REPORT OF GEOTECHNICAL INVESTIGATION

SEDONA LOFTS
10 NAVAJO DRIVE
SEDONA, ARIZONA 86336
ACS PROJECT NO. 2001877

PREPARED FOR:

Mr. Keith Holben, Manager
KMJ LIV, LLC
15010 N. 78th Way, Suite 109
Scottsdale, AZ 85260

PREPARED BY:

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January 12, 2021

ACS

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ACS SERVICES LLC

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DBE - SBE - WBE

January 12, 2021 Project 2001877

Mr. Keith Holben, Manager
KMJ LIV, LLC
15010 N. 78th Way, Suite 109
Scottsdale, AZ 85260

RE: GEOTECHNICAL INVESTIGATION REPORT
SEDONA LOFTS
10 NAVAJO DRIVE
SEDONA, ARIZONA 86336

Dear Keith:

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

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 **SEDONA LOFTS**, located at 10 Navajo Drive, in Sedona, Arizona 86336. The objectives of the investigation were to determine the physical characteristics of the soil 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	74	4.5

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 December 15 and 16, 2020, this firm advanced fifteen (15) exploratory test borings (6.625-inch hollow stem auger) for examination of the subsurface soil profile to depths ranging from 2.0 to 15.5 feet below the existing site grade. Borings 3, 6, 9, 10, 11, 13, 14, and 15 were terminated at depths ranging from 2.0 to 12.0 feet due auger refusal on hard mudstone bedrock (Supai Formation). 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 boring locations. Refer to Figure 2 in Appendix A for the approximate locations of the borings.

On December 15, 2020, one (1) standard percolation test was conducted at the location of a proposed retention basin in the southwest corner of the site (See Figure 2 in Appendix A). The percolation test was initiated through the advancement of a 14-inch boring to a depth of approximately 3 feet below the existing site grade. A PVC sleeve or lining with a diameter of 12.0 inches was placed within the borehole and soil was backfilled around it. The test hole was presoaked for approximately one hour, and then refilled to a water depth of approximately 12 inches. The rate of water level decline was recorded at approximately 10 minute time intervals until a stabilized rate had been achieved. The results of the percolation test are presented in Appendix C. The measured stabilized infiltration rate was 8.577 minutes per inch (0.5833 ft^3/hr per ft^2 of drainage area) for Percolation Test P-1**. This percolation rate has not be de-rated, which may be required for retention basin design.**

Boring B-1 was drilled next to the percolation test to a depth of 14.0 feet below the existing ground surface. The native soils below 3.0 feet are generally stiff to very stiff sandy silt soils. Refer to the boring log for Boring B-1 in Appendix B for a detailed description of the subsurface soil conditions below the location of the standard percolation test.

LABORATORY TESTING

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

Test	Sample(s)	Purpose
Consolidation	Undisturbed native soils (9)	Allowable soil bearing capacity and settlement analysis
Sieve Analysis and Atterberg Limits	Native subgrade soils (13)	Soil classification
Proctor	Native subgrade soils (2)	Moisture-Density Relationship

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

SITE CONDITIONS

General Notes:

(1) Topographic relief — The surface of the site slopes gently downward to the south-southwest.

(2) Fill — No apparent fill was encountered at the locations of the borings.

(3) Evidence of surface disturbance — The surface of the site has not been significantly disturbed.

(4) Site use — The site is currently vacant native high desert land. The site is moderately vegetated with some trees and bushes, weeds and wild grass, and a few yucca cacti. Refer to Figure 2 in Appendix A for an aerial view of the current site conditions.

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 test data for the upper native site soils
Potential for soil collapse - Moderate based on the laboratory consolidation test data and field penetration blow counts for the native soils below foundation level
Existence of loose soil at foundation bearing elevation - Possible
Potential for excessive differential soil movement - Moderate based soil collapse potential

Potential for earth subsidence fissures	- Not applicable
Frost depth	- 1.0 feet, Sedona
Presence of caliche, bedrock or other hard stratum	- Hard sandy clay or silt soils or very dense silty gravelly sand soils (highly weathered mudstone bedrock) were encountered below depths ranging from 1.5 to 9.0 feet at the locations of the borings. Auger refusal on hard mudstone bedrock (Supai Formation) was encountered at depths ranging from 2.0 to 12.0 feet at the locations of the Borings 3, 6, 9, 10, 11, 13, 14, and 15.
2006/2018 IBC Site Class	- C, very dense soil or soft rock

RECOMMENDATIONS

The recommendations contained herein are based upon the properties of the surface and subsurface soils 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 pad grade within 5.0 feet of proposed exterior 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.

Conventional 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	1.0 feet of controlled compacted fill	1500 PSF	4.5	74

***** It is necessary that a minimum of 1.0 feet of controlled compacted fill lie beneath all foundations for the structure. The over-excavation to a depth of 2.5 feet below finished pad

grade to achieve 1.0 feet of controlled compacted fill beneath foundations shall extend across the entire building pad and to a minimum lateral distance of five feet beyond exterior foundation edges. **The over-excavation for placement of controlled compacted fill below foundations may be terminated upon contact with hard sandy silt to clay soils or very dense silty gravelly sand soils (highly weathered mudstone bedrock - Supai Formation), which were encountered below depths ranging from 1.5 to 9.0 feet at the locations of the borings.**

Alternatively, foundations may bear directly on native undisturbed soil as follows:

Surface Level Foundations Bearing on Native Undisturbed Soil

			Allowable Load	
Foundation Depth (ft)	**Bearing Stratum**	**Allowable Soil Bearing Capacity**	**Wall (KLF)**	**Column (KIP)**
2.5	Native undisturbed soil	1500 PSF	4.5	74

A mixture of 2-sack ABC/cement slurry may be utilized in the lower portions of the foundation excavations for footings bearing on native undisturbed soil. If 2-sack ABC/cement slurry is used, a minimum of 1.0 feet of the mixture should underlie a conventional foundation depth of 1.5 feet (for an allowable soil bearing capacity of 1500 PSF). The width of the mixture of 2-sack ABC/cement slurry shall equal the width of the footing. **Foundation excavations for foundations bearing on native undisturbed soils may be terminated at a depth of less than 2.5 feet upon contact with hard sandy silt to clay soils or very dense silty gravelly sand soils (highly weathered mudstone bedrock - Supai Formation), which were encountered below depths ranging from 1.5 to 9.0 feet at the locations of the borings. However all foundations must have a minimum foundation embedment depth of 1.5 feet.**

Explanations

Foundation Embedment Depth - i.e.,

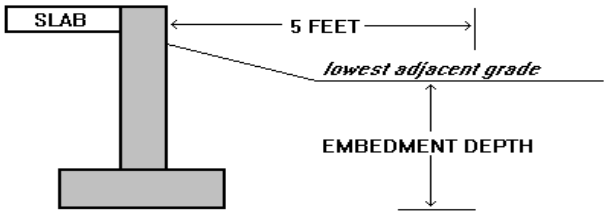
A) The depth below the lowest adjacent exterior pad grade within 5.0 feet of proposed exterior walls;

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);

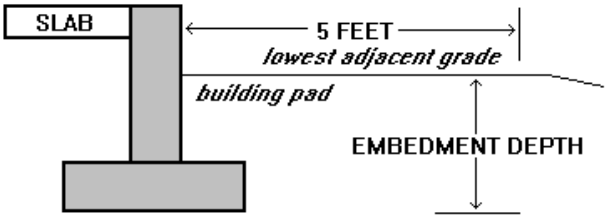
C) The depth below finish floor level for interior foundations.

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, **ACS Services LLC**, to verify that the footings will bear upon a minimum of 1.0 feet of controlled compacted fill as described above with a minimum foundation embedment of 1.5 feet. Alternatively, footings may bear on native undisturbed soil as described above with a minimum foundation embedment depth of 2.5 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, controlled compacted fill, and highly weathered mudstone bedrock:

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

	Native Undisturbed Soil	Controlled Compacted Fill	Highly Weathered Mudstone Bedrock
[b]Lateral Backfill Pressures:			
Unrestrained walls	38 psf/ft.	34 psf/ft.	30 psf/ft.
Restrained walls[c]	56 psf/ft.	52 psf/ft.	46 psf/ft.
Lateral Passive Pressures For Surficial Soils:			
Continuous walls/footings	195 psf/ft.	240 psf/ft.	249 psf/ft.
Spread columns/footings	291 psf/ft.	358 psf/ft.	371 psf/ft.
Coefficient of Base Friction For Surficial Soils:			
Independent of passive resistance	0.53	0.62	0.67
In conjunction with passive resistance	0.36	0.42	0.45

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 Slab Support

Site grading within the building areas should be accomplished as recommended herein. Aggregate base course (ABC) floor fill should immediately underlie interior grade floor slabs with a typical thickness of 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

Building pads for conventional systems should be constructed with sufficient lateral pad “blow-up” to accommodate the entire perimeter slab width.

To further reduce the potential for slab related damage in conjunction with conventional systems, we recommend the following:

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 302.1R-04, Section 3.2.3 Moisture protection.

Fill Slope Stability

The maximum fill slopes may conform to a 3:1 (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 (Parking Areas)

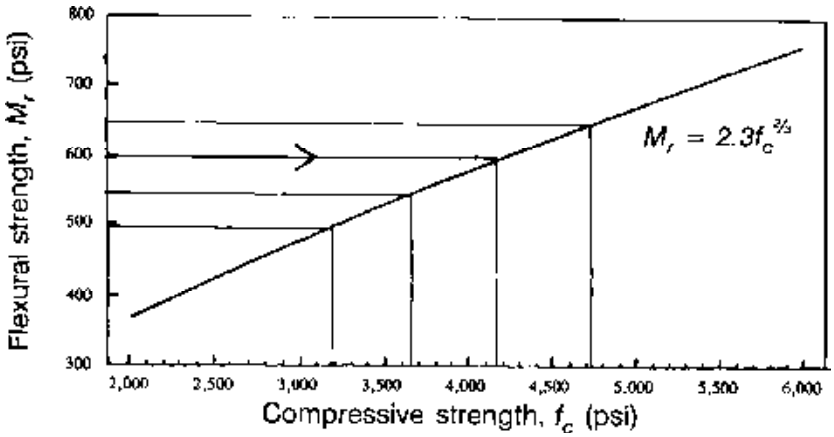
Alternate	Prepared Subgrade (Inches)	ABC (Inches)	Asphaltic Concrete (Inches)	Concrete Pavement (Inches)
A[a]	8	6	2	
B[a]	8		4	
C[b]	8			5.5*

Heavy Vehicle Areas (Drive Areas or Path of Garbage Trucks)

Alternate	Prepared Subgrade (Inches)	ABC (Inches)	Asphaltic Concrete (Inches)	Concrete Pavement (Inches)
A[a]	8	6	3	
B[a]	8		5	
C[b]	8			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
Asphaltic Concrete	95 minimum

The asphaltic concrete material shall conform to all requirements as established in MAG Section 710 for Asphaltic Concrete Mix Designation 1/2" Marshall mix.

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

It is recommended that all trees or bushes (inclusive of significant root systems), weeds, wild grass, yucca, and any other deleterious material be removed from proposed structure and pavement areas at the commencement of site grading activities.

Following the removal of the above-listed items, the uppermost 8.0 inches of the native soils should be scarified, moisture processed and properly compacted in accordance with the section on compaction and moisture content recommendations in all areas (i.e. slab support areas and proposed pavement areas), prior to the placement of structural fill or resultant in a cut situation.

Scarification and compaction may be waived if highly weathered mudstone bedrock is exposed after completion of the removals.

Special note for all structures for conventional foundations on controlled compacted fill: To accommodate a minimum of 1.0 feet of controlled compacted fill below foundations to achieve an allowable bearing pressure of 1500 PSF, over-excavation and re-compaction of soils to a minimum depth of 2.5 feet below finish pad grade shall be required. **The over-excavation for placement of controlled compacted fill below foundations may be terminated upon contact with hard sandy silt to clay soils or very dense silty sandy gravel soils (highly weathered mudstone bedrock - Supai Formation), which were encountered below depths ranging from 1.5 to 9.0 feet at the locations of the borings.** Over-excavation and re-compaction shall extend across the entire area of the building pad and to a minimum lateral distance of five feet beyond foundation edges. **The proper depth of over-excavation must be verified by the project geotechnical engineer, ACS Services LLC, prior to placement of controlled compacted fill for the building pads.** The base of the zone of sub-excavation will not require scarification and compaction prior to placement of controlled compacted fill for the building pad.

Complete removal and cleaning of any undesirable materials and proper backfilling of removal excavations will be necessary to develop support for the proposed facilities. Widen all removal over-excavations or depressions 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 recommendations.

All removed native soils are considered by this firm to be suitable for use as engineered fill, provided that they are free of vegetation, debris, and oversized particles (greater than 3.0 inches).

All subbase fill required to bring the structure areas up to subgrade elevation should be placed in horizontal lifts not exceeding 6.0 inches compacted thickness or in horizontal lifts with thicknesses compatible with the compaction equipment utilized.

It is very important that a sufficient pad blow-up (the lateral extent to which each building pad is constructed beyond the limits of the exterior walls or other structural elements, inclusive of exterior column foundations) be incorporated into the site grading (5.0 feet or greater).

It is the understanding of this firm that various utility trenches may traverse the completed pads. The backfill of all utility trenches, if not in conformance with this report, may adversely impact the integrity of the completed pads. This firm recommends that all utility trench backfill crossing the pads 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 used as subbase fill or backfill for structural or pavement support should be accomplished to the following density criteria:

Material	Percent Compaction (ASTM D698)
On-site native soils:	
Building areas below foundation level	95 min.
Building areas above foundation level	95 min.
Below asphalt pavements	95 min.
Imported fill material:	
Building areas below foundation level	95 min.
Building areas above foundation level	95 min.
Below asphalt pavements	95 min.
Base course:	
Below asphalt pavements	100 min.
Below interior concrete slabs	95 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 soils:	
Building areas below foundation level	optimum -2 to optimum +2%
Building areas above foundation level	optimum -2 to optimum +2%
Below asphalt pavements	optimum -2 to optimum +2%
Imported fill material:	
Building areas below foundation level	optimum -2 to optimum +2%
Building areas 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" also apply to the subgrade in exterior slab, sidewalk, curb, and gutter areas except as otherwise noted.

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	14
Maximum Passing #200 Sieve	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 upper site soils should be 20 to 25 percent based on the laboratory test data. This may result in a vertical elevation change of approximately 0.20 to 0.25 feet following the pre-compaction effort.

Excavating Conditions

Excavations into the site subsurface soils, extending to depths ranging from 1.5 to 9.0 feet, should be possible with conventional excavating equipment. Heavier excavating equipment may be required below depths ranging from 1.5 to 9.0 feet due to the presence of hard sandy silt to clay soils or very dense silty sandy gravel soils (highly weathered mudstone bedrock – Supai Formation). Auger refusal on hard mudstone bedrock was encountered at depths ranging from 2.0 to 12.0 feet at the locations of Borings 3, 6, 9, 10, 11, 13, 14, and 15.

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 this firm's involvement 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. This firm 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 this firm 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.

January 12, 2021
Project 2001877 – Sedona Lofts
10 Navajo Drive
Sedona, Arizona 86336

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.

APPENDIX A

NORTH
N.T.S.

PROJECT NUMBER: 2001877

FIGURE 1

ACS SERVICES LLC
2235 W BROADWAY RD
MESA, ARIZONA 85202
(480) 968-0190
(480) 968-0156 FAX
WWW.ACSSERVICESLLC.COM

VICINITY MAP

Sedona Lofts
10 Navajo Drive
Sedona, AZ. 86336

NORTH
N.T.S.

PROJECT NUMBER: 2001877

FIGURE 2

ACS SERVICES LLC

2235 W BROADWAY RD
MESA, ARIZONA 85202
(480) 968-0190
(480) 968-0156 FAX
WWW.ACSSERVICESLLC.COM

SITE PLAN & APPROXIMATE BORING LOCATIONS

Sedona Lofts
10 Navajo Drive
Sedona, AZ. 86336

APPENDIX B

ACS Services LLC

BORING B-1

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/15/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1				ML	Red sandy SILT, stiff, slightly damp, low to NP
2					
3					
4					
5				ML	Red sandy SILT, stiff to very stiff, slightly damp, low to NP
6					
7					
8					
9					
10				ML	Red sandy SILT, stiff to very stiff, slightly damp, low to NP
11					
12					
13					
14					
15					Terminated boring at a depth of 14.0 feet
16					
17					

ACS Services LLC

BORING B-2

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/15/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Bulk sample obtained from 0.0 to 4.0 feet Description of Subsurface Conditions
1		4.8		CL	Red sandy CLAY, stiff, slightly damp, PI of 8
2					
3					
4					
5					Terminated boring at a depth of 4.0 feet
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-3

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/15/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Bulk sample obtained from 0.0 to 2.0 feet Description of Subsurface Conditions
1		3.0		ML	Red sandy SILT, very stiff to hard, slightly damp, PI of 3
2					
3					Terminated drilling at a depth of 2.0 feet due to auger refusal on possible mudstone bedrock (Supai Formation)
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-4

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/15/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Bulk sample obtained from 0.0 to 4.0 feet Description of Subsurface Conditions
1		1.9		SM	Red silty gravelly SAND, medium dense to dense, dry, NP
2					
3					
4					
5					Terminated drilling at a depth of 4.0 feet
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-5

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/15/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Bulk sample obtained from 0.0 to 4.0 feet Description of Subsurface Conditions
1		4.9		CL-ML	Red sandy CLAY to SILT, stiff, slightly damp, PI of 7
2					
3					
4					
5					Terminated drilling at a depth of 4.0 feet
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-6

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive, Sedona, AZ

Date: 12/16/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Remarks: Ring sample obtained from 1.5 to 2.5 feet

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1	4 6	1.7		ML	Red sandy SILT, stiff, dry, NP
2	8 10			ML	Red sandy SILT, very stiff, dry, low to NP
3	14 18	2.6	94.0		
4	21 24				
5	20 29	4.9		CL	Red sand CLAY, hard, slightly damp, PI of 8
6	37				
7					
8					
9					
10	50/4"				Red silty sandy GRAVEL, very dense, dry, low PI (probable highly weathered mudstone bedrock - Supai Formation)
11					
12					Terminated boring at a depth of 11.0 feet due to auger refusal on hard mudstone bedrock (Supai Formation)
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-7

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive, Sedona, AZ

Date: 12/16/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Remarks: Ring sample obtained from 1.5 to 2.5 feet

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
	6			ML	Red sandy SILT, stiff, dry, low PI
1	6				
	10				
2	12	4.6		CL	Red CLAY with sand, very stiff, slightly damp, PI of 8
	15	5.4	95.4		
3	20				
	32				
4	28				
	15				
5	22	4.9		CL	Red CLAY sandy CLAY, hard, slightly damp, PI of 8
	36				
6					
7					
8					
9					
	50/5"			CL-ML	Red sandy CLAY to SILT, trace of gravel, very hard, dry, low PI
10					(highly weathered mudstone bedrock (Supai Formations)
11					
12					
13					
14					
	50/2"			GM	Tan silty sandy GRAVEL, very dense, dry, NP (mudstone bedrock)
15					Terminated boring at a depth of 14.2 feet
16					
17					

ACS Services LLC

BORING B-8

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/16/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Remarks: Ring sample obtained from 1.5 to 2.5 feet

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1	14 21	4.1		CL	Red sandy CLAY, very stiff, slightly damp, PI of 10
2	17 18			CL	Red CLAY sandy CLAY, hard, slightly damp, PI of 8
3	22 25	5.8	97.8		
4	28 32				
5	14 50/6"	4.9		CL	Red sandy CLAY, hard, slightly damp, PI of 8 (highly weathered mudstone bedrock - Supai Formation)
6					
7					
8					
9					
10	36 50/3"			SC	Red clayey SAND, very dense, slightly damp, low PI (highly weathered mudstone bedrock (Supai Formations)
11					
12					
13					
14					
15	50/6"			SC	Red clayey SAND, very dense, slightly damp, low PI
16					Terminated boring at a depth of 14.5 feet
17					

ACS Services LLC

BORING B-9

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/16/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Ring sample obtained from 1.5 to 2.3 feet Description of Subsurface Conditions
1	9 13 15			ML	Red sandy SILT, very stiff, dry, low PI
2	32			ML	Red sandy SILT, very hard, slightly damp, low PI
3	50/4"	4.8	111.4		(highly weathered mudstone bedrock - Supai Formation)
4					
5	50/6"	2.8		SC-SM	Red very clayey silty SAND, very dense, slightly damp, PI of 4
6					(highly weathered mudstone bedrock - Supai Formation)
7					
8					Terminated boring at a depth of 7.0 feet due to auger refusal on hard mudstone bedrock (Supai Formation)
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-10

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/16/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Ring sample obtained from 1.5 to 1.8 feet - no recovery Description of Subsurface Conditions
1	6 14 26			GM	Red silty sandy GRAVEL, medium dense, dry, low PI
2	50/3'			GM	Red silty sandy GRAVEL, very dense, dry, low PI (highly weathered mudstone bedrock - Supai Formation)
3					
4					
5	50/6"	2.8		SC-SM	Red very clayey silty SAND, very dense, slightly damp, PI of 4 (highly weathered mudstone bedrock - Supai Formation)
6					
7					
8					Terminated boring at a depth of 7.0 feet due to auger refusal on hard mudstone bedrock (Supai Formation)
9					
10					
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-11

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/16/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Ring sample obtained from 1.5 to 2.5 feet Description of Subsurface Conditions
1	20 34			ML	Red sandy SILT, very stiff, slightly damp, low PI
2	30 6	3.5		ML	Red sandy SILT, very stiff, slightly damp, PI of 3
3	13	3.8	88.2		
4	25 23 22				
5	9	2.8		SC-SM	Red very clayey silty SAND, medium dense, slightly damp, PI of 4
6	14 18				
7					
8					
9					
10	50/5"			SM	Red silty SAND, very dense, slightly damp, low PI (highly weathered mudstone bedrock - Supai Formation)
11					
12					
13					Terminated boring at a depth of 12.0 feet due to auger refusal on hard mudstone bedrock (Supai Formation)
14					
15					
16					
17					

ACS Services LLC

BORING B-12

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive, Sedona, AZ

Date: 12/16/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Remarks: Ring sample obtained from 1.5 to 2.5 feet

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Description of Subsurface Conditions
1	5			ML	Red sandy SILT, stiff, slightly damp, low PI
	7				
2	8				
	3	3.5		ML	Red sandy SILT, firm, slightly damp, PI of 3
3	4	1.8	94.1		
	4				
4	6				
	6				
5	4	3.2		ML	Red sandy SILT, stiff to very stiff, slightly damp, NP
	7				
6	12				
7					
8					
9					
10	11			CL-ML	Red sandy CLAY to SILT, hard, slightly damp, low PI
	18				
11	21				
12					
13					
14					
15	13			CL	Red sandy CLAY, very stiff to hard, slightly damp, low PI
	20				
16	50/3"				(possible mudstoned bedrock below 15.0 feet - Supai Formation)
					Terminated boring at a depth of 15.3 feet
17					

ACS Services LLC

BORING B-13

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/16/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Ring sample obtained from 1.5 to 2.5 feet Description of Subsurface Conditions
1	23 25	2.3		SM	Red silty gravelly SAND, dense, dry, NP
2	18 17			SM	Red silty gravelly SAND, dense, dry, low PI
3	16 15	1.6	106.0		
4	17 18				
5	12 14	3.2		ML	Red sandy SILT, very stiff, dry, no PI
6	15				
7					
8					
9					
10	15 30			SM	Red silty gravelly SAND, very dense, dry, low PI (very highly weathered mudstone bedrock - Supai Formation)
11	38				
12					Terminated boring at a depth og 11.0 feet due to auger refusal on hard mudstone bedrock (Supai Formation)
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-14

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/16/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew, EIT
Location: See Site Plan

Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Ring sample obtained from 1.5 to 2.5 feet Description of Subsurface Conditions
1	9 16 13			ML	Red sandy SILT, very stiff, dry, low PI
2	8	4.1		CL-ML	Red sandy CLAY to SILT, stiff, slightly damp, PI of 7
3	7 12	4.9	90.9		
4	12 13				
5	11 17	3.2		ML	Red sandy SILT, hard, dry, NP
6	31				
7					
8					
9				GM	Red silty sand GRAVEL, very dense, dry, low PI (mudstone bedrock)
10					Terminated boring at a depth of 9.0 feet due to auger refusal on hard mudstone bedrock (Supai Formation)
11					
12					
13					
14					
15					
16					
17					

ACS Services LLC

BORING B-15

For: KMJ LIV, LLC
Project: Sedona Lofts
Location: 10 Navajo Drive
Sedona, AZ

Date: 12/16/2020 **Project No.** 2001877
Type of Boring: 6.625-inch HS Auger
Field Engineer: Geoffrey Matthew
Location: See Site Plan

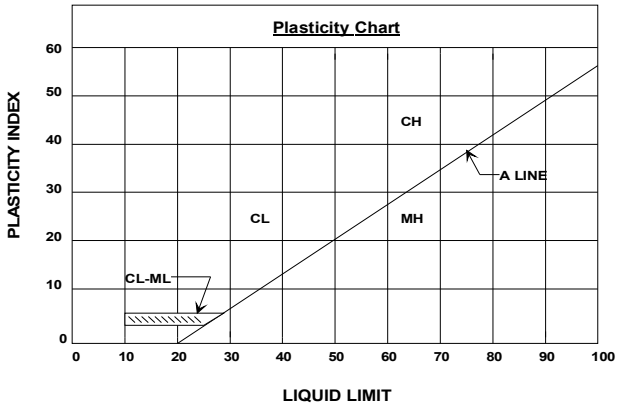
Depth (Feet)	Blows per 6"	Moisture %	Dry Density (PCF)	USCS Soil Class	Remarks: Ring sample obtained from 1.5 to 2.5 feet Description of Subsurface Conditions
1	11 22			SM	Red silty gravelly SAND, medium dense, dry, low PI
2	16 10			ML	Red sandy SILT, very stiff, to hard, dry, low pl
3	30 21	2.7	94.6		
4	31 45				
5	50/5"			SM	Red silty SAND, very dense, dry, low PI (highly weathered mudstone bedrock - Supai Formation)
6					
7					
8					
9					
10	50/4"			SM	Red silty SAND, very dense, dry, low PI (highly weathered mudstone bedrock - Supai Formation)
11					
12					
13					Terminated boring at a depth of 12.0 feet due to auger refusal on hard mudstone bedrock (Supai Formation)
14					
15					
16					
17					

January 12, 2021
Project 2001877 – Sedona Lofts
10 Navajo Drive
Sedona, Arizona 86336

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

January 12, 2021
Project 2001877 – Sedona Lofts
10 Navajo Drive
Sedona, Arizona 86336

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.

APPENDIX C

ACS SERVICES LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION

* *PERCOLATION DATA*

ACS Project No.:	**2001877**		
Client:	KMJ LIV, LLC	Test Date:	12/15/2020
Project Name:	Sedona Lofts	Tested By:	Geoffrey Matthew, EIT
Project Address:	10 Navajo Drive	Test Type:	Preliminary Percolation Test
Project City:	Sedona, AZ	Location:	See Site Plan

Apparatus Data:

- ☐ Square _____ in
- ☑ Diameter 12 in
- ☐ Other _____

Site Data:

Test No.: P-1
Test Depth: 3.00 ft
Area: 0.785 sqft
Weather: Sunny

Presoak Information:

Start Time - 1:30 PM
End Time - 3:25 PM

Percolation Data:

Reading No.	Start (S) End (E)	Time	Change in Time (min)	Reading Level (in)	Drop (in)	Water Added (gal)	Perc. Rate (min/in)	Perc. Rate (cu.ft./hr/sf)
1	S	3:25 PM	10.00	23.6875	1.19		8.421	0.5938
	E	3:35 PM		24.875				
2	S	3:36 PM	10.00	24.125	1.13		8.889	0.5625
	E	3:46 AM		25.25				
3	S	3:47 PM	10.00	23.625	1.19		8.421	0.5938
	E	3:57 PM		24.8125				
4								
5			Average		1.17		8.577	0.5833
6								
7								
8								
9								
10								
11								
12								

Average	
Flow Rate (min./in.)	**Flow Rate (cu.ft./hr/sf)**
8.577	0.5833

APPENDIX D

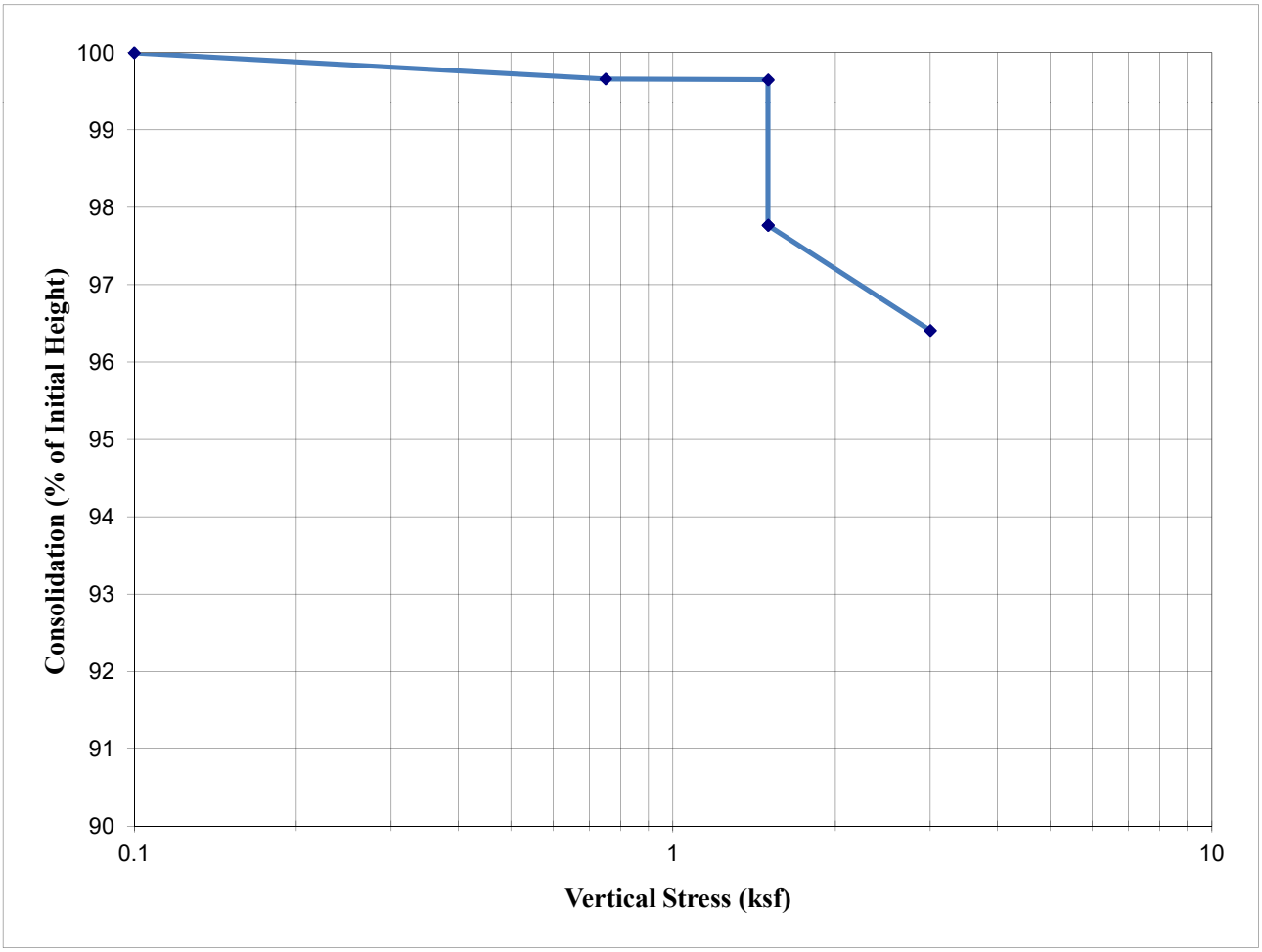
ACS Services LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION

* ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

ACS Project No.:	**2001877**		
Lab No.:	20-5939-8	Material Type:	Native
Client:	KMJ LIV, LLC	Date of Extraction:	12/16/2020
Project Name:	Sedona Lofts	Extracted By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Date of Lab Test:	12/28/2020
Project City:	Sedona, AZ	Lab Tested By:	Trevor Burns
Sample Location:	B-6 @ 1.5'-2.5'	Reviewed By:	Gene Hansen

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.44
INITIAL MOISTURE CONTENT	2.6%	FINAL MOISTURE CONTENT	22.4%
INITIAL DRY DENSITY(pcf)	94.0	FINAL DRY DENSITY(pcf)	97.4
INITIAL DEGREE OF SATURATION	9%	FINAL DEGREE OF SATURATION	85%
INITIAL VOID RATIO	0.8	FINAL VOID RATIO	0.7
ESTIMATED SPECIFIC GRAVITY	2.65	SATURATED AT	1.5 ksf



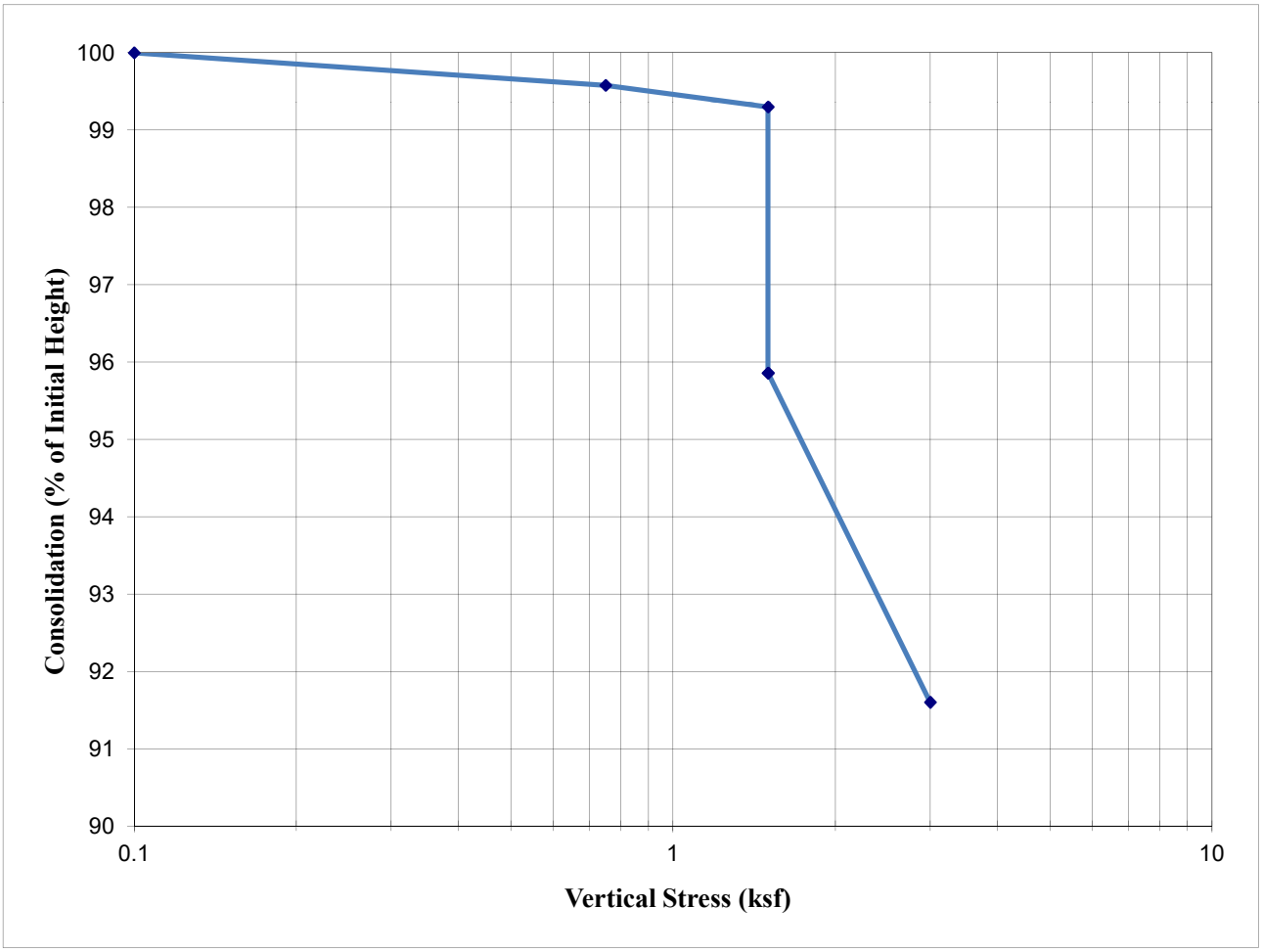
ACS Services LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION

* ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

ACS Project No.:	**2001877**		
Lab No.:	20-5939-9	Material Type:	Native
Client:	KMJ LIV, LLC	Date of Extraction:	12/16/2020
Project Name:	Sedona Lofts	Extracted By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Date of Lab Test:	12/28/2020
Project City:	Sedona, AZ	Lab Tested By:	Trevor Burns
Sample Location:	B - 7 @ 1.5' - 2.5'	Reviewed By:	Gene Hansen

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.22
INITIAL MOISTURE CONTENT	5.4%	FINAL MOISTURE CONTENT	20.6%
INITIAL DRY DENSITY(pcf)	95.4	FINAL DRY DENSITY(pcf)	104.1
INITIAL DEGREE OF SATURATION	19%	FINAL DEGREE OF SATURATION	93%
INITIAL VOID RATIO	0.7	FINAL VOID RATIO	0.6
ESTIMATED SPECIFIC GRAVITY	2.65	SATURATED AT	1.5 ksf



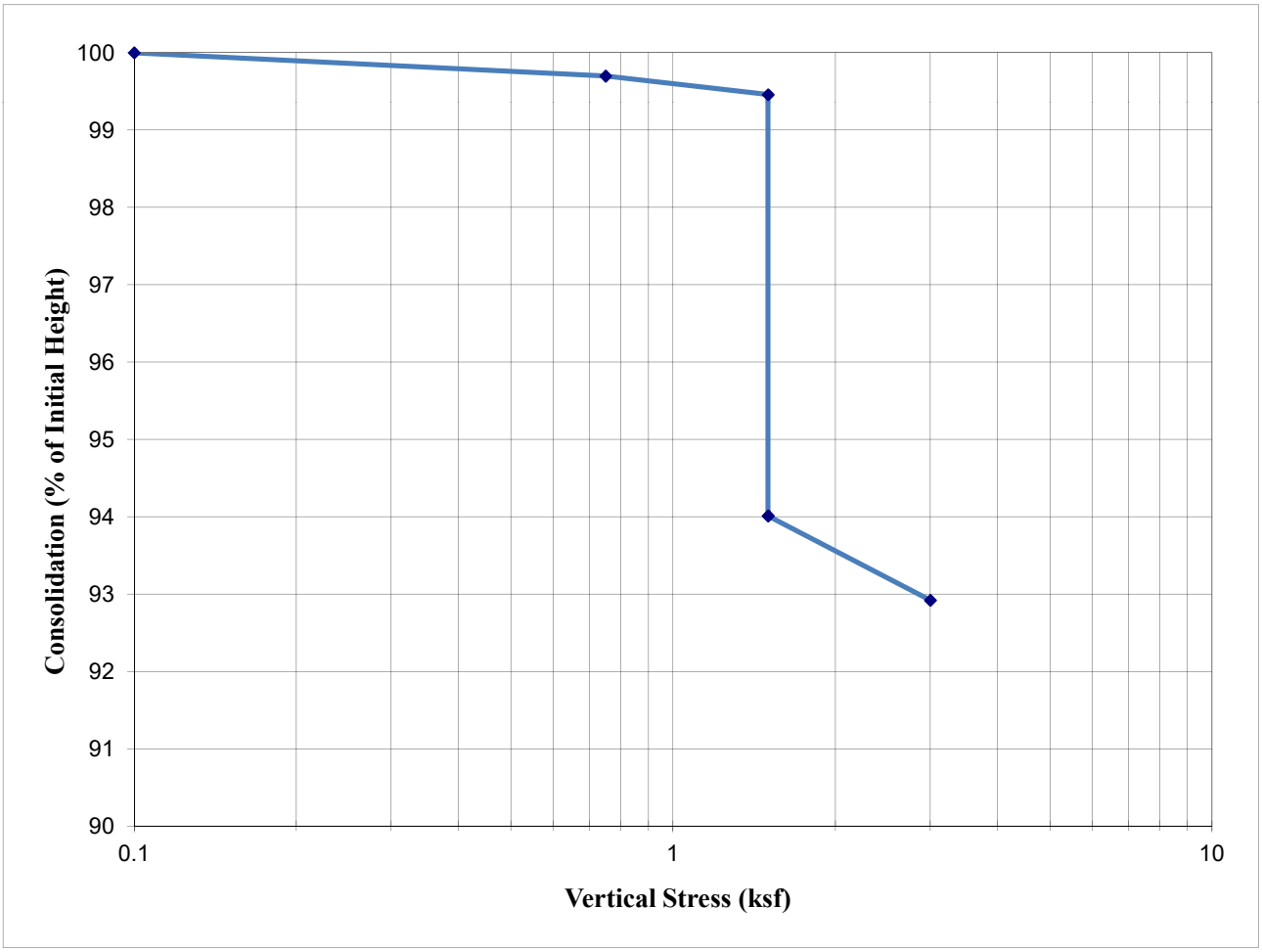
ACS Services LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION

* ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

ACS Project No.:	**2001877**		
Lab No.:	20-5939-10	Material Type:	Native
Client:	KMJ LIV, LLC	Date of Extraction:	12/16/2020
Project Name:	Sedona Lofts	Extracted By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Date of Lab Test:	12/28/2020
Project City:	Sedona, AZ	Lab Tested By:	Trevor Burns
Sample Location:	B - 8 @ 1.5' - 2.5'	Reviewed By:	Gene Hansen

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.28
INITIAL MOISTURE CONTENT	5.8%	FINAL MOISTURE CONTENT	18.3%
INITIAL DRY DENSITY(pcf)	97.8	FINAL DRY DENSITY(pcf)	105.2
INITIAL DEGREE OF SATURATION	22%	FINAL DEGREE OF SATURATION	85%
INITIAL VOID RATIO	0.7	FINAL VOID RATIO	0.6
ESTIMATED SPECIFIC GRAVITY	2.65	SATURATED AT	1.5 ksf



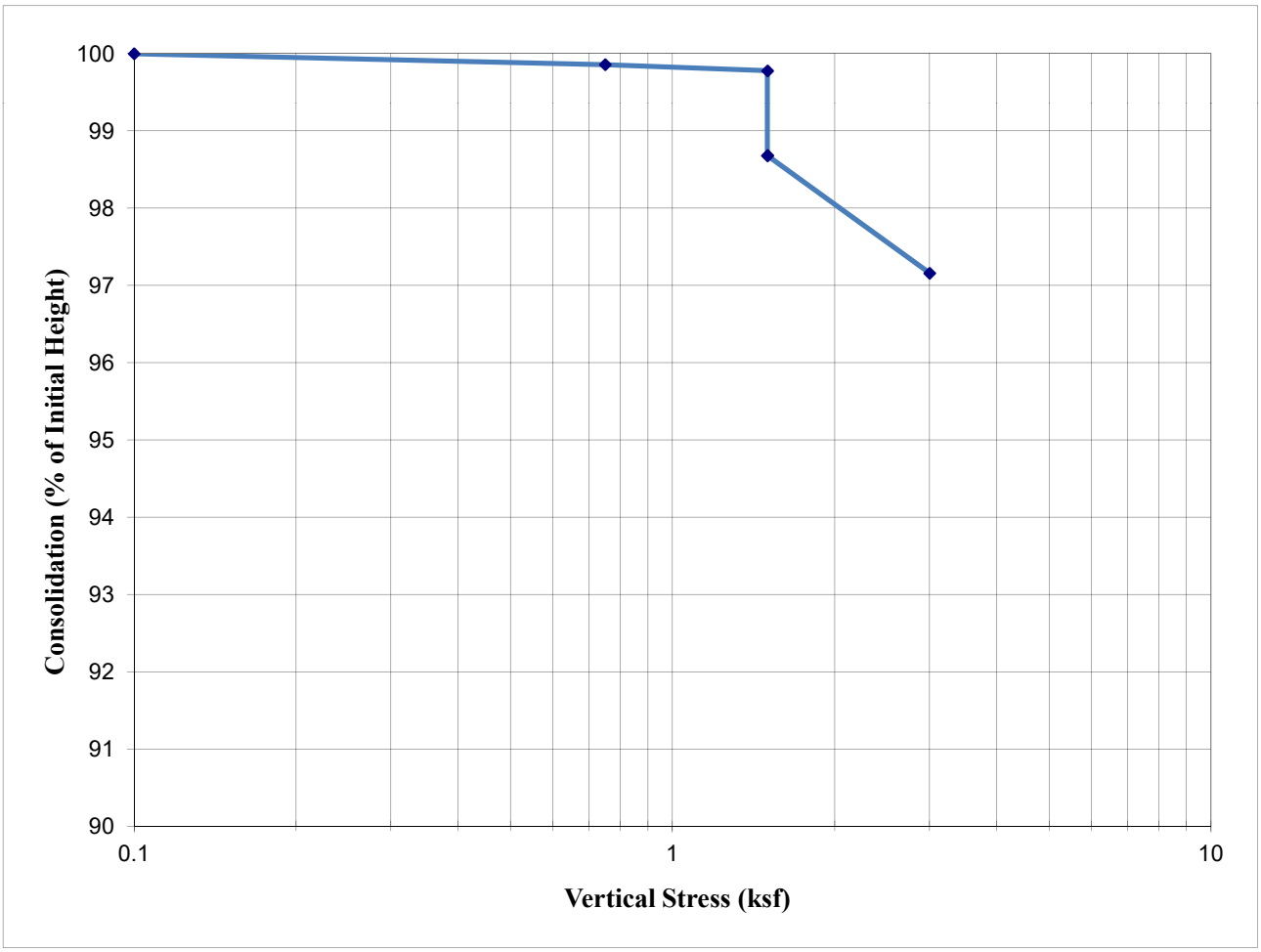
ACS Services LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION

* ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

ACS Project No.:	**2001877**		
Lab No.:	20-5939-11	Material Type:	Native
Client:	KMJ LIV, LLC	Date of Extraction:	12/16/2020
Project Name:	Sedona Lofts	Extracted By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Date of Lab Test:	12/29/2020
Project City:	Sedona, AZ	Lab Tested By:	Trevor Burns
Sample Location:	B - 9 @ 1.5' - 2.3'	Reviewed By:	Gene Hansen

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.47
INITIAL MOISTURE CONTENT	4.8%	FINAL MOISTURE CONTENT	13.9%
INITIAL DRY DENSITY(pcf)	111.4	FINAL DRY DENSITY(pcf)	114.7
INITIAL DEGREE OF SATURATION	26%	FINAL DEGREE OF SATURATION	83%
INITIAL VOID RATIO	0.5	FINAL VOID RATIO	0.4
ESTIMATED SPECIFIC GRAVITY	2.65	SATURATED AT	1.5 ksf



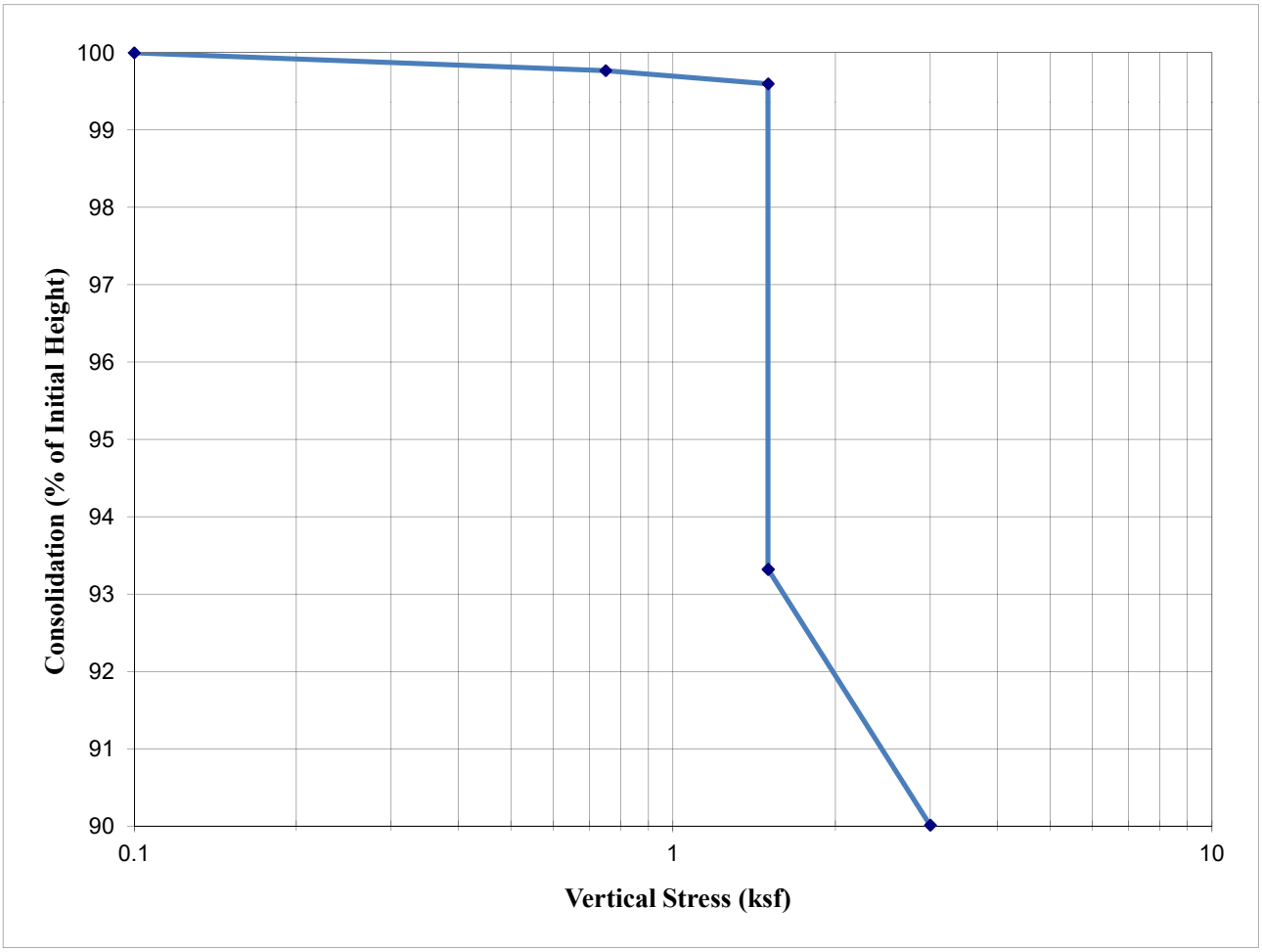
ACS Services LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION

* ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

ACS Project No.:	**2001877**		
Lab No.:	20-5939-12	Material Type:	Native
Client:	KMJ LIV, LLC	Date of Extraction:	12/16/2020
Project Name:	Sedona Lofts	Extracted By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Date of Lab Test:	12/29/2020
Project City:	Sedona, AZ	Lab Tested By:	Trevor Burns
Sample Location:	B - 11 @ 1.5' - 2.5'	Reviewed By:	Gene Hansen

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.14
INITIAL MOISTURE CONTENT	3.8%	FINAL MOISTURE CONTENT	18.7%
INITIAL DRY DENSITY(pcf)	88.2	FINAL DRY DENSITY(pcf)	97.9
INITIAL DEGREE OF SATURATION	11%	FINAL DEGREE OF SATURATION	72%
INITIAL VOID RATIO	0.9	FINAL VOID RATIO	0.7
ESTIMATED SPECIFIC GRAVITY	2.65	SATURATED AT	1.5 ksf



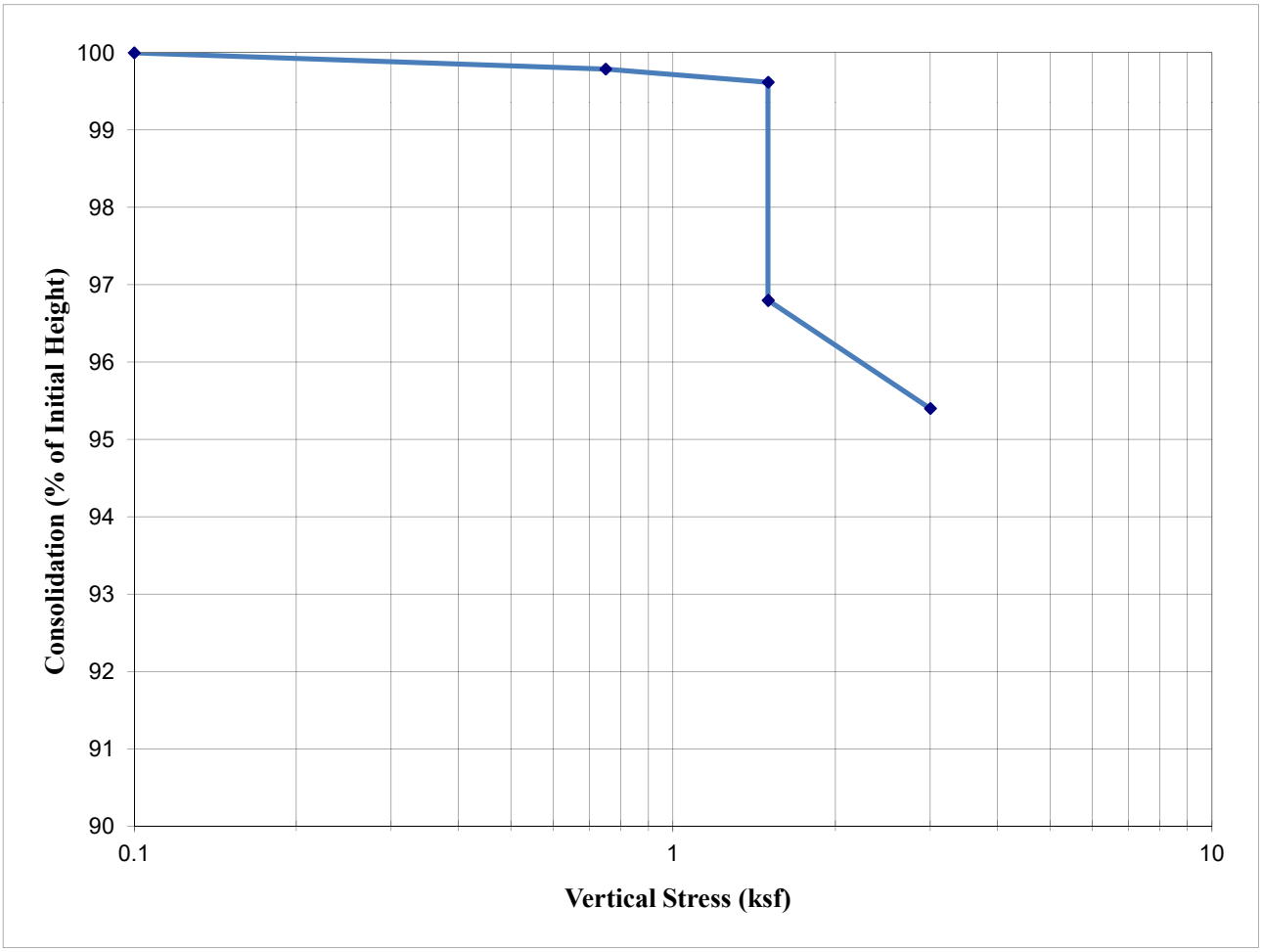
ACS Services LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION

* ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

ACS Project No.:	**2001877**		
Lab No.:	20-5939-13	Material Type:	Native
Client:	KMJ LIV, LLC	Date of Extraction:	12/16/2020
Project Name:	Sedona Lofts	Extracted By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Date of Lab Test:	12/28/2020
Project City:	Sedona, AZ	Lab Tested By:	Trevor Burns
Sample Location:	B - 12 @ 1.5' - 2.5'	Reviewed By:	Gene Hansen

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.39
INITIAL MOISTURE CONTENT	1.8%	FINAL MOISTURE CONTENT	19.0%
INITIAL DRY DENSITY(pcf)	94.1	FINAL DRY DENSITY(pcf)	98.6
INITIAL DEGREE OF SATURATION	6%	FINAL DEGREE OF SATURATION	74%
INITIAL VOID RATIO	0.8	FINAL VOID RATIO	0.7
ESTIMATED SPECIFIC GRAVITY	2.65	SATURATED AT	1.5 ksf



ACS Services LLC

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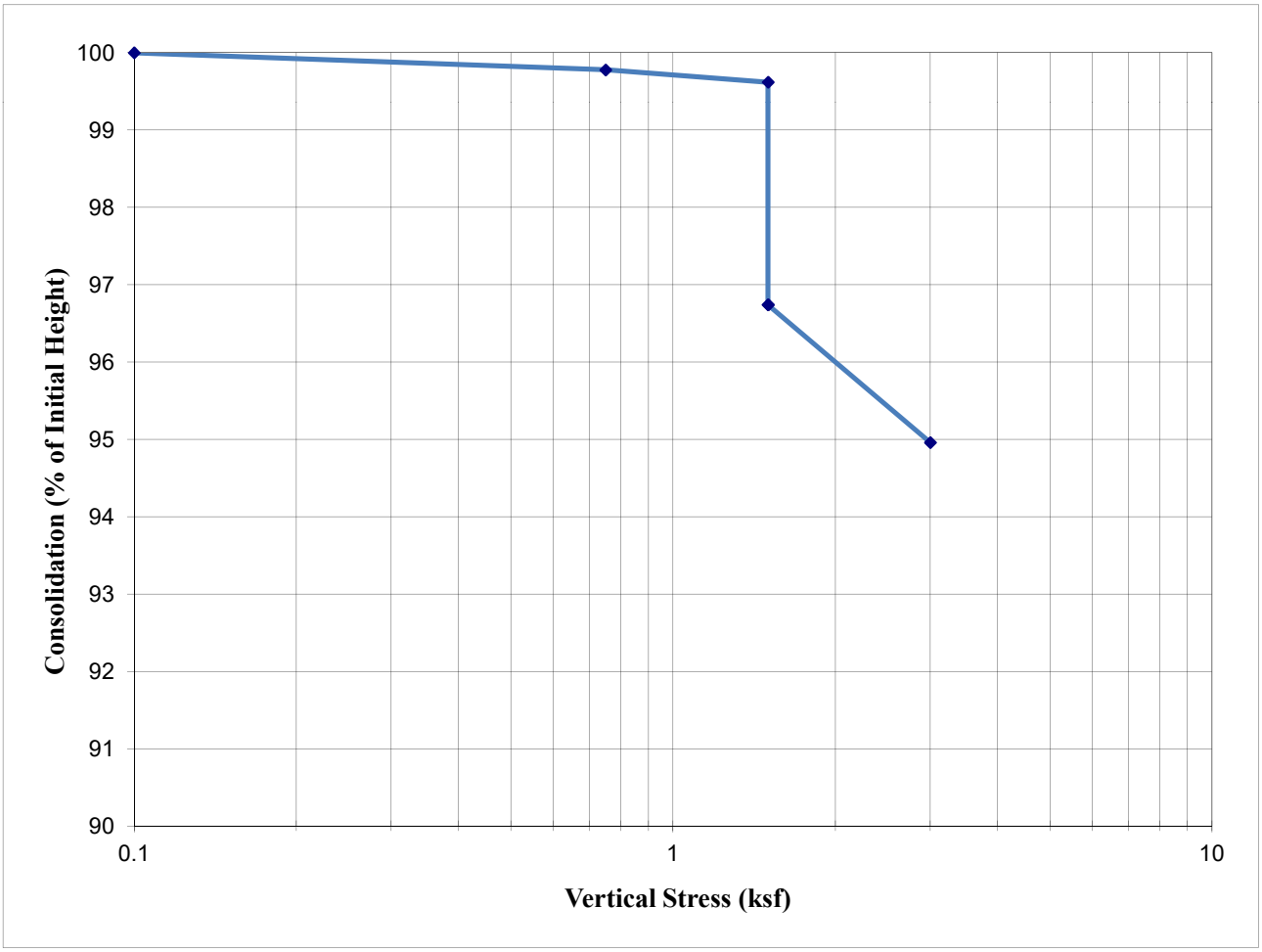
* ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

ACS Project No.:	**2001877**		
Lab No.:	20-5939-14	Material Type:	Native
Client:	KMJ LIV, LLC	Date of Extraction:	12/16/2020
Project Name:	Sedona Lofts	Extracted By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Date of Lab Test:	12/23/2020
Project City:	Sedona, AZ	Lab Tested By:	Trevor Burns
Sample Location:	B - 13 @ 1.5' - 2.5'	Reviewed By:	Gene Hansen

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.37
INITIAL MOISTURE CONTENT	1.6%	FINAL MOISTURE CONTENT	13.9%
INITIAL DRY DENSITY(pcf)	106.0	FINAL DRY DENSITY(pcf)	111.6
INITIAL DEGREE OF SATURATION	7%	FINAL DEGREE OF SATURATION	76%
INITIAL VOID RATIO	0.6	FINAL VOID RATIO	0.5
ESTIMATED SPECIFIC GRAVITY	2.65	SATURATED AT	1.5 ksf



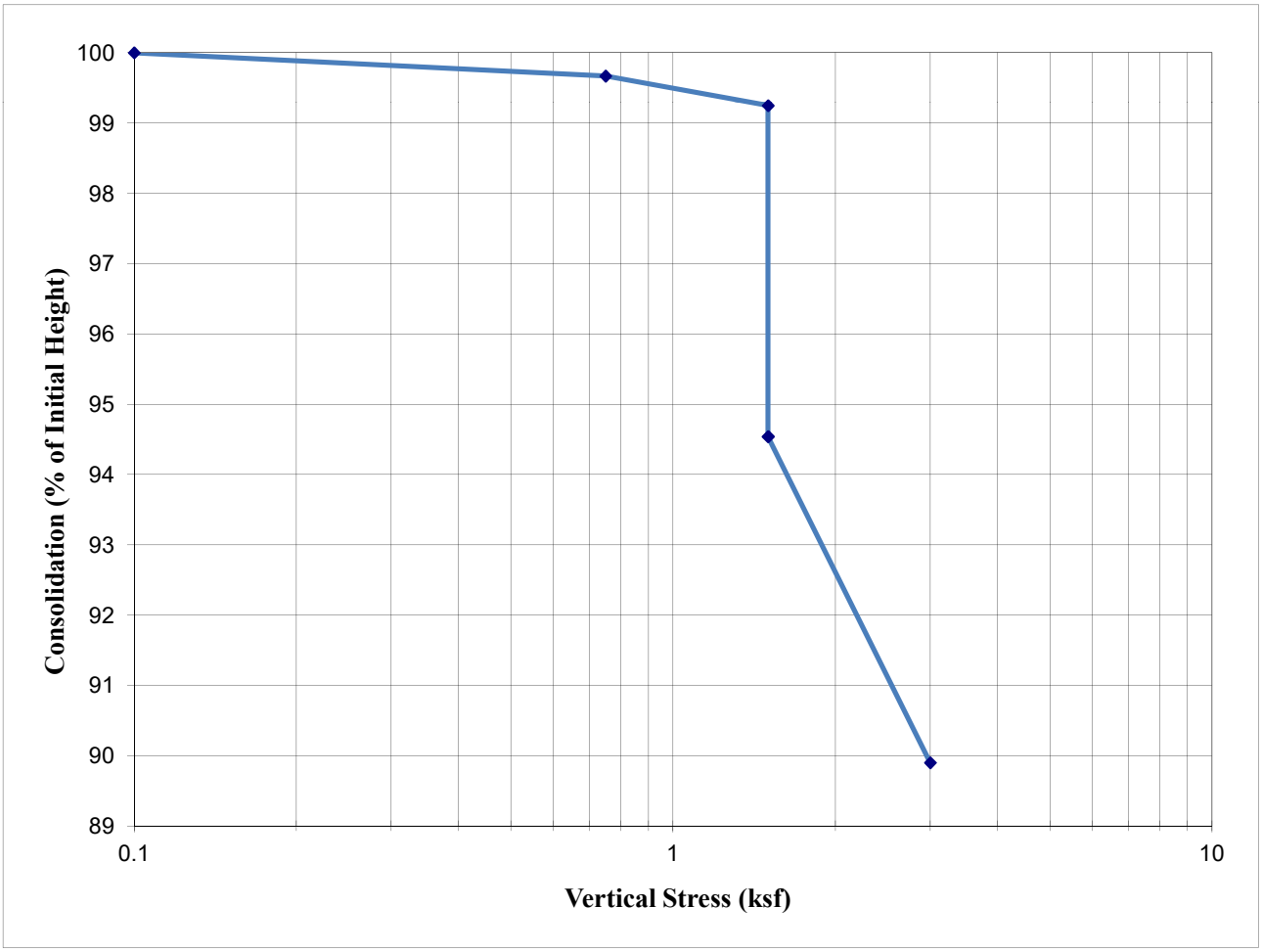
ACS Services LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION

* ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

ACS Project No.:	**2001877**		
Lab No.:	20-5939-15	Material Type:	Native
Client:	KMJ LIV, LLC	Date of Extraction:	12/16/2020
Project Name:	Sedona Lofts	Extracted By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Date of Lab Test:	12/28/2020
Project City:	Sedona, AZ	Lab Tested By:	Trevor Burns
Sample Location:	B - 14 @ 1.5' - 2.5'	Reviewed By:	Gene Hansen

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.14
INITIAL MOISTURE CONTENT	4.9%	FINAL MOISTURE CONTENT	19.7%
INITIAL DRY DENSITY(pcf)	90.9	FINAL DRY DENSITY(pcf)	101.1
INITIAL DEGREE OF SATURATION	16%	FINAL DEGREE OF SATURATION	82%
INITIAL VOID RATIO	0.8	FINAL VOID RATIO	0.6
ESTIMATED SPECIFIC GRAVITY	2.65	SATURATED AT	1.5 ksf



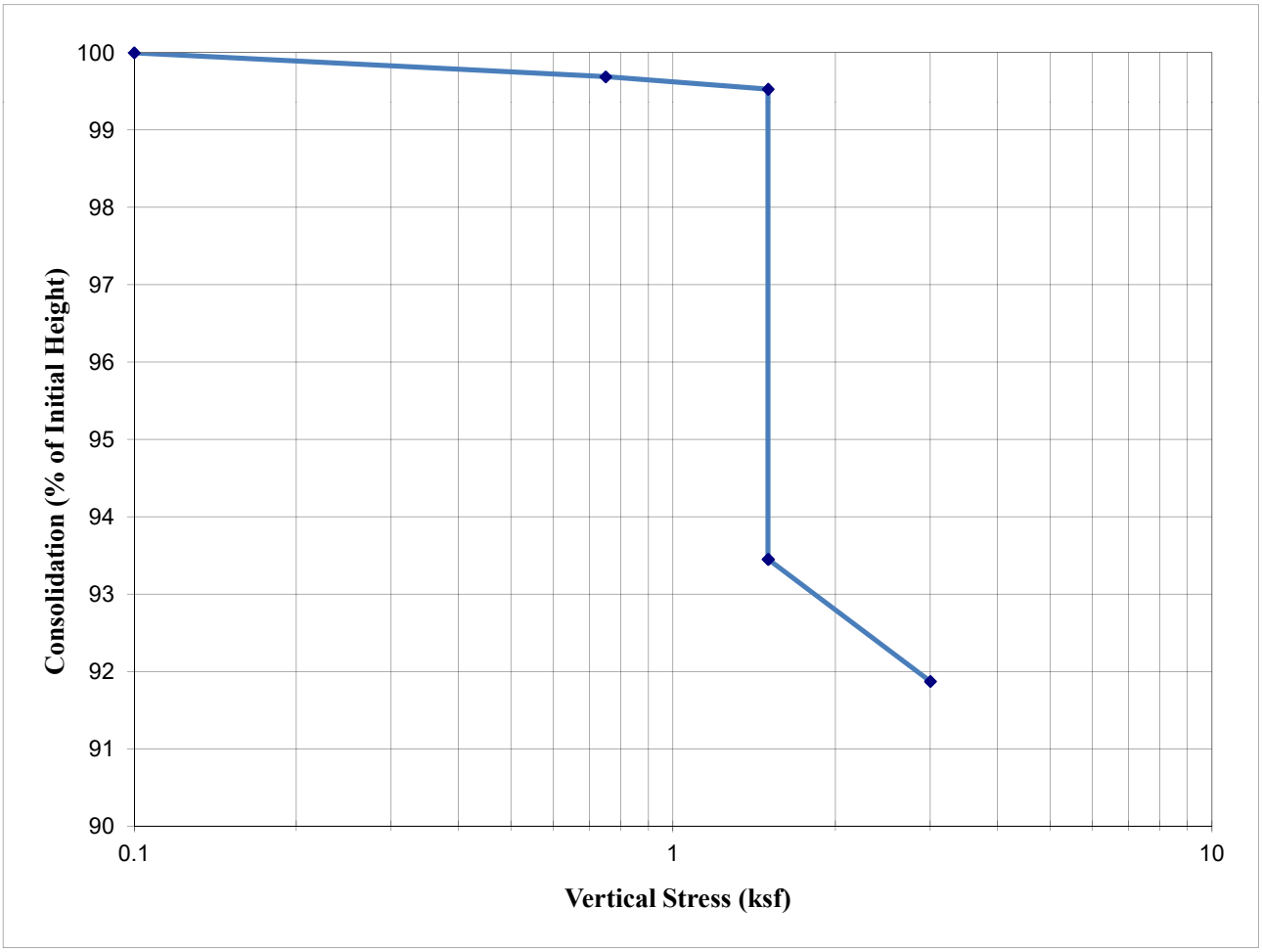
ACS Services LLC

ENGINEERING DESIGN • MATERIAL TESTING • CONSTRUCTION INSPECTION

* ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

ACS Project No.:	**2001877**		
Lab No.:	20-5939-16	Material Type:	Native
Client:	KMJ LIV, LLC	Date of Extraction:	12/16/2020
Project Name:	Sedona Lofts	Extracted By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Date of Lab Test:	12/28/2020
Project City:	Sedona, AZ	Lab Tested By:	Trevor Burns
Sample Location:	B - 15 @ 1.5' - 2.5'	Reviewed By:	Gene Hansen

INITIAL VOLUME (cu.in)	4.60	FINAL VOLUME (cu.in)	4.23
INITIAL MOISTURE CONTENT	2.7%	FINAL MOISTURE CONTENT	17.1%
INITIAL DRY DENSITY(pcf)	94.6	FINAL DRY DENSITY(pcf)	102.9
INITIAL DEGREE OF SATURATION	10%	FINAL DEGREE OF SATURATION	74%
INITIAL VOID RATIO	0.7	FINAL VOID RATIO	0.6
ESTIMATED SPECIFIC GRAVITY	2.65	SATURATED AT	1.5 ksf



ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-1	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/15/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona, AZ	Tested By:	Trevor Burns
Sample Location:	B - 2 @ 0.0'-4.0'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
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	99	
1/4"	1	98	
#4	1	98	
#8	2	95	
#10	1	95	
#16	1	93	
#30	2	91	
#40	1	90	
#50	2	88	
#100	6	82	
#200	16	66.2	

Liquid Limit (AASHTO T-89)	24
Plastic Limit (AASHTO T-90)	16
Plasticity Index (AASHTO T-90)	8
Moisture Content (AASHTO T-255)	4.8
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	CL

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-2	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/15/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/26/2020
Project City	Sedona, AZ	Tested By:	Trevor Burns
Sample Location:	B-3 @ 0.0'-2.0'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
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"	0	99	
#4	0	99	
#8	1	98	
#10	0	98	
#16	0	98	
#30	1	97	
#40	1	97	
#50	1	95	
#100	8	87	
#200	36	51.4	

Liquid Limit (AASHTO T-89)	20
Plastic Limit (AASHTO T-90)	17
Plasticity Index (AASHTO T-90)	3
Moisture Content (AASHTO T-255)	3.0
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	ML

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-3	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/15/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona Lofts	Tested By:	Trevor Burns
Sample Location:	B-4 @ 0.0'-4.0'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	0	100	
3/4"	3	97	
1/2"	7	89	
3/8"	5	85	
1/4"	7	78	
#4	5	73	
#8	10	63	
#10	2	61	
#16	4	57	
#30	4	53	
#40	1	52	
#50	2	50	
#100	6	44	
#200	13	31.5	

Liquid Limit (AASHTO T-89)	
Plastic Limit (AASHTO T-90)	
Plasticity Index (AASHTO T-90)	NP
Moisture Content (AASHTO T-255)	1.9
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SM

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-4	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/15/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona, AZ	Tested By:	Trevor Burns
Sample Location:	B - 5 @ 0.0'-4.0'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
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"	0	100	
#4	0	99	
#8	0	99	
#10	0	99	
#16	0	99	
#30	1	98	
#40	1	97	
#50	1	96	
#100	4	92	
#200	12	79.9	

Liquid Limit (AASHTO T-89)	23
Plastic Limit (AASHTO T-90)	16
Plasticity Index (AASHTO T-90)	7
Moisture Content (AASHTO T-255)	4.9
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	CL-ML

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-5	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/16/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona, AZ	Tested By:	Trevor Burns
Sample Location:	B-6 @ 0.0'-1.5'	Reviewed By:	0

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	0	100	
3/4"	0	100	
1/2"	0	99	
3/8"	0	99	
1/4"	1	98	
#4	1	97	
#8	4	93	
#10	1	92	
#16	3	89	
#30	3	86	
#40	1	85	
#50	2	83	
#100	6	77	
#200	22	54.3	

Liquid Limit (AASHTO T-89)	
Plastic Limit (AASHTO T-90)	
Plasticity Index (AASHTO T-90)	NP
Moisture Content (AASHTO T-255)	1.7
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	ML

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-17	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/16/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona, AZ	Tested By:	Trevor Burns
Sample Location:	B-6, B-7, B-8 @ 4.0'-5.5'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
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"	1	99	
1/4"	1	98	
#4	1	97	
#8	2	95	
#10	0	94	
#16	1	93	
#30	1	92	
#40	1	91	
#50	1	90	
#100	2	88	
#200	9	79.6	

Liquid Limit (AASHTO T-89)	24
Plastic Limit (AASHTO T-90)	16
Plasticity Index (AASHTO T-90)	8
Moisture Content (AASHTO T-255)	4.9
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	CL

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-9	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/16/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona, AZ	Tested By:	Trevor Burns
Sample Location:	B-7 @ 1.5'-2.5'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
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"	0	99	
#4	0	99	
#8	1	98	
#10	0	98	
#16	0	98	
#30	1	97	
#40	0	97	
#50	0	96	
#100	1	95	
#200	9	85.6	

Liquid Limit (AASHTO T-89)	24
Plastic Limit (AASHTO T-90)	16
Plasticity Index (AASHTO T-90)	8
Moisture Content (AASHTO T-255)	4.6
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	CL

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-6	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/16/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona, AZ	Tested By:	Trevor Burns
Sample Location:	B-8 @ 0.0'-1.5'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
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	99	
#8	1	97	
#10	0	97	
#16	1	96	
#30	2	94	
#40	1	93	
#50	1	92	
#100	2	90	
#200	9	81.0	

Liquid Limit (AASHTO T-89)	26
Plastic Limit (AASHTO T-90)	16
Plasticity Index (AASHTO T-90)	10
Moisture Content (AASHTO T-255)	4.1
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	CL

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-18	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/16/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona , AZ	Tested By:	Trevor Burns
Sample Location:	B-9, B-10, B-11 @ 4.0'-5.5'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	0	100	
3/4"	0	100	
1/2"	0	99	
3/8"	1	98	
1/4"	2	96	
#4	2	94	
#8	9	85	
#10	2	83	
#16	5	78	
#30	5	73	
#40	2	71	
#50	2	69	
#100	6	63	
#200	17	45.9	

Liquid Limit (AASHTO T-89)	21
Plastic Limit (AASHTO T-90)	17
Plasticity Index (AASHTO T-90)	4
Moisture Content (AASHTO T-255)	2.8
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	SC-SM

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-12	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/16/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona, AZ	Tested By:	Trevor Burns
Sample Location:	B-11 @ 1.5'-2.5'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
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"	0	100	
#4	0	100	
#8	0	99	
#10	0	99	
#16	0	99	
#30	0	99	
#40	0	99	
#50	0	98	
#100	4	94	
#200	20	74.5	

Liquid Limit (AASHTO T-89)	20
Plastic Limit (AASHTO T-90)	17
Plasticity Index (AASHTO T-90)	3
Moisture Content (AASHTO T-255)	3.5
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	ML

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-19	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/16/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona, AZ	Tested By:	Trevor Burns
Sample Location:	B-12, B-13, B-14 @ 4.0'-5.5'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
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"	0	99	
#4	0	99	
#8	1	98	
#10	0	98	
#16	1	97	
#30	1	97	
#40	0	96	
#50	1	96	
#100	5	91	
#200	25	66.0	

Liquid Limit (AASHTO T-89)	
Plastic Limit (AASHTO T-90)	
Plasticity Index (AASHTO T-90)	NP
Moisture Content (AASHTO T-255)	3.2
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	ML

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-7	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/16/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona, AZ	Tested By:	Trevor Burns
Sample Location:	B-13 @ 0.0'-1.5'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
2 1/2"	0	100	
2"	0	100	
1 1/2"	0	100	
1"	2	98	
3/4"	2	96	
1/2"	4	92	
3/8"	3	89	
1/4"	6	83	
#4	3	80	
#8	6	74	
#10	1	73	
#16	3	70	
#30	3	66	
#40	1	65	
#50	2	63	
#100	6	57	
#200	17	40.2	

Liquid Limit (AASHTO T-89)	
Plastic Limit (AASHTO T-90)	
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

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

Laboratory Soil Test Results

ACS PROJECT #	2001877	Material Type:	Native
ACS Lab #	20-5939-15	Supplier:	
Client:	KMJ LIV, LLC	Sample Date:	12/16/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Test Date:	12/29/2020
Project City	Sedona, AZ	Tested By:	Trevor Burns
Sample Location:	B-14 @ 1.5'-2.5'	Reviewed By:	Gene Hansen

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

Sieve Size	% Retained	% Passed	Specs
6"	0	100	
3"	0	100	
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"	0	100	
#4	0	100	
#8	4	96	
#10	1	95	
#16	2	93	
#30	2	90	
#40	1	89	
#50	1	88	
#100	6	82	
#200	19	63.2	

Liquid Limit (AASHTO T-89)	23
Plastic Limit (AASHTO T-90)	16
Plasticity Index (AASHTO T-90)	7
Moisture Content (AASHTO T-255)	4.1
Fractured Faces (ARIZ 212)	
Soluble Salts (ARIZ 237)	
USCS Soil Classification	CL-ML

Gene Hansen
Project Manager

Gene Hansen
Signature

ACS Services LLC

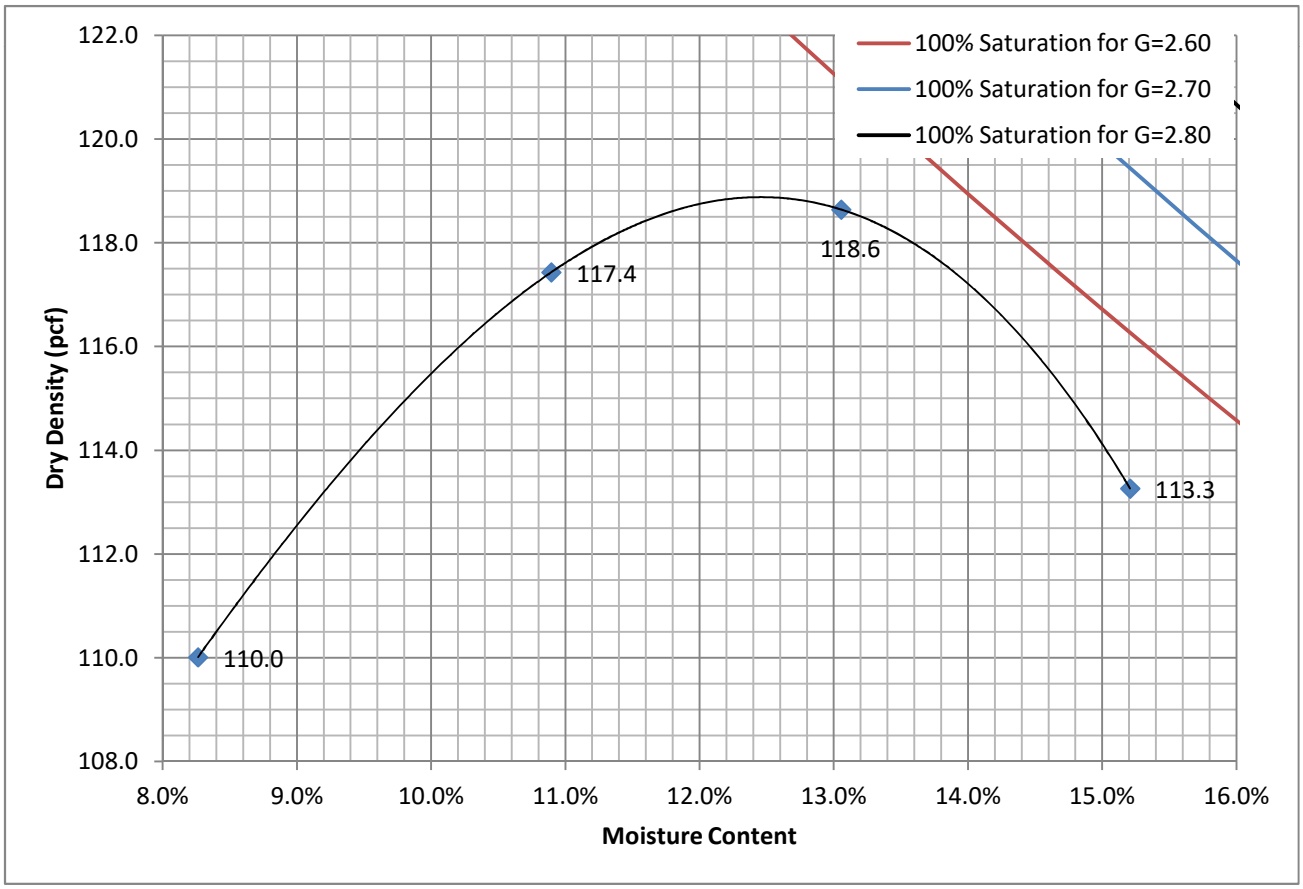
Maximum Dry Density & Optimum Moisture

☐ AASHTO T-99 | ☐ AASHTO T-180 | ☑ ASTM D-698 | ☐ ASTM D-1557

ACS Project #	2001877	Material Type:	Native
ACS Lab #	20-5939-6	Material Supplier:	-
Client Name:	KMJ LIV, LLC	Sample Date:	12/16/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Date Tested:	12/28/2020
Project City:	Sedona, AZ	Tested By:	Brett Rotenberger
		Reviewed By:	Gene Hansen
Sample Location:	B8 @ 0.0'-1.5'	Method:	☑ A ☐ B ☐ C ☐ D

Dry Density	117.4	118.6	113.3	110.0
Moisture Content	10.9%	13.1%	15.2%	8.3%

Uncorrected Dry Density	118.9	Uncorrected Moisture Content	12.4
% Rock	1	% Passing	99
Rock Corrected Dry Density	**118.9**	Rock Corrected Moisture Content	**12.4**
Specific Gravity of Oversize Aggregate	**2.650**		



Gene Hansen

Project Manager

ACS Services LLC

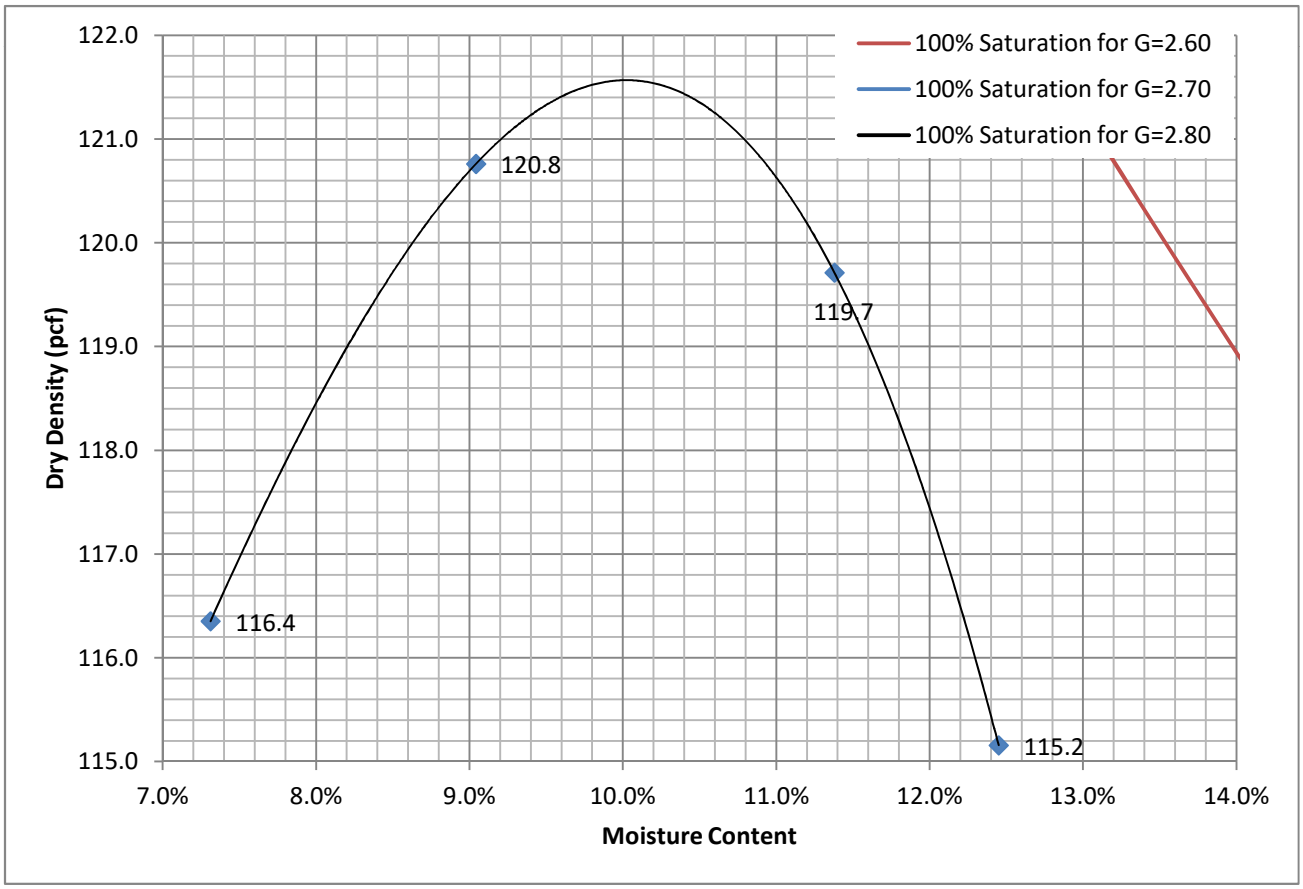
Maximum Dry Density & Optimum Moisture

☐ AASHTO T-99 | ☐ AASHTO T-180 | ☑ ASTM D-698 | ☐ ASTM D-1557

ACS Project #	2001877	Material Type:	Native
ACS Lab #	20-5939-7	Material Supplier:	-
Client Name:	KMJ LIV, LLC	Sample Date:	12/16/2020
Project Name:	Sedona Lofts	Sampled By:	Geoffrey Matthew
Project Address:	10 Navajo Drive	Date Tested:	12/28/2020
Project City:	Sedona, AZ	Tested By:	Brett Rottenberger
		Reviewed By:	Gene Hansen
Sample Location:	B13 @ 0.0'-1.5'	Method:	☑ A ☐ B ☐ C ☐ D

Dry Density	120.8	119.7	116.4	115.2
Moisture Content	9.0%	11.4%	7.3%	12.4%

Uncorrected Dry Density	121.6	Uncorrected Moisture Content	10.0
% Rock	20	% Passing	80
Rock Corrected Dry Density	**128.4**	Rock Corrected Moisture Content	**8.4**
Specific Gravity of Oversize Aggregate	**2.650**		



Gene Hansen

Project Manager

DRAINAGE REPORT

Navajo Lofts

Sedona, Arizona

Prepared for:

MKC HOLDINGS, LLC
15010 N 78TH Way, Suite 109
Scottsdale, AZ 85260

Prepared by:

LANDCOR CONSULTING

6859 E. Rembrandt Ave, #124
Mesa, AZ 85212
480-223-8573

April 2021
Revised July 2021
Revised October 2021
Job # 1763

DRAINAGE REPORT

FOR

NAVAJO LOFTS

TABLE OF CONTENTS

1.0 INTRODUCTION

This project consists of thirty new duplex buildings, each having two units, as well as associated site improvements including an office, pool, and ramada. The site is located just north of State Route 89A and east of Dry Creek Road in Sedona, AZ, in Section 11, Township 17 North, Range 5 East of the Gila and Salt River Base and Meridian. The site is bounded by Aria Street to the north, Symphony Way to the east, vacant land to the south, and Navajo Drive to the west. The terrain is typical high desert, and slopes generally from northeast to southwest.

This report presents the results of an analysis used to support the Preliminary Grading & Drainage Plan for the subject property prepared by Landcor Consulting. The drainage design presented with this report complies with the City of Sedona *Design Review, Engineering, and Administrative Manual* and the *Drainage Design Manual for Yavapai County* and is compatible with existing drainage conditions in the area.

2.0 FLOODPLAIN DESIGNATION

The site is located within FEMA Flood Zone "X" as shown on the FEMA Flood Insurance Rate Map 04025C1435G dated September 3, 2010 (see Figure 1).

Flood Zone "X" is defined as:

> "Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood."

The site is located within a City of Sedona 100-yr Local Floodplain (see Figure 2). The zone is classified as "AO" with a depth of 0.5 feet, which is defined as:

> "Flood depths of 0.5 feet to 3 feet (usually sheet flow on sloped terrain); average depth determined.

3.0 OFFSITE DRAINAGE

Offsite flows approach the site on both the northern and eastern property lines flowing toward the south and southwest. There are existing culverts that cross Aria Street on both the northeast and northwest corners of the site. These culverts convey flow under Aria Street into swales that run north-south on the east and west property lines. The western swale continues south until reaching State Route 89A, the eastern swale terminates approximately 170-ft south of Aria Street at which point the stormwater sheet flows across the property to the southwest. There is also a culvert which crosses Symphony Way just north of Cantabile Street and outlets flow onto the site. From there, the flow sheets across the property toward the southwest.

A Floodplain Analysis of the local floodplain (Harmony Floodplain) was completed by Heritage Land Survey and Engineering in May of 2014. This study shows that roughly 103-cfs enters the property along the eastern boundary as sheet flow which passes through the site, leaving near the southwest property corner (see Appendix D). Per City of Sedona requirements, the peak flow rates for the 2-year, 10-year, 25-year, and 100-year storms are provided in Appendix E

Lastly, there is some amount of flow which enters the site on the north side of the property, sheet flowing across Aria Street. This flow enters as a result of the existing swale on the north side of Aria Street overtopping during larger storm events.

4.0 ON-SITE DRAINAGE

The existing culverts entering the site will be maintained in their current location without any modification. The existing swale along the west side of the property will also be maintained.

On the east side of the property, a new channel will be constructed to intercept the offsite flows entering along the eastern boundary. This channel will be sized for 103-cfs (with 1-ft of freeboard) which is the 100-yr peak flow rate calculated in the Harmony Floodplain Study (see Appendix D). This channel will convey flow along the eastern and southern property boundary before releasing it in its historic location near the southwest property corner. This offsite flow will not be co-mingled with the onsite flows, thereby maintaining historic peak discharge rates.

Flows crossing Aria Street will be intercepted in a swale along the south side of Aria Street and conveyed west into the existing swale along Navajo Street.

There will be no adverse impacts to adjacent properties as a result of these improvements. All flows will enter and exit the site in their historic locations.

5.0 STORMWATER DETENTION

Stormwater Retention will be provided for the pre- vs. post-development storm events. Retention will be stored in above ground basins located on the south side of the site. Stormwater will be collected and conveyed to the basins with catch basins and underground storm drain pipe. Storm Drain Hydraulic calculations will be performed during final design. The pre- and post-development flow rates for various storm events were calculated to ensure that post-development flows did not exceed pre-development. These computations were accomplished using *Autodesk Hydraflow Hydrographs* (2021). Below is a summary of pre- and post-development flow rates, calculations can be found in Appendix E.

Recurrence Interval	**Pre-Development Q (cfs)**	**Post-Development Q (cfs)**
2-year	2.9	2.9
10-year	6.5	4.2
25-year	8.9	4.9
100-year	13.1	7.0

Also included in Appendix C are drain time calculations which show that the basin will drain within 12-hours.

6.0 FINISHED FLOOR

The finished floor elevations for the proposed condominium buildings will be set a minimum of 12 inches above the 100-year base flood elevation of the adjacent washes. Therefore, the finished floor elevation is established in accordance with City of Sedona requirements and is free from inundation by the 100-year peak runoff event.

7.0 CONCLUSIONS

- The project is located within FEMA flood Zone “X” and City of Sedona Local Floodplain Zone “AO” with a depth of 0.5 feet.
- The eastern channel will have 1-ft of freeboard.
- All off-site flows will enter and exit the site as per historical conditions with no adverse effects to adjacent properties.
- Finished floor elevations for new construction are established in accordance with the minimum requirements of the City of Sedona and are free from inundation during a 100-year event.
- Stormwater Retention is being provided for the pre- vs. post-development flows.
- This report has been prepared in accordance with the current versions of the City of Sedona *Design Review, Engineering, and Administrative Manual* and the *Drainage Design Manual for Yavapai County* and is compatible with existing drainage conditions in the area

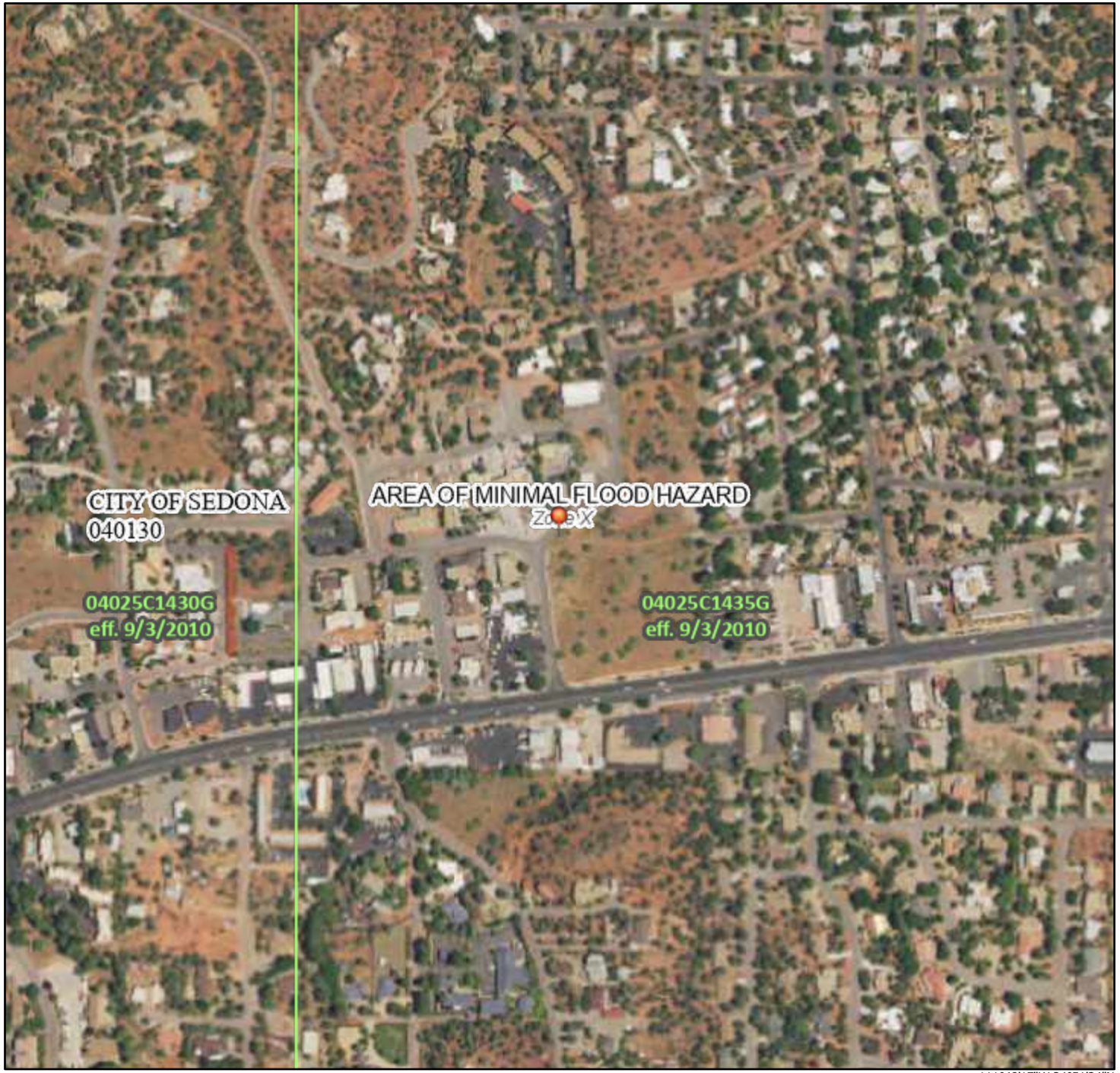
APPENDIX A

FIGURES

National Flood Hazard Layer FIRMette

FEMA

111°48'55"W 34°52'3"N



111°48'17"W 34°51'34"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

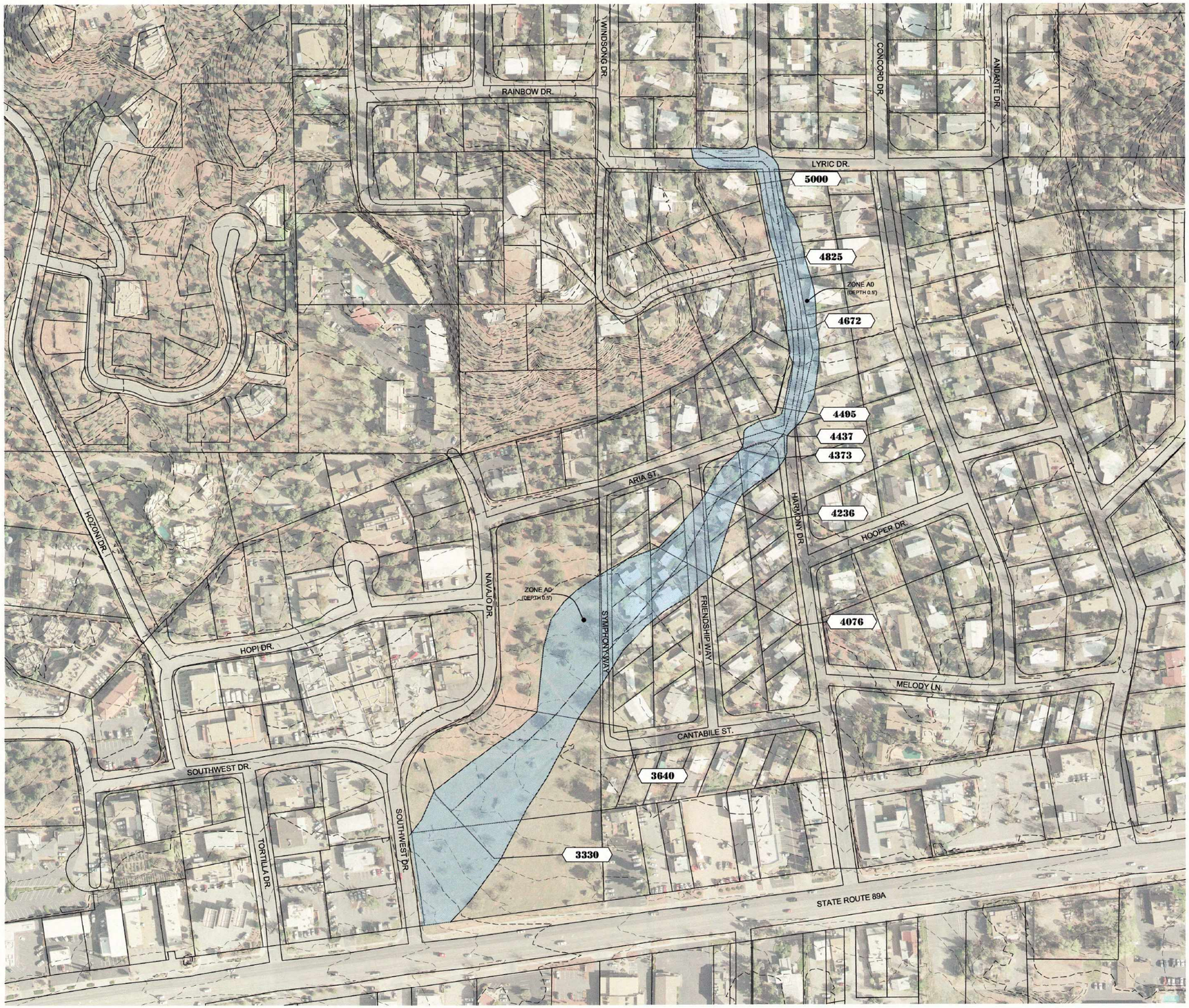
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 4/29/2021 at 2:12 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

FIGURE 1



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, and AO. The Base Flood Elevation is the water-surface elevation of the 1 % annual chance flood.

ZONE A	No Base Flood Elevation determined
ZONE AE	Base Flood Elevations determined
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding; Base Flood Elevations determined
ZONE AO	Flood depths of 0.5 to 3 feet (usually sheet flow on sloped terrain); average depths determined

FLOODPLAIN BOUNDARY

XXXX — CROSS SECTION ID

N

S

0 50' 100' 200'

SCALE IN FEET

FIGURE 2

CITY OF SEDONA

Professional Engineer — CERTIFICATE NO. 37322 — LUKE A. SEFTON — ARIZONA, U.S.A.

EXPIRES 3/31/2017

HERITAGE LAND SURVEY & ENGINEERING
P.O. BOX 3270
CAMP VERDE, ARIZONA 86322
PH: (928) 301-5964
dbmcdonald78@gmail.com

SHEET TITLE: 100-YEAR FLOODPLAIN

PROJECT TITLE: **CITY OF SEDONA HARMONY**

DRAWN BY:	T.C.H.
SCALE:	1'=100'
DATE:	5/1/14
PROJECT NO:	14-0304
SHEET NO.	C-1

PRELIMINARY GRADING & DRAINAGE PLAN
FOR
NAVAJO LOFTS

OWNER

MKC HOLDINGS LLC
15010 N 78TH WAY SUITE 109
SCOTTSDALE AZ 85260
PHONE: (602) 390-9401
CONTACT: KEITH HOLBEN
EMAIL: kh@mkcompany.com

ENGINEER

LANDCOR CONSULTING
6859 E. REMBRANDT AVE. #124
MESA, AZ 85212
PHONE: (480) 734-9157
CONTACT: JOEL D. MILLER, P.E.
EMAIL: joel@landcorconsulting.com

PROJECT DATA

ADDRESS:	10 NAVAJO DR CITY OF SEDONA
TAX ASSESSORS PARCEL NUMBER:	408-24-536B
ZONING	CO
PARCEL AREA:	196,020 SQFT. (4.5 ACRES)

LEGAL DESCRIPTION

PER 2019-0036008 YAVAPAI COUNTY RECORDER.

SHEET INDEX

RETENTION CALCULATIONS

RETENTION VOLUME REQUIRED:

	A (S.F.)	
Area (gross)	196,020	4.50 AC

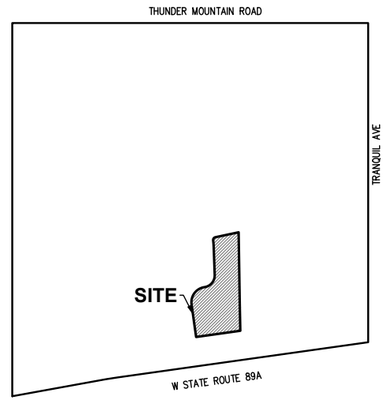
A = Drainage Area in square feet
Cpre = 0.50 Undeveloped Desert Rangeland
Cpost = 0.94 Multiple Family Residential
ΔC = Cpost - Cpre Runoff Coefficient
P = Precipitation Depth (100-yr, 2-hr) 2.64 inches
Vr = Retention Volume Required, cubic feet

Vr = C x P/12 x A

	Area (S.F.)	ΔC	Pre vs. Post Volume (C.F.)	First Flush Volume (C.F.)
DA1	196,020	0.44	18,975	8,168
Total Required	196,020		**18,975**	**8,168**

RETENTION VOLUME PROVIDED:

Basin No.	Top Area (S.F.)	Bot. Area (S.F.)	Depth (FT)	Volume Provided (C.F.)
1	6,760	3,617	3.0	15,566
2	1,908	757	3.0	3,998
			TOTAL =	**19,563**



VICINITY MAP
SEC 11, T17N, R5E
NTS

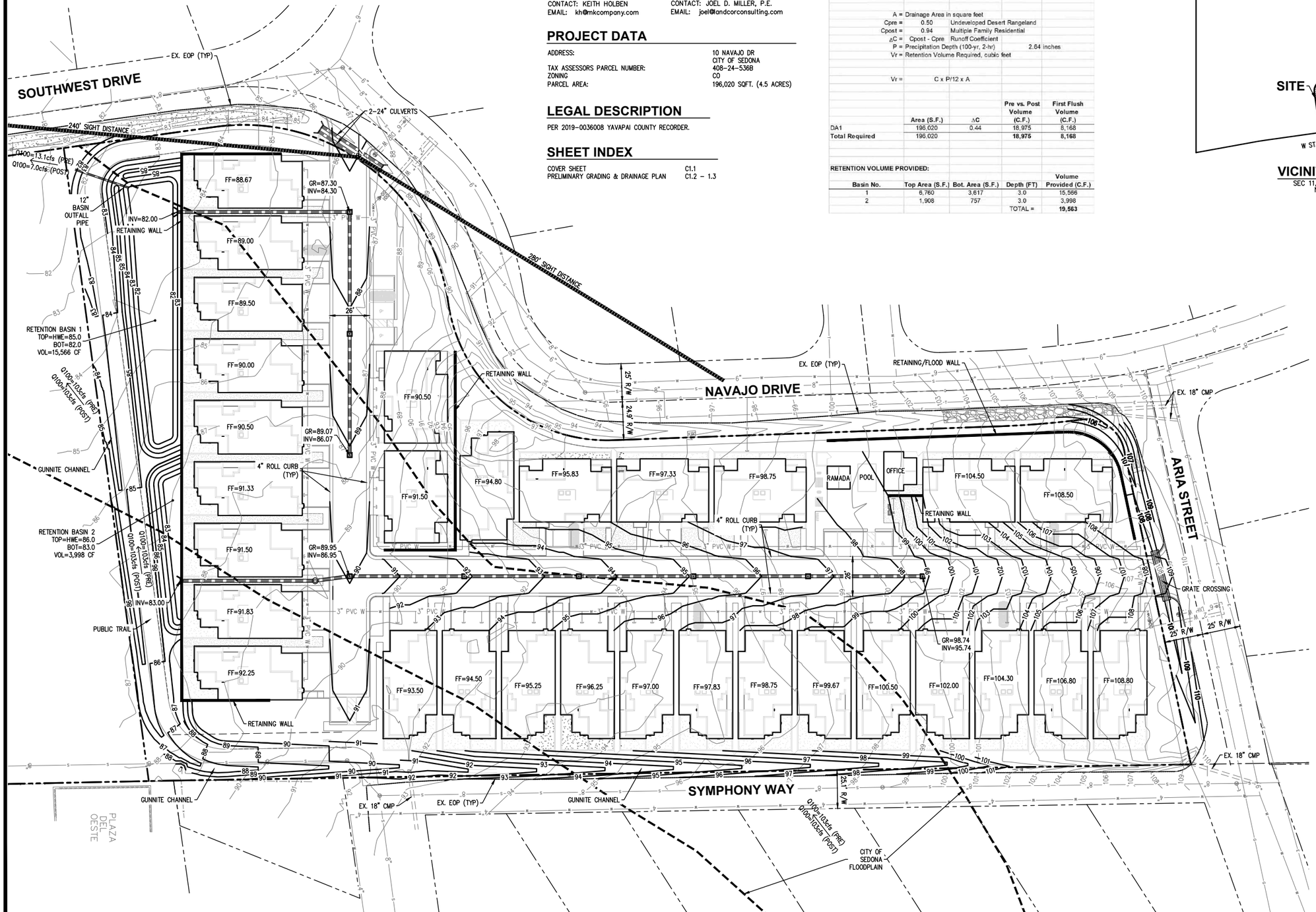


FIGURE 3

PRELIMINARY NOT FOR CONSTRUCTION

53735
JOEL D. MILLER
7/14/21
REGISTERED PROFESSIONAL ENGINEER
State of Arizona, U.S.A.

N

30 15 0 15 30 60
SCALE: 1"=30'

6859 E. Rembrandt Ave, #124
Mesa, AZ 85212
Ph: (480) 223-8573
landcorconsulting.com

LANDCOR CONSULTING

NAVAJO LOFTS
PRELIMINARY GRADING & DRAINAGE PLAN
10 NAVAJO DRIVE
SEDONA, ARIZONA

DATE:

REVISIONS:

PRELIMINARY GRADING & DRAINAGE PLAN

DATE: 7/14/21

PROJ. # : 1763

C1.1
1 OF 3

APPENDIX B

HYDRAULIC CALCULATIONS

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 29 2021

TRAPEZOIDAL CHANNEL ON EAST PROPERTY LINE

Trapezoidal

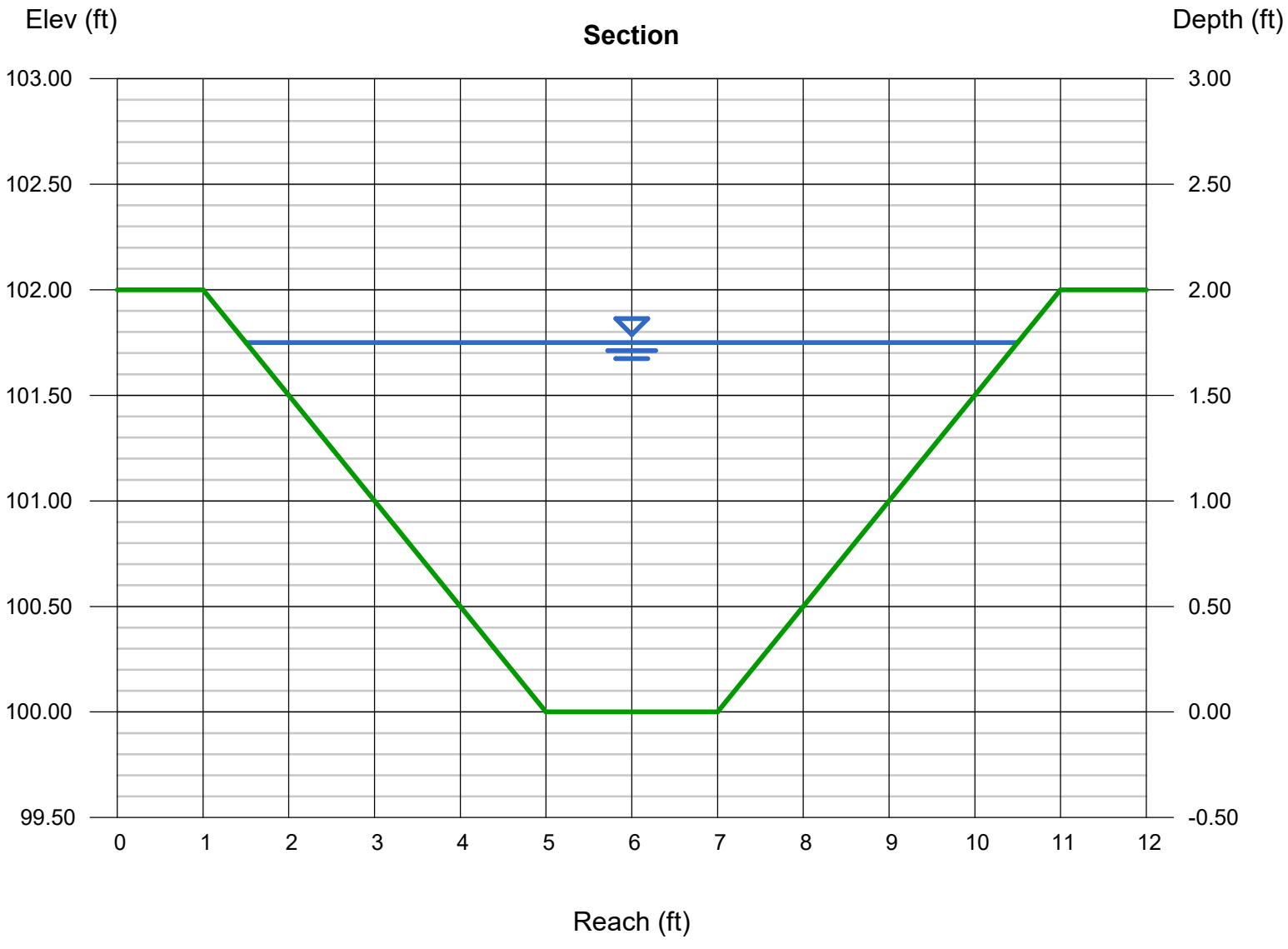
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.77
N-Value	= 0.018

Calculations

Compute by:	Known Q
Known Q (cfs)	= 103.00

Highlighted

Depth (ft)	= 1.75
Q (cfs)	= 103.00
Area (sqft)	= 9.62
Velocity (ft/s)	= 10.70
Wetted Perim (ft)	= 9.83
Crit Depth, Yc (ft)	= 2.00
Top Width (ft)	= 9.00
EGL (ft)	= 3.53



APPENDIX C

STORMWATER RETENTION CALCULATIONS

RETENTION CALCULATIONS

4/29/2021

Sedona Lofts

RETENTION VOLUME REQUIRED:

	A (S.F.)	
Area (gross)	196,020	4.50 AC

A = Drainage Area in square feet
Cpre = 0.50 Undeveloped Desert Rangeland
Cpost = 0.94 Multiple Family Residential
ΔC = Cpost - Cpre Runoff Coefficient
P = Precipitation Depth (100-yr, 2-hr) 2.64 inches
Vr = Retention Volume Required, cubic feet

Vr = C x P/12 x A

	Area (S.F.)	ΔC	Pre vs. Post Volume (C.F.)	First Flush Volume (C.F.)
DA1	196,020	0.44	18,975	8,168
Total Required	196,020		**18,975**	**8,168**

RETENTION VOLUME PROVIDED:

Basin No.	Top Area (S.F.)	Bot. Area (S.F.)	Depth (FT)	Volume Provided (C.F.)
1	6,760	3,617	3.0	15,566
2	1,908	757	3.0	3,998
			TOTAL =	**19,563**

Project: **Navajo Lofts**
Job No.: **1763**
Date: **7/13/2021**

ORIFICE CALCULATIONS (for proposed bleed-off pipe)

Orifice Flow Equation:

$$Q = 0.5A(2gH)^{.5}$$

where,

Q = Flow in cfs
A = Area if Orifice in ft^2
H = Head in feet
g = 32.2 (feet per sec^2)

Therefore,

ORIFICE CALCULATOR

H =	1.00	ft (average)
Orifice Size =	12.0	inches
A =	0.785	ft^2
g =	32.2	ft/s^2
Q =	3.15	cfs

DRAIN TIME CALCULATIONS

Retention Basin:

Q =	3.15	cfs (from orifice calculation)
Vp =	19,563	ft^3

Time to Drain = Vp/Q/3600 = 1.7 hrs

APPENDIX D

HARMONY FLOODPLAIN ANALYSIS

Since 1993
Heritage Land Survey & Engineering
P.O. BOX 3270
CAMP VERDE, ARIZONA, 86322

SERVING: AZ. CO. NM. OK. (PHONE: 928-567-9170

May 6, 2014

David Peck
City of Sedona Public Works
104 Roadrunner Drive
Sedona, Arizona 86336

Subject: COS Harmony Floodplain Analysis
Final Report

Mr. Peck,

The purpose of this letter is to provide a report of the floodplain analysis performed on Profile 4400B as identified within the City of Sedona Floodplain Management Study dated May 1994. Within the original 1994 Floodplain Management Study, Profile 4440 had a break-out flow occur at Lyric Drive which resulted in two different flow profiles from Lyric Drive to State Route 89A, Profile 4400 and Profile 4400B. The City of Sedona has completed a drainage improvement project, extending from State Route 89A to Thunder Mountain Road, which was designed to contain storm flows up to the 25-year frequency event. This report assumes the new drainage system does contain storm flows up to the 25-year event. Based on the changes in hydrologic conditions, a floodplain analysis was performed from Lyric Drive to State Route 89A to show changes to the 100-year floodplain of Profile 4400B. As a result of the drainage improvements completed by the City of Sedona, the hydrology and hydraulics of the area have been modified; therefore, the 100-year floodplain of Profile 4400B, as identified within the 1994 City of Sedona Floodplain Management Study, is not effective.

Hydrology

A hydrologic review was conducted to determine the break-out discharge near Lyric Drive since the completion of the drainage improvements, during the 100-year storm event. We have reviewed the Harmony-Windsong Drainage Improvements Design Report for Phase III prepared by Dibble Engineering and the Final Drainage Report for Harmony-Windsong Phase IV prepared by Shephard Wesnitzer. Based on the results presented within these two drainage studies we have determined that a break-out flow of **40 cfs** will occur near Lyric Drive.

According to the drainage studies for Harmony-Windsong Phase III and Phase IV, the system was designed to capture and convey peak discharges for storm events up to the 25-year event. The Harmony-Windsong Phase I through Phase IV projects extend from Thunder Mountain Road to the south side of State Route 89A. At Concentration Point A33AC located at Thunder Mountain Road, the 25-year peak discharge and the 100-year peak discharge are 537.9 cfs and 590.5 cfs respectively. Since the system has a 25-year

* Dugan L. Mc Donald, R.L.S., P.L.S., (928-301-5964) * Clinton Gillespie R.L.S. (928-301-3072) * Shane Nauert, R.L.S. (928-451-2493)
* Daniel L. Mc Donald, S.P.C. (928-301-7206) * Jesse Sharp S.P.C. (928-301-6238)
* Luke Sefton, P.E. (928-646-3494) * Timothy Huskett, E.I.T (928-707-2078)

capacity, there will be an overflow of 52.6 cfs during the 100-year storm event at this location. A hydraulic analysis of the improved channel, extending from CP-A33AC to Manhole 4A & 4B as shown in the construction plans for Phase IV, shows the overflow will be contained within the channel, at an approximate depth of 1 foot. At Manhole 4A & 4B, approximately 20 cfs of the 52.6 cfs overflow will drain back into the dual pipes, and allow 32.6 cfs to bypass the grated manholes, and continue down the improved channel to Manhole 3A & 3B. At Manhole 3A & 3B, the 32.6 cfs will combine with runoff flow from Sub-Basin A29B-1. Sub-Basin A29B-1 has a 25-year and 100-year peak discharge of 33.1 cfs and 42.1 cfs respectively. Flows through each of the manholes were determined with a 50% clogging factor. Since the improved drainage system was designed to accept discharges up to the 25-year event, the amount of runoff from A29B-1 bypassing Manhole 3A & 3B is 9 cfs. Of the 32.6 cfs coming from upstream, another 20 cfs will drain back into the dual pipes, and allow 12.6 cfs to bypass the grated manhole. The combination of the 9 cfs and the 12.6 cfs will then overtop Moonglow Drive, and add to the overflow from Sub-Basin A29B-2. Sub-Basin A29B-2 has a 25-year and 100-year peak discharge of 43.3 cfs and 55.1 cfs respectively. The improved drainage system will accept the 25-year event; therefore approximately 11.8 cfs will combine with the 21.6 cfs overtopping Moonglow Drive upstream, and drain to Manhole 2A & 2B. The combined flow of 33.4 cfs will be contained within the improved channel between Moonglow Drive and Manhole 2A & 2B. At Manhole 2A & 2B, the 33.4 cfs will bypass the grated manholes and continue within the improved channel to Manhole 1A & 1B, since the system at this point will be under pressure during the 100-year storm event. At Manhole 1A & 1B, the 33.4 cfs will again bypass the opening during the 100-year storm event. The improved drainage system accepting runoff from Sub-Basin A29B-3, and conveying the flow to the dual pipes, has the capacity to contain the peak discharges from the basin up to the 100-year storm event; therefore there will be no overflow from Sub-Basin A29B-3. The overflow of 33.4 cfs, from Manhole 1A & 1B, will combine with the overflow from Sub-Basin A29B-4. Sub-Basin A29B-4 has a 25-year and 100-year peak discharge of 23.5 cfs and 29.8 cfs respectively. Since the improved drainage system was designed to accept discharges up to the 25-year storm event, the amount of runoff bypassing the 24-in pipe beneath Lyric Drive is 6.3 cfs. A combined flow of **40 cfs** will then overtop Lyric Drive.

Of the **40 cfs** crossing Lyric Drive, **10 cfs** will continue directly across the street to a small drainage channel along the westside of the improved drainage system. Therefore approximately **30 cfs** will flow east down Lyric Drive towards the intersection of Harmony Drive and Lyric Drive.

Local drainage through Basin A37B as identified within the City of Sedona Stormwater Master Plan was determined, and added to the break-out flow near Lyric Drive. The Basin A37B was sub-divided into 6 sub-basins. The Rational Method was used to calculate the 25-year and 100-year peak discharges. Calculations were based on a Time of Concentration of 10 minutes, since this is the minimum time that could be used for the Rational Method. The 25-year rainfall intensity and 100-year rainfall intensity were 6.06 inches per hour and 8.22 inches per hour, respectively. The rainfall intensities was based on the precipitation data within Table 8.3 of the City of Sedona Land Development Code Article 8.

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Table 8.3

Upper Limit Precipitation Frequency Estimates

Freq (yr)	5-min	10-min	15-min	30-min	60-min	120-min	3-hr	6-hr	12-hr	24-hr	2-day	4-day	7-day	10-day	20-day
1	0.26	0.39	0.48	0.65	0.80	0.93	0.99	1.16	1.49	1.88	2.23	2.57	3.00	3.43	4.43
2	0.33	0.50	0.62	0.83	1.03	1.18	1.26	1.44	1.84	2.36	2.79	3.21	3.75	4.27	5.50
5	0.44	0.67	0.83	1.12	1.39	1.55	1.60	1.79	2.24	2.94	3.47	4.02	4.64	5.26	6.68
10	0.54	0.82	1.01	1.36	1.69	1.87	1.91	2.10	2.57	3.41	4.01	4.68	5.39	6.05	7.56
25	0.67	1.02	1.26	1.70	2.10	2.31	2.34	2.54	3.03	4.05	4.77	5.60	6.43	7.10	8.70
50	0.78	1.19	1.47	1.98	2.46	2.69	2.71	2.89	3.38	4.55	5.36	6.34	7.27	7.94	9.56
100	0.90	1.37	1.70	2.29	2.84	3.12	3.14	3.29	3.76	5.08	5.99	7.14	8.16	8.80	10.40
200	1.03	1.57	1.95	2.63	3.25	3.57	3.59	3.72	4.14	5.63	6.66	7.97	9.06	9.66	11.21
500	1.23	1.88	2.33	3.12	3.88	4.24	4.27	4.37	4.70	6.40	7.56	9.18	10.37	10.84	12.26
1,000	1.40	2.13	2.65	3.56	4.41	4.79	4.85	4.90	5.15	7.02	8.28	10.15	11.39	11.74	13.05

Using the Rational Method, the accumulated flow from the sub-basins of Basin A37B, was determined to equal 179.60 cfs for the 100-year storm event. According to the City of Sedona Dry Creek HEC-1 Model Output, which was calculated using HEC-1 methodology, the Basin A37B had a 100-year peak discharge of 156 cfs. The difference in the peak discharges can be attributed to the different hydrology methods used but an attempt was made to match the output from the City of Sedona Master Plan.

Hydraulics

A steady state hydraulic analysis of the break-out flow through the area was performed using HEC-RAS version 4.1.0 to determine the hydraulic conditions, including the depth of flow, through the project area. Ten cross-sections were delineated along a 1900 feet reach from Lyric Drive to State Route 89A, using the City of Sedona 2-ft topography. The Manning's Roughness Coefficients ranged from 0.065 to 0.100, since the project area was identified as dense residential. Smooth surfaces, such as road surfaces were assigned a roughness coefficient of 0.015. The flow path through the project area has an average slope of 1% along the reach; therefore the steady state boundary condition used for the model was based on a Normal Depth of 0.01 foot per foot.

The 100-year peak discharges, along the flow path, were adjusted based on the 100-year hydrologic calculations for local drainage within Basin A37B. It should be noted that each cross section is not located

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at a well-defined concentration point but the associated discharge does account for the hydraulic conditions at or near the cross section location.

Conclusion

The hydraulic results from the HEC-RAS model were used to determine the effective flood hazard area and the depth of flow. A Special Flood Hazard Map identifying the 100-year floodplain area with depth of flow has been provided. The hydraulic conditions within this report represent the current conditions at the time this report was developed.

If you have any questions, please contact me at (928) 202-3999.

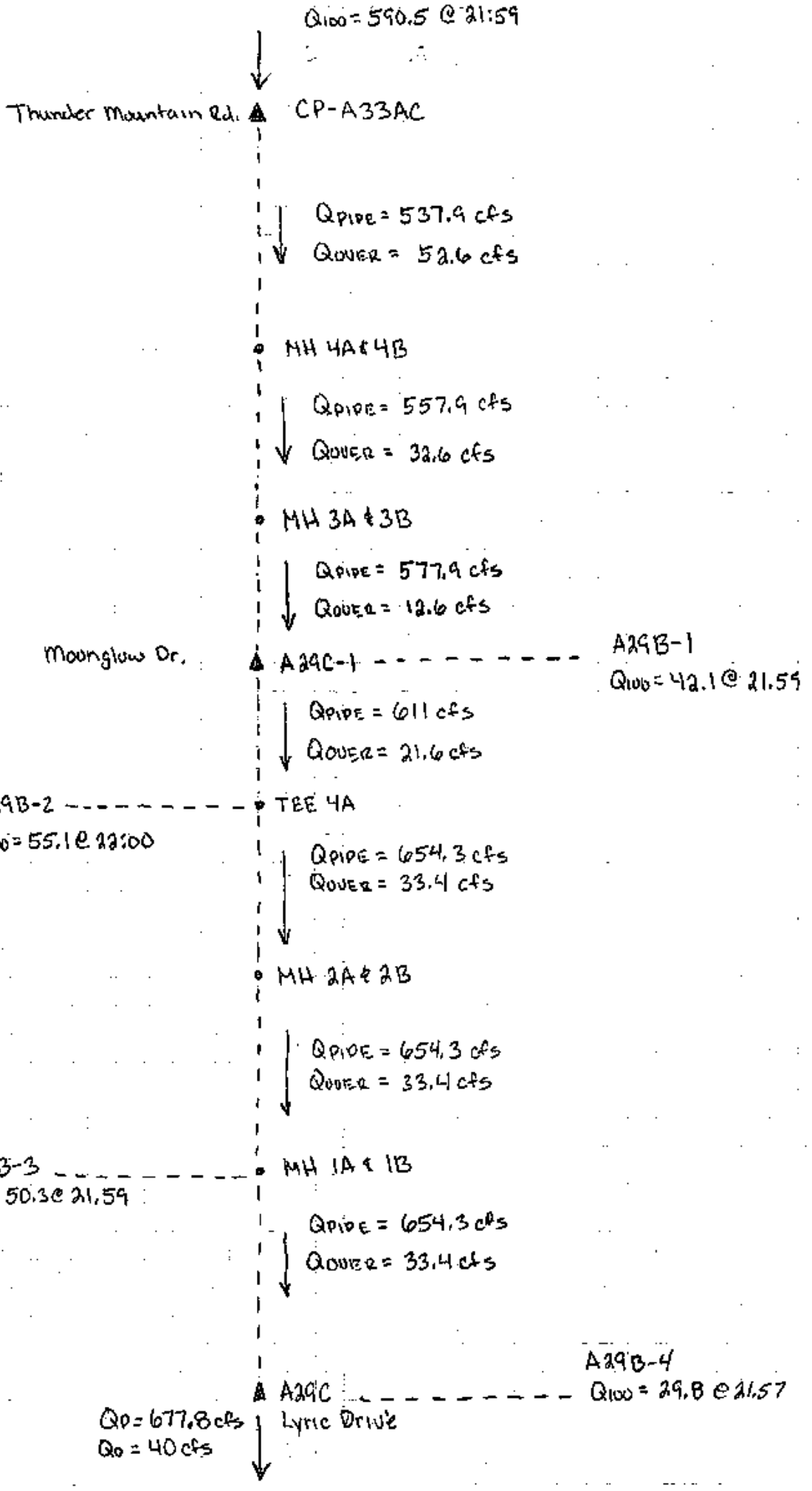
Sincerely,

Luke A. Sefton, P.E.
President

Attachment: Hydrologic Map Network
Hydraulic Structure Calcs
HEC-RAS Summary Table
HEC-RAS Cross Sections
100-year Floodplain Map
Drainage Map

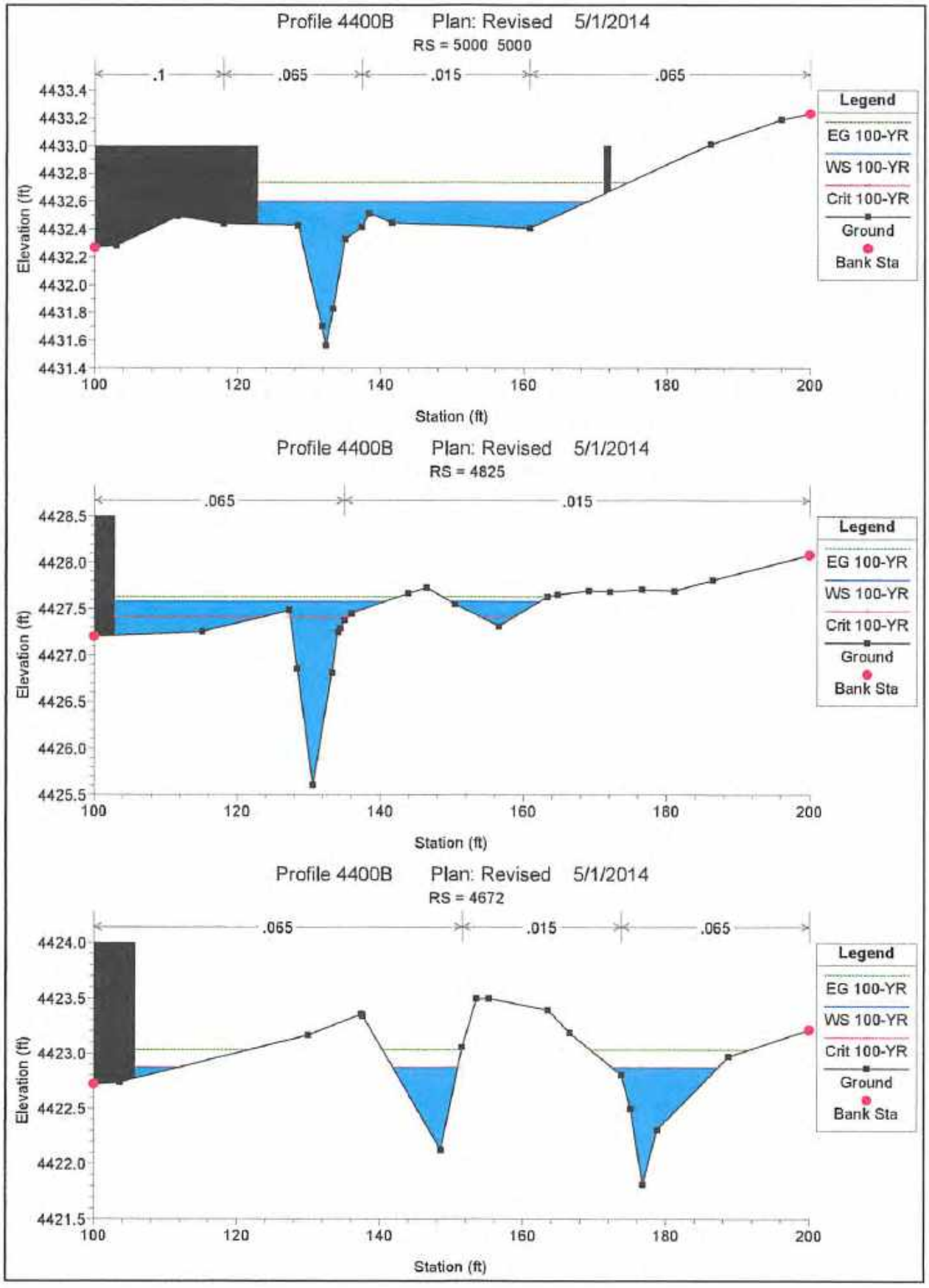
LAS:tch

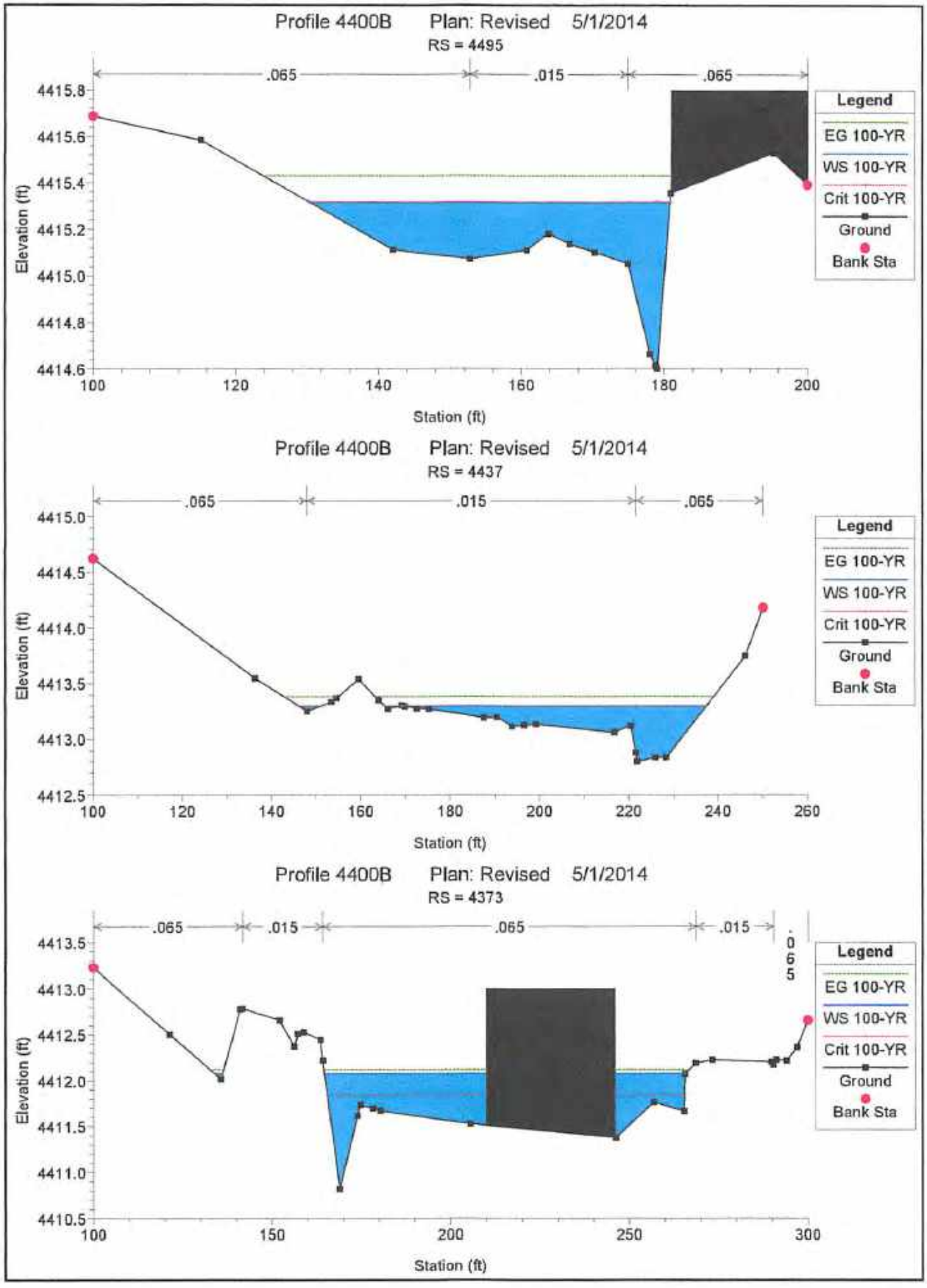
14-0304


Q100 = 590.5 @ 21:59
Thunder Mountain Rd.
CP-A33AC
QPIPE = 537.9 cfs
QOVER = 52.6 cfs
MH 4A & 4B
QPIPE = 557.9 cfs
QOVER = 32.6 cfs
MH 3A & 3B
QPIPE = 577.9 cfs
QOVER = 12.6 cfs
Moonglow Dr.
A29C-1
A29B-1
Q100 = 42.1 @ 21.59
QPIPE = 611 cfs
QOVER = 21.6 cfs
A29B-2
Q100 = 55.1 @ 22:00
TEE 4A
QPIPE = 654.3 cfs
QOVER = 33.4 cfs
MH 2A & 2B
QPIPE = 654.3 cfs
QOVER = 33.4 cfs
A29B-3
Q100 = 50.3 @ 21.59
MH 1A & 1B
QPIPE = 654.3 cfs
QOVER = 33.4 cfs
A29B-4
Q100 = 29.8 @ 21.57
A29C
Lyric Drive
Q0 = 677.8 cfs
Q0 = 40 cfs

HEC-RAS Plan: Revised River: Profile 4400B Reach: Harmony Profile: 100-YR

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Harmony	5000	100-YR	30.00	4431.57	4432.60	4432.60	4432.73	0.026751	2.95	10.17	46.08	1.11
Harmony	4825	100-YR	30.00	4425.61	4427.58	4427.41	4427.63	0.015241	1.79	16.72	50.33	0.55
Harmony	4672	100-YR	30.00	4421.82	4422.88	4422.88	4423.04	0.083887	3.19	9.40	30.40	1.01
Harmony	4495	100-YR	30.00	4414.60	4415.32	4415.32	4415.43	0.018533	2.74	10.93	50.44	1.04
Harmony	4437	100-YR	30.00	4412.80	4413.30	4413.30	4413.38	0.014530	2.32	12.95	77.22	1.00
Harmony	4373	100-YR	55.00	4410.82	4412.08	4411.84	4412.12	0.013953	1.68	32.83	67.40	0.42
Harmony	4236	100-YR	55.00	4406.53	4407.98	4407.08	4407.24	0.216976	3.29	17.05	53.36	1.01
Harmony	4076	100-YR	80.30	4402.55	4403.55		4403.58	0.010173	1.40	57.34	140.61	0.39
Harmony	3640	100-YR	102.85	4391.07	4391.72	4391.72	4391.89	0.086790	3.32	30.94	89.21	0.99
Harmony	3330	100-YR	102.85	4383.67	4384.37	4384.13	4384.40	0.010019	1.23	83.54	211.67	0.35


Profile 4400B Plan: Revised 5/1/2014
RS = 5000 5000
.1
.065
.015
.065
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Profile 4400B Plan: Revised 5/1/2014
RS = 4825
.065
.015
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Profile 4400B Plan: Revised 5/1/2014
RS = 4672
.065
.015
.065
Elevation (ft)
Station (ft)
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta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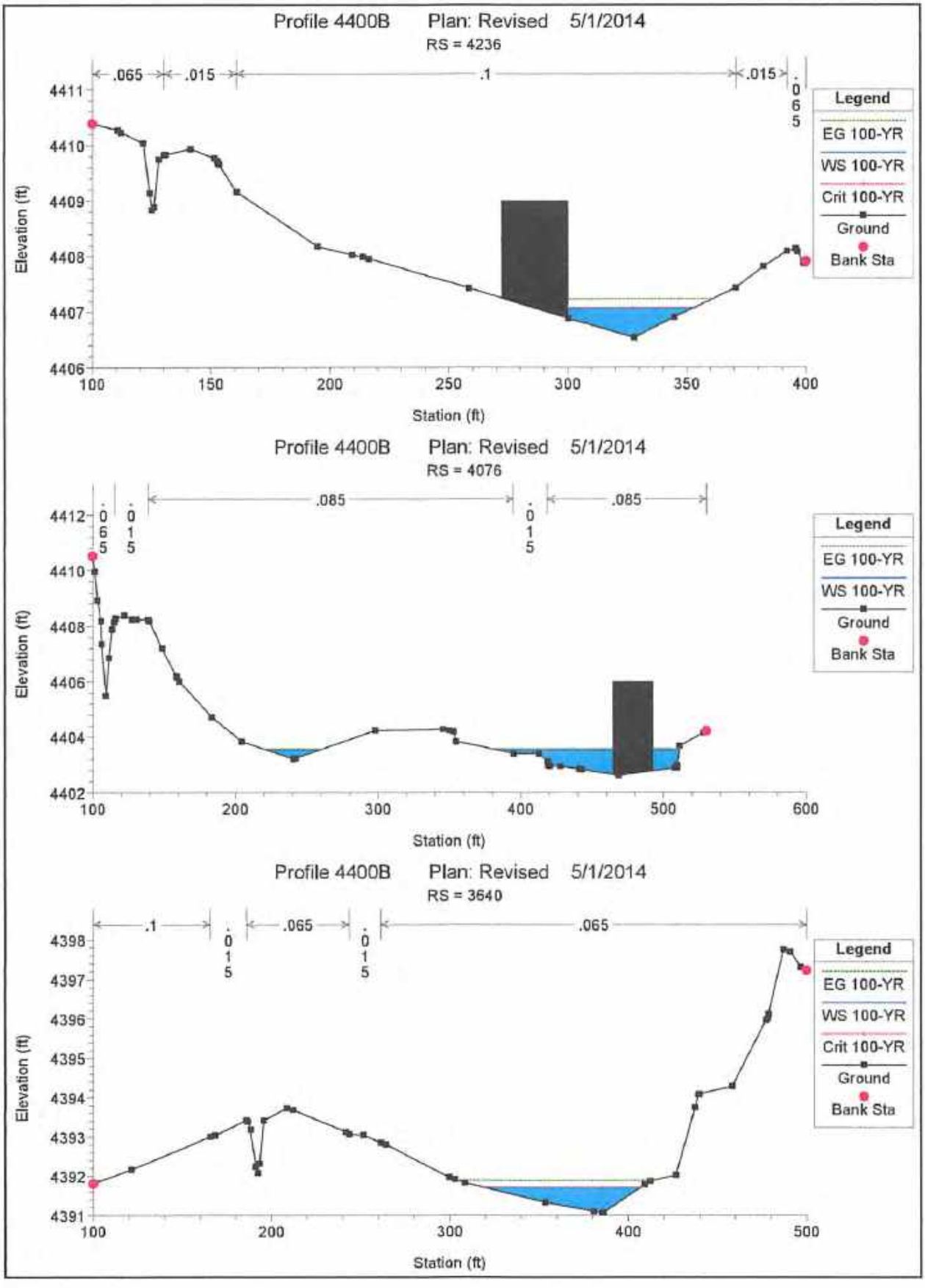
.015
.065
Elevation (ft)
4415.8
4415.6
4415.4
4415.2
4415.0
4414.8
4414.6
100
120
140
160
180
200
Station (ft)
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Profile 4400B Plan: Revised 5/1/2014
RS = 4437
.065
.015
.065
Elevation (ft)
4415.0
4414.5
4414.0
4413.5
4413.0
4412.5
100
120
140
160
180
200
220
240
260
Station (ft)
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Profile 4400B Plan: Revised 5/1/2014
RS = 4373
.065
.015
.065
.015
.065
Elevation (ft)
4413.5
4413.0
4412.5
4412.0
4411.5
4411.0
4410.5
100
150
200
250
300
Station (ft)
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta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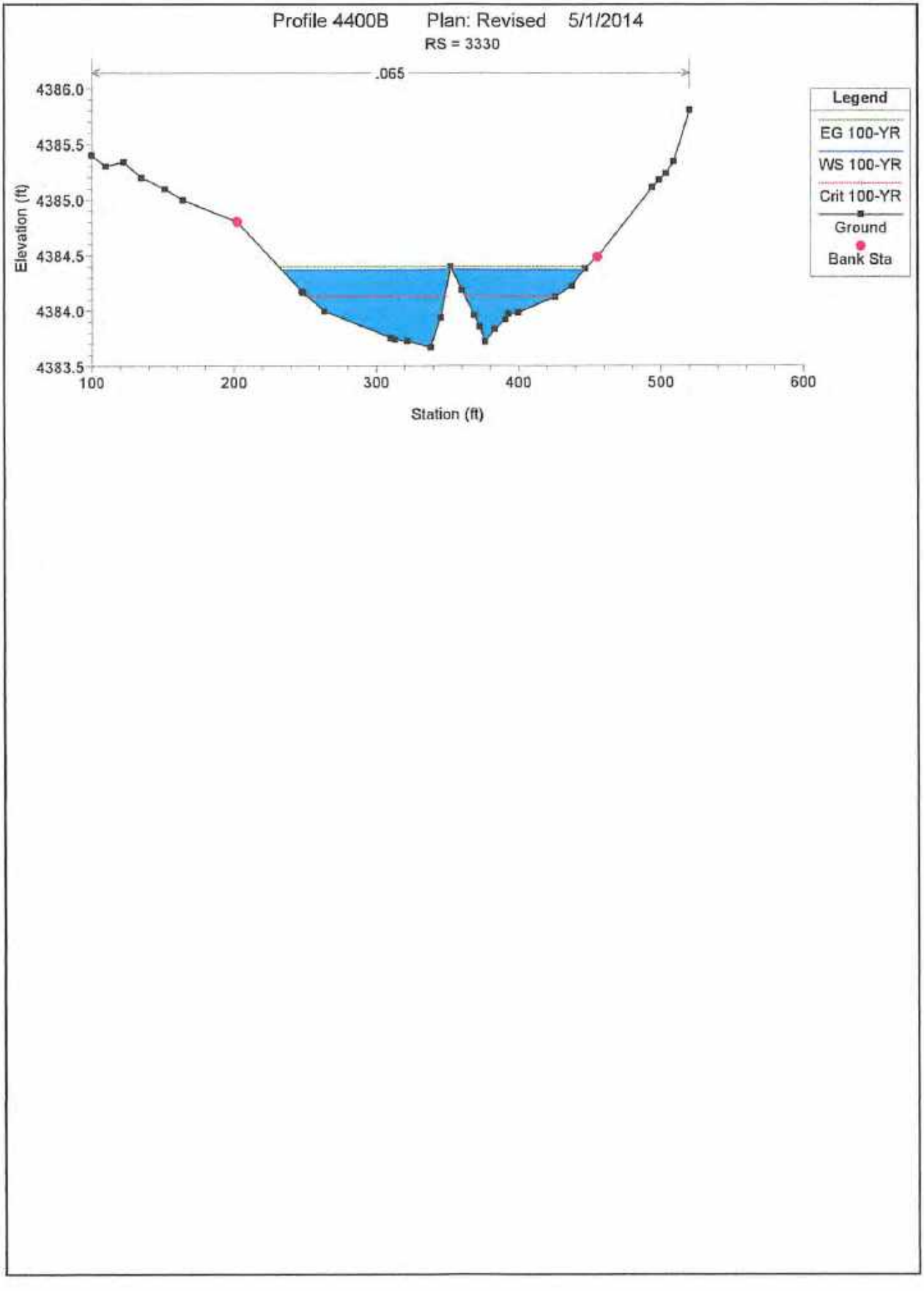
RS = 4236
.065
.015
.1
.015
.065
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
Profile 4400B Plan: Revised 5/1/2014
RS = 4076
.065
.015
.085
.015
.085
Legend
EG 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
Profile 4400B Plan: Revised 5/1/2014
RS = 3640
.1
.015
.065
.015
.065
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


Profile 4400B Plan: Revised 5/1/2014
RS = 3330
.065
4386.0
4385.5
4385.0
4384.5
4384.0
4383.5
Elevation (ft)
100
200
300
400
500
600
Station (ft)
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta

Culvert Report

Inlet A29B3

Invert Elev Dn (ft)	= 4432.98
Pipe Length (ft)	= 169.20
Slope (%)	= 5.03
Invert Elev Up (ft)	= 4441.49
Rise (in)	= 30.0
Shape	= Cir
Span (in)	= 30.0
No. Barrels	= 1
n-Value	= 0.023
Inlet Edge	= Sq Edge
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

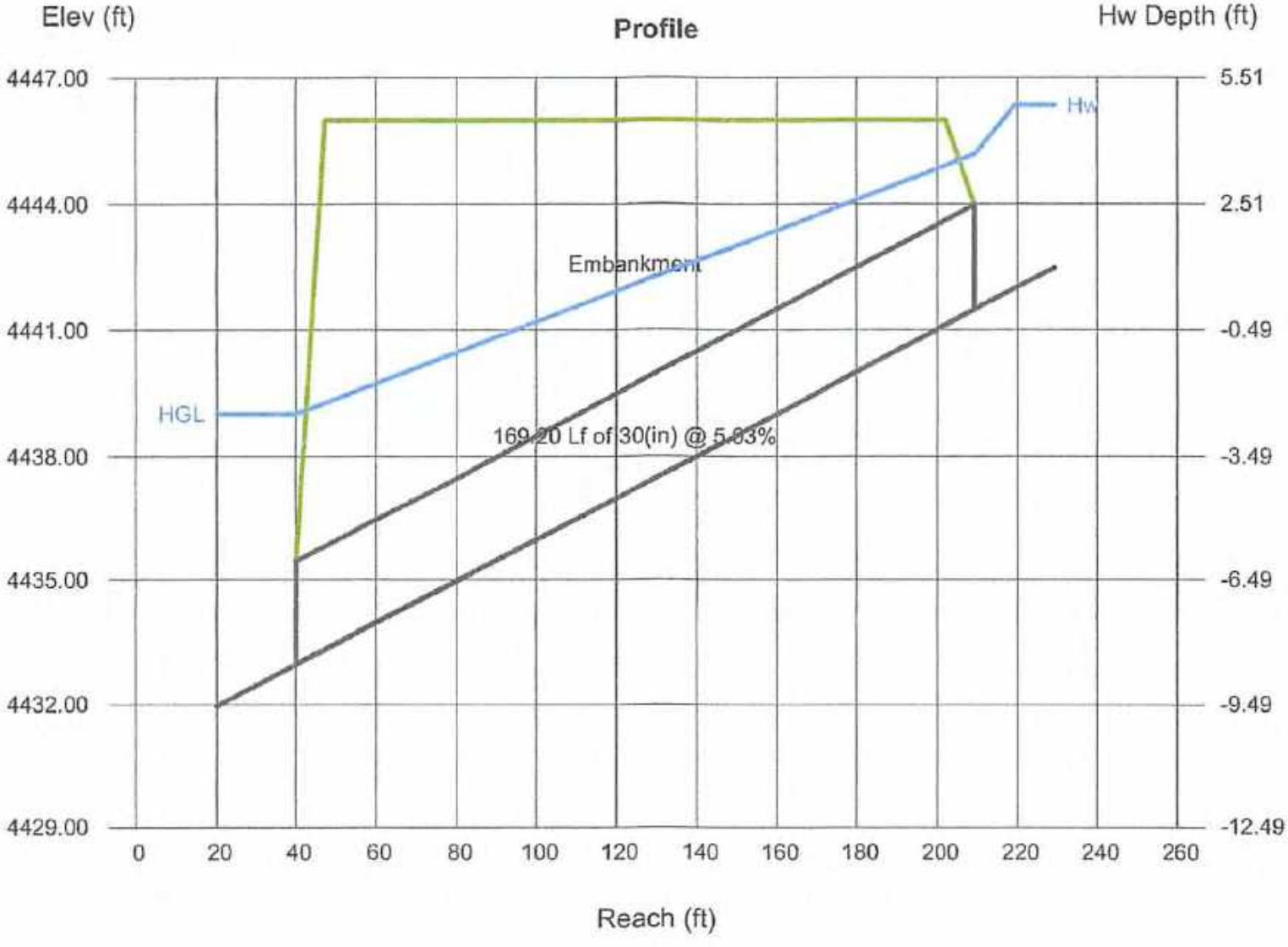
Top Elevation (ft)	= 4446.00
Top Width (ft)	= 155.00
Crest Width (ft)	= 10.00

Calculations

Qmin (cfs)	= 42.00
Qmax (cfs)	= 50.00
Tailwater Elev (ft)	= 4439.02

Highlighted

Qtotal (cfs)	= 50.00
Qpipe (cfs)	= 44.24
Qovertop (cfs)	= 5.76
Veloc Dn (ft/s)	= 9.01
Veloc Up (ft/s)	= 9.01
HGL Dn (ft)	= 4439.02
HGL Up (ft)	= 4445.19
Hw Elev (ft)	= 4446.34
Hw/D (ft)	= 1.94
Flow Regime	= Inlet Control



Channel Report

Hydraflow Express by Intelisolve — Thursday, Mar 13 2014, 1:5 PM

Drainage Channel Above Pipe

User-defined

Invert Elev (ft)	= 97.25
Slope (%)	= 5.50
N-Value	= 0.023

Calculations

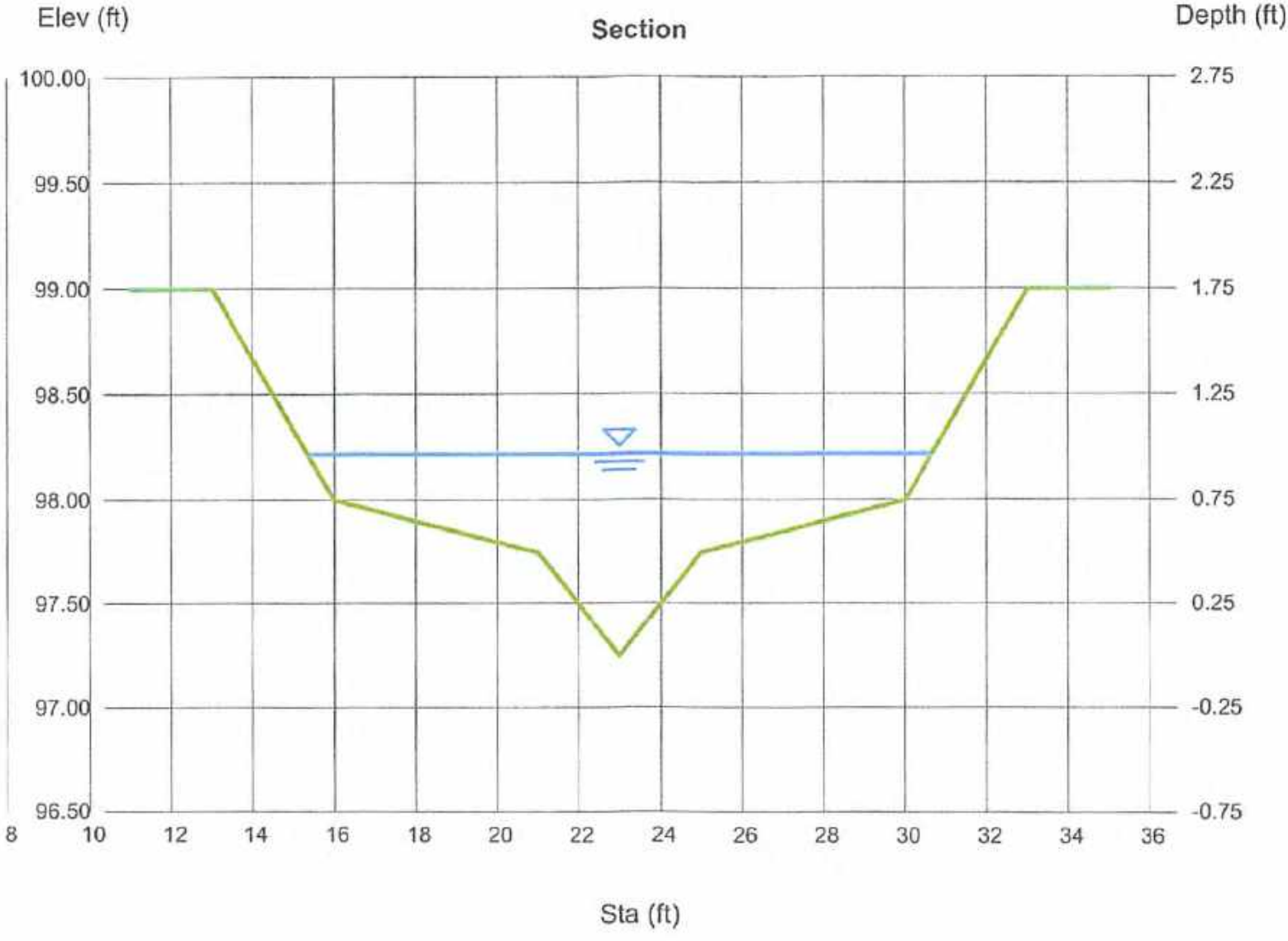
Compute by:	Known Q
Known Q (cfs)	= 53.00

Highlighted

Depth (ft)	= 0.97
Q (cfs)	= 53.00
Area (sqft)	= 6.48
Velocity (ft/s)	= 8.19
Wetted Perim (ft)	= 15.53
Crit Depth, Yc (ft)	= 1.28
Top Width (ft)	= 15.32
EGL (ft)	= 2.01

(Sta, El, n)-(Sta, El, n)...

(13.00, 99.00)-(16.00, 98.00, 0.023)-(21.00, 97.75, 0.023)-(23.00, 97.25, 0.023)-(25.00, 97.75, 0.023)-(30.00, 98.00, 0.023)-(33.00, 99.00, 0.023)



Inlet Report

Hydraflow Express by Intelisolve — Thursday, Mar 13 2014, 1:8 PM

<Name>

Drop Grate Inlet

Location	= Sag
Curb Length (ft)	= -0-
Throat Height (in)	= -0-
Grate Area (sqft)	= 2.60
Grate Width (ft)	= 2.60
Grate Length (ft)	= 2.50
Grate Length (ft)	= 2.50

Gutter

Slope, Sw (ft/ft)	= 0.500
Slope, Sx (ft/ft)	= 0.500
Local Depr (in)	= -0-
Gutter Width (ft)	= 2.50
Gutter Slope (%)	= -0-
Gutter n-value	= -0-

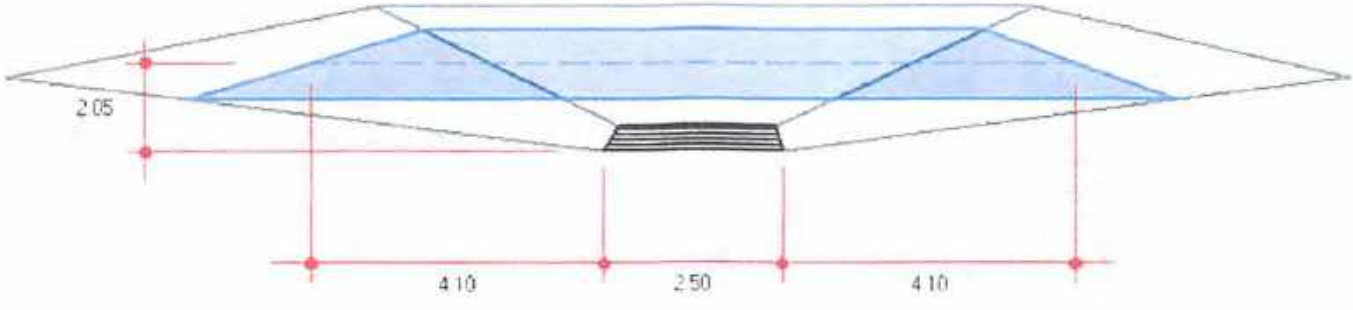
Calculations

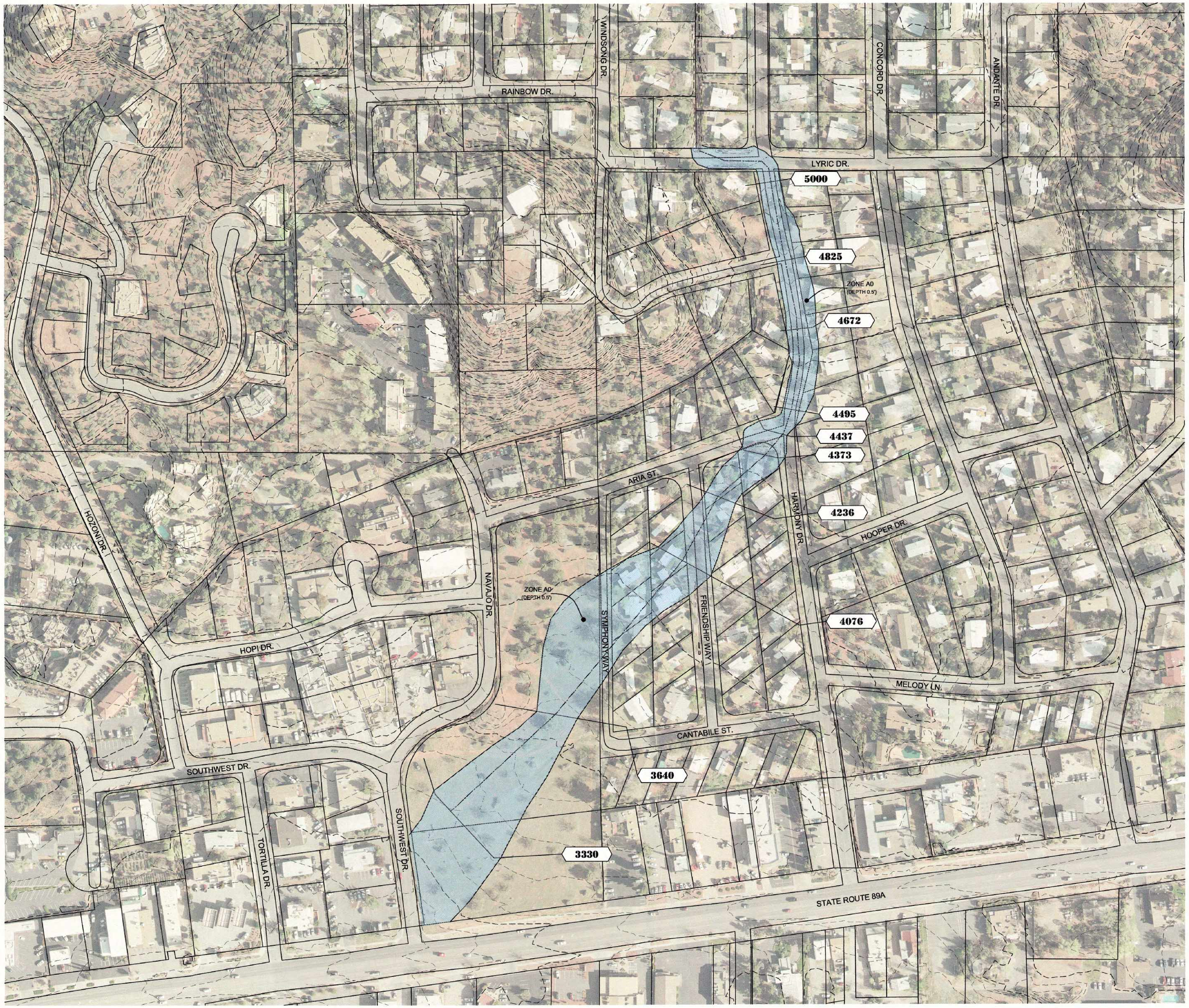
Compute by:	Known Q
Q (cfs)	= 20.00

Highlighted

Q Total (cfs)	= 20.00
Q Capt (cfs)	= 20.00
Q Bypass (cfs)	= -0-
Depth at Inlet (in)	= 24.59
Efficiency (%)	= 100
Gutter Spread (ft)	= 10.70
Gutter Vel (ft/s)	= -0-
Bypass Spread (ft)	= -0-
Bypass Depth (in)	= -0-

All dimensions in feet





LEGEND

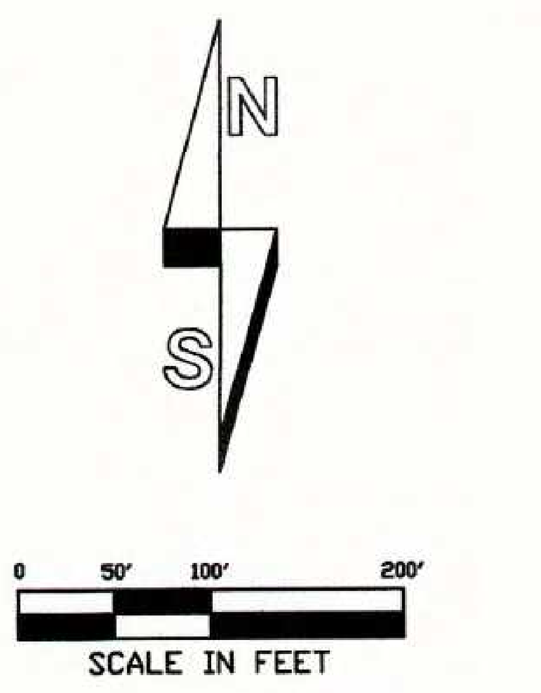
SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year), also known as the base flood, is the flood that has a 1 % chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, and AO. The Base Flood Elevation is the water-surface elevation of the 1 % annual chance flood.

ZONE A	No Base Flood Elevation determined
ZONE AE	Base Flood Elevations determined
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding; Base Flood Elevations determined
ZONE AO	Flood depths of 0.5 to 3 feet (usually sheet flow on sloped terrain); average depths determined

FLOODPLAIN BOUNDARY

XXXX CROSS SECTION ID



Registered Professional Engineer
CERTIFICATE NO. 37322
LUKE A. SEFTON
ARIZONA, U.S.A.
EXPIRES 3/31/2017

HERITAGE LAND SURVEY & ENGINEERING
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SHEET TITLE: 100-YEAR FLOOPLAIN

PROJECT TITLE:

CITY OF SEDONA HARMONY

DRAWN BY: T.C.H.

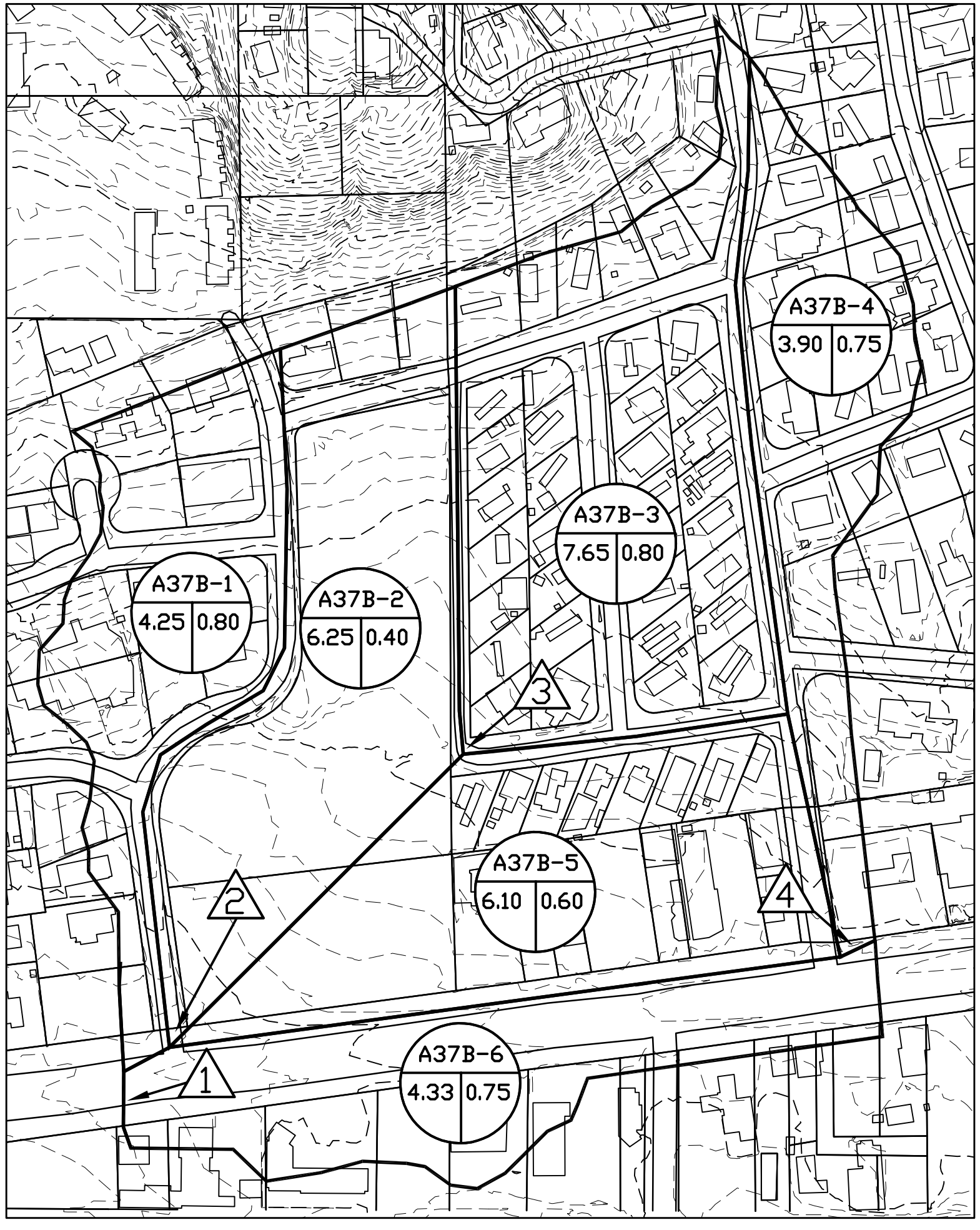
SCALE: 1'=100'

DATE: 5/1/14

PROJECT NO: 14-0304

SHEET NO.

C-1



DRAINAGE MAP

PEAK DISCHARGES

SUB-BASIN	*2-yr PEAK (cfs)*	*5-yr PEAK (cfs)*	*10-yr PEAK (cfs)*	*25-yr PEAK (cfs)*	*50-yr PEAK (cfs)*	*100-yr PEAK (cfs)*
A37B-1	-	-	-	*20.60*	-	*27.95*
A37B-2	-	-	-	*15.15*	-	*20.55*
A37B-3	-	-	-	*37.10*	-	*50.30*
A37B-4	-	-	-	*17.70*	-	*24.00*
A37B-5	-	-	-	*22.20*	-	*30.10*
A37B-6	-	-	-	*19.70*	-	*26.70*
DESIGN PT						
1	-	-	-	*132.45*	-	*179.60*
2	-	-	-	*74.45*	-	*100.95*
3	-	-	-	*37.10*	-	*50.30*
4	-	-	-	*17.70*	-	*24.00*

A = BASIN DESIGNATION
B = AREA IN ACRES
C = COMPOSITE RUNOFF COEFFICIENTS

D = DESIGN POINT DESIGNATION

NTS

APPENDIX E

2-, 10-, 25-year STORM CALCULATIONS

NOAA Atlas 14, Volume 1, Version 5
Location name: Sedona, Arizona, USA*
Latitude: 34.8635°, Longitude: -111.81°
Elevation: 4397.28 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.211** (0.177-0.251)	**0.272** (0.228-0.322)	**0.366** (0.307-0.435)	**0.446** (0.373-0.529)	**0.559** (0.464-0.660)	**0.654** (0.538-0.771)	**0.756** (0.616-0.893)	**0.866** (0.696-1.02)	**1.03** (0.810-1.22)	**1.16** (0.903-1.39)
10-min	**0.321** (0.270-0.381)	**0.414** (0.347-0.491)	**0.558** (0.468-0.662)	**0.679** (0.568-0.804)	**0.851** (0.707-1.00)	**0.995** (0.819-1.17)	**1.15** (0.938-1.36)	**1.32** (1.06-1.56)	**1.56** (1.23-1.86)	**1.77** (1.38-2.12)
15-min	**0.398** (0.334-0.473)	**0.513** (0.430-0.609)	**0.691** (0.579-0.821)	**0.841** (0.705-0.997)	**1.06** (0.876-1.25)	**1.23** (1.02-1.46)	**1.43** (1.16-1.68)	**1.64** (1.31-1.93)	**1.94** (1.53-2.31)	**2.19** (1.71-2.62)
30-min	**0.537** (0.450-0.637)	**0.691** (0.579-0.820)	**0.931** (0.780-1.11)	**1.13** (0.949-1.34)	**1.42** (1.18-1.68)	**1.66** (1.37-1.96)	**1.92** (1.57-2.27)	**2.20** (1.77-2.60)	**2.61** (2.06-3.11)	**2.95** (2.30-3.53)
60-min	**0.664** (0.557-0.788)	**0.855** (0.717-1.01)	**1.15** (0.966-1.37)	**1.40** (1.17-1.66)	**1.76** (1.46-2.07)	**2.06** (1.69-2.42)	**2.38** (1.94-2.81)	**2.73** (2.19-3.22)	**3.23** (2.55-3.84)	**3.65** (2.84-4.37)
2-hr	**0.784** (0.681-0.908)	**0.991** (0.857-1.15)	**1.31** (1.13-1.52)	**1.58** (1.35-1.83)	**1.97** (1.67-2.27)	**2.29** (1.92-2.64)	**2.64** (2.20-3.06)	**3.03** (2.48-3.51)	**3.59** (2.89-4.18)	**4.06** (3.21-4.73)
3-hr	**0.843** (0.742-0.973)	**1.07** (0.942-1.23)	**1.37** (1.20-1.58)	**1.63** (1.43-1.87)	**2.01** (1.74-2.30)	**2.32** (2.00-2.66)	**2.67** (2.27-3.08)	**3.06** (2.56-3.53)	**3.62** (2.97-4.20)	**4.09** (3.29-4.78)
6-hr	**1.02** (0.915-1.14)	**1.27** (1.14-1.42)	**1.58** (1.41-1.76)	**1.85** (1.65-2.07)	**2.24** (1.99-2.50)	**2.56** (2.25-2.86)	**2.91** (2.53-3.25)	**3.28** (2.81-3.68)	**3.82** (3.22-4.32)	**4.26** (3.53-4.85)
12-hr	**1.31** (1.18-1.46)	**1.62** (1.46-1.81)	**1.98** (1.78-2.20)	**2.28** (2.05-2.52)	**2.69** (2.41-2.98)	**3.01** (2.67-3.32)	**3.34** (2.93-3.70)	**3.68** (3.20-4.08)	**4.15** (3.57-4.64)	**4.54** (3.86-5.10)
24-hr	**1.65** (1.49-1.81)	**2.05** (1.86-2.27)	**2.56** (2.32-2.83)	**2.96** (2.68-3.28)	**3.52** (3.17-3.89)	**3.96** (3.56-4.37)	**4.41** (3.94-4.88)	**4.88** (4.34-5.40)	**5.52** (4.85-6.13)	**6.02** (5.25-6.70)
2-day	**1.92** (1.75-2.12)	**2.39** (2.17-2.64)	**2.97** (2.71-3.28)	**3.44** (3.13-3.80)	**4.09** (3.71-4.51)	**4.61** (4.15-5.06)	**5.13** (4.60-5.64)	**5.68** (5.06-6.26)	**6.42** (5.67-7.10)	**7.00** (6.13-7.76)
3-day	**2.06** (1.88-2.27)	**2.57** (2.34-2.83)	**3.21** (2.93-3.53)	**3.72** (3.39-4.10)	**4.44** (4.03-4.88)	**5.01** (4.52-5.50)	**5.61** (5.03-6.16)	**6.22** (5.55-6.85)	**7.07** (6.24-7.81)	**7.73** (6.77-8.57)
4-day	**2.21** (2.02-2.42)	**2.75** (2.51-3.03)	**3.44** (3.15-3.79)	**4.00** (3.65-4.40)	**4.79** (4.35-5.26)	**5.42** (4.89-5.94)	**6.08** (5.46-6.68)	**6.76** (6.03-7.44)	**7.72** (6.81-8.52)	**8.47** (7.41-9.39)
7-day	**2.59** (2.37-2.83)	**3.22** (2.95-3.53)	**3.99** (3.65-4.37)	**4.63** (4.23-5.06)	**5.51** (5.02-6.02)	**6.21** (5.63-6.79)	**6.94** (6.26-7.59)	**7.69** (6.89-8.42)	**8.72** (7.75-9.59)	**9.53** (8.39-10.5)
10-day	**2.94** (2.69-3.22)	**3.66** (3.35-4.01)	**4.52** (4.13-4.95)	**5.19** (4.74-5.68)	**6.10** (5.55-6.67)	**6.80** (6.17-7.44)	**7.51** (6.78-8.23)	**8.23** (7.38-9.02)	**9.19** (8.19-10.1)	**9.92** (8.79-10.9)
20-day	**3.81** (3.50-4.16)	**4.72** (4.34-5.17)	**5.74** (5.28-6.27)	**6.51** (5.97-7.10)	**7.49** (6.85-8.16)	**8.21** (7.49-8.95)	**8.91** (8.10-9.72)	**9.58** (8.69-10.5)	**10.4** (9.40-11.4)	**11.0** (9.91-12.1)
30-day	**4.57** (4.19-5.00)	**5.68** (5.20-6.21)	**6.87** (6.28-7.51)	**7.77** (7.10-8.48)	**8.91** (8.12-9.72)	**9.74** (8.86-10.6)	**10.5** (9.55-11.5)	**11.3** (10.2-12.4)	**12.3** (11.1-13.5)	**12.9** (11.6-14.2)
45-day	**5.41** (4.93-5.98)	**6.72** (6.13-7.43)	**8.16** (7.44-8.99)	**9.25** (8.41-10.2)	**10.7** (9.68-11.7)	**11.7** (10.6-12.8)	**12.7** (11.4-13.9)	**13.6** (12.3-15.0)	**14.9** (13.3-16.4)	**15.7** (14.1-17.4)
60-day	**6.30** (5.74-6.92)	**7.82** (7.13-8.59)	**9.43** (8.59-10.4)	**10.6** (9.65-11.6)	**12.1** (11.0-13.3)	**13.2** (11.9-14.5)	**14.2** (12.8-15.6)	**15.2** (13.7-16.7)	**16.4** (14.7-18.0)	**17.2** (15.4-18.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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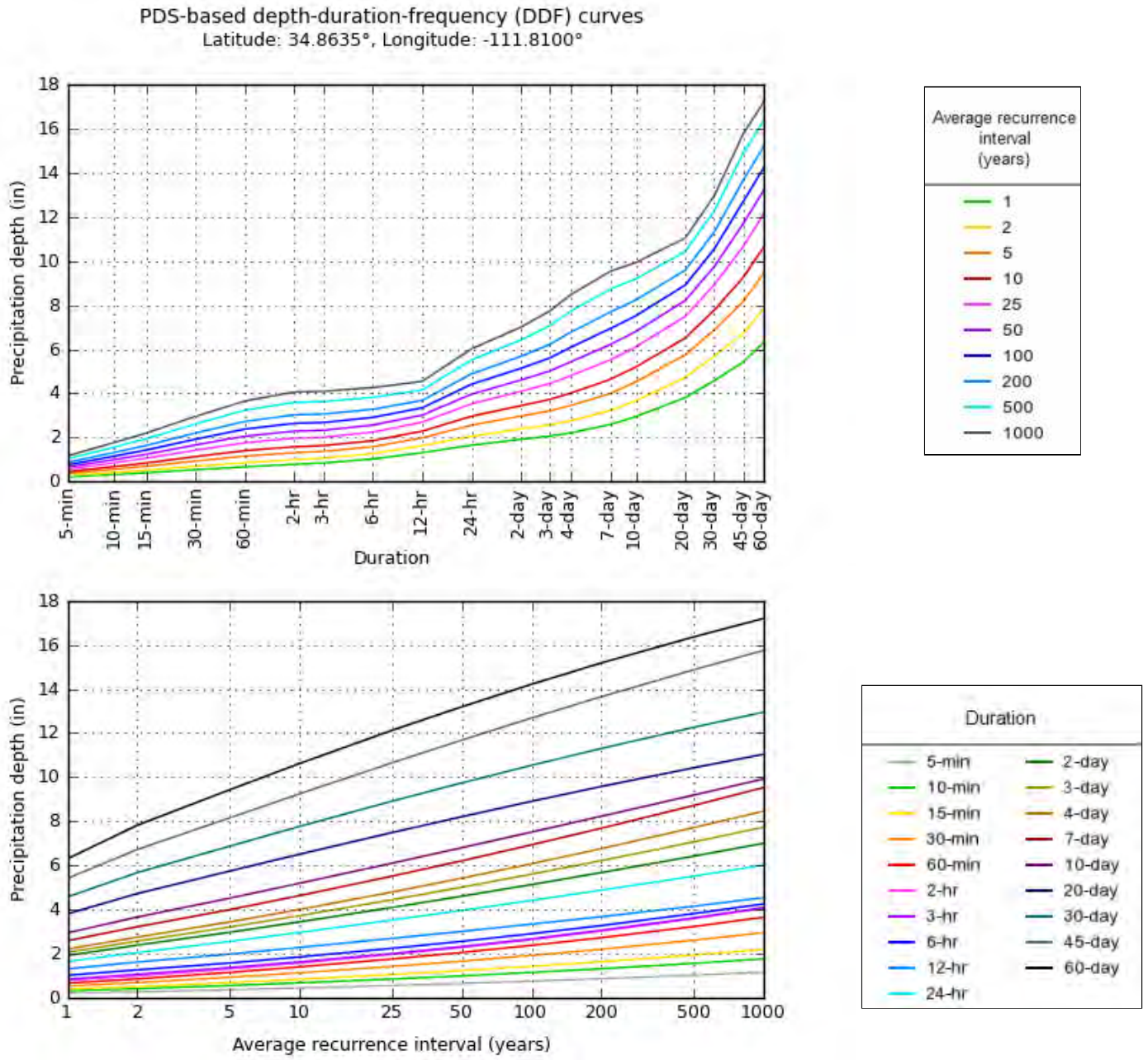
PF graphical



NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Mon Jul 12 21:45:17 2021

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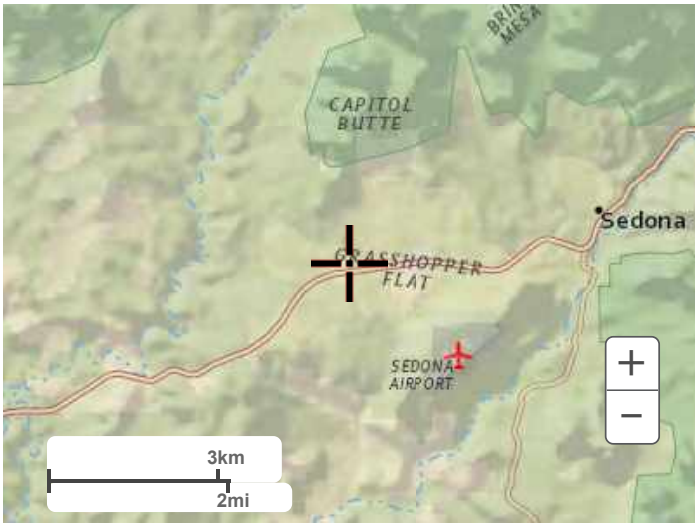
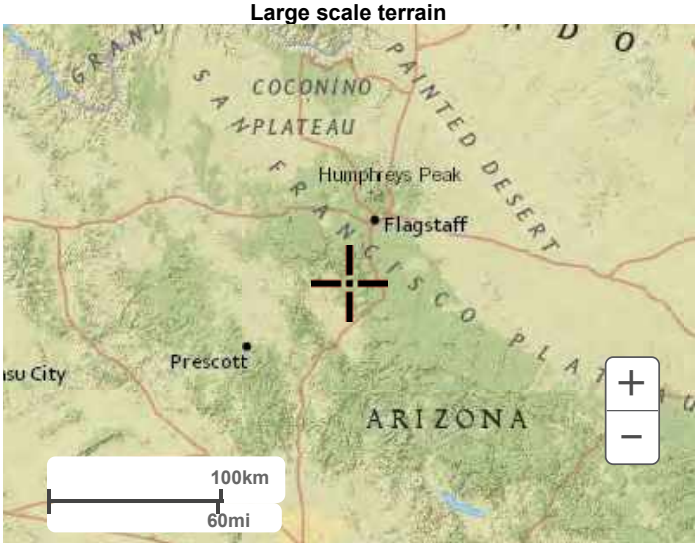
Maps & aerials

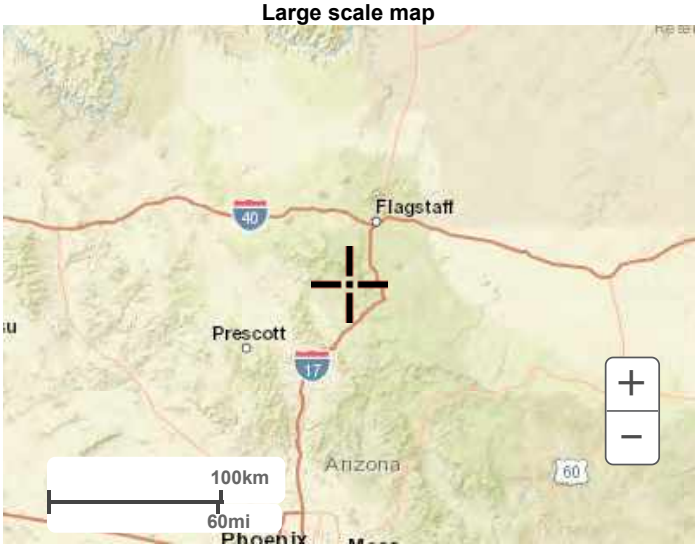
Small scale terrain



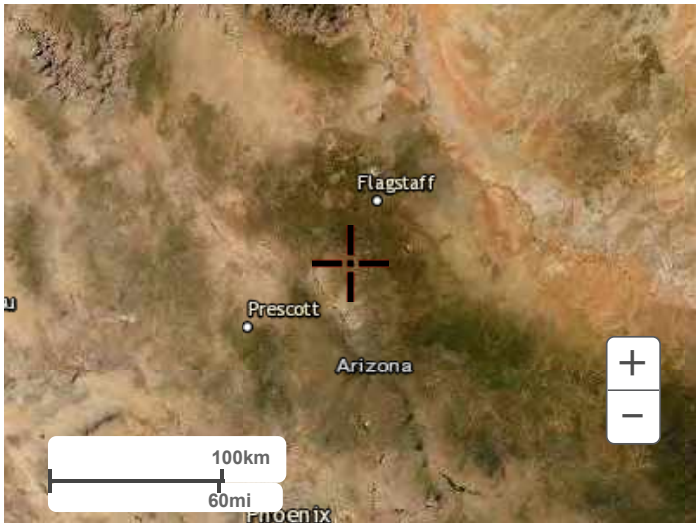
Large scale terrain



Large scale map



Large scale aerial



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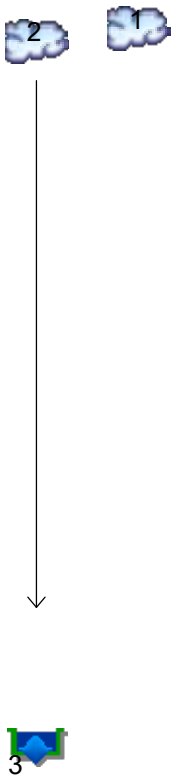
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Hydraflow Table of Contents

1763-Hydrology.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 07 / 14 / 2021

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre-Development
2	SCS Runoff	Post-Development Hydrograph
3	Reservoir	Retention Basin

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	2.904	-------	-------	6.456	8.925	-------	13.07	Pre-Development
2	SCS Runoff	------	-------	7.384	-------	-------	12.52	15.72	-------	20.81	Post-Development Hydrograph
3	Reservoir	2	-------	2.911	-------	-------	4.235	4.858	-------	7.016	Retention Basin

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

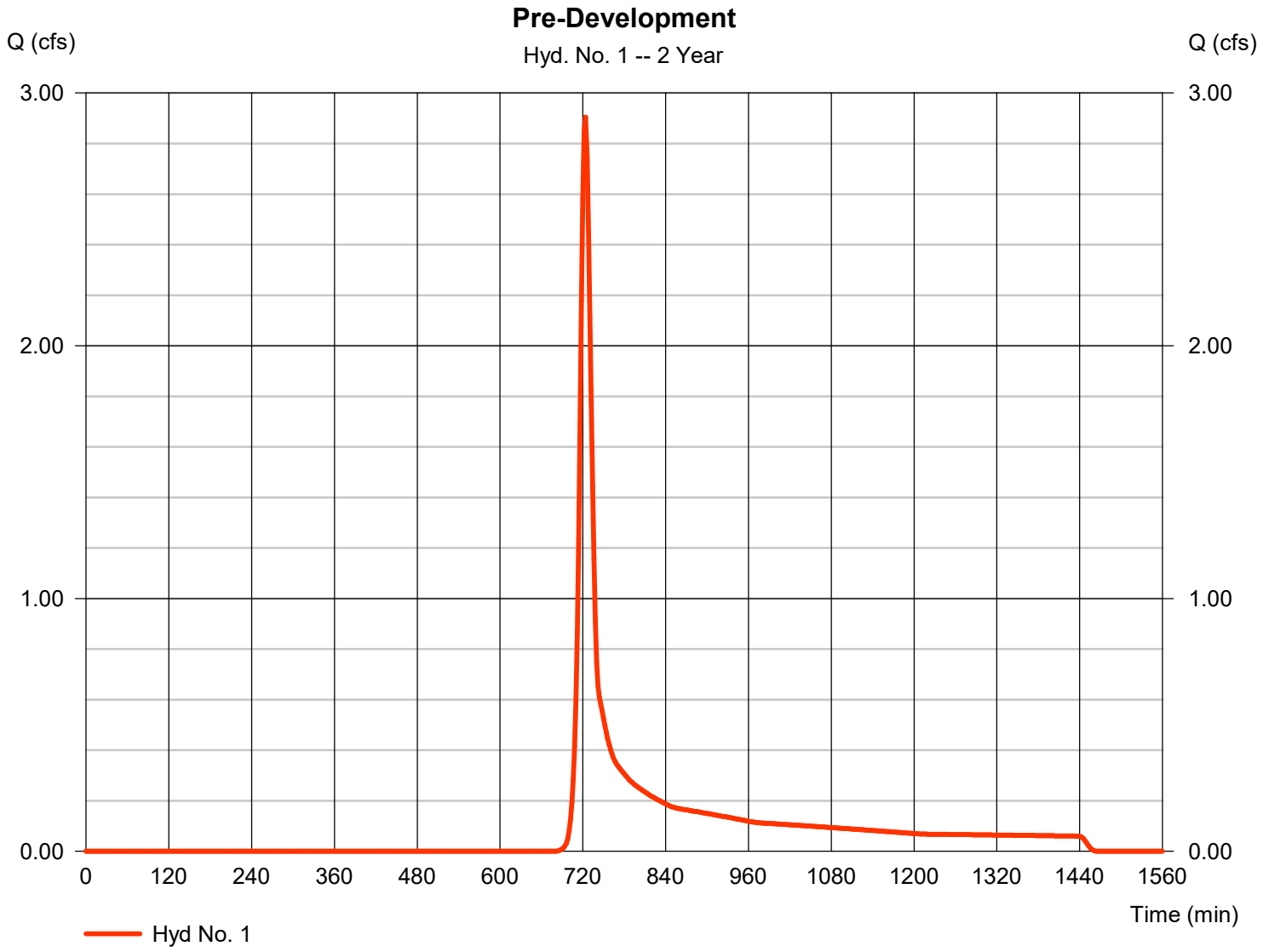
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2.904	2	724	8,791	------	------	------	Pre-Development
2	SCS Runoff	7.384	2	720	19,149	------	------	------	Post-Development Hydrograph
3	Reservoir	2.911	2	730	11,148	2	83.09	5,158	Retention Basin

Hydrograph Report

Hyd. No. 1

Pre-Development

Hydrograph type	= SCS Runoff	Peak discharge	= 2.904 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 8,791 cuft
Drainage area	= 4.500 ac	Curve number	= 79
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 15.40 min
Total precip.	= 2.05 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

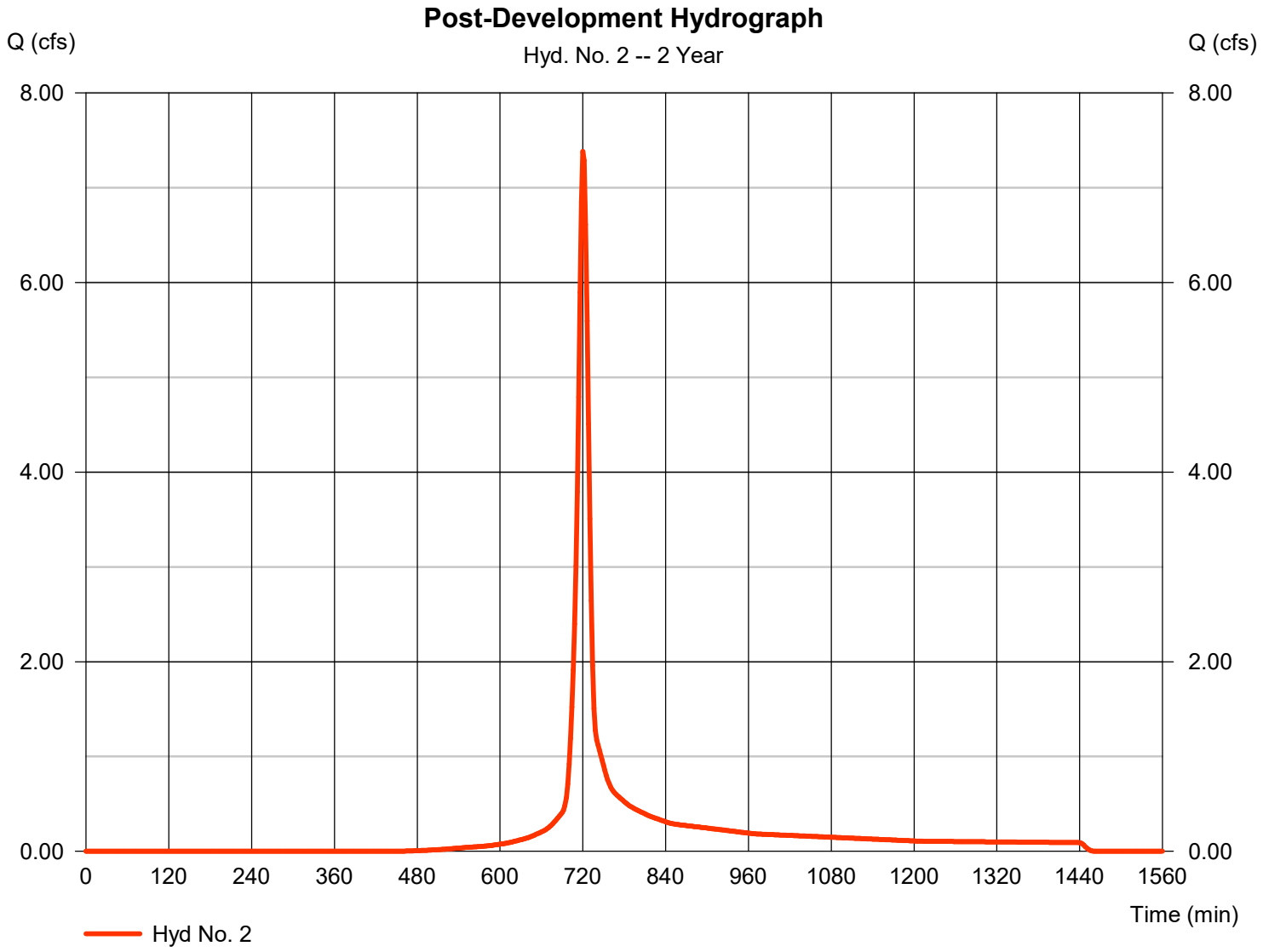


Hydrograph Report

Hyd. No. 2

Post-Development Hydrograph

Hydrograph type	= SCS Runoff	Peak discharge	= 7.384 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 19,149 cuft
Drainage area	= 4.500 ac	Curve number	= 90
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 10.50 min
Total precip.	= 2.05 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



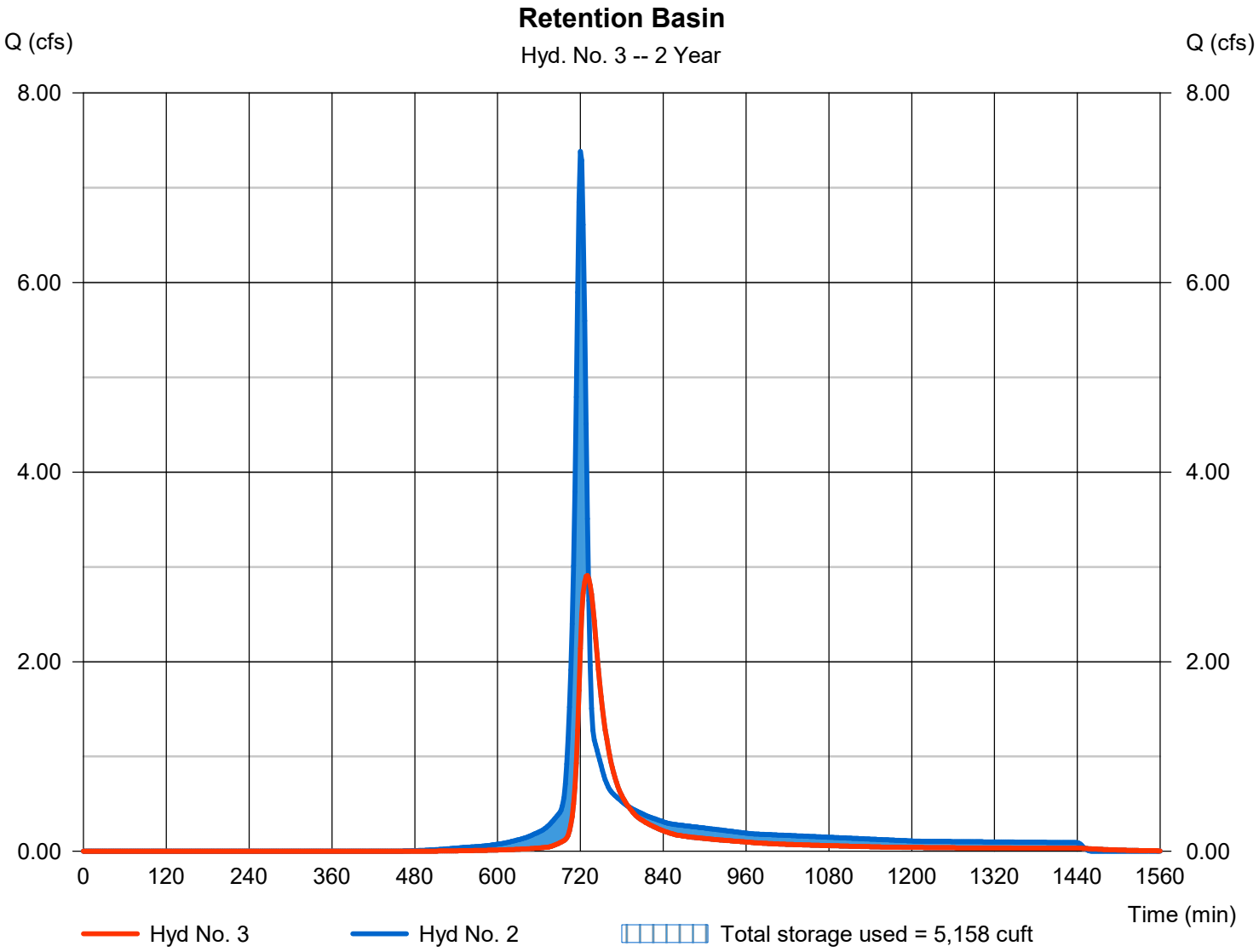
Hydrograph Report

Hyd. No. 3

Retention Basin

Hydrograph type	=	Reservoir	Peak discharge	=	2.911 cfs
Storm frequency	=	2 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	11,148 cuft
Inflow hyd. No.	=	2 - Post-Development Hydrograph	Max. Elevation	=	83.09 ft
Reservoir name	=	Retention Basin	Max. Storage	=	5,158 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 1 - Retention Basin

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 82.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	82.00	3,614	0	0
1.00	83.00	5,528	4,571	4,571
2.00	84.00	7,114	6,321	10,892
3.00	85.00	10,228	8,671	19,563

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	Inactive	Inactive	Inactive
Span (in)	= 12.00	12.00	0.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 82.00	82.50	83.00	0.00
Length (ft)	= 38.00	0.00	38.00	0.00
Slope (%)	= 3.40	0.00	3.90	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.00	0.00	0.00	0.00
Crest El. (ft)	= 84.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 7.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	82.00	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
1.00	4,571	83.00	2.67 ic	0.00	---	---	0.00	---	---	---	0.896	---	3.569
2.00	10,892	84.00	4.63 ic	0.00	---	---	0.00	---	---	---	1.153	---	5.784
3.00	19,563	85.00	5.98 ic	0.00	---	---	7.06	---	---	---	1.657	---	14.70

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

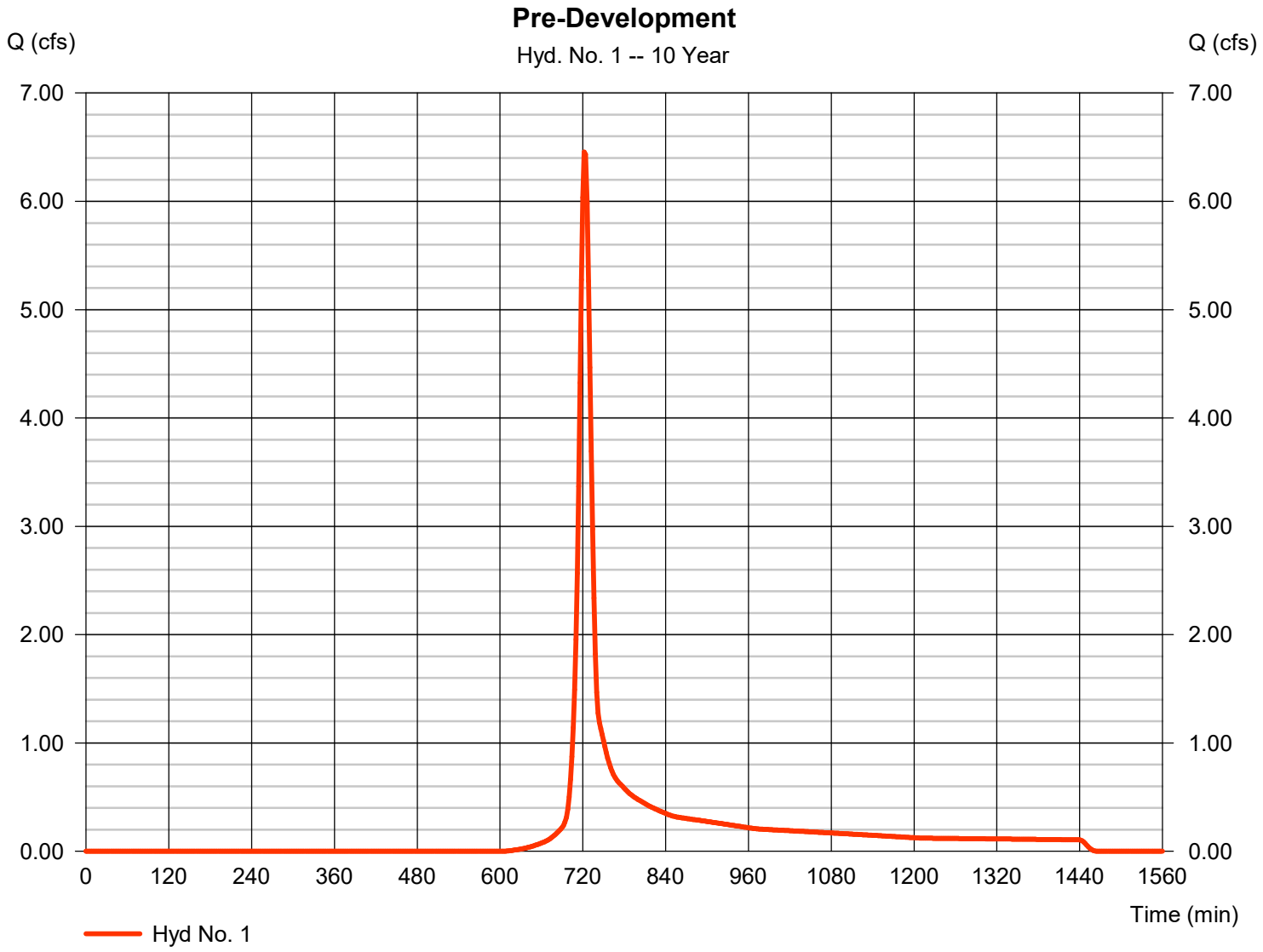
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	6.456	2	722	18,464	------	------	------	Pre-Development
2	SCS Runoff	12.52	2	720	32,805	------	------	------	Post-Development Hydrograph
3	Reservoir	4.235	2	730	20,876	2	83.76	9,345	Retention Basin

Hydrograph Report

Hyd. No. 1

Pre-Development

Hydrograph type	= SCS Runoff	Peak discharge	= 6.456 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 18,464 cuft
Drainage area	= 4.500 ac	Curve number	= 79
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 15.40 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

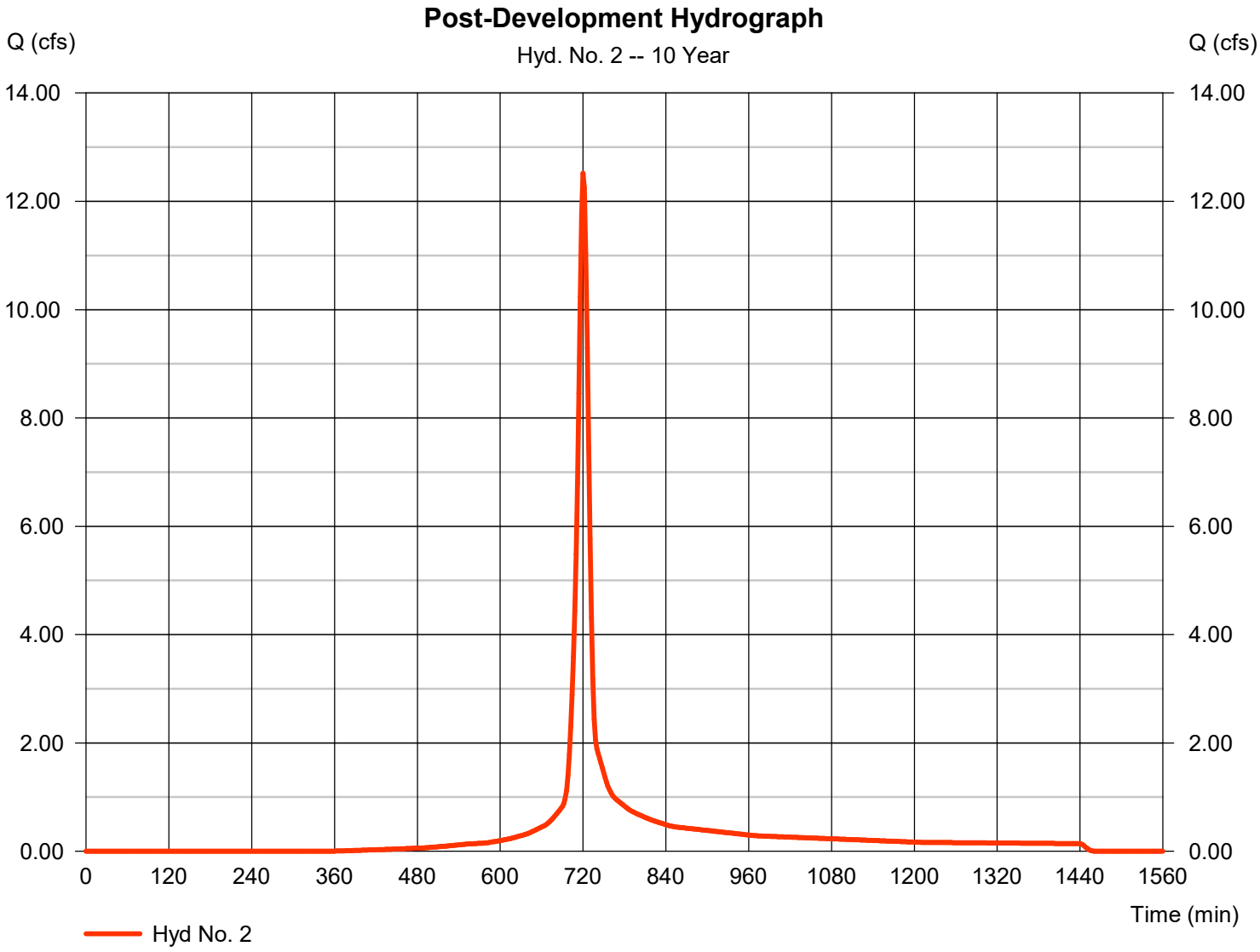


Hydrograph Report

Hyd. No. 2

Post-Development Hydrograph

Hydrograph type	= SCS Runoff	Peak discharge	= 12.52 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 32,805 cuft
Drainage area	= 4.500 ac	Curve number	= 90
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 10.50 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



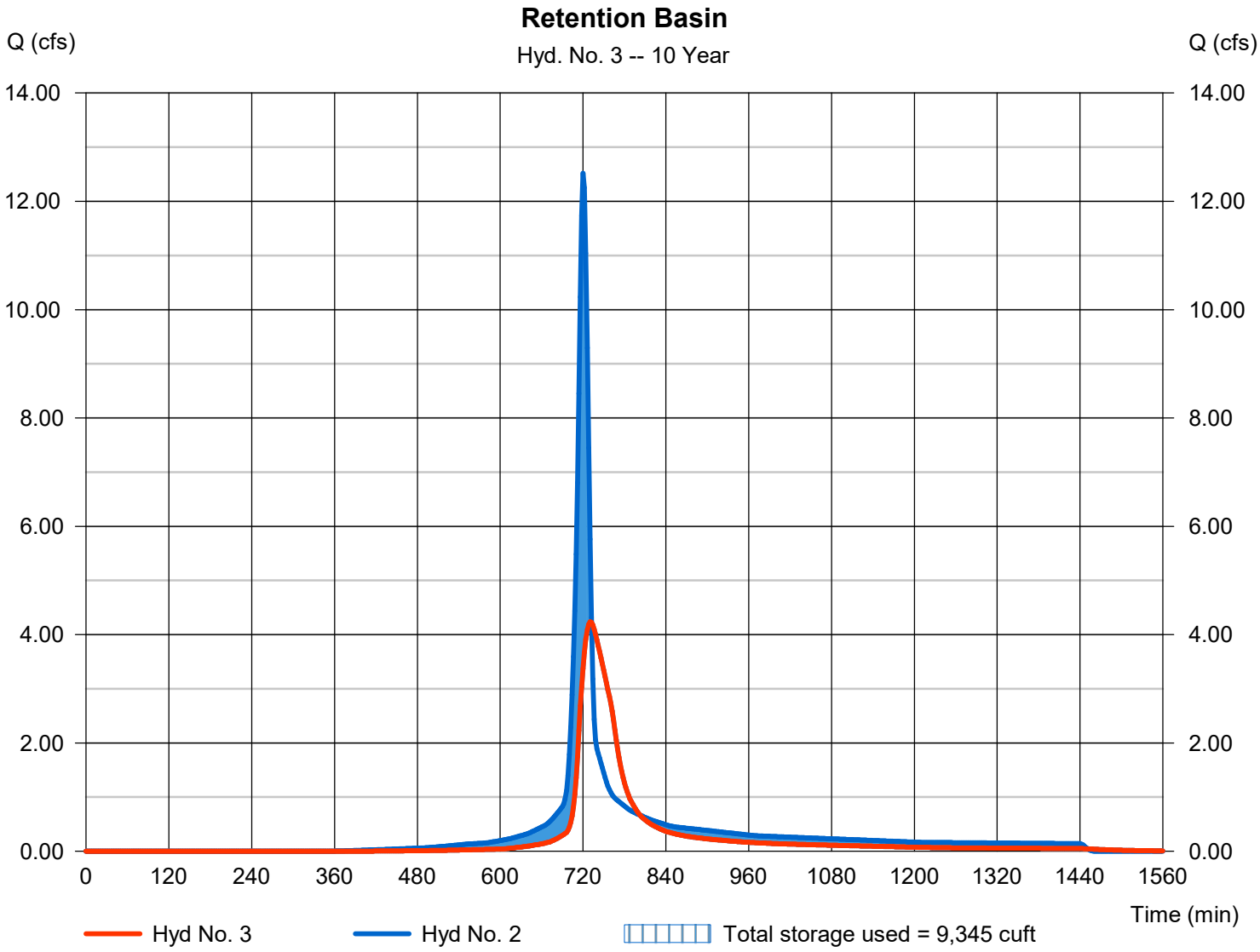
Hydrograph Report

Hyd. No. 3

Retention Basin

Hydrograph type	=	Reservoir	Peak discharge	=	4.235 cfs
Storm frequency	=	10 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	20,876 cuft
Inflow hyd. No.	=	2 - Post-Development Hydrograph	Max. Elevation	=	83.76 ft
Reservoir name	=	Retention Basin	Max. Storage	=	9,345 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

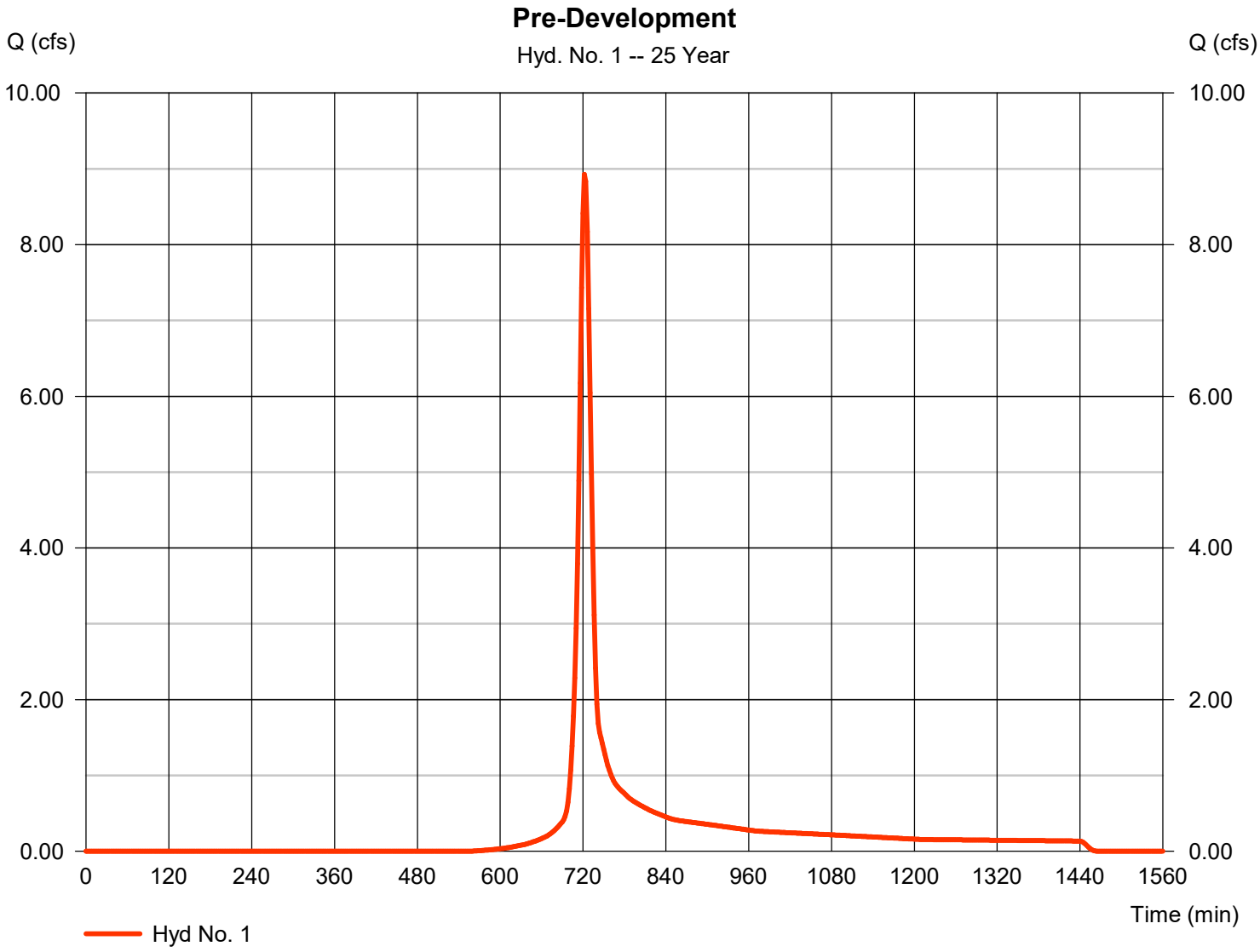
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	8.925	2	722	25,189	------	------	------	Pre-Development
2	SCS Runoff	15.72	2	720	41,552	------	------	------	Post-Development Hydrograph
3	Reservoir	4.858	2	732	27,322	2	84.15	12,201	Retention Basin

Hydrograph Report

Hyd. No. 1

Pre-Development

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.925 cfs
Storm frequency	=	25 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	25,189 cuft
Drainage area	=	4.500 ac	Curve number	=	79
Basin Slope	=	3.4 %	Hydraulic length	=	840 ft
Tc method	=	LAG	Time of conc. (Tc)	=	15.40 min
Total precip.	=	3.52 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

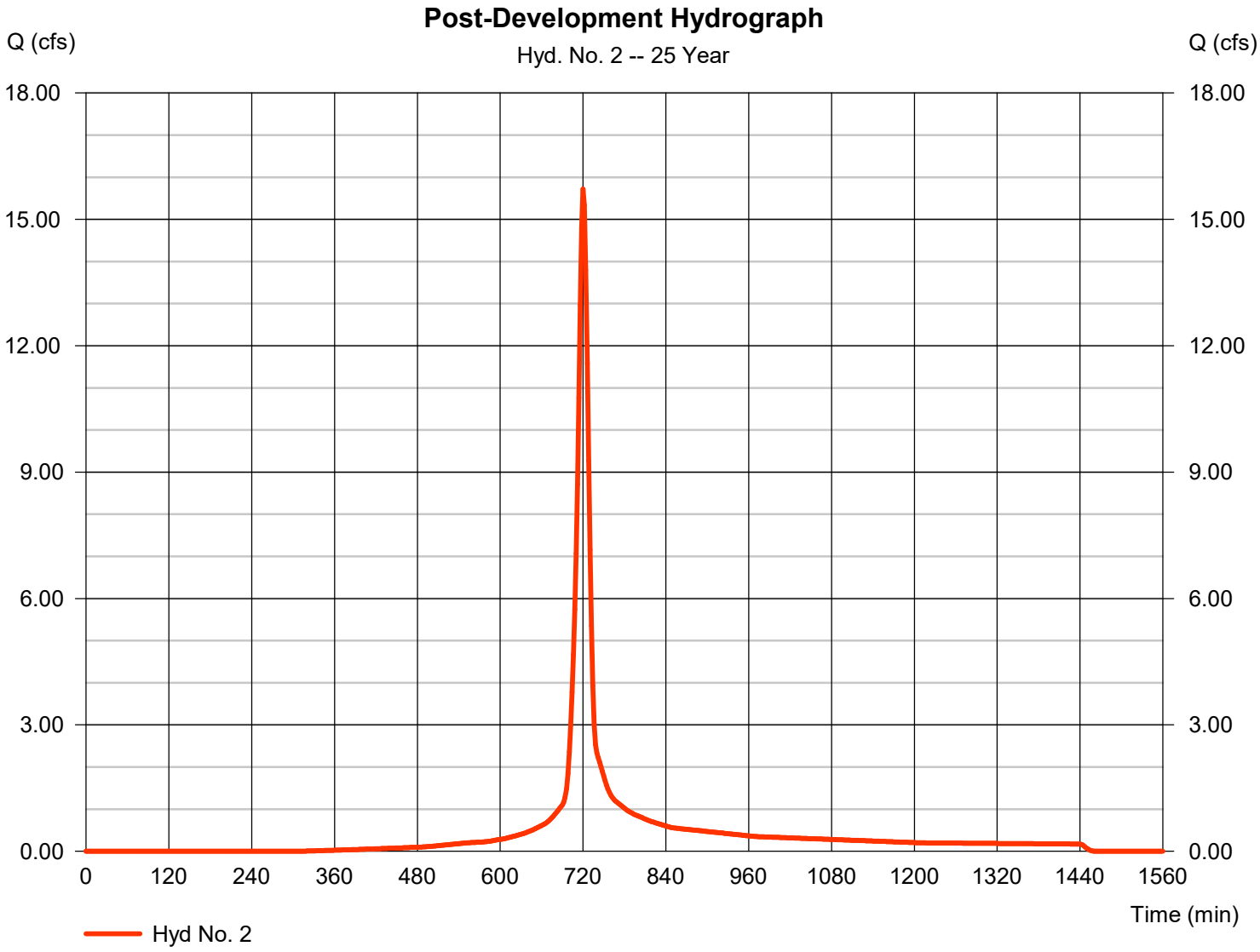


Hydrograph Report

Hyd. No. 2

Post-Development Hydrograph

Hydrograph type	= SCS Runoff	Peak discharge	= 15.72 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 41,552 cuft
Drainage area	= 4.500 ac	Curve number	= 90
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 10.50 min
Total precip.	= 3.52 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



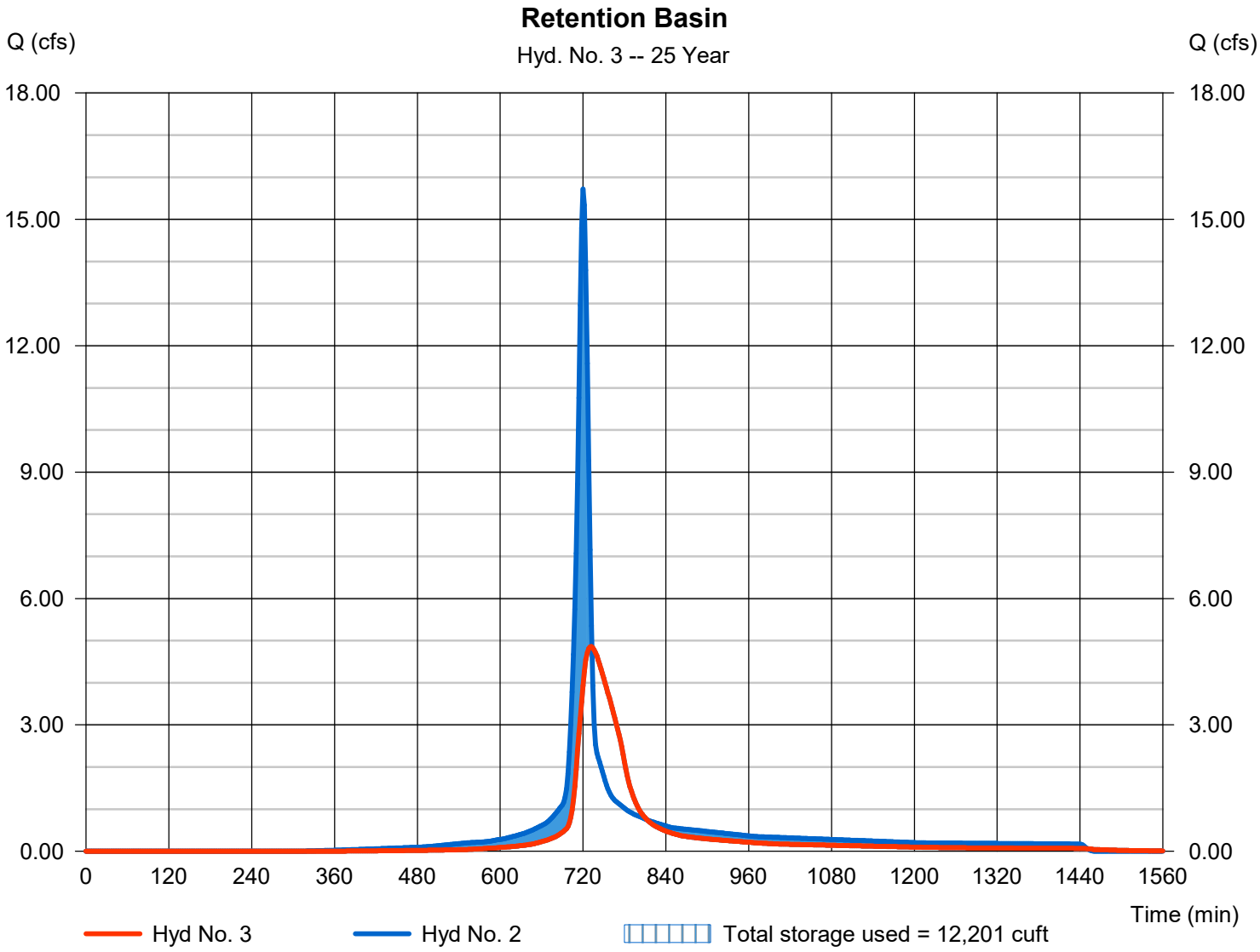
Hydrograph Report

Hyd. No. 3

Retention Basin

Hydrograph type	=	Reservoir	Peak discharge	=	4.858 cfs
Storm frequency	=	25 yrs	Time to peak	=	732 min
Time interval	=	2 min	Hyd. volume	=	27,322 cuft
Inflow hyd. No.	=	2 - Post-Development Hydrograph	Max. Elevation	=	84.15 ft
Reservoir name	=	Retention Basin	Max. Storage	=	12,201 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

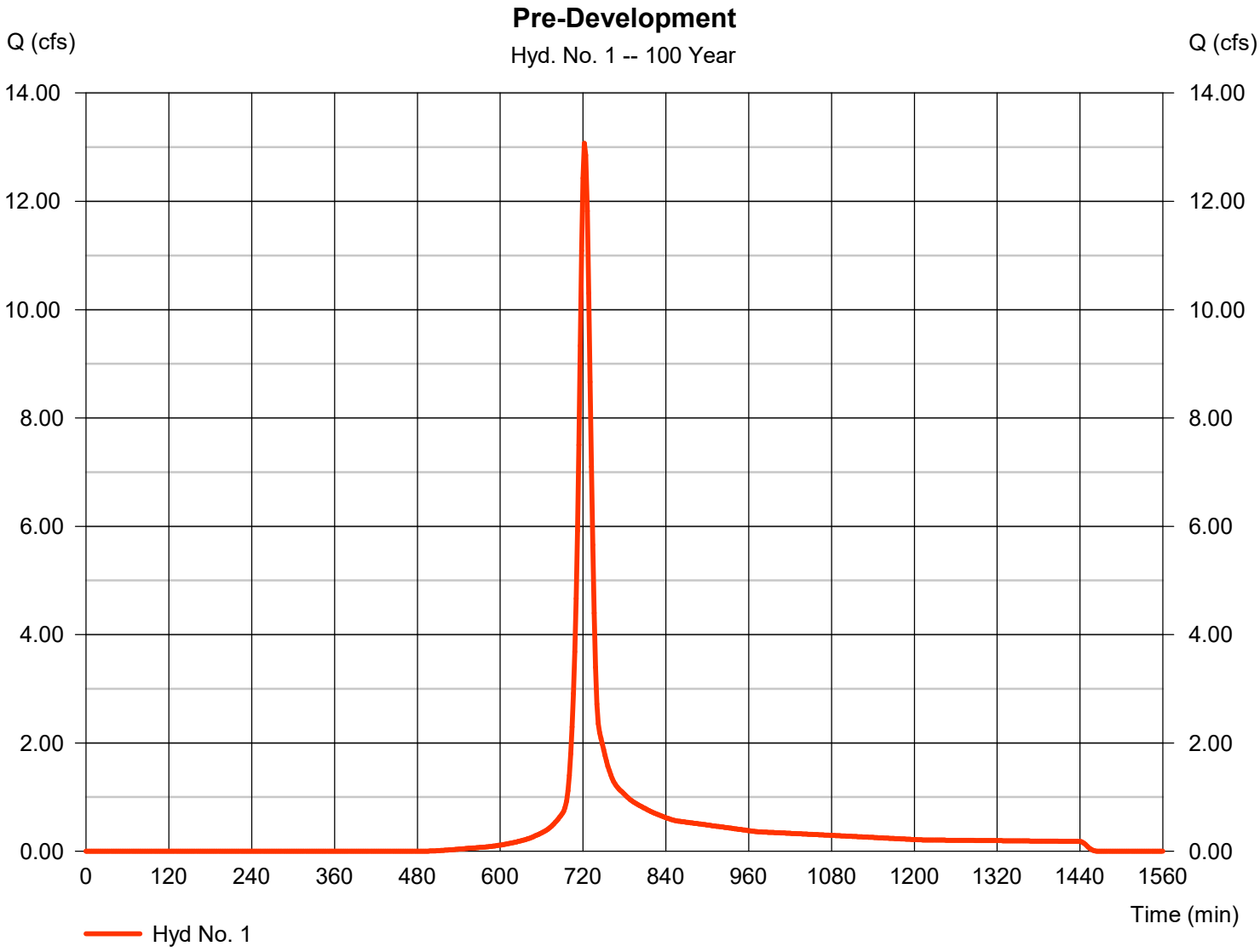
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	13.07	2	722	36,649	------	------	------	Pre-Development
2	SCS Runoff	20.81	2	720	55,753	------	------	------	Post-Development Hydrograph
3	Reservoir	7.016	2	730	37,925	2	84.67	16,706	Retention Basin

Hydrograph Report

Hyd. No. 1

Pre-Development

Hydrograph type	= SCS Runoff	Peak discharge	= 13.07 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 36,649 cuft
Drainage area	= 4.500 ac	Curve number	= 79
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 15.40 min
Total precip.	= 4.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

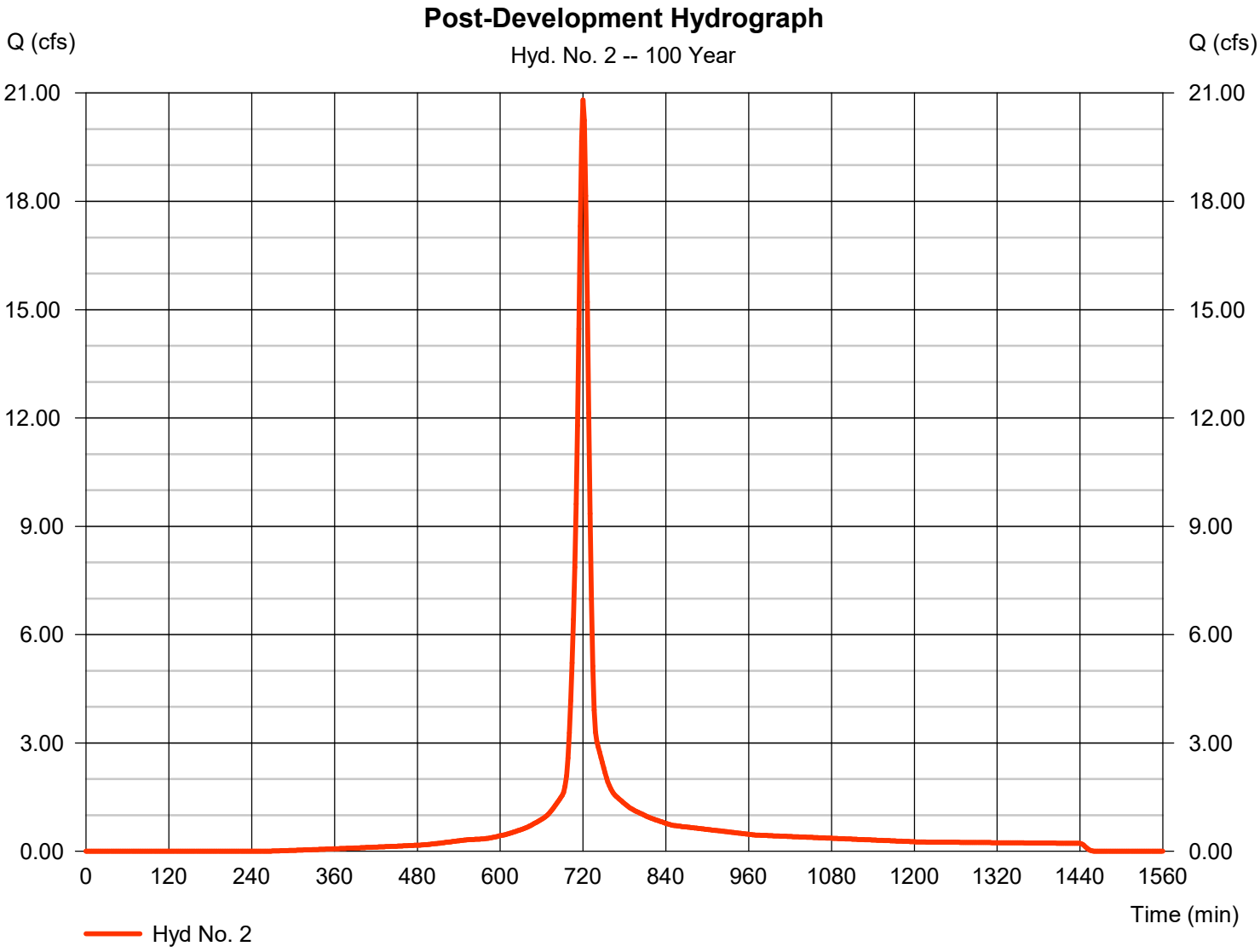


Hydrograph Report

Hyd. No. 2

Post-Development Hydrograph

Hydrograph type	= SCS Runoff	Peak discharge	= 20.81 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 55,753 cuft
Drainage area	= 4.500 ac	Curve number	= 90
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 10.50 min
Total precip.	= 4.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



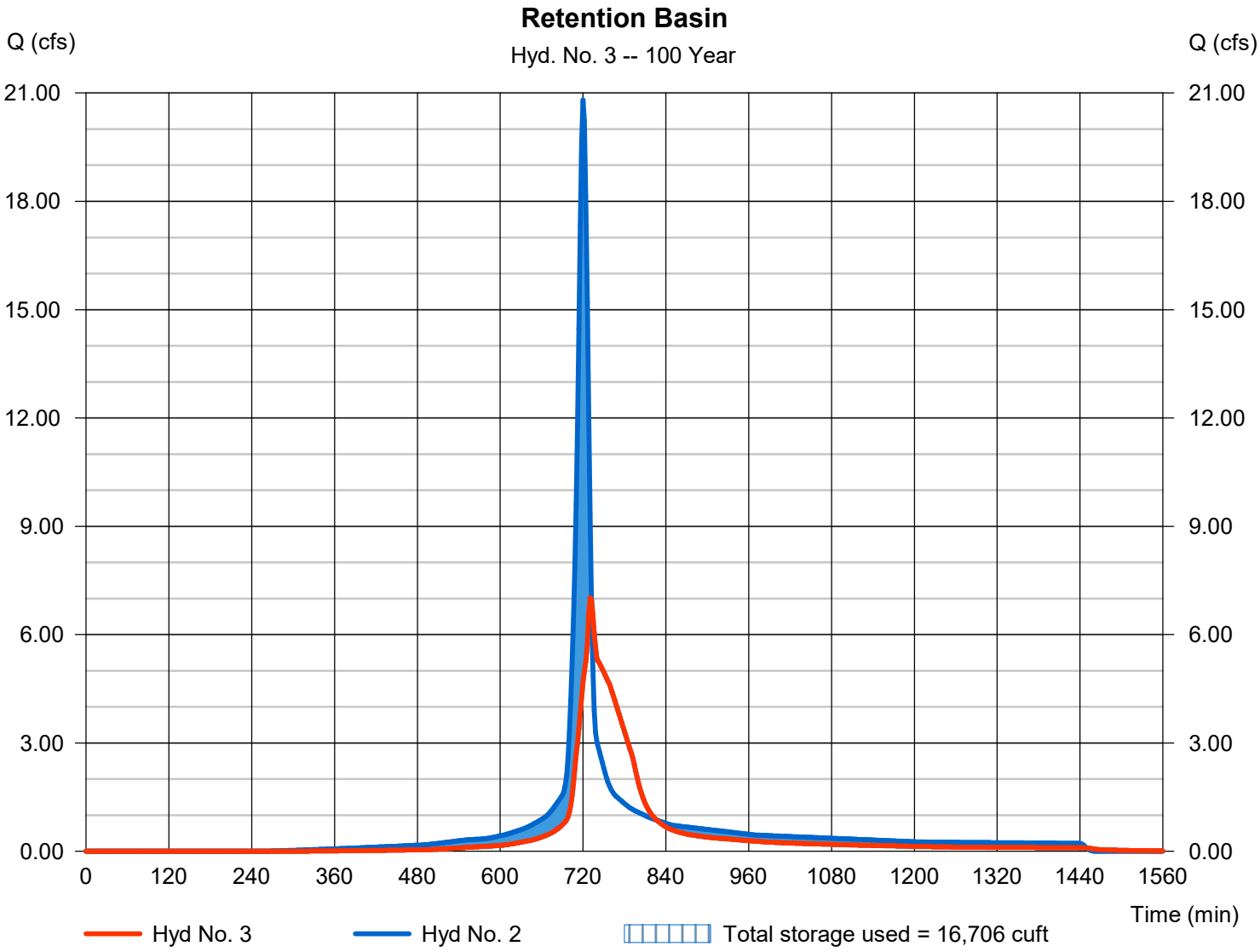
Hydrograph Report

Hyd. No. 3

Retention Basin

Hydrograph type	=	Reservoir	Peak discharge	=	7.016 cfs
Storm frequency	=	100 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	37,925 cuft
Inflow hyd. No.	=	2 - Post-Development Hydrograph	Max. Elevation	=	84.67 ft
Reservoir name	=	Retention Basin	Max. Storage	=	16,706 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	26.4069	10.7000	0.8283	--------
3	0.0000	0.0000	0.0000	--------
5	40.0690	10.7000	0.8283	--------
10	50.4836	10.7000	0.8283	--------
25	62.2420	10.7000	0.8283	--------
50	72.3207	10.7000	0.8283	--------
100	81.2794	10.7000	0.8283	--------

File name: Navajo Rainfall Data.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	2.70	2.15	1.79	1.55	1.37	1.23	1.11	1.02	0.95	0.88	0.82	0.78
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	4.09	3.26	2.72	2.35	2.07	1.86	1.69	1.55	1.43	1.34	1.25	1.18
10	5.16	4.10	3.43	2.96	2.61	2.34	2.13	1.95	1.81	1.68	1.58	1.48
25	6.36	5.06	4.23	3.65	3.22	2.89	2.62	2.41	2.23	2.07	1.94	1.83
50	7.39	5.88	4.91	4.24	3.74	3.36	3.05	2.80	2.59	2.41	2.26	2.12
100	8.31	6.61	5.52	4.77	4.21	3.77	3.43	3.15	2.91	2.71	2.54	2.39

Tc = time in minutes. Values may exceed 60.

ps_Morgan Taylor Homes\1763 - Sedona Lofts\Documents\Drainage Report\Hydrology\Precipitation - Navajo Lofts.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.05	0.00	3.30	2.96	3.52	6.80	4.41
SCS 6-Hr	0.00	1.27	0.00	0.00	1.85	2.24	0.00	2.91
Huff-1st	0.00	0.00	0.00	2.75	0.00	0.00	6.50	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	2.80	0.00	0.00	6.00	0.00

SEWER REPORT

Navajo Lofts

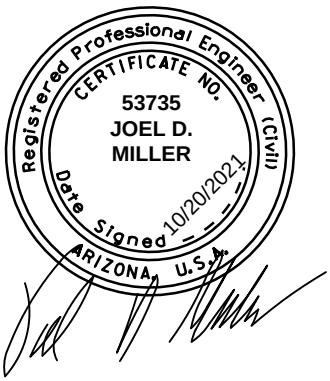
10 Navajo Drive
Sedona, AZ 86336

Prepared for:

MKC HOLDINGS, LLC
15010 N 78th Way, Suite 109
Scottsdale, AZ 85260

Prepared by:

LANDCOR CONSULTING
6859 E. Rembrandt Ave. #124
Mesa, Arizona 85212
(480) 223-8573



July 2021
Revised October 2021
Job # 1763

SEWER REPORT

FOR

NAVAJO LOFTS

TABLE OF CONTENTS

I. PROJECT DESCRIPTION

This project consists of thirty new duplex buildings, each having two units, as well as associated site improvements including an office, pool, and ramada. The site is located just north of State Route 89A and east of Dry Creek Road in Sedona, AZ, in Section 11, Township 17 North, Range 5 East of the Gila and Salt River Base and Meridian. The site is bounded by Aria Street to the north, Symphony Way to the east, vacant land to the south, and Navajo Drive to the west. The terrain is typical high desert, and slopes generally from northeast to southwest.

Sewer improvements proposed as part of this project include two new sewer taps connecting to the existing sewer main in Navajo Drive and associated onsite piping. See the *Preliminary Sewer Plan* (Appendix A) for the location of existing and proposed sewer facilities.

II. EXISTING CONDITIONS

The public sanitary sewer line serving the site is an 8-in line which runs in Navajo Drive, flowing to the south. There is also an 8" sewer line running in Symphony Way to the east of the site, and an 8" line in a portion of Aria Street on the north side of the site.

III. BASIS OF DESIGN

Wastewater discharge from this site will be collected in two new 6-inch taps which will be constructed to the existing public sewer main in Navajo Drive.

Based on the Arizona Administrative Code, Title 18, Chapter 9, Table 1, the projected sewer flow for this project is 9,120 GPD.

The 6-inch sewer services are adequately sized to accommodate flow from this Project (see Appendix B).

IV. CONCLUSIONS

- Sewer infrastructure will be designed in accordance with City of Sedona design guidelines.
- The proposed 6-inch sewer service is adequately sized to meet the calculated wastewater demand.
- All construction will be in compliance with applicable environmental laws and regulations.

APPENDIX A

FIGURES

N

LANDCOR CONSULTING

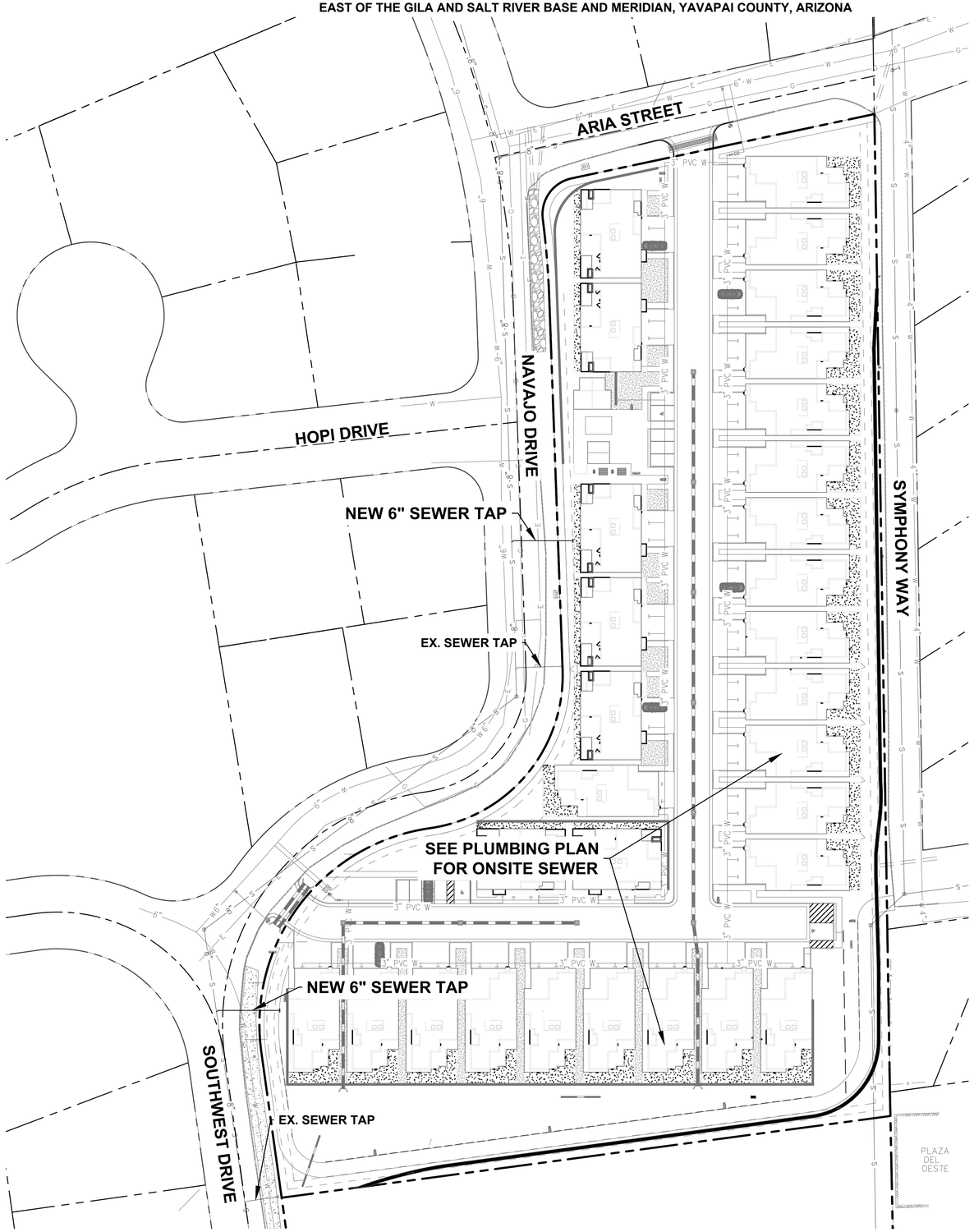
6859 E. Rembrandt Ave, 124
Phoenix, AZ 85212
Ph: (480) 223-8573
landcorconsulting.com

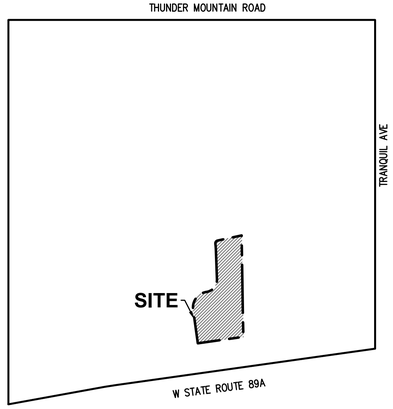
DATE: 7/14/21	FIGURE 1	JOB NO.
SCALE: 1"=750'	SITE LOCATION MAP	1763

PRELIMINARY SEWER PLAN
FOR
10 NAVAJO DR

APN:408-24-536B

SOUTHWEST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 11, TOWNSHIP 17 NORTH, RANGE 5 EAST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, YAVAPAI COUNTY, ARIZONA





VICINITY MAP
SEC 11, T17N, R5E
NTS

OWNER

MKC HOLDINGS LLC
15010 N 78TH WAY SUITE 109
SCOTTSDALE AZ 85260
PHONE: (602) 390-9401
CONTACT: KEITH HOLBEN
EMAIL: kh@mkcompany.com

ENGINEER

LANDCOR CONSULTING
6859 E. REMBRANDT AVE. #124
MESA, AZ 85212
PHONE: (480) 734-9157
CONTACT: JOEL D. MILLER, P.E.
EMAIL: joel@landcorconsulting.com

PROJECT DATA

ADDRESS:	10 NAVAJO DR CITY OF SEDONA
TAX ASSESSORS PARCEL NUMBER:	408-24-536B
ZONING	CO
PARCEL AREA:	196,020 SQFT. (4.5 ACRES)

PRELIMINARY
NOT FOR CONSTRUCTION

REGISTERED PROFESSIONAL ENGINEER
53735
JOEL D. MILLER
Date Signed 10/19/21
ARIZONA U.S.A.

N

40 20 0 20 40 80
SCALE: 1"=40'

LANDCOR CONSULTING
6859 E Rembrandt Ave, #124
Mesa, AZ 85212
Ph: (480) 223-8573
landcorconsulting.com

NAVAJO LOFTS
PRELIMINARY SEWER PLAN
10 NAVAJO DRIVE
SEDONA, ARIZONA

DATE:

REVISIONS:

PRELIMINARY SEWER PLAN

DATE: 10/19/21

PROJ. # : 1763

C2.1
1 OF 1

APPENDIX B

SEWER CALCULATIONS

LANDCOR CONSULTING

6859 E. Rembrandt Ave. #124
Mesa, Arizona 85212
(480) 223-8573

Navajo Lofts
Wastewater Calculations

Development Data:

Development:	Navajo Lofts
Location:	10 Navajo Dr Sedona, AZ
Land Use:	Condominium
Population:	See below

Wastewater Impact:

Wastewater Source	Use	Sewage Design Flow per Applicable Unit (GPD)*	Applicable Unit	Quantity**	Sewage Design Flow (GPD)
Condominiums	Residential	80	Person	114.0	9,120

Design Flow =	**9,120**	GPD
Peak Day = 4.5 x Design Flow =	**41,040**	GPD
=	**28.5**	GPM
=	**0.06**	CFS

* Sewage Design Flow per AAC Title 18, Chapter 9, Table 1. Unit Design flows
**Based on 60 units @ 1.9 persons/dwelling unit.

Channel Report

Navajo Lofts Sewer Capacity

Circular

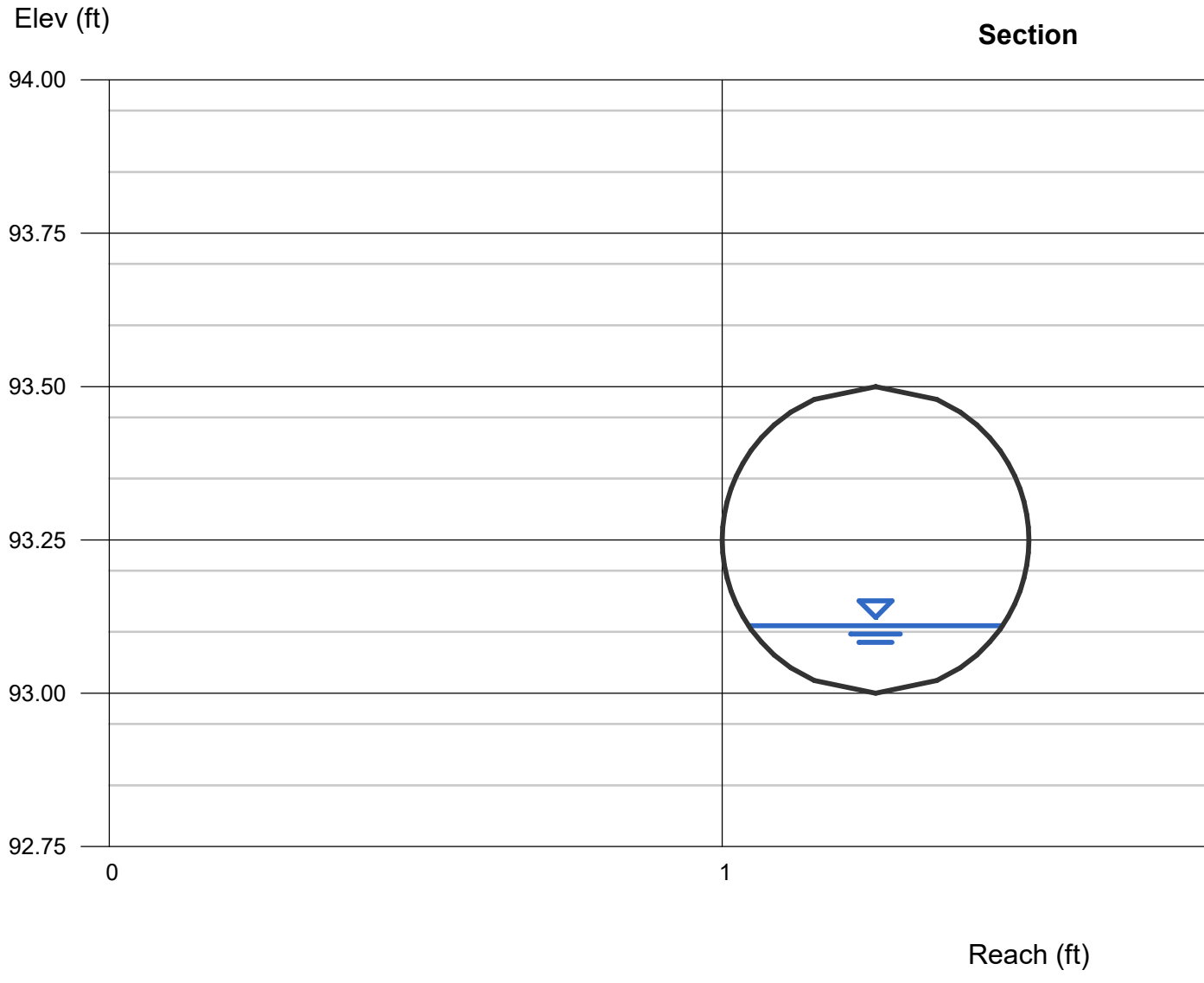
Diameter (ft)	= 0.50
Invert Elev (ft)	= 93.00
Slope (%)	= 1.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.06

Highlighted

Depth (ft)	= 0.11
Q (cfs)	= 0.060
Area (sqft)	= 0.03
Velocity (ft/s)	= 1.86
Wetted Perim (ft)	= 0.49
Crit Depth, Yc (ft)	= 0.12
Top Width (ft)	= 0.42
EGL (ft)	= 0.16



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

School		
Staff and office	Person	20
Elementary, add	Student	15
Middle and High, add	Student	20
with gym & showers, add	Student	5
with cafeteria, add	Student	3
Boarding, total flow	Person	100
Service Station with toilets	First bay	1000
	Each additional bay	500
Shopping Center, no food or laundry	Square foot of retail space	0.1
Store	Employee	20
Public restroom, add	Square foot of retail space	0.1
Swimming Pool, Public	Person	10
Theater		
Indoor	Seat	5
Drive-in	Car space	10

Note: Unit flow rates published in standard texts, literature sources, or relevant area or regional studies are considered by the Department, if appropriate to the project.

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).

ARTICLE 4. NITROGEN MANAGEMENT GENERAL PERMITS

R18-9-401. Definitions

In addition to the definitions established in A.R.S. §§ 49-101 and 49-201 and A.A.C. R18-9-101, the following terms apply to this Article:

1. "Application of nitrogen fertilizer" means any use of a substance containing nitrogen for the commercial production of a crop or plant. The commercial production of a crop or plant includes commercial sod farms and nurseries.
2. "Contact stormwater" means stormwater that comes in contact with animals or animal wastes within a concentrated animal feeding operation.
3. "Crop or plant needs" means the amount of water and nitrogen required to meet the physiological demands of a crop or plant to achieve a defined yield.
4. "Crop or plant uptake" means the amount of water and nitrogen that can be physiologically absorbed by the roots and vegetative parts of a crop or plant following the application of water.
5. "Impoundment" means any structure, other than a tank or a sump, designed and maintained to contain liquids. A structure that stores or impounds only non-contact stormwater is not an impoundment under this Article.
6. "Liner" or "lining system" means any natural, amendment, or synthetic material used to reduce seepage of impounded liquids into a vadose zone or aquifer.
7. "NRCS guidelines" means the United States Department of Agriculture, Natural Resources Conservation Service, National Engineering Handbook, Part 651 Agricultural Waste Management Field Handbook, Chapter 10, 651.1080, Appendix 10D – Geotechnical, Design, and Construction Guideline (November 1997). This material is incorporated by reference and does not include any later amendments or editions of the incorporated material. Copies of the incorporated material are available for inspection at the Arizona Department of Environmental Quality, 1110 W. Washington, Phoenix, AZ 85007 or may be obtained from the United States Department of Agriculture, Natural Resources Conservation Service at ftp://ftp.wcc.nrcs.usda.gov/downloads/wastemgmt/AWMFH/awmfh-chap10-app10d.pdf.

Historical Note

Adopted effective January 4, 1991 (Supp. 91-1). Section R18-9-401 renumbered from R18-9-201 and amended by final rulemaking at 7 A.A.R. 235, effective December 8, 2000 (Supp. 00-4). Amended by final rulemaking at 11 A.A.R. 4544, effective November 12, 2005 (05-3).

R18-9-402. Nitrogen Management General Permits: Nitrogen Fertilizers

An owner or operator may apply a nitrogen fertilizer under this general permit without submitting a notice to the Director, if the owner or operator complies with the following best management practices:

1. Limit application of the fertilizer so that it meets projected crop or plant needs;
2. Time application of the fertilizer to coincide to maximum crop or plant uptake;
3. Apply the fertilizer by a method designed to deliver nitrogen to the area of maximum crop or plant uptake;
4. Manage and time application of irrigation water to minimize nitrogen loss by leaching and runoff; and
5. Use tillage practices that maximize water and nitrogen uptake by a crop or plant.

Historical Note

Adopted effective January 4, 1991 (Supp. 91-1). Section R18-9-402 renumbered from R18-9-202 and amended by final rulemaking at 7 A.A.R. 235, effective December 8, 2000 (Supp. 00-4). Amended by final rulemaking at 11 A.A.R. 4544, effective November 12, 2005 (05-3).

R18-9-403. Nitrogen Management General Permits: Concentrated Animal Feeding Operations

A. An owner or operator may discharge from a concentrated animal feeding operation without submitting a notice to the Director, if the owner or operator complies with the following best management practices:

1. Harvest, stockpile, and dispose of animal manure from a concentrated animal feeding operation to minimize discharge of any nitrogen pollutant by leaching and runoff;

PRELIMINARY GRADING & DRAINAGE PLAN
FOR
NAVAJO LOFTS

OWNER

MKC HOLDINGS LLC
15010 N 78TH WAY SUITE 109
SCOTTSDALE AZ 85260
PHONE: (602) 390-9401
CONTACT: KEITH HOLBEN
EMAIL: kh@mkcompany.com

ENGINEER

LANDCOR CONSULTING
6859 E. REMBRANDT AVE. #124
MESA, AZ 85212
PHONE: (480) 734-9157
CONTACT: JOEL D. MILLER, P.E.
EMAIL: joel@landcorconsulting.com

PROJECT DATA

ADDRESS:	10 NAVAJO DR CITY OF SEDONA
TAX ASSESSORS PARCEL NUMBER:	408-24-536B
ZONING	CO
PARCEL AREA:	196,020 SQFT. (4.5 ACRES)

LEGAL DESCRIPTION

PER 2019-0036008 YAVAPAI COUNTY RECORDER.

SHEET INDEX

RETENTION CALCULATIONS

RETENTION VOLUME REQUIRED:

	A (S.F.)		
Area (gross)	196,020	4.50 AC	

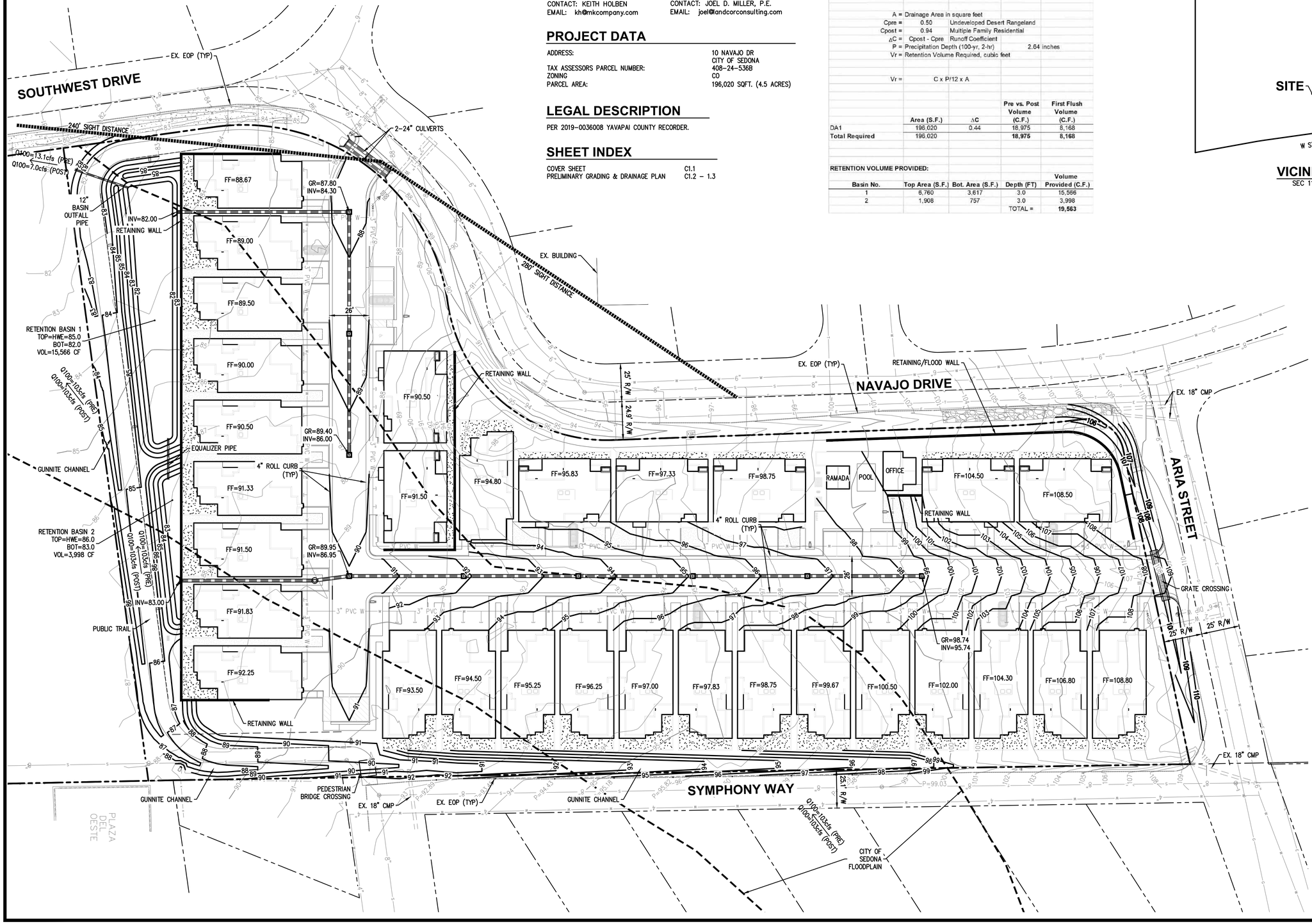
A = Drainage Area in square feet
Cpre = 0.50 Undeveloped Desert Rangeland
Cpost = 0.94 Multiple Family Residential
ΔC = Cpost - Cpre Runoff Coefficient
P = Precipitation Depth (100-yr, 2-hr) 2.64 inches
Vr = Retention Volume Required, cubic feet

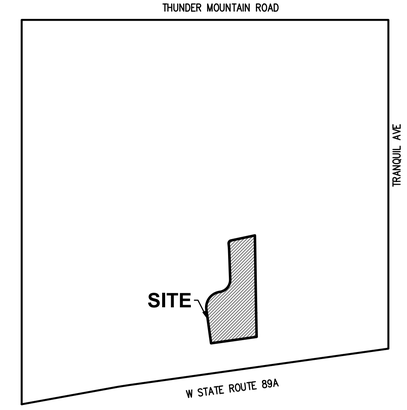
Vr = C x P/12 x A

	Area (S.F.)	ΔC	Pre vs. Post Volume (C.F.)	First Flush Volume (C.F.)
DA1	196,020	0.44	18,975	8,168
Total Required	196,020		**18,975**	**8,168**

RETENTION VOLUME PROVIDED:

Basin No.	Top Area (S.F.)	Bot. Area (S.F.)	Depth (FT)	Volume Provided (C.F.)
1	6,760	3,617	3.0	15,566
2	1,908	757	3.0	3,998
			TOTAL =	**19,563**





VICINITY MAP

SEC 11, T17N, R5E
NTS

PRELIMINARY NOT FOR CONSTRUCTION

REGISTERED PROFESSIONAL ENGINEER
53735
JOEL D. MILLER
Date Signed 10/20/21
ARIZONA, U.S.A.

N

30 15 0 15 30 60
SCALE: 1"=30'

LANDCOR CONSULTING
6859 E Rembrandt Ave, #124
Mesa, AZ 85212
Ph: (480) 223-8573
landcorconsulting.com

NAVAJO LOFTS
PRELIMINARY GRADING & DRAINAGE PLAN
10 NAVAJO DRIVE
SEDONA, ARIZONA

DATE:

REVISIONS:

PRELIMINARY GRADING & DRAINAGE PLAN

DATE: 10/20/21

PROJ. # : 1763

C1.1
1 OF 3

EX. GUNNITE CHANNEL
EX. EOP (TYP)
2-24" CULVERTS
Q100=13.1cfs (PRE)
Q100=7.0cfs (POST)
10' PUBLIC TRAIL ESMT.
FF=88.67
12" BASIN OUTFALL PIPE
GR=87.80
INV=84.30
INV=82.00
RETAINING WALL
FF=89.00
5' SW
10' PEDESTRIAN ACCESS ESMT.
FF=89.50
26'
EX. BUILDING
RETENTION BASIN 1
TOP=HWE=85.0
BOT=82.0
VOL=15,566 CF
FF=90.00
Q100=103cfs (PRE)
Q100=103cfs (POST)
FF=90.50
RETAINING WALL
25' R/W
24.9' R/W
NAVAJO DRIVE
EX. EOP (TYP)
RETAINING/FLOOD WALL
5' SW
EQUALIZER PIPE
GR=89.40
INV=86.00
FF=95.83
FF=97.33
FF=98.75
RAMADA
POOL
OFFICE
FF=104.50
GUNNITE CHANNEL
4" ROLL CURB (TYP)
FF=91.33
FF=91.50
FF=94.80
RETENTION BASIN 2
TOP=HWE=86.0
BOT=83.0
VOL=3,998 CF
Q100=103cfs (PRE)
Q100=103cfs (POST)
GR=89.95
INV=86.95
INV=83.00
CITY OF SEDONA FLOODPLAIN
FF=91.83
PUBLIC TRAIL
FF=92.25
FF=93.50
FF=94.50
FF=95.25
FF=96.25
FF=97.00
FF=97.83
FF=98.75
FF=99.67
FF=100.50
FF=102.00
GR=98.74
INV=95.74
RETAINING WALL
PEDE. ACCESS ESMT.
PEDESTRIAN BRIDGE CROSSING
Q100=103cfs (PRE)
Q100=103cfs (POST)
GUNNITE CHANNEL
GUNNITE CHANNEL
SYMPHONY WAY
25.1' R/W

PRELIMINARY
NOT FOR CONSTRUCTION

HEREBY CERTIFY THAT THE ABOVE PLANS WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND CONTROL
53735
JOEL D. MILLER
Date Signed 10/20/21
ARIZONA U.S.A.

N
20 10 0 10 20 40
SCALE: 1"=20'

MATCH LINE - SEE SHEET C1.3

LANDCOR CONSULTING
4959 E. Rembrandt Ave, #124
Mesa, AZ 85206
Ph: (480) 223-8573
landcorconsulting.com

NAVAJO LOFTS

PRELIMINARY GRADING & DRAINAGE PLAN

10 NAVAJO DRIVE
SEDONA, ARIZONA

DATE:

REVISIONS:

PRELIMINARY GRADING & DRAINAGE PLAN

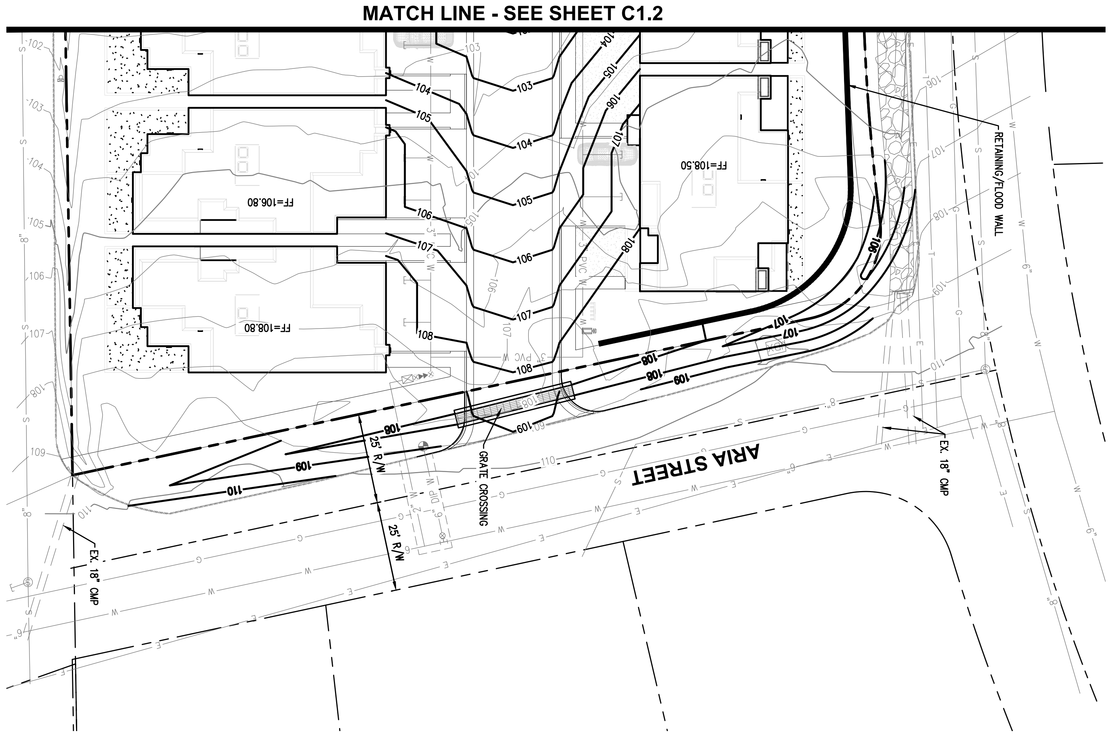
DATE: 10/20/21

PROJ. # : 1763

C1.2

2 OF 3

MATCH LINE - SEE SHEET C1.2



PRELIMINARY
NOT FOR CONSTRUCTION

SCALE: 1"=20'

C1.3	PRELIMINARY GRADING & DRAINAGE PLAN	REVISIONS:	DATE:	NAVAJO LOFTS PRELIMINARY GRADING & DRAINAGE PLAN 10 NAVAJO DRIVE SEDONA, ARIZONA	LANDCOR CONSULTING 6859 E. Rembrandt Ave, #124 Mesa, AZ 85212 Ph: (480) 223-8573 landcorconsulting.com
3 OF 3	PROJ.#: 1763				
	DATE: 10/20/21				