ACS SERVICES LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION
DBE - SBE - WBE

REPORT OF GEOTECHNICAL INVESTIGATION

COURTYARD BY MARRIOTT

4105 WEST SR89A
SEDONA, ARIZONA
ACS PROJECT NO. 1401316

PREPARED FOR:

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July 10, 2014

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Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

ACS

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ACS SERVICES LLC

July 10, 2014 Project 1401316

Mr. John White
WESTERN HORIZONS, INC.
7255 E. Hampton Avenue, Suite 122
Mesa, AZ 85209

RE: GEOTECHNICAL INVESTIGATION REPORT
COURTYARD BY MARRIOTT
4105 WEST SR89A
SEDONA, ARIZONA

Dear John:

Transmitted herewith is a copy of the final report of the subsurface soil and foundation investigation on the above-mentioned project. The services performed provide an evaluation at selected locations of the subsurface soil conditions throughout the zone of significant foundation influence. As an additional service, this firm may review the project plans and structural notes for conformance to the intent of this report.

This firm possesses the capability to provide testing and inspection services during the course of construction. Such quality control/assurance activities may include, but are not limited to, compaction testing as related to fill control, foundation inspection, and concrete sampling. Please notify this firm if a proposal for such services is desired.

Should any questions arise concerning the content of this report, please feel free to contact this office at your earliest convenience.

Respectfully submitted,

ACS SERVICES LLC

Registered Professional Engineer (Geological) CERTIFICATE NO. 14741 H. EUGENE HANSEN Date Signed 7/10/14 ARIZONA, U.S.A.

Expires 3/31/15

H. Eugene Hansen, P.E.
Geotechnical and Materials Testing Engineer

cc: (1) Addressee via email (pdf copy)

SCOPE

This report is submitted following a geotechnical investigation conducted by this firm for the proposed **COURTYARD BY MARRIOTT**, to be located at 4105 West SR89A, in Sedona, Arizona. The objectives of the investigation were to determine the physical characteristics of the soil and rock underlying the site and to provide final recommendations for safe and economical foundation design and slab support. For purposes of foundation design, the maximum column and wall loads have been assumed to be as summarized below.

	Maximum Column Load (KIPS)	Maximum Wall Load (KLF)
Shallow Spread Foundations	125	7.5

Anticipated structural loads in excess of those stated above will need to be addressed in an addendum, i.e. they are not covered under the scope of work involved with this effort. The recommendations for site grading contained in this report do not address the presence or removal of contaminants from the site soils.

FIELD INVESTIGATION

On June 24, 2014, this firm advanced five (5) exploratory test borings (6.25-inch hollow stem auger) for examination of the subsurface profile to depths ranging from 2 to 15.5 feet below the existing site grade in the building area. Three (3) borings were advanced to depths ranging from 2 to 8 feet below the existing site grade in the proposed pavement and buried retention tank areas. One (1) boring was advanced to a depth of 3 feet in the area of the proposed pool. All borings less than 15 feet in depth were terminated due to auger refusal in hard sandstone bedrock. The soils and rock encountered were examined, visually classified and wherever applicable, sampled. Refer to the Boring Logs in Appendix B for a detailed description of the subsurface soil and rock conditions at the specified locations. Refer to Figure 2 in Appendix A for the approximate locations of the borings.

LABORATORY TESTING

Representative samples obtained during the field investigation were subjected to the following laboratory analyses:

Test	Sample(s)	Purpose
Sieve Analysis and Atterberg Limits	Native subgrade soils (9)	Soil classification
Proctor	Native subgrade soils (1)	Moisture-Density Relationship
pH and Resistivity	Native subgrade soils (2)	Potential for metal corrosion
Sulfates and Chlorides	Native subgrade soils (2)	Potential for concrete corrosion

Refer to Appendix C of this report for the results of the laboratory testing.

SITE CONDITIONS

General Notes:

(1) Topographic relief	The site gently slopes to the south, but a raised area exists in the south portion of the site. Except for that area, the grade does not change that much in the building area.
(2) Fill	Approximately 3 feet of possible fill was encountered at the location of Boring 8. No other fill was encountered at the locations of the borings, but some fill may exist due to the existing paved access road that crosses the site.
(3) Evidence of surface disturbance	Some grubbing has been done on the surface of the site. An existing paved access road crosses the site from west to northeast in the area of the proposed building.
(4) Site use	The site is a vacant commercial lot along the southeast side of SR89A with Upper Red Rock Road forming the west boundary of the site. The site is covered with moderate vegetation consisting of Pinion and Juniper trees.

GEOLOGIC HAZARDS

The following list represents a general summary of the on-site soil characteristics relative to engineering applications:

Depth to groundwater	- None encountered
Potential for soil expansion	- Low based on the plasticity index data for the upper silty to clayey sand and gravel soils at the site
Potential for soil collapse	- Low based on the penetration blow counts for the red to pink sandstone bedrock below a loose to medium dense upper soil layer of varying thickness
Existence of loose soil at foundation bearing elevation	- Not probable
Potential for excessive differential soil movement	- Low
Potential for earth subsidence fissures	- Not applicable
Frost depth	- 1.0 feet for Sedona based on 2006 IBC
Presence of caliche, bedrock or other hard stratum	- Very dense, silty sand to gravel soils, consisting of weathered and fractured sandstone bedrock to hard sandstone bedrock was from 0 to 3 below the existing site grade at the location of the borings. Auger refusal was encountered at all borings except Boring 2 at depths ranging from 2 to 8 feet. Sandstone bedrock outcrops were noted on the surface of the site.

SEISMIC DESIGN CONSIDERATIONS

The project site is located within a municipality that employs the 2006 edition of the International Building Code. As part of this code, the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the earthquake event as well as the properties of the soils that underlie the site. As part of the procedure to evaluate seismic forces, the code requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile within the upper 100 feet of the ground surface. To define the Site Class for this project, we have interpreted the results of soil test borings drilled within the project site and estimated appropriate soil properties below the base of the borings to a depth of 100 feet as permitted by the code. The estimated soil properties were based upon our experience with subsurface conditions in the general site area.

Based upon our evaluation, the subsurface conditions within the site are consistent with the characteristics of a Site Class "B" as defined in Table 1613.5.2 of the building code. The associated USGS-IBC 2006/2009 probabilistic ground acceleration values and site coefficients for the general site area (Latitude 34.8500^{o}, Longitude -111.8275^{o}) were obtained from the USGS Design Maps Summary Report for the site which is attached in Appendix D.

UNDERGROUND STORM WATER RETENTION SYSTEM

An underground stormwater retention tank with associated storm drains and dry well disposal or metering into existing washes or storm drains may be utilized below the pavement areas. To determine pipe requirements, bulk samples were obtained over the depth range of 3-5 feet and 3-8 feet. These samples were tested for pH, resistivity, chloride and sulfate concentrations.

Soil Corrosion Potential – Metals

pH and Resistivity – Two pH and resistivity tests were conducted on samples of the soil and rock below a depth of 3 feet at the possible locations of buried stormwater retention tanks. The results of these tests are presented in Appendix C. Based on the laboratory results and the information presented in the following table, the site soils have a **moderate potential for corrosion** with respect to resistivity (2007-3177 ohms-cm) and low potential for corrosion with respect to pH (8.3-8.4).

Potential for Corrosion	Soil Resistivity (ohms-cm)	pH
Low	>10,000	6.5 – 9.5
Moderate	2,000 – 10,000	3.5 – 6.5 >9.5
High	<2,000	<3.5

The pH and resistivity measured for the subsurface soils was utilized to determine the minimum thickness for corrugated galvanized or aluminized steel pipe based in a required design life of 50 years. The pH and resistivity values determined by the laboratory testing were entered into the Chart for Estimating Average Service Life of Corrugated Galvanized and Aluminized Steel Pipe. To achieve a design life of 50 years, a minimum metal thickness of 0.52 inches (Gage 18) is required for the steel pipe of the retention tank. Depending upon the size and loading condition, a higher metal thickness for the pipe may be required.

Soil Corrosion Potential - Concrete

Soil sulfate concentration - The measured sulfate concentration in the soil (***refer to the Soil Analysis Report in Appendix C***) was 18 ppm for both samples. This is equivalent to a sulfate content in the soil (***percentage by weight - refer to the following table and the attached Sulfates and Chlorides Test Data)*** of 0.00186%. Although this suggests a negligible potential for sulfate attack due to the subsurface soils at the site, Type II cement is normally recommended to prevent potential sulfate attack over the long term. Type II cement should be used in the concrete for any pre-cast concrete utilized in the construction of the dry well. Refer to the following Table for the type of cement suitable for use in concrete exposed to sulfate in soils.

Table 2-2. Types of Cement Required for Concrete Exposed to Sulfate Attack

Sulfate exposure	Water-soluble sulfate (SO_4) in soil, percent by weight	Sulfate (SO_4) in water, ppm	Cement type
Negligible	0.00-0.10	0-150	—
Moderate*	0.10-0.20	150-1500	II, IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)
Severe	0.20-2.00	1500-10,000	V
Very severe	Over 2.00	Over 10,000	V plus pozzolan**

*Seawater.
**Pozzolan that has been determined by test or service record to improve sulfate resistance when used in concrete containing Type V cement.
Source: Adapted from Reference 2-20 and ACI 318, Table 4.5.3.

Soil Corrosion Potential – Reinforcing Steel

Soil chloride concentration - The measured chloride concentration in the soil (***refer to the Soil Analysis Report in Appendix C***) ranges from 12 to 35 ppm. To cause corrosion to reinforcing steel as a result of low concrete cover, a chloride concentration of over 10,000 ppm would be required. This suggests a negligible potential for corrosion of reinforcing steel due to chlorides in the soil. However, it is good practice to provide sufficient concrete cover over reinforcing

steel and lower water cement ratios for the reinforced concrete utilized in the construction of any facilities associated with the planned storm water retention tank.

RECOMMENDATIONS

The recommendations contained herein are based upon the properties of the surface and subsurface soils and rock as described by the field and laboratory testing, the results of which are presented and discussed in this report. Alternate recommendations may be possible and will be considered upon request.

Conventional Spread Foundations

It is recommended that all perimeter foundations and isolated exterior foundations be embedded a minimum of 1.5 feet below the lowest adjacent finish grade within 5.0 feet of proposed foundation walls. Interior footings should be founded a minimum of 1.5 feet below finish floor level. For all construction, 2.0 feet and 1.33 feet are recommended as the minimum width of spread and continuous footings, respectively.

The following tabulation may be used in the design of spread (column) and continuous (wall) foundations for the proposed structures. The column labeled Bearing stratum refers to the soil layer that the footing pad rests on, and does not imply that the foundation be fully embedded into that particular stratum.

Surface Level Foundations Bearing on Controlled Compacted Fill:

			Allowable Load	
Foundation Depth (ft)	**Bearing Stratum**	**Allowable Soil Bearing Pressure**	**Wall (KLF)**	**Column (KIP)**
1.5	0.5 feet of controlled compacted fill*	2500 PSF	7.5	125

***To achieve an allowable soil bearing pressure of 2500 PSF, conventional spread foundations must bear on a minimum of 0.5 feet of controlled compacted fill. To accommodate the required 0.5 feet of controlled compacted fill below foundations, it is recommended that overexcavation and recompaction of soils be accomplished to a minimum depth of 2.0 feet below finished pad grade. The controlled compacted fill should have a lateral extent of at least twice the fill thickness beyond the edges of wall or column footing pads. A minimum pad blow-up of 5 feet is recommended.**

Surface Level or Retaining Wall Foundations Bearing on Red to Pink Highly to Moderately Fractured and Weathered Sandstone Bedrock:

Foundation Depth (ft)	Bearing Stratum	Allowable Soil Bearing Pressure
1.5	Red to Pink Highly to Moderately Fractured and Weathered Sandstone Bedrock*	3000 PSF

*The presence of red to pink highly to moderately weathered and fractured sandstone bedrock at foundation bearing level must be verified by a representative of **ACS Services LLC** prior to placing foundation reinforcing steel to utilize an allowable soil bearing pressure of 3000 PSF. In cases where the red to pink highly to moderately fractured and weathered sandstone bedrock is encountered deeper than 1.5 feet, a mixture of 2-sack ABC/cement slurry may be utilized to occupy the lower portion of the foundation excavations, below a conventional foundation embedment depth of 1.5 feet.

Special Note: Foundations should all bear on either the red to pink highly to moderately fractured and weathered sandstone bedrock or controlled compacted fill. It is not considered good construction practice to bear some foundations directly on the sandstone bedrock and bear other foundations on a minimum of 0.5 feet of controlled compacted fill. If any foundations will bear on controlled compacted fill, all foundations should bear on a minimum of 0.5 feet of controlled compacted fill to reduce the potential for differential settlement. Alternatively, if any foundations will bear directly on the red to pink highly to moderately fractured and weathered sandstone bedrock, all foundations should bear directly on this harder stratum. This does not apply to exterior retaining or site wall foundations that are structurally separate.

Explanations

Foundation Embedment Depth - i.e.,

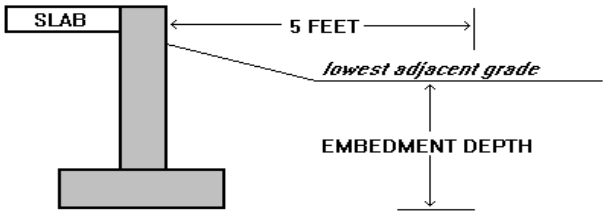
A) The depth below the lowest adjacent exterior pad grade within 5.0 feet of proposed exterior walls;

B) The depth below finish compacted pad grade provided that a sufficient pad blow-up (the lateral extent to which the building pad is constructed beyond the limits of the exterior walls or other structural elements, inclusive of exterior column foundations) has been incorporated into the grading and drainage design (5.0 feet or greater);

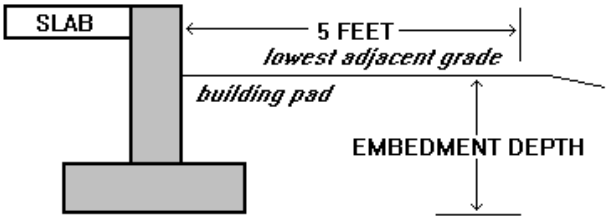
C) The depth below finish floor level for interior foundations.

FOUNDATION EMBEDMENT

Condition A



Condition B



The previously tabulated bearing values and the allowable wall and column loads associated with each are based on a total settlement of 1/2 inch. **It is anticipated that the magnitude of differential settlement will be roughly 1/4 inch** if construction is performed in accordance with locally accepted standards and the recommendations contained herein.

The allowable loads are based on maximum footing sizes of 3.0 and 7.0 feet for continuous and spread footings, respectively. Greater loads and larger footings may be accommodated by the listed bearing values, if there is toleration for increased settlements. This office should be contacted if this situation should arise.

The weight of the foundation below grade may be neglected in dead load computations.

The previously tabulated bearing capacities should be considered allowable maximums for dead plus design live loads and may be increased by one-third when considering total loads, including wind or seismic forces or other transient loading conditions.

Retaining wall or building foundations to be constructed in close proximity to retention basins (within 5.0 feet) should be embedded 1.0 feet deeper than the stated depths in the preceding bearing capacity tables.

Shallow foundations that are adjacent to lower foundation areas must be stepped down so that their base is below the lower backfill materials, and below a line projected upward from the

nearest lower foundation edge at a 45 degree angle. In no case should ancillary structures be designed or constructed, whose foundations will bear into deeper, non-verified backfills.

This firm recommends that continuous footings and stem walls be reinforced, and bearing walls be constructed with frequent joints to better distribute stresses in the event of localized foundation movements. Similarly, all masonry walls should be constructed with both vertical and horizontal reinforcement.

It is strongly recommended that all foundation excavations be inspected (prior to the placement of reinforcing steel) by a representative of the project geotechnical engineer, **ACS Services LLC**, to ensure that they are free of loose soil which may have blown or sloughed into the excavations, the embedment depth is adequate, and the dimensions are in accordance with the project requirements. It will also be necessary for the project geotechnical engineer to verify that the footings will bear upon one of the strata described above with a minimum foundation embedment of 1.5 feet.

A minimum of MAG A (3000 PSI), or equivalent, concrete with Type II cement should be used for footings, stem walls and floor slabs.

Lateral Stability Analyses

The following tabulation presents recommendations for lateral stability analyses for native undisturbed soil and controlled compacted fill:

[a]Foundation Toe Pressures.....1.33 x max. allowable

	Native Undisturbed Soil	Controlled Compacted Fill	Red to Pink Fractured Sandstone BR
[b]Lateral Backfill Pressures:			
Unrestrained walls	37 psf/ft.	35 psf/ft.	30 psf/ft.
Restrained walls[c]	57 psf/ft.	55 psf/ft.	48 psf/ft.
Lateral Passive Pressures For Surficial Soils:			
Continuous walls/footings	284 psf/ft.	296 psf/ft.	355 psf/ft.
Spread columns/footings	424 psf/ft.	442 psf/ft.	529 psf/ft.
Coefficient of Base Friction For Surficial Soils:			
Independent of passive resistance	0.62	0.67	0.78
In conjunction with passive resistance	0.42	0.45	0.52

Superscript Explanations

[a]Increase in allowable foundation bearing pressure (previously stated) for foundation toe pressures due to eccentric or lateral loading.

[b]Equivalent fluid pressures for vertical walls and horizontal backfill surfaces (maximum 12.0 feet in height). Pressures do not include temporary forces during compaction of the

backfill, expansion pressures developed by overcompacted clayey backfill, hydrostatic pressures from inundation of backfill, or surcharge loads. Walls should be suitably braced during backfilling to prevent damage and excessive deflection.

[C]The backfill pressure can be reduced to the unrestrained value if the backfill zone between the wall and cut slope is a narrow wedge (width less than one-half height).

Drainage

In unpaved areas, it is suggested that finished slopes extend a minimum of 5.0 feet horizontally from building walls and have a minimum vertical fall of 3.0 inches. Minimum grades of 2 percent should be maintained where the horizontal slope distance exceeds 5.0 feet. **In no case should long-term ponding be allowed near structures.** Backfill against footings, exterior walls, retaining walls, and in utility trenches should be well compacted to minimize the possibility of moisture infiltration through loose soil.

Conventional Unreinforced Concrete Slabs

Site grading within the building areas should be accomplished as recommended herein. Four (4.0) inches of aggregate base course (ABC) floor fill should immediately underlie interior grade floor slabs with a typical thickness of four (4.0) inches. The aggregate base material should conform to the requirements of Section 702 under Sub-section 702.2 "Crushed Aggregate" of the "Uniform Standard Specifications for Public Works Construction" sponsored by the Maricopa Association of Governments and all supplements which require a particle size grading as follows:

Sieve Size	Percent Passing
1-1/4”	100
#4	38-65
#8	25-60
#30	10-40
#200	3-12

Maximum Plasticity Index - 5

Special Note: To further reduce the potential for slab related damage, we recommend the following for conventional systems:

1. Placement of effective control joints on relatively close centers.
2. Proper moisture and density control during placement of subgrade fills.
3. Provision for adequate drainage in areas adjoining the slabs.
4. Use of designs which allow for the differential vertical movement described herein between the slabs and adjoining structural elements, i.e. **½ inch**.

The use of vapor retarders may be considered for any slab-on-grade where the floor will be covered by products using water based adhesives, wood, vinyl backed carpet, vinyl tile, impermeable floor coatings (urethane, epoxy, or acrylic terrazzo),and moisture-sensitive rock tile products. When used, the design and installation should be in accordance with the recommendations given in ACI 301.1R-04, Section 3.2.3 Moisture protection.

A minimum of MAG A (3000 PSI), or equivalent, concrete with Type II cement should be used for unreinforced interior and exterior slabs.

Fill Slope Stability

The maximum fill slopes may conform to a 2:1 (horizontal:vertical) ratio if fill is placed in accordance with the recommendations contained herein.

Pavement Design

Site grading within pavement areas should provide requisite subgrade support for flexible pavements. A compacted subgrade of on-site soils or soils with comparable properties is assumed. The stability of compacted pavement subgrade soils is reduced under conditions of increased soil moisture. Therefore, base course or pavement materials should not be placed when the surface is in a wet condition. Adequate surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade.

The following presents the recommended pavement sections for on-site pavements:

Light Vehicles or Low Volume Traffic Areas

Alternate	Prepared Subgrade (Inches)	ABC (Inches)	Asphaltic Concrete (Inches)	Concrete Pavement (Inches)
A[a]	6	4	2	
B[a]	6		3.5	
C[b]	6			4.5*

Light Truck Vehicles or Moderate Volume Traffic Areas

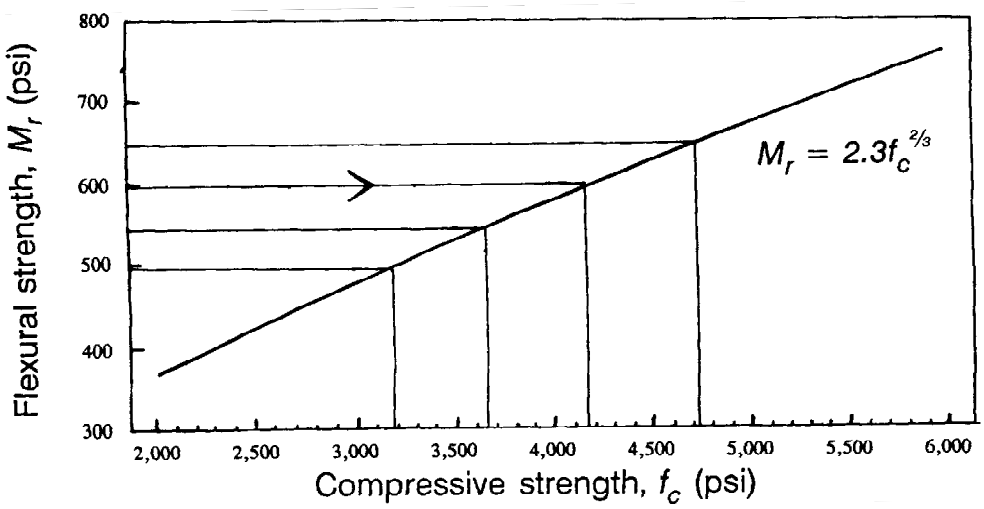
Alternate	Prepared Subgrade (Inches)	ABC (Inches)	Asphaltic Concrete (Inches)	Concrete Pavement (Inches)
A[a]	6	4	3	
B[a]	6		4.5	
C[b]	6			5.5*

Heavy Truck Vehicles or Heavy Volume Traffic Areas

Alternate	Prepared Subgrade (Inches)	ABC (Inches)	Asphaltic Concrete (Inches)	Concrete Pavement (Inches)
A[a]	6	4	4	
B[a]	6		5.5	
C[b]	6			6.5*

[a] – 10 to 15 year design life, with typical maintenance
[b] – 20 year design life, with typical maintenance

***The above thicknesses for Portland Cement concrete pavement are based on a modulus of rupture of 600 PSI. The recommended concrete thicknesses should be increased in increments of 0.5 inch for every 50 PSI decrease in the modulus of rupture. The following chart relates rupture modulus to compressive strength.**



All 8.0 inches of the prepared subgrade may be comprised of the native site soils.

Specifications for ABC should be as previously stated under "Slab Support". Compaction of subbase fill and base course materials should be accomplished to the density criteria listed under "Compaction and Moisture Content Recommendations". Compaction of asphalt should be accomplished to the following density criteria:

Material	Percent Compaction 75-blow method
Asphalt Base Course	95 minimum

The asphaltic concrete material shall conform to all requirements as established in MAG Section 710 for Asphaltic Concrete Mix Designation 1/2" or 3/4" Marshall mix for light and moderate traffic areas, and 3/4" Marshall mix for heavy traffic areas.

EARTHWORK

The following final earthwork recommendations are presented as a guide in the compilation of construction specifications. The final recommendations are not comprehensive contract documents and should not be utilized as such.

Site Preparation

The following final recommendations are presented as a guide in the compilation of construction specifications. The final recommendations are not comprehensive contract documents and should not be utilized as such.

It is recommended that all vegetation, trash, debris, the existing pavement, and all other deleterious matter be removed from the proposed structure and pavement areas at the commencement of site grading activities.

Following the removal of the above listed items, any existing fill or loose soil disturbed by previous grading of the site must be removed. Fill may exist at locations not explored due to the previous grading of the site for commercial development. **The presence of native undisturbed soil or rock across the entire building site for the proposed building must be verified by the project geotechnical engineer, ACS Services LLC, prior to scarification and placement of engineered fill for the building pad.** All removed disturbed or loose native soil is considered by this firm to be suitable for use as engineered fill provided that it is free of vegetation, debris, and oversized rock particles (greater the 6.0 inches).

Subsequent to the surface grubbing efforts and any existing fill or loose soil removal, and prior to the placement of subgrade or subbase fill, the exposed native ground surface should be prepared to a minimum depth of **6.0 inches** in all proposed building and pavement areas except in areas where the red to pink highly to moderately weathered and fractured sandstone bedrock is encountered and scarification is not possible. Subgrade preparation should include some degree of moisture processing and/or scarification prior to compaction and should also incorporate a minimum pad blow-up of five (5) feet in all proposed building areas.

Special note for foundations on controlled compacted fill: To achieve an allowable soil bearing pressure of 2500 PSF, conventional spread foundations must bear on a minimum of 0.5 feet of controlled compacted fill. To accommodate the required 0.5 feet of controlled compacted fill below foundations, it is recommended that overexcavation and recompaction of soils be accomplished to a minimum depth of 2.0 feet below finished pad grade. The controlled compacted fill should have a lateral extent of at least twice the fill thickness beyond the edges of wall or column footing pads. A minimum pad blow-up of 5 feet is recommended.

Complete removal and cleaning of any undesirable materials and proper backfilling of depressions or overexcavations will be necessary to develop support for the proposed facilities. Widen all depressions or overexcavations as necessary to accommodate compaction equipment and provide a level base for placing any fill. All fill shall be properly moistened and compacted as specified in the section on compaction and moisture content final recommendations.

All subbase fill required to bring the structure areas up to subgrade elevation should be placed in horizontal lifts not exceeding six inches compacted thickness or in horizontal lifts with thickness compatible with the compaction equipment utilized.

It is the understanding of this firm that various utility trenches may traverse the completed pad. The backfill of all utility trenches, if not in conformance with this report, may adversely impact the integrity of the completed pad. This firm recommends that all utility trench backfill crossing the pad be inspected and tested to ensure full conformance with this report. Untested utility trench backfill will nullify any as-built grading report regarding the existence of controlled compacted fill beneath the proposed building foundations and place the owner at greater risk in terms of potential unwanted foundation and floor slab movement.

Compaction and Moisture Content Recommendations

Compaction of backfill, subgrade soil, subbase fill, and base course materials should be accomplished to the following density criteria:

Material	Required Degree of Compaction (ASTM D698)
On-site native and fill soils used as subbase fill or backfill for slab or pavement support:	
Building areas below foundation level	95 min.
Building areas above foundation level	90 min.
Below asphalt pavements	95 min.
Imported subbase fill or backfill for structural or pavement support:	
Building areas below foundation level	95 min.
Building areas above foundation level	90 min.
Below asphalt pavements	95 min.
Base course:	
Below interior unreinforced or reinforced concrete Slabs	95 min.
Below asphalt pavements	100 min.

Increase the required degree of compaction to a minimum of 98 percent for fill materials greater than 5.0 feet below final grade.

During construction and prior to concrete placement, moisture contents should be controlled as follows:

Material	Compaction Moisture Content Range
On-site native and fill soils:	
Below foundation level	optimum -2 to optimum +2%
Above foundation level	optimum -2 to optimum +2%
Below asphalt pavements	optimum -2 to optimum +2%
Imported fill material:	
Below foundation level	optimum -2 to optimum +2%
Above foundation level	optimum -2 to optimum +2%
Below asphalt pavements	optimum -2 to optimum +2%

Note: The recommendations previously tabulated under the heading entitled "Above Foundation Level" apply to the subgrade in exterior reinforced concrete patio, pool deck, sidewalk, or driveway slab areas.

Any soil disturbed during construction shall be compacted to the applicable percent compaction as specified herein.

Natural undisturbed soils or compacted soils subsequently disturbed or removed by construction operations should be replaced with materials compacted as specified above.

All imported fill material to be used as structural-supporting fill, should be free of vegetation, debris, and other deleterious material and meet the following requirements:

Maximum Particle Size	3 inches
Maximum Plasticity Index	15
Range of Passing #200 Sieve	25-60 percent
Maximum Expansion	1.5 %*

* - Performed on a sample remolded to 95 percent of the maximum ASTM D698 density at roughly 2.0 percent below the optimum moisture content, under a 100 PSF surcharge.

Water settling and/or slurry shall not be used, in any case, to compact or settle surface soils, fill material, or trench backfill within 10.0 feet of any proposed structure.

Shrinkage

Assuming the average degree of compaction will approximate 95 percent of the standard maximum density, the approximate shrinkage of the reworked site soils should be 0 to 10 percent based on the field SPT blow count data. This may result in a vertical elevation change of approximately 0.00 to 0.10 feet following the precompaction effort.

Excavating Conditions

Excavations into the site surface soils to depths ranging from 0 to 3 feet should be possible with conventional excavating equipment. Heavier excavating equipment may be required below depths ranging from 0 to 3 feet due to the presence of very dense, silty sand to gravel soils, consisting of highly to moderately weathered and fractured sandstone bedrock to hard sandstone bedrock. Auger refusal in hard sandstone bedrock was encountered at all boring locations at depths ranging from 2 to 8 feet except at the location of Boring 2. Even in that boring, intermittent thin layers of hard sandstone bedrock were encountered in the very dense fractured sandstone rock. Where auger refusal was encountered, a hoe ram or blasting may be required for efficient excavation. Difficult excavation should be assumed across the entire site at a very shallow depth. The excavated sandstone rock will be platy and will need to be broken up to be utilized in fills on the site.

Excavations greater than 4.0 feet should be sloped or braced as required to provide personnel safety and satisfy local safety code regulations.

CONSTRUCTION OBSERVATION

ACS Services LLC should be retained to provide documentation that the recommendations set forth are met. These include but are not limited to documentation of site clearing activities, verification of fill suitability and compaction, and inspection of footing excavations. Relative to field density testing, a minimum of 1 field density test should be taken for every 2500 square feet of building area, per 6.0-inch layer of compacted fill.

Prior to construction, we recommend the following:

1. Consultation with the design team in all areas that concern soils and rocks to ensure a clear understanding of all key elements contained within this report.
2. Review of the General Structural Notes to confirm compliance to this report and determination of which allowable soil bearing capacity has been selected by the project structural engineer (this directly affects the extent of earthwork and foundation preparation at the site).
3. This firm be notified of all specific areas to be treated as special inspection items (designated by the architect, structural engineer or governmental agency).

Relative to the involvement of **ACS Services LLC** with the project during the course of construction, we offer the following recommendations:

1. The site or development owner should be directly responsible for the selection of the geotechnical consultant to provide testing and observation services during the course of construction.
2. **ACS Services LLC** should be contracted by the owner to provide the course of construction testing and observation services for this project, as we are most familiar with the interpretation of the methodology followed herein.
3. All parties concerned should understand that there exists a priority surrounding the testing and observation services completed at the site. From a geotechnical perspective, it is imperative to understand the following priority list, presented in order of decreasing priority.

    A. Fill control for building pads (verification of overexcavation depths and lateral extents, compaction testing, and the general monitoring of fill placement).
    B. Foundation observations (compliance with the General Structural Notes, depths, bearing strata, etc.).
    C. Basement, structural or retaining wall backfill testing.
    D. Utility trench backfill
    E. Special inspections as dictated by the local municipality.
    F. Concrete sampling and testing for footings, stem walls and floor slabs.
    G. Subgrade testing for proposed pavement areas.
    H. ABC testing for proposed pavement areas.
    I. Asphaltic concrete testing for proposed pavement areas.
    J. Subgrade preparation for on-site sidewalk areas
    K. Grout sampling and testing, where applicable.

L. Mortar sampling and testing, where applicable.
M. Off-site subgrade, ABC, asphalt, curb, gutter and sidewalk testing.

Please understand that Item A above is the only area where ACS Services LLC has control on-site (once it has started) to verify or deny compliance with applicable standards, without the need for any entity to schedule testing activities with this office. Other than Item A, it shall be another entity's responsibility to schedule all testing and observation services, to coincide with the progress of construction. Since this firm is not a contributor to the construction schedule, we do not possess an inherent knowledge as to when our services shall be needed or required.

LIMITATIONS

Since our investigation is based upon review of background data, the site materials observed, selected laboratory testing and engineering analysis, the conclusions and recommendations are professional opinions. Our professional services have been performed using that degree and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities. These opinions have been derived in accordance with current standards of practice and no other warranty, express or implied, is made.

This report is not intended as a bidding document, and any contractor reviewing this report must draw his own conclusions regarding specific construction techniques to be used on this project.

The scope of services carried out by **ACS Services LLC** does not include an evaluation pertaining to environmental issues. If these services are required by the lender, we would be most pleased to discuss the varying degrees of environmental site assessments.

The materials encountered on the subject site and utilized in our laboratory analysis are believed to be representative of the total area; however, soil and rock materials do vary in character between points of investigation. The recommendations contained in this report are based on the assumption that the soil conditions do not deviate appreciably from those disclosed by the investigation. Should unusual material or conditions be encountered during construction, the soil engineer must be notified so that he may make supplemental recommendations if they should be required.

This report is issued with the understanding that it is the responsibility of the owner to see that its provisions are carried out or brought to the attention of those concerned. In the event that any changes of the proposed project are planned, the conclusions and recommendations contained in this report shall be reviewed and the report shall be modified or supplemented as necessary.

July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

DEFINITION OF TERMINOLOGY

Allowable Soil Bearing Capacity	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
Aggregate Base Course (ABC)	A sand and gravel mixture of specified gradation, used for slab and pavement support.
Backfill	A specified material placed and compacted in a confined area.
Base Course	A layer of specified material placed on a subgrade or subbase.
Base Course Grade	Top of base course.
Bench	A horizontal surface in a sloped deposit.
Caisson	A concrete foundation element cased in a circular excavation, which may have an enlarged base. Sometimes referred to as a cast-in-place pier.
Concrete Slabs-on-Grade	A concrete surface layer cast directly upon a base, subbase, or subgrade.
Controlled Compacted Fill	Engineered Fill. Specific material placed and compacted to specified density and/or moisture conditions under observation of a representative of a soil engineer.
Differential Settlement	Unequal settlement between or within foundation elements of a structure.
Existing Fill	Materials deposited through the action of man prior to exploration of the site.
Expansive Potential	The potential of a soil to increase in volume due to the absorption of moisture.
Fill	Materials deposited by the action of man.
Finish Grade	The final grade created as a part of the project.
Heave	Upward movement due to expansion or frost action.
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil.
Overexcavate	Lateral extent of subexcavation.
Rock	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting, or other methods of extraordinary force for excavation.
Scarify	To mechanically loosen soil or break down the existing soil structure.
Settlement	Downward movement of the soil mass and structure due to vertical loading.
Soil	Any unconsolidated material composed of disintegrated vegetable or mineral matter, which can be separated by gentle mechanical means, such as agitation in water.
Strip	To remove from present location.
Subbase	A layer of specified material between the subgrade and base course.
Subexcavate	Vertical zone of soil removal and recompaction required for adequate foundation or slab support
Subgrade	Prepared native soil surface.

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Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

APPENDIX A

NORTH
N.T.S.

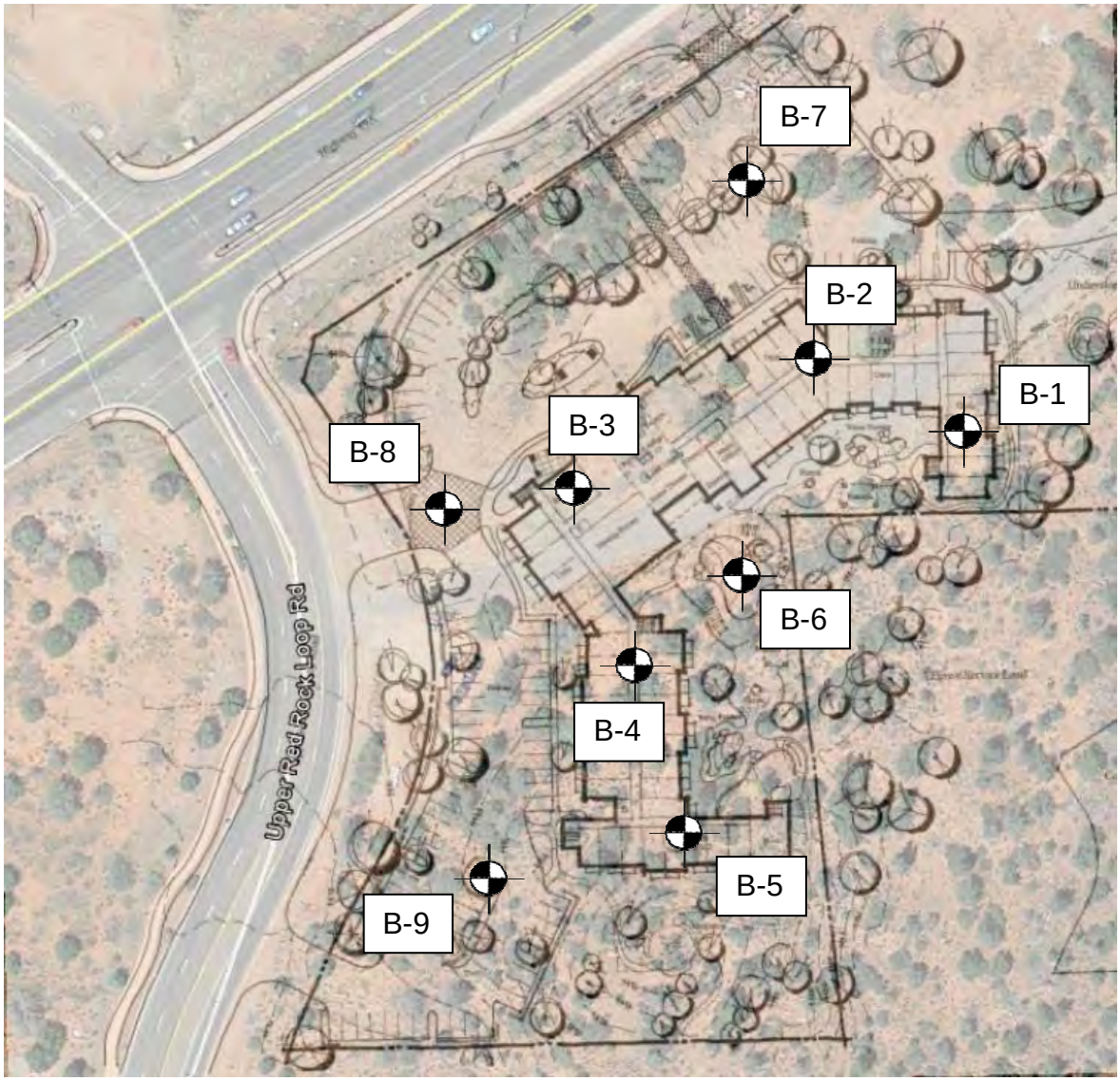
PROJECT NUMBER: 1401316

FIGURE 1

ACS SERVICES LLC
550 EAST UNIVERSITY DRIVE
MESA, ARIZONA 85203
(480) 968-0190
(480) 968-0156 FAX
WWW.ACSSERVICESLLC.COM

VICINITY MAP

Courtyard by Marriott
4105 West SR89A
Sedona, AZ.



NORTH
N.T.S.

PROJECT NUMBER: 1401316

FIGURE 2

ACS SERVICES LLC

550 EAST UNIVERSITY DRIVE
MESA, ARIZONA 85203
(480) 968-0190
(480) 968-0156 FAX
WWW.ACSSERVICESLLC.COM

SITE PLAN & APPROXIMATE BORING LOCATIONS

Courtyard by Marriott
4105 West SR89A
Sedona, AZ.

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Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

APPENDIX B

ACS Services LLC

BORING B-1

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: No ring sample taken
1-2" of topsoi
Red sandstone bedrock exposed at the surface at boring location

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1	39 50/3"			SM-GM	Red SANDSTONE BEDROCK, hard, slightly damp, low PI
2					Very slow drilling, drilling rate of 6 minutes per inch
3					Terminated boring at 2 feet due to auger refusal in hard SANDSTONE BEDROCK
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-2

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Ring sample from 1.5 to 2.5 feet

6" of soft topsoi

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1				SM-GM	Red highly fractured and weathered SANDSTONE BEDROCK, very dense, slightly damp, low PI
2	16			GM-GP	Dark red highy fractured and weatherd SANDSTONE BEDROCK, dense, damp to moist, low PI
3	32				
4					
5	36			GM-GP	Red highly fractured and weathered SANDSTONE BEDROCK, very dense, slightly damp, low PI
6	50/4"				
7					Harder drilling at 7 feet
8					
9					
10	20	2.3		SM	Red silty SAND, dense, slightly damp, NP (badly weathered and soft SANDSTONE BEDROCK)
11	16				
12	33				
13					
14					
15	9	6.1		SM	Dark red very silty SAND, medium dense, damp to moist, NP (badly weathered and very soft SANDSTONE bedrock)
16	8				
	13				
17					Terminated boring at 15.5 feet in very soft SANDSTONE BEDROCK

ACS Services LLC

BORING B-3

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Ring sample from 1.5 to 1.9 feet

2" of gravel on the surface

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1				SC	Dark red clayey SAND, medium dense, medium dense, damp, low PI
2	50/5.5"	5.8		GC	Dark red clayey sandy GRAVEL, very dense, damp, PI of 16
3				GP	Pink SANDSTONE BEDROCK, hard, dry, NP
4					Terminated boring at 3 feet due to auger refusal in hard SANDSTONE BEDROCK
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-4

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Ring sample from 1.5 to 2.4 feet

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1	8			SC	Red-brown silty clayey SAND, medium dense, damp, low PI
2	17 21				
3	18 50/5"			GM	Red soft SANDSTONE BEDROCK, very dense, slightly damp, low PI
4	33 50/3"				
5	6 48	2.7		GM	Red soft SANDSTONE BEDROCK, very dense, slightly damp, NP
6	50/2"				
7				GP	Red soft to hard SANDSTONE BEDROCK, very dense, slightly damp, NP Variable drilling soft then hard Drilling rate 6 minutes per inch
8					Terminated boring at 7 feet due to auger refusal in hard SANDSTONE BEDROCK
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-5

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Ring sample from 1.5 to 1.8 feet Description of Subsurface Conditions
1	4 9			SC-SM	Red silty clayey SAND, medium dense, damp, low PI
2	24 50/4"			GM	Pink SANDSTONE BEDROCK, very dense, dry, NP Harder drilling at 2 feet
3					
4					Terminated boring at 3 feet due to auger refusal in hard SANDSTONE BEDROCK
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-6

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Ring sample from 1.5 to 1.7 feet

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1	14			SC-SM	Red silty clayey SAND, medium dense, damp, low PI
2	50/2"			GM	Pink SANDSTONE BEDROCK, very dense, dry, NP
3	50/2"	0.6		GM	Hard drilling Pink sandy GRAVEL, very dense, dry, NP (SANDSTONE BEDROCK) Drilling rate of 5 minutes per inch
4					Terminated boring at 3 feet due to auger refusal in hard SANDSTONE BEDROCK
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-7

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Obtained bag samples from 0 to 3 feet and 3 to 8 feet

Intermittent soft and hard bedrock layers

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1				GM-GC	Red clayey silty sandy GRAVEL, very dense, damp, PI of 5 (SANDSTONE BEDROCK)
2					Slow drilling
3					
4					Easier drilling
5		2.8		SM	Red gravelly silty SAND, very dense, slightly damp, PI of 3 (SANDSTONE BEDROCK)
6					Harder drillling
7					Easier drilling Harder drilling at 7 feet
8					
9					Terminated boring at 8 feet due to auger refusal in hard SANDSTONE BEDROCK
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-8

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Obtained bag samples from 0 to 3 feet and 3 to 5 feet

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1		7.0		SM	Red gravelly silty SAND, medium dense, damp, PI of 2 (possible fill)
2					Easy drilling to 3 feet
3					
4				GM	Red SANDSTONE BEDROCK, very dense, dry, NP
5					Harder drilling at 4 feet Drilling rate of 5.5 minutes per inch
6					Terminated boring at 5 feet due to auger refusal in hard SANDSTONE BEDROCK
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-9

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Obtained bag sample from 0 to 2 feet Description of Subsurface Conditions
1		3.4		SM	Red-brown gravelly silty SAND, medium dense, damp, PI of 2 (topsoil)
2				GM	Pink SANDSTONE BEDROCK, very dense, dry, NP Drilling rate of 7.0 minutes per inch
3					Terminated boring at 5 feet due to auger refusal in hard SANDSTONE BEDROCK
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

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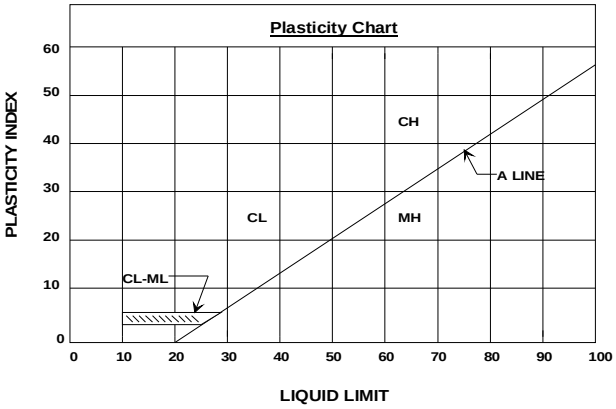
4105 West SR89A
Sedona, Arizona

LEGEND

Major Divisions				Group Symbol	Typical Names
Coarse-Grained Soils (Less than 50% passes No. 200 sieve)	Gravels (50% or less or coarse fraction passes No. 4 sieve)	Clean Gravels (Less than 5% passes No. 200 sieve)		GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
				GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		Gravels with Fines (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on Plasticity Chart.	GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plots above "A" line & hatched zone on Plasticity Chart.	GC	Clayey gravels, gravel-sand-clay mixtures.
	Sands (More than 50% of coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% passes No. 200 sieve)		SW	Well graded sands, gravelly sands.
				SP	Poorly graded sands, gravelly sands.
		Sands with Fines (More than 12% passes No. 200 sieve)	Limits plots below "A" line & hatched zone on Plasticity Chart.	SM	Silty sands, sand-silt mixtures.
			Limits plots above "A" line & hatched zone on Plasticity Chart.	SC	Clayey sands, sand-clay mixtures.
Fine-Grained Soils (50% or more passes No. 200 sieve)	Silts-Plot below "A" line & hatched zone on Plasticity Chart	Silts of Low Plasticity (Liquid Limit Less Than 50)		ML	Inorganic silts, clayey silts with slight plasticity.
		Silts of High Plasticity (Liquid Limit More Than 50)		MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	Clays-Plot above "A" line & hatched zone on Plasticity Chart	Clays of Low Plasticity (Liquid Limit Less Than 50)		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		Clays of High Plasticity (Liquid Limit More Than 50)		CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

Note: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the Plasticity Chart to have double symbol.



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to 3/4 in.
Fine gravel	3/4 in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

TEST DRILLING EQUIPMENT & PROCEDURES

Drilling Equipment

ACS SERVICES LLC uses a CME-45 drill-rig capable of auger drilling to depths of 50 feet in southwestern soils. The drill is truck-mounted for rapid, low cost mobilization to the jobsite and on the jobsite. Drilling through soil or softer rock is performed with 6.625 inch O.D. hollow-stem auger. Carbide insert teeth are normally used on the auger bits so they can often penetrate rock or very strongly cemented soils that require blasting or very heavy equipment for excavation. The operation of well-maintained equipment by an experienced crew allows **ACS SERVICES LLC** to complete drilling jobs to a depth of 50 feet with minimum downtime and maximum efficiency.

Sampling Procedures

Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 procedure. In many cases, 2 inch O.D., $1^{3}/_{8}$-inch I.D. samplers are used to obtain the standard penetration resistance. Undisturbed" samples of firmer soils are often obtained with 3 inch O.D. samplers lined with 2.42 inch I.D. brass rings. The driving energy is generally recorded as a number of blows of a 140-pound hammer, utilizing a 30-inch free fall drop, per six inches of penetration. However, in stratified soils, driving resistance is sometimes recorded in 2 or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per six inches on the logs. Undisturbed sampling of softer soils is sometimes performed with thin-walled Shelby tubes (ASTM D1587). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing from auger cuttings.

Continuous Penetration Tests

Continuous penetration tests are performed by driving a 2-inch O.D. bullnose penetrometer adjacent to or in the bottom of test borings. The penetrometer is attached to $1^{5}/_{8}$-inch O.D. drill rods to provide clearance and thus minimize side friction so that penetration values are as nearly as possible a measure of end resistance. Penetration values are recorded as the number of blows of a 140 pound hammer, utilizing a 30 inch drop required to advance the penetrometer in six-inch increments or less.

Boring Records

Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487) with appropriate group symbols being shown on the logs.

July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

APPENDIX C

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-1	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 2 @ 9.0 - 10.5'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	0	100	
3/4"	5	95	
1/2"	6	89	
3/8"	4	86	
1/4"	8	78	
#4	7	71	
#8	4	67	
#10	1	66	
#16	2	64	
#30	3	61	
#40	2	59	
#50	2	58	
#100	6	51	
#200	28	23.6	

Liquid Limit (AASHTO T-89)	NV
Plastic Limit (AASHTO T-90)	NV
Plasticity Index (AASHTO T-90)	NP
Moisture Content (AASHTO T-255)	2.3
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-5	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 2 @ 14.0 - 15.5'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	0	100	
3/4"	0	100	
1/2"	0	100	
3/8"	0	100	
1/4"	1	99	
#4	1	98	
#8	3	95	
#10	1	94	
#16	3	91	
#30	3	87	
#40	1	86	
#50	2	84	
#100	8	76	
#200	31	45.3	

Liquid Limit (AASHTO T-89)	NV
Plastic Limit (AASHTO T-90)	NV
Plasticity Index (AASHTO T-90)	NP
Moisture Content (AASHTO T-255)	6.1
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-2	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 3 @ 1.5 - 2.5'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)			
Sieve Size	**% Retained**	**% Passed**	**Specs**
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	12	88	
1"	0	88	
3/4"	0	88	
1/2"	1	87	
3/8"	2	84	
1/4"	12	72	
#4	11	61	
#8	3	58	
#10	1	57	
#16	2	56	
#30	2	54	
#40	1	53	
#50	2	51	
#100	5	46	
#200	15	31.7	

Liquid Limit (AASHTO T-89)	31
Plastic Limit (AASHTO T-90)	15
Plasticity Index (AASHTO T-90)	16
Moisture Content (AASHTO T-255)	5.8
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	GC

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-3	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 4 @ 4.0 - 5.1'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	7	93	
3/4"	4	89	
1/2"	4	86	
3/8"	4	81	
1/4"	11	70	
#4	5	65	
#8	3	63	
#10	1	62	
#16	2	60	
#30	3	57	
#40	2	55	
#50	2	53	
#100	5	48	
#200	13	35.1	

Liquid Limit (AASHTO T-89)	NV
Plastic Limit (AASHTO T-90)	NV
Plasticity Index (AASHTO T-90)	NP
Moisture Content (AASHTO T-255)	2.7
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	GM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-4	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 6 @ 2.0 - 3.0'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	30	70	
1"	11	60	
3/4"	7	53	
1/2"	4	49	
3/8"	2	47	
1/4"	4	44	
#4	2	41	
#8	4	38	
#10	1	37	
#16	1	36	
#30	1	35	
#40	1	34	
#50	1	33	
#100	2	31	
#200	11	20.7	

Liquid Limit (AASHTO T-89)	NV
Plastic Limit (AASHTO T-90)	NV
Plasticity Index (AASHTO T-90)	NP
Moisture Content (AASHTO T-255)	0.6
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	GM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-6	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 7 @ 0.0 - 3.0'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)			
Sieve Size	**% Retained**	**% Passed**	**Specs**
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	1	99	
1"	3	96	
3/4"	4	92	
1/2"	9	83	
3/8"	7	76	
1/4"	12	64	
#4	6	58	
#8	7	51	
#10	2	50	
#16	3	46	
#30	3	43	
#40	1	42	
#50	1	41	
#100	3	38	
#200	7	30.9	

Liquid Limit (AASHTO T-89)	22
Plastic Limit (AASHTO T-90)	17
Plasticity Index (AASHTO T-90)	5
Moisture Content (AASHTO T-255)	3.0
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	GM-GC

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-7	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 7 @ 3.0 - 8.0'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	0	100	
3/4"	2	98	
1/2"	3	95	
3/8"	3	93	
1/4"	6	87	
#4	5	82	
#8	12	70	
#10	3	67	
#16	7	60	
#30	6	54	
#40	2	52	
#50	2	51	
#100	3	47	
#200	7	40.1	

Liquid Limit (AASHTO T-89)	22
Plastic Limit (AASHTO T-90)	19
Plasticity Index (AASHTO T-90)	3
Moisture Content (AASHTO T-255)	2.8
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-8	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 8 @ 0.0 - 3.0'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	2	98	
3/4"	2	96	
1/2"	1	95	
3/8"	3	92	
1/4"	7	85	
#4	6	79	
#8	7	73	
#10	2	71	
#16	5	67	
#30	6	60	
#40	3	58	
#50	3	55	
#100	6	49	
#200	14	34.7	

Liquid Limit (AASHTO T-89)	22
Plastic Limit (AASHTO T-90)	20
Plasticity Index (AASHTO T-90)	2
Moisture Content (AASHTO T-255)	7.0
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-9	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 9 @ 0.0 - 2.0'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	0	100	
3/4"	1	99	
1/2"	3	97	
3/8"	3	94	
1/4"	8	85	
#4	7	78	
#8	8	70	
#10	2	69	
#16	4	65	
#30	4	61	
#40	1	60	
#50	2	58	
#100	4	54	
#200	13	40.4	

Liquid Limit (AASHTO T-89)	20
Plastic Limit (AASHTO T-90)	18
Plasticity Index (AASHTO T-90)	2
Moisture Content (AASHTO T-255)	3.4
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

ACS SERVICES LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION

* *MAXIMUM DRY DENSITY & OPTIMUM MOISTURE CONTENT*

ACS Project No.:	**1401316**		
Lab No.:	14-2035-6	Material Type:	GEO - Native
Client:	Western Horizons, Inc.	Extraction Date:	6/24/2014
Project Name:	Courtyard by Marriott	Extracted By:	Nathan Sorensen
Project Address:	4105 West SR89A	Laboratory Test Date:	6/28/2014
Project City:	Sedona	Laboratory Tested By:	Felipe Sanchez
Material Source:	B7 @ 0.0' - 3.0'	Reviewed By:	Jeff Donkersley

TEST METHOD

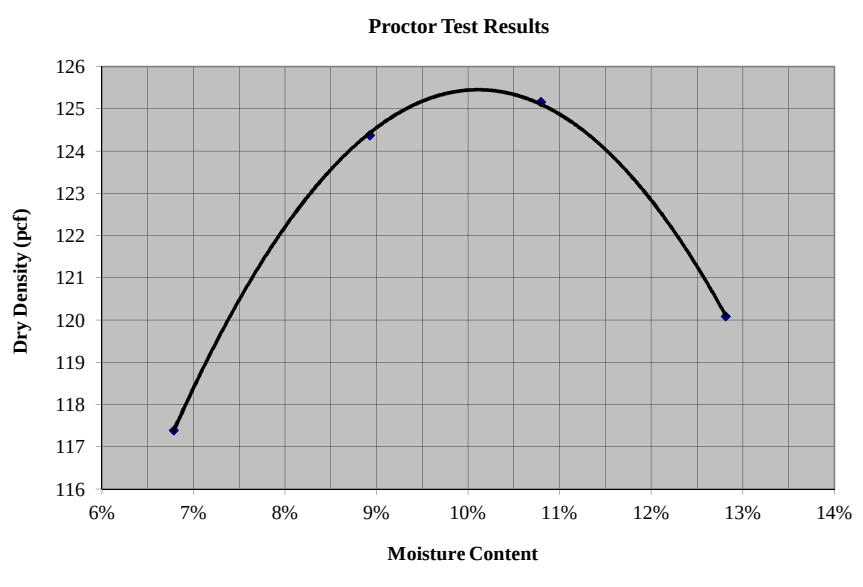
☑ AASHTO T99 / ASTM D698		
☐ AASHTO T180 / ASTM D1557		
☐ Ariz 225	☐ Ariz 227	☐ Ariz 245
☑ A	☐ B	☐ C

☑ 4" Mold	☑ Manual Hammer
☐ 6" Mold	☐ Automatic Hammer

Mold Weight	4421 grams
Mold Volume	0.0331 cuft

LABORATORY RESULTS

Water Added	Wet Weight of Sample & Mold	Wet Weight of Sample	Wet Density	Wet Weight of Moisture Sample	Dry Weight of Moisture Sample	Weight of Water	Moisture Content	Dry Density
(ml)	(grams)	(grams)	(pcf)	(grams)	(grams)	(grams)	(%)	(pcf)
150	6455.0	2,034	135.5	312.4	286.8	25.6	8.9%	124.4
200	6503.0	2,082	138.7	315.1	284.4	30.7	10.8%	125.2
250	6455.0	2,034	135.5	324.9	288.0	36.9	12.8%	120.1
100	6303.0	1,882	125.4	344.7	322.8	21.9	6.8%	117.4



FINAL RESULTS

Dry Density (Figure 1)	125.4	pcf
Moisture Content (Figure 1)	10.3	%
Total Dry Sample	17,592	grams
Dry Sample < #4	10,190	grams
Dry Sample > #4	7,402	grams
% Rock	42.1	%
% Passed #4	57.9	%
Maximum Dry Density	**132.6**	**pcf**
Optimum Moisture Content	**6.4**	**%**

SPECIFIC GRAVITY

A: Mass of Oven Dry Sample	2939.5	grams
B: Mass of S.S.D. Sample	3027.4	grams
C: Mass of Immersed Sample	1879.9	grams
Bulk (O.D.) Specific Gravity	**2.562**	
Percent Absorption	**2.99**	**%**

ACS

COURTYARD BY MARRIOTT
4105 WEST SR89A
SEDONA, ARIZONA
ACS PROJECT NO. 1401316

pH and Resistivity Test Results

Sample Location	Depth	Resistivity (ohms-cm)	pH
B-7	3.0-8.0'	3144	8.4
B-8	3.0-5.0'	2007	8.3

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

MOTZZ LABORATORY, INC.

Soil Analysis Report

ACS Services LLC
Nathan Sorensen
550 East University Drive
Mesa. AZ 85203

Project: 1401316
Sampler:
Date Received: 7/2/2014
Date Reported: 7/3/2014
PO Number: 1401316

Lab Number: 910675-01 **14-2035-7**

Sulfate & Chloride	Method	Result	Units	Levels
Sulfate, SO4	ARIZ 733	18	ppm	
Chloride, Cl	ARIZ 736	35	ppm	

Sulfate 0.0018% ; Chloride 0.0035%

Lab Number: 910675-02 **14-2035-9**

Sulfate & Chloride	Method	Result	Units	Levels
Sulfate, SO4	ARIZ 733	18	ppm	
Chloride, Cl	ARIZ 736	12	ppm	

Sulfate 0.0018% ; Chloride 0.0012%

July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

APPENDIX D

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

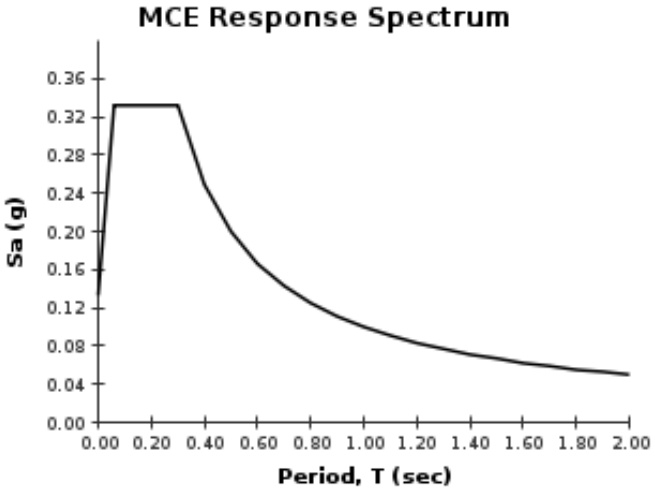
Design Maps Summary Report

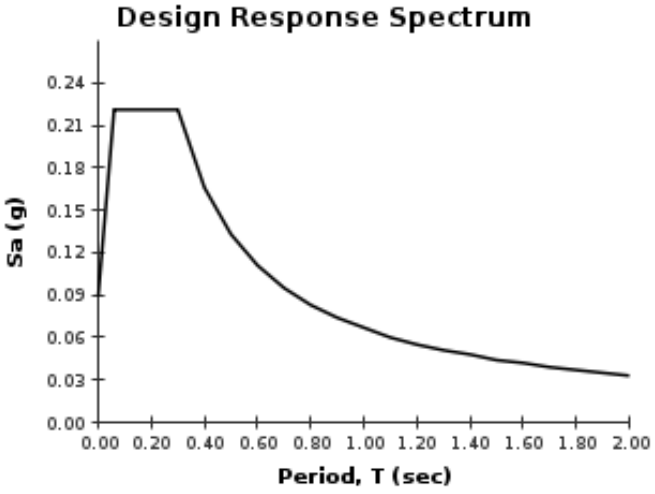
User–Specified Input

Report Title	Courtyard by Marriott Fri July 11, 2014 00:41:08 UTC
Building Code Reference Document	2006/2009 International Building Code (which utilizes USGS hazard data available in 2002)
Site Coordinates	34.85°N, 111.8275°W
Site Soil Classification	Site Class B – "Rock"
Occupancy Category	I/II/III

USGS–Provided Output

S_S =	0.332 g	S_{MS} =	0.332 g	S_{DS} =	0.221 g
S_1 =	0.100 g	S_{M1} =	0.100 g	S_{D1} =	0.067 g





LYON ENGINEERING
Civil Engineers • Land Surveyors

DATE: November 10, 2016

TO: Sedona Hospitality Group, LLC
7225 E Hampton Ave, Suite 122
Mesa, AZ 85209

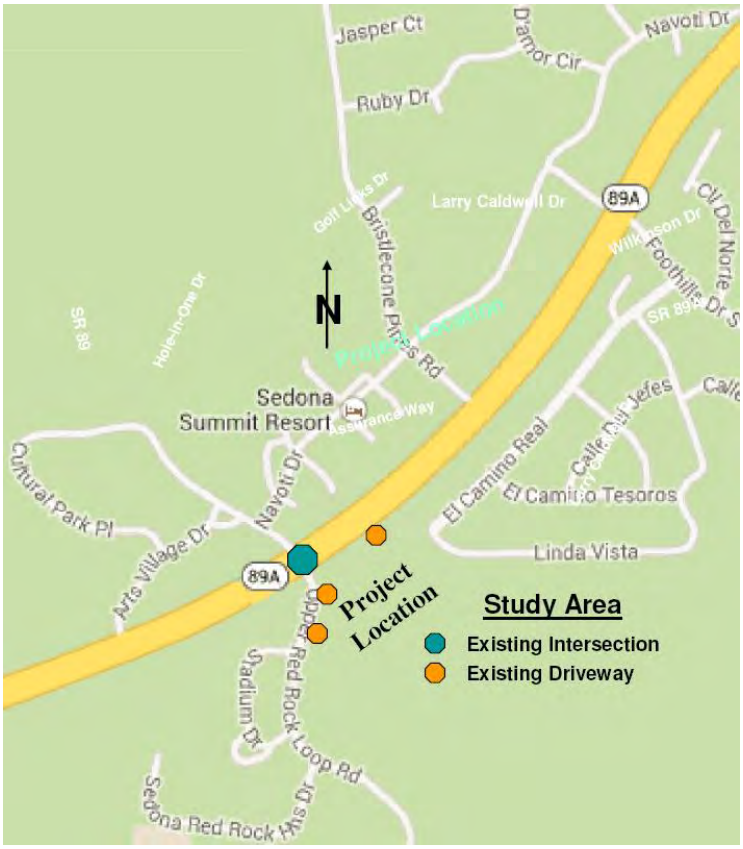
FROM: Scott Lyon, P.E., RLS

PROJECT: Residence Inn by Marriott - Traffic Study
Sedona, Arizona

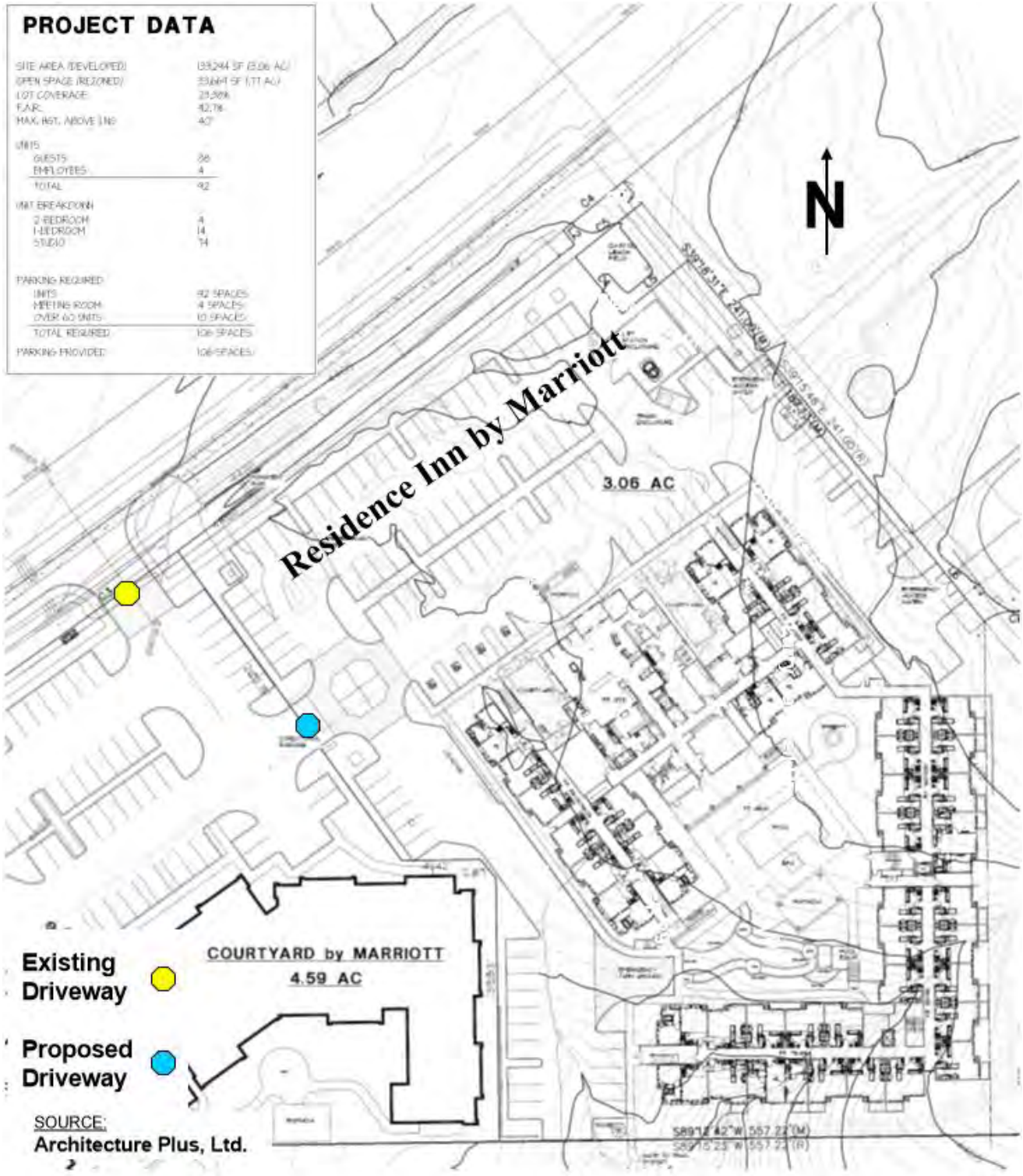
Sedona Hospitality Group (Owner) has asked Lyon Engineering to provide guidance in the identification of impacts the additional traffic from the Residence Inn by Marriott development (Subject Parcel) will have on State Route (SR) 89A, Upper Red Rock Loop Rd (URRLR) and their intersection in the City of Sedona (City), Arizona.

Introduction. The *purpose* of this study is to provide data to the City, Arizona Department of Transportation (ADOT) and Owner to demonstrate that the existing plus proposed roadway and traffic control systems will provide acceptable safety and operational conditions after the addition of the Residence Inn by Marriott. The *methodology* will be to develop the trip generation and assignment; then provide an evaluation and identify any appropriate mitigation.

Proposed Development. The **map** to the right shows the Subject Parcel is located on the southeast corner of the SR 89A/URRLR intersection. The **site plan** showing the ninety-two room facility is shown on the next page. Access to the Subject Parcel will be provided to/from the north by a shared driveway along SR 89A and to/from the west to URRLR through the Courtyard parking lot. URRLR, provides access to SR 89A to the north. The SR 89A driveway provides right-in/out access. URRLR provides for all the left and right turn movements at its intersection with SR 89A. There are 106 parking spaces planned along the east, north and west sides of the buildings. The roadway improvements along SR 89A and URRLR were previously built with the Courtyard project.



LE • 3623 Crossing Drive Prescott, Arizona 86305 • Phone (928) 776-1750 • Fax (928) 776-0605



Site Plan – Residence Inn by Marriott

Study Area Conditions. This project is projected to generate less the 1,000 trips per day and 90 trips during any peak hour. Therefore, the *study area* (shown on the **map** on page 1) will be limited and include the SR 89A/URRLR intersection, URRLR between the Subject Parcel and US 89A,

the URRLR intersection with the access street to the Courtyard Parcel, and the access and circulation within the Courtyard and Residence Inn parcels. Given the small volume of traffic that will be generated by the development, the *study horizon* is the opening year.

The aerial **photo** below shows the *land use* surrounding the Subject Parcel; however does not show the Courtyard Hotel built in 2014/15. To the north is SR 89A, Yavapai College Sedona Center, Jazz on the Rocks and Sedona Summit Resort condo complex. To the east is residential. To the south is undeveloped. To the west are the Courtyard Hotel (not shown in the aerial), URRLR and Sedona Red Rock High School. The Subject Parcel is one of the few remaining vacant parcels in the area (within several hundred feet of the property).

Analysis of Existing Conditions. SR 89A is a 4-lane median divided roadway with sidewalk on both sides. Left and right turn lanes are provided at the URRLR intersection. A 150' long right turn lane is provided along EB SR 89A to the joint Project driveway. The posted speed limit is 40 mph. URRLR provides 1-through, left and right turn lane at its approach and 2-lanes going south from the intersection. Sidewalk is provided on both sides of URRLR, south of SR 89A. The posted speed limit is 25 mph. Cultural Park Pl provides 1-through/right and left turn lane at its approach and 2-lanes going north away from the intersection. Sidewalk is provided on both sides of Cultural Park Pl. The SR 89A/URRLR/Cultural Park Pl intersection is signalized.

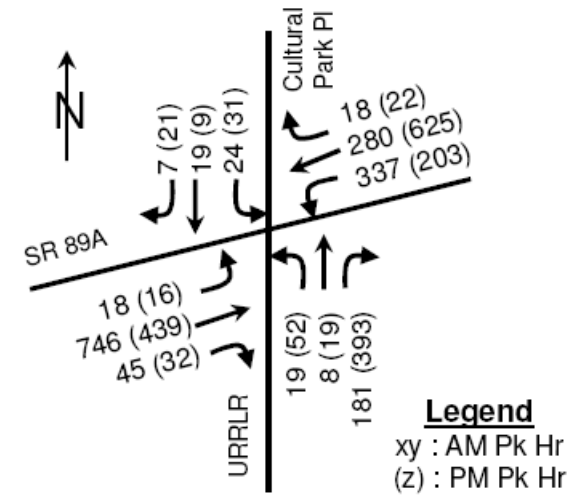
The 24-hour traffic counts taken on June 10 and 11, 2014 for the *Courtyard TS* were 16,353 vehicles per day (vpd) along SR 89A. The hourly volumes were steady between 7:00 am and 6:00 pm ranging between a low of 1,007 vehicles per hour (vph) between 7:00 and 8:00 am and a high of 1,287 vph between 2:00 and 3:00 pm. The am peak hour (7:00 – 9:00) volume was 1,237 vph

between 7:30 and 8:30 with a peak hour factor (PHF) of 0.94 and directional distribution (D) of 73% eastbound. The pm peak hour (3:00 – 6:00) volume was 1,360 vph with a PHF of 0.95 and D of 56% westbound.

Our search of the ADOT Transportation Planning web site shows the 2015 average annual daily traffic (AADT) volume to be 16,418 vpd.

The 24-hour counts taken on June 10 and 11, 2014 for the *Courtyard TS* along URRLR south of SR 89A were 1,986 vpd. The hourly volumes were steady between 11:00 am and 6:00 pm, with a low of 142 vph (11:00 – 12:00 am) and a high of 167 vph (12:00 – 1:00 pm & 2:00 pm – 3:00 pm). The highest am peak hour (7:00 – 9:00) volume was 114 vph (8:00 – 9:00), PHF of 0.60 and D of 56% northbound. The highest pm peak hour (3:00 – 6:00) volume was 181 vph (3:30 – 4:30), PHF of 0.91 and D of 52% southbound.

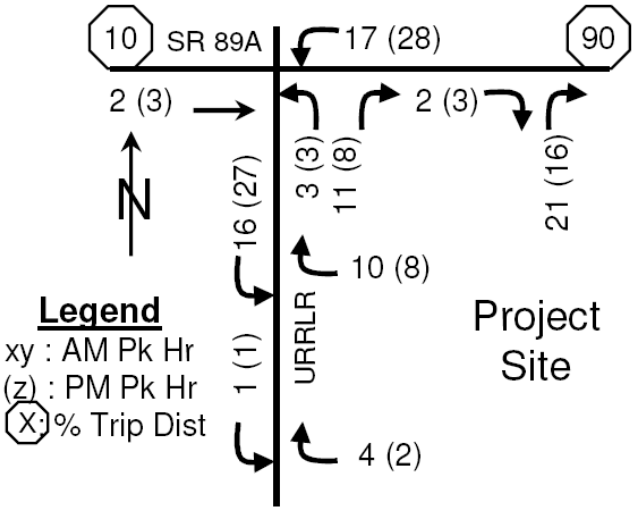
The *Courtyard TS* also took into account the traffic contribution from the Schools along URRLR. The 2014 "existing combined traffic" is shown in the **figure** to the right.



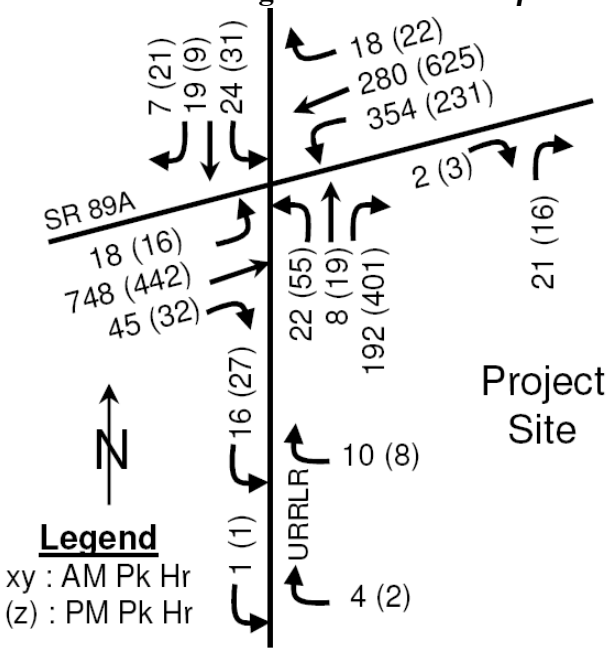
Existing Combined Traffic

Lastly, the *Courtyard TS* assessed the "future combined traffic" that included the "project traffic" generated by the Courtyard hotel. The daily forecast for the Courtyard hotel was 681 vpd. The ***trip distribution*** for the Courtyard traffic was calculated as follows: 10% from the west and 90% from the east. The Courtyard Hotel ***trip assignment*** is shown on the **figure** below and the ***future combined traffic forecast*** is shown to the right.

The *Courtyard TS* review of the ***basic section capacity*** for SR 89A is based on ***Table 2.1*** from



Project Traffic



Future Combined Traffic

the Maricopa County *Roadway Design Manual (RDM)* to access operations and capacity. Looking at the row for "minor arterial" roads and column for "2-way ADT Range," it is suggested that up to 22,000 vpd can be accommodated to provide a level of service (LOS) C or better. Therefore, it was concluded the 2014 existing traffic + high school + Courtyard Hotel traffic of (16,353 + 1,040 + 681) 18,074 vpd was within the capacity of SR 89A to provide a LOS C or better.

MCDOT Roadway Design Manual

Urban Roadway Level of Service and Service Volumes

Road Classification	Desired LOS	ADT/ Lane	No. Thru Lanes	2-Way ADT Range	Pk.Hr./ ADT %	Max. Pk. Hr. Ln. Vol.	*Max. Rdwy. Length
Local	A	350	2	50 -700	15	60	1,000 ft.
Minor Collector	B	2,500	2	500 - 5,000	12	360	1/2 mi.
Major Collector	C	3,500	2	600 - 7,000	10	420	2 mi.
Minor Arterial	C	5,500	4	6,000 - 22,000	8	530	---
Principal Arterial	D	7,500	6	18,000 - 45,000	8	720	---

Table 2.1: Urban and Rural Roadway Levels of Service and Service Volumes

Looking at the row for "minor collector" roads and column for "2-way ADT Range," it is suggested that up to 5,000 vpd can be accommodated to provide a level of service (LOS) B or better. Therefore it was concluded that the 2014 existing traffic + high school + Courtyard Hotel traffic of (1,986 + 1,040 + 681) 3,707 vpd was within the capacity of URRLR to provide a LOS B or better.

To assess the ***level of service*** along NB URRLR at the intersection with SR 89A, a *HCS* analysis using the combined total traffic volumes was run, see page **11** and **12**. Per the analysis, the am and pm peak hours will operate at an overall LOS C with several movements operating at a LOS B and only the NB and SB left turns operating at a LOS D in the pm peak hour.

The existing WB SR 89A left turn lane along SR 89A at its approach to URRLR is approximately 325' long. To assess the ***queuing*** along WB SR 89A at its approach to the URRLR intersection with the Project, ***Figure 9.3*** from the *ITE Guidelines for Urban Major Street Design* was used. The analysis shows a left turn lane length of 325' (minimum) to 440' (desirable) is warranted.

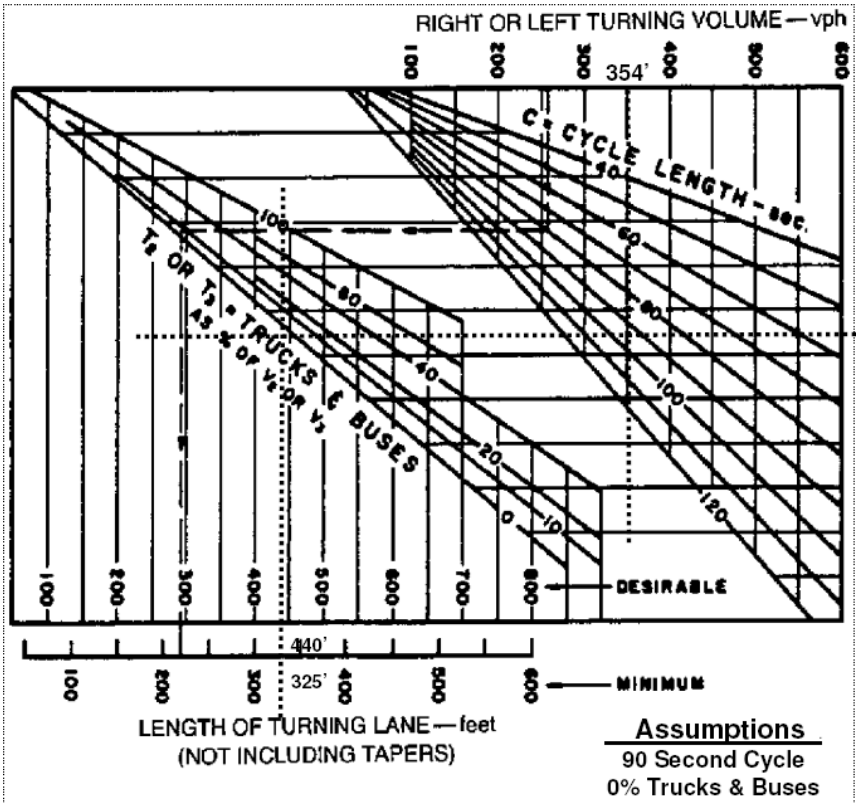


Figure 9.3. Length of Right- or Left-turn Lane with Separate Signal Indications for Turning Movements. (1 foot = 0.3 m; 1 MPH = 1 KPH)

Source: Ref. 114, Chart 18C.

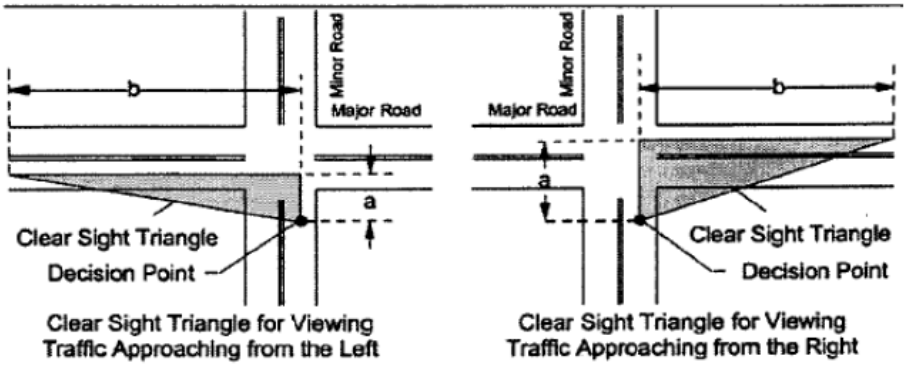
The operations and safety between SB traffic along URRLR turning left into the Project with traffic continuing south will be limited due to the two SB lanes. A majority of the SB traffic is getting into the right lane to make a right turn into the school property. The operations and safety between NB traffic along URRLR and traffic turning right onto URLLR from the Project is anticipated to be within normal operational parameters. Though the NB right turn volume (most of which originates from the high school) is high, there are only 14 vph leaving the Project in the am peak and 10 leaving in the pm peak. With the Courtyard Project, the NB right turn lane to SR 89A was extended to the northern Project driveway by approximately 40'. This served the dual function of providing a degree of protection for motorists leaving the Project and adding length for queuing.

Intersection (Driveway) spacing along URRLR and SR 89A was evaluated based on *Article 9 of the City of Sedona Land Development Code (SLDC).* Per the *SLDC* (*Figure 9-44*) a separation of 85' is necessary along URRLR between SR 89A and the first driveway. The second (northern most) driveway should be 175' south of the first driveway. Along SR 89A the proposed driveway should be at least 230' east of URRLR. The actual spacing exceeds these requirements. Therefore; the existing driveway locations are acceptable.

Sight Distance along URRLR was evaluated. Per *Exhibit 9-55* from the *AASHTO Green Book* the horizontal and vertical geometry for the URRLR should provide a stopping sight distance (SSD) of 155' for a design speed of 25 mph. The SSD for SR 89A for a speed of 40 mph is 305'. Based on a review of the aerial images on the Google Maps web site, these distances are met.

While SSD satisfies the minimum requirement for sight distance at an intersection, intersection sight distance (ISD) is recommended for the new intersection along URRLR and SR 89A with the Project. ***Exhibit 9-50*** from the *AASHTO Green Book* shows the ISD layout for the "departure sight triangles." For the existing driveways along URRLR the recommended ISD is 280' for a left turn (looking right) and 240' for a right turn (looking left) for a design speed of 25 mph. For the proposed driveway along SR 89A, which is a right-out only, an ISD of 385' is recommended. There is adequate space to accommodate these distances; though it is unknown if there is landscaping or other obstacles hindering the sight lines.

AASHTO—Geometric Design of Highways and Streets



B -- Departure Sight Triangles

Exhibit 9-50. Intersection Sight Triangles

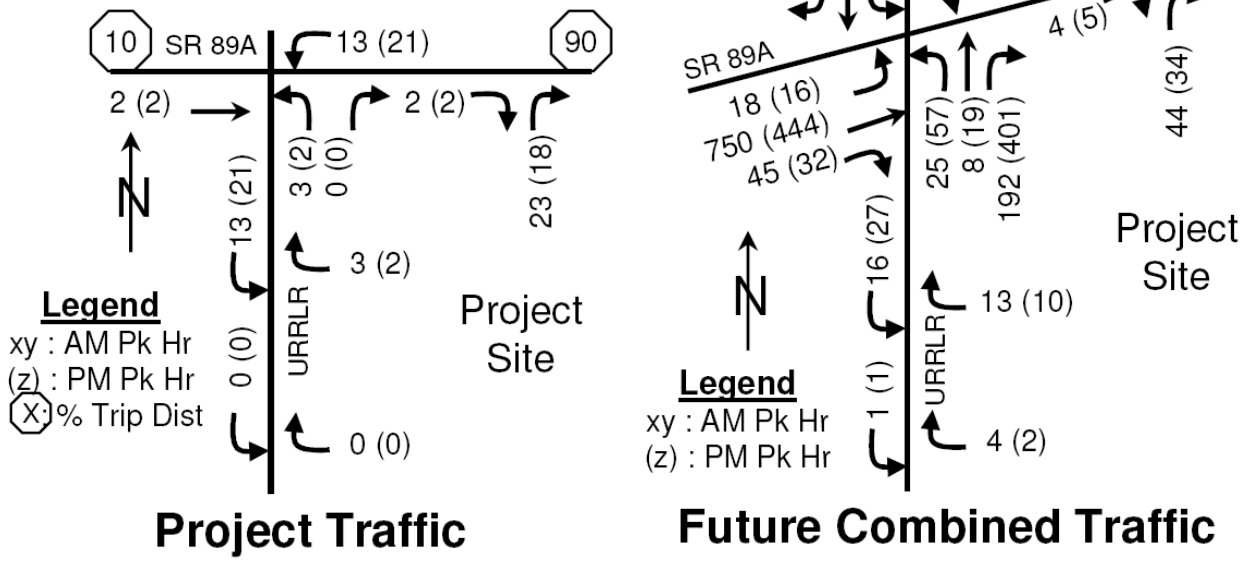
Traffic control is required to maintain safety and orderly progression of traffic. A stop sign exists at each of the 3-driveways at their approach to SR 89A and URRLR.

Pedestrian needs are currently provided for along both sides of SR 89A and URRLR. Therefore no further enhancements are needed.

Projected Traffic. The ***trip generation*** for the site based on factors from the *ITE Trip Generation Manual*, Land Use Code 320 – Motel. Based on the number of rooms (92), the following trip generation (trips per unit – tpu) is estimated:

- Daily Trips: (92 * 5.63 tpu =) 518 total trips, 50% entering and 50% exiting
- am Peak Hr: (92 * 0.45 tpu =) 41 total trips, 36% entering (15) and 64% exiting (26)
- pm Peak Hr: (92 * 0.47 tpu =) 43 total trips, 54% entering (23) and 46% exiting (20)

The ***trip distribution*** for traffic is as follows: 10% from the west and 90% from the east. The ***trip assignment*** is shown on the **figure** below and to the left. The ***future combined traffic forecast*** includes the existing traffic plus the traffic projected to be added by the Residence Inn. The **figure** to the right shows the volumes estimated for the opening of the Project.



Traffic and Improvement Analysis. This analysis is based on the understanding no additional off-site improvements will be completed with the Residents Inn project. It is assumed that the peak period for school and hotel traffic demand will occur simultaneously. This may not be the case, particularly in the afternoon when the end of day school release occurs before the peak period for the hotel. This approach provides a snap shot of the worst hour of the day.

Our review of the ***basic section capacity*** for SR 89A is based on *MCDOT* ***Table 2.1***, shown on page 5. Per ***Table 2.1***, a 4-lane minor arterial can provide a LOS C or better while carrying up to 22,000 vpd. The existing + Project traffic of [18,074 + (518*90%)] results in a total demand of 18,540 vpd, which is within the capacity of the existing SR 89A facility.

URRLR, a 2-lane minor collector, can provide a LOS B or better while carrying up to 5,000 vpd. The existing + Project traffic of [3,707 + (518*50%)] results in a total demand of 3,966 vpd, which is within the capacity of the existing URRLR facility.

To assess the ***level of service*** along NB URRLR at the intersection with SR 89A, a *HCS* analysis using the combined total traffic volumes was run, see page **13** and **14**. Per the analysis, the am and pm peak hours will operate the same as without the Project, providing an overall LOS C with several movements operating at a LOS B and only the NB and SB left turns operating at a LOS D in the pm peak hour. The overall delay increases by 0.3 seconds per vehicle in the am peak and 0.1 seconds in the pm peak.

To assess the ***queuing*** along WB SR 89A at its approach to the URRLR intersection with the Project, ***Figure 9.3*** from the *ITE Guidelines for Urban Major Street Design* was used. The analysis shows a left turn lane length of 340' (minimum) to 455' (desirable) is warranted. The change in the WB SR 89A queuing length between the existing and with Project condition is measure-able, but insignificant. Motorists will not notice a change is queuing or delay.

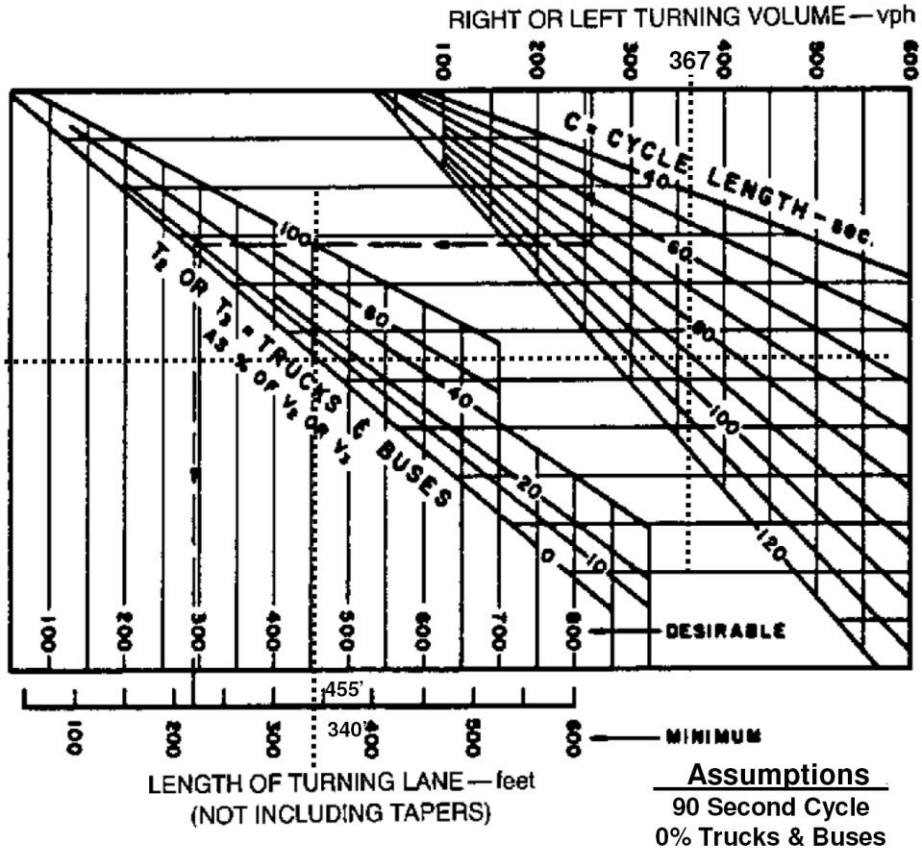


Figure 9.3. Length of Right- or Left-turn Lane with Separate Signal Indications for Turning Movements. (1 foot = 0.3 m; 1 MPH = 1 KPH)

Source: Ref. 114, Chart 18C.

Most of the existing NB traffic along URRLR is turning right (192 in the am peak and 401 in the pm peak). The Project does not add any additional traffic to this movement. Therefore, no change in operations and safety will occur.

The operations and safety between SB traffic along URRLR turning left into the Project with traffic continuing south will be limited due to the two SB lanes. A majority of the SB traffic is getting into the right lane to make a right turn into the school property. The operations and safety between NB traffic along URRLR and traffic turning right onto URLLR from the Project is anticipated to be within normal operational parameters. Though the NB right turn volume (most of which originates from the high school) is high, there are only 14 vph leaving the Project in the am peak and 10 leaving in the pm peak.

Intersection (Driveway) spacing does not change along SR 89A and URRLR, therefore remains acceptable.

Within the project property, the queuing length between the return from the joint driveway to the Residence Inn to the curb along SR 89A is roughly 170'. This satisfies the spacing criteria and provide ample length for queuing for departing right turn traffic.

Sight Distance along SR 89A and URRLR does not change, therefore remains acceptable.

No assessment of sight distance within the Project was made.

Traffic control along SR 89A and URRLR does not change, therefore remains acceptable.

No assessment of traffic control within the Project was made.

Pedestrian along SR 89A and URRLR does not change, therefore remains acceptable.

The **figure** on page 10 shows the extension of the sidewalk circulation system with the Residence Inn project. This system provides acceptable access to the public sidewalk system. The system shall be designed and constructed to meet the current American with Disability Act (ADA) requirements.

Conclusions and Recommendations. The analysis shows that the additional traffic generated by the Residence Inn project on SR 89A, URRLR and the three driveways is minimal and will have a nominal impact on operations, capacity and safety. Intersection spacing, driveway ISD and traffic control criteria are all met. The existing pedestrian facilities are adequate. Therefore, no additional improvements are warranted or recommended.

Within the site the proposed design provides for travel ways with acceptable spacing's for queuing and turn movements. The additional sidewalk locations are acceptable. The sidewalks shall be designed and built to meet current ADA requirements. No additional improvements are warranted or recommended.

Note: These evaluations and recommendations are based on the exiting traffic volumes, physical conditions and the proposed land uses and site improvements. As improvements to SR 89A and/or additional development or changes in adjacent properties land use occur, the travel demand may increase or decrease resulting in more or less impacts at the locations evaluated in this memo. Therefore the recommendations in this study reflect the standard of care for the information known to be true today, and may need to be re-evaluated by others as changes occur.

If you have any questions regarding this memo, please don't hesitate to call me at (928) 776-1750.

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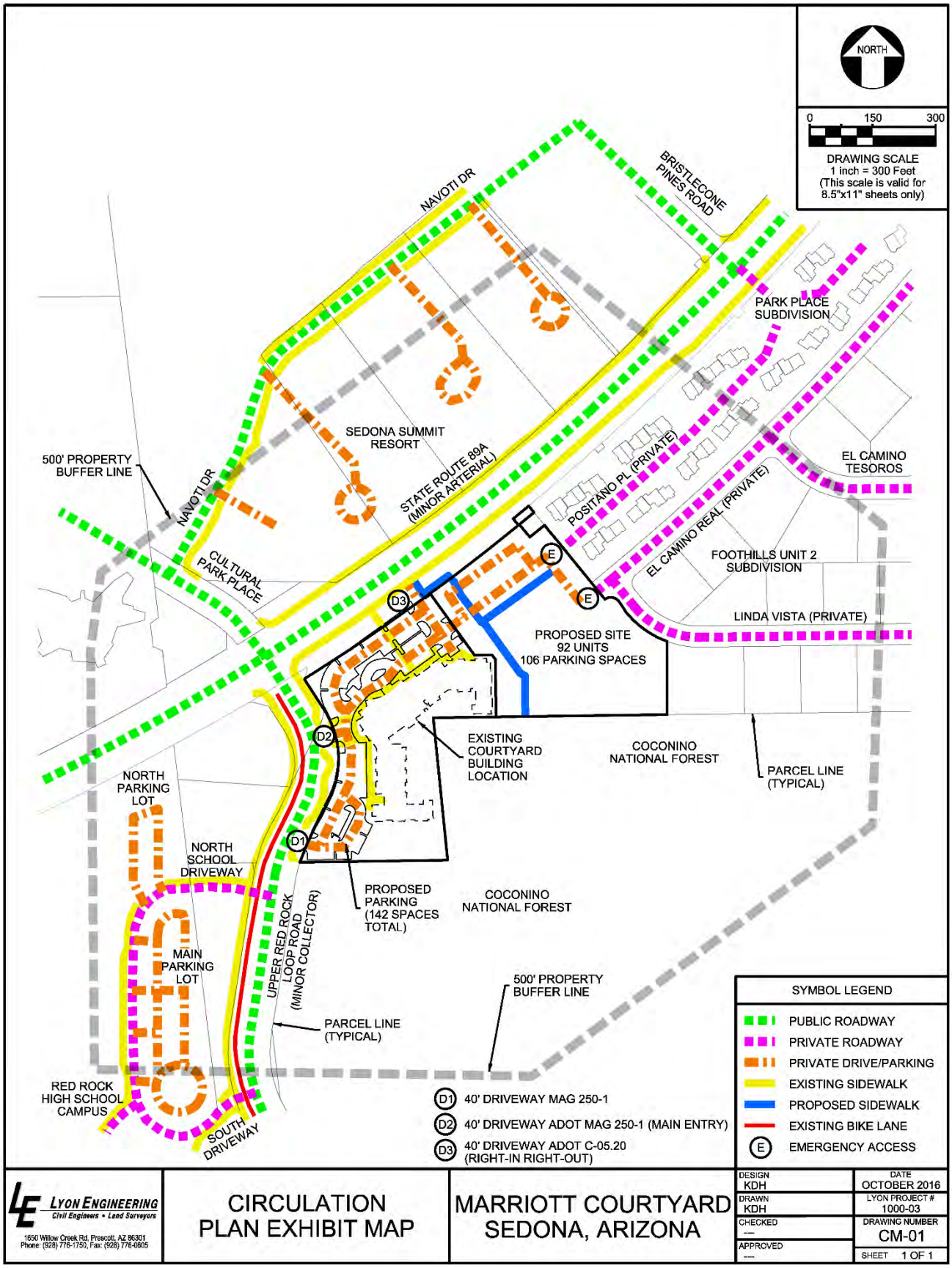


HCS2000: Signalized Intersections

Analyst: Lyon Engineering
Agency:
Date: 10/17/2016
Period: AM Peak Hour
Project ID: Residence Inn Traffic Study - Existing Traffic
E/W St: SR 89A

Inter.:
Area Type: CBD or Similar
Jurisd: ADOT / Sedona
Year : 2016
N/S St: URRLR/Cultural Park Pl

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	18	748	45	354	280	18	22	8	192	24	20	7
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
RTOR Vol			30			15			45			5

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	A		
Thru		P			Thru	A		
Right		P			Right	A		
Peds		X			Peds	X		
WB Left	P				SB Left	A		
Thru		P			Thru	A		
Right		P			Right	A		
Peds		X			Peds	X		
NB Right	A				EB Right			
SB Right					WB Right			
Green	31.0	31.0			12.0			
Yellow	4.0	4.0			4.0			
All Red	1.5	1.5			1.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	559	1624	0.03	0.34	19.6	B		
T	1119	3249	0.71	0.34	29.5	C	29.1	C
R	501	1454	0.03	0.34	19.7	B		
Westbound								
L	559	1624	0.67	0.34	31.6	C		
T	1119	3249	0.27	0.34	21.9	C	27.3	C
R	501	1454	0.01	0.34	19.4	B		
Northbound								
L	170	1272	0.14	0.13	34.8	C		
T	228	1710	0.04	0.13	34.1	C	15.1	B
R	775	1454	0.20	0.53	11.1	B		
Southbound								
L	171	1286	0.15	0.13	34.9	C		
T	228	1710	0.09	0.13	34.4	C	34.6	C
R	194	1454	0.01	0.13	33.9	C		

Intersection Delay = 27.0 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections

Analyst: Lyon Engineering
Agency:
Date: 10/17/2016
Period: PM Peak Hour
Project ID: Residence Inn Traffic Study - Existing Traffic
E/W St: SR 89A

Inter.:
Area Type: CBD or Similar
Jurisd: ADOT / Sedona
Year : 2016
N/S St: URRLR/Cultural Park Pl

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	16	442	32	231	625	22	55	19	401	31	9	21
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
RTOR Vol			30			15			45			5

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	A		
Thru		P			Thru	A		
Right		P			Right	A		
Peds		X			Peds	X		
WB Left	P				SB Left	A		
Thru		P			Thru	A		
Right		P			Right	A		
Peds		X			Peds	X		
NB Right	A				EB Right			
SB Right					WB Right			
Green	31.0	31.0			12.0			
Yellow	4.0	4.0			4.0			
All Red	1.5	1.5			1.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	559	1624	0.03	0.34	19.6	B		
T	1119	3249	0.42	0.34	23.8	C	23.6	C
R	501	1454	0.00	0.34	19.4	B		
Westbound								
L	559	1624	0.44	0.34	25.3	C		
T	1119	3249	0.59	0.34	26.6	C	26.2	C
R	501	1454	0.01	0.34	19.5	B		
Northbound								
L	171	1284	0.35	0.13	36.6	D		
T	228	1710	0.09	0.13	34.4	C	17.6	B
R	775	1454	0.49	0.53	13.7	B		
Southbound								
L	170	1273	0.19	0.13	35.3	D		
T	228	1710	0.04	0.13	34.1	C	34.8	C
R	194	1454	0.09	0.13	34.4	C		

Intersection Delay = 23.8 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections

Analyst: Lyon Engineering
Agency:
Date: 10/18/2016
Period: AM Peak Hour
Project ID: Residence Inn Traffic Study - Combined Future Traffic
E/W St: SR 89A

Inter.:
Area Type: CBD or Similar
Jurisd: ADOT / Sedona
Year : 2016
N/S St: URRLR/Cultural Park Pl

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	18	750	45	367	280	18	25	8	192	24	19	7
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
RTOR Vol			30			15			45			5

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	A		
Thru		P			Thru	A		
Right		P			Right	A		
Peds		X			Peds	X		
WB Left	P				SB Left	A		
Thru		P			Thru	A		
Right		P			Right	A		
Peds		X			Peds	X		
NB Right	A				EB Right			
SB Right					WB Right			
Green	31.0	31.0			12.0			
Yellow	4.0	4.0			4.0			
All Red	1.5	1.5			1.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	559	1624	0.03	0.34	19.6	B		
T	1119	3249	0.71	0.34	29.5	C	29.1	C
R	501	1454	0.03	0.34	19.7	B		
Westbound								
L	559	1624	0.70	0.34	32.5	C		
T	1119	3249	0.27	0.34	21.9	C	27.9	C
R	501	1454	0.01	0.34	19.4	B		
Northbound								
L	170	1273	0.16	0.13	35.0-	C		
T	228	1710	0.04	0.13	34.1	C	15.5	B
R	775	1454	0.20	0.53	11.1	B		
Southbound								
L	171	1286	0.15	0.13	34.9	C		
T	228	1710	0.09	0.13	34.4	C	34.6	C
R	194	1454	0.01	0.13	33.9	C		

Intersection Delay = 27.3 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections

Analyst: Lyon Engineering
Agency:
Date: 10/18/2016
Period: PM Peak Hour
Project ID: Residence Inn Traffic Study - Combined Future Traffic
E/W St: SR 89A

Inter.:
Area Type: CBD or Similar
Jurisd: ADOT / Sedona
Year : 2016
N/S St: URRLR/Cultural Park Pl

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	1
LGConfig	L	T	R	L	T	R	L	T	R	L	T	R
Volume	16	444	32	252	625	22	57	19	401	31	9	21
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
RTOR Vol			30			15			45			5

Duration 0.25 Area Type: CBD or Similar

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	A		
Thru		P			Thru	A		
Right		P			Right	A		
Peds		X			Peds	X		
WB Left	P				SB Left	A		
Thru		P			Thru	A		
Right		P			Right	A		
Peds		X			Peds	X		
NB Right	A				EB Right			
SB Right					WB Right			
Green	31.0	31.0			12.0			
Yellow	4.0	4.0			4.0			
All Red	1.5	1.5			1.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	559	1624	0.03	0.34	19.6	B		
T	1119	3249	0.42	0.34	23.8	C	23.6	C
R	501	1454	0.00	0.34	19.4	B		
Westbound								
L	559	1624	0.48	0.34	26.1	C		
T	1119	3249	0.59	0.34	26.6	C	26.4	C
R	501	1454	0.01	0.34	19.5	B		
Northbound								
L	171	1284	0.36	0.13	36.8	D		
T	228	1710	0.09	0.13	34.4	C	17.7	B
R	775	1454	0.49	0.53	13.7	B		
Southbound								
L	170	1273	0.19	0.13	35.3	D		
T	228	1710	0.04	0.13	34.1	C	34.8	C
R	194	1454	0.09	0.13	34.4	C		

Intersection Delay = 23.9 (sec/veh) Intersection LOS = C

LYON ENGINEERING
Civil Engineers • Land Surveyors

January 6, 2017

City of Sedona
Public Works Department
102 Roadrunner Drive
Sedona, AZ 86336
928-204-7127

Attn: Andy Dickey

Re: Preliminary Marriott Residence Inn Sewer Analysis

This sewer report is to determine the proposed flow from the Marriott Residence Inn project and determine if the existing sewer infrastructure is adequate. Wastewater from this project will flow from the existing Marriott sewer pump station into the existing gravity wastewater collection system that discharges into the El Camino Pump Station. This sewer analysis will calculate the proposed discharge from the project, analyze capacity of an 8" sewer main at minimum slope (0.0033 ft/ft), and review the capacity of the existing Marriott pump station and collection system from El Camino Road to the El Camino Pump Station.

This project is located on the southeast corner of State Route 89A and Upper Red Rock Loop Road in west Sedona. The proposed site includes a hotel, pool, small restaurant, and parking lot. Sewer design flows per ADEQ usage calculations and per mechanical engineer's fixture count calculations are both presented in this report. Hotel unit count for the existing Courtyard by Marriott is 121; unit count for the proposed Residence Inn is 92. The ratio for hotel water demand is anticipated to be 92/121 = 0.76. The Courtyard by Marriott final design flows determined by the mechanical engineer were significantly higher than the preliminary ADEQ usage calculations. For this sewer report, ADEQ usage calculations will be utilized to verify existing infrastructure sizing and capacity since these seem more reasonable and realistic, and not all fixtures will statistically be used at the same time.

Swimming pool usage was estimated at 338,000 gallons per year by the pool designer. Landscaping usage was estimated at 4,500 gallons per week by the landscape designer. A peaking factor of 2.5 is used based on the July 21, 2000 City of Sedona Wastewater Master Plan Update by Wilson & Company.

ADEQ Usage Calculations (utilized for this report)

"Table 1: Unit Design Flows" from Arizona Administrative Code Section R18-9-E323 is used to determine the cumulative design flow. Several assumptions have been made, including the following:

- 92 rooms with a total of 137 beds
- Small restaurant (9 employees, public bathroom, 76 meals per day)
- Cocktail area in restaurant (23 customers per day)

Calculations are as follows:

Hotel Rooms:

$$50gal/day * 137beds * 1day/1440\min * 2.5peaking = 11.89gal/\min$$

Restaurant: (Add Toilet, Kitchen Waste, Garbage Disposal, Cocktail Lounge, Waste Disposal Service)

$$\left[\begin{array}{l}(20gal/day * 9employees) + (7gal/day * 76Customers) + \\ (9gal/day * 76meals) + (38Customers * 2gal/day)\end{array}\right] * (1day/1440\min) * 2.5peaking = 2.56gal/\min$$

Flow Calculations for Residence Inn (from ADEQ Usage Calculations)

	Average Day (gpd)	Average Day (gpm)	Peaking Factor	Peak (gpd)	Peak (gpm)
Hotel	8,323	5.78	2.5	20,808	14.45
Swimming Pool	926	0.64	2.5	2,315	1.60
Landscaping	650	0.45	2.5	1,625	1.13
Total	9,899	6.87	2.5	24,748	17.18

Mechanical Engineer's Fixture Count Calculations (**NOT** utilized for this report)

Flow Calculations for Residence Inn (from Mechanical Engineer's Fixture Count Calculations from Courtyard by Marriott, incorporating the 0.76 ratio for hotel demand)

	Average Day (gpd)	Average Day (gpm)	Peaking Factor	Peak (gpd)	Peak (gpm)
Hotel	61,286	42.56	2.5	153,216	106.40
Swimming Pool	926	0.64	2.5	2,315	1.60
Landscaping	650	0.45	2.5	1,625	1.13
Total	62,862	43.65	2.5	157,156	109.13

Flow Calculation and Summary

Utilizing the more reasonable and realistic ADEQ sewage flows, the total **average day flow** of **15.56 gpm** (8.69 for Courtyard and 6.87 Residence Inn) will be routed in the proposed sewer main from the hotel to the existing Marriott sewage lift station at the northeast corner of the subject property. The total **peak flow** is **38.90 gpm** (21.73 for Courtyard and 17.17 Residence Inn). From the lift station, sewage will be lifted to the existing manhole at the western limit of the Park Place subdivision via a 3" forcemain. The hotel building will be provided with 6" sewer services from the proposed on-site sewer main. The attached worksheet from Bentley's FlowMaster shows that the proposed 6" service laterals will be sufficient for each building.

Forcemain:

Length of proposed 3" PVC sewer force main: 109 lf
Total average daily flow = 15.56 gpm
Q = 15.56 gpm ≈ 0.71 ft/s in 3" PVC pipe (See FlowMaster data) → **Inadequate velocity** (3-7 ft/s)
Q_{min} = 66 gpm ≈ 3.00 ft/s in 3" PVC pipe (See FlowMaster data) → Minimum velocity
Q_{max} = 154 gpm ≈ 7.00 ft/s in 3" PVC pipe (See FlowMaster data) → Maximum velocity

Verification of Lift Station Size Calculations:

Total peak flow to lift station = 38.90 gpm
Pump rate for peak velocity = 38.90 gpm

Volume of wet well required = $V_W = \frac{\theta q}{4}$ (per ADEQ)

θ = 15-minute cycle time (per ADEQ recommended criteria)

$$V_W = \frac{\theta q}{4} = \frac{(15)(38.90)}{4} = 145.88 \text{ gallons} \sim 19.50 \text{ cf (minimum volume w/ 38.90 gpm pump)}$$

The wet well is an Oldcastle Precast RC509 pump station vault, 5' x 9' with rounded corners, and has a capacity of 310 gallons per foot (see attached detail).

Total wet well volume from the pump off control up to the 8-inch gravity sewer main:
4472.37 (IE-In) – 4470.12 (sump) = 2.25 ft
2.25 ft * 310 gal/ft = 698 gallons
This is greater than the required 145.88 gallons.
The duration of emergency storage in the wet well for peak flow:
698 gallons / 38.90 gpm = 17.94 minutes

Solving for TDH Required from Lift Station

Length of 3" Force Main: 109 lf (includes pump station piping)
Pump Discharge Elevation: 4468.80
Force Main outlet elevation into manhole: 4487.40

Submersed Pump Depth: 1.0 ft (worst case at pump off elevation)

Static head from Pump Discharge to Force Main Outlet:

4487.40 – 4468.80 = 18.60 ft

Using the pump curve, it is determined that the pump will reach equilibrium when discharging ~160 gpm. The pipe and fittings headloss generated from ~160 gpm flow plus the static head will result in TDH at ~160 gpm discharge.

C Coefficient: 140
Friction head loss at 160 gpm, C=140, thru 109 lf 3" pipe: 6.93 ft (FlowMaster)

Static + Friction head (not including L.S. fittings):

18.60 ft +6.93 ft = 25.53 ft ~ see lift station fittings calculations below

Solve for headloss through Lift Station fittings and piping:

Lift station headloss per fittings using the equation: $h = K\frac{v^2}{2g}$

$$h = \frac{0.25\left(v_1^2 - v_2^2\right)}{2g}$$

Lift Station headloss for an Increaser:

Q = 160 gpm
v = velocity in 3" Pipe = 7.26 ft/s
(3" Force Main piping used in Lift Station up to Wye fitting)
g = gravitational acceleration constant = 32.2 ft/sec^2
K = Energy Loss Coefficients per Tables B-6 and B-7 in Section 2

45° Bend:	K=0.2	~	h=0.16 ft
90° Bend:	K=0.3	~	h=0.25 ft
90° Bend:	K=0.3	~	h=0.25 ft
Check Valve, Swing:	K=1.1	~	h=0.90 ft
Eccentric Plug Valve:	K=0.5	~	h=0.41 ft
Wye, 45 degree	K=0.5	~	h=0.41 ft
			h=2.38 ft, Total

TDH Required: 25.53 ft + 2.38 ft = 27.91 ft

Final Lift Station Criteria

L.S. pumps produce 160 gpm @ 27.91 ft TDH

The velocity @ 160 gpm in the 3" pipe is 7.26 fps. This is greater than the ADEQ required maximum of 7 fps.

Design Requirements:

ADEQ $V_{minimum}$ = 3 fps
ADEQ $V_{maximum}$ = 7 fps
ADEQ minimum solid handling = 2.5" sphere
Backup power required when average flow > 10,000 gpd (6.9 gpm) → **Backup power existing**
Maximum sewage retention time without aeration = 30 min → **Aeration not recommended**

The existing lift station wet well volume and pumps are sufficient for the additional sewer design flow of the proposed Residence Inn by Marriott.

Offsite Collection Capacity Existing 8" Main:

Instead of analyzing each individual existing sewer main, Lyon Engineering analyzed the capacity of an 8" sewer main at the minimum required slope of 0.0033 ft/ft. Lyon used the City of Sedona GIS data to create a sewer basin that included all contributing flows into the existing 8" City of Sedona gravity collection system. This GIS information was compared to the basins outlined in the Wastewater Master Plan Update, dated July, 21, 2000, by Wilson & Company and Shephard-Wesnitzer, Inc. This master plan also designated the design flow parameters for Equivalent Residential Units (ERU) of 200 gallons per day per ERU, and a peaking factor of 2.5. The capacity of an 8" sewer main at a minimum slope of 0.0033 ft/ft is **311.55 gpm**.

Based on the sewer basin, there are a total 373 platted single family home sites, Verde Valley Medical Center, and the Sedona Racquet Club. Undeveloped parcels including 408-11-177J, 408-11-177R, 408-11-402A, and 408-11-402C are owned by Northern Arizona Healthcare Corporation based on the Yavapai County GIS web site. These parcels are approximately 33.2 acres total. The existing Verde Valley Medical Center has 12 beds on 4.2 acres, or 2.8 beds per acre. Assuming the same density for the adjacent parcels this would be approximately 93 beds on 33.2 acres. Existing flows were calculated as follows:

ERU:

$$200gal/day*373ERU*1day/1440\min*\ 2.5peaking=129.5gal/\min$$

Verde Valley Medical Center (Table 1: Unit Design Flows) with 12 beds:

$$315gal/day-bed*12beds*1day/1440\min*\ 2.5peaking=6.56gal/\min$$

Sedona Racquet Club (currently closed) (Table 1: Unit Design Flows) assume 100 members:

$$100gal/day-member*100member*1day/1440\min*\ 2.5peaking=17.36gal/\min$$

Northern Arizona Healthcare (Table 1: Unit Design Flows) with 93 beds:

$$315gal/day-bed*93beds*1day/1440\min*\ 2.5peaking=50.86gal/\min$$

Total calculated existing **peak** flow = 129.5+6.56+17.36+50.86 = *204.28 gal/min*

Total projected flow through an 8" sewer main is calculated by combining the existing **peak** flow (as calculated above) with the anticipated equilibrium flow from the Marriott (Courtyard plus Residence Inn) lift station pump.

204.28 gpm + 160 gpm = 364.28 gpm

This is greater than the maximum capacity of an 8" sewer main at the required minimum slope. Therefore, the existing 8" sewer collection system would not have capacity for the Marriott development if the mains are existing at minimum slope. At this time, there are still undeveloped lots within the sewer basin including 72 units within Park Place and approximately 46 units throughout the basin. For the final design, it will be prudent to field verify existing sewer main sizes and slopes to determine which offsite sewer mains (if any) will need to be upsized.

Offsite Collection Capacity El Camino Road to El Camino Pump Station:

A significant portion of the wastewater is conveyed down El Camino Road within the existing collection system. The existing 8" wastewater main connects to this collection system at the intersection of El Camino Road and Red Hawk Lane. Lyon reviewed the existing collection system from this intersection to the El Camino Pump Station based on data provided by the City of Sedona. The updated data is shown below outlined in red (full size copy attached).

14	3	B-1	750	420	4311.80	4301.60	12	300.00	0.0340	8.4	4.257	252,381	0.252	2.50	0.631	15
13	3	B-1	420	410	4296.97	4296.49	12	40.00	0.0120	5.0	2.529	292,701	0.293	2.50	0.732	29
12	3	B-1	410	400	4296.49	4291.63	12	380.00	0.0120	5.0	2.529	292,701	0.293	2.50	0.732	29
11	3	B-1	400	390	4291.63	4288.99	12	150.00	0.0160	5.8	2.921	292,701	0.293	2.50	0.732	25
10	3	B-1	390	380	4288.99	4287.31	12	95.00	0.0177	6.1	3.072	292,701	0.293	2.50	0.732	24
9	3	B-1	380	1540	4287.31	4282.10	12	102.00	0.0511	10.3	5.219	292,701	0.293	2.50	0.732	14
													0.000			
8	2	B-1	1540	1580	4282.10	4282.00	18	48.00	0.0019	2.6	2.967	460,421	0.460	2.50	1.151	39
7	2	B-1	1580	1550	4282.00	4281.91	18	50.00	0.0019	2.6	2.967	460,421	0.460	2.50	1.151	39
6	2	B-1	1550	2230	4281.91	4281.88	18	16.00	0.0014	2.2	2.547	460,421	0.460	2.50	1.151	45
El Camino LS												480,501	0.481	2.50	1.201	

This updated data sheet shows between manhole 1550 and 2230 the existing 18" sewer main has an average daily flow of 460,421 gallons/day and a peak flow of 1.151 million gallons/day (MGD). The capacity of this main is 2.547 MGD and currently has a committed capacity of 45%. This leaves approximately 1.396 MGD available within this segment. The overall El Camino gravity sewer collection system has not reached full build. There are still undeveloped areas within Masterplan basins A-7 and A-5 and at the intersection of Bristlecone Pines Road and SR89A. Based on the undeveloped land within the service area of the El Camino Pump Station, and the updated capacity data from the City of Sedona the sewer main sections have excess capacity for the project.

Conclusion:

The existing onsite Marriott wastewater pump station has been verified for flow, size, and pump functionality. The additional Residence Inn sewer flows are capable of being handled by the existing lift station. The downstream capacity of the existing City of Sedona wastewater collection system that this project will connect to was analyzed based on the minimum pipe diameter of the collection mains (8 inches) at the required minimum slope of 0.0033 ft/ft. Lyon Engineering utilized the City of Sedona GIS and master plan data to delineate the sewer basin that contributes to this collection main. Based on this data, the existing sewer collection main may have to be upsized for this project. For the final design, it will be prudent to field verify existing sewer main sizes and slopes to determine which offsite sewer mains (if any) will need to be upsized. The second portion of the collection main that was analyzed was from the intersection of El Camino Road and Red Hawk Lane to the El Camino Pump Station. The updated master plan data provided by the City of Sedona show that the collection mains have excess capacity to service the Courtyard and Residence Inn projects within the El Camino Pump station sewer basin.

The onsite pump station is equipped with an emergency generator for backup power. In the event of a failure, if the system sat idle for 30 minutes prior to the pump turning on with peak flow conditions, the waste water collection system would back up to the following elevation:

38.90 gpm (peak flow) * 30 min = 1,167 gallons
1,167 gallons / 310 gal/ft = 3.76 ft
4470.12 (pump off) +3.76 = 4473.88

The lowest manhole rim on the site is at an elevation of 4482, so the system will not discharge to the surface.

Included with this analysis are the overall sewer exhibit, 8" sewer capacity calculation, 3 inch force main headloss calculation, pump station basin detail, and City of Sedona Wastewater Collection System Gravity Sewer Model exhibit.

Respectfully Submitted,

Scott A. Lyon, P.E., R.L.S.
Vice President

b. Any changes are reflected in as-built plans submitted with the Engineer's Certificate of Completion.

2. The name of the service provider or certified operator that is responsible for implementing the performance assurance plan.

G. Reporting requirement. The permittee shall provide the Department with the following information on the anniversary date of the Discharge Authorization:

1. A form signed by the certified operator or service provider that:
   a. Provides any data or documentation required by the performance assurance plan,
   b. Certifies compliance with the requirements of the performance assurance plan, and
   c. Describes any additions to the facility during the year that increased flows and certifies that the flow did not exceed 24,000 gallons per day during any day; and
2. Any applicable fee required by 18 A.A.C. 14.

H. Facility expansion. If an expansion of an on-site wastewater treatment facility operating under this Section involves the installation of a separate on-site wastewater treatment facility on the property with a design flow of less than 3000 gallons per day, the applicant shall submit the applicable Notice of Intent to Discharge and fee required under 18 A.A.C. 14 for the separate on-site wastewater treatment facility.

1. The applicant shall indicate in the Notice of Intent to Discharge the Department's file number and the issuance date of the Discharge Authorization previously issued by the Director under this Section for the property.
2. Upon satisfactory review, the Director shall reissue the Discharge Authorization for this Section, with the new issuance date and updated information reflecting the expansion.
3. If the expansion causes the accumulative design flow from on-site wastewater treatment facilities on the property to equal or exceed 24,000 gallons per day, the Director shall not reissue the Discharge Authorization, but shall require the applicant to submit an application for an individual permit addressing all proposed and operating facilities on the property.

Historical Note

New Section adopted by final rulemaking at 7 A.A.R. 235, effective January 1, 2001 (Supp. 00-4). Amended by final rulemaking at 11 A.A.R. 4544, effective November 12, 2005 (05-3).

Table 1. Unit Design Flows

Wastewater Source	Applicable Unit	Sewage Design Flow per Applicable Unit, Gallons Per Day
Airport	Passenger (average daily number) Employee	4 15
Auto Wash	Facility	Per manufacturer, if consistent with this Chapter
Bar/Lounge	Seat	30
Barber Shop	Chair	35
Beauty Parlor	Chair	100
Bowling Alley (snack bar only)	Lane	75
Camp Day camp, no cooking facilities Campground, overnight, flush toilets Campground, overnight, flush toilets and shower Campground, luxury Camp, youth, summer, or seasonal	 Camping unit Camping unit Camping unit Person Person	 30 75 150 100-150 50
Church Without kitchen With kitchen	 Person (maximum attendance) Person (maximum attendance)	 5 7
Country Club	Resident Member Nonresident Member	100 10
Dance Hall	Patron	5
Dental Office	Chair	500
Dog Kennel	Animal, maximum occupancy	15
Dwelling For determining design flow for sewage treatment facilities under R18-9-B202(A)(9)(a) and sewage collection systems under R18-9-E301(D) and R18-9-B301(K), excluding peaking factor.	Person	80

Dwelling For on-site wastewater treatment facilities per R18-9-E302 through R18-9-E323: Apartment Building 1 bedroom 2 bedroom 3 bedroom 4 bedroom Seasonal or Summer Dwelling (with recorded seasonal occupancy restriction) Single Family Dwellings Other than Single Family Dwelling, the greater flow value based on: Bedroom count 1-2 bedrooms Each bedroom over 2 Fixture count	 Apartment Apartment Apartment Apartment Resident see R18-9-A314(D)(1) Bedroom Bedroom Fixture unit	 200 300 400 500 100 see R18-9-A314(D)(1) 300 150 25
Fire Station	Employee	45
Hospital All flows Kitchen waste only Laundry waste only	 Bed Bed Bed	 250 25 40
Hotel/motel Without kitchen With kitchen	 Bed (2 person) Bed (2 person)	 50 60
Industrial facility Without showers With showers Cafeteria, add	 Employee Employee Employee	 25 35 5
Institutions Resident Nursing home Rest home	 Person Person Person	 75 125 125
Laundry Self service Commercial	 Wash cycle Washing machine	 50 Per manufacturer, if consistent with this Chapter
Office Building	Employee	20
Park (temporary use) Picnic, with showers, flush toilets Picnic, with flush toilets only Recreational vehicle, no water or sewer connections Recreational vehicle, with water and sewer connections Mobile home/Trailer	 Parking space Parking space Vehicle space Vehicle space Space	 40 20 75 100 250
Restaurant/Cafeteria With toilet, add Kitchen waste, add Garbage disposal, add Cocktail lounge, add Kitchen waste disposal service, add	Employee Customer Meal Meal Customer Meal	20 7 6 1 2 2
Restroom, public	Toilet	200

Worksheet for 3 Inch at 15 gpm

Project Description

Friction Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data

Pressure 2	0.00	psi
Elevation 1	4468.80	ft
Elevation 2	4487.40	ft
Length	109.00	ft
Roughness Coefficient	140.000	
Diameter	3.00	in
Discharge	15.56	gal/min

Results

Pressure 1	8.10	psi
Headloss	0.09	ft
Energy Grade 1	4487.50	ft
Energy Grade 2	4487.41	ft
Hydraulic Grade 1	4487.49	ft
Hydraulic Grade 2	4487.40	ft
Flow Area	0.05	ft²
Wetted Perimeter	0.79	ft
Velocity	0.71	ft/s
Velocity Head	0.01	ft
Friction Slope	0.00085	ft/ft

Worksheet for 3 Inch at 66 gpm

Project Description

Friction Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data

Pressure 2	0.00	psi
Elevation 1	4468.80	ft
Elevation 2	4487.40	ft
Length	109.00	ft
Roughness Coefficient	140.000	
Diameter	3.00	in
Discharge	66.00	gal/min

Results

Pressure 1	8.65	psi
Headloss	1.34	ft
Energy Grade 1	4488.88	ft
Energy Grade 2	4487.54	ft
Hydraulic Grade 1	4488.74	ft
Hydraulic Grade 2	4487.40	ft
Flow Area	0.05	ft²
Wetted Perimeter	0.79	ft
Velocity	3.00	ft/s
Velocity Head	0.14	ft
Friction Slope	0.01233	ft/ft

Worksheet for 3 Inch at 154 gpm

Project Description

Friction Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data

Pressure 2	0.00	psi
Elevation 1	4468.80	ft
Elevation 2	4487.40	ft
Length	109.00	ft
Roughness Coefficient	140.000	
Diameter	3.00	in
Discharge	154.33	gal/min

Results

Pressure 1	10.87	psi
Headloss	6.48	ft
Energy Grade 1	4494.64	ft
Energy Grade 2	4488.16	ft
Hydraulic Grade 1	4493.88	ft
Hydraulic Grade 2	4487.40	ft
Flow Area	0.05	ft²
Wetted Perimeter	0.79	ft
Velocity	7.00	ft/s
Velocity Head	0.76	ft
Friction Slope	0.05943	ft/ft

Worksheet for 3 Inch at 160 gpm

Project Description

Friction Method	Hazen-Williams Formula
Solve For	Pressure at 1

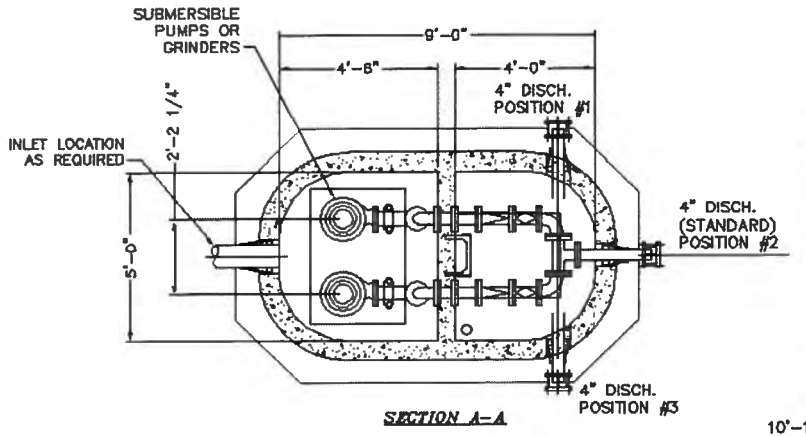
Input Data

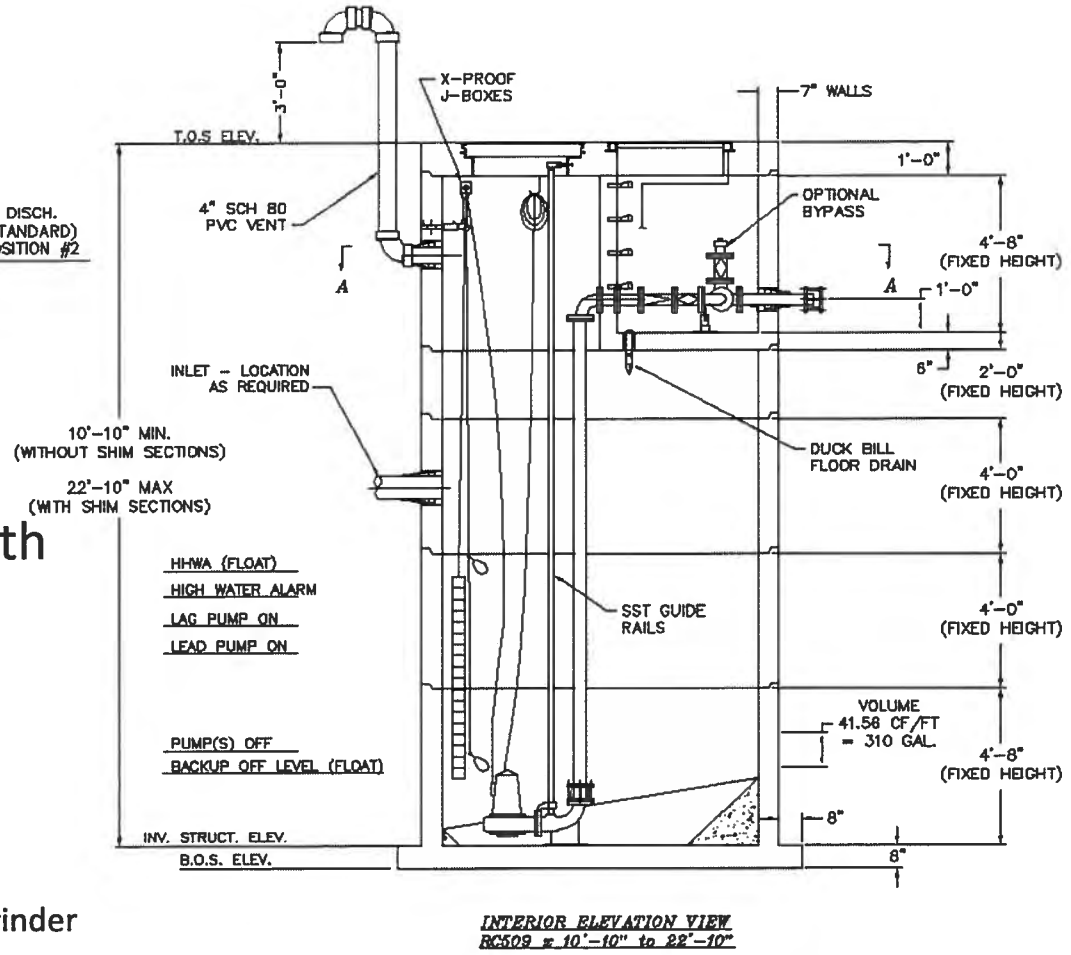
Pressure 2	0.00	psi
Elevation 1	4468.80	ft
Elevation 2	4487.40	ft
Length	109.00	ft
Roughness Coefficient	140.000	
Diameter	3.00	in
Discharge	160.00	gal/min

Results

Pressure 1	11.07	psi
Headloss	6.93	ft
Energy Grade 1	4495.14	ft
Energy Grade 2	4488.22	ft
Hydraulic Grade 1	4494.33	ft
Hydraulic Grade 2	4487.40	ft
Flow Area	0.05	ft²
Wetted Perimeter	0.79	ft
Velocity	7.26	ft/s
Velocity Head	0.82	ft
Friction Slope	0.06353	ft/ft

The RC509 pump station



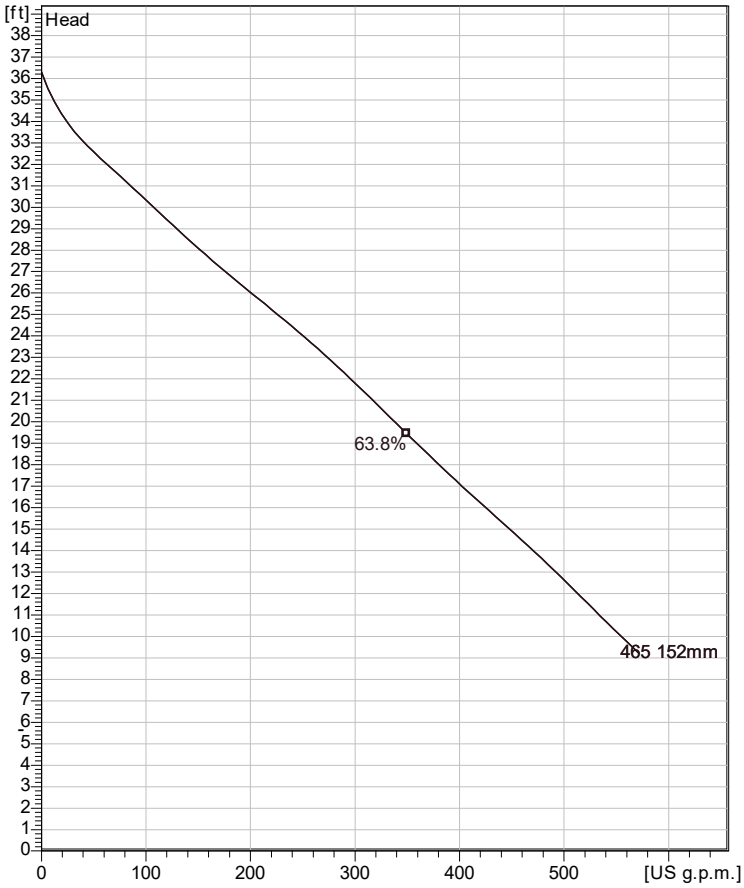


- Interior dimension 5’ x 9’ with rounded corners
  - 310 gal/ft
    - (vs. 6’ dia. at 210 gal/ft)
    - (vs. 8’ dia. at 374 gal/ft)
- 4” DIP Max. discharge
  - 2” & 3” discharge available for grinder pumps

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

NP 3085 MT 3~ 465

Technical specification



Water, pure

Curve according to: ISO 9906 grade 2 annex 1 or 2

Note: Picture might not correspond to the current configuration.

General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

Impeller

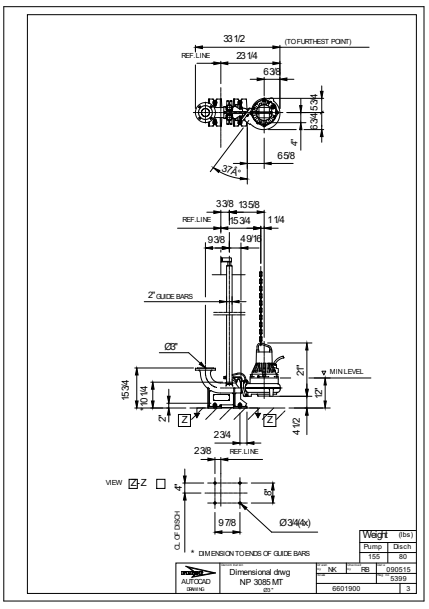
Impeller material	Hard-Iron ™
Discharge Flange Diameter	3 1/8 inch
Suction Flange Diameter	80 mm
Impeller diameter	152 mm
Number of blades	2

Motor

Motor #	N3085.183 15-10-4AL-W 3hp
Stator variant	68
Frequency	60 Hz
Rated voltage	200 V
Number of poles	4
Phases	3~
Rated power	3 hp
Rated current	9.9 A
Starting current	50 A
Rated speed	1690 rpm
Power factor	
1/1 Load	0.85
3/4 Load	0.80
1/2 Load	0.70
Efficiency	
1/1 Load	77.0 %
3/4 Load	79.0 %
1/2 Load	78.0 %

Configuration

Installation: P - Semi permanent, Wet



Project	Project ID	Created by	Created on	Last update
			2015-04-30	

NP 3085 MT 3~ 465

Performance curve

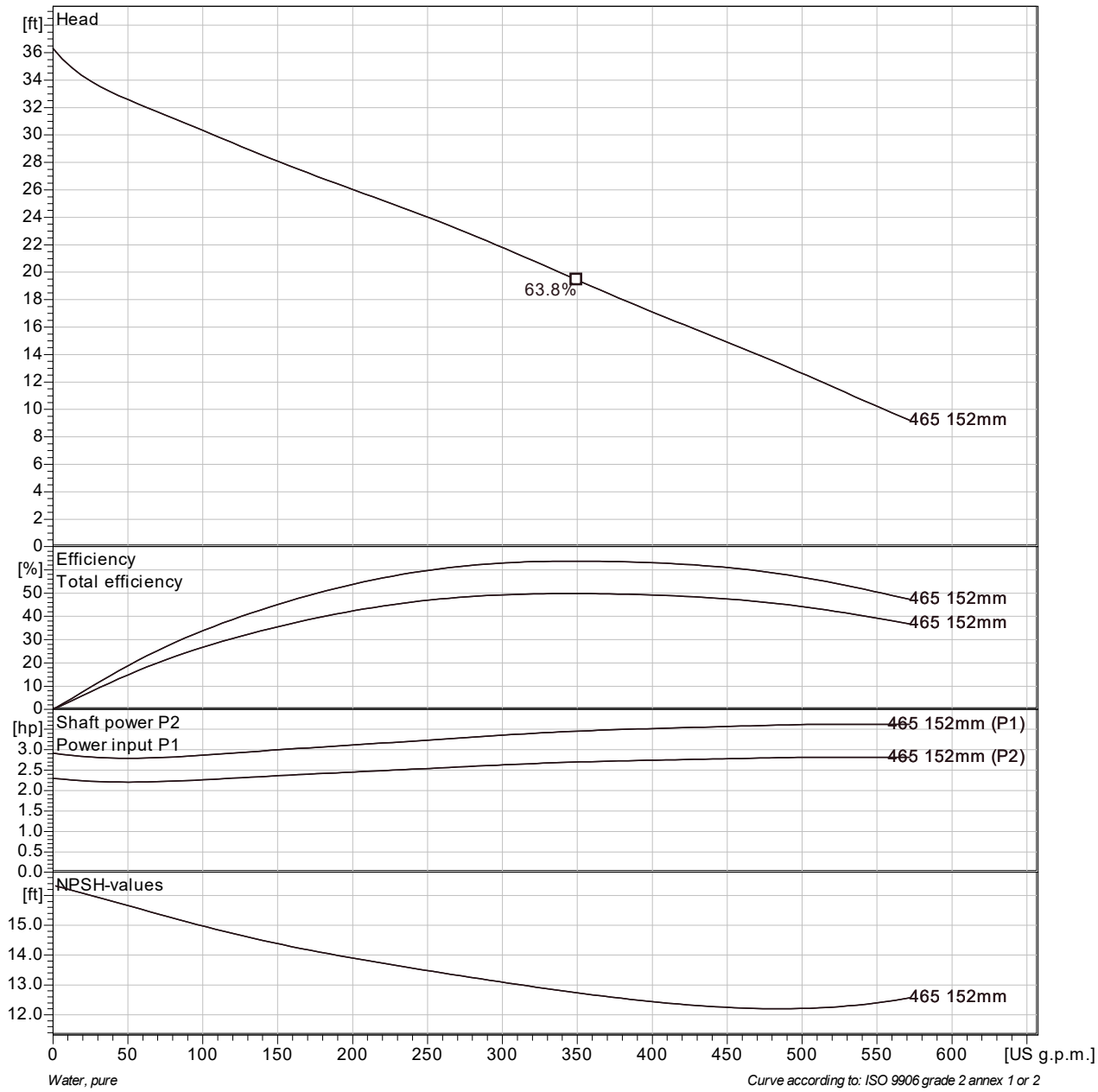
Pump

Discharge Flange Diameter	3 1/8 inch
Suction Flange Diameter	80 mm
Impeller diameter	6"
Number of blades	2

Motor

Motor #	N3085.183 15-10-4AL-W 3hp
Stator variant	68
Frequency	60 Hz
Rated voltage	200 V
Number of poles	4
Phases	3~
Rated power	3 hp
Rated current	9.9 A
Starting current	50 A
Rated speed	1690 rpm

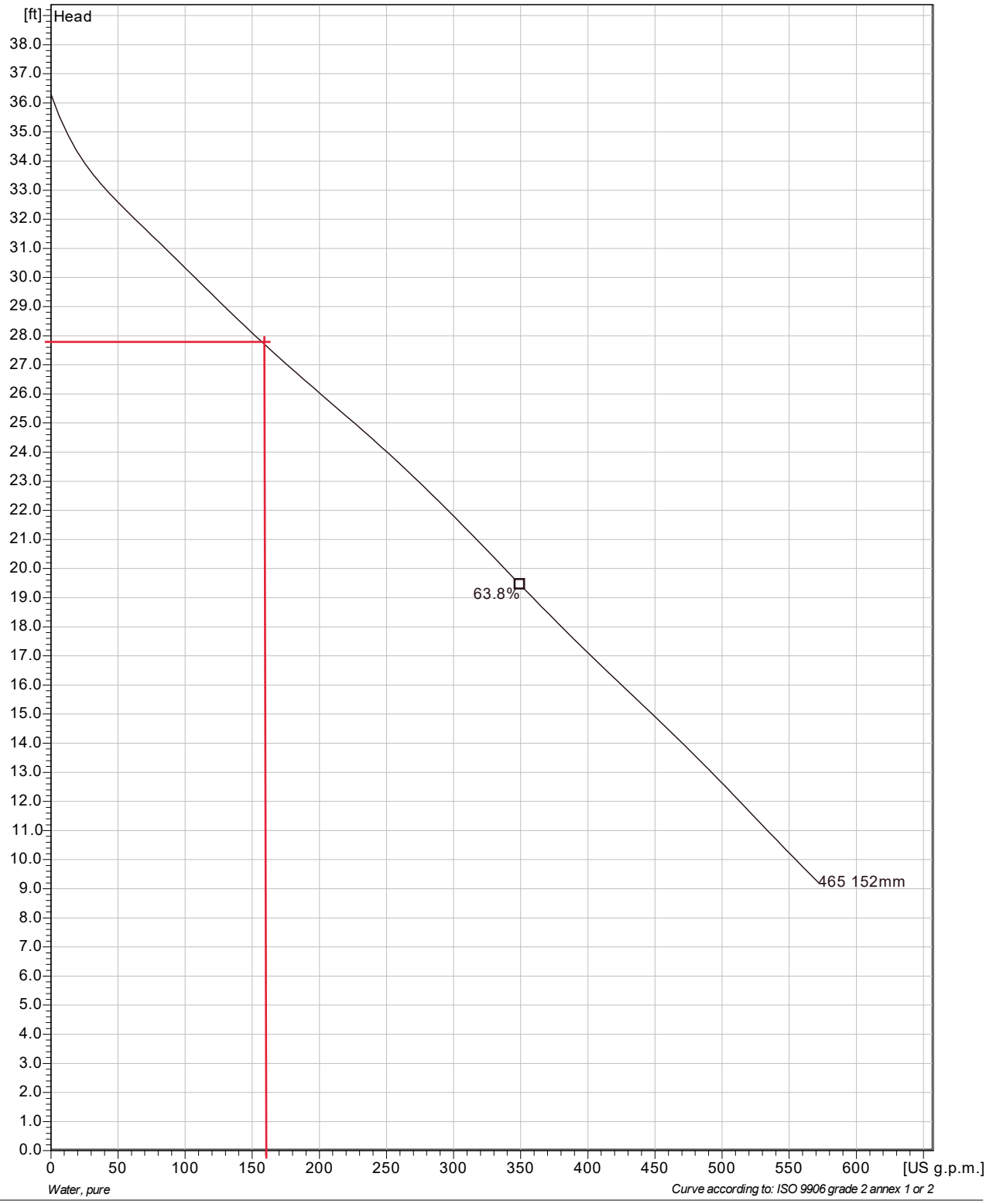
Power factor	
1/1 Load	0.85
3/4 Load	0.80
1/2 Load	0.70
Efficiency	
1/1 Load	77.0 %
3/4 Load	79.0 %
1/2 Load	78.0 %



Project	Project ID	Created by	Created on	Last update
			2015-04-30	

NP 3085 MT 3~ 465

Duty Analysis



Project	Project ID	Created by	Created on	Last update
			2015-04-30	

Table B-6. Recommended Energy Loss Coefficients, K, for Flanged Pipe Fittings[a]

Fitting	K
Entrance	
Bellmouth	0.05
Rounded	0.25
Sharp-edged	0.5
Projecting	0.8
Exits	
All of the above	1.0
Bends, mitered	
$\theta = 15°$	0.05
$\theta = 22.5°$	0.075
$\theta = 30°$	0.10
$\theta = 45°$	0.20
$\theta = 60°$	0.35
$\theta = 90°$	0.80
90° bend $3 \times 30° = 90°$ $4 \times 22.5° = 90°$	0.30
Forged or cast fittings	
90° elbow, standard	0.25
90° elbow long radius	0.18
45° elbow	0.18
Forged or cast fittings	
Return bend, $r = 1.4$ D	0.40
Tee, line flow	0.30
Tee, branch flow	0.75
Cross, line flow	0.50
Cross, branch flow	0.75
Wye, 45°	0.50
Increasers	
Conical	$h = K\left[1 - \left(\frac{D_1}{D_2}\right)^2\right] v_2^2/2g$ $K = 3.5(\tan\theta)^{1.22}$
Conical (approximate)	$h = 0.25\left(v_1^2 - v_2^2\right)/2g$
Sudden	$h = \frac{v_1^2 - v_2^2}{2g} = \left[\left(\frac{A_2}{A_1}\right)^2 - 1\right]\frac{v_2^2}{2g}$
Reducers	
Conical	$h = K v_2^2/2g$ $K = 0.03 \pm 0.01$
Sudden	$h = \frac{1}{2}\left[1 - \left(\frac{D_2}{D_1}\right)^2\right] v_2^2/2g$

[a] $h = Kv^2/2g$, where v is the maximum velocity in nonprismatic fittings. Increase K by 5% for each 25-mm (1-in.) decrement in pipe smaller than 300 mm (12 in.). Expect K values to vary from –20 to +30% or more.

Table B-7. Recommended Energy Loss Coefficient Valves Fully Open[a,b,c]

Valve type	K
Angle	1.8–2.9
Ball	0.04
Butterfly	
25-lb Class	0.16
75-lb Class	0.27
150-lb Class	0.35
Check valves	
Ball	0.9–1.7 but see Mfr's data for specific size and flowrate.
Center-guided globe style	2.6
Double door	
8 in. or smaller	2.5
10 to 16 in.	1.2
Foot	
Hinged disc	1–1.4
Poppet	5–14
Rubber flapper	
$v < 6$ ft/s	2.0
$v > 6$ ft/s	1.1
Slanting disc[d]	0.25–2.0
Swing[d]	0.6–2.2, but see Figures B-2 and B-3.
Cone	0.04
Diaphragm or pinch	0.2–0.75
Gate	
Double disc	0.1–0.2
Resilient seat	0.3
Globe	4.0–6.0
Knife gate	
Metal seat	0.2
Resilient seat	0.3
Plug	
Lubricated	0.5–1.0
Eccentric	
Rectangular (80%) opening	1.0
Full bore opening	0.5

[a] $h = Kv^2/2g$, where v is the velocity in the approach piping.

[b] For 300-mm (12-in.) valves and velocities of about 2 m/s (6 ft/s). Note that K may increase significantly for smaller valves. Consult the manufacturer.

[c] Expect K to vary from –20 to +50% or more.

[d] Depending on adjustment of closure mechanism, velocity may have to exceed 4 m/s (12 ft/s) to open the valve fully. Adjustment is crucial to prevent valve slam.

Worksheet for 8" Sewer Main

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00330	ft/ft
Normal Depth	0.67	ft
Diameter	8.00	in
Discharge	311.55	gal/min

Results

Discharge	311.55	gal/min
Normal Depth	0.67	ft
Flow Area	0.35	ft²
Wetted Perimeter	2.09	ft
Hydraulic Radius	0.17	ft
Top Width	0.00	ft
Critical Depth	0.39	ft
Percent Full	100.0	%
Critical Slope	0.00771	ft/ft
Velocity	1.99	ft/s
Velocity Head	0.06	ft
Specific Energy	0.73	ft
Froude Number	0.00	
Maximum Discharge	0.75	ft³/s
Discharge Full	0.69	ft³/s
Slope Full	0.00330	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

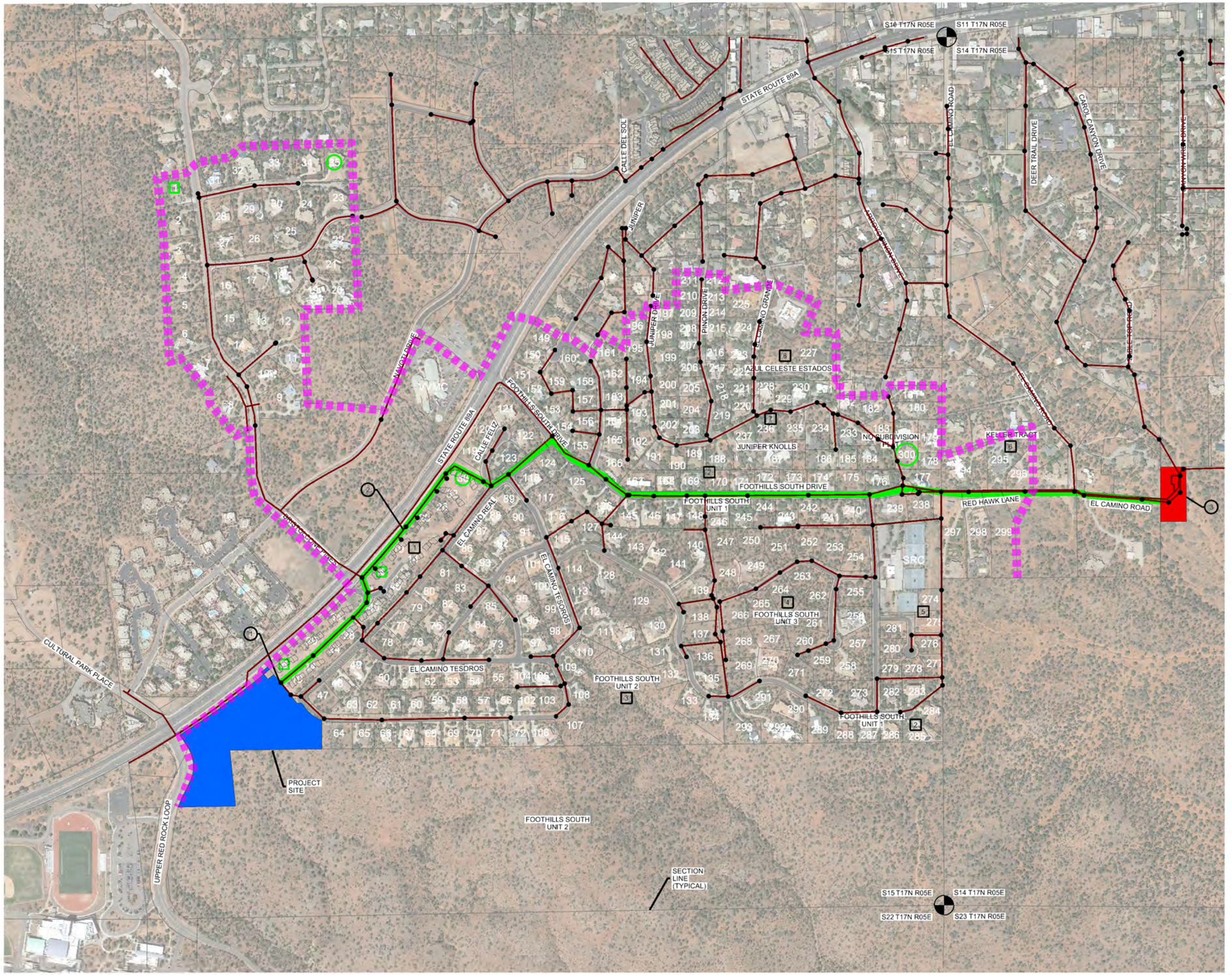
Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 8" Sewer Main

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.39	ft
Channel Slope	0.00330	ft/ft
Critical Slope	0.00771	ft/ft

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF



NORTH

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY
0 1"

0 300 600

DRAWING SCALE
1 inch = 300 Feet
(This scale is valid for 22"x34" sheets only)

DESIGN KDH
DRAWN KDH
CHECKED
APPROVED

SEWER BASIN CONTRIBUTING TO THE EXISTING 8" GRAVITY COLLECTION SYSTEM

SEWER FLOW NOTES

1. COURTYARD AT MARRIOTT PROJECT SITE DISCHARGE POINT LOCATION INTO EXISTING GRAVITY SYSTEM DESIGN FLOW FROM PROPOSED ON-SITE LIFT STATION = 66 GMP.
2. EXISTING 6,400 LF CITY OF SEDONA GRAVITY WASTEWATER COLLECTION SYSTEM FROM PROJECT SITE TO EXISTING EL CAMINO PUMP STATION
3. EXISTING CITY OF SEDONA EL CAMINO PUMP STATION AT 700 EL CAMINO ROAD

SUBDIVISIONS

1. PARK PLACE CONDOMINIUM PLATTED 2005
2. FOOTHILLS SOUTH UNIT 1 PLATTED 1974
3. FOOTHILLS SOUTH UNIT 2 PLATTED 1982
4. FOOTHILLS SOUTH UNIT 3 PLATTED 2003
5. FOOTHILLS SOUTH UNIT 4 PLATTED 2005
6. KELLER TRACT PLATTED 1965
7. JUNIPER KNOLLS PLATTED 1960
8. AZUL CELESTE ESTADOS PLATTED 1970

EXHIBIT USE ONLY
NOT FOR CONSTRUCTION

LYON ENGINEERING
Civil Engineers • Land Surveyors
1650 Willow Creek Rd Prescott, AZ 86301
Phone: (928) 776-1756, Fax: (928) 776-0605

NO. | DATE | REVISION | APP'D

COURTYARD AT MARRIOTT
SEDONA, ARIZONA

CIVIL

DOWNSTREAM SEWER REACH MAP

DATE
JANUARY 2015
LYON PROJECT #
1000-02
DRAWING NUMBER
EXHIBIT
SHEET 1 OF 1

FILENAME: G:\Projects\1000_Sunridge\1000-02_Sedona Marriot Design\CADD\DGN\Maps&Exhibits\Marriott Exhibits.dgn

SCALE: 1:300

LYON ENGINEERING
Civil Engineers • Land Surveyors

January 6, 2017

City of Sedona
Public Works Department
102 Roadrunner Drive
Sedona, AZ 86336
928-204-7127

Attn: Andy Dickey

Re: Preliminary Marriott Residence Inn Water Analysis

This water report is to determine the proposed flow to the Marriott Residence Inn project. This project is located on the southeast corner of State Route 89A and Upper Red Rock Loop Road in west Sedona. The proposed site includes a hotel, pool, small restaurant, and parking lot. Hotel unit count for the existing Courtyard by Marriott is 121; unit count for the proposed Residence Inn is 92. The ratio for hotel water demand is anticipated to be 92/121 = 0.76. The Courtyard by Marriott final design flows determined by the mechanical engineer were significantly higher than the preliminary ADEQ usage calculations.

The peak flow based on the fixture count for the Courtyard by Marriot was 140 gpm; utilizing the 0.76 ratio, Residence Inn peak flow is 106.40 gpm. Swimming pool usage was estimated at 338,000 gallons per year by the pool designer. Landscaping usage was estimated at 4,500 gallons per week by the landscape designer. The water report for the final design will be based off of the mechanical engineer's plumbing calculations based on actual fixture counts. A peaking factor of 2.5 is used based on the July 21, 2000 City of Sedona Wastewater Master Plan Update by Wilson & Company. Flow calculations are shown in Table 1.

Table 1: Flow Calculations from Courtyard by Marriott (incorporating the 0.76 ratio for hotel demand)

	Average Day (gpd)	Average Day (gpm)	Peaking Factor	Peak (gpd)	Peak (gpm)
Hotel	61,286	42.56	2.5	153,216	106.40
Swimming Pool	926	0.64	2.5	2,315	1.60
Landscaping	650	0.45	2.5	1,625	1.13
Total	62,862	43.65	2.5	157,156	109.13

The total of 43.65 gpm will be provided through a commercial water meter which will be sized in final design. The meter size will be specified by the mechanical engineer for this building based on the total demand and head loss calculations. Lyon Engineering will not size the water meter. It is anticipated that the site will use an approximate average of 62,862 gpd, based on the calculations in Table 1. There will also be a fire line to the building. The water service and fire lines will be connected to the existing water distribution mains and extended within the site.

Two water line tests were performed by Arizona Water Company on the hydrants that were closest to the proposed site. The first fire hydrant (FH329) is located on the northwest corner of Hwy 89A and Cultural Park Place, and the second fire hydrant (FH151) is located at the end of El Camino Real. The results of the water test are as follows:

FH151
Static Pressure: 64 psi
Residual Pressure: 46 psi
Flow: 780 gpm

FH329
Static Pressure: 76 psi
Residual Pressure: 65 psi
Flow: 780 gpm

WaterCAD software was used to update the Marriott water system model. The reservoir was connected to the two existing 12" water mains with a 12" water main with a length of 15,849 lineal feet. This pipe (P-10) simulates

the pressure drop within the water system based on the test of FH329 (11 psi drop at 780 gpm). The reservoir elevation was set at 4,478.00 (existing ground) + (76 psi * 2.31 ft/psi) = 4,653.56.

The analysis of the proposed water distribution system is attached. This analysis is used to determine the capacity of the existing water distribution system and onsite main size to deliver the required fire flow.

Due to limitations in the existing water system, a maximum of 1,600 gpm is available for the site fire flow. Using a Building Type of V-A and a square footage of 71,314, the 2003 IFC requires 4,750 gpm for 4 hours without a sprinkler system. When a sprinkler system is proposed, a 50% reduction in required fire flow is allowed; this reduces the requirement to 2,375 gpm. For the Courtyard by Marriott project (which required 2,500 gpm with the 50% reduction), former Sedona Fire District Marshal Gary Johnson granted an exception that a fire flow of 1,600 gpm for a 2-hour duration is acceptable if there are three fire hydrants surrounding the building, the building is sprinkled, and fire walls are utilized. See the appendix for email documentation and final water agreement form.

The final fire flow requirements are assumed to be determined by the Sedona Fire District. Based on the hotel having fire sprinklers, the requested allowable fire flow is 1,600 gpm for a two-hour duration, with a minimum of three fire hydrants on site, consistent with the adjacent Courtyard by Marriott project. A proposed 8" water main will be connected to the existing 12" water main within Highway 89A.

Based on the results of the water model, the existing water distribution system is capable of delivering 1,620 gpm (during average day demand) from all three proposed fire hydrants. The system is also capable of delivering 43.65 gpm average day flow, 109.13 gpm peak flow, and a fire flow residual pressure above 20 psi. The proposed building will be constructed with two-hour fire walls per the Sedona Fire District.

All water shall be provided by:
Arizona Water Co.
65 Coffee Pot Drive, Ste. 7
Sedona, AZ 86336
928-282-5555

Respectfully submitted,

Scott A. Lyon, P.E., R.L.S.
Vice President

APPENDIX A

AVERAGE DAY DEMAND

FlexTable: Junction Table (Marriott.wtg)

Current Time: 0.000 hours

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)	Zone	Demand (Target) (gpm)
J-1	4,479.00	4,652.99	75.3	0	<None>	0
J-2	4,477.76	4,652.99	75.8	0	<None>	0
J-3	4,476.00	4,652.99	76.6	0	<None>	0
J-4	4,482.00	4,652.99	74.0	0	<None>	0
J-7	4,480.07	4,652.99	74.8	0	<None>	0
J-8	4,484.00	4,652.98	73.1	0	<None>	0
J-9	4,483.39	4,652.97	73.4	0	<None>	0
J-10	4,484.00	4,652.97	73.1	0	<None>	0
J-11	4,483.00	4,652.94	73.5	57	<None>	57
J-44	4,490.00	4,652.98	70.5	0	<None>	0
J-45	4,490.00	4,652.97	70.5	0	<None>	0
J-46	4,490.00	4,652.96	70.5	43	<None>	43

FlexTable: Pipe Table (Marriott.wtg)

Current Time: 0.000 hours

Label	Length (ft)	Diameter (in)	Hazen-Williams C	Headloss (ft)	Flow (gpm)	Velocity (ft/s)	Is Open?
P-2	174	12.0	130.0	0.00	0	0.00	True
P-3	246	12.0	130.0	0.00	0	0.00	True
P-4	392	12.0	130.0	0.01	-100	0.28	True
P-5	104	6.0	130.0	0.00	0	0.00	True
P-6	102	6.0	130.0	0.00	0	0.00	True
P-8	127	8.0	130.0	0.01	-57	0.36	True
P-9	76	6.0	130.0	0.03	-57	0.65	True
P-10	15,849	12.0	130.0	0.57	100	0.28	True
P-11	10	6.0	110.0	0.00	0	0.00	True
P-84	255	12.0	130.0	0.00	43	0.12	True
P-85	111	10.0	130.0	0.00	43	0.18	True
P-86	153	8.0	130.0	0.01	43	0.28	True

Fire Flow Node FlexTable: Fire Flow Report (Marriott.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Pressure (Calculated Zone Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Velocity of Maximum Pipe (ft/s)	Pipe w/ Maximum Velocity	Pressure (Calculated Residual @ Total Flow Needed) (psi)
J-1	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-2	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-3	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-4	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-7	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-8	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-9	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-10	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-11	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-44	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-45	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-46	2,500	1,620	20.0	23.0	J-45	10.34	P-86	-40.3

APPENDIX B

PEAK DEMAND

FlexTable: Junction Table (Marriott.wtg)

Current Time: 0.000 hours

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)	Zone	Demand (Target) (gpm)
J-1	4,479.00	4,650.51	74.2	0	<None>	0
J-2	4,477.76	4,650.51	74.7	0	<None>	0
J-3	4,476.00	4,650.51	75.5	0	<None>	0
J-4	4,482.00	4,650.51	72.9	0	<None>	0
J-7	4,480.07	4,650.51	73.7	0	<None>	0
J-8	4,484.00	4,650.44	72.0	0	<None>	0
J-9	4,483.39	4,650.38	72.2	0	<None>	0
J-10	4,484.00	4,650.38	72.0	0	<None>	0
J-11	4,483.00	4,650.23	72.4	140	<None>	140
J-44	4,490.00	4,650.43	69.4	0	<None>	0
J-45	4,490.00	4,650.41	69.4	0	<None>	0
J-46	4,490.00	4,650.37	69.4	109	<None>	109

FlexTable: Pipe Table (Marriott.wtg)

Current Time: 0.000 hours

Label	Length (ft)	Diameter (in)	Hazen-Williams C	Headloss (ft)	Flow (gpm)	Velocity (ft/s)	Is Open?
P-2	174	12.0	130.0	0.00	0	0.00	True
P-3	246	12.0	130.0	0.00	0	0.00	True
P-4	392	12.0	130.0	0.08	-249	0.70	True
P-5	104	6.0	130.0	0.00	0	0.00	True
P-6	102	6.0	130.0	0.00	0	0.00	True
P-8	127	8.0	130.0	0.06	-140	0.89	True
P-9	76	6.0	130.0	0.15	-140	1.59	True
P-10	15,849	12.0	130.0	3.05	249	0.70	True
P-11	10	6.0	110.0	0.00	0	0.00	True
P-84	255	12.0	130.0	0.01	109	0.31	True
P-85	111	10.0	130.0	0.01	109	0.44	True
P-86	153	8.0	130.0	0.05	109	0.69	True

Fire Flow Node FlexTable: Fire Flow Report (Marriott.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Pressure (Calculated Zone Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Velocity of Maximum Pipe (ft/s)	Pipe w/ Maximum Velocity	Pressure (Calculated Residual @ Total Flow Needed) (psi)
J-1	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-2	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-3	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-4	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-7	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-8	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-9	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-10	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-11	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-44	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-45	2,500	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
J-46	2,500	1,544	20.0	22.7	J-45	9.86	P-86	-46.5

APPENDIX C

FIRE FLOW RESULTS

From: Joe Whelan [mailto:jwhelan@azwater.com]
Sent: Wednesday, July 16, 2014 8:48 AM
To: 'khortoneng@gmail.com' <khortoneng@gmail.com>
Cc: John Snickers <jsnickers@azwater.com>
Subject: FW: Marriott Courtyard Letter of Serviceability Request - AZ Water

Kevin, we flowed the fire hydrant on the NW corner of Cultural Park Place and HWY 89A yesterday (7/15/14) and it had the following results:
Static pressure = 76
Kinetic pressure = 65
GPM = 780 GPM

Joseph Whelan
Engineering Development Coordinator
Arizona Water Company
3805 N. Black Canyon Hwy
Phoenix, AZ 85015
Phone: 602-240-6860
Fax: 602-240-6878
Email: jwhelan@azwater.com

APPENDIX D

2003 IFC EXCERPTS, EMAIL DOCUMENTATION, AND FINAL WATER AGREEMENT FORM

APPENDIX B

FIRE-FLOW REQUIREMENTS FOR BUILDINGS

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

SECTION B101
GENERAL

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

SECTION B102
DEFINITIONS

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

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

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

SECTION B103
MODIFICATIONS

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

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

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

SECTION B104
FIRE-FLOW CALCULATION AREA

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

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

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

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

SECTION B105
FIRE-FLOW REQUIREMENTS FOR BUILDINGS

B105.1 One- and two-family dwellings. The minimum fire-flow requirements for one- and two-family dwellings having a fire-flow calculation area which does not exceed 3,600 square feet (344.5 m^2) shall be 1,000 gallons per minute (3785.4 L/min). Fire flow and flow duration for dwellings having a fire-flow calculation area in excess of 3,600 square feet (344.5 m^2) shall not be less than that specified in Table B105.1.

Exception: A reduction in required fire flow of 50 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system.

B105.2 Buildings other than one- and two-family dwellings. The minimum fire flow and flow duration for buildings other than one- and two-family dwellings shall be as specified in Table B105.1.

Exception: A reduction in required fire flow of up to 50 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 of the *International Fire Code.* Where buildings are also of Type I or II construction and are a light-hazard occupancy as defined by NFPA 13, the reduction may be up to 75 percent. The resulting fire flow shall not be less than 1,500 gallons per minute (5678 l/min) for the prescribed duration as specified in Table B 105.1.

SECTION B106
REFERENCED STANDARDS

ICC	IBC	International Building Code	B104.2, Table B105.1
ICC	IFC	International Fire Code	B105.2
ICC	IUWIC	International Urban-Wildland Interface Code	B103.3
NFPA	1142	Standard on Water Supplies for Suburban and Rural Fire Fighting	B103.3

TABLE B105.1
MINIMUM REQUIRED FIRE FLOW AND FLOW DURATION FOR BUILDINGS[a]

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

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

a. The minimum required fire flow shall be allowed to be reduced by 25 percent for Group R.

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

c. Measured at 20 psi.

APPENDIX C
FIRE HYDRANT LOCATIONS AND DISTRIBUTION

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

SECTION C101
GENERAL

C101.1 Scope. Fire hydrants shall be provided in accordance with this appendix for the protection of buildings, or portions of buildings, hereafter constructed.

SECTION C102
LOCATION

C102.1 Fire hydrant locations. Fire hydrants shall be provided along required fire apparatus access roads and adjacent public streets.

SECTION C103
NUMBER OF FIRE HYDRANTS

C103.1 Fire hydrants available. The minimum number of fire hydrants available to a building shall not be less than that listed in Table C105.1. The number of fire hydrants available to a complex or subdivision shall not be less than that determined by spacing requirements listed in Table C105.1 when applied to fire apparatus access roads and perimeter public streets from which fire operations could be conducted.

SECTION C104
CONSIDERATION OF EXISTING FIRE HYDRANTS

C104.1 Existing fire hydrants. Existing fire hydrants on public streets are allowed to be considered as available. Existing fire hydrants on adjacent properties shall not be considered available unless fire apparatus access roads extend between properties and easements are established to prevent obstruction of such roads.

SECTION C105
DISTRIBUTION OF FIRE HYDRANTS

C105.1 Hydrant spacing. The average spacing between fire hydrants shall not exceed that listed in Table C105.1.

Exception: The fire chief is authorized to accept a deficiency of up to 10 percent where existing fire hydrants provide all or a portion of the required fire hydrant service.

Regardless of the average spacing, fire hydrants shall be located such that all points on streets and access roads adjacent to a building are within the distances listed in Table C105.1.

TABLE C105.1
NUMBER AND DISTRIBUTION OF FIRE HYDRANTS

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

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

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

b. Where streets are provided with median dividers which can be crossed by fire fighters pulling hose lines, or where arterial streets are provided with four or more traffic lanes and have a traffic count of more than 30,000 vehicles per day, hydrant spacing shall average 500 feet on each side of the street and be arranged on an alternating basis up to a fire-flow requirement of 7,000 gallons per minute and 400 feet for higher fire-flow requirements.

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

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

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

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

From: Gary Johnson
To: kevinhorton@lyonengineering.com
Subject: RE: Sedona Marriott Fire Flow Requirements
Date: Monday, April 13, 2015 10:40:42 AM
Attachments: image001.gif

Kevin,

After our phone discussion and reviewing the plans feel there are three options.

Option #1: Talking to AZ Water to determine what it would take to upgrade their water system to meet the required fire flow plus fire sprinkler system demand.

Option #3: Change the construction type from type V-A to Type IA or IB. Fire flow would be 1,500 GPM plus 200 for the fire sprinkler system for a total of 1,700 GPM.

Option #2: As per your email the maximum flow that the water system can supply the site is 1,600 GPM at 20 psi. The currently adopted fire code, the 2003 Edition of the International Fire Code, requires a fire flow of 2500 GPM plus 200 GPM for the fire sprinklers for a total of 2700 GPM. This includes a 50% reduction for fire sprinklers.

The 2012 edition of the International Fire code allows for a 75% in fire flow. Fire flow would be 1250 GPM. However the minimum allowable fire flow is 1500 GPM.

I will accept the available fire flow of 1600 GPM with the following:

1. The installation of three fire hydrants as originally proposed.
2. The building is separated by two 2-hour fire walls. I am open to the exact location. The intent is to break the building into three sections.
3. Confirm the design requirements for the NFPA 13 automatic fire sprinklers system. The preliminary requirement for the system is 200 GPM. Is this correct?
4. Documentation is provided supporting the fact that the maximum flow that the water system can supply the site is 1,600 GPM at 20 psi. You have evaluated other options, such as connecting to Foothills South subdivision. What options are available to upgrade AZ Water System to meet the 2700 GPM fire flow?

If you have any questions please feel free to call me. Feel free to use my cell.

Gary J. Johnson
District Fire Marshal
Sedona Fire District
(928) 204-8907
(928) 300-0686

From: Kevin Horton [mailto:khortoneng@gmail.com]
Sent: Thursday, April 09, 2015 4:40 PM
To: Gary Johnson

Cc: Scott Lyon; 'Joe Whelan'
Subject: Sedona Marriott Fire Flow Requirements

Gary,

We coordinated with AZ Water Company and refined the Sedona Marriott water model with their latest fire flow information. The maximum flow that the system can supply the site is 1,600 gmp while maintaining 20 psi residual in the system. Adding additional hydrants and/or looping the line will not increase the supply due to system limits between the site and the source. Please call to discuss our options at your convenience. Thank you.

Kevin D. Horton, P.E., CFM
Project Manager

1650 Willow Creek Road
Prescott, AZ 86301
Phone: (928) 776-1750
Fax: (928) 776-0605
www.lyonengineering.com

From: Gary Johnson [mailto:GJohnson@sedonafire.org]
Sent: Wednesday, April 08, 2015 9:53 AM
To: kevinhorton@lyonengineering.com
Subject: RE: Sedona Marriott Fire Flow Requirements

Kevin,

I would add the sprinkler required flow to the fire flow requirements for a total of 2700 GPM.

If this is going to present a problem please let me know. As we discussed I would need to know what is available. I assume the issue is with GPM not pressure?

Gary

From: Kevin Horton [mailto:khortoneng@gmail.com]
Sent: Wednesday, April 08, 2015 9:38 AM
To: Gary Johnson
Cc: 'Paul Welker'; Rich Poynor; Scott Lyon
Subject: Sedona Marriott Fire Flow Requirements

Gary,

We are still unable to reach AZ Water Company personnel to further discuss the system capacity for the Sedona Marriott 2,500 gpm fire flow requirements, but did hear back from the sprinkler company (Complete Fire Protection). The proposed system is a "13", and will require a flow of at least 200 gpm. When we coordinate with the water company regarding fire flow capacity, is the 2,500 gpm requirement in addition to the 200 gpm sprinkler flow (2,700 gpm total), or is the sprinkler flow inclusive in the 2,500 gpm requirement (2,300 gpm from hydrants + 200 gpm from sprinklers)? I understand that the 2,500 gpm is already a "sprinkler reduction" but wanted to get your input on the intent of the code. Thanks.

Kevin D. Horton, P.E., CFM
Project Manager

1650 Willow Creek Road
Prescott, AZ 86301
Phone: (928) 776-1750
Fax: (928) 776-0605
www.lyonengineering.com

ARIZONA WATER COMPANY

E-6-1

DESIGN POLICY AND SYSTEM PLANNING CRITERIA FOR WATER DISTRIBUTION SYSTEMS

The following guidelines will be used for main extensions or new subdivisions (the "additions(s)") that will be connected to and served from Arizona Water Company's existing water distribution systems:

A. Whenever possible, water mains shall be looped or of circulating configuration.

B. The proposed additions shall be designed, and constructed, to maintain a minimum pressure of 20 p.s.i. at all points in the existing water distribution system and the addition under normal conditions of flow whenever possible and practical.

C. The water distribution system design shall satisfy both of the following design criteria:

1. The water distribution system design for the new addition shall use the peak domestic demand[1] of the system expressed in gallons per minute. For the purpose of the water distribution system design and analysis, the peak domestic demand shall be distributed evenly throughout the water system, unless more accurate information is available concerning the actual distribution of water system demand.

2. When the proposed addition is to serve fire flows from the existing distribution system, the water system design will use system demands computed by adding the minimum required fire flows expressed in gallons per minute to the average peak domestic demand[2] of the system expressed in gallons per minute. For the purpose of water distribution design and analysis one fire hydrant will be designed to flow the minimum fire flow requirement within the addition. The analysis will also place the average peak domestic demand distributed evenly throughout the water system, unless more accurate information is available concerning the actual domestic demand distribution.

D. The required fire flows and fire flow duration relating to any new addition will be specified by the local fire authority and reported to Arizona Water Company (the "Company") on the Company's Form E-3-5 prior to final design and Company approval of the addition.

E. Water storage shall be designed to meet peak domestic demands and fire protection where possible and practical. The water storage design shall be based upon a 24-hour system study, with peak domestic demands and fire flow storage requirements, with the assumption that the largest source of supply is removed from the analysis.

---

[1]Definition—peak domestic demand: This number shall be calculated using available water system peak production records. The peak demand shall be calculated by multiplying the peak daily production by 2.0. The peak per customer demand shall be calculated by dividing the peak demand by the current customer count and expressed as gallons per minute per customer. Where maximum daily production numbers are not available, the peak domestic demand shall be the peak domestic demand as indicated by ADEQ Engineering Bulletin No. 10.

[2]Definition—average peak domestic demand: The number shall be calculated by multiplying the peak domestic demand by 0.30 and expressed as gallons per minute per customer.

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

TO: ARIZONA WATER COMPANY

FROM:

SUBJECT: Installation of Public Fire Hydrant(s)

The undersigned Arizona public fire protection agency (the "Agency") hereby accepts the location of the public fire hydrant(s) noted below. The Agency agrees to comply with all terms, conditions and special provisions of Arizona Water Company's Public Fire Hydrant Service Tariff, No. FH-241, as now in effect or hereafter amended. The Agency understands and agrees that its failure to comply with all terms, conditions and special provisions of Tariff No. FH-241 may result in termination of fire hydrant service by Arizona Water Company and removal of the hydrant(s).

TO BE LOCATED AT

1) South side of eastbound SR89A approximately 330' east of Upper Red Rock Loop Road
2) East side of Upper Red Rock Loop Road approximately 160' south of SR89A
3) East side of Upper Red Rock Loop Road approximately 400' south of SR89A

(Public Fire Protection Agency)

By Gary Johnson

Title Fire Marshal/PIO, Sedona Fire District

Date 4/20/2015

2860 Southwest Drive
(Mailing Address)
Sedona, AZ 86336
(City and State)

ARIZONA WATER COMPANY

3805 N. BLACK CANYON HIGHWAY, PHOENIX, ARIZONA 85015-5351 • P.O. BOX 29006, PHOENIX, AZ 85038-9006
PHONE: (602) 240-6860 • FAX: (602) 240-6874 • TOLL FREE: (800) 533-6023 • www.azwater.com

March 24, 2015

Mr. Paul Welker
Sedona Hospitality Group, LLC
7255 E. Hampton Avenue, Suite 122
Mesa, AZ 85209

Re: Preliminary Water Plan for Sedona Courtyard by Marriott

Dear Mr. Welker:

Enclosed is a copy of your Preliminary Water Plan and water report for Sedona Courtyard by Marriott located in Sedona, with the required changes and comments of Arizona Water Company (the "Company") shown in red.

Please use this letter to guide you in your preparation of the Formal Water Plan. When the plan is completed, please send us the following:

- Two copies of the formal water plans.
- Drawings indicating the location of all other utilities (gas, electric, telephone, cable television, sewer, etc.) as well as paving and profile.

We will then review your plans and, if everything meets with our approval, we will sign the mylar/vellum cover sheet or the original and return it to you for submittal to the plan review section of the appropriate state and/or county health department with a signed *ADEQ Drinking Water Service Agreement.*

The following items should be understood by the developer:

a. The Formal Water Plan is to be prepared by the developer's consulting engineer following the Company's Design Policy and System Planning criteria (copy attached).

b. The plans and *Water Service Agreement* must **both** be approved and signed by the Company prior to submittal to the state and/or county health department.

c. The Company will not participate in the cost of any facilities required for extending service to a new project.

d. Any reports to the Arizona Department of Water Resources ("ADWR"), Real Estate Department, etc., are the responsibility of the developer and/or his agent.

e. Prior to bidding, roads must be prepared to rough grade and waterline locations surveyed and staked by the developer so that the actual waterline locations correspond with the water plan.

f. The funds for the water system addition including any off-site improvements that may be required will be advanced by the developer prior to construction. **The bidding, contracting, installation and inspection will be performed by the Company**.

g. The developer must obtain a Certificate of Assured Water Supply for the project and furnish a copy of it to the Company before the Company will sign a contract for installation of the water system. If the project is located in an area outside an active management area established by the Arizona Groundwater Code, the developer must submit plans for the water supply for the project and demonstrate the adequacy thereof to the ADWR. The developer must submit a copy of the report received from the ADWR on the developer's plan.

h. The ADWR has adopted its Third Management Plan, which establishes mandatory conservation programs. These conservation programs require that all projects must report the size of "turf-related facilities" associated with the proposed project. ("Turf-related watering" means the application of water from any source to grow landscaping plants on the grounds of the turf-related facility and the use of water from any source to fill or refill any bodies of water, including lakes, ponds or lagoons that are an integral part of the landscaped area of a turf-related facility. Bodies of water used primarily for swimming purposes are not an integral part of the landscaped area of a turf-related facility.) Indicate in the space provided the total area of this proposed project that will be developed as "turf-related facilities".

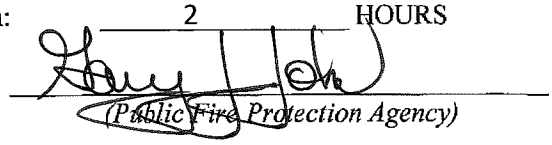
Total turf-related facilities: _____ acre(s)

All turf-related facilities ten (10) acres or larger in size must be metered separately pursuant to the provisions of the Third Management Plan.

Projected annual water usage: _____ acre feet (non-residential)

i. When the project involves fire hydrants, the legally recognized public fire protection agency that has the responsibility for fire protection will determine the number and location of the fire hydrants, the minimum required fire flow rate (gpm) and flow duration (hours). The fire protection authority must specify the required fire flow rate and duration.

1. Minimum required fire flow rate: 1,600 GPM
2. Minimum required fire flow duration: 2 HOURS



(Public Fire Protection Agency)

By: Gary Johnson

Title: Fire Marshal/PIO, Sedona Fire District

Date: 4/20/2015

j. The developer must specify, in writing, the date on which the Company will be required to put the project out to bid. Any requirements regarding time constraints, construction completion deadlines, etc., must be noted in the request to bid so that they may be specified in the bid documents. All necessary approvals from regulatory agencies having jurisdiction over project construction must be received prior to bidding. Please note that the estimated time required from the initial invitation to bid to the start of construction can be eight (8) weeks, or longer. This time is dependent on, but not limited to, material procurement, highway permits, contractor mobilization, etc. An option is available to the developer to make payment for materials in advance of construction. If the developer desires to add qualified contractors to the Company's bid list for obtaining labor bids for the project, the developer must so inform the Company prior to the date the project is put out to bid and any such contractors must meet the due date of the bid.

k. If this project includes 2" or larger meters or private fire service taps, those services will begin to be billed for monthly service charges immediately after installation. It is the responsibility of the developer or his agent to contact the local office to provide the information needed for monthly billing.

Please provide the information requested and sign this document where indicated, retain a copy, and return the original to the Company. **This project will not be approved until the Company receives this signed document.**

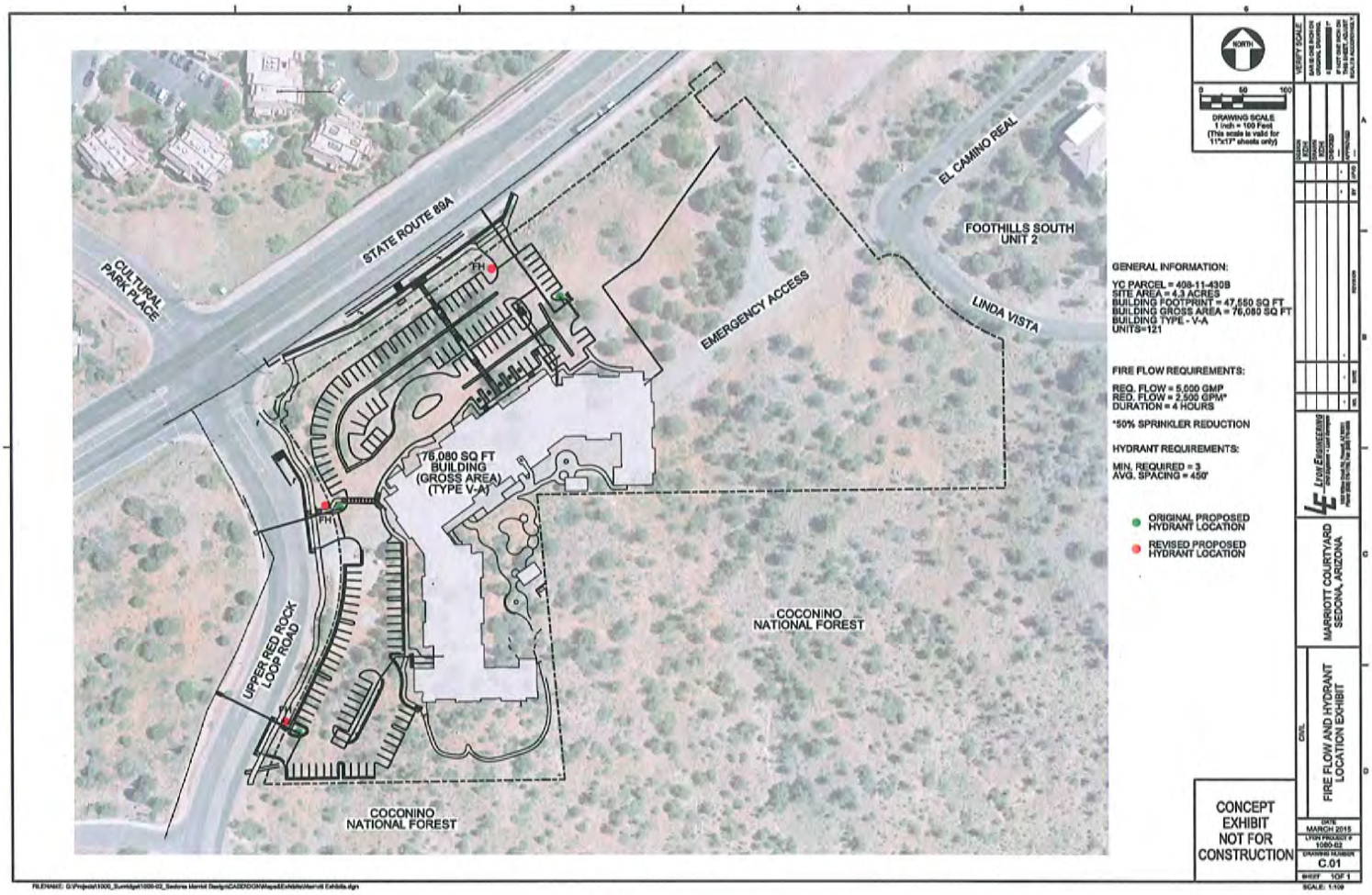
Very truly yours,

Joseph Whelan
Engineering Development Coordinator
engineering@azwater.com

afh
Enclosure

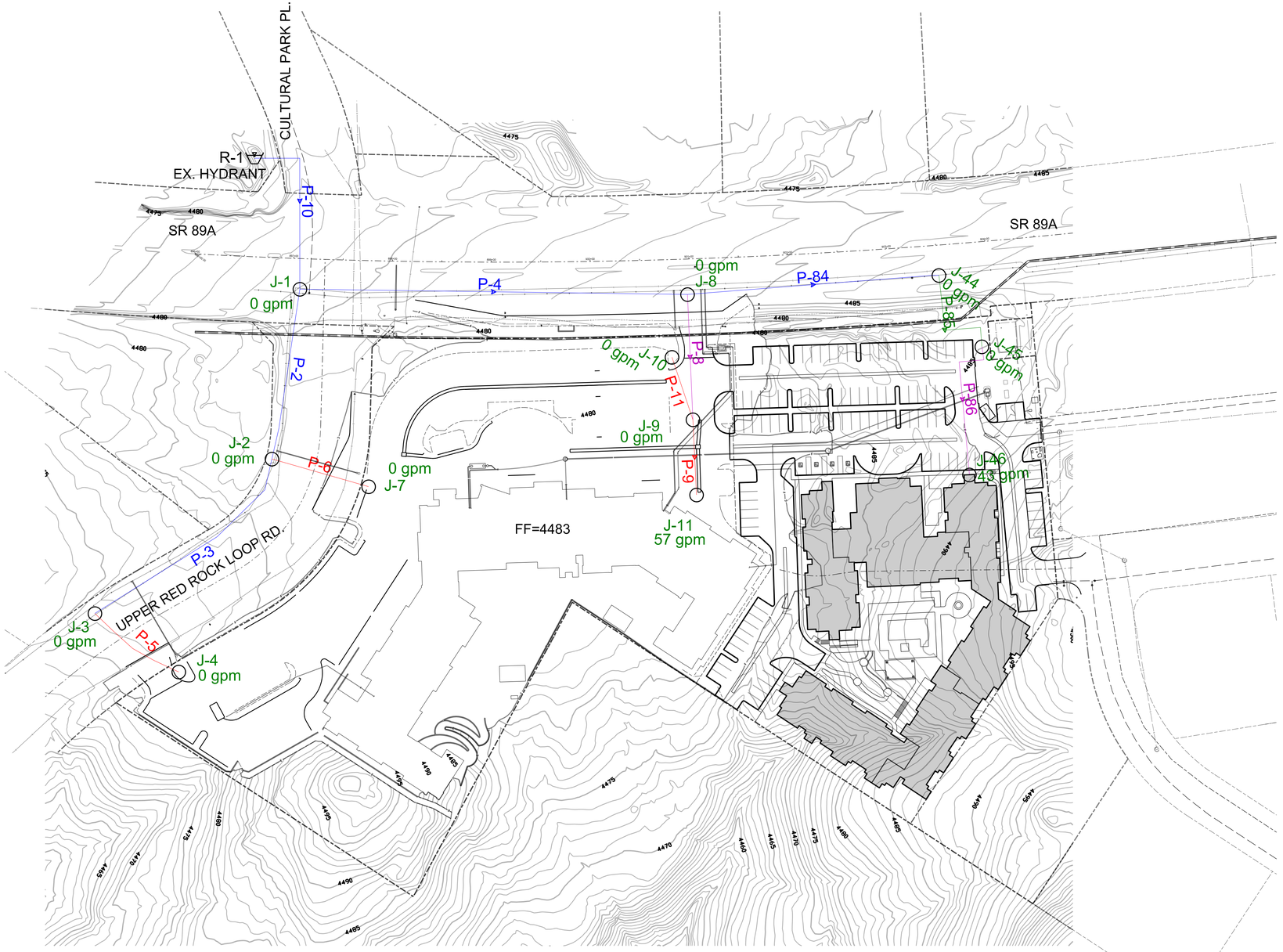
SEDONA HOSPITALITY GROUP, LLC
Developer
By: Paul Wells
Title: MAN / CEO
Date: 3/31/15

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF



WATER SYSTEM EXHIBITS

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF



NORTH

0 30 60
DRAWING SCALE
1 inch = 60 Feet, Horizontal
(This scale is valid for 22"x34" sheets only)

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"
IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY.

COLOR CODING LEGEND
PIPE: DIAMETER (in)

- <= 6.0
- <= 8.0
- <= 10.0
- <= 12.0
- <= 16.0
- <= Other

COLOR CODING LEGEND
JUNCTION: PRESSURE (psi)

- J-1 <= 39.0
- J-1 <= 80.0
- J-1 <= 100.0
- J-1 <= 130.0
- J-1 <= Other

NOTE:
SYSTEM PRESSURE OBTAINED FROM A FIRE HYDRANT FLOW PROVIDED BY THE ARIZONA WATER COMPANY.
FIRE HYDRANT IS AT THE NORTHWEST CORNER OF CULTURAL PARK PLACE AND SR-89A.
STATIC PRESSURE = 76 PSI
KINETIC PRESSURE = 65 PSI
GPM = 780 GPM

DESIGN SAL
DRAWN SAL
CHECKED BAB
APPROVED KDH

NO.	DATE	REVISION	BY	APVD
-	-		-	-

LYON ENGINEERING
Civil Engineers • Land Surveyors
1650 Willow Creek Rd, Prescott, AZ 86301
Phone: (928) 776-1750, Fax: (928) 776-0605

PRELIMINARY FIRE FLOW ANALYSIS

CIVIL

MARRIOTT RESIDENCE INN

EXHIBIT ONLY

DATE JANUARY 2017
LYON PROJECT # 1000-03
DRAWING NUMBER C.01
SHEET - OF -

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

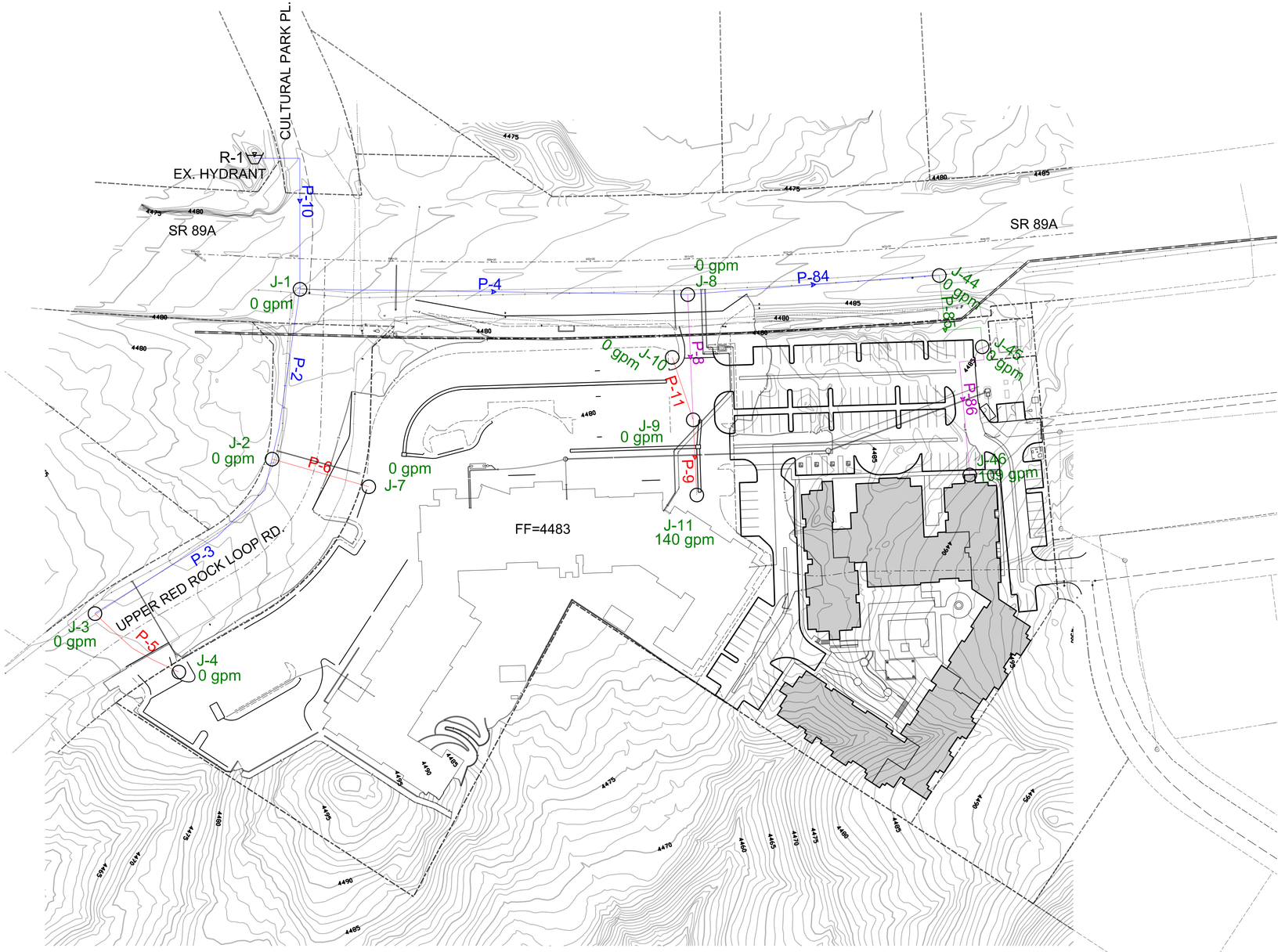


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EXHIBIT ONLY

DESIGN SAL
DRAWN SAL
CHECKED BAB
APPROVED KDH

NO.	DATE	REVISION	BY	APVD
-	-	-	-	-

LYON ENGINE RING
Civil Engineers • Land Surveyors
1650 Willow Creek Rd, Prescott, AZ 86301
Phone: (928) 776-1750, Fax: (928) 776-0605

PRELIMINARY FIRE FLOW ANALYSIS

CIVIL

MARRIOTT RESIDENCE INN

DATE
JANUARY 2017
LYON PROJECT #
1000-03
DRAWING NUMBER
C.01
SHEET - OF -

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

RESIDENCE INN BY MARRIOTT
SEDONA, ARIZONA
PRELIMINARY DRAINAGE REPORT

Registered Professional Engineer (Civil)
CERTIFICATE No.
47997
BRIAN A.
BUCHOLTZ
Date Signed 1/6/17
ARIZONA, U.S.A.
EXPIRES 6-30-17

Residence Inn Marriott

CITY OF SEDONA

LYON ENGINEERING
Civil Engineers • Land Surveyors

Drainage design by:
Brian A. Bucholtz, P.E., CFM

Prepared for:
Sunridge Properties
7255 E. Hampton Ave., Suite 122
Mesa, AZ 85209

Prepared by:
Lyon Engineering & Surveying, Inc.
1650 Willow Creek Road
Prescott, AZ 86301

Table of Contents

(Report follows the Yavapai County Drainage Criteria Manual format.)

List of Tables

List of Figures

SECTION 1. General Location and Description

1.1 Location

1.1.1 Owner/Developer Name

Sunridge Properties
7255 E. Hampton Ave., Suite 122
Mesa, AZ 85209

1.1.2 **Assessor's Parcel Number**(s)

APN 408-11-430B, Eastern portion of the property; The western portion of the property is the existing Courtyard by Marriott, designed by Lyon Engineering in 2015 and constructed in 2015/2016.

1.1.3 Township, Range, Section, and ¼ Section

Township 17 North, Range 5 East, Section 15, Southwest ¼

1.1.4 City, County, State Highway, and Local Streets within ¼ Mile (with ROW Widths)

Residence Inn by Marriott is located on the southeast corner of SR89A (147' ROW) and Upper Red Rock Loop Road (100' ROW). Other local residential streets within ¼ mile are Linda Vista (50' ROW), El Camino Real (60' ROW), Positano Place (No ROW), El Camino Tesoros (50' ROW), Calle Del Jefes (50' ROW), and Bristlecone Pines Road (65' ROW).

1.1.5 Major Drainageways, Facilities, and Easements

There is a major drainageway that begins on the east side of the property, near Linda Vista, and flows southwest through the property, then south on to National Forest land. The adjacent Courtyard by Marriott was designed by Lyon Engineering in 2015 and constructed in 2015/2016. This is located on the west portion of the property. Substantial drainage facilities are existing for this project. There are a few non-drainage-related facilities located on the property, such as a switching cabinet, air release valve, gas stub, blowoff, and electrical cabinet. There are a few non-drainage-related easements on the property, such as a temporary ingress/egress easement, temporary emergency access easement, utility easements, and a sewer line easement.

1.1.6 Surrounding Developments, Land Uses, and Identification of Present Zoning

The western portion of the subject property is the existing Courtyard by Marriott, zoned L (Lodging). The eastern portion of the subject property is currently vacant land. This portion is the proposed Residence Inn by Marriott, zoned L (Lodging) and OS (Open Space and Recreation). Park Place Condominium is located to the northeast, zoned RM-2 (High Density Multi-Family District – Maximum 12 Units/Acre). Foothills South Unit 2 is located to the east, zoned RS-18a (Single Family Residential – Minimum 18,000 ft^2). The land to the south of the subject property is Coconino National Forest.

1.2 Description of Property

Figure 1-1 General Location Map

1.2.1 Area in Acres

The subject property contains approximately 8.2 acres. The proposed Residence Inn encompasses approximately 2.7 acres.

1.2.2 Ground Cover (Types of Trees, Shrubs, Vegetation, General Soil Conditions, Topography, and Slope)

The subject property contains Juniper trees, various shrubs, and grasses. The vegetative cover is estimated at 10% from aerial imagery and site visit and photographs. Per the Report of Geotechnical Investigation for Courtyard by Marriott (attached), prepared by ACS Services LLC and dated July 10, 2014, the surface soils are generally classified as silty loam and sandy clay. The proposed site is generally flat, with a substantial drainageway on the south boundary.

1.2.3 All Drainageways and Floodplains

As mentioned in Section 1.1.5, there is a major drainageway on the east side of the property that flows to the southwest and south to the Coconino National Forest land. There are no other drainageways on the property. There are no FEMA or local floodplains on the site, and it is located completely within Flood Insurance Rate Map Zone X. Zone X is defined as an area outside the 500-year floodplain. See Section 2.1.1 and Figure 2-1.

1.2.4 Project Description

The proposed site is a Residence Inn by Marriott hotel, including a parking lot.

1.2.5 Irrigation Facilities

The adjacent Courtyard by Marriott was designed by Lyon Engineering in 2015 and constructed in 2015/2016. This is located on the west portion of the property. Substantial drainage facilities are existing for this project.

1.2.6 Proposed Land Use

The proposed land use is a hotel and parking lot.

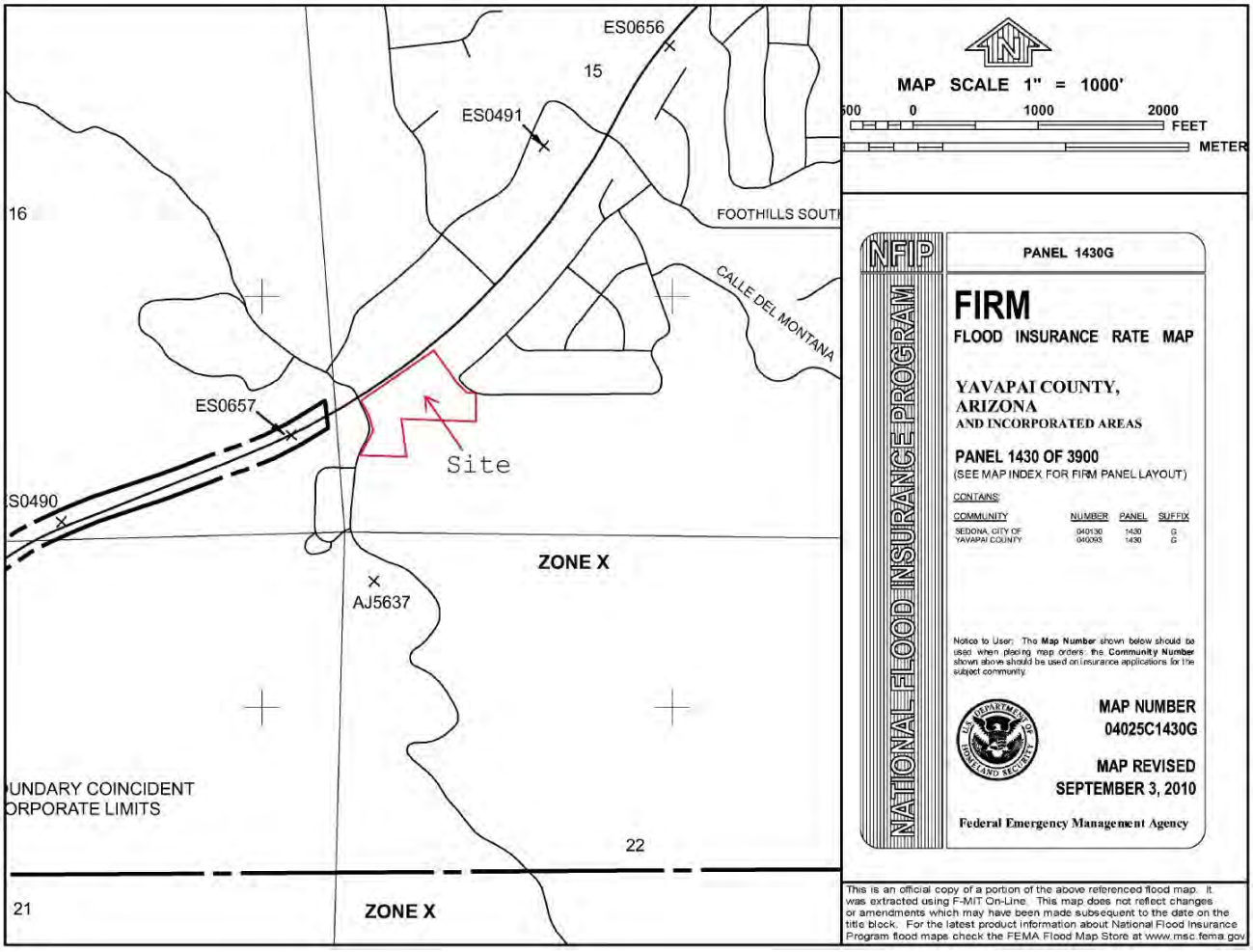
SECTION 2. Drainage Basins and Sub-Basins

2.1 Major Basin Description

2.1.1 Drainageway Planning Studies and FIRMs

There are no existing drainageway planning studies for the site. The subject property is located in Zone X on the FEMA FIRM Map 04025C1430G, dated 9/3/2010. See Figure 2-1.

Figure 2-1 Flood Insurance Rate Map(s)



2.1.2 Major Basin Drainage Characteristics, Existing and Planned Land Uses

The project has two existing drainage outlets from the site, and the pre-development basins were divided accordingly. The post-development basins will outlet the site at the same locations, with the addition of a portion (shown as post Basin 3A) being directed to existing drainage infrastructure in the central-western portion of the project. See Exhibits 1 and 2 for pre and post-development drainage plans. Each basin was studied in detail to determine the peak discharge. The existing land is vacant; the proposed land use is a Residence Inn by Marriott hotel and parking lot.

2.1.3 Irrigation Facilities which will Influence or be Influenced by the Local Drainage

The existing Courtyard by Marriott drainage infrastructure for Basin 1 was extended for a future development connection. The previous design of the storm drain system and catch basin assumed existing conditions and flows. The proposed site will include detention to mitigate the post-development flow to the existing conditions and flows for the 2, 10, 25, and 100-year events.

2.1.4 Soils Classification Map

The soils classification map and details can be found in the included Report of Geotechnical Investigation for Courtyard by Marriott. The soils are generally classified as silty loam and sandy clay. Refer to the Appendix for the soils report.

2.1.5 Detention Facilities

Detention is needed for this site for Basin 1 (outletting to the Courtyard by Marriott site) and Basin 2 (outletting south to forest service land). The pre vs. post discharge increase will be detained and released in a pre-development manner for the 2, 10, 25, and 100-year events. A portion of the site (shown as post Basin 3A) can be outlet to the existing drainage infrastructure in the central-western portion of the project without detention since this was accounted for in the Courtyard by Marriott drainage report and design. Refer to Exhibit 2: Post-Development Drainage Plan for details. Refer to Section 3.3.3 for specific detention details.

2.2 Sub-Basin Description

2.2.1 Historic Drainage Patterns of the Property

Historically, the site outlets to the north, west, and south via sheet and channel flow. These patterns are maintained in the proposed condition.

2.2.2 Off-Site Drainage Flow Patterns and the Impact on Development Under Existing and Fully Developed Basin Conditions, as Defined by the Planning Department

There is a small amount of offsite drainage entering the site from the east. See the included drainage exhibits for details. The intent for the design of the drainage for this project is to keep runoff in existing drainageways when exiting the project. Drainage entering the site from Park Place Condominium and Foothills South Unit 2 will not be redirected until it enters the subject property. There will be no impact to adjacent properties or projects.

SECTION 3. Drainage Design Criteria

3.1 Regulations

This report does not deviate from the Sedona City Code or the Sedona Land Development Code.

3.2 Development Criteria and Constraints

3.2.1 Previous Drainage Studies

The Courtyard by Marriott Drainage Report was completed by Lyon Engineering and dated March 16, 2015.

3.2.2 Existing Drainage Studies

There is an existing drainage report for the SR89A storm drain system titled “SR 89A – Dry Creek to Sedona Section Final Drainage Report” by Baker, dated February 8, 2000. This report includes the flows entering the storm drainage system from the Courtyard by Marriott and was used for the drainage design for the Courtyard by Marriott.

There is an existing drainage report for Park Place Condominium titled “Drainage Report for Park Place” by Shephard-Wesnitzer, Inc., dated 4/18/2005. This report includes detention design for the site and allows only the pre-development drainage to exit Park Place and enter the subject property.

No existing drainage report has been found for Foothills South Unit 2.

3.2.3 Site Constraints

The only site constraint is the existing culvert at the Basin 1 outlet. This culvert connects to the existing storm drain system for the Courtyard by Marriott. The post-development (after detention) flow outletting from Basin 1 must not exceed the original drainage design flow for the culvert. The proposed drainage is routed as it historically flowed.

3.3 Hydrologic Criteria and Results

3.3.1 Design Rainfall

Design rainfall was obtained from the Sedona City Code. Refer to the Appendix for the rainfall data.

3.3.2 Runoff Calculation Method

The Green & Ampt and Clark Unit Hydrograph methods were used to obtain the peak discharges and hydrographs of basins for design. The ADWR State Standard (SS) for Hydrologic Modeling Guidelines (SS10-07) was used as a guide to determine the peak discharge using these methods. XKSAT, DTHETA, PSIF, IA, time of concentration, and storage coefficients are obtained from tables, figures, and equations in Section 3.4. Per SS10-07 Section 3.4.3.5, time of concentration and storage coefficients are adjusted for the 2 and 10-year events by utilizing the Standard Manual for Drainage Design and Floodplain Management in Tucson Arizona. Pertinent pages showing the input variables are located in Appendix 7.3.

3.3.3 Detention Discharge/Volumes and Storage Calculation Method

Per City of Sedona Code, detention is required for this project for the 2, 10, 25, and 100-year events. Determined in previous discussions with City of Sedona staff, the proposed post-development flows must be no more than one (1) cfs greater than the pre-development flows at each outlet location. Per this criteria, Basins 1 and 2 require detention. Refer to Exhibit 2: Post-Development Drainage Plan for details. The required detention volumes are calculated within the HEC-HMS program for each storm event, in conjunction with the proposed outlet structure.

Detention volume, discharge, and outlet structure parameters and information is shown in Table 3-1. The proposed outlet structures are modeled in HEC-HMS and shown in Section 7.6.

Table 3-1 Detention Volume, Discharge, and Outlet Structure Parameters

	Basin 1	Basin 2
Storage Volume Proposed	555 LF of 48” Culvert	500 LF of 24” Culvert
2-Year Discharge Pre/Post (cfs)	0.04 / 0.27	0.12 / 0.82
10-Year Discharge Pre/Post (cfs)	2.54 / 2.71	8.86 / 8.96
25-Year Discharge Pre/Post (cfs)	7.95 / 7.37	25.99 / 24.20
100-Year Discharge Pre/Post (cfs)	12.50 / 12.33	40.53 / 36.76
Orifice Elevation(s)	3” Orifice @ IE 6” Orifice @ IE + 1.20’	3” Orifice @ IE
Weir Elevation(s)	3” Weir @ IE + 2.00’	12” Weir @ IE + 2.00’
Emergency Overflow Elevation	IE + 3.99’	IE + 4.47’
Basins Contributing to Detention	1A and 1B	2B, 2C, 2D, 2E, 2H, and 2I
Basins Bypassing Detention	1C	2A, 2F, 2G, 2J, and 2K

3.3.4 Design Storm Recurrence Intervals

Design storm recurrence intervals include the 2, 10, 25, and 100-year events. All drainage infrastructure is designed to pass the 100-year storm event.

3.3.5 Other Criteria or Calculations

All calculation methods are presented or referenced in the Sedona City Code or the Sedona Land Development Code.

3.3.6 Summary Tables of Watershed Areas and Peak Discharges

Table 3-2 Summary of Pre-Development Areas and Discharges

Basin Number	Area (sq mi)	2-Year Flow (cfs)	10-Year Flow (cfs)	25-Year Flow (cfs)	100-Year Flow (cfs)
1A	0.0014	0.02	0.95	2.80	4.34
1B	0.0037	0.03	1.70	5.37	8.47
2A	0.0037	0.09	4.53	11.71	17.58
2B	0.0037	0.04	2.41	7.19	11.17
2C	0.0049	0.06	3.37	9.96	15.47

Table 3-3 Summary of Post-Development Areas and Discharges

Basin Number	Area (sq mi)	2-Year Flow (cfs)	10-Year Flow (cfs)	25-Year Flow (cfs)	100-Year Flow (cfs)
1A	0.0011	0.91	2.47	4.29	5.79
1B	0.0008	1.02	2.37	3.82	5.13
1C	0.0037	0.03	1.71	5.40	8.52
2A	0.0004	0.01	0.33	0.93	1.43
2B	0.0004	0.65	1.28	2.01	2.71
2C	0.0001	0.16	0.32	0.50	0.68
2D	0.0006	0.15	0.82	1.85	2.67
2E	0.0003	0.45	0.90	1.46	1.96
2F	0.0004	0.55	1.13	1.83	2.46
2G	0.0002	0.06	0.31	0.67	0.96
2H	0.0003	0.46	0.97	1.52	2.05
2I	0.0002	0.27	0.61	0.98	1.32
2J	0.0037	0.04	2.41	7.19	11.17
2K	0.0049	0.06	3.37	9.96	15.47
3A	0.0002	Accounted for in Courtyard by Marriott Drainage Design.			

Table 3-4 100-Year Pre vs. Post Flow Summary Comparison

Basin Number	Pre Flow (cfs)	Post Flow (cfs) Without Detention or Routing	Post Flow (cfs) With Detention and Routing
1	12.50	19.44	12.33
2	40.53	42.88	36.76

3.4 Hydraulic Criteria

3.4.1 References/Methodologies

The final drainage report appendix for this project will include design points, located where peak discharges must be calculated, such as culverts, grate openings, channels, or detention areas. The final drainage report for this project will also have CulvertMaster and FlowMaster calculation worksheets in the Appendix.

3.4.2 Drainage Facility Design Criteria

All of the drainage facility criteria used in this design is presented within the Sedona City Code or the Sedona Land Development Code.

3.5 Variances from the Sedona City Code or the Sedona Land Development Code

3.5.1 Variances Requested

There are no variances requested for this project.

3.5.2 Justification

N/A

SECTION 4. Drainage Facility Design

4.1 General Concept

4.1.1 Existing Drainage Patterns

The proposed drainage will not alter the existing drainage patterns.

4.1.2 Off-Site Runoff Considerations

Offsite runoff considerations include drainage discharging onto the site from the Park Place Condominiums and Foothills South Unit 2. The drainage will enter the subject property in the same manner as it did historically.

4.1.3 Tables, Charts, Figures, and Exhibits

This report includes tables, charts, figures, and exhibits contained within the text and the appendices. Hydrologic and hydraulic worksheets are available for all calculations. See the appendices.

4.1.4 Proposed Drainage Improvements

The design strategy for this project was to route all drainage in historic drainageways in order to preserve the offsite runoff. Proposed drainage improvements include culverts, grate openings, channels, and detention pipes. The outlet culverts and detention outlet structure will release the flow in a pre-development, historic manner.

4.1.5 Stormwater Runoff Quality

Pollutants (oils, greases, solids, sediment, and debris) from the site will be captured and collected in parking lot grate inlets via the ADS FleXstorm Pure permanent inlet protection system to comply with City of Sedona Code and AZPDES requirements. Routine maintenance of the system will be required. Due to the installation of this system, the quality of the stormwater runoff is not expected to change when the site is completed. During construction and grading, erosion and sedimentation controls will be utilized, including bio-wattle and silt fence. These erosion mitigation strategies are illustrated in the construction plans.

4.2 Specific Details

4.2.1 Drainage Problems and Solutions

No drainage problems were encountered during this project.

4.2.2 Detention Storage and Outlet Design

Detention is required for the site. See Sections 2.1.5 and 3.3.3 for specific details.

4.2.3 Maintenance Access and Aspects

Maintenance access to all drainage structures will be provided during and after construction. All culverts will be maintained by the owner. All maintenance will be the responsibility of the owner. Lyon Engineering's recommended maintenance schedule includes inspections twice per year (spring and fall) and after every major storm event. A major storm event shall be defined as a 1-year or greater event, based on NOAA Atlas 14, as recorded at the nearest weather station to the site. Maintenance shall be required when sediment in the storm drain facilities (including the detention culverts and outlet vault) exceeds 1/8 of the pipe diameter.

4.2.4 Easements and Tracts

No drainage easements and/or drainage tracts will be needed for this project. All drainage maintenance will be the responsibility of the owner.

SECTION 5. Conclusions

5.1 Compliance with Standards

5.1.1 Compliance with the Sedona City Code and the Sedona Land Development Code

Drainage improvements were designed in compliance with the Sedona City Code and the Sedona Land Development Code.

5.2 Drainage Plan

5.2.1 Influence of Proposed Development on Existing Drainage Conditions

The impact the proposed development has on existing drainage conditions is negligible. The drainage was kept in the historic drainageways via detention and culverts.

5.2.2 Effectiveness of the Drainage Design to Control Storm Runoff Damage

The drainage design is effective in controlling damage from storm runoff by proposing erosion control strategies, both during construction and permanently.

SECTION 6. References

ACS Services LLC, Report of Geotechnical Investigation, Courtyard by Marriott, July 10, 2014, Mesa, AZ.

Arizona Department of Transportation, 2000 SR 89A – Dry Creek to Sedona Section Final Drainage Report, Contract No. 97-82, Baker. Phoenix, AZ.

Arizona Department of Water Resources, Flood Mitigation Section, State Standard for Hydrologic Modeling Guidelines, SS10-07, August 2007, Phoenix, AZ.

Park Place Sedona, L.L.C., 2005 Drainage Report for Park Place, Shephard-Wesnitzer, Inc., Sedona, AZ.

Sedona City Code. Online. Sedona, AZ.

Sedona Land Development Code. Online. Sedona, AZ.

Sunridge Properties, Mesa, AZ, 2015 Drainage Report for Courtyard by Marriott, Sedona, AZ, Lyon Engineering, & Surveying, Inc., Prescott, AZ.

SECTION 7. Appendices

7.1 Report of Geotechnical Investigation

7.2 Rainfall Data

7.3 Green & Ampt and Clark Unit Hydrograph Data

7.4 HEC-HMS Basin Schematic, Runoff Results, and Design Point Summary

7.5 Drainage Structures Calculation Worksheets (To Be Included In Final Drainage Report)

7.6 HEC-HMS Detention Volumes, Outlet Configurations, and Results

Section 7.1

Report of Geotechnical Investigation

ACS SERVICES LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION
DBE - SBE - WBE

REPORT OF GEOTECHNICAL INVESTIGATION

COURTYARD BY MARRIOTT

4105 WEST SR89A
SEDONA, ARIZONA
ACS PROJECT NO. 1401316

PREPARED FOR:

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WESTERN HORIZONS, INC.
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PREPARED BY:

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July 10, 2014

July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

ACS

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Appendices

ACS SERVICES LLC

July 10, 2014 Project 1401316

Mr. John White
WESTERN HORIZONS, INC.
7255 E. Hampton Avenue, Suite 122
Mesa, AZ 85209

RE: GEOTECHNICAL INVESTIGATION REPORT
COURTYARD BY MARRIOTT
4105 WEST SR89A
SEDONA, ARIZONA

Dear John:

Transmitted herewith is a copy of the final report of the subsurface soil and foundation investigation on the above-mentioned project. The services performed provide an evaluation at selected locations of the subsurface soil conditions throughout the zone of significant foundation influence. As an additional service, this firm may review the project plans and structural notes for conformance to the intent of this report.

This firm possesses the capability to provide testing and inspection services during the course of construction. Such quality control/assurance activities may include, but are not limited to, compaction testing as related to fill control, foundation inspection, and concrete sampling. Please notify this firm if a proposal for such services is desired.

Should any questions arise concerning the content of this report, please feel free to contact this office at your earliest convenience.

Respectfully submitted,

ACS SERVICES LLC

Registered Professional Engineer (Geological) CERTIFICATE NO. 14741 H. EUGENE HANSEN Date Signed 7/10/14 ARIZONA, U.S.A.

Expires 3/31/15

H. Eugene Hansen, P.E.
Geotechnical and Materials Testing Engineer

cc: (1) Addressee via email (pdf copy)

SCOPE

This report is submitted following a geotechnical investigation conducted by this firm for the proposed **COURTYARD BY MARRIOTT**, to be located at 4105 West SR89A, in Sedona, Arizona. The objectives of the investigation were to determine the physical characteristics of the soil and rock underlying the site and to provide final recommendations for safe and economical foundation design and slab support. For purposes of foundation design, the maximum column and wall loads have been assumed to be as summarized below.

	Maximum Column Load (KIPS)	Maximum Wall Load (KLF)
Shallow Spread Foundations	125	7.5

Anticipated structural loads in excess of those stated above will need to be addressed in an addendum, i.e. they are not covered under the scope of work involved with this effort. The recommendations for site grading contained in this report do not address the presence or removal of contaminants from the site soils.

FIELD INVESTIGATION

On June 24, 2014, this firm advanced five (5) exploratory test borings (6.25-inch hollow stem auger) for examination of the subsurface profile to depths ranging from 2 to 15.5 feet below the existing site grade in the building area. Three (3) borings were advanced to depths ranging from 2 to 8 feet below the existing site grade in the proposed pavement and buried retention tank areas. One (1) boring was advanced to a depth of 3 feet in the area of the proposed pool. All borings less than 15 feet in depth were terminated due to auger refusal in hard sandstone bedrock. The soils and rock encountered were examined, visually classified and wherever applicable, sampled. Refer to the Boring Logs in Appendix B for a detailed description of the subsurface soil and rock conditions at the specified locations. Refer to Figure 2 in Appendix A for the approximate locations of the borings.

LABORATORY TESTING

Representative samples obtained during the field investigation were subjected to the following laboratory analyses:

Test	Sample(s)	Purpose
Sieve Analysis and Atterberg Limits	Native subgrade soils (9)	Soil classification
Proctor	Native subgrade soils (1)	Moisture-Density Relationship
pH and Resistivity	Native subgrade soils (2)	Potential for metal corrosion
Sulfates and Chlorides	Native subgrade soils (2)	Potential for concrete corrosion

Refer to Appendix C of this report for the results of the laboratory testing.

SITE CONDITIONS

General Notes:

(1) Topographic relief	The site gently slopes to the south, but a raised area exists in the south portion of the site. Except for that area, the grade does not change that much in the building area.
(2) Fill	Approximately 3 feet of possible fill was encountered at the location of Boring 8. No other fill was encountered at the locations of the borings, but some fill may exist due to the existing paved access road that crosses the site.
(3) Evidence of surface disturbance	Some grubbing has been done on the surface of the site. An existing paved access road crosses the site from west to northeast in the area of the proposed building.
(4) Site use	The site is a vacant commercial lot along the southeast side of SR89A with Upper Red Rock Road forming the west boundary of the site. The site is covered with moderate vegetation consisting of Pinion and Juniper trees.

GEOLOGIC HAZARDS

The following list represents a general summary of the on-site soil characteristics relative to engineering applications:

Depth to groundwater	- None encountered
Potential for soil expansion	- Low based on the plasticity index data for the upper silty to clayey sand and gravel soils at the site
Potential for soil collapse	- Low based on the penetration blow counts for the red to pink sandstone bedrock below a loose to medium dense upper soil layer of varying thickness
Existence of loose soil at foundation bearing elevation	- Not probable
Potential for excessive differential soil movement	- Low
Potential for earth subsidence fissures	- Not applicable
Frost depth	- 1.0 feet for Sedona based on 2006 IBC
Presence of caliche, bedrock or other hard stratum	- Very dense, silty sand to gravel soils, consisting of weathered and fractured sandstone bedrock to hard sandstone bedrock was from 0 to 3 below the existing site grade at the location of the borings. Auger refusal was encountered at all borings except Boring 2 at depths ranging from 2 to 8 feet. Sandstone bedrock outcrops were noted on the surface of the site.

SEISMIC DESIGN CONSIDERATIONS

The project site is located within a municipality that employs the 2006 edition of the International Building Code. As part of this code, the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the earthquake event as well as the properties of the soils that underlie the site. As part of the procedure to evaluate seismic forces, the code requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile within the upper 100 feet of the ground surface. To define the Site Class for this project, we have interpreted the results of soil test borings drilled within the project site and estimated appropriate soil properties below the base of the borings to a depth of 100 feet as permitted by the code. The estimated soil properties were based upon our experience with subsurface conditions in the general site area.

Based upon our evaluation, the subsurface conditions within the site are consistent with the characteristics of a Site Class "B" as defined in Table 1613.5.2 of the building code. The associated USGS-IBC 2006/2009 probabilistic ground acceleration values and site coefficients for the general site area (Latitude 34.8500^{o}, Longitude -111.8275^{o}) were obtained from the USGS Design Maps Summary Report for the site which is attached in Appendix D.

UNDERGROUND STORM WATER RETENTION SYSTEM

An underground stormwater retention tank with associated storm drains and dry well disposal or metering into existing washes or storm drains may be utilized below the pavement areas. To determine pipe requirements, bulk samples were obtained over the depth range of 3-5 feet and 3-8 feet. These samples were tested for pH, resistivity, chloride and sulfate concentrations.

Soil Corrosion Potential – Metals

pH and Resistivity – Two pH and resistivity tests were conducted on samples of the soil and rock below a depth of 3 feet at the possible locations of buried stormwater retention tanks. The results of these tests are presented in Appendix C. Based on the laboratory results and the information presented in the following table, the site soils have a **moderate potential for corrosion** with respect to resistivity (2007-3177 ohms-cm) and low potential for corrosion with respect to pH (8.3-8.4).

Potential for Corrosion	Soil Resistivity (ohms-cm)	pH
Low	>10,000	6.5 – 9.5
Moderate	2,000 – 10,000	3.5 – 6.5 >9.5
High	<2,000	<3.5

The pH and resistivity measured for the subsurface soils was utilized to determine the minimum thickness for corrugated galvanized or aluminized steel pipe based in a required design life of 50 years. The pH and resistivity values determined by the laboratory testing were entered into the Chart for Estimating Average Service Life of Corrugated Galvanized and Aluminized Steel Pipe. To achieve a design life of 50 years, a minimum metal thickness of 0.52 inches (Gage 18) is required for the steel pipe of the retention tank. Depending upon the size and loading condition, a higher metal thickness for the pipe may be required.

Soil Corrosion Potential - Concrete

Soil sulfate concentration - The measured sulfate concentration in the soil (***refer to the Soil Analysis Report in Appendix C***) was 18 ppm for both samples. This is equivalent to a sulfate content in the soil (***percentage by weight - refer to the following table and the attached Sulfates and Chlorides Test Data)*** of 0.00186%. Although this suggests a negligible potential for sulfate attack due to the subsurface soils at the site, Type II cement is normally recommended to prevent potential sulfate attack over the long term. Type II cement should be used in the concrete for any pre-cast concrete utilized in the construction of the dry well. Refer to the following Table for the type of cement suitable for use in concrete exposed to sulfate in soils.

Table 2-2. Types of Cement Required for Concrete Exposed to Sulfate Attack

Sulfate exposure	Water-soluble sulfate (SO_4) in soil, percent by weight	Sulfate (SO_4) in water, ppm	Cement type
Negligible	0.00-0.10	0-150	—
Moderate*	0.10-0.20	150-1500	II, IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)
Severe	0.20-2.00	1500-10,000	V
Very severe	Over 2.00	Over 10,000	V plus pozzolan**

*Seawater.
**Pozzolan that has been determined by test or service record to improve sulfate resistance when used in concrete containing Type V cement.
Source: Adapted from Reference 2-20 and ACI 318, Table 4.5.3.

Soil Corrosion Potential – Reinforcing Steel

Soil chloride concentration - The measured chloride concentration in the soil (***refer to the Soil Analysis Report in Appendix C***) ranges from 12 to 35 ppm. To cause corrosion to reinforcing steel as a result of low concrete cover, a chloride concentration of over 10,000 ppm would be required. This suggests a negligible potential for corrosion of reinforcing steel due to chlorides in the soil. However, it is good practice to provide sufficient concrete cover over reinforcing

steel and lower water cement ratios for the reinforced concrete utilized in the construction of any facilities associated with the planned storm water retention tank.

RECOMMENDATIONS

The recommendations contained herein are based upon the properties of the surface and subsurface soils and rock as described by the field and laboratory testing, the results of which are presented and discussed in this report. Alternate recommendations may be possible and will be considered upon request.

Conventional Spread Foundations

It is recommended that all perimeter foundations and isolated exterior foundations be embedded a minimum of 1.5 feet below the lowest adjacent finish grade within 5.0 feet of proposed foundation walls. Interior footings should be founded a minimum of 1.5 feet below finish floor level. For all construction, 2.0 feet and 1.33 feet are recommended as the minimum width of spread and continuous footings, respectively.

The following tabulation may be used in the design of spread (column) and continuous (wall) foundations for the proposed structures. The column labeled Bearing stratum refers to the soil layer that the footing pad rests on, and does not imply that the foundation be fully embedded into that particular stratum.

Surface Level Foundations Bearing on Controlled Compacted Fill:

			Allowable Load	
Foundation Depth (ft)	**Bearing Stratum**	**Allowable Soil Bearing Pressure**	**Wall (KLF)**	**Column (KIP)**
1.5	0.5 feet of controlled compacted fill*	2500 PSF	7.5	125

***To achieve an allowable soil bearing pressure of 2500 PSF, conventional spread foundations must bear on a minimum of 0.5 feet of controlled compacted fill. To accommodate the required 0.5 feet of controlled compacted fill below foundations, it is recommended that overexcavation and recompaction of soils be accomplished to a minimum depth of 2.0 feet below finished pad grade. The controlled compacted fill should have a lateral extent of at least twice the fill thickness beyond the edges of wall or column footing pads. A minimum pad blow-up of 5 feet is recommended.**

Surface Level or Retaining Wall Foundations Bearing on Red to Pink Highly to Moderately Fractured and Weathered Sandstone Bedrock:

Foundation Depth (ft)	Bearing Stratum	Allowable Soil Bearing Pressure
1.5	Red to Pink Highly to Moderately Fractured and Weathered Sandstone Bedrock*	3000 PSF

*The presence of red to pink highly to moderately weathered and fractured sandstone bedrock at foundation bearing level must be verified by a representative of **ACS Services LLC** prior to placing foundation reinforcing steel to utilize an allowable soil bearing pressure of 3000 PSF. In cases where the red to pink highly to moderately fractured and weathered sandstone bedrock is encountered deeper than 1.5 feet, a mixture of 2-sack ABC/cement slurry may be utilized to occupy the lower portion of the foundation excavations, below a conventional foundation embedment depth of 1.5 feet.

Special Note: Foundations should all bear on either the red to pink highly to moderately fractured and weathered sandstone bedrock or controlled compacted fill. It is not considered good construction practice to bear some foundations directly on the sandstone bedrock and bear other foundations on a minimum of 0.5 feet of controlled compacted fill. If any foundations will bear on controlled compacted fill, all foundations should bear on a minimum of 0.5 feet of controlled compacted fill to reduce the potential for differential settlement. Alternatively, if any foundations will bear directly on the red to pink highly to moderately fractured and weathered sandstone bedrock, all foundations should bear directly on this harder stratum. This does not apply to exterior retaining or site wall foundations that are structurally separate.

Explanations

Foundation Embedment Depth - i.e.,

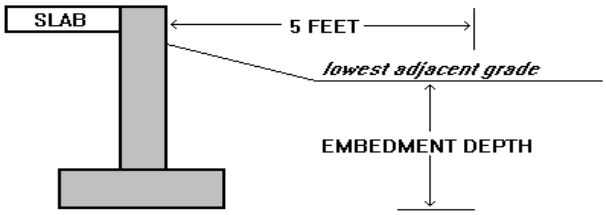
A) The depth below the lowest adjacent exterior pad grade within 5.0 feet of proposed exterior walls;

B) The depth below finish compacted pad grade provided that a sufficient pad blow-up (the lateral extent to which the building pad is constructed beyond the limits of the exterior walls or other structural elements, inclusive of exterior column foundations) has been incorporated into the grading and drainage design (5.0 feet or greater);

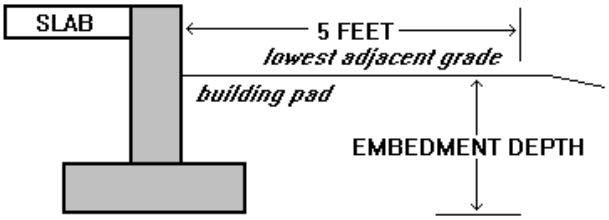
C) The depth below finish floor level for interior foundations.

FOUNDATION EMBEDMENT

Condition A



Condition B



The previously tabulated bearing values and the allowable wall and column loads associated with each are based on a total settlement of 1/2 inch. **It is anticipated that the magnitude of differential settlement will be roughly 1/4 inch** if construction is performed in accordance with locally accepted standards and the recommendations contained herein.

The allowable loads are based on maximum footing sizes of 3.0 and 7.0 feet for continuous and spread footings, respectively. Greater loads and larger footings may be accommodated by the listed bearing values, if there is toleration for increased settlements. This office should be contacted if this situation should arise.

The weight of the foundation below grade may be neglected in dead load computations.

The previously tabulated bearing capacities should be considered allowable maximums for dead plus design live loads and may be increased by one-third when considering total loads, including wind or seismic forces or other transient loading conditions.

Retaining wall or building foundations to be constructed in close proximity to retention basins (within 5.0 feet) should be embedded 1.0 feet deeper than the stated depths in the preceding bearing capacity tables.

Shallow foundations that are adjacent to lower foundation areas must be stepped down so that their base is below the lower backfill materials, and below a line projected upward from the

nearest lower foundation edge at a 45 degree angle. In no case should ancillary structures be designed or constructed, whose foundations will bear into deeper, non-verified backfills.

This firm recommends that continuous footings and stem walls be reinforced, and bearing walls be constructed with frequent joints to better distribute stresses in the event of localized foundation movements. Similarly, all masonry walls should be constructed with both vertical and horizontal reinforcement.

It is strongly recommended that all foundation excavations be inspected (prior to the placement of reinforcing steel) by a representative of the project geotechnical engineer, **ACS Services LLC**, to ensure that they are free of loose soil which may have blown or sloughed into the excavations, the embedment depth is adequate, and the dimensions are in accordance with the project requirements. It will also be necessary for the project geotechnical engineer to verify that the footings will bear upon one of the strata described above with a minimum foundation embedment of 1.5 feet.

A minimum of MAG A (3000 PSI), or equivalent, concrete with Type II cement should be used for footings, stem walls and floor slabs.

Lateral Stability Analyses

The following tabulation presents recommendations for lateral stability analyses for native undisturbed soil and controlled compacted fill:

[a]Foundation Toe Pressures.....1.33 x max. allowable

	Native Undisturbed Soil	Controlled Compacted Fill	Red to Pink Fractured Sandstone BR
[b]Lateral Backfill Pressures:			
Unrestrained walls	37 psf/ft.	35 psf/ft.	30 psf/ft.
Restrained walls[c]	57 psf/ft.	55 psf/ft.	48 psf/ft.
Lateral Passive Pressures For Surficial Soils:			
Continuous walls/footings	284 psf/ft.	296 psf/ft.	355 psf/ft.
Spread columns/footings	424 psf/ft.	442 psf/ft.	529 psf/ft.
Coefficient of Base Friction For Surficial Soils:			
Independent of passive resistance	0.62	0.67	0.78
In conjunction with passive resistance	0.42	0.45	0.52

Superscript Explanations

[a]Increase in allowable foundation bearing pressure (previously stated) for foundation toe pressures due to eccentric or lateral loading.

[b]Equivalent fluid pressures for vertical walls and horizontal backfill surfaces (maximum 12.0 feet in height). Pressures do not include temporary forces during compaction of the

backfill, expansion pressures developed by overcompacted clayey backfill, hydrostatic pressures from inundation of backfill, or surcharge loads. Walls should be suitably braced during backfilling to prevent damage and excessive deflection.

[C]The backfill pressure can be reduced to the unrestrained value if the backfill zone between the wall and cut slope is a narrow wedge (width less than one-half height).

Drainage

In unpaved areas, it is suggested that finished slopes extend a minimum of 5.0 feet horizontally from building walls and have a minimum vertical fall of 3.0 inches. Minimum grades of 2 percent should be maintained where the horizontal slope distance exceeds 5.0 feet. **In no case should long-term ponding be allowed near structures.** Backfill against footings, exterior walls, retaining walls, and in utility trenches should be well compacted to minimize the possibility of moisture infiltration through loose soil.

Conventional Unreinforced Concrete Slabs

Site grading within the building areas should be accomplished as recommended herein. Four (4.0) inches of aggregate base course (ABC) floor fill should immediately underlie interior grade floor slabs with a typical thickness of four (4.0) inches. The aggregate base material should conform to the requirements of Section 702 under Sub-section 702.2 "Crushed Aggregate" of the "Uniform Standard Specifications for Public Works Construction" sponsored by the Maricopa Association of Governments and all supplements which require a particle size grading as follows:

Sieve Size	Percent Passing
1-1/4”	100
#4	38-65
#8	25-60
#30	10-40
#200	3-12

Maximum Plasticity Index - 5

Special Note: To further reduce the potential for slab related damage, we recommend the following for conventional systems:

1. Placement of effective control joints on relatively close centers.
2. Proper moisture and density control during placement of subgrade fills.
3. Provision for adequate drainage in areas adjoining the slabs.
4. Use of designs which allow for the differential vertical movement described herein between the slabs and adjoining structural elements, i.e. **½ inch**.

The use of vapor retarders may be considered for any slab-on-grade where the floor will be covered by products using water based adhesives, wood, vinyl backed carpet, vinyl tile, impermeable floor coatings (urethane, epoxy, or acrylic terrazzo),and moisture-sensitive rock tile products. When used, the design and installation should be in accordance with the recommendations given in ACI 301.1R-04, Section 3.2.3 Moisture protection.

A minimum of MAG A (3000 PSI), or equivalent, concrete with Type II cement should be used for unreinforced interior and exterior slabs.

Fill Slope Stability

The maximum fill slopes may conform to a 2:1 (horizontal:vertical) ratio if fill is placed in accordance with the recommendations contained herein.

Pavement Design

Site grading within pavement areas should provide requisite subgrade support for flexible pavements. A compacted subgrade of on-site soils or soils with comparable properties is assumed. The stability of compacted pavement subgrade soils is reduced under conditions of increased soil moisture. Therefore, base course or pavement materials should not be placed when the surface is in a wet condition. Adequate surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade.

The following presents the recommended pavement sections for on-site pavements:

Light Vehicles or Low Volume Traffic Areas

Alternate	Prepared Subgrade (Inches)	ABC (Inches)	Asphaltic Concrete (Inches)	Concrete Pavement (Inches)
A[a]	6	4	2	
B[a]	6		3.5	
C[b]	6			4.5*

Light Truck Vehicles or Moderate Volume Traffic Areas

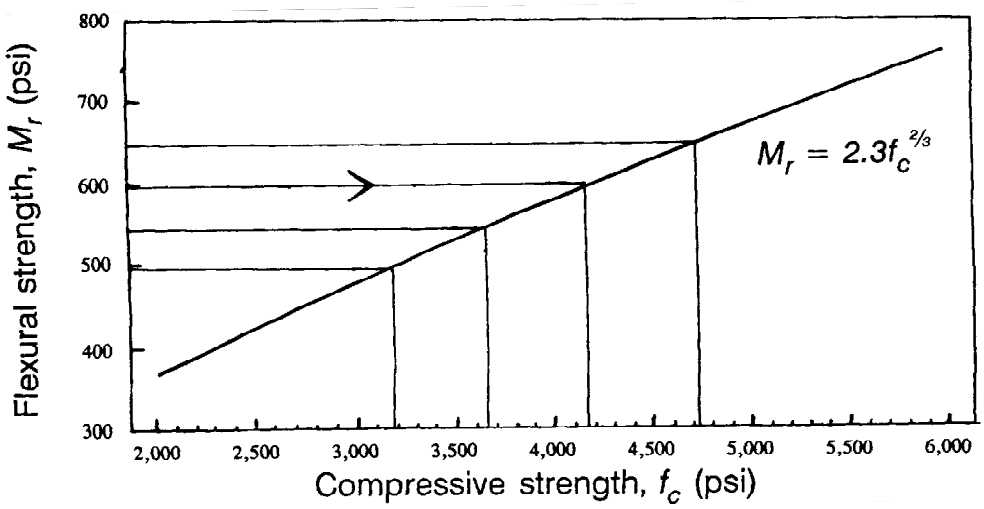
Alternate	Prepared Subgrade (Inches)	ABC (Inches)	Asphaltic Concrete (Inches)	Concrete Pavement (Inches)
A[a]	6	4	3	
B[a]	6		4.5	
C[b]	6			5.5*

Heavy Truck Vehicles or Heavy Volume Traffic Areas

Alternate	Prepared Subgrade (Inches)	ABC (Inches)	Asphaltic Concrete (Inches)	Concrete Pavement (Inches)
A[a]	6	4	4	
B[a]	6		5.5	
C[b]	6			6.5*

[a] – 10 to 15 year design life, with typical maintenance
[b] – 20 year design life, with typical maintenance

***The above thicknesses for Portland Cement concrete pavement are based on a modulus of rupture of 600 PSI. The recommended concrete thicknesses should be increased in increments of 0.5 inch for every 50 PSI decrease in the modulus of rupture. The following chart relates rupture modulus to compressive strength.**



All 8.0 inches of the prepared subgrade may be comprised of the native site soils.

Specifications for ABC should be as previously stated under "Slab Support". Compaction of subbase fill and base course materials should be accomplished to the density criteria listed under "Compaction and Moisture Content Recommendations". Compaction of asphalt should be accomplished to the following density criteria:

Material	Percent Compaction 75-blow method
Asphalt Base Course	95 minimum

The asphaltic concrete material shall conform to all requirements as established in MAG Section 710 for Asphaltic Concrete Mix Designation 1/2" or 3/4" Marshall mix for light and moderate traffic areas, and 3/4" Marshall mix for heavy traffic areas.

EARTHWORK

The following final earthwork recommendations are presented as a guide in the compilation of construction specifications. The final recommendations are not comprehensive contract documents and should not be utilized as such.

Site Preparation

The following final recommendations are presented as a guide in the compilation of construction specifications. The final recommendations are not comprehensive contract documents and should not be utilized as such.

It is recommended that all vegetation, trash, debris, the existing pavement, and all other deleterious matter be removed from the proposed structure and pavement areas at the commencement of site grading activities.

Following the removal of the above listed items, any existing fill or loose soil disturbed by previous grading of the site must be removed. Fill may exist at locations not explored due to the previous grading of the site for commercial development. **The presence of native undisturbed soil or rock across the entire building site for the proposed building must be verified by the project geotechnical engineer, ACS Services LLC, prior to scarification and placement of engineered fill for the building pad.** All removed disturbed or loose native soil is considered by this firm to be suitable for use as engineered fill provided that it is free of vegetation, debris, and oversized rock particles (greater the 6.0 inches).

Subsequent to the surface grubbing efforts and any existing fill or loose soil removal, and prior to the placement of subgrade or subbase fill, the exposed native ground surface should be prepared to a minimum depth of **6.0 inches** in all proposed building and pavement areas except in areas where the red to pink highly to moderately weathered and fractured sandstone bedrock is encountered and scarification is not possible. Subgrade preparation should include some degree of moisture processing and/or scarification prior to compaction and should also incorporate a minimum pad blow-up of five (5) feet in all proposed building areas.

Special note for foundations on controlled compacted fill: To achieve an allowable soil bearing pressure of 2500 PSF, conventional spread foundations must bear on a minimum of 0.5 feet of controlled compacted fill. To accommodate the required 0.5 feet of controlled compacted fill below foundations, it is recommended that overexcavation and recompaction of soils be accomplished to a minimum depth of 2.0 feet below finished pad grade. The controlled compacted fill should have a lateral extent of at least twice the fill thickness beyond the edges of wall or column footing pads. A minimum pad blow-up of 5 feet is recommended.

Complete removal and cleaning of any undesirable materials and proper backfilling of depressions or overexcavations will be necessary to develop support for the proposed facilities. Widen all depressions or overexcavations as necessary to accommodate compaction equipment and provide a level base for placing any fill. All fill shall be properly moistened and compacted as specified in the section on compaction and moisture content final recommendations.

All subbase fill required to bring the structure areas up to subgrade elevation should be placed in horizontal lifts not exceeding six inches compacted thickness or in horizontal lifts with thickness compatible with the compaction equipment utilized.

It is the understanding of this firm that various utility trenches may traverse the completed pad. The backfill of all utility trenches, if not in conformance with this report, may adversely impact the integrity of the completed pad. This firm recommends that all utility trench backfill crossing the pad be inspected and tested to ensure full conformance with this report. Untested utility trench backfill will nullify any as-built grading report regarding the existence of controlled compacted fill beneath the proposed building foundations and place the owner at greater risk in terms of potential unwanted foundation and floor slab movement.

Compaction and Moisture Content Recommendations

Compaction of backfill, subgrade soil, subbase fill, and base course materials should be accomplished to the following density criteria:

Material	Required Degree of Compaction (ASTM D698)
On-site native and fill soils used as subbase fill or backfill for slab or pavement support:	
Building areas below foundation level	95 min.
Building areas above foundation level	90 min.
Below asphalt pavements	95 min.
Imported subbase fill or backfill for structural or pavement support:	
Building areas below foundation level	95 min.
Building areas above foundation level	90 min.
Below asphalt pavements	95 min.
Base course:	
Below interior unreinforced or reinforced concrete Slabs	95 min.
Below asphalt pavements	100 min.

Increase the required degree of compaction to a minimum of 98 percent for fill materials greater than 5.0 feet below final grade.

During construction and prior to concrete placement, moisture contents should be controlled as follows:

Material	Compaction Moisture Content Range
On-site native and fill soils:	
Below foundation level	optimum -2 to optimum +2%
Above foundation level	optimum -2 to optimum +2%
Below asphalt pavements	optimum -2 to optimum +2%
Imported fill material:	
Below foundation level	optimum -2 to optimum +2%
Above foundation level	optimum -2 to optimum +2%
Below asphalt pavements	optimum -2 to optimum +2%

Note: The recommendations previously tabulated under the heading entitled "Above Foundation Level" apply to the subgrade in exterior reinforced concrete patio, pool deck, sidewalk, or driveway slab areas.

Any soil disturbed during construction shall be compacted to the applicable percent compaction as specified herein.

Natural undisturbed soils or compacted soils subsequently disturbed or removed by construction operations should be replaced with materials compacted as specified above.

All imported fill material to be used as structural-supporting fill, should be free of vegetation, debris, and other deleterious material and meet the following requirements:

Maximum Particle Size	3 inches
Maximum Plasticity Index	15
Range of Passing #200 Sieve	25-60 percent
Maximum Expansion	1.5 %*

* - Performed on a sample remolded to 95 percent of the maximum ASTM D698 density at roughly 2.0 percent below the optimum moisture content, under a 100 PSF surcharge.

Water settling and/or slurry shall not be used, in any case, to compact or settle surface soils, fill material, or trench backfill within 10.0 feet of any proposed structure.

Shrinkage

Assuming the average degree of compaction will approximate 95 percent of the standard maximum density, the approximate shrinkage of the reworked site soils should be 0 to 10 percent based on the field SPT blow count data. This may result in a vertical elevation change of approximately 0.00 to 0.10 feet following the precompaction effort.

Excavating Conditions

Excavations into the site surface soils to depths ranging from 0 to 3 feet should be possible with conventional excavating equipment. Heavier excavating equipment may be required below depths ranging from 0 to 3 feet due to the presence of very dense, silty sand to gravel soils, consisting of highly to moderately weathered and fractured sandstone bedrock to hard sandstone bedrock. Auger refusal in hard sandstone bedrock was encountered at all boring locations at depths ranging from 2 to 8 feet except at the location of Boring 2. Even in that boring, intermittent thin layers of hard sandstone bedrock were encountered in the very dense fractured sandstone rock. Where auger refusal was encountered, a hoe ram or blasting may be required for efficient excavation. Difficult excavation should be assumed across the entire site at a very shallow depth. The excavated sandstone rock will be platy and will need to be broken up to be utilized in fills on the site.

Excavations greater than 4.0 feet should be sloped or braced as required to provide personnel safety and satisfy local safety code regulations.

CONSTRUCTION OBSERVATION

ACS Services LLC should be retained to provide documentation that the recommendations set forth are met. These include but are not limited to documentation of site clearing activities, verification of fill suitability and compaction, and inspection of footing excavations. Relative to field density testing, a minimum of 1 field density test should be taken for every 2500 square feet of building area, per 6.0-inch layer of compacted fill.

Prior to construction, we recommend the following:

1. Consultation with the design team in all areas that concern soils and rocks to ensure a clear understanding of all key elements contained within this report.
2. Review of the General Structural Notes to confirm compliance to this report and determination of which allowable soil bearing capacity has been selected by the project structural engineer (this directly affects the extent of earthwork and foundation preparation at the site).
3. This firm be notified of all specific areas to be treated as special inspection items (designated by the architect, structural engineer or governmental agency).

Relative to the involvement of **ACS Services LLC** with the project during the course of construction, we offer the following recommendations:

1. The site or development owner should be directly responsible for the selection of the geotechnical consultant to provide testing and observation services during the course of construction.
2. **ACS Services LLC** should be contracted by the owner to provide the course of construction testing and observation services for this project, as we are most familiar with the interpretation of the methodology followed herein.
3. All parties concerned should understand that there exists a priority surrounding the testing and observation services completed at the site. From a geotechnical perspective, it is imperative to understand the following priority list, presented in order of decreasing priority.

    A. Fill control for building pads (verification of overexcavation depths and lateral extents, compaction testing, and the general monitoring of fill placement).
    B. Foundation observations (compliance with the General Structural Notes, depths, bearing strata, etc.).
    C. Basement, structural or retaining wall backfill testing.
    D. Utility trench backfill
    E. Special inspections as dictated by the local municipality.
    F. Concrete sampling and testing for footings, stem walls and floor slabs.
    G. Subgrade testing for proposed pavement areas.
    H. ABC testing for proposed pavement areas.
    I. Asphaltic concrete testing for proposed pavement areas.
    J. Subgrade preparation for on-site sidewalk areas
    K. Grout sampling and testing, where applicable.

L. Mortar sampling and testing, where applicable.
M. Off-site subgrade, ABC, asphalt, curb, gutter and sidewalk testing.

Please understand that Item A above is the only area where ACS Services LLC has control on-site (once it has started) to verify or deny compliance with applicable standards, without the need for any entity to schedule testing activities with this office. Other than Item A, it shall be another entity's responsibility to schedule all testing and observation services, to coincide with the progress of construction. Since this firm is not a contributor to the construction schedule, we do not possess an inherent knowledge as to when our services shall be needed or required.

LIMITATIONS

Since our investigation is based upon review of background data, the site materials observed, selected laboratory testing and engineering analysis, the conclusions and recommendations are professional opinions. Our professional services have been performed using that degree and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities. These opinions have been derived in accordance with current standards of practice and no other warranty, express or implied, is made.

This report is not intended as a bidding document, and any contractor reviewing this report must draw his own conclusions regarding specific construction techniques to be used on this project.

The scope of services carried out by **ACS Services LLC** does not include an evaluation pertaining to environmental issues. If these services are required by the lender, we would be most pleased to discuss the varying degrees of environmental site assessments.

The materials encountered on the subject site and utilized in our laboratory analysis are believed to be representative of the total area; however, soil and rock materials do vary in character between points of investigation. The recommendations contained in this report are based on the assumption that the soil conditions do not deviate appreciably from those disclosed by the investigation. Should unusual material or conditions be encountered during construction, the soil engineer must be notified so that he may make supplemental recommendations if they should be required.

This report is issued with the understanding that it is the responsibility of the owner to see that its provisions are carried out or brought to the attention of those concerned. In the event that any changes of the proposed project are planned, the conclusions and recommendations contained in this report shall be reviewed and the report shall be modified or supplemented as necessary.

July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

DEFINITION OF TERMINOLOGY

Allowable Soil Bearing Capacity	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
Aggregate Base Course (ABC)	A sand and gravel mixture of specified gradation, used for slab and pavement support.
Backfill	A specified material placed and compacted in a confined area.
Base Course	A layer of specified material placed on a subgrade or subbase.
Base Course Grade	Top of base course.
Bench	A horizontal surface in a sloped deposit.
Caisson	A concrete foundation element cased in a circular excavation, which may have an enlarged base. Sometimes referred to as a cast-in-place pier.
Concrete Slabs-on-Grade	A concrete surface layer cast directly upon a base, subbase, or subgrade.
Controlled Compacted Fill	Engineered Fill. Specific material placed and compacted to specified density and/or moisture conditions under observation of a representative of a soil engineer.
Differential Settlement	Unequal settlement between or within foundation elements of a structure.
Existing Fill	Materials deposited through the action of man prior to exploration of the site.
Expansive Potential	The potential of a soil to increase in volume due to the absorption of moisture.
Fill	Materials deposited by the action of man.
Finish Grade	The final grade created as a part of the project.
Heave	Upward movement due to expansion or frost action.
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil.
Overexcavate	Lateral extent of subexcavation.
Rock	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting, or other methods of extraordinary force for excavation.
Scarify	To mechanically loosen soil or break down the existing soil structure.
Settlement	Downward movement of the soil mass and structure due to vertical loading.
Soil	Any unconsolidated material composed of disintegrated vegetable or mineral matter, which can be separated by gentle mechanical means, such as agitation in water.
Strip	To remove from present location.
Subbase	A layer of specified material between the subgrade and base course.
Subexcavate	Vertical zone of soil removal and recompaction required for adequate foundation or slab support
Subgrade	Prepared native soil surface.

July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

APPENDIX A

NORTH
N.T.S.

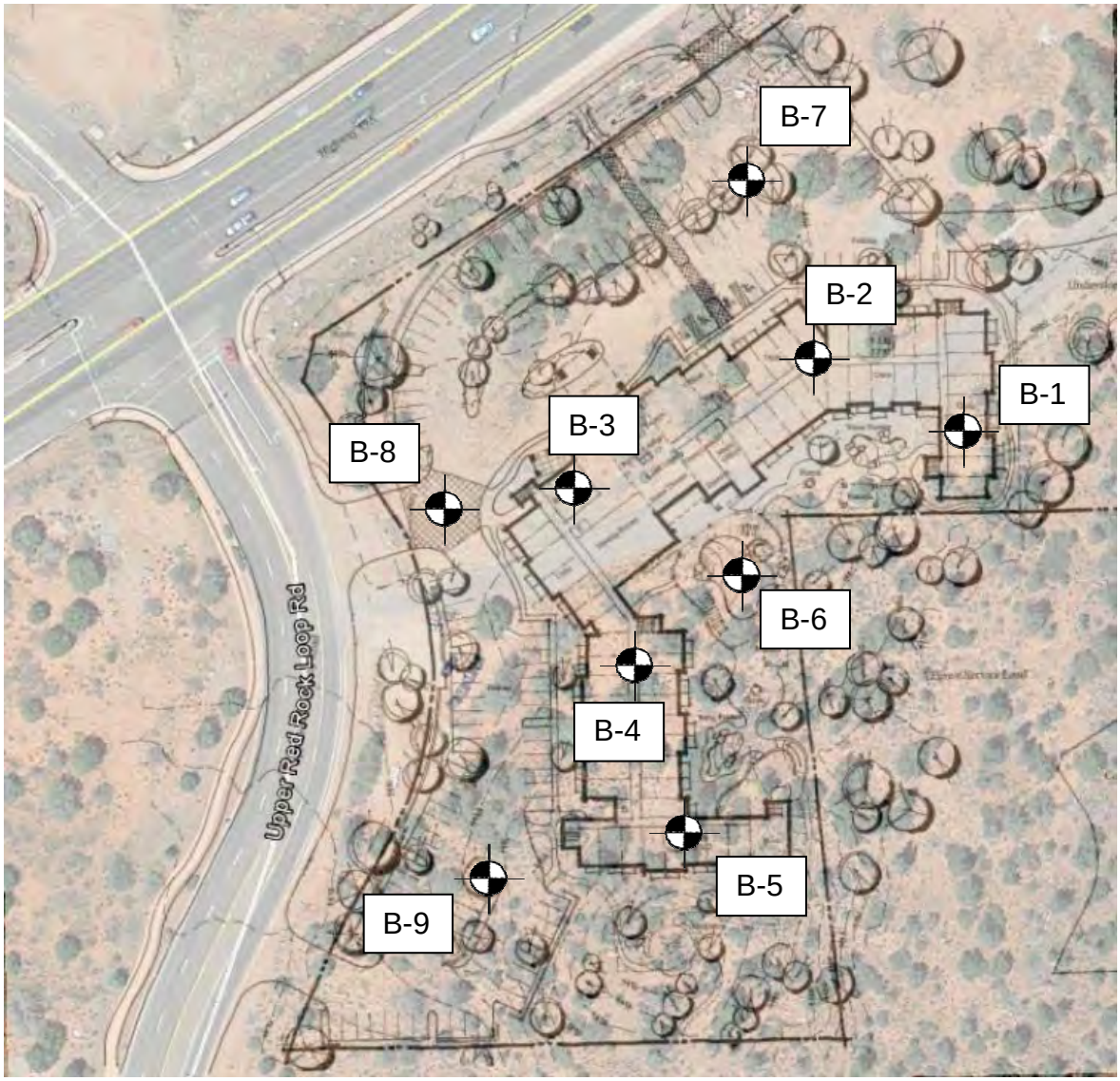
PROJECT NUMBER: 1401316

FIGURE 1

ACS SERVICES LLC
550 EAST UNIVERSITY DRIVE
MESA, ARIZONA 85203
(480) 968-0190
(480) 968-0156 FAX
WWW.ACSSERVICESLLC.COM

VICINITY MAP

Courtyard by Marriott
4105 West SR89A
Sedona, AZ.



NORTH
N.T.S.

PROJECT NUMBER: 1401316

FIGURE 2

ACS SERVICES LLC

550 EAST UNIVERSITY DRIVE
MESA, ARIZONA 85203
(480) 968-0190
(480) 968-0156 FAX
WWW.ACSSERVICESLLC.COM

SITE PLAN & APPROXIMATE BORING LOCATIONS

Courtyard by Marriott
4105 West SR89A
Sedona, AZ.

July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

APPENDIX B

ACS Services LLC

BORING B-1

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: No ring sample taken
1-2" of topsoi
Red sandstone bedrock exposed at the surface at boring location

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1	39 50/3"			SM-GM	Red SANDSTONE BEDROCK, hard, slightly damp, low PI
2					Very slow drilling, drilling rate of 6 minutes per inch
3					Terminated boring at 2 feet due to auger refusal in hard SANDSTONE BEDROCK
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-2

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Ring sample from 1.5 to 2.5 feet

6" of soft topsoi

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1				SM-GM	Red highly fractured and weathered SANDSTONE BEDROCK, very dense, slightly damp, low PI
2	16			GM-GP	Dark red highy fractured and weatherd SANDSTONE BEDROCK, dense, damp to moist, low PI
3	32				
4					
5	36			GM-GP	Red highly fractured and weathered SANDSTONE BEDROCK, very dense, slightly damp, low PI
6	50/4"				
7					Harder drilling at 7 feet
8					
9					
10	20	2.3		SM	Red silty SAND, dense, slightly damp, NP (badly weathered and soft SANDSTONE BEDROCK)
11	16				
12	33				
13					
14					
15	9	6.1		SM	Dark red very silty SAND, medium dense, damp to moist, NP (badly weathered and very soft SANDSTONE bedrock)
16	8				
	13				
17					Terminated boring at 15.5 feet in very soft SANDSTONE BEDROCK

ACS Services LLC

BORING B-3

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Ring sample from 1.5 to 1.9 feet

2" of gravel on the surface

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1				SC	Dark red clayey SAND, medium dense, medium dense, damp, low PI
2	50/5.5"	5.8		GC	Dark red clayey sandy GRAVEL, very dense, damp, PI of 16
3				GP	Pink SANDSTONE BEDROCK, hard, dry, NP
4					Terminated boring at 3 feet due to auger refusal in hard SANDSTONE BEDROCK
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-4

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Ring sample from 1.5 to 2.4 feet

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1	8			SC	Red-brown silty clayey SAND, medium dense, damp, low PI
2	17 21				
3	18 50/5"			GM	Red soft SANDSTONE BEDROCK, very dense, slightly damp, low PI
4	33 50/3"				
5	6 48	2.7		GM	Red soft SANDSTONE BEDROCK, very dense, slightly damp, NP
6	50/2"				
7				GP	Red soft to hard SANDSTONE BEDROCK, very dense, slightly damp, NP Variable drilling soft then hard Drilling rate 6 minutes per inch
8					Terminated boring at 7 feet due to auger refusal in hard SANDSTONE BEDROCK
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-5

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Ring sample from 1.5 to 1.8 feet Description of Subsurface Conditions
1	4 9			SC-SM	Red silty clayey SAND, medium dense, damp, low PI
2	24 50/4"			GM	Pink SANDSTONE BEDROCK, very dense, dry, NP Harder drilling at 2 feet
3					
4					Terminated boring at 3 feet due to auger refusal in hard SANDSTONE BEDROCK
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-6

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Ring sample from 1.5 to 1.7 feet

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1	14			SC-SM	Red silty clayey SAND, medium dense, damp, low PI
2	50/2"			GM	Pink SANDSTONE BEDROCK, very dense, dry, NP
3	50/2"	0.6		GM	Hard drilling Pink sandy GRAVEL, very dense, dry, NP (SANDSTONE BEDROCK) Drilling rate of 5 minutes per inch
4					Terminated boring at 3 feet due to auger refusal in hard SANDSTONE BEDROCK
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-7

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Obtained bag samples from 0 to 3 feet and 3 to 8 feet

Intermittent soft and hard bedrock layers

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1				GM-GC	Red clayey silty sandy GRAVEL, very dense, damp, PI of 5 (SANDSTONE BEDROCK)
2					Slow drilling
3					
4					Easier drilling
5		2.8		SM	Red gravelly silty SAND, very dense, slightly damp, PI of 3 (SANDSTONE BEDROCK)
6					Harder drillling
7					Easier drilling Harder drilling at 7 feet
8					
9					Terminated boring at 8 feet due to auger refusal in hard SANDSTONE BEDROCK
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-8

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

Remarks: Obtained bag samples from 0 to 3 feet and 3 to 5 feet

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1		7.0		SM	Red gravelly silty SAND, medium dense, damp, PI of 2 (possible fill)
2					Easy drilling to 3 feet
3					
4				GM	Red SANDSTONE BEDROCK, very dense, dry, NP
5					Harder drilling at 4 feet Drilling rate of 5.5 minutes per inch
6					Terminated boring at 5 feet due to auger refusal in hard SANDSTONE BEDROCK
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-9

For: Western Horizons, Inc.
Project: Courtyard by Marriott
Location: 4105 West SR89A
Sedona, Arizona

Date: 6/24/2014 **Project No.** 1401316
Type of Boring: 6.625-inch HS Auger
Field Engineer: Chris Carpenter
Location: See Site Plan

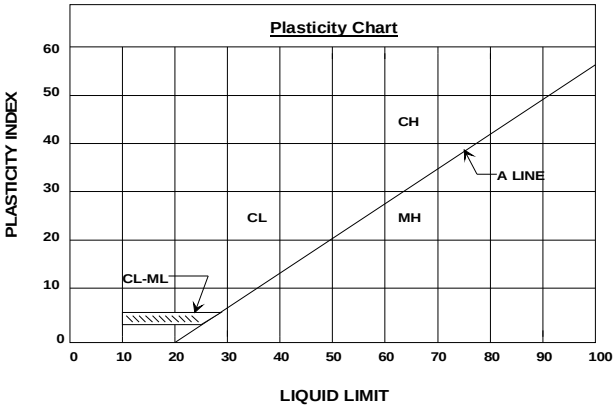
Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Obtained bag sample from 0 to 2 feet Description of Subsurface Conditions
1		3.4		SM	Red-brown gravelly silty SAND, medium dense, damp, PI of 2 (topsoil)
2				GM	Pink SANDSTONE BEDROCK, very dense, dry, NP Drilling rate of 7.0 minutes per inch
3					Terminated boring at 5 feet due to auger refusal in hard SANDSTONE BEDROCK
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

LEGEND

Major Divisions				Group Symbol	Typical Names
Coarse-Grained Soils (Less than 50% passes No. 200 sieve)	Gravels (50% or less or coarse fraction passes No. 4 sieve)	Clean Gravels (Less than 5% passes No. 200 sieve)		GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
				GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		Gravels with Fines (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on Plasticity Chart.	GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plots above "A" line & hatched zone on Plasticity Chart.	GC	Clayey gravels, gravel-sand-clay mixtures.
	Sands (More than 50% of coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% passes No. 200 sieve)		SW	Well graded sands, gravelly sands.
				SP	Poorly graded sands, gravelly sands.
		Sands with Fines (More than 12% passes No. 200 sieve)	Limits plots below "A" line & hatched zone on Plasticity Chart.	SM	Silty sands, sand-silt mixtures.
			Limits plots above "A" line & hatched zone on Plasticity Chart.	SC	Clayey sands, sand-clay mixtures.
Fine-Grained Soils (50% or more passes No. 200 sieve)	Silts-Plot below "A" line & hatched zone on Plasticity Chart	Silts of Low Plasticity (Liquid Limit Less Than 50)		ML	Inorganic silts, clayey silts with slight plasticity.
		Silts of High Plasticity (Liquid Limit More Than 50)		MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	Clays-Plot above "A" line & hatched zone on Plasticity Chart	Clays of Low Plasticity (Liquid Limit Less Than 50)		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		Clays of High Plasticity (Liquid Limit More Than 50)		CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

Note: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the Plasticity Chart to have double symbol.



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to 3/4 in.
Fine gravel	3/4 in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

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July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

TEST DRILLING EQUIPMENT & PROCEDURES

Drilling Equipment

ACS SERVICES LLC uses a CME-45 drill-rig capable of auger drilling to depths of 50 feet in southwestern soils. The drill is truck-mounted for rapid, low cost mobilization to the jobsite and on the jobsite. Drilling through soil or softer rock is performed with 6.625 inch O.D. hollow-stem auger. Carbide insert teeth are normally used on the auger bits so they can often penetrate rock or very strongly cemented soils that require blasting or very heavy equipment for excavation. The operation of well-maintained equipment by an experienced crew allows **ACS SERVICES LLC** to complete drilling jobs to a depth of 50 feet with minimum downtime and maximum efficiency.

Sampling Procedures

Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 procedure. In many cases, 2 inch O.D., $1^{3}/_{8}$-inch I.D. samplers are used to obtain the standard penetration resistance. Undisturbed" samples of firmer soils are often obtained with 3 inch O.D. samplers lined with 2.42 inch I.D. brass rings. The driving energy is generally recorded as a number of blows of a 140-pound hammer, utilizing a 30-inch free fall drop, per six inches of penetration. However, in stratified soils, driving resistance is sometimes recorded in 2 or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per six inches on the logs. Undisturbed sampling of softer soils is sometimes performed with thin-walled Shelby tubes (ASTM D1587). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing from auger cuttings.

Continuous Penetration Tests

Continuous penetration tests are performed by driving a 2-inch O.D. bullnose penetrometer adjacent to or in the bottom of test borings. The penetrometer is attached to $1^{5}/_{8}$-inch O.D. drill rods to provide clearance and thus minimize side friction so that penetration values are as nearly as possible a measure of end resistance. Penetration values are recorded as the number of blows of a 140 pound hammer, utilizing a 30 inch drop required to advance the penetrometer in six-inch increments or less.

Boring Records

Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487) with appropriate group symbols being shown on the logs.

July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

APPENDIX C

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-1	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 2 @ 9.0 - 10.5'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	0	100	
3/4"	5	95	
1/2"	6	89	
3/8"	4	86	
1/4"	8	78	
#4	7	71	
#8	4	67	
#10	1	66	
#16	2	64	
#30	3	61	
#40	2	59	
#50	2	58	
#100	6	51	
#200	28	23.6	

Liquid Limit (AASHTO T-89)	NV
Plastic Limit (AASHTO T-90)	NV
Plasticity Index (AASHTO T-90)	NP
Moisture Content (AASHTO T-255)	2.3
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-5	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 2 @ 14.0 - 15.5'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	0	100	
3/4"	0	100	
1/2"	0	100	
3/8"	0	100	
1/4"	1	99	
#4	1	98	
#8	3	95	
#10	1	94	
#16	3	91	
#30	3	87	
#40	1	86	
#50	2	84	
#100	8	76	
#200	31	45.3	

Liquid Limit (AASHTO T-89)	NV
Plastic Limit (AASHTO T-90)	NV
Plasticity Index (AASHTO T-90)	NP
Moisture Content (AASHTO T-255)	6.1
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-2	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 3 @ 1.5 - 2.5'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)			
Sieve Size	**% Retained**	**% Passed**	**Specs**
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	12	88	
1"	0	88	
3/4"	0	88	
1/2"	1	87	
3/8"	2	84	
1/4"	12	72	
#4	11	61	
#8	3	58	
#10	1	57	
#16	2	56	
#30	2	54	
#40	1	53	
#50	2	51	
#100	5	46	
#200	15	31.7	

Liquid Limit (AASHTO T-89)	31
Plastic Limit (AASHTO T-90)	15
Plasticity Index (AASHTO T-90)	16
Moisture Content (AASHTO T-255)	5.8
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	GC

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-3	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 4 @ 4.0 - 5.1'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	7	93	
3/4"	4	89	
1/2"	4	86	
3/8"	4	81	
1/4"	11	70	
#4	5	65	
#8	3	63	
#10	1	62	
#16	2	60	
#30	3	57	
#40	2	55	
#50	2	53	
#100	5	48	
#200	13	35.1	

Liquid Limit (AASHTO T-89)	NV
Plastic Limit (AASHTO T-90)	NV
Plasticity Index (AASHTO T-90)	NP
Moisture Content (AASHTO T-255)	2.7
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	GM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-4	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 6 @ 2.0 - 3.0'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	30	70	
1"	11	60	
3/4"	7	53	
1/2"	4	49	
3/8"	2	47	
1/4"	4	44	
#4	2	41	
#8	4	38	
#10	1	37	
#16	1	36	
#30	1	35	
#40	1	34	
#50	1	33	
#100	2	31	
#200	11	20.7	

Liquid Limit (AASHTO T-89)	NV
Plastic Limit (AASHTO T-90)	NV
Plasticity Index (AASHTO T-90)	NP
Moisture Content (AASHTO T-255)	0.6
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	GM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-6	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 7 @ 0.0 - 3.0'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)			
Sieve Size	**% Retained**	**% Passed**	**Specs**
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	1	99	
1"	3	96	
3/4"	4	92	
1/2"	9	83	
3/8"	7	76	
1/4"	12	64	
#4	6	58	
#8	7	51	
#10	2	50	
#16	3	46	
#30	3	43	
#40	1	42	
#50	1	41	
#100	3	38	
#200	7	30.9	

Liquid Limit (AASHTO T-89)	22
Plastic Limit (AASHTO T-90)	17
Plasticity Index (AASHTO T-90)	5
Moisture Content (AASHTO T-255)	3.0
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	GM-GC

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-7	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 7 @ 3.0 - 8.0'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	0	100	
3/4"	2	98	
1/2"	3	95	
3/8"	3	93	
1/4"	6	87	
#4	5	82	
#8	12	70	
#10	3	67	
#16	7	60	
#30	6	54	
#40	2	52	
#50	2	51	
#100	3	47	
#200	7	40.1	

Liquid Limit (AASHTO T-89)	22
Plastic Limit (AASHTO T-90)	19
Plasticity Index (AASHTO T-90)	3
Moisture Content (AASHTO T-255)	2.8
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-8	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 8 @ 0.0 - 3.0'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	2	98	
3/4"	2	96	
1/2"	1	95	
3/8"	3	92	
1/4"	7	85	
#4	6	79	
#8	7	73	
#10	2	71	
#16	5	67	
#30	6	60	
#40	3	58	
#50	3	55	
#100	6	49	
#200	14	34.7	

Liquid Limit (AASHTO T-89)	22
Plastic Limit (AASHTO T-90)	20
Plasticity Index (AASHTO T-90)	2
Moisture Content (AASHTO T-255)	7.0
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	1401316	Material Type:	Native
ACS Lab #	14-2035-9	Supplier:	N/A
Client:	Western Horizons, Inc.	Sample Date:	6/24/2014
Project Name:	Courtyard by Marriott	Sampled By:	Nathan Sorensen
Project Address:	4105 West SR89A	Test Date:	6/28/2014
Project City	Sedona	Tested By:	Felipe Sanchez
Sample Location:	B - 9 @ 0.0 - 2.0'	Reviewed By:	Gene Hansen

Sieve Analysis (ASTM C-139 / AASHTO T-27)

Sieve Size	% Retained	% Passed	Specs
6"			
3"			
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	0	100	
3/4"	1	99	
1/2"	3	97	
3/8"	3	94	
1/4"	8	85	
#4	7	78	
#8	8	70	
#10	2	69	
#16	4	65	
#30	4	61	
#40	1	60	
#50	2	58	
#100	4	54	
#200	13	40.4	

Liquid Limit (AASHTO T-89)	20
Plastic Limit (AASHTO T-90)	18
Plasticity Index (AASHTO T-90)	2
Moisture Content (AASHTO T-255)	3.4
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SM

Jeff Donkersley
Operations Manager

Jeff Donkersley
Signature

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ACS SERVICES LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION

* *MAXIMUM DRY DENSITY & OPTIMUM MOISTURE CONTENT*

ACS Project No.:	**1401316**		
Lab No.:	14-2035-6	Material Type:	GEO - Native
Client:	Western Horizons, Inc.	Extraction Date:	6/24/2014
Project Name:	Courtyard by Marriott	Extracted By:	Nathan Sorensen
Project Address:	4105 West SR89A	Laboratory Test Date:	6/28/2014
Project City:	Sedona	Laboratory Tested By:	Felipe Sanchez
Material Source:	B7 @ 0.0' - 3.0'	Reviewed By:	Jeff Donkersley

TEST METHOD

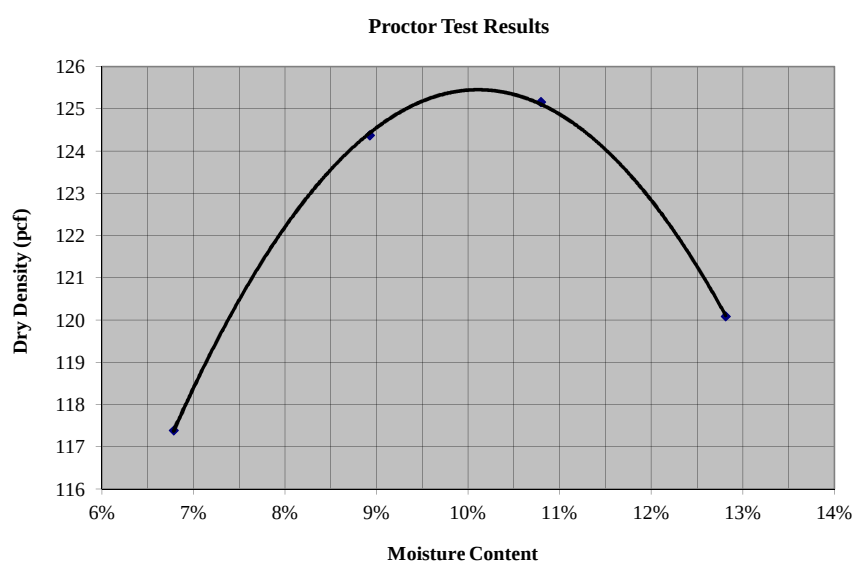
☑ AASHTO T99 / ASTM D698		
☐ AASHTO T180 / ASTM D1557		
☐ Ariz 225	☐ Ariz 227	☐ Ariz 245
☑ A	☐ B	☐ C

☑ 4" Mold	☑ Manual Hammer
☐ 6" Mold	☐ Automatic Hammer

Mold Weight	4421 grams
Mold Volume	0.0331 cuft

LABORATORY RESULTS

Water Added	Wet Weight of Sample & Mold	Wet Weight of Sample	Wet Density	Wet Weight of Moisture Sample	Dry Weight of Moisture Sample	Weight of Water	Moisture Content	Dry Density
(ml)	(grams)	(grams)	(pcf)	(grams)	(grams)	(grams)	(%)	(pcf)
150	6455.0	2,034	135.5	312.4	286.8	25.6	8.9%	124.4
200	6503.0	2,082	138.7	315.1	284.4	30.7	10.8%	125.2
250	6455.0	2,034	135.5	324.9	288.0	36.9	12.8%	120.1
100	6303.0	1,882	125.4	344.7	322.8	21.9	6.8%	117.4



FINAL RESULTS

Dry Density (Figure 1)	125.4	pcf
Moisture Content (Figure 1)	10.3	%
Total Dry Sample	17,592	grams
Dry Sample < #4	10,190	grams
Dry Sample > #4	7,402	grams
% Rock	42.1	%
% Passed #4	57.9	%
Maximum Dry Density	**132.6**	**pcf**
Optimum Moisture Content	**6.4**	**%**

SPECIFIC GRAVITY

A: Mass of Oven Dry Sample	2939.5	grams
B: Mass of S.S.D. Sample	3027.4	grams
C: Mass of Immersed Sample	1879.9	grams
Bulk (O.D.) Specific Gravity	**2.562**	
Percent Absorption	**2.99**	**%**

ACS

COURTYARD BY MARRIOTT
4105 WEST SR89A
SEDONA, ARIZONA
ACS PROJECT NO. 1401316

pH and Resistivity Test Results

Sample Location	Depth	Resistivity (ohms-cm)	pH
B-7	3.0-8.0'	3144	8.4
B-8	3.0-5.0'	2007	8.3

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MOTZZ LABORATORY, INC.

Soil Analysis Report

ACS Services LLC
Nathan Sorensen
550 East University Drive
Mesa. AZ 85203

Project: 1401316
Sampler:
Date Received: 7/2/2014
Date Reported: 7/3/2014
PO Number: 1401316

Lab Number: 910675-01 **14-2035-7**

Sulfate & Chloride	Method	Result	Units	Levels
Sulfate, SO4	ARIZ 733	18	ppm	
Chloride, Cl	ARIZ 736	35	ppm	

Sulfate 0.0018% ; Chloride 0.0035%

Lab Number: 910675-02 **14-2035-9**

Sulfate & Chloride	Method	Result	Units	Levels
Sulfate, SO4	ARIZ 733	18	ppm	
Chloride, Cl	ARIZ 736	12	ppm	

Sulfate 0.0018% ; Chloride 0.0012%

July 10, 2014
Project 1401316 – Courtyard by Marriott
4105 West SR89A
Sedona, Arizona

APPENDIX D

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

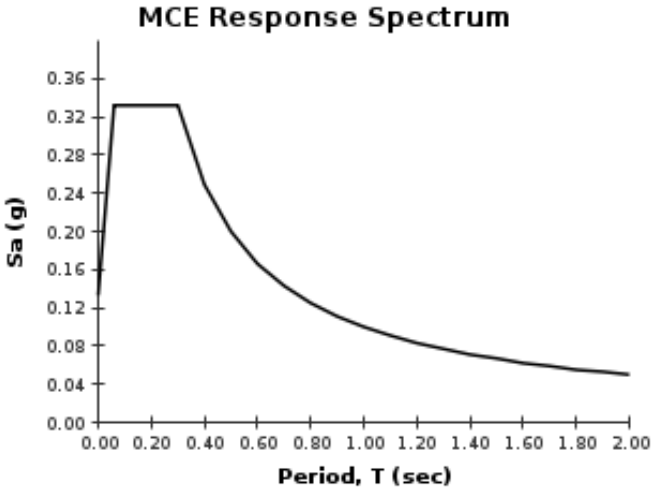
Design Maps Summary Report

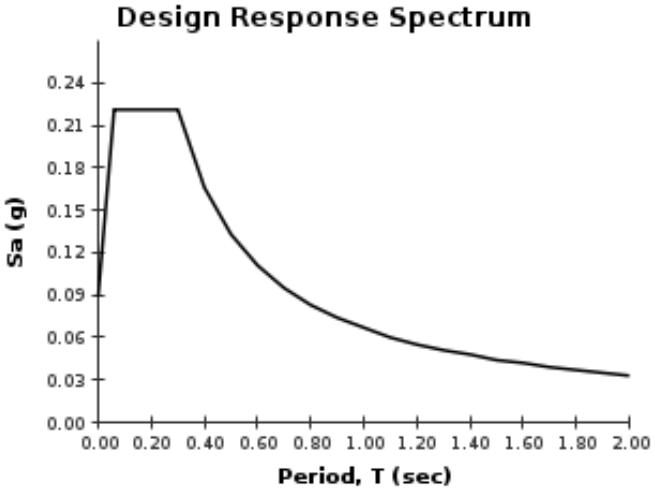
User–Specified Input

Report Title	Courtyard by Marriott Fri July 11, 2014 00:41:08 UTC
Building Code Reference Document	2006/2009 International Building Code (which utilizes USGS hazard data available in 2002)
Site Coordinates	34.85°N, 111.8275°W
Site Soil Classification	Site Class B – "Rock"
Occupancy Category	I/II/III

USGS–Provided Output

S_S =	0.332 g	S_{MS} =	0.332 g	S_{DS} =	0.221 g
S_1 =	0.100 g	S_{M1} =	0.100 g	S_{D1} =	0.067 g





Section 7.2

Rainfall Data

Sedona Marriott

Intensity-Duration-Frequency Curve Equations

Intensity Duration Frequency Data (IDF)

Rainfall Depth in Inches/Hour

Return Period (min)	2YR	5YR	10YR	25YR	50YR	100YR
5	3.36	4.44	5.40	8.04	9.36	10.80
10	2.52	3.36	4.08	6.12	7.14	8.22
15	2.08	2.80	3.40	5.04	5.88	6.80
30	1.40	1.88	2.28	3.40	3.96	4.58
60	0.86	1.16	1.41	2.10	2.46	2.84
120	0.51	0.67	0.80	1.16	1.35	1.56
180	0.36	0.46	0.55	0.78	0.90	1.05
360	0.22	0.27	0.32	0.42	0.48	0.55
720	0.14	0.17	0.19	0.25	0.28	0.31
1440	0.09	0.11	0.13	0.17	0.19	0.21

IDF Curve Equation Generation

(1) $$i = \frac{A}{B+t}$$

(2) $$i_{10} = \frac{A}{B+t_{10}}$$

(3) $$i_{30} = \frac{A}{B+t_{30}}$$

(4) $$i_{30} = \frac{i_{10}(B+t_{10})}{B+t_{30}}$$

i = rainfall intensity, in./hr
t = duration, min

A,B = return period and climatic constants

Solving for B from the above equation (4)... $$B = \frac{i_{30}t_{30} - i_{10}t_{10}}{i_{10} - i_{30}}$$

Solving for A from above equation (2)... $$A = i_{10}(B+t_{10})$$

Return Period	**2YR**	**5YR**	**10YR**	**25YR**	**50YR**	**100YR**
A =	63.000	85.362	103.360	153.000	177.826	206.855
B =	15.000	15.405	15.333	15.000	14.906	15.165

Section 7.3

Green & Ampt and Clark Unit Hydrograph Data

Sedona Marriott

Basin K Hydraulic Conductivity

$$CompositeXKSAT = anti\log\left(\frac{\sum` A_i \log XKSAT_i}{A_T}\right)$$

CALCULATIONS FOR THE GREEN AND AMPT PARAMETER XKSAT-HYDRAULIC CONDUCTIVITY (IN/HR)
SOIL TYPES AS A PERCENTAGE OF TOTAL ARE SCS SOIL SERIES FROM THE SOIL SURVEY OF YAVAPAI COUNTY

		GM Silt, Sand-Silt		**GC** Clay, Sand-Clay		**SM** Silt, Sand-Silt		**SC** Clay-Sand, Sand-Clay		Composite
		Use Silt Loam		**Use Sandy Clay**		**Use Silt Loam**		**Use Sandy Clay**		
Basin	Area	XKSAT =	0.40	XKSAT =	0.20	XKSAT =	0.40	XKSAT =	0.20	XKSAT
	acres (At)	Area (Ai)	% Area	Area (Ai)	% Area	Area (Ai)	% Area	Area (Ai)	% Area	in/hour
Pre	15.67	4.82	30.8%	1.21	7.7%	6.03	38.5%	3.62	23.1%	**0.323**

XKSAT values from ADWR State Standard SS10-07, Table 3.4
Surface soil types are obtained from the Report of Geotechnical Investigation boring logs

Sedona Marriott

Green and Ampt Rainfall Loss Parameters

Basin	XKSAT	Comp. DTHETA	Comp. PSIF	Comp. Veg. Cover %	Comp. Ck Factor	Adjusted XKSAT	Comp. IA	Comp. RTIMP
Pre	0.323	0.34	4.30	10.0%	1.0000	0.3229	0.35	0.0%

HYDRAULIC CONDUCTIVITY (XKSAT)	ADWR DRAINAGE MANUAL TABLE 3.4
VOLUMETRIC MOISTURE DEFECIT (DTHETA)	ADWR DRAINAGE MANUAL FIGURE 3.7
WETTING FRONT SUCTION (PSIF)	ADWR DRAINAGE MANUAL FIGURE 3.7
COMPOSITE VEGETATIVE COVER	Engineering Estimation
CORRECTION FACTOR (Ck)	ADWR DRAINAGE MANUAL FIGURE 3.8
INITIAL LOSS (IA)	ADWR DRAINAGE MANUAL TABLE 3.3
PERCENT IMPERVIOUS (RTIMP)	ADWR DRAINAGE MANUAL TABLE 3.5

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

Sedona Marriott

Time of Concentration and Storage Coefficient Calculations - Pre-Development

Basin	Area (acres)	Area (sq miles)	L (feet)	L (miles)	L_{ca} (feet)	L_{ca} (miles)	Top Basin Elevation	Bottom Basin Elevation	Slope (ft/mile)	RTIMP %	Formula Used	100/25-Year T_c (Hours)	100/25-Year Storage Coefficient R	10-Year T_c (Hours) (100-Year *1.36)	10-Year Storage Coefficient R	2-Year T_c (Hours) (100-Year *1.99)	2-Year Storage Coefficient R
1A	0.9086	0.0014	400	0.0758	200	0.0379	4499	4484	198	0.00	Desert	0.1001	0.1533	0.1492	0.2387	0.2513	0.4258
1B	2.3397	0.0037	778	0.1473	482	0.0913	4516	4479	251	0.00	Desert	0.1544	0.2463	0.2301	0.3834	0.3876	0.6841
2A	2.3513	0.0037	340	0.0644	124	0.0235	4499	4467	497	0.00	Desert	0.0780	0.0594	0.1163	0.0925	0.1959	0.1649
2B	2.3754	0.0037	614	0.1163	274	0.0519	4534	4500	292	0.00	Desert	0.1228	0.1566	0.1829	0.2439	0.3082	0.4351
2C	3.1079	0.0049	658	0.1246	328	0.0621	4540	4486	433	0.00	Desert	0.1241	0.1437	0.1849	0.2237	0.3114	0.3991

Equations Used For Time of Concentration:

$$Tc = 3.2A^{.1}L^{.25}L_{CA}{}^{.25}S^{-.14}RTIMP^{-.36}$$ (Urban)

$$Tc = 2.4A^{.1}L^{.25}L_{CA}{}^{.25}S^{-.2}$$ (Desert/Mountain)

Equations 3.4 ADWR Drainage Design Manual

Equation Used For Storage Coefficient:

$$R = .37T_c^{1.11}L^{.80}A^{-.57}$$ (T_c from Respective Event Frequency is Used)

Equation 3.5 ADWR Drainage Design Manual

Equations used for undeveloped 2-Year and 10-Year T_c:

$$Tc = (1/0.10)^{0.4}T_{C100}$$ (2-Year = 2.51 Ratio)

$$Tc = (1/0.37)^{0.4}T_{C100}$$ (10-Year = 1.49 Ratio)

Equation 4.5 and Table 4.5 City of Tucson Drainage Design Manual

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF

Sedona Marriott

Time of Concentration and Storage Coefficient Calculations - Post-Development

Basin	Area (acres)	Area (sq miles)	L (feet)	L (miles)	L_{ca} (feet)	L_{ca} (miles)	Top Basin Elevation	Bottom Basin Elevation	Slope (ft/mile)	RTIMP %	Formula Used	100/25-Year T_c (Hours)	100/25-Year Storage Coefficient R	10-Year T_c (Hours)	10-Year Storage Coefficient R	2-Year T_c (Hours)	2-Year Storage Coefficient R
1A	0.6928	0.0011	492	0.0932	277	0.0525	4495	4484	118	100	Urban	0.0418	0.0800	0.0551	0.1089	0.0764	0.1565
1B	0.5383	0.0008	278	0.0527	115	0.0218	4490	4483	133	100	Urban	0.0279	0.0374	0.0368	0.0508	0.0510	0.0731
1C	2.3741	0.0037	778	0.1473	479	0.0907	4516	4479	251	0	Desert	0.1544	0.2442	0.2301	0.3802	0.3876	0.6783
2A	0.2369	0.0004	204	0.0386	106	0.0201	4483	4477	155	0	Desert	0.0663	0.1217	0.0987	0.1895	0.1663	0.3381
2B	0.2457	0.0004	185	0.0350	79	0.0150	4486	4475	314	100	Urban	0.0188	0.0272	0.0248	0.0370	0.0344	0.0532
2C	0.0433	0.0001	65	0.0123	25	0.0047	4500	4499	81	100	Urban	0.0170	0.0284	0.0224	0.0386	0.0311	0.0555
2D	0.3686	0.0006	192	0.0364	81	0.0153	4486	4480	165	0	Desert	0.0630	0.0852	0.0939	0.1327	0.1581	0.2367
2E	0.1639	0.0003	147	0.0278	74	0.0140	4500	4499	36	100	Urban	0.0227	0.0352	0.0300	0.0479	0.0415	0.0688
2F	0.2671	0.0004	220	0.0417	105	0.0199	4500	4498	48	100	Urban	0.0276	0.0457	0.0365	0.0623	0.0506	0.0895
2G	0.0971	0.0002	145	0.0275	45	0.0085	4487	4470	619	0	Desert	0.0341	0.0736	0.0508	0.1146	0.0855	0.2044
2H	0.1683	0.0003	121	0.0229	51	0.0097	4500	4499	44	100	Urban	0.0192	0.0247	0.0254	0.0336	0.0352	0.0482
2I	0.1527	0.0002	140	0.0265	63	0.0119	4500	4499	38	100	Urban	0.0212	0.0327	0.0280	0.0445	0.0389	0.0640
2J	2.3754	0.0037	614	0.1163	274	0.0519	4534	4500	292	0	Desert	0.1228	0.1566	0.1829	0.2439	0.3082	0.4351
2K	3.1079	0.0049	658	0.1246	328	0.0621	4540	4486	433	0	Desert	0.1241	0.1437	0.1849	0.2237	0.3114	0.3991
3A	0.1021	0.0002	This area (0.1021 acres or less) has already been accounted for in Courtyard by Marriott drainage design and will be directly connected to the Phase 1 storm drain network.														

Note: Red highlighted text is manually rounded up for HEC-HMS minimum input

Equations Used For Time of Concentration:

$$Tc = 3.2A^{.1}L^{.25}L_{CA}{}^{.25}S^{-.14}RTIMP^{-.36}$$ (Urban)

$$Tc = 2.4A^{.1}L^{.25}L_{CA}{}^{.25}S^{-.2}$$ (Desert/Mountain)

Equations 3.4 ADWR Drainage Design Manual

Equation Used For Storage Coefficient:

$$R = .37T_c^{1.11}L^{.80}A^{-.57}$$ (T_c from Respective Event Frequency is Used)

Equation 3.5 ADWR Drainage Design Manual

Equations used for undeveloped 2-Year and 10-Year T_c:

$$Tc = (1/0.10)^{0.4}T_{C100}$$ (2-Year = 2.51 Ratio)

$$Tc = (1/0.37)^{0.4}T_{C100}$$ (10-Year = 1.49 Ratio)

Equation 4.5 and Table 4.5 City of Tucson Drainage Design Manual

Equations used for developed 2-Year and 10-Year T_c:

$$Tc = (1/0.22)^{0.4}T_{C100}$$ (2-Year = 1.83 Ratio)

$$Tc = (1/0.50)^{0.4}T_{C100}$$ (10-Year = 1.32 Ratio)

Equation 4.5 and Table 4.5 City of Tucson Drainage Design Manual

STANDARDS MANUAL FOR DRAINAGE DESIGN AND FLOODPLAIN MANAGEMENT IN TUCSON, ARIZONA

DECEMBER, 1989

(REVISED JULY, 1998)

Prepared for
City of Tucson
Department of Transportation
Engineering Division

Prepared by
Simons, Li & Associates, Inc.

TABLE 4.4: CONTRIBUTING AREA FACTORS				
TYPE OF LAND USE				
NATURAL/ RURAL	SUBURBAN	MODERATELY URBAN	HIGHLY URBAN	COMMERCIAL/ INDUSTRIAL
1.00	0.90	0.70	0.80	0.90

NOTE: While the Contributing Area Factors listed in Table 4.4 are consistent with TSMS hydrology, there are other values of these factors which may be more appropriate for use with the particular application intended. Accordingly, when applying the Flood Peak Estimator Procedure, it is the responsibility of the engineer to verify the appropriateness of using the factors listed in Table 4.4 in conjunction with the land-use characteristics of the contributing watershed associated with a site-specific project. Consequently, the engineer shall provide the City Engineer with sufficient supporting data (e.g., aerial-photographic analysis and field verification), as required, to justify use of the Contributing Area Factors which have been chosen. The TSMS, Phase II report titled: "Existing Conditions Hydrologic Modeling" (SLA, 1995), as well as TSMS, Phase II Technical Memorandum No. 4.10[f] (SLA, 1993), provide detailed documentation for the development and application of Contributing Area Factors for individual land uses within the City of Tucson.

TABLE 4.5: RATIOS OF MORE FREQUENT FLOODS TO THE 100-YEAR FLOOD					
PREDOMINANT WATERSHED TYPE	RECURRENCE INTERVAL				
	2-YR	5-YR	10-YR	25-YR	50-YR
Pre NATURAL/RURAL	0.10	0.23	0.37	0.58	0.77
SUBURBAN	0.13	0.28	0.41	0.61	0.79
MODERATELY URBAN	0.18	0.30	0.46	0.65	0.85
Post HIGHLY URBAN/ COMMERCIAL-INDUSTRIAL	0.22	0.35	0.50	0.70	0.90

NOTE: The ratios listed in Table 4.5 are indexed to 100-year flood peaks computed from the procedures found within this chapter, and are compatible with TSMS hydrology. Consequently, if less than 100-year flood peaks are computed by using the full Flood Peak Estimator Procedure, the engineer should note that it may no longer be appropriate to use "100-year" basin factors from Table 4.2 of this chapter (i.e., n_{b100}'s may be too large for computing the more frequent events).

computed to be outside of the channel (Q_{po}), all divided by the numerical value of 100 (i.e., $n_{bc100} = [n_{bn100}Q_{pc} + n_{bu100}Q_{po}]/100$).

Finally, if the bankfull capacity of the channel is equal to or greater than 100% of the computed 100-year discharge, then the 100-year basin factors originally chosen are the appropriate ones to be used.

The preceding evaluation procedure for the selection of 100-year basin factors should always be employed before classifying any channel within the City of Tucson as "underfit."

4.4 Calculating Times of Concentration for Frequent Floods

This procedure should only be applied to "small watersheds," which are defined as watersheds whose times of concentration for a 2-year flood are less than 180 minutes.

Step 1: Compute the time of concentration (T_{c100}) and the peak discharge (Q_{p100}) for the 100-year flood using the City of Tucson Flood Peak Estimator Procedure.

Step 2: Compute Q_{pn} (see Equation 4.5) for floods with recurrence intervals of less than 100 years by multiplying Q_{p100} by the appropriate factors provided in Table 4.5.

Step 3: Compute the times of concentration for floods with recurrence intervals of less than 100 years by utilizing the following relationship:

	2-Year	10-Year
Pre	2.51	1.49
Post	1.83	1.32

$$T_{cn} = \left(\frac{Q_{p100}}{Q_{pn}}\right)^{0.4} T_{c100} \qquad \textbf{(4.5)}$$

Where:

T_{cn} = Time of concentration for the n-year flood ($T_{cn} > T_{c100}$), in minutes;
T_{c100} = Time of concentration for the 100-year flood, in minutes;
Q_{pn} = Peak discharge for the n-year flood (determined as described under Step Two of this procedure), in cubic feet per second (cfs); and,
Q_{p100} = Peak discharge for the 100-year flood, in cubic feet per second.

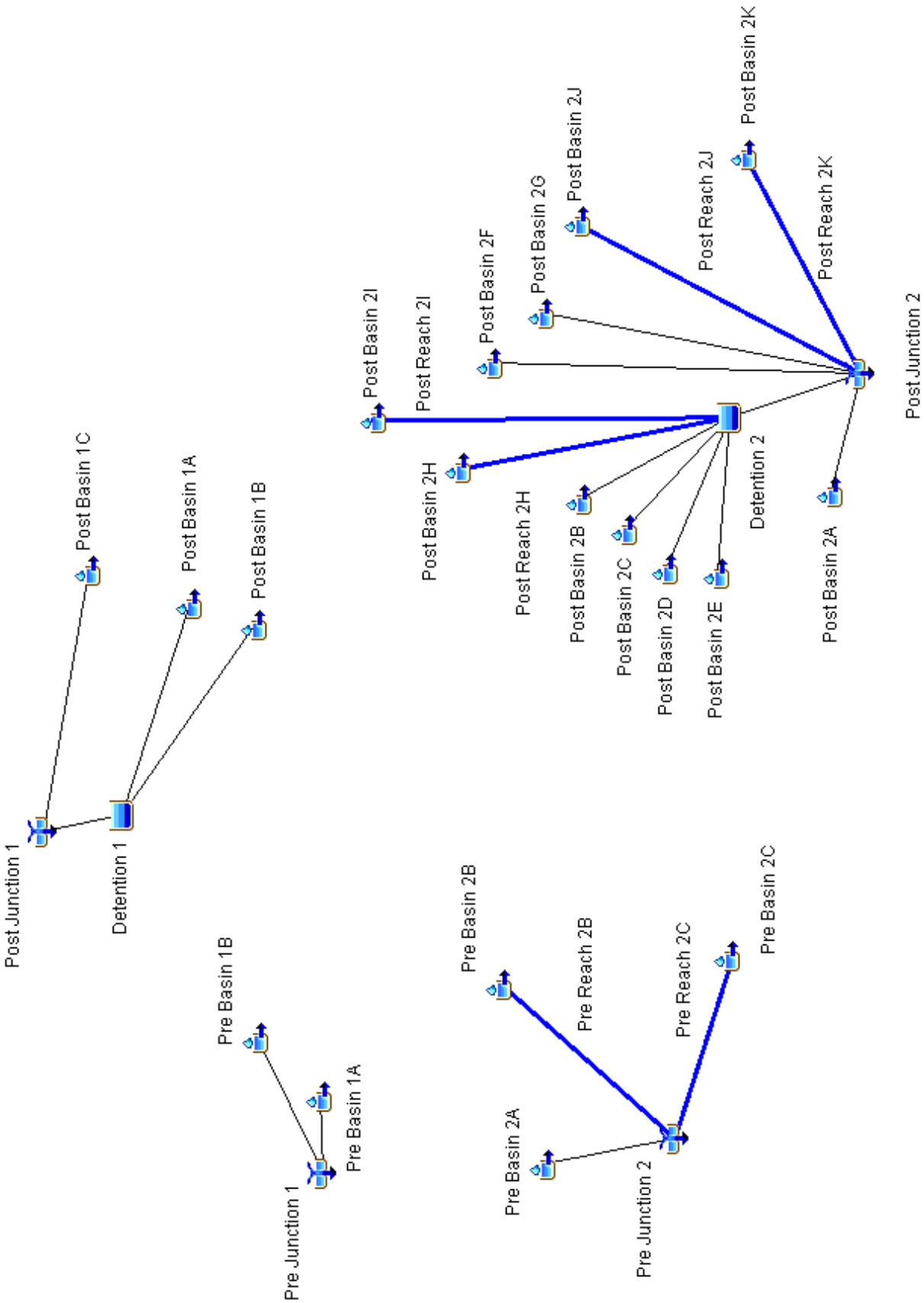
4.5 Development of a Flood Hydrograph

When using the Flood Peak Estimator Procedure provided within this chapter, a corresponding flood hydrograph for the watershed under investigation shall be based upon the

Section 7.4

HEC-HMS Basin Schematic, Runoff Results, and Design Point Summary

Residence Inn by Marriott
HEC-HMS Basin Schematic



Project: Marriott2_HMS Simulation Run: 2-Year

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 28Dec2016, 17:01:56

Basin Model: 2-Year
Meteorologic Model: 2-Year
Control Specifications: Sedona Marriot

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Detention 1	0.0019	0.25	01Jan2000, 02:13	0.60
Detention 2	0.0019	0.32	01Jan2000, 01:57	0.60
Post Basin 1A	0.0011	0.91	01Jan2000, 01:38	0.60
Post Basin 1B	0.0008	1.02	01Jan2000, 01:35	0.60
Post Basin 1C	0.0037	0.03	01Jan2000, 01:54	0.01
Post Basin 2A	0.0004	0.01	01Jan2000, 01:42	0.01
Post Basin 2B	0.0004	0.65	01Jan2000, 01:34	0.95
Post Basin 2C	0.0001	0.16	01Jan2000, 01:34	0.95
Post Basin 2D	0.0006	0.15	01Jan2000, 01:40	0.13
Post Basin 2E	0.0003	0.45	01Jan2000, 01:34	0.95
Post Basin 2F	0.0004	0.55	01Jan2000, 01:35	0.95
Post Basin 2G	0.0002	0.06	01Jan2000, 01:37	0.13
Post Basin 2H	0.0003	0.46	01Jan2000, 01:34	0.60
Post Basin 2I	0.0002	0.27	01Jan2000, 01:34	0.60
Post Basin 2J	0.0037	0.04	01Jan2000, 01:50	0.01
Post Basin 2K	0.0049	0.06	01Jan2000, 01:50	0.01
Post Junction 1	0.0056	0.27	01Jan2000, 02:02	0.21
Post Junction 2	0.0115	0.82	01Jan2000, 01:35	0.14
Post Reach 2H	0.0003	0.45	01Jan2000, 01:36	0.60
Post Reach 2I	0.0002	0.26	01Jan2000, 01:37	0.60
Post Reach 2J	0.0037	0.04	01Jan2000, 01:59	0.01
Post Reach 2K	0.0049	0.06	01Jan2000, 01:54	0.01
Pre Basin 1A	0.0014	0.02	01Jan2000, 01:47	0.01
Pre Basin 1B	0.0037	0.03	01Jan2000, 01:55	0.01
Pre Basin 2A	0.0037	0.09	01Jan2000, 01:43	0.01
Pre Basin 2B	0.0037	0.04	01Jan2000, 01:50	0.01
Pre Basin 2C	0.0049	0.06	01Jan2000, 01:50	0.01

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Pre Junction 1	0.0051	0.04	01Jan2000, 01:53	0.01
Pre Junction 2	0.0123	0.12	01Jan2000, 01:44	0.01
Pre Reach 2B	0.0037	0.04	01Jan2000, 02:03	0.01
Pre Reach 2C	0.0049	0.06	01Jan2000, 01:53	0.01

Project: Marriott2_HMS Simulation Run: 10-Year

Start of Run: 01Jan2000, 00:00 Basin Model: 10-Year
End of Run: 02Jan2000, 00:00 Meteorologic Model: 10-Year
Compute Time: 28Dec2016, 17:04:05 Control Specifications: Sedona Marriot

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Detention 1	0.0019	1.08	01Jan2000, 01:53	1.28
Detention 2	0.0019	4.58	01Jan2000, 01:35	1.21
Post Basin 1A	0.0011	2.47	01Jan2000, 01:35	1.28
Post Basin 1B	0.0008	2.37	01Jan2000, 01:34	1.28
Post Basin 1C	0.0037	1.71	01Jan2000, 01:45	0.39
Post Basin 2A	0.0004	0.33	01Jan2000, 01:38	0.39
Post Basin 2B	0.0004	1.28	01Jan2000, 01:33	1.63
Post Basin 2C	0.0001	0.32	01Jan2000, 01:33	1.63
Post Basin 2D	0.0006	0.82	01Jan2000, 01:37	0.56
Post Basin 2E	0.0003	0.90	01Jan2000, 01:34	1.63
Post Basin 2F	0.0004	1.13	01Jan2000, 01:34	1.63
Post Basin 2G	0.0002	0.31	01Jan2000, 01:35	0.56
Post Basin 2H	0.0003	0.97	01Jan2000, 01:33	1.28
Post Basin 2I	0.0002	0.61	01Jan2000, 01:33	1.28
Post Basin 2J	0.0037	2.41	01Jan2000, 01:42	0.39
Post Basin 2K	0.0049	3.37	01Jan2000, 01:42	0.39
Post Junction 1	0.0056	2.71	01Jan2000, 01:45	0.69
Post Junction 2	0.0115	8.96	01Jan2000, 01:40	0.57
Post Reach 2H	0.0003	0.95	01Jan2000, 01:35	1.29
Post Reach 2I	0.0002	0.60	01Jan2000, 01:35	1.29
Post Reach 2J	0.0037	2.40	01Jan2000, 01:44	0.39
Post Reach 2K	0.0049	3.36	01Jan2000, 01:43	0.39
Pre Basin 1A	0.0014	0.95	01Jan2000, 01:40	0.39
Pre Basin 1B	0.0037	1.70	01Jan2000, 01:45	0.39
Pre Basin 2A	0.0037	4.53	01Jan2000, 01:37	0.39
Pre Basin 2B	0.0037	2.41	01Jan2000, 01:42	0.39
Pre Basin 2C	0.0049	3.37	01Jan2000, 01:42	0.39

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Pre Junction 1	0.0051	2.54	01Jan2000, 01:43	0.39
Pre Junction 2	0.0123	8.86	01Jan2000, 01:41	0.39
Pre Reach 2B	0.0037	2.41	01Jan2000, 01:44	0.39
Pre Reach 2C	0.0049	3.36	01Jan2000, 01:42	0.39

Project: Marriott2_HMS Simulation Run: 25-Year

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 28Dec2016, 17:05:29

Basin Model: 100/25-Year
Meteorologic Model: 25-Year
Control Specifications: Sedona Marriot

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Detention 1	0.0019	2.17	01Jan2000, 01:47	1.99
Detention 2	0.0019	8.11	01Jan2000, 01:34	1.87
Post Basin 1A	0.0011	4.29	01Jan2000, 01:34	1.99
Post Basin 1B	0.0008	3.82	01Jan2000, 01:33	1.99
Post Basin 1C	0.0037	5.40	01Jan2000, 01:41	0.95
Post Basin 2A	0.0004	0.93	01Jan2000, 01:36	0.95
Post Basin 2B	0.0004	2.01	01Jan2000, 01:33	2.34
Post Basin 2C	0.0001	0.50	01Jan2000, 01:33	2.34
Post Basin 2D	0.0006	1.85	01Jan2000, 01:35	1.14
Post Basin 2E	0.0003	1.46	01Jan2000, 01:33	2.34
Post Basin 2F	0.0004	1.83	01Jan2000, 01:33	2.34
Post Basin 2G	0.0002	0.67	01Jan2000, 01:34	1.14
Post Basin 2H	0.0003	1.52	01Jan2000, 01:33	1.99
Post Basin 2I	0.0002	0.98	01Jan2000, 01:33	1.99
Post Basin 2J	0.0037	7.19	01Jan2000, 01:39	0.95
Post Basin 2K	0.0049	9.96	01Jan2000, 01:38	0.95
Post Junction 1	0.0056	7.37	01Jan2000, 01:41	1.30
Post Junction 2	0.0115	24.20	01Jan2000, 01:38	1.15
Post Reach 2H	0.0003	1.49	01Jan2000, 01:34	1.99
Post Reach 2I	0.0002	0.96	01Jan2000, 01:35	2.00
Post Reach 2J	0.0037	7.18	01Jan2000, 01:40	0.95
Post Reach 2K	0.0049	9.96	01Jan2000, 01:39	0.95
Pre Basin 1A	0.0014	2.80	01Jan2000, 01:38	0.95
Pre Basin 1B	0.0037	5.37	01Jan2000, 01:41	0.95
Pre Basin 2A	0.0037	11.71	01Jan2000, 01:35	0.95
Pre Basin 2B	0.0037	7.19	01Jan2000, 01:39	0.95
Pre Basin 2C	0.0049	9.96	01Jan2000, 01:38	0.95

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Pre Junction 1	0.0051	7.95	01Jan2000, 01:40	0.95
Pre Junction 2	0.0123	25.99	01Jan2000, 01:37	0.95
Pre Reach 2B	0.0037	7.18	01Jan2000, 01:40	0.95
Pre Reach 2C	0.0049	9.96	01Jan2000, 01:39	0.95

Project: Marriott2_HMS Simulation Run: 100-Year

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 28Dec2016, 17:06:30

Basin Model: 100/25-Year
Meteorologic Model: 100-Year
Control Specifications: Sedona Marriot

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Detention 1	0.0019	3.94	01Jan2000, 01:44	2.79
Detention 2	0.0019	11.34	01Jan2000, 01:34	2.64
Post Basin 1A	0.0011	5.79	01Jan2000, 01:34	2.79
Post Basin 1B	0.0008	5.13	01Jan2000, 01:33	2.79
Post Basin 1C	0.0037	8.52	01Jan2000, 01:41	1.65
Post Basin 2A	0.0004	1.43	01Jan2000, 01:36	1.65
Post Basin 2B	0.0004	2.71	01Jan2000, 01:33	3.14
Post Basin 2C	0.0001	0.68	01Jan2000, 01:33	3.14
Post Basin 2D	0.0006	2.67	01Jan2000, 01:35	1.85
Post Basin 2E	0.0003	1.96	01Jan2000, 01:33	3.14
Post Basin 2F	0.0004	2.46	01Jan2000, 01:33	3.14
Post Basin 2G	0.0002	0.96	01Jan2000, 01:34	1.85
Post Basin 2H	0.0003	2.05	01Jan2000, 01:33	2.79
Post Basin 2I	0.0002	1.32	01Jan2000, 01:33	2.79
Post Basin 2J	0.0037	11.17	01Jan2000, 01:39	1.65
Post Basin 2K	0.0049	15.47	01Jan2000, 01:38	1.65
Post Junction 1	0.0056	12.33	01Jan2000, 01:41	2.03
Post Junction 2	0.0115	36.76	01Jan2000, 01:37	1.87
Post Reach 2H	0.0003	2.01	01Jan2000, 01:34	2.79
Post Reach 2I	0.0002	1.29	01Jan2000, 01:35	2.79
Post Reach 2J	0.0037	11.16	01Jan2000, 01:40	1.65
Post Reach 2K	0.0049	15.46	01Jan2000, 01:39	1.65
Pre Basin 1A	0.0014	4.34	01Jan2000, 01:38	1.65
Pre Basin 1B	0.0037	8.47	01Jan2000, 01:41	1.65
Pre Basin 2A	0.0037	17.58	01Jan2000, 01:35	1.65
Pre Basin 2B	0.0037	11.17	01Jan2000, 01:39	1.65
Pre Basin 2C	0.0049	15.47	01Jan2000, 01:38	1.65

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Pre Junction 1	0.0051	12.50	01Jan2000, 01:40	1.65
Pre Junction 2	0.0123	40.53	01Jan2000, 01:37	1.65
Pre Reach 2B	0.0037	11.16	01Jan2000, 01:40	1.65
Pre Reach 2C	0.0049	15.44	01Jan2000, 01:39	1.65

Sedona Marriott

Green & Ampt Method Runoff Summary

Basin	Pre-Development				Post-Development w/o Detention or Routing				Post-Development with Detention & Routing			
	2-Year	10-Year	25-Year	100-Year	2-Year	10-Year	25-Year	100-Year	2-Year	10-Year	25-Year	100-Year
	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)
	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
1	0.04	2.54	7.95	12.50	1.96	6.55	13.51	19.44	0.27	2.71	7.37	12.33
2	0.12	8.86	25.99	40.53	2.86	12.45	28.90	42.88	0.82	8.96	24.20	36.76
	0.16	**11.40**	**33.94**	**53.03**	**4.82**	**19.00**	**42.41**	**62.32**	**1.09**	**11.67**	**31.57**	**49.09**

Basin	Change w/o Detention or Routing				Change with Detention & Routing			
	2-Year	10-Year	25-Year	100-Year	2-Year	10-Year	25-Year	100-Year
1	**1.92**	**4.01**	**5.56**	**6.94**	**0.23**	**0.17**	**-0.58**	**-0.17**
2	**2.74**	**3.59**	**2.91**	**2.35**	**0.70**	**0.10**	**-1.79**	**-3.77**

Red represents > 1 cfs increase. **Green represents ≤ 1 cfs increase.**

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Final Design Report
Design Point Summary

Section 7.5

Drainage Structures Calculation Worksheets

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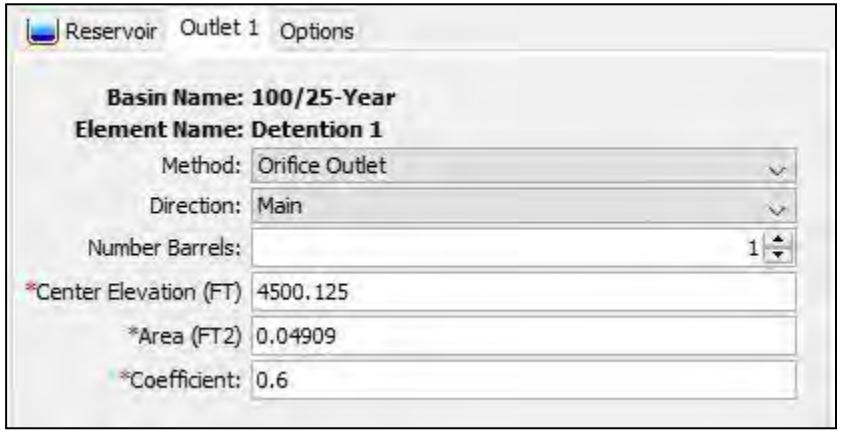
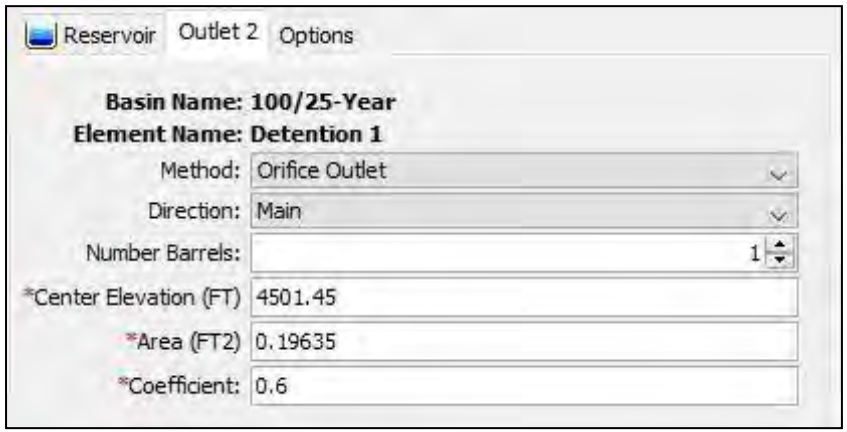
Final Design Report
Drainage Structures Calculation Worksheets

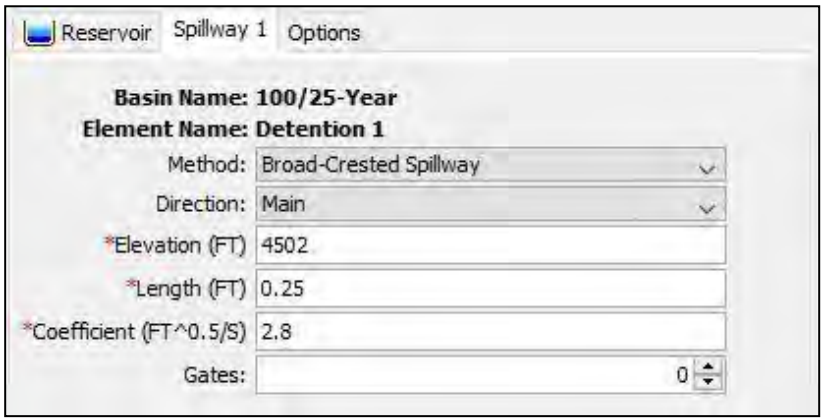
Section 7.6

HEC-HMS Detention Volumes, Outlet Configuration, and Results

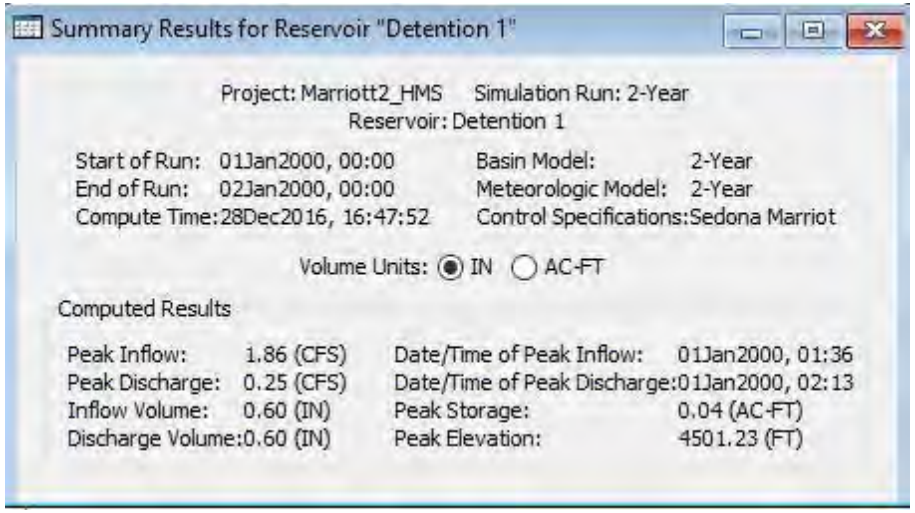
Residence Inn by Marriott
HEC-HMS Basin 1 Detention Outlet Configuration

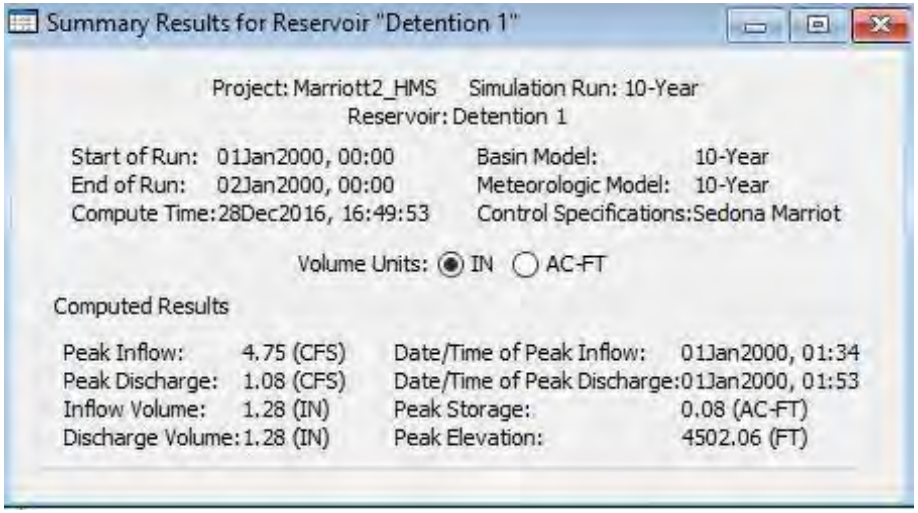


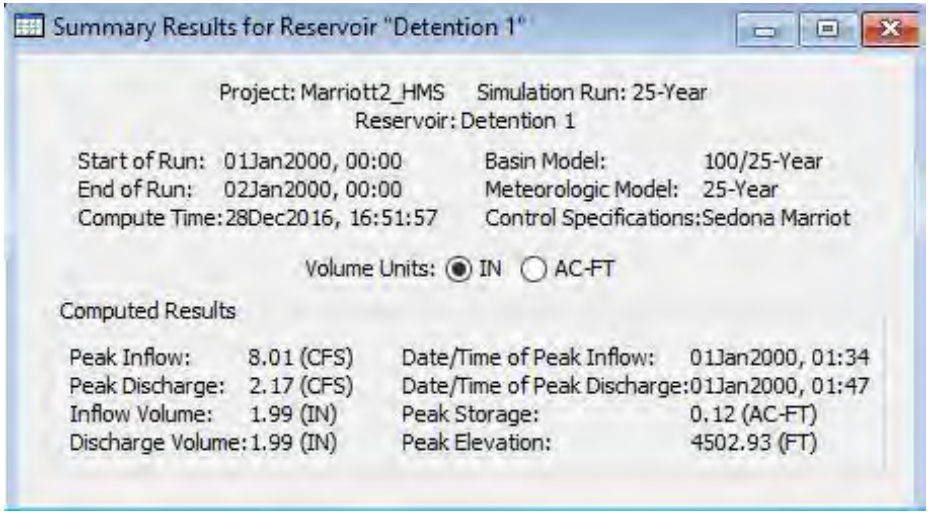


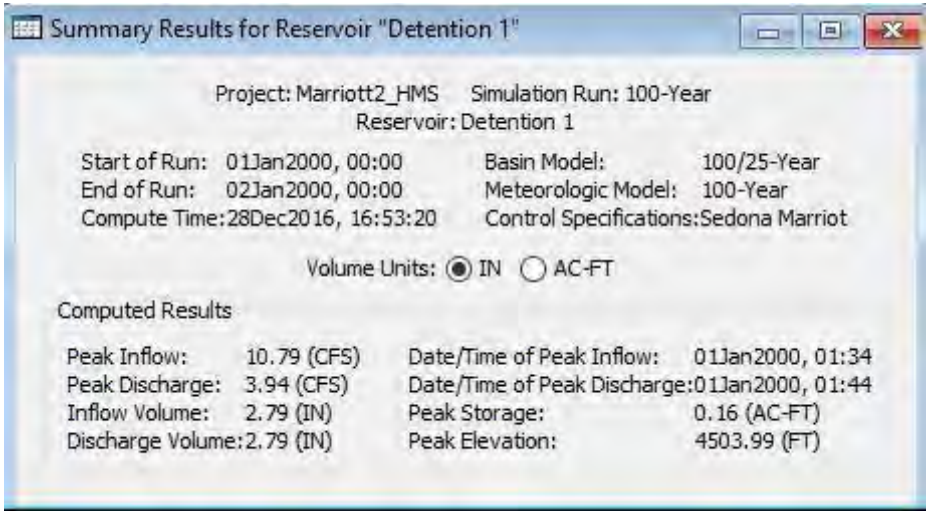


Residence Inn by Marriott
HEC-HMS Basin 1 Detention Summary Tables

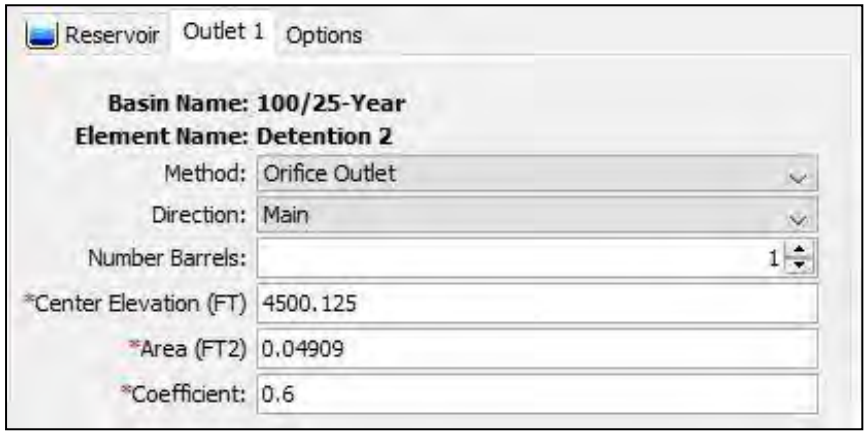


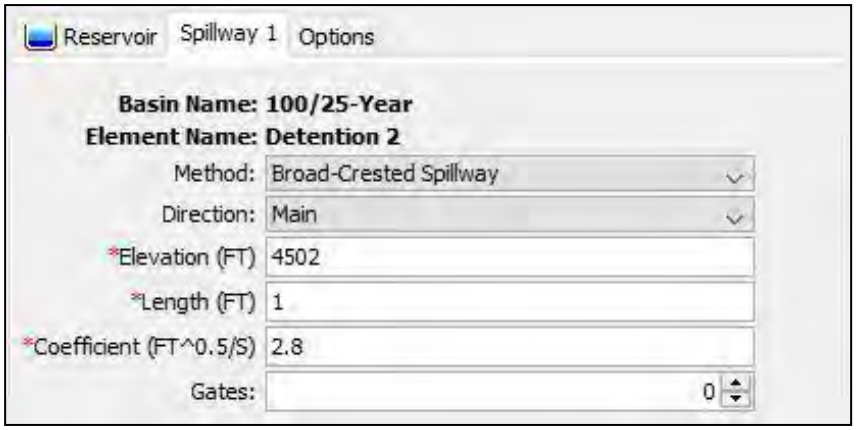




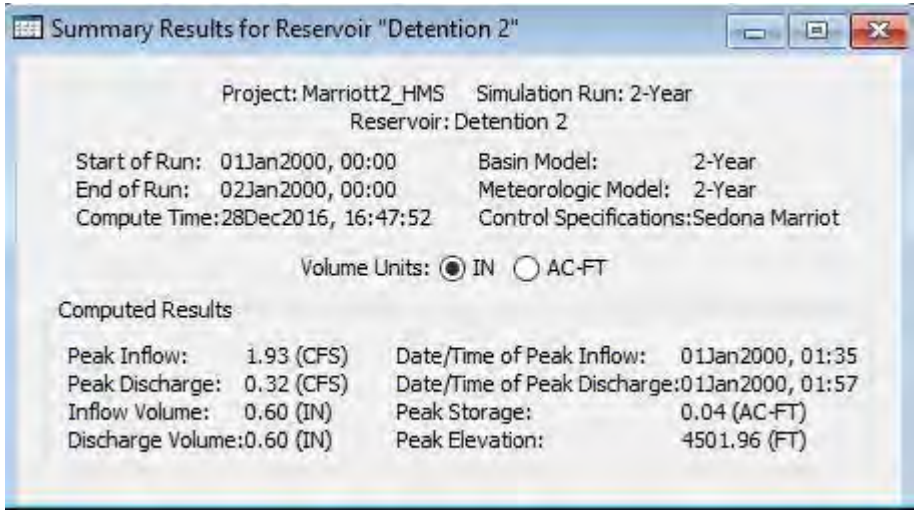


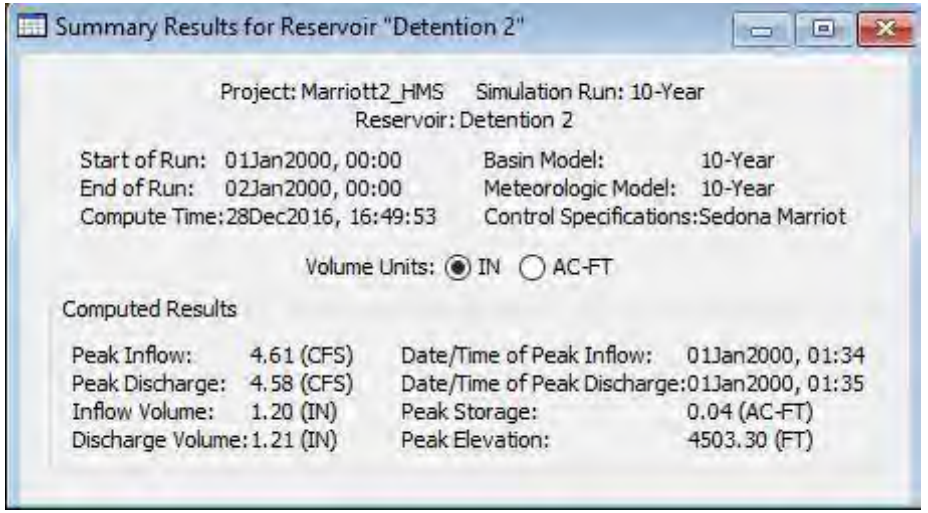
Residence Inn by Marriott
HEC-HMS Basin 2 Detention Outlet Configuration

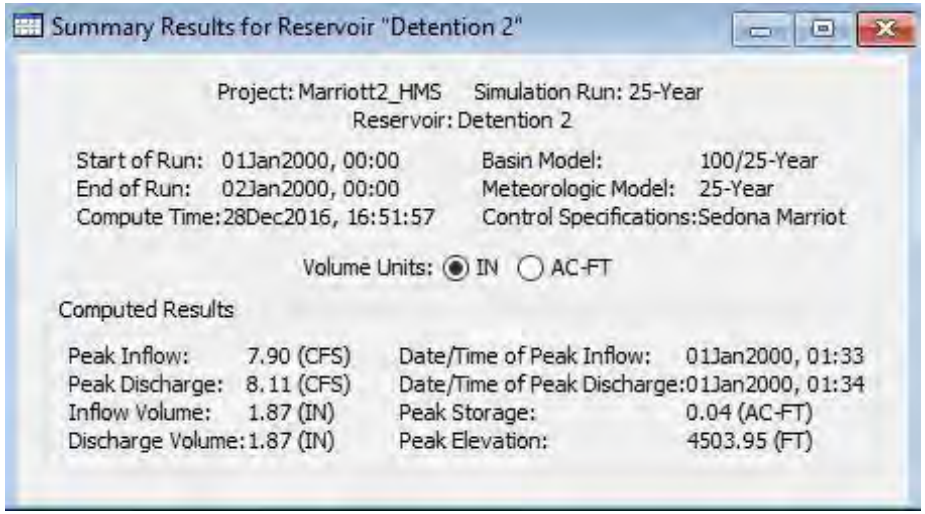




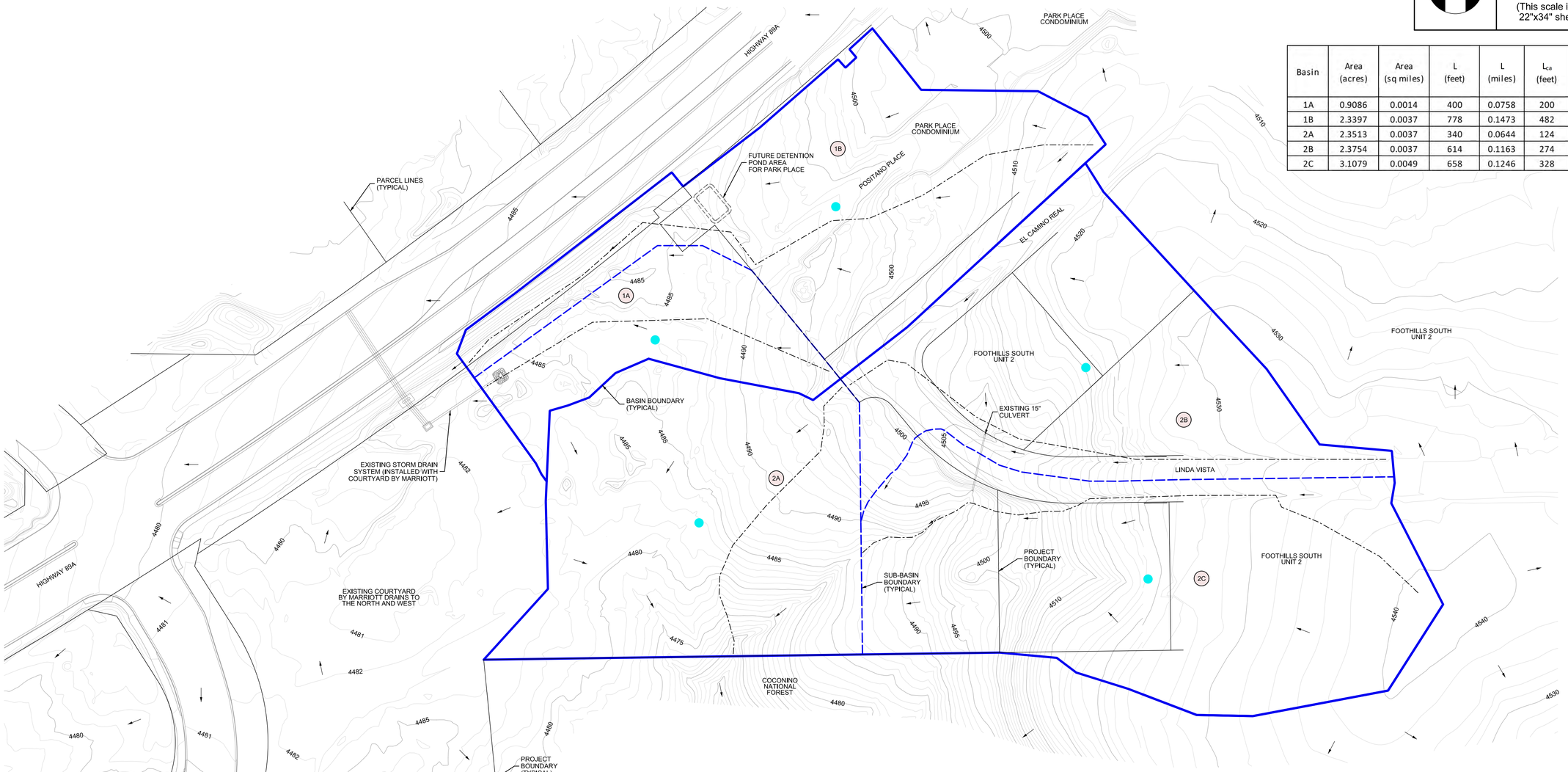
Residence Inn by Marriott
HEC-HMS Basin 2 Detention Summary Tables







REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF



Basin	Area (acres)	Area (sq miles)	L (feet)	L (miles)	L_{ca} (feet)	L_{ca} (miles)
1A	0.9086	0.0014	400	0.0758	200	0.0379
1B	2.3397	0.0037	778	0.1473	482	0.0913
2A	2.3513	0.0037	340	0.0644	124	0.0235
2B	2.3754	0.0037	614	0.1163	274	0.0519
2C	3.1079	0.0049	658	0.1246	328	0.0621

Basin	Pre-Development				Post-Development w/o Detention or Routing				Post-Development with Detention & Routing			
	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	25-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	25-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	25-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
1	0.04	2.54	7.95	12.50	1.96	6.55	13.51	19.44	0.27	2.71	7.37	12.33
2	0.12	8.86	25.99	40.53	2.86	12.45	28.90	42.88	0.82	8.96	24.20	36.76
	0.16	**11.40**	**33.94**	**53.03**	**4.82**	**19.00**	**42.41**	**62.32**	**1.09**	**11.67**	**31.57**	**49.09**

Basin	Change w/o Detention or Routing				Change with Detention & Routing			
	2-Year	10-Year	25-Year	100-Year	2-Year	10-Year	25-Year	100-Year
1	**1.92**	**4.01**	**5.56**	**6.94**	**0.23**	**0.17**	**-0.58**	**-0.17**
2	**2.74**	**3.59**	**2.91**	**2.35**	**0.70**	**0.10**	**-1.79**	**-3.77**

Red represents > 1 cfs increase. **Green represents ≤ 1 cfs increase.**

- 1' AND 2' EXISTING CONTOURS (TYPICAL)
- 1' PROPOSED CONTOURS (TYPICAL)
- SURFACE RUNOFF FLOW DIRECTION
- LOT LINE
- # = SUB-BASIN NUMBER
- DESIGN POINT
- BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- FLOWLINE
- BASIN CENTROID

EXHIBIT USE ONLY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"
IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY.

DESIGN	DRAWN	CHECKED	APPROVED
BAB	BAB	KDH	BAB

NO.	DATE	REVISION	BY	APVD
-	-	-	-	-

LYON ENGINEERING
Civil Engineers • Land Surveyors
1650 Willow Creek Rd, Prescott, AZ 86301
Phone: (928) 776-1750, Fax: (928) 776-0605

RESIDENCE INN
BY MARRIOTT
SEDONA, ARIZONA

CIVIL
EXHIBIT 1:
PRE-DEVELOPMENT
DRAINAGE PLAN

DATE 1/6/2017
LYON PROJECT # 1000-03
DRAWING NUMBER DR.01
SHEET 1 OF 2

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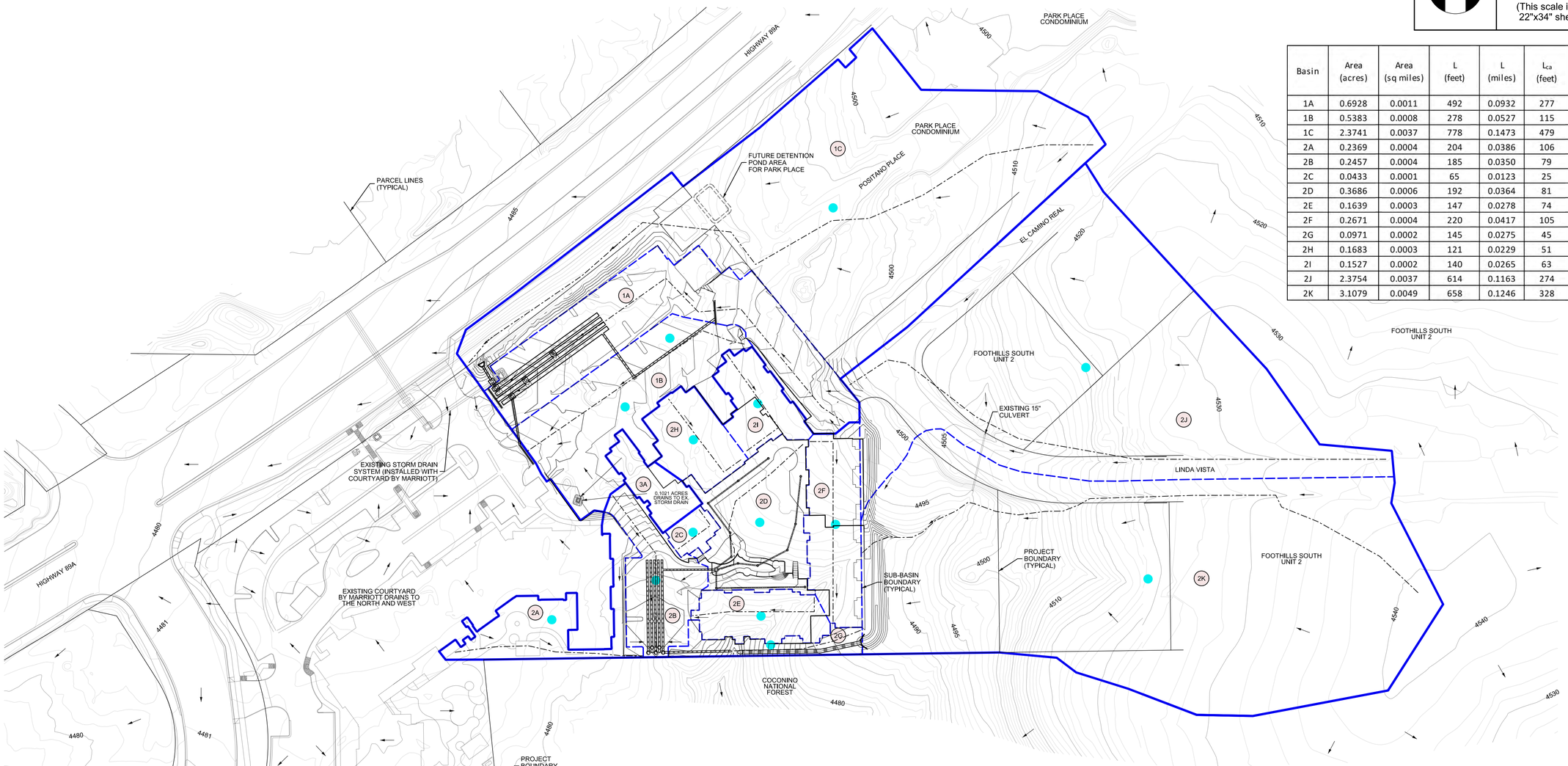

Basin	Area (acres)	Area (sq miles)	L (feet)	L (miles)	L_{ca} (feet)	L_{ca} (miles)
1A	0.6928	0.0011	492	0.0932	277	0.0525
1B	0.5383	0.0008	278	0.0527	115	0.0218
1C	2.3741	0.0037	778	0.1473	479	0.0907
2A	0.2369	0.0004	204	0.0386	106	0.0201
2B	0.2457	0.0004	185	0.0350	79	0.0150
2C	0.0433	0.0001	65	0.0123	25	0.0047
2D	0.3686	0.0006	192	0.0364	81	0.0153
2E	0.1639	0.0003	147	0.0278	74	0.0140
2F	0.2671	0.0004	220	0.0417	105	0.0199
2G	0.0971	0.0002	145	0.0275	45	0.0085
2H	0.1683	0.0003	121	0.0229	51	0.0097
2I	0.1527	0.0002	140	0.0265	63	0.0119
2J	2.3754	0.0037	614	0.1163	274	0.0519
2K	3.1079	0.0049	658	0.1246	328	0.0621

Basin	Pre-Development				Post-Development w/o Detention or Routing				Post-Development with Detention & Routing			
	2-Year	10-Year	25-Year	100-Year	2-Year	10-Year	25-Year	100-Year	2-Year	10-Year	25-Year	100-Year
	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)	Peak Runoff (cfs)
	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
1	0.04	2.54	7.95	12.50	1.96	6.55	13.51	19.44	0.27	2.71	7.37	12.33
2	0.12	8.86	25.99	40.53	2.86	12.45	28.90	42.88	0.82	8.96	24.20	36.76
	0.16	**11.40**	**33.94**	**53.03**	**4.82**	**19.00**	**42.41**	**62.32**	**1.09**	**11.67**	**31.57**	**49.09**

Basin	Change w/o Detention or Routing				Change with Detention & Routing			
	2-Year	10-Year	25-Year	100-Year	2-Year	10-Year	25-Year	100-Year
1	1.92	4.01	5.56	6.94	0.23	0.17	-0.58	-0.17
2	2.74	3.59	2.91	2.35	0.70	0.10	-1.79	-3.77

Red represents > 1 cfs increase. Green represents ≤ 1 cfs increase.

- 1' AND 2' EXISTING CONTOURS (TYPICAL)
- 1' PROPOSED CONTOURS (TYPICAL)
- SURFACE RUNOFF FLOW DIRECTION
- LOT LINE
- # = SUB-BASIN NUMBER
- DESIGN POINT
- BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- FLOWLINE
- BASIN CENTROID

EXHIBIT USE ONLY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"
IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY.

DESIGN BAB | DRAWN BAB | CHECKED KDH | APPROVED BAB

NO.	DATE	REVISION	BY	APVD
-	-		-	-

LYON ENGINEERING
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Phone: (928) 776-1750, Fax: (928) 776-0605

RESIDENCE INN BY MARRIOTT SEDONA, ARIZONA

CIVIL

EXHIBIT 2: POST-DEVELOPMENT DRAINAGE PLAN

DATE 1/6/2017
LYON PROJECT # 1000-03
DRAWING NUMBER DR.02
SHEET 2 OF 2

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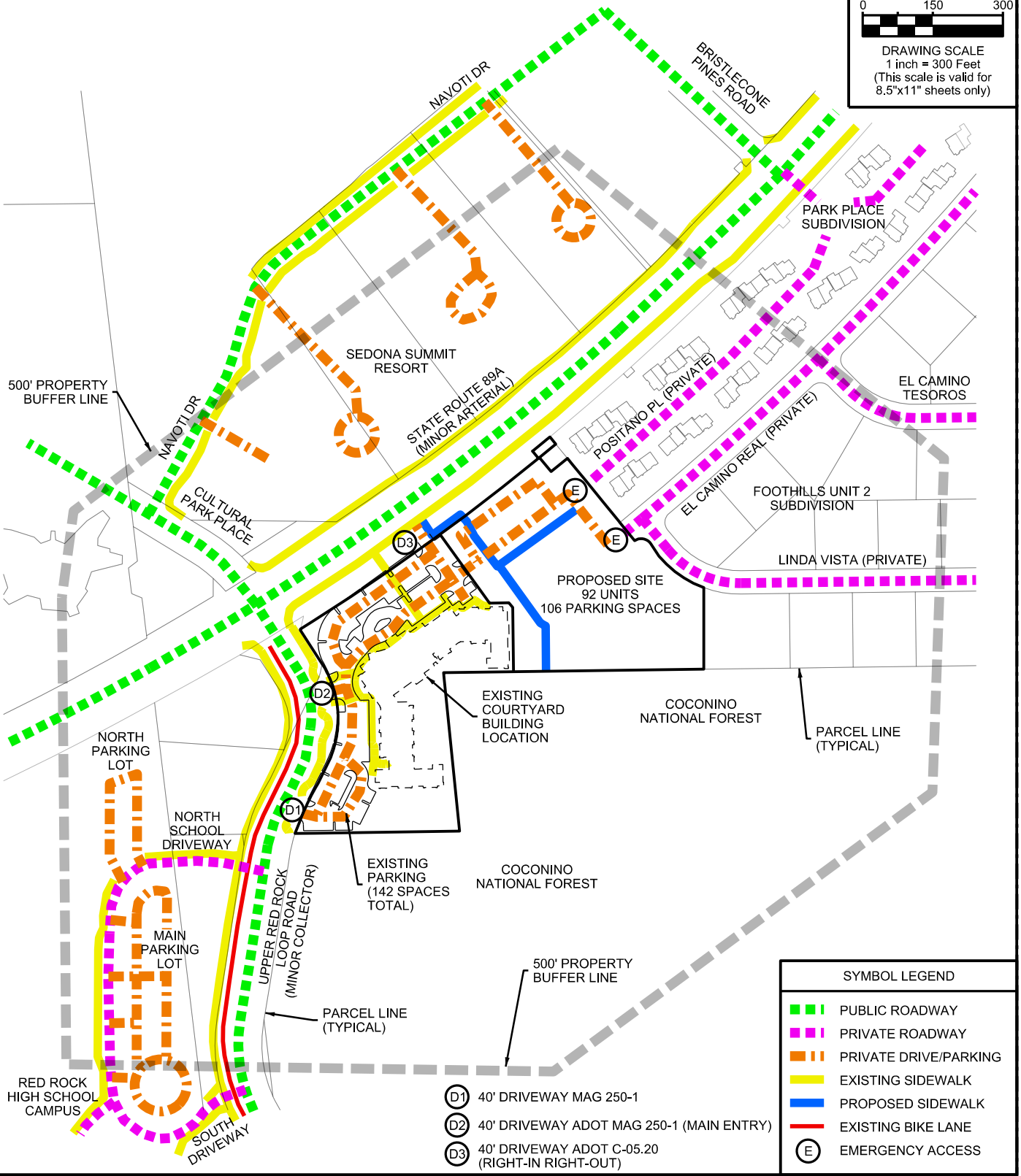
REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF



LYON ENGINEERING
Civil Engineers • Land Surveyors
1650 Willow Creek Rd. Prescott, AZ 86301
Phone: (928) 776-1750, Fax: (928) 776-0605

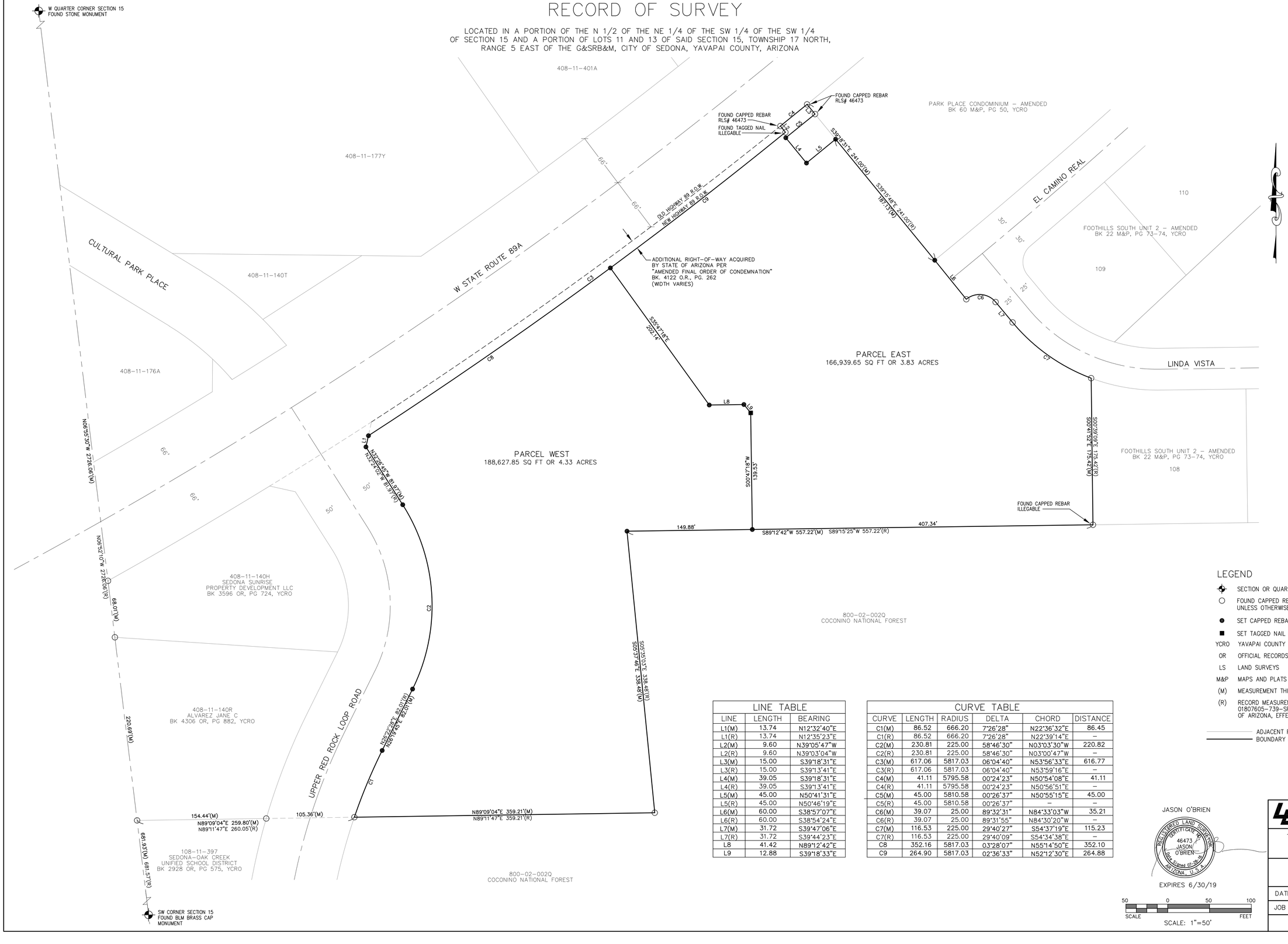
CIRCULATION PLAN EXHIBIT MAP

MARRIOTT RES. INN SEDONA, ARIZONA

DESIGN KDH	DATE JANUARY 2017
DRAWN KDH	LYON PROJECT # 1000-03
CHECKED ---	DRAWING NUMBER CM-01
APPROVED ---	SHEET 1 OF 1

RECORD OF SURVEY

LOCATED IN A PORTION OF THE N 1/2 OF THE NE 1/4 OF THE SW 1/4 OF THE SW 1/4 OF SECTION 15 AND A PORTION OF LOTS 11 AND 13 OF SAID SECTION 15, TOWNSHIP 17 NORTH, RANGE 5 EAST OF THE G&SRB&M, CITY OF SEDONA, YAVAPAI COUNTY, ARIZONA



LINE TABLE		
LINE	LENGTH	BEARING
L1(M)	13.74	N12°32'40"E
L1(R)	13.74	N12°35'23"E
L2(M)	9.60	N39°05'47"W
L2(R)	9.60	N39°03'04"W
L3(M)	15.00	S39°18'31"E
L3(R)	15.00	S39°13'41"E
L4(M)	39.05	S39°18'31"E
L4(R)	39.05	S39°13'41"E
L5(M)	45.00	N50°41'31"E
L5(R)	45.00	N50°46'19"E
L6(M)	60.00	S38°57'07"E
L6(R)	60.00	S38°54'24"E
L7(M)	31.72	S39°47'06"E
L7(R)	31.72	S39°44'23"E
L8	41.42	N89°12'42"E
L9	12.88	S39°18'33"E

CURVE TABLE					
CURVE	LENGTH	RADIUS	DELTA	CHORD	DISTANCE
C1(M)	86.52	666.20	7°26'28"	N22°36'32"E	86.45
C1(R)	86.52	666.20	7°26'28"	N22°39'14"E	–
C2(M)	230.81	225.00	58°46'30"	N03°03'30"W	220.82
C2(R)	230.81	225.00	58°46'30"	N03°00'47"W	–
C3(M)	617.06	5817.03	06°04'40"	N53°56'33"E	616.77
C3(R)	617.06	5817.03	06°04'40"	N53°59'16"E	–
C4(M)	41.11	5795.58	00°24'23"	N50°54'08"E	41.11
C4(R)	41.11	5795.58	00°24'23"	N50°56'51"E	–
C5(M)	45.00	5810.58	00°26'37"	N50°55'15"E	45.00
C5(R)	45.00	5810.58	00°26'37"	–	–
C6(M)	39.07	25.00	89°32'31"	N84°33'03"W	35.21
C6(R)	39.07	25.00	89°31'55"	N84°30'20"W	–
C7(M)	116.53	225.00	29°40'27"	S54°37'19"E	115.23
C7(R)	116.53	225.00	29°40'09"	S54°34'38"E	–
C8	352.16	5817.03	03°28'07"	N55°14'50"E	352.10
C9	264.90	5817.03	02°36'33"	N52°12'30"E	264.88

LEGEND

- SECTION OR QUARTER CORNER
- FOUND CAPPED REBAR LS#14184 UNLESS OTHERWISE SPECIFIED
- SET CAPPED REBAR LS# 46473
- SET TAGGED NAIL LS# 46473
- YCRO YAVAPAI COUNTY RECORDERS OFFICE
- OR OFFICIAL RECORDS
- LS LAND SURVEYS
- M&P MAPS AND PLATS
- (M) MEASUREMENT THIS SURVEY
- (R) RECORD MEASUREMENT PER COMMITMENT NUMBER 01807605-739-SPC, PROVIDED BY LAWYERS TITLE OF ARIZONA, EFFECTIVE DATE OF APRIL 7, 2014.

ADJACENT PROPERTY LINES
BOUNDARY LINE

JASON O'BRIEN
REGISTERED LAND SURVEYOR
CERTIFICATE NO.
46473
JASON
O'BRIEN
Date Signed 07-28-16
ARIZONA, U.S.A.

EXPIRES 6/30/19

50 0 50 100
SCALE FEET
SCALE: 1"=50'

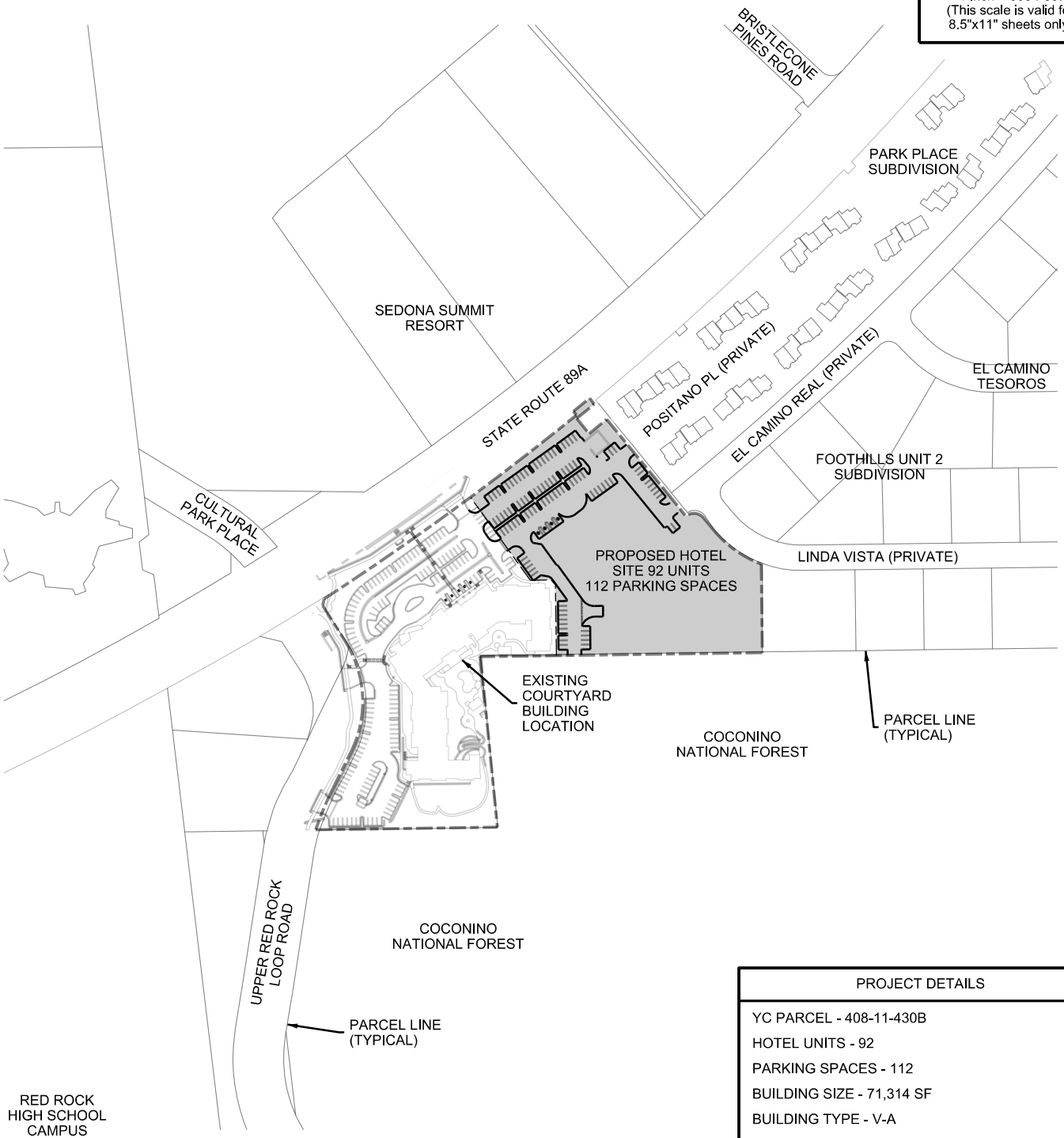
LYON ENGINEERING
Civil Engineers • Land Surveyors
1650 WILLOW CREEK ROAD
PRESCOTT, AZ 86301
(928) 776-1750

RECORD OF SURVEY

DATE: 07-28-16	DRAWN BY: RJW
JOB NO: 1000-02	CHECKED BY: JO

SHEET 1 OF 1

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF



PROJECT DETAILS
YC PARCEL - 408-11-430B
HOTEL UNITS - 92
PARKING SPACES - 112
BUILDING SIZE - 71,314 SF
BUILDING TYPE - V-A
FIRE FLOW REQ. - 2,375 GMP (IFC 2003)
WATER USAGE - 82,000 GPD (APPROXIMATED)

LYON ENGINEERING
Civil Engineers • Land Surveyors
1650 Willow Creek Rd. Prescott, AZ 86301
Phone: (928) 776-1750, Fax: (928) 776-0605

PROJECT LOCATION MAP

- EXHIBIT USE ONLY -

MARRIOTT RESIDENCE INN
SEDONA, ARIZONA

DESIGN KDH	DATE JANUARY 2017
DRAWN KDH	LYON PROJECT # 1000-03
CHECKED ---	DRAWING NUMBER EXHIBIT
APPROVED ---	SHEET 1 OF 1

ARIZONA WATER COMPANY

3805 N. BLACK CANYON HIGHWAY, PHOENIX, ARIZONA 85015-5351 • P.O. BOX 29006, PHOENIX, AZ 85038-9006
PHONE: (602) 240-6860 • FAX: (602) 240-6874 • TOLL FREE: (800) 533-6023 • www.azwater.com

January 18, 2017

Paul Welker
Sedona Hospitality Group, LLC
7255 E. Hampton Avenue, Suite 122
Mesa, AZ 85209

Re: Domestic Water Service to APN No. 408-11-430B

Dear Mr. Welker:

Arizona Water Company (the "Company") certifies that the above-described property is located within its Certificate of Convenience and Necessity in Sedona, Arizona, and that it will provide water service to the property in accordance with the Company's tariffs and the Arizona Corporation Commission's rules and regulations. It will be the responsibility of the developer to provide the funds to install the necessary water facilities, and the Company assumes no liability to install those facilities if the funds are not advanced by the developer.

The design of the water distribution system must comply with the Company's standard specifications that are on file at the Arizona Department of Environmental Quality. Both preliminary and final water system designs must be approved by the Company.

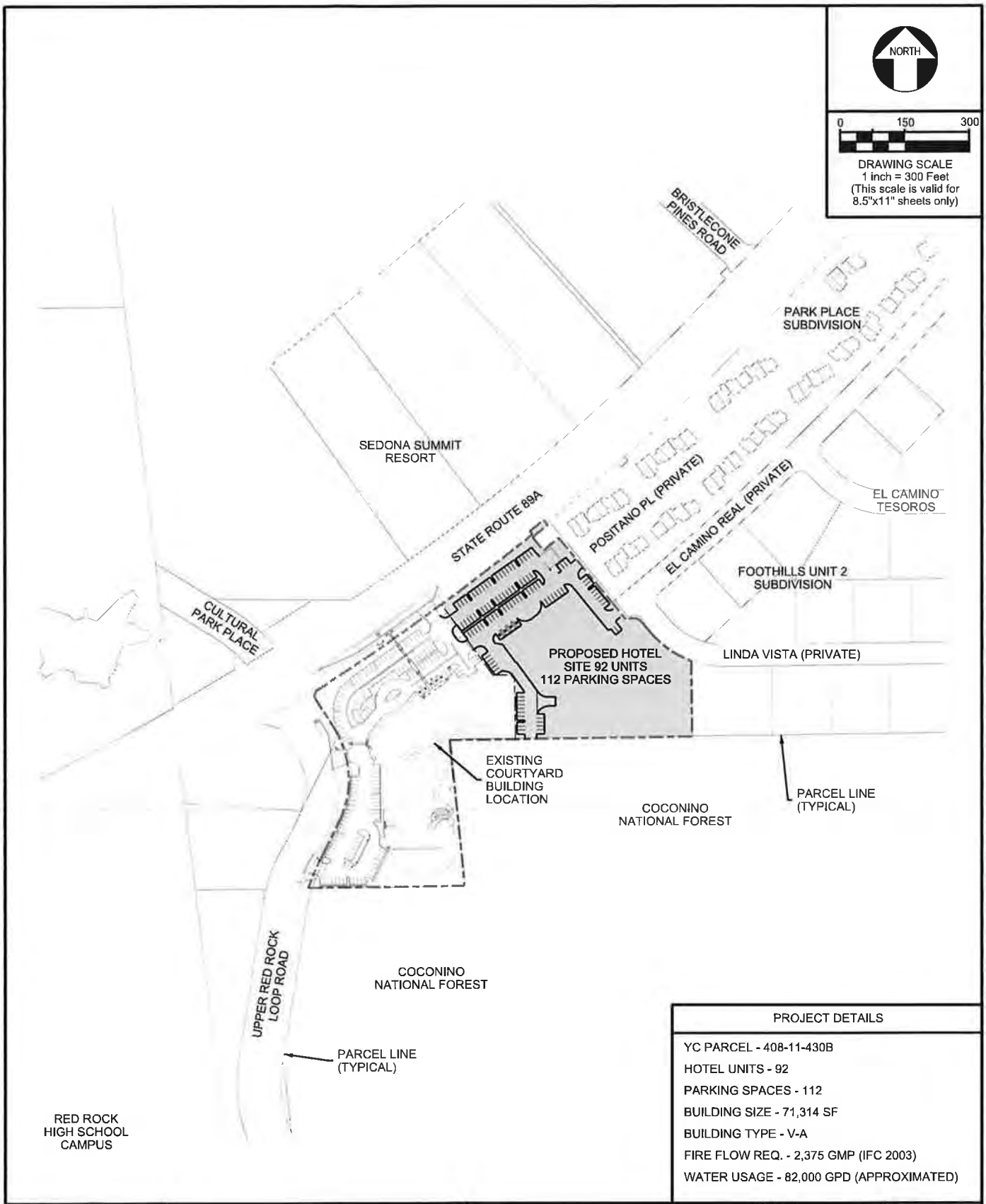
It will also be the responsibility of the developer to meet all the requirements of regulatory agencies having jurisdiction over Arizona subdivisions and of Arizona statutes applicable to subdivided or unsubdivided land, including, but not limited to, requirements relating to a Certificate of Assured Water Supply, as set forth in the Arizona Groundwater Management Act, A.R.S. §45-576.

Very truly yours,

Joseph Whelan
Engineering Development Coordinator
engineering@azwater.com

gs

REVISED SUBMITTAL - NOT YET REVIEWED BY STAFF



PROJECT DETAILS
YC PARCEL - 408-11-430B
HOTEL UNITS - 92
PARKING SPACES - 112
BUILDING SIZE - 71,314 SF
BUILDING TYPE - V-A
FIRE FLOW REQ. - 2,375 GMP (IFC 2003)
WATER USAGE - 82,000 GPD (APPROXIMATED)

LYON ENGINEERING
Civil Engineers • Land Surveyors
1650 Willow Creek Rd, Prescott, AZ 86301
Phone: (928) 776-1750, Fax: (928) 776-0605

PROJECT LOCATION MAP

- EXHIBIT USE ONLY -

MARRIOTT RESIDENCE INN
SEDONA, ARIZONA

DESIGN	KDH
DRAWN	KDH
CHECKED	—
APPROVED	—
DATE	JANUARY 2017
LYON PROJECT #	1000-03
DRAWING NUMBER	EXHIBIT
SHEET	1 OF 1

From: Natalie Taylor [mailto:tandshauling@gmail.com]
Sent: Tuesday, January 10, 2017 6:43 AM
To: kevinhorton@lyonengineering.com
Subject: Re: City of Sedona Marriott Residence Inn - Taylor & Sons Serviceability Letter Request

Kevin Horton,

S.Taylor and Sons Hauling, can provide service for your up coming project. Please contact our office for prices on construction service we provide
Also please let us know when the project is close to being complete and my sales man Reeves Moosman, will come meet with you at this site to discuss services we can provide in the future.

We are locally owned and operated

Thank You

Scott Taylor
S. Taylor & Sons Hauling, Inc.
PO Box 4389
Cottonwood, AZ 86326
928-649-8335

On Mon, Jan 9, 2017 at 10:23 AM, Kevin Horton <khortoneng@gmail.com> wrote:

Mr. Taylor,

Lyon Engineering is working on the preliminary design of the proposed Marriott Residence Inn project at the southeast side of the SR 89A and Upper Red Rock Loop intersection in west Sedona (YC Parcel 408-11-430B). Taylor & Sons currently provides waste removal services for the Marriott Courtyard (4105 Hwy 89A) directly west of this proposed project. I am preparing conceptual engineering drawings to submit to the City as a part of the development review process. As a part of our submittal, the City requires that we provide "Letters of Serviceability" from all proposed service providers. I have attached a project location map with information for your use. Can you please provide me and the owner (copied) with an e-mail or letter stating that you can provide waste removal services for the upcoming project? Below is the owner/developer's contact information for the serviceability letter. Please call me with any questions, comments, or need for additional information. Thank you.

Owner/Developer:

Paul Welker
Sedona Hospitality Group, LLC
7255 E. Hampton Ave, Suite 122
Mesa, AZ 85209
(480) 854-1414

Kevin D. Horton, P.E., CFM
Project Manager

LYON ENGINEERING
Civil Engineers • Land Surveyors

1650 Willow Creek Road
Prescott, AZ 86301
Phone: (928) 776-1750
Fax: (928) 776-0605

www.lyonengineering.com

aps

1250 E. STATE ROUTE 89A
COTTONWOOD, AZ 86325

January 6, 2017

Paul Welker
Sedona Hospitality Group, LLC
7255 E. Hampton Ave., Suite 122
Mesa, AZ 85209

Re: Marriott Residence Inn, APN 408-11-430B

Dear Mr. Welker,

The above referenced project is located in Arizona Public Service Company's electric service area. The Company extends its lines in accordance with the "Conditions Governing Extensions of Electric Distribution Lines and Services," Schedule 3, and the "Terms and Conditions for the Sale of Electric Service," Schedule 1, on file with the Arizona Corporation Commission at the time we begin installation of the electric facilities.

Application for the Company's electric service often involves construction of new facilities for various distances and costs depending upon customer's location, load size and load characteristics. With such variations, it is necessary to establish conditions under which Arizona Public Service will extend its facilities.

The policy governs the extension of overhead and underground electric facilities to customers whose requirements are deemed by Arizona Public Service to be usual and reasonable in nature.

Please give me a call at 928-646-8463 so that we may set up an appointment to discuss the details necessary for your project.

Sincerely,

Sandra Finley

Sandra Finley
Customer Project Manager
Verde District

Suddenlink Communications
1601 South Plaza Way
Flagstaff, AZ 86001

January 24, 2017

Paul Welker
Sedona Hospitality Group, LLC
7255 E. Hampton Ave, Suite 122
Mesa, AZ 85209
(480) 854-1414

Mr. Welker

Suddenlink Communications will be able to provide you with services to the new building that will be planned to construct in Sedona AZ. Fiber and Coaxial Cable is available in the area.

Thank You

Sanford Yazzie

Sanford Yazzie

Upgrade Construction Supervisor
1601 South Plaza Way
Flagstaff, AZ 86001
928-606-2464
Sanford.yazzie@alticeusa.com