a slope of three horizontal to one vertical (3H:1V) or flatter unless structurally retained. Competent claystone should be maintained at a slope of 1H:1V or flatter unless structurally retained.

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. Construction procedures should ensure adequate compaction of slope faces. All excavations should conform to OSHA standards.

6.0 FOUNDATION & CONSTRUCTION CONSIDERATIONS

6.1 Shallow Footings

The following recommendations apply to conventional strip and spot footings. Footings should be established on imported, granular, structural fill as indicated in section 5.0. Foundation excavations should be visually observed and tested by qualified personnel prior to placement of reinforcing steel or concrete. Additional foundation recommendations are subsequently presented.

DESCRIPTION	VALUE
Foundation Type	Continuous or spread footings
Bearing Material	Imported, granular, structural fill
Allowable Bearing Capacity	2,500 psf on imported, granular, structural fill underlain by on-site soils.
Minimum embedment depth below finished grade	12 inches (for frost and confinement)
Minimum footing width	12 inches (continuous) 24-inches (isolated spread)
Total estimated settlement	1-inch
Total differential settlement	less than 3/4 inch

The allowable bearing capacity is based upon dead load plus long-term live load. A one-third increase in allowable bearing capacity for short duration loads such as wind or seismic loads is permitted with the alternative load combinations given in Section 1605.3.2 of the IBC.

Basement/retaining walls should be designed to resist the lateral earth pressured listed above. Basement backfill should be placed subsequent to floor slab and floor joist construction. Otherwise, the walls should be braced to prevent lateral movement and cracking. 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. It is recommended that relatively light, manually propelled compactors be used within 5 feet of the walls and that compactors used beyond 5 feet be limited in weight to 3,000 pounds. We suggest that the below grade portion of the basement walls be damp-proofed with an impervious damp-proofing agent or membrane.

6.2 Micro Piles

If the micro pile option is chosen, we recommend that the following recommendations be followed.

Micropile design details are presented below.

1. Micropiles should be designed according to the procedures outlined in the FHWA design manual.
2. Micropiles for the buildings should be installed a minimum of 20 feet into the clay or claystone, or 25 feet below the ground surface (if encountered at 5 feet).
3. A minimum pile diameter of 8-inches is recommended to allow for insertion of the rebar and sleeve and to allow adequate grout cover. However, smaller pile diameter piles are acceptable based on structural engineer design.
4. Micropiles should be designed for a maximum allowable end bearing pressure of 10,000 psf.
5. Micropiles should be designed for an allowable skin friction value of 1,500 psf for the portion of micropile embedded in clay.
6. Micropiles should be designed and spaced for a minimum deadload pressure of 10,000 psf

based on the pile cross-sectional area. A smaller number of higher loaded micropiles are preferred to a larger number of lightly loaded micropiles. Micropile capacities in excess of 100 kips are readily achievable.

7. Micropiles 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 6 feet of pile length with a skin friction of 1,500 psf for the portion embedded in clay. The minimum percent of steel should be 1% of the grout area. Reinforcement should extend into grade beams and foundation walls.
8. Laterally loaded micropiles 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)
Stiff Clay	130.0	0.005	1000	n/a	2,000	4,000	8,000
Claystone	135.0	0.004	2000	n/a	3,000	6,000	20,000

9. Micropile excavations should be carefully cleaned prior to placing grout for post grouted micropiles. Grout should be pumped into the pile excavations immediately after the excavations are cleaned and inspected. Pumping or tremie methods of grout placement are required. The maximum aggregate size should be less than 1/3 of the clearance between rebar ties.
10. The grout placed in the micro-piles should consist of Type HS, neat cement, mixed in a high-shear mixer to between 15.3 and 16.2 lbs of cement per gallon of water. Grout should be checked frequently with a mud balance.
11. A minimum 8-inch continuous void beneath all grade beams and foundations walls supported on micropiles is recommended to concentrate dead loads and to minimize potential uplift pressures. It is imperative that void space be maintained throughout the life of the structure and backfill adjacent to the grade beams is not allowed to fill the void space.
12. Micropile installation should be observed by competent personnel to assure that adequate bearing is achieved, clean out is performed, and the re-bar is properly placed, as required by IBC 2021.
13. Mushrooming or enlargement at the top of piles should be avoided during installation and subsequent construction operations.
14. Grout should be continuously poured to the bottom of the grade beams such that construction joints are not formed.
15. Ensure that exterior concrete elements are not placed beneath protruding components of the buildings that may limit free vertical movement of the concrete element. This includes porches, driveways, and sidewalks that may be poured adjacent to structures.

7.0 FLOOR SLABS

It is recommended that concrete floor slabs be constructed on a pad that has been prepared as previously indicated in section 5.0. A minimum of 4-inches of relatively free-draining material should be used beneath the slab in order to help distribute floor loads, break the rise of capillary

water, and aid in the concrete curing process. Alternatively, 6 inches of road base may be used in place of the free draining-material.

Concrete slabs should be designed using rebar reinforcement and frequent crack control joints to help control normal shrinkage and stress cracking. Concrete placement and curing should meet ACI[4] requirements including following hot or cold weather placement recommendations, when appropriate. If a moisture-sensitive floor covering will be installed, we recommend that a vapor barrier be installed beneath the concrete slab. 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.IR-96 for more information regarding vapor barrier location). If the vapor 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

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 are presented in the following table.

CASE EVALUATED	SOIL TYPE	VALUE
Active	Imported Granular Structural Fill	35 psf/ft
		52 psf/ft (with seismic)
At-Rest	Imported Granular Structural Fill	55 psf/ft
Passive	Imported Granular Structural Fill	440 psf/ft
		390 psf/ft (with seismic)
Seismic Coefficient	IBC 1610.1.1	0.181
Coefficient of friction tan(φ*0.6) where φ = 34	Imported Granular Structural Fill	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 and that the backfill is in a drained condition with no build-up of hydrostatic pressure. 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.

4 American Concrete Institute

9.0 MOISTURE CONTROL

This soils report provides recommendations for site preparation and foundation design. Inadequate surface drainage or failure to control moisture will likely result in excessive differential movement and structural damage. The following moisture control measures are highly recommended:

1. The ground surface should be graded to drain surface water away from the building addition in all directions. A minimum grade of 5% (IBC 1803.3) in the first 10 feet is recommended. Impervious surfaces such as concrete walkways or asphalt pavement adjacent to the structure are effective in reducing the potential for water migration beneath foundations and slabs and should be considered in design. Impervious surfaces

   such as asphalt or concrete within 10 feet of the building foundation should be sloped a minimum of 2% away from the building.
2. Roof runoff should be collected, and downspouts should be designed to discharge collected water a minimum of 10 feet beyond the building footprint or onto impervious surfaces.
3. Xeriscape (landscaping that eliminates the need for supplemental irrigation of plants) is recommended within 5 feet of the building foundation. Bubblers, although more efficient than sprinkler irrigation, still have a significant potential of introducing excessive water into the ground and saturating foundation soils. Bubblers are not recommended in the 10 feet buffer zone area. As an alternative, sealed bottom planter boxes may be used.
4. Grass should not be placed within 10-feet of the foundation. Grass, if planted, should have a minimum slope of 5% away from the foundation.
5. Inadequate compaction of utility trench backfill provides a conduit for water migration. All utility trenches within the building footprint and extending 5 feet beyond the footprint 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 should be compacted to at least 95% of the maximum dry density.
6. Grading should be such that surface water is directed away from all cut and fill slopes and collected only in channels protected against erosion. Water should not be allowed to pond on-site.

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 owner/contractor is responsible to ensure that these surface drainage and moisture control recommendations are followed throughout the life of the structure.

10.0 PAVEMENT DESIGN RECOMMENDATIONS

10.1 FLEXIBLE PAVEMENT DESIGN

Design of the asphalt pavement section 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, which

is standard for parking lots accommodating light traffic. A traffic index of 7.0 was used for areas with frequent heavy truck traffic.

Prior to construction of the pavement section, the subgrade should be prepared as previously outlined. A CBR of 2 was used for design based on our experience with similar clays in the area. In-situ values of the clays are likely to exceed the CBR value of 2. However, this design is based on the clay becoming wet, which would decrease the CBR value of the clay.

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

- Pavement Design Life - 20 years
- Structural Layer Coefficients
  - Asphalt = 0.42
  - Road base = 0.12
  - Subbase = 0.08

Based on design parameters, the following pavement sections are provided for the portions of the parking lot with a low volume of light to moderately loaded truck traffic.

Location	Asphalt Thickness (inches)	Base Course (inches)	Subbase (inches)
Light Traffic Area (T.I) = 5.5	3.5	10.0	8.0
Light Traffic Area Stabilized	3.5	8.0	6.0
Heavy Traffic Area (T.I) = 7.0	4.5	12.0	14.0
Heavy Traffic Area Stabilized	4.5	10.0	12.0

The geogrid reinforced/stabilized section designs require a geogrid layer be placed between the subbase and subgrade layers. We recommend Tensar TX5 geogrid or equivalent be used. Placement of the geogrid, and subbase over the geogrid, should be according to the manufacturer's recommendations.

Recompacted on-site soils should be compacted to a minimum of 95% of the maximum dry density as determined by ASTM D-1557 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 base should be tested prior to site delivery and during placement for conformance with project specifications.

10.2 RIGID PAVEMENT DESIGN

We anticipate that a concrete pad may be installed by the dumpster or other areas with heavy truck traffic. Procedures outlined in the Portland Cement Association's guide "Thickness Design for Concrete Highway and Street Pavements" were utilized for concrete pavement design.

The following design parameters were used:
Average daily truck traffic = 3 (Axle -load category 1)
Subgrade-subbase support = low (based on site soils)
Concrete modulus of rupture = 650 psi

Based on input parameters, a minimum of 5.5 inches of concrete, 8 inches of road base, and 8 inches of subbase over subgrade as previously outlined for asphaltic pavement will be adequate. The design recommendations are based on the following assumptions:

Road base and subbase soils should be compacted to a minimum of 95% of the maximum dry density (ASTM D-1557). Most concrete pavement in St. George utilizes fiber reinforcement. The design is based on the assumption of the utilization of fiber reinforcement in the concrete. Concrete and base coarse materials and construction should meet St. George City specifications.

As a rough guide, the joint spacing in feet for plain concrete pavement should not generally exceed twice the slab thickness in inches. Thus, for a 5.5-inch-thick slab, joint spacing would be on the order of 11 feet as a maximum. Also, as a general guideline, the ratio of slab width to length should not exceed 1.25.

Joint depth should be 1/4 of the slab thickness and continuous across the slab. If sawn joints are used, the joints should be sawn as soon as possible following concrete set.

11.0 SOIL CORROSIVITY

Soluble sulfates testing has not been performed on the soils in the project area. However, soils in the vicinity have been shown to be moderately to severely corrosive to concrete. Therefore, it is recommended that concrete mixes in contact with or within 6 inches of the onsite soil be designed for sulfate exposure category S3. It is recommended that all concrete be designed in accordance with ACI 318, R19.3. Buried pipes should be plastic (PVC or HDPE) instead of metal, where possible.

12.0 FOUNDATION REVIEW AND TESTING

This report has been prepared to assist in 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.

13.0 LIMITATIONS

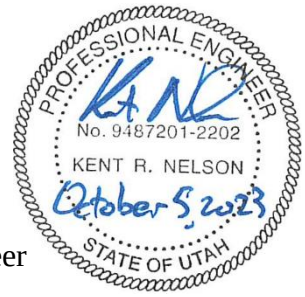
The exploratory data presented in this report were collected to provide geotechnical design recommendations for this project and subsurface site descriptions represent conditions observed at the time and at the locations explored. The investigations may not be indicative of subsurface conditions beyond the investigation locations 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.

Site conditions and standards of practice change, therefore, we should be notified to review and update the report and its recommendations if construction is not commenced within 3 years of the date it was issued.

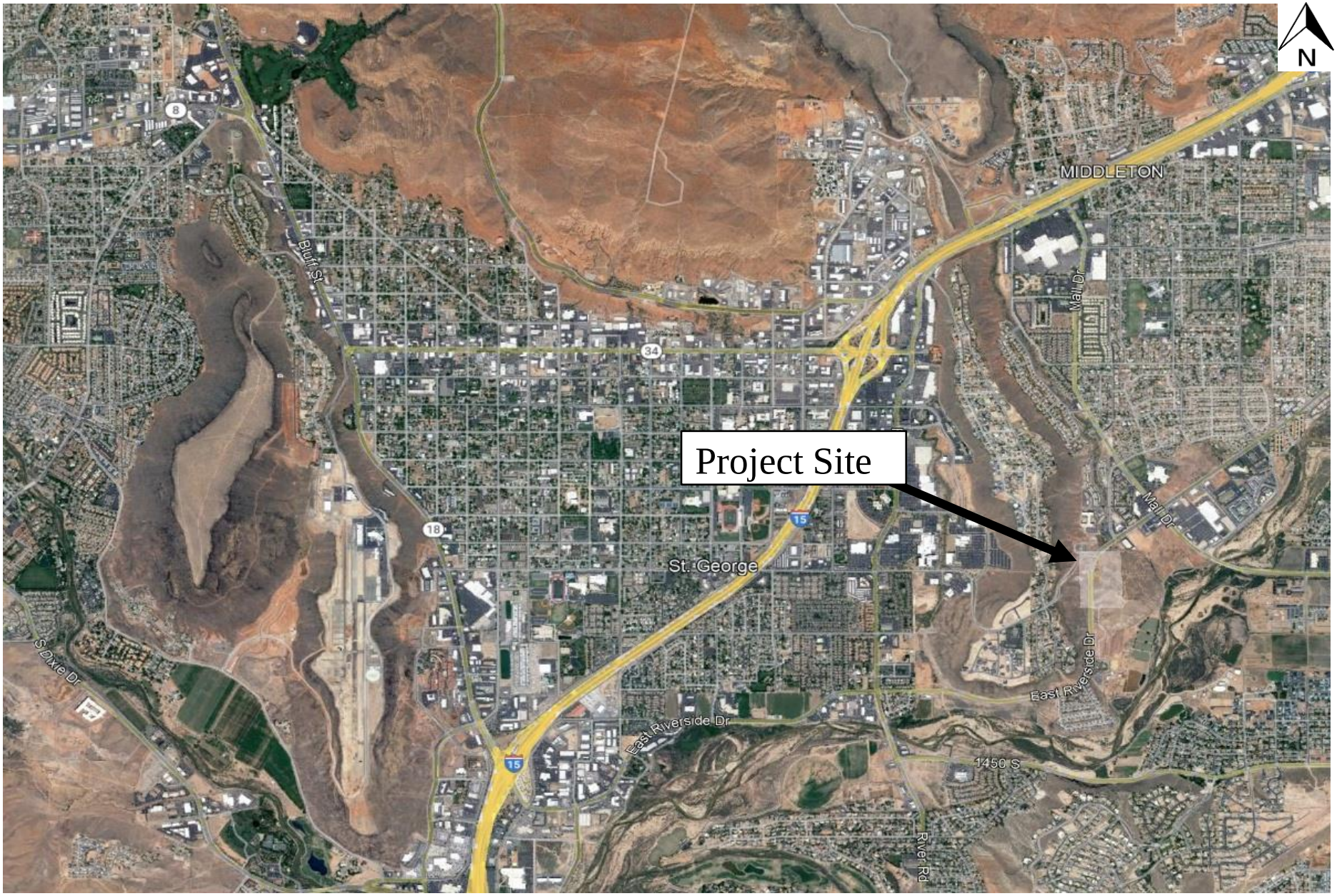
LANDMARK TESTING & ENGINEERING



Kent Nelson
Project Engineer

Reviewed by:

Chad Hardman, P.E.
Project Engineer



LANDMARK TESTING & ENGINEERING	VICINITY MAP PROJECT NUMBER 230521	Figure 1



LANDMARK TESTING & ENGINEERING	SITE MAP PROJECT NUMBER 230521	Figure 2

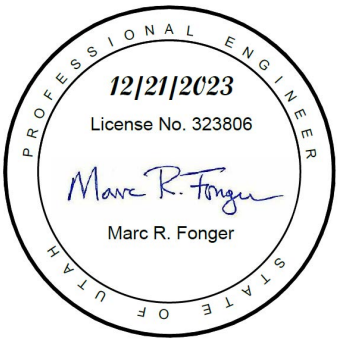
EXHIBIT E
Drainage Control Plan

River Knoll

St. George, Utah
Drainage Control Plan and Report

Prepared By

PREMIER DESIGN & ENGINEERING
75 E 100 N
Ivins, Utah, 84738
Phone: (775) 385-7647
Contact: Marc Fonger, P.E.



December 21, 2023

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Property Description

Existing Site Description
The existing site is located on the southeast corner of Riverside Drive and Foremaster Drive. The existing site is partially disturbed by previous construction and recreation activities. The portion of the undisturbed site is made up of desert brush with poor coverage. Existing soil is labeled as Stony Colluvial by the Natural Resource Service Commission and does not include a description of the soil characteristics related to runoff potential. However, the geotechnical report issued by Landmark Testing and Engineer (Project No. 230521), describes the onsite soil as clay expansive clays. Therefore, a Hydrologic Group classification of D is used in this analysis.

The site slopes steeply from the hillsides on the east side of the property to Riverside Drive. Only a portion of the property owned by the developer will be developed. This undeveloped portion of the property drains towards the improved area, proposed improvements described below will be utilized to control the runoff from this area.

Proposed Site Description
The proposed use consists of two commercial buildings, associated sidewalks, landscaping, and parking areas. The site will utilize underground detention to manage the peak flows. Onsite stormwater will be directed to the underground basin via multiple catch basins and storm drain pipes. The outlet will deliver stormwater to an existing storm drain pipe at the north end of the site.

Off-Site Drainage Description

Off-site drainage from the undeveloped portion of the property will be intercepted by a 6-foot-wide storm drain channel located along the east side of the proposed improved area. The channel will route the storm water to the north and empty into the south side of Foremaster Drive..

On-Site Drainage Description

Existing runoff patterns run from east to west. The site will be designed to drain from the south to north. Surface improvements, catch basins, underground pipelines and detention structures will be used to manage the onsite storm water..

Description of Proposed Drainage Facilities

Description of Proposed Drainage Facilities
All proposed drainage improvements were designed using the 100-year 24-hour, 100-year 3-hour, 10-year 24-hour, or the 10-year 3-hour design storm event per the St. George City Drainage Control Manual.

Flow will be collected and directed to a single underground detention basin located within the proposed parking areas.

Detention
Based on comparisons between the pre- and post-developed hydrographs, detention is warranted for this development. The detention required is based on the 100-year, 24-hour storm event and is calculated to be 324 cubic feet (cf) in volume, the volume of required Low Impact Design retention which is calculated to be 1,198 cf. The underground detention basin will be designed to contain a minimum of 1,522 cf, which is the sum of the two values. A Stormbrixx (or similar) system will be used to create the majority of the storage capacity.

Design Runoff Computations

The site was modeled using HEC-HMS Version 4.11, which is a computer modeling program developed by the United States Army Corp of Engineers (USACE).

Model Input Parameters
The input parameters selected for computing discharge using the computer model were derived from site observations and field surveys. Input parameters for the project are included in the attached calculation sheets. The existing conditions were modeled and labeled as Pre-Developed where future conditions modeled were labeled as Post-Developed.

The site was modelled as Hydrologic Group D.

Rainfall Depth and Design Storm
The current City of St. George Drainage Control Manual was used in this analysis to estimate stormwater generated on the site.

Model Output
The results of the HEC-HMS analysis are also illustrated in the attached calculations in the form of combined hydrographs for each set of subareas reporting to specific detention basins.

Available on request are the output from each run in HEC-HMS. These files include all input parameters used to determine the flow rates for the sub areas.

Drainage Facility Design Calculations

LID Retention/Detention Basin
Since the native soil at the site is clay with very low permeability, based on a site-specific Geotechnical report, no LID retention is proposed for this site.

Outlet
To the limit the outflow to the pre-developed flow, a 5 1/4 inch diameter orifice will need to be placed between the Stormbrixx system and the existing storm drain in Foremaster Drive. See the attached calculation sheets for the input values used to calculate this orifice size.

Curb Inlet and Catch Basin Inlet Capacities
The curb inlets and catch basins for the proposed streets and/or parking lots were analyzed using HEC-22. The inlet capacity is 7.22 cfs for a single curb inlet and 9.30 cfs for a double inlet. Calculations are available upon request.

FEMA Compliance

No FEMA regulatory floodplain exists on the site.

Conclusions

The following conclusions summarize the recommendations proposed for this development:

Onsite Drainage: The proposed storm water system can handle a 10-year and 100-year storms for the site and delivering it to the existing storm drain system.

Off-site Drainage: Off-site drainage enters the site from upstream and will be conveyed around the project. All drainage is adequately conveyed by the proposed improvements.

PREMIER DESIGN & ENGINEERING INC.

PROJECT:	**River Knoll**	BY:	Marc Fonger	DATE:	12/21/2023
SUBJECT:	**Drainage Study**	CHKD. BY:	Marc Fonger	DATE:	12/21/2023

Watershed Area Delineation

Subarea: Pre Sub Area 1 — Description: *Pre Developed Sub Area 1 (Newly Graded)*

Area Summary = 82,745 sq ft; 1.90 acres; 0.0030 sq mi

Longest Length: 334 ft — Average Slope: 0.1198 ft/ft

Subarea: Post Sub Area 1 — Description: *Post Developed Sub Area 1*

Area Summary = 82,745 sq ft; 1.90 acres; 0.0030 sq mi

Longest Length: 627 ft — Average Slope: 0.0284 ft/ft

Subarea: Offsite 1 — Description: *Offsite area will not be developed*

Area Summary = 79,949 sq ft; 1.84 acres; 0.0029 sq mi

Longest Length: 491 ft — Average Slope: 0.0835 ft/ft

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Runoff Curve Number

Subarea(s) General Chart

Soil Description Existing soil is Type D - Landmark Geotech report shows expansive clays throughout the site

Land Use and Description					**Soil Type**				**Use**		
					A	**B**	**C**	**D**			
Urban Developed Open Space (Lawns, Parks, Golf Courses, Cemeteries, etc.)											
	Poor Condition; Grass Cover < 50%				68	79	86	89	89		Use for Landscaping
	Fair Condition; Grass Cover 50% to 75%				49	69	75	84			
	Good Condition; Grass Cover > 75%				39	61	74	80			
Impervious Areas											
					98	98	98				
	Streets and Roads										
		Paved; Curbs and Storm Sewers			98	98	98	98	98		Use for impervious areas
		Paved; Open Ditches (including Right-of-Way)			83	89	92	93			
		Gravel (including Right-of-Way)			76	85	89	91			
		Dirt (including Right-of-Way)			72	82	87	89			
Urban Districts											
	Commercial and Business Average 85% Impervious				89	92	95	98			
	Industrial Average 72% Impervious				81	88	91	93			
Residential Districts											
	1/8 Acre or less (Town Houses) Average 65% Impervious				77	85	90	92			
	1/4 Acre Average 38% Impervious				61	75	83	87			
	1/3 Acre Average 30% Impervious				57	72	81	86			
	1/2 Acre Average 25% Impervious				54	70	80	85			
	1 Acre Average 20% Impervious				51	68	79	84			
	2 Acre Average 12% Impervious				46	65	77	82			
Developing Urban Areas											
Newly Graded Areas (pervious areas only, no vegetation)					77	86	91	94			
Cultivated Agricultural Land					77	86	91	94			
	Fallow:	Bare soil		Poor	76	85	90	93			
		Crop residue cover (CR)		Good	74	83	88	90			
				Poor	72	81	88	91			
	Row Crops:	Straight Row (SR)		Good	67	78	85	89			
				Poor	71	80	85	90			
		SR + CR		Good	64	75	82	85			
				Poor	70	79	84	88			
		Contoured, C		Good	65	75	82	86			
				Poor	69	78	83	87			
		C + CR		Good	64	74	81	85			
				Poor	66	74	80	82			
				Poor	45	66	77	83			
	Woods[4]			Fair	36	60	73	79			
				Good	30	55	70	77			
	Farmsteads-buildings, lanes, driveways,				59	74	82	86			
	and surrounding lots										

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[1] *Poor: <50% ground cover or heavily grazed with no mulch*					[3] *CN's shown were computed for areas with 50% grass (pasture) cover. Other*						
Fair: 50 to 75% ground cover and not heavily grazed.					*combinations of conditions of may be computed from the CN's for woods and pasture.*						
Good: >75% ground cover and lightly or only occasionally grazed.					[4] *Poor: Forest litter, small trees, and brush are destroyed by heavy grazing*						
[2] *Poor: <50% ground cover*					*or regular burning*						
Fair: 50 to 75% ground cover					*Fair: Woods are grazed but not burned, and some forest litter covers the soil*						
Good: >75% ground cover					*Good: Woods are protected from grazing, and litter and brush adequately cover the soil*						
Arid and Semi-Arid Rangelands	Herbaceous-mixture of grass, weeds, and			Poor		80	87	93	93		Use for existing conditions
	low growing brush, with brush the minor			Fair		71	81	89			
	element.			Good		62	74	85			
	Oak-aspen-mountain brush mixture of oak			Poor		66	74	79			
	brush, aspen, mountain mahogany, bitter brush,			Fair		48	57	63			
	maple, and other brush			Good		30	41	48			
	Pinyon-juniper-pinyon, juniper, or both;			Poor		75	85	89			
	grass understory			Fair		58	73	80			
				Good		41	61	71			
	Sagebrush with Grass Understory			Poor		67	80	85			
				Fair		51	63	70			
				Good		35	47	55			
	Desert shrub-major plants include saltbrush,			Poor	63	77	85	88			
	greasewood, creosote bush, blackbrush,			Fair	55	72	81	86			
	bursage, palo verde, mesquite, and cactus			Good	49	68	79	84			
Poor: <30% ground cover (litter, grass, and brush overstory)											
Fair: 30 to 70% ground cover											
Good: >70% ground cover											
Pre Sub Area 1			**Total Area=**	**82,745**	**sq ft**			**Weighted Avg. CN =**			**93.0**
			Impervious Area =	0							98
			Existing Ground =	82,745							93
Post Sub Area 1			**Total Area=**	**82,745**	**sq ft**			**Weighted Avg. CN =**			**95.0**
			Impervious Area =	55,600							98
			Landscaping =	27,145							89
Offsite 1			**Total Area=**	**79,949**	**sq ft**			**Weighted Avg. CN =**			**93.0**
			Impervious Area =								98
			Existing Ground =	79,949							93

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SCS Lag Time

Time of Concent t_c

$$t_c = 0.00526 * L^{0.8}\left[\frac{1000}{CN} - 9\right]^{0.7} S^{-0.5}$$

Where:

CN	=	SCS runoff curve number
S	=	Average slope
L_f	=	Longest Length in ft

SCS Lag = $0.6 * t_c$

Subarea	**Post Sub Area 1**	**CN**	**L_f**	**S_f**	**t_c**	**Lag**
Name	**Description**		**(ft)**	**(ft/ft)**	**(min)**	**(min)**
Pre Sub Area 1	*Existing Conditions*	93.0	334	0.1198	2.35	1.41
Post Sub Area 1	*Post developed Conditions*	95.0	627	0.0284	7.24	4.34
Offsite 1	*Existing Conditions*	93.0	491	0.0835	3.83	2.30

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Low Impact Design - Retention Volume Calculation

$$WQRV = \frac{P_{80\%} * R_{new} * A}{12}, \qquad \text{EQ 1}$$

Where,

WQRV = Water Quality Retention Volume, in ac-ft,

$P_{80\%}$ = 80th percentile precipitation value (excluding snowfall, from gage analysis, in inches),

R_{new} = Storm Water Runoff Coefficient associated with the proposed new development, and

R_{new} = 1.14 (Imp) -0.371 when imp ≥ 55%

R_{new} = .225 (Imp) +-0.05 when imp ≤ 55%

A = Area, in Acres.

Imp = decimal percentage of impervious surface in the contributing watershed

Area (ac)	$P_{80\%}$ (in)	A_{imp} (ft^2)	A_{total} (ft^2)	Imp (%)	R_{new} Imp>55%	R_{new} Imp<55%	R_{new}	**WQRV (ac-ft)**	**WQRV (ft^3)**
1.90	0.44	55,600	82,745	0.67	0.40	0.20	0.40	**0.028**	**1,198**

PREMIER DESIGN & ENGINEERING INC.

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Sub Area 1
HEC-HMS 100-Year, 3-Hour Storm Hydrographs

Time (min)	Pre-Dev Flow (cfs)	Volume (cf)	Post-Dev Flow (cfs)	Detention		
				Outflow	Volume	Acc. Volume
	3.58		**3.96**	**(cfs)**	**(cf)**	**(cf)**
0	0.00	0	0.00	0	0	0
5	0.00	0	0.00	0	0	0
10	0.00	0	0.00	0	0	0
15	0.00	0	0.00	0	0	0
20	0.00	0	0.00	0	0	0
25	0.00	0	0.00	0	0	0
30	0.00	0	0.00	0	0	0
35	0.00	0	0.00	0	0	0
40	0.00	0	0.00	0	0	0
45	0.00	0	0.00	0	0	0
50	0.00	0	0.00	0	0	0
55	0.00	0	0.00	0	0	0
60	0.00	0	0.00	0	0	0
65	0.43	129	0.56	0.56	0	0
70	3.58	1,074	3.18	3.18	0	0
75	3.17	951	3.96	3.58	114	114
80	2.24	672	2.99	3.37	-114	0
85	2.06	618	2.43	2.43	0	0
90	2.07	621	2.31	2.31	0	0
95	1.39	417	1.82	1.82	0	0
100	1.21	363	1.42	1.42	0	0
105	1.19	357	1.31	1.31	0	0
110	1.19	357	1.29	1.29	0	0
115	1.21	363	1.28	1.28	0	0
120	1.22	366	1.29	1.29	0	0
125	0.46	138	0.80	0.8	0	0
130	0.25	75	0.39	0.39	0	0
135	0.21	63	0.27	0.27	0	0
140	0.20	60	0.23	0.23	0	0
145	0.21	63	0.22	0.22	0	0
150	0.21	63	0.22	0.22	0	0
155	0.05	15	0.12	0.12	0	0
160	0.01	3	0.03	0.03	0	0
165	0.00	0	0.01	0.01	0	0
170	0.00	0	0.00	0	0	0
175	0.00	0	0.00	0	0	0
180	0.00	0	0.00	0	0	0
				100-YR Storm Volume =		**114**

PREMIER DESIGN & ENGINEERING INC.

PROJECT:	**River Knoll**	BY:	Marc Fonger	DATE:	12/21/2023
SUBJECT:	**Drainage Study**	CHKD. BY:	Marc Fonger	DATE:	12/21/2023

Sub Area 1
HEC-HMS 10-Year, 3-Hour Storm Hydrographs

Time (min)	Pre-Dev Flow (cfs)	Volume (cf)	Post-Dev Flow (cfs)	Detention		
				Outflow	Volume	Acc. Volume
	1.42		**1.90**	**(cfs)**	**(cf)**	**(cf)**
0	0.00	0	0.00	0.00	0	0
5	0.00	0	0.00	0.00	0	0
10	0.00	0	0.00	0.00	0	0
15	0.00	0	0.00	0.00	0	0
20	0.00	0	0.00	0.00	0	0
25	0.00	0	0.00	0.00	0	0
30	0.00	0	0.00	0.00	0	0
35	0.00	0	0.00	0.00	0	0
40	0.00	0	0.00	0.00	0	0
45	0.00	0	0.00	0.00	0	0
50	0.00	0	0.00	0.00	0	0
55	0.00	0	0.00	0.00	0	0
60	0.00	0	0.00	0.00	0	0
65	0.08	24	0.18	0.18	0	0
70	1.42	426	1.42	1.42	0	0
75	1.41	423	1.90	1.42	144	144
80	1.09	327	1.53	1.42	33	177
85	1.06	318	1.31	1.42	-33	144
90	1.10	330	1.29	1.42	-39	105
95	0.65	195	0.96	1.31	-105	0
100	0.53	159	0.68	0.68	0	0
105	0.51	153	0.61	0.61	0	0
110	0.51	153	0.59	0.59	0	0
115	0.52	156	0.59	0.59	0	0
120	0.53	159	0.59	0.59	0	0
125	0.27	81	0.41	0.41	0	0
130	0.20	60	0.26	0.26	0	0
135	0.18	54	0.22	0.22	0	0
140	0.18	54	0.20	0.20	0	0
145	0.18	54	0.20	0.20	0	0
150	0.18	54	0.20	0.20	0	0
155	0.05	15	0.11	0.11	0	0
160	0.01	3	0.03	0.03	0	0
165	0.00	0	0.01	0.01	0	0
170	0.00	0	0.00	0.00	0	0
175	0.00	0	0.00	0.00	0	0
180	0.00	0	0.00	0.00	0	0
				10-YR 3-HR Storm Volume =		**177**

PREMIER DESIGN & ENGINEERING INC.

PROJECT:	**River Knoll**	BY:	Marc Fonger	DATE:	12/21/2023
SUBJECT:	**Drainage Study**	CHKD. BY:	Marc Fonger	DATE:	12/21/2023

Sub Area 1
HEC-HMS 100-Year, 24-Hour Storm Hydrographs

Time	Pre-Dev Flow	Volume	Post-Dev Flow	Detention		
				Outflow	Volume	Acc. Volume
(min)	(cfs)	(cf)	(cfs)	(cfs)	(cf)	(cf)
	3.09		**3.36**			
0	0.02	24	0.03	0.03	0	0
20	0.02	24	0.04	0.04	0	0
40	0.03	36	0.04	0.04	0	0
60	0.03	36	0.05	0.05	0	0
80	0.04	48	0.05	0.05	0	0
100	0.04	48	0.06	0.06	0	0
120	0.05	60	0.08	0.08	0	0
140	0.06	72	0.09	0.09	0	0
160	0.07	84	0.09	0.09	0	0
180	0.08	96	0.11	0.11	0	0
200	0.10	120	0.13	0.13	0	0
220	0.13	156	0.16	0.16	0	0
240	0.17	204	0.21	0.21	0	0
260	0.24	288	0.29	0.29	0	0
280	0.60	720	0.70	0.70	0	0
300	3.09	3,708	3.36	3.09	324	324
320	1.38	1,656	1.48	1.75	-324	0
340	0.62	744	0.66	0.66	0	0
360	0.38	456	0.39	0.39	0	0
380	0.27	324	0.28	0.28	0	0
400	0.22	264	0.23	0.23	0	0
420	0.19	228	0.20	0.20	0	0
440	0.17	204	0.17	0.17	0	0
460	0.15	180	0.16	0.16	0	0
480	0.14	168	0.15	0.15	0	0
500	0.13	156	0.14	0.14	0	0
520	0.12	144	0.13	0.13	0	0
540	0.11	132	0.12	0.12	0	0
560	0.10	120	0.11	0.11	0	0
580	0.10	120	0.10	0.10	0	0
600	0.10	120	0.10	0.10	0	0
620	0.10	120	0.09	0.09	0	0
640	0.10	120	0.09	0.09	0	0
660	0.10	120	0.09	0.09	0	0
680	0.10	120	0.08	0.08	0	0
700	0.10	120	0.08	0.08	0	0
720	0.10	120	0.08	0.08	0	0
			100-YR 24-hr Storm Volume =			**324**

PREMIER DESIGN & ENGINEERING INC.

PROJECT:	**River Knoll**	BY:	Marc Fonger	DATE:	12/21/2023
SUBJECT:	**Drainage Study**	CHKD. BY:	Marc Fonger	DATE:	12/21/2023

Sub Area 1
HEC-HMS 10-Year, 24-Hour Storm Hydrographs

Time	Pre-Dev Flow	Volume	Post-Dev Flow	Detention		
				Outflow	Volume	Acc. Volume
(min)	(cfs)	(cf)	(cfs)	(cfs)	(cf)	(cf)
	1.78		**2.04**			
0	0.02	24	0.05	0.05	0	0
20	0.02	24	0.07	0.07	0	0
40	0.03	36	0.08	0.08	0	0
60	0.03	36	0.11	0.11	0	0
80	0.04	48	0.16	0.16	0	0
100	0.06	72	0.39	0.39	0	0
120	0.08	96	2.04	1.78	312	312
140	0.12	144	0.91	1.17	-312	0
160	0.31	372	0.41	0.41	0	0
180	1.78	2,136	0.25	0.25	0	0
200	0.81	972	0.18	0.18	0	0
220	0.38	456	0.15	0.15	0	0
240	0.23	276	0.13	0.13	0	0
260	0.17	204	0.11	0.11	0	0
280	0.14	168	0.10	0.10	0	0
300	0.12	144	0.10	0.10	0	0
320	0.10	120	0.09	0.09	0	0
340	0.10	120	0.08	0.08	0	0
360	0.09	108	0.07	0.07	0	0
380	0.08	96	0.07	0.07	0	0
400	0.08	96	0.07	0.07	0	0
420	0.07	84	0.06	0.06	0	0
440	0.07	84	0.06	0.06	0	0
460	0.06	72	0.06	0.06	0	0
480	0.06	72	0.06	0.06	0	0
500	0.06	72	0.05	0.05	0	0
520	0.06	72	0.05	0.05	0	0
540	0.05	60	0.05	0.05	0	0
560	0.05	60	0.05	0.05	0	0
580	0.05	60	0.04	0.04	0	0
600	0.05	60	0.04	0.04	0	0
620	0.04	48	0.04	0.04	0	0
640	0.04	48	0.04	0.04	0	0
660	0.04	48	0.04	0.04	0	0
680	0.04	48	0.04	0.04	0	0
700	0.04	48	0.04	0.04	0	0
720	0.04	48	0.10	0.10	0	0
			10-YR 24-hr Storm Volume =			**312**

PREMIER DESIGN & ENGINEERING INC.

PROJECT:	**River Knoll**	BY:	Marc Fonger	DATE:	12/21/2023
SUBJECT:	**Drainage Study**	CHKD. BY:	Marc Fonger	DATE:	12/21/2023

Retention/Detention Basin Design

Subarea 1

Volume of Storage Required = 1,522 cf Including LID Volume

Pipe Size (in)	(cf/lf)	Length Required	Length Provided	Volume Provided	Comments
12	0.79	1928			
15	1.23	1238			
18	1.77	861			
24	3.14	485			
30	4.91	311			
36	7.07	216			
42	9.62	159			
48	12.56	122			
54	15.9	96			
60	19.63	78			
66	23.75	65			
72	28.26	54			
78	33.17	46			
84	38.47	40			
Stormbrixx Boxes				1,600	Or other similar product
		Total Volume Provided =		1,600	

PREMIER DESIGN & ENGINEERING INC.

PROJECT:	**River Knoll**	BY:	Marc Fonger	DATE:	12/21/2023
SUBJECT:	**Drainage Study**	CHKD. BY:	Marc Fonger	DATE:	12/21/2023

Detention Outlet Design

Subarea 1

Circular Orifice Equation $Q=C_d(0.25piD^2)(2gh)^{0.5}$

Solving for A (Area of orifice, sf) $A=Q/(C_d(2gh)^{0.5}$

Q =	1.42	cfs
C_d =	0.62	
g =	32.2	ft/s^2
h =	4.00	ft
pi =	3.14	
A =	0.14	sf
D =	0.43	ft
D =	5 1/4	in

Diameter of Orifice

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Dec 21 2023

Offsite Channel - 100-yr Flow = 3.58 cfs

Triangular

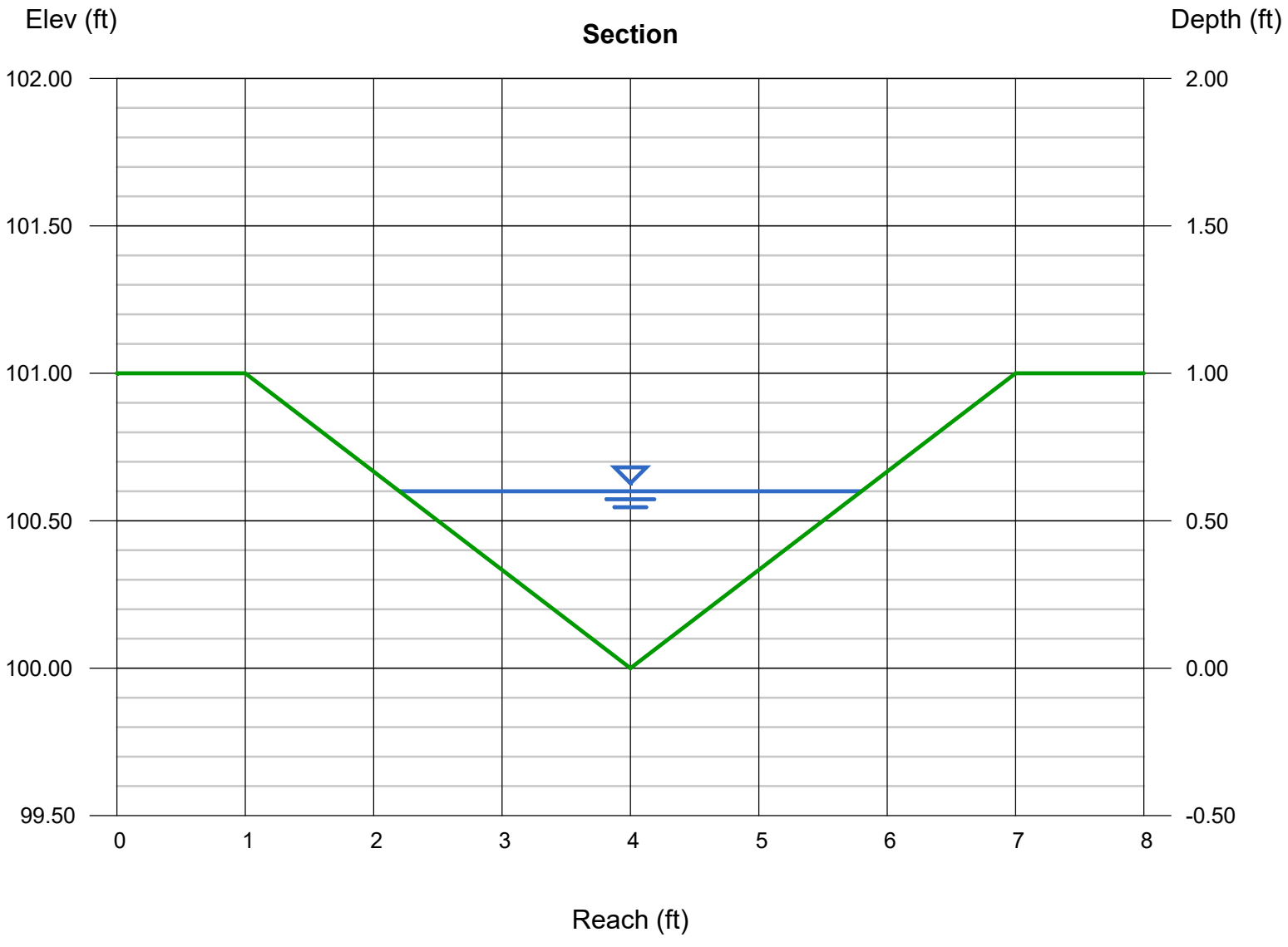
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.21
N-Value	= 0.020

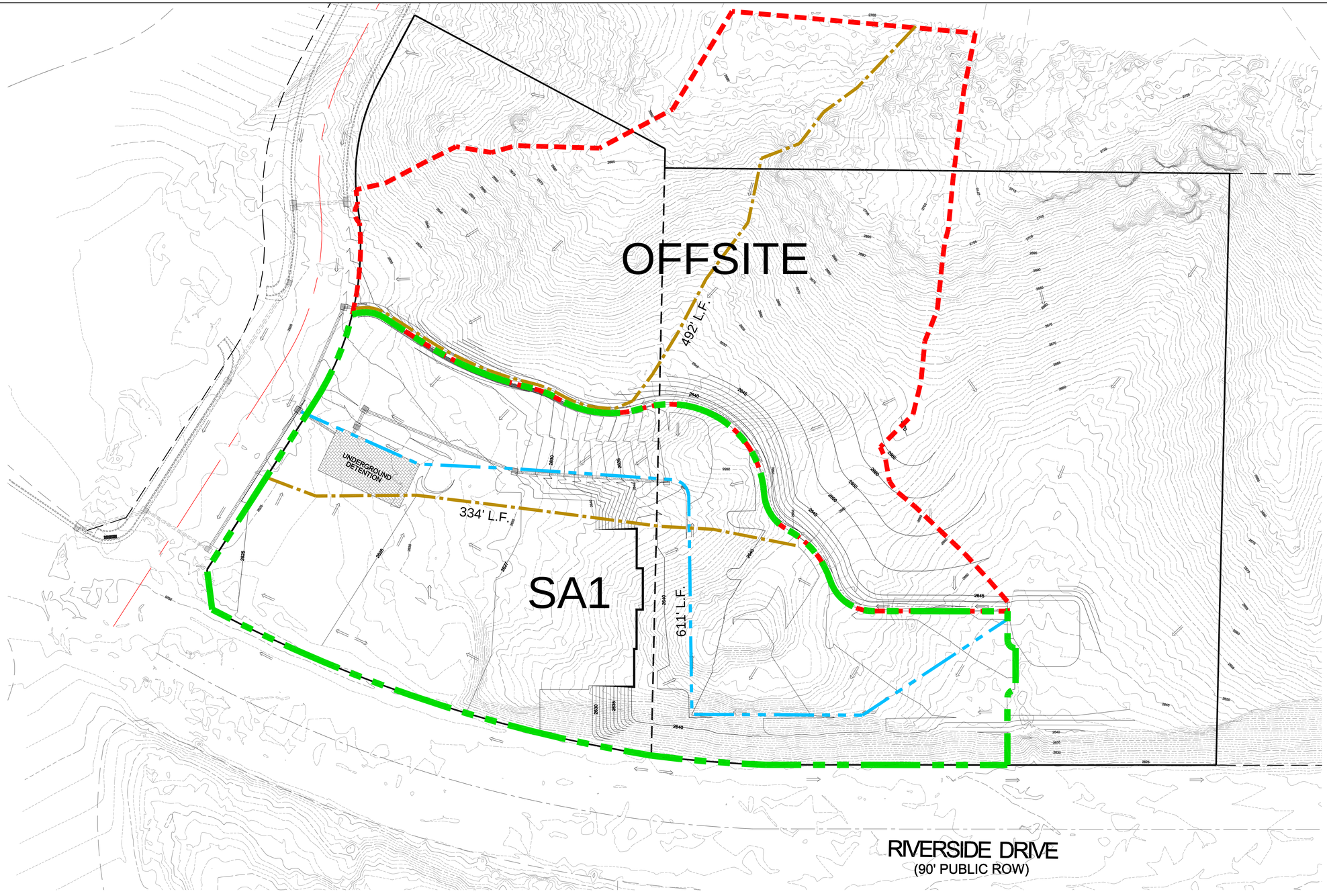
Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.60
Q (cfs)	= 3.818
Area (sqft)	= 1.08
Velocity (ft/s)	= 3.53
Wetted Perim (ft)	= 3.79
Crit Depth, Yc (ft)	= 0.64
Top Width (ft)	= 3.60
EGL (ft)	= 0.79





LEGEND

- EXISTING 1' CONTOUR
- EXISTING 5' CONTOUR
- PROPOSED 1' CONTOUR
- PROPOSED 5' CONTOUR
- PROPERTY LINE
- DIRECTION OF FLOW
- SA1 (1.90 ACRES)
- OFF-SITE DRAINAGE AREA (1.83 ACRES HILLSIDE)
- LONGEST RUN (PRE)
- LONGEST RUN (POST)

DATE:	12/13/2023
DRAWN BY:	E.A.M.
CHECKED BY:	M.R.F.
CLIENT:	AGLLC

SCALE: N.T.S.

DRAINAGE EXHIBIT
PARCEL SG-5-2-28-325 & 3 ACRES SOUTH
ASPENS GROVE LLC
ST.GEORGE, UTAH 84770

PREMIER Design & Engineering
75 EAST 100 NORTH IVINS, UTAH 84738 (435) 313-2267

PROFESSIONAL ENGINEER
12/13/2023
License No. 323886
Marc R. Fonger
STATE OF UTAH

SHEET
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