# Summit Christian Church

**Phase 4.0 Worship Center**

Washoe County - Special Use Permit

December 16th, 2019

SUMMIT CHRISTIAN CHURCH

DYER ENGINEERING CONSULTANTS

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Reno, NV 89521
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December 16, 2019

Planning Department
Washoe County
1001 East Ninth Street
Reno, Nevada 89512

**RE: Summit Christian Church Phase 4.0 Worship Center**

To Whom It May Concern:

Dyer Engineering Consultants is pleased to submit a Special Use Permit (SUP) request on behalf of Summit Christian Church. The enclosed Washoe County applications and supporting materials are meant to provide Planning and Engineering staff and the Board of Adjustment ample detail to approve site grading and a religious assembly use located at 7075 Pyramid Way, Sparks, Nevada (APN 083-730-13). Summit Christian Church and the affiliated Summit Ridge Christian Preschool and Daycare center are growing, which is evidence of their valued contribution to the local community. With this positive expansion comes need for additional facilities that accommodate activities and operations such as worship, office and administration, childcare and education, parking, and enclosed storage. Phase 4.0 is outlined in this SUP - it is anchored on a new 40,689-square foot two-story worship center building with seating for 1,500 plus a smaller 33,06 square foot administrative office building to the rear (to be built at a later date) phased parking, and a reconfiguration of the existing church building for expanded family use that also accommodates 645 square feet of interior storage. As designed, this 15-year buildout is the full realization of a master planned vision for the Summit Christian Church complex.

Summit Christian Church received previous SUP approvals (beginning in January 2001 with SW011-027) with 52 conditions that were either completed or have expired. In the previous land use cases the County Board of Adjustment approved a SUP by making the following findings:

*a)* *Consistency. The proposed use is consistent with the action programs, policies, standards and maps of the Master Plan and the applicable area plan;*

The parcel is 36.7-acres with split Master Plan and Zoning designations. Development on the site is clustered on less than half of the total site area and lies entirely within the Medium Density Suburban (MDS) zone which is consistent with its Master Plan Suburban Residential (SR) designation (refer to the land use maps provided). This portion of the site is flatter and has been identified in the Spanish Springs Development Suitability Map.

The church has had no issues with land use conflicts over the past two decades and will continue to be a good transition between the conserved open space lands to the west and the adjacent single-family residences present on GR to the north, MDS/GR to the south, and HDS to the east (across Pyramid Way).

Master plan policies that support this development project are identified below:

- LUT.4.1 Maintain a balanced distribution of land use patterns to:
  - Provide opportunities for a variety of land uses, facilities and services that serve present and future population;
  - Promote integrated communities with opportunities for employment, housing, schools, park civic facilities, and services essential to the daily life of residents
- LUT.21.2 Nonresidential development shall be compatible with the nearby neighborhoods, service and facility capacities, and the surrounding environment
- SS.1.1.1 A minimum 25-foot buffer should be provided between all property lines and rights-of-way along all arterial streets. No fences, walls, or structures shall be permitted in these areas. Development designs shall be encouraged to maintain a compatible landscaping theme for buffers areas throughout the planning area.

b) *Improvements. There are or will be adequate services and infrastructure to support the proposed development;*

The proposed expansion ties right into existing utilities and infrastructure already present on site and that have been sized for this buildout. Summit Christian Church is already served by Waste Management, NV Energy, Truckee Meadows Water Authority, and the Truckee Meadows Water Reclamation Facility (via City of Sparks Sanitary Sewer). Generated demand from the proposed expansion is anticipated to be minimal given that the site facilities fit within a larger shared use development:

<u>Hours of Operation</u>

- Church Office: Monday thru Thursday 9:00am – 4:30pm
- Church Services: Saturday at 5:00pm, Sunday at 9:00am/10:30am/12:00pm
- Church Facility: Sunday 7:00am-5:00pm, Monday thru Friday 6:00am-9:30pm, and Saturday 7:00am-7:00pm

<u>Employees & Student Enrollment</u>
85 Summit Christian Church Staff
30 Summit Ridge Preschool and Daycare Staff
121 Preschool/Pre-Kindergarten/Daycare Students
180 Anchor Point Before & After School Care Students

<u>Congregation</u>
Easter weekend attracts 4,000 attendees versus a typical weekend attendance of 2,200
Christmas Eve attracts 4,800 attendees over a four-day period

c) *Site Suitability. The site is physically suitable for the type of development and for the intensity of development;*

Phase 4.0 development can only occur at this location since it will be an integral part of the Summit Christian Church complex (refer to Site Photographs). Site hydrology, geology, or soils pose no hazards or constraints on the project as designed. This is confirmed in the Dyer Engineering Consultants and CFA Hydrology Reports, and in the Black Eagle Consulting geotechnical study included with this application.

From an architectural and site planning perspective the parcel is large and could accommodate varied layouts, however the creation of a clustered church complex or campus perched upon the hill allows for physical distance from rights-of-way and adjacent residential properties. This isolation and elevation take advantage of the surrounding inspiring mountain views and the expansive Spanish Springs Valley below to invite deeper reflection and contemplation in one's religious participation.

Considerable attention has been paid to transportation at this parcel. The buildings are surrounded by parking not visible from Pyramid Way because of site topography and matured landscaping. Circulation analysis was conducted by Solaegui Engineers (report included with this application) and proactively, Summit Christian Church has instituted a comprehensive transportation management plan including mitigation like restricted one-way circulation through the site, adding a NDOT deceleration lane and contributing to the signalized intersection at Pyramid Way, instituting volunteer attendants to direct parking cars, and also by providing sufficient off-street parking to meet project need. Based on a parking ratio of 1 stall per 3 auditorium seats it is anticipated that the new 1,500 seat worship center will generate need for 295 stalls. Future phasing of the administrative office building will require 74 more spaces at the site, thus bringing the total expansion to 369 spaces. As shown on the attached Preliminary Site Plan, all parking can be accommodated and with the existing parking lot at Summit Christian Church the site will have a total of 738 off-street parking spaces after buildout of Phase 4.0. Note, the northeast portion of the parking lot will remain unpaved until such time as the administration building gets constructed in Phase 4.0 thus necessitating paving and striping of its 77 stalls.

d) *Issuance Not Detrimental: The issuance of the permit will not be significantly detrimental to the public health, safety or welfare; injurious to the property or improvements of adjacent properties; or detrimental to the character of the surrounding area; and*

Summit Christian Church serves its community and the public at large through its long tradition of service and charity. The issuance of a building permit will not be beneficial, injurious, to adjacent properties. Site operations primarily occur indoors - with the exception being use of the playground located behind the family building and occasional use of the proposed outdoor space wedged between the existing building and the new worship center.

As shown on the building elevations and in the attached renderings the design demonstrates use of desert colors and materials that complement the parcel’s mountain backdrop and that elevate the architectural quality and aesthetic conditions currently present in the immediate landscape. Exterior lighting has also been designed for Washoe County residential adjacency standards and all parking lot and all exterior wall mount fixtures meet dark sky requirements (refer to the Photometric Plan included with this application). The proposed “Worship Center” wall signage has also been included on the elevations and meets Washoe County Land Development Code standards.

*e)* *Effect on a Military Installation: Issuance of the permit will not have a detrimental effect on the location, purpose or mission of the military installation.*

This finding is not applicable since there are currently no military installations in the site vicinity.

Thank you for taking time to review the Summit Christian Church Special Use Permit application. I appreciate your time and consideration. Should you have any questions or be in need of additional information, please feel free to contact me at (510) 993-4034 or via email at kerry@tdg-inc.com.

Sincerely,

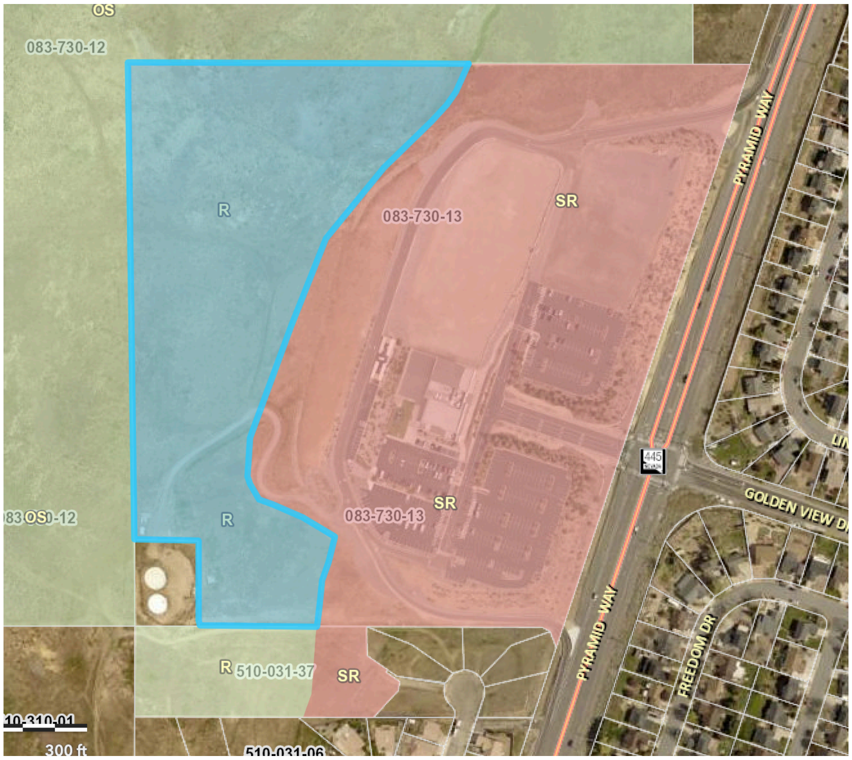
Kerry D. Rohrmeier

Kerry Rohrmeier, PhD AICP

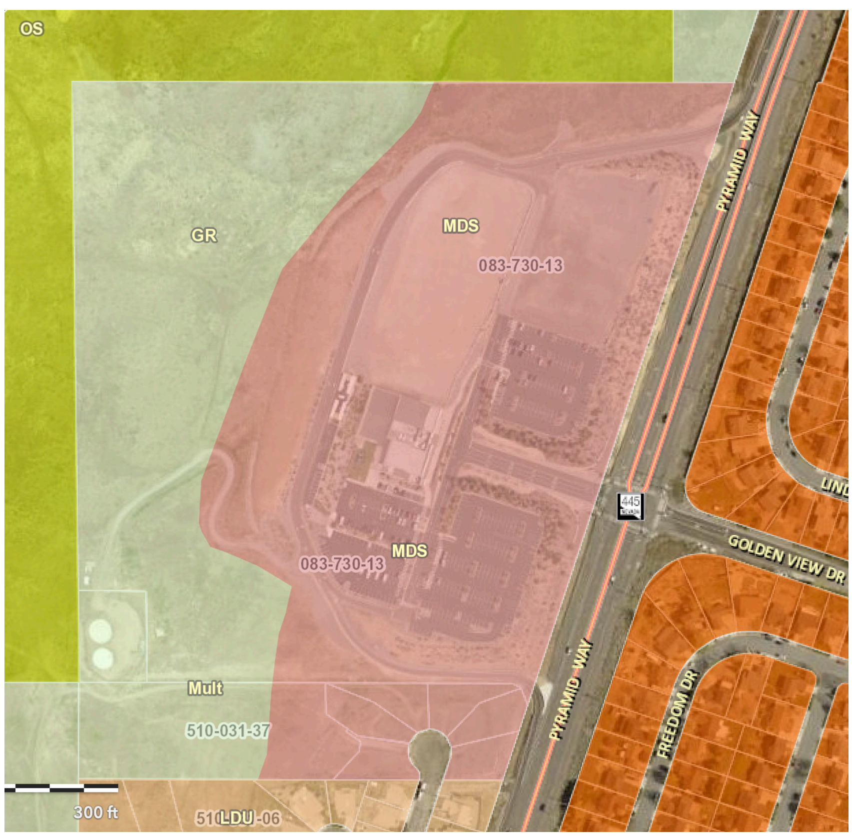
*Enclosure*

Fees
Owner Affidavit
General Development Application
Special Use Permit Application
Property Tax Proof
Slope Map
Preliminary Site Plan
Preliminary Grading Plan
Preliminary Utility Plan
Cross Sections
Preliminary Landscape Plan
Preliminary Irrigation Plan
Conceptual Building Elevations
Conceptual Building Floorplan
Preliminary Photometric Plan
Dyer Preliminary Hydrology Letter and CFA Report
Black Eagle Consulting Preliminary Geotechnical Report
Solaegui Engineers Traffic Impact Report

*Master Plan – Suburban Residential*




*Zoning – Medium Density Suburban*



*Photographs of existing Summit Christian Church and Summit Ridge facilities. Image 1 (top) is the existing 700 seat auditorium. Image 2 (right) is the Summit Ridge Preschool and Daycare Center Playground. Image 3 (bottom) is a concrete pad and the exposed dirt area to be developed with Phase 4.0 as the new - worship center.*


*Renderings of the new worship center building. Images 1 and 2 (left) show the stage and audience vantages. Images 3 and 4 (below) are spaces to socialize.*

# PHASE 4 LANDSCAPE DATA

PROPERTY SITE AREA = 36.7 ACRES (1,599,044 SQ FT)
ZONING: GENERAL COMMERCIAL

AREA SUBJECT TO CONSTRUCTION APPROX. 435,835 SQ FT (8.07 ACRES)
REQUIRED LANDSCAPE AREA = 87,169 SQ FT (20%)

**PROVIDED LANDSCAPE AREAS AS AS SHOWN:**
- WORSHIP CENTER & PARKING EXPANSION ORNAMENTAL LANDSCAPE AREA = 56,209 SQ FT
- EXISTING ORNAMENTAL LANDSCAPING = 84,260 SQ FT
- REVEGETATION AREA = 60,924 SQ FT

TREES REQUIRED = 38

- 38 = 1 TREE PER 10 PARKING SPACES
  (383 SPACES PROVIDED)

TREES PROVIDED = 38 MIN

SHRUBS REQUIRED = SHRUBS SUFFICIENT TO REACH COVERAGE REQUIREMENT PER WASHOE COUNTY CODE

NEW ORNAMENTAL LANDSCAPE

EXISTING ORNAMENTAL LANDSCAPE TO REMAIN

REVEGETATION

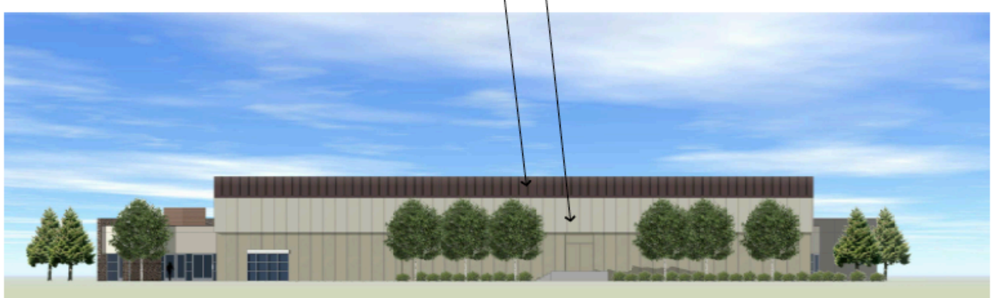
FUTURE PROJECT SITE


# PLANT LEGEND

| SYM. | QNT. | BOTANICAL NAME/COMMON NAME | MIN. SIZE |
|---|---|---|---|
| | | DECIDUOUS TREES | |
| | -- | ACER PLATANOIDES/NORWAY MAPLE | 2-½" CAL. |
| | -- | MALUS 'IOENSIS'/PRAIRIE ROSE CRAB | 2-½" CAL. |
| | -- | PLATANUS ACERIFOLIA 'BLOODGOOD'/BLOODGOOD LONDON PLANE | 2-½" CAL. |
| | -- | PRUNUS VIRGINIANA 'CANADA RED'/CANADA RED CHOKECHERRY | 2-½" CAL. |
| | -- | PYRUS CALLERYANA 'REDSPIRE'/REDSPIRE PEAR | 2-½" CAL. |
| | | EVERGREEN TREES | MIN. SIZE |
| | -- | CALOCEDRUS DECURRENS/INCENSE CEDAR | 6' HT. |
| | -- | PICEA PUNGENS 'HOOPSII'/HOOPSII BLUE SPRUCE | 6' HT. |
| | -- | PINUS NIGRA/AUSTRIAN PINE | 6' HT. |
| | | COLUMNAR JUNIPERS (INCLUDED IN SHRUB COUNT) | |
| | -- | JUNIPERUS CHINENSIS 'BLUE POINT'/BLUE POINT JUNIPER | 6' HT. |
| | -- | JUNIPERUS CHINENSIS 'SPARTAN'/SPARTAN JUNIPER | 6' HT. |
| | -- | JUNIPERUS SCOPULORUM 'MOONGLOW'/MOONGLOW JUNIPER | 6' HT. |
| | -- | JUNIPERUS SCOPULORUM 'WICHITA BLUE'/WICHITA BLUE JUNIPER | 6' HT. |
| | | SHRUBS & ORNAMENTAL GRASSES | MIN. SIZE |
| | -- | BERBERIS THUNBERGII 'ATROPURPUREA'/RED-LEAF BARBERRY | 5 GAL. |
| | -- | CALAMAGROSTIS X ACUTIFLORA 'KARL FOERSTER'/FEATHER REED GRASS | 1 GAL. |
| | -- | CORNUS SERICEA 'ISANTI'/ISANTI RED-OSIER DOGWOOD | 5 GAL. |
| | -- | CORNUS STOLONIFERA/REDTWIG DOGWOOD | 5 GAL. |
| | -- | COTONEASTER MICROPHYLLUS/EVERGREEN COTONEASTER | 5 GAL. |
| | -- | EUONYMUS ALATUS 'COMPACTA'/DWARF BURNING BUSH | 5 GAL. |
| | -- | EUONYMUS FORTUNEI/EVERGREEN EUONYMUS | 5 GAL. |
| | -- | EUONYMUS FORTUNEI 'EMERALD AND GOLD'/E&G EUONYMUS | 5 GAL. |
| | -- | EUONYMUS KIAUTSCHOVICUS 'MANHATTAN'/MANHATTAN EUONYMUS | 5 GAL. |
| | -- | FORSYTHIA X INTERMEDIA/FORSYTHIA | 5 GAL. |
| | -- | JUNIPERUS CHINENSIS 'SEA GREEN'/S.G. JUNIPER | 5 GAL. |
| | -- | JUNIPERUS SABINA 'TAMARISCIFOLIA'/TAMARIX JUNIPER | 5 GAL. |
| | -- | PANICUM VIRGATUM/SWITCH GRASS | 1 GAL. |
| | -- | PEROVSKIA ATRIPLICIFOLIA/RUSSIAN SAGE | 1 GAL. |
| | -- | PHOTINIA X INTERMEDIA/PHOTINIA | 5 GAL. |
| | -- | PINUS MUGO MUGO/MUGHO PINE | 5 GAL. |
| | -- | PRUNUS CISTENA/DWARF PURPLE-LEAF PLUM | 5 GAL. |
| | -- | RHUS AROMATICA 'GRO-LOW'/GRO-LOW FRAGRANT SUMAC | 5 GAL. |
| | -- | ROSA X 'NOARE'/RED GROUNDCOVER ROSE | 3 GAL. |
| | -- | ROSA X 'RADRAZZ'/KNOCK OUT ROSE | 3 GAL. |


SOUTH ELEVATION


EAST ELEVATION




NORTH ELEVATION


WEST ELEVATION

## Washoe County Development Application

Your entire application is a public record. If you have a concern about releasing personal information, please contact Planning and Building staff at 775.328.6100.

| **Project Information** | **Staff Assigned Case No.:** ______________ |
|---|---|
| Project Name: Summit Christian Church Phase 4.0 Worship Center | |
| Project Description: Special Use Permit for Religious Assembly in MDS and GR zones and for Grading | |
| Project Address: 7075 Pyramid Highway, Sparks, NV 89436 | |
| Project Area (acres or square feet): New development = 8.1-acres. Existing development = 21.5-acres | |
| Project Location (with point of reference to major cross streets **AND** area locator): The western corners of Golden View Way and Pyramid Highway | |

| Assessor's Parcel No.(s): | Parcel Acreage: | Assessor's Parcel No.(s): | Parcel Acreage: |
|---|---|---|---|
| 083-730-13 | 36.7-acres | | |
| | | | |

**Indicate any previous Washoe County approvals associated with this application:**
Case No.(s). SW011-027, SW02-006 (Amendment to SW0011-027)

### Applicant Information (attach additional sheets if necessary)

| **Property Owner:** | | **Professional Consultant:** | |
|---|---|---|---|
| Name: Summit Christian Church | | Name: Dyer Engineering Consultants | |
| Address: 7075 Pyramid Highway | | Address: 9160 Double Diamond Pkwy | |
| Sparks, NV | Zip: 89436 | Reno, NV | Zip: 89521 |
| Phone: 775-424-5683x106 | Fax: | Phone: 775-420-4549 | Fax: |
| Email: cwinslow@summitnv.org | | Email: ljohnson@dyerengineering.com | |
| Cell: 775-745-8520 | Other: | Cell: 775-342-5171 | Other: |
| Contact Person: Christopher Winslow | | Contact Person: Lonnie J. Johnson, PE | |
| **Applicant/Developer:** | | **Other Persons to be Contacted:** | |
| Name: Summit Christian Church | | Name: Dyer Engineering | |
| Address: 7075 Pyramid Highway | | Address: 9160 Double Diamond Pkwy | |
| Sparks, NV | Zip: 89436 | Reno, NV | Zip: 89521 |
| Phone: 775-424-5683x106 | Fax: | Phone: 510-993-4034 | Fax: |
| Email: cwinslow@summitnv.org | | Email: kerry@tdg-inc.com | |
| Cell: | Other: | Cell: 510-993-4034 | Other: |
| Contact Person: Christopher Winslow | | Contact Person: Kerry Rohrmeier, Planner | |

### For Office Use Only

| Date Received: | Initial: | Planning Area: |
|---|---|---|
| County Commission District: | | Master Plan Designation(s): |
| CAB(s): | | Regulatory Zoning(s): |

# Special Use Permit Application
# Supplemental Information

(All required information may be separately attached)

1. What is the project being requested?

An expansion of Summit Christian Church to include a new 40,689-sq ft two story worship center, a new administrative 33,064-sq ft office building and 369 parking spaces along with a reconfiguration of the existing church to be a family center with an additional 645-square feet of enclosed storage to be developed over the next 15 years.

2. Provide a site plan with all existing and proposed structures (e.g. new structures, roadway improvements, utilities, sanitation, water supply, drainage, parking, signs, etc.)

This application includes a Preliminary Site Plan, Colored Slope Map, Preliminary Grading Plan, Preliminary Utility Plan, Cross Sections, Landscape and Irrigation Plans, Building Elevations and Floorplans, and a Photometric Plan.

3. What is the intended phasing schedule for the construction and completion of the project?

It will take 15 years to accomplish full buildout. Construction of the new two-story worship center along with reconfiguration of the existing Summit Church Building and parking scheduled next. Followed by construction of an administrative/office building behind the worship center, paved parking at the northeast corner of the existing surface lot, and the enclosed storage addition to the south side of the family center building.

4. What physical characteristics of your location and/or premises are especially suited to deal with the impacts and the intensity of your proposed use?

This is an expansion of an existing development which was master planned to include the Worship Center. The northeastern portion of the parcel within the MDS zone is well suited to this development in part because it has been previously graded (refer to the Colored Slope Map) and also because this area has been identified on the Spanish Springs Development Suitability Map. Site topography is such that steeper slopes are protected by the GR zoning designation, and yet the flatter areas are still elevated above neighboring residences to the east. (across Pyramid Highway). Further, the adjacent housing to the north and south is a significant distance from any Summit Church building far exceeding the 25' requirement in the Spanish Springs Plan.

5. What are the anticipated beneficial aspects or affects your project will have on adjacent properties and the community?

Summit Christian Church takes an active and important role in the local community. As such the Church has offered its facilities for use in emergency situations given it has ample multipurpose rooms, a kitchen/coffee bar, spaces geared for children and a playground.

6. What are the anticipated negative impacts or affect your project will have on adjacent properties? How will you mitigate these impacts?

Negative impacts have been mitigated. The building is set way back from the streetfront, the site has matured landscaping, all slopes will be stabilized, most grading will be covered by structure or paving, and the worship center building will hide the proposed retaining wall.

7. Provide specific information on landscaping, parking, type of signs and lighting, and all other code requirements pertinent to the type of use being purposed. Show and indicate these requirements on submitted drawings with the application.

Parking, lighting, landscaping, and wall signage are included on the plans and have been designed pursuant to the Washoe Count Land Development Code

8. Are there any restrictive covenants, recorded conditions, or deed restrictions (CC&Rs) that apply to the area subject to the special use permit request? (If so, please attach a copy.)

| | |
|---|---|
| ❑ Yes | ■ No |

9. Utilities:

| | |
|---|---|
| a. Sewer Service | Through the City of Sparks to the Truckee Meadows Water Reclamation Facility |
| b. Electrical Service | NV Energy |
| c. Telephone Service | ATT |
| d. LPG or Natural Gas Service | NV Energy |
| e. Solid Waste Disposal Service | Waste Management |
| f. Cable Television Service | Charter or AT&T |
| g. Water Service | Truckee Meadows Water Authority |

For most uses, Washoe County Code, Chapter 110, Article 422, Water and Sewer Resource Requirements, requires the dedication of water rights to Washoe County. Please indicate the type and quantity of water rights you have available should dedication be required.

| | | | |
|---|---|---|---|
| h. Permit # | | acre-feet per year | |
| i. Certificate # | | acre-feet per year | |
| j. Surface Claim # | | acre-feet per year | |
| k. Other # | | acre-feet per year | |

Title of those rights (as filed with the State Engineer in the Division of Water Resources of the Department of Conservation and Natural Resources).

| |
|---|
| The site is currently served by the Truckee Meadows Water Authority and will continue to be served with expansion. |

10. Community Services (provided and nearest facility):

| | |
|---|---|
| a. Fire Station | Sparks Fire Station is slightly closer than Truckee Meadows Fire Station 46 |
| b. Health Care Facility | Northern Nevada Medical Center |
| c. Elementary School | Miguel Sepulveda Elementary School |
| d. Middle School | Sky Ranch Middle School |
| e. High School | Edward Reed High School |
| f. Parks | Wedekind Regional Park |
| g. Library | Spanish Springs Library |
| h. Citifare Bus Stop | Rock Boulevard at York Way |

# Special Use Permit Application for Grading Supplemental Information

(All required information may be separately attached)

1. What is the purpose of the grading?

Land disturbing activities are required to prepare this site for development including cuts and fills and retaining walls not more than 6' in height.

2. How many cubic yards of material are you proposing to excavate on site?

Parking, lighting, landscaping, and wall signage are included on the plans and have been designed pursuant to the Washoe Count Land Development Code

3. How many square feet of surface of the property are you disturbing?

New development extends 8.1-acres and is an expansion to the existing 21.5-acres.

4. How many cubic yards of material are you exporting or importing? If none, how are you managing to balance the work on-site?

About 50,000 cubic yards will be cut from the site. 30,000 cubic yards will be placed on the north end of the parcel and shaped into a naturally appearing mound that is stabilized with revegation. The remaining 20,000 cubic yards will be exported from the site.

5. Is it possible to develop your property without surpassing the grading thresholds requiring a Special Use Permit? (Explain fully your answer.)

It is not possible to develop the property without surpassing a Washoe County SUP threshold due to site topography. To respect the natural environment much of the parcel will continue to be left in a natural state that has been conserved through GR zoning. Development, both new and existing, has been clustered toward the MDS portion of the site to make the building complex compatible and easily accessible.

6. Has any portion of the grading shown on the plan been done previously? (If yes, explain the circumstances, the year the work was done, and who completed the work.)

As shown on the slope map there is an existing flat pad area which was always intended for buildout of this phase of development (specifically the worship center and administration/office buildings). This pad stems from previous initial site preparations, however as the project nears construction these flattened dirt areas must be refined to finished floor elevations as specified in Black Eagle Consulting's Preliminary Geotechnical Report and on the Preliminary Grading Plan.

7. Have you shown all areas on your site plan that are proposed to be disturbed by grading? (If no, explain your answer.)

Yes

8. Can the disturbed area be seen from off-site? If yes, from which directions and which properties or roadways?

| |
|---|
| Disturbed areas should not be noticeable from the right of way or neighboring properties. The mounded material on the north end of the property will fit in with site topography and the worship center will completely screen the retaining wall behind it. |

9. Could neighboring properties also be served by the proposed access/grading requested (i.e. if you are creating a driveway, would it be used for access to additional neighboring properties)?

| |
|---|
| The Summit Christian Church development has improved downhill drainage conditions by directing stormwater into detention basins allowing for greater infiltration than what would flow downhill toward existing residences if left in a purely natural state. This improvement isn't shared directly with neighbors but it does help the immediate vicinity. |

10. What is the slope (horizontal/vertical) of the cut and fill areas proposed to be? What methods will be used to prevent erosion until the revegetation is established?

| |
|---|
| Cut and fill areas as designed to be have slopes no greater than 3:1. All slopes will be contoured for a natural appearance then stabilized for public safety and seeded for native vegetation growth. |

11. Are you planning any berms?

| | | |
|---|---|---|
| Yes x | No | If yes, how tall is the berm at its highest? 10' |

12. If your property slopes and you are leveling a pad for a building, are retaining walls going to be required? If so, how high will the walls be and what is their construction (i.e. rockery, concrete, timber, manufactured block)?

| |
|---|
| Yes, an engineered retaining wall is proposed but will not exceed 6' in height. |

13. What are you proposing for visual mitigation of the work?

| |
|---|
| The site is currently served by the Truckee Meadows Water Authority and will continue to be served with expansion. |

14. Will the grading proposed require removal of any trees? If so, what species, how many and of what size?

| |
|---|
| No |

15. What type of revegetation seed mix are you planning to use and how many pounds per acre do you intend to broadcast? Will you use mulch and, if so, what type?

| |
|---|
| The contractor will employ site BMPs including a seed mix sufficient to meet or surpass year one coverage in twelve months time. |

16. How are you providing temporary irrigation to the disturbed area?

| |
|---|
| BMP strongly encourage that the contractor seed and plant in Fall as vegetation is best established just prior to a wet season in their first year. The contractor must comply with revegetation requirements specified in the Washoe County code. |

17. Have you reviewed the revegetation plan with the Washoe Storey Conservation District? If yes, have you incorporated their suggestions?

| |
|---|
| Corridination with the Washoe Storey Conservation District will take place concurrent with the planning process. |

18. Are there any restrictive covenants, recorded conditions, or deed restrictions (CC&Rs) that may prohibit the requested grading?

| | | |
|---|---|---|
| Yes | No x | If yes, please attach a copy. |

# Property Owner Affidavit

**Applicant Name:** Summit Christian Church

The receipt of this application at the time of submittal does not guarantee the application complies with all requirements of the Washoe County Development Code, the Washoe County Master Plan or the applicable area plan, the applicable regulatory zoning, or that the application is deemed complete and will be processed.

STATE OF NEVADA )
)
COUNTY OF WASHOE )

I, CHRISTOPHER WINSLOW,
(please print name)

being duly sworn, depose and say that I am the owner* of the property or properties involved in this application as listed below and that the foregoing statements and answers herein contained and the information herewith submitted are in all respects complete, true, and correct to the best of my knowledge and belief. I understand that no assurance or guarantee can be given by members of Planning and Building.

**(A separate Affidavit must be provided by each property owner named in the title report.)**

Assessor Parcel Number(s): 083-730-13

Printed Name CHRISTOPHER WINSLOW

Signed [signature]

Address 7075 PYRAMID WAY, SPARKS NV 89436

Subscribed and sworn to before me this 18 day of November, 2019.

[signature]
Notary Public in and for said county and state Washoe, Nevada

My commission expires: 9-1-2023

(Notary Stamp)

RUTH A. FAIGIN
Notary Public - State of Nevada
Appointment Recorded in Washoe County
No: 15-2899-2 - Expires September 01, 2023

*Owner refers to the following: (Please mark appropriate box.)

- ☐ Owner
- ☑ Corporate Officer/Partner (Provide copy of record document indicating authority to sign.)
- ☐ Power of Attorney (Provide copy of Power of Attorney.)
- ☐ Owner Agent (Provide notarized letter from property owner giving legal authority to agent.)
- ☐ Property Agent (Provide copy of record document indicating authority to sign.)
- ☐ Letter from Government Agency with Stewardship

Washoe County Treasurer
Tammi Davis

Washoe County Treasurer
P.O. Box 30039, Reno, NV 89520-3039
ph: (775) 328-2510 fax: (775) 328-2500
Email: tax@washoecounty.us

# Account Detail

Back to Account Detail | Change of Address | Print this Page

## CollectionCart

| | Items | Total | | |
|---|---|---|---|---|
| Collection Cart | 0 | $0.00 | Checkout | View |

## Pay Online

No payment due for this account.

## Washoe County Parcel Information

| Parcel ID | Status | Last Update |
|---|---|---|
| 08373013 | Active | 12/12/2019 2:07:59 AM |

**Current Owner:**
SUMMIT CHRISTIAN CHURCH

7075 PYRAMID WAY
SPARKS, NV 89436

**SITUS:**
7075 PYRAMID WAY
WASHOE COUNTY NV

**Taxing District**
4000

**Geo CD:**

| Legal Description |
|---|
| Township 20 Section 16 Lot A-1 Block Range 20 SubdivisionName _UNSPECIFIED |

## Tax Bill (Click on desired tax year for due dates and further details)

| Tax Year | Net Tax | Total Paid | Penalty/Fees | Interest | Balance Due |
|---|---|---|---|---|---|
| 2019 | $112.03 | $112.03 | $0.00 | $0.00 | $0.00 |
| 2018 | $80.07 | $80.07 | $0.00 | $0.00 | $0.00 |
| 2017 | $118.10 | $118.10 | $0.00 | $0.00 | $0.00 |
| 2016 | $72.48 | $72.48 | $0.00 | $0.00 | $0.00 |
| 2015 | $141.35 | $141.35 | $0.00 | $0.00 | $0.00 |
| | | | | Total | $0.00 |

## Disclaimer

- ALERTS: If your real property taxes are delinquent, the search results displayed may not reflect the correct amount owing. Please contact our office for the current amount due.
- For your convenience, online payment is available on this site. E-check payments are accepted without a fee. However, a service fee does apply for online credit card payments. See Payment Information for details.

**Pay By Check**

Please make checks payable to:
**WASHOE COUNTY TREASURER**

**Mailing Address:**
P.O. Box 30039
Reno, NV 89520-3039

**Overnight Address:**
1001 E. Ninth St., Ste D140
Reno, NV 89512-2845

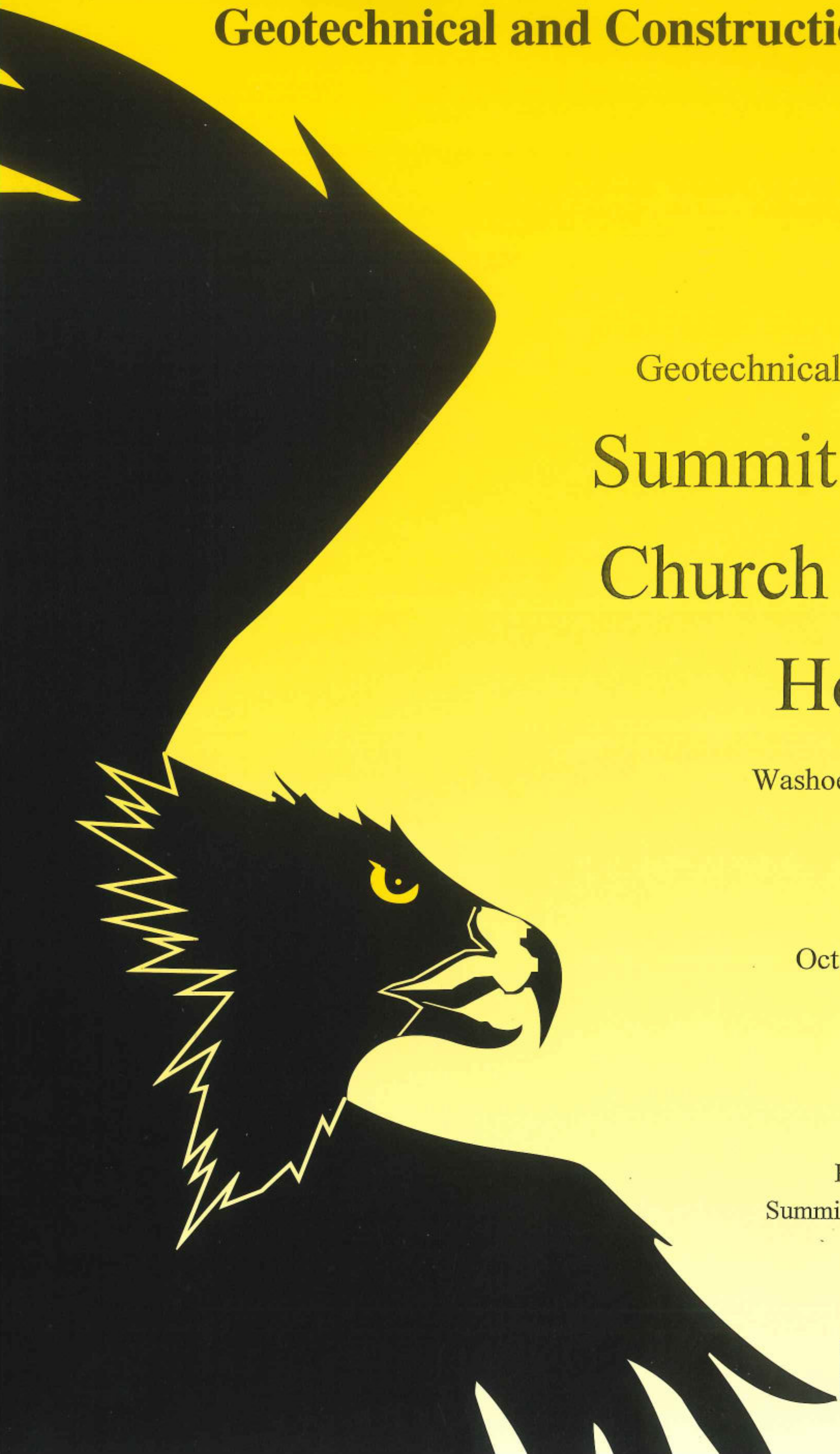
Payment Information

Special Assessment District

Installment Date Information

Assessment Information

# Black Eagle Consulting, Inc.
## Geotechnical and Construction Services



Geotechnical Investigation Update

# Summit Christian Church Mountain House

Washoe County, Nevada

October 16, 2018

Prepared for
Summit Christian Church

Black Eagle Consulting, Inc.
Geotechnical & Construction Services

Mr. Chris Winslow
Summit Christian Church
7075 Pyramid Highway
Sparks, NV 89436

Project No.: 0412-02-4
October 16, 2018

RE: Geotechnical Investigation Update
Summit Christian Church Mountain House
Washoe County, Nevada

Dear Mr. Winslow:

Black Eagle Consulting, Inc. (BEC) is pleased to present this update to our geotechnical investigation for the new building project to be located at the Summit Christian Church titled *Geotechnical Investigation, Summit 2.0, 7075 Pyramid Highway, Washoe County, Nevada*, dated June 19, 2014 (BEC, 2014). The June 2014 report was for a new worship center building as well as an accessway (including acceleration and deceleration lanes within Pyramid Highway) and a parking lot addition within the southern limits of the church property. The access driveways and southern parking lot have been constructed as part of a previous phase. During this previous construction phase, the area to host the new building as well as the parking area located east of the existing building were mass excavated. This geotechnical investigation update is related to the design and construction of the proposed new worship center building, the parking lot north of the building, and other associated exterior improvements.

The 2014 BEC geotechnical investigation report is enclosed as Appendix A (2014 Geotechnical Investigation Report) and completes this geotechnical investigation update report for the proposed new building project at the Summit Christian Church.

## Project Description

The proposed project will involve the design and construction of a building addition and associated improvements north of the existing building. The building will include an approximately 23,500-square-foot, single-story auditorium portion as well as minor areas for administration, a lobby, and a café that will be located in a 1- to 2-story portion of the building within the eastern limits. The auditorium will have a large clear span with roof loads supported by exterior building columns. The building will


Summit Christian Church Existing and Future Improvements have a Portland cement concrete (PCC) slab-on-grade floor. Structural load information was not available at the time of this report. The auditorium portion of the building will likely have a sloped/stepped floor.

The area between the existing building and new building will include various exterior improvements such as shade structures, architectural monuments/towers, walking suspension bridges, PCC walking patios/paths, landscape areas, and pond/water features.

A final grading plan was not available for the project at the time of this report. A preliminary finished floor elevation of 4,593.5 feet above mean sea level is being considered, and this finished floor elevation will require minimal cuts and fills (less than 3 feet) from the existing ground surface within the mass excavated building pad area. The parking lot and other exterior improvements will also be at or near the existing ground surface (after the mass excavation that occurred in an earlier phase).

## Site Conditions

As noted earlier, the project site was mass excavated as part of the earlier construction phase. It is our understanding the mass excavation occurred sometime in 2015 to 2016 as part of the access driveways and parking lot improvements project. The pad extends from the existing building to the northern access drive and is located below the western access drive. The mass excavation included cuts on the order of 10 feet. The southern limit of the pad hosts a temporary PCC pad and a tent structure. The western slope between the pad and the access drive includes rip-rap protection. The pad is relatively flat, with a minor drainage slope to the east.

Site Conditions – Mass Excavated Pad Looking Southwest

## Subsurface Materials Conditions Update

The proposed building area is underlain by altered volcanic bedrock of the Alta Formation extending to depths of at least 51.5 feet (maximum depth of boring exploration associated with our June 2014 geotechnical investigation) below the ground surface that existed prior to mass excavation. The mass excavation essentially removed a minor surficial fill layer and the upper portion of the altered bedrock. With this, the current project site (mass excavated pad) exhibits altered volcanic bedrock through at least 40 feet below the pad grade. The altered bedrock generally exhibits characteristics of fat clays with extremely high plasticity fines. Based on our experience with the bedrock in the area, including within the Summit Christian Church, the altered bedrock is generally expansive and is severely expansive locally. The sporadic distribution (both horizontally and vertically) of severely expansive altered bedrock presents very high risks to the performance of the proposed improvements.

## Updated Geotechnical Design and Construction Recommendations

All recommendations and design parameters presented in our June 2014 geotechnical report remain applicable for the proposed worship center building and associated improvements except as updated/amended below.

### Seismic Design Criteria

The 2012 *International Building Code* ([*IBC*] International Code Council [ICC], 2012) is the presently adopted code by Washoe County and remains applicable for the project. Based on our experience with some recent projects, the local governing agency will likely adopt the 2018 *IBC* (ICC, 2018) in the near future. If the project design is to follow the 2018 *IBC*, the following shall be applicable.

Similar to the 2012 *IBC*, the 2018 *IBC* requires a detailed soils evaluation to a depth of 100 feet to develop appropriate soils criteria. However, the code states that a Site Class D may be used as a default value when the soil properties are not known in sufficient detail to determine the soil profile type. The Site Class D soil profile is for stiff soils with a shear velocity between 600 and 1,200 feet per second, or with an N (Standard Penetration Test) value between 15 and 50, or an undrained shear strength between 1,000 and 2,000 pounds per square foot. Based on our experience, soils borings, and the geology consisting of altered bedrock at the Summit Christian Church site, it is our opinion that the default Site Class D is appropriate. The 2018 *IBC* seismic design loads are based on the American Society of Civil Engineers (ASCE) 7-16 Standards titled *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE, 2017). With the assumed Site Class D, the recommended seismic design criteria using the 2018 *IBC* are presented in Table 1 (Seismic Design Criteria Using 2018 *International Building Code*). It is noted that for Site Class D and the site location, the determination of site coefficient ($F_v$) as well as site-adjusted and design spectral response values at long periods ($S_{M1}$ and $S_{D1}$, respectively) follows an exception provided under Section 11.4.8 of ASCE 7-16 for Site Class D to alleviate detailed, site-specific ground motion hazard analyses for the project. The assumption related to this exception is shown in the footnote, and additional discussion is provided below Table 1.

| TABLE 1 - SEISMIC DESIGN CRITERIA USING 2018 *INTERNATIONAL BUILDING CODE* (ASCE, 2018) | |
|---|---|
| Approximate Latitude | 39.5960 |
| Approximate Longitude | -119.7405 |
| Spectral Response at Short Periods, $S_s$, percent of gravity | 138.5 |
| Spectral Response at 1-Second Period, $S_1$, percent of gravity | 48.2 |
| Site Class | D |
| Site Coefficient $F_a$, decimal | 1.0 |
| Site Coefficient $F_v$, decimal | 1.818* |
| Site Adjusted Spectral Response at Short Periods, $S_{MS}$, percent of gravity | 138.5 |
| Site Adjusted Spectral Response at Long Periods, $S_{M1}$, percent of gravity | 87.6* |
| Design Spectral Response at Short Periods, $S_{DS}$, percent of gravity | 92.3 |
| Design Spectral Response at Long Periods, $S_{D1}$, percent of gravity | 58.4* |
| *These values assume the use of seismic response coefficient ($C_s$) to calculate seismic base shear is determined by the structural engineer in accordance with Section 11.4.8 (Exception Note 2 for Site Class D) and Section 12.8.1 of ASCE 7-16 (ASCE, 2017). | |

As noted earlier and in Table 1, the determination of site coefficient ($F_v$) as well as site-adjusted and design spectral response values at long periods ($S_{M1}$ and $S_{D1}$, respectively) assumes the seismic response coefficient ($C_s$) for the structure/structural elements will be calculated by the structural engineer in accordance with Exception Note 2 of Section 11.4.8 of ASCE 7-16 for Site Class D and then following Section 12.8.1 of ASCE 7-16 (ASCE, 2017). The equation to calculate $C_s$ shall be selected based on the fundamental period of the structure (T) in seconds. It is emphasized that this assumption requires the seismic response coefficient calculated from Section 12.8.1 of ASCE 7-16 be increased by 50 percent when the fundamental period of the structure is greater than 1.5 times the short period for the site ($T_s$). The short period, $T_s$, for the site is equal to $S_{D1}/S_{DS}$, or 0.422 seconds, based on the parameters provided in Table 1. In general, the fundamental periods of typical single-story to mid-rise structures are expected to be significantly lower than the above-discussed criteria needing a 50 percent increase in seismic response coefficient and associated seismic loads. If the proposed structure requires the use of increased seismic loads in the structural design due to the assumption noted earlier (and therefore the associated, significant project cost increase), the need for site-specific ground motion procedures for seismic design provided in Chapter 21 of ASCE 7-16 shall be evaluated. If requested, BEC can provide site-specific ground motion analyses/evaluation services as a separate scope of work, which may require additional field exploration along with detailed analyses.

## Geotechnical Recommendations for Building Foundations and Floor Slab

As noted above, the mass excavated site exhibits altered volcanic bedrock extending to at least 40 feet below the existing pad grade. This altered bedrock is generally expansive everywhere and can be wildly expansive locally. More importantly, unlike clay soils, the expansive behavior of altered bedrock is unpredictable and will not be uniform. The June 2014 geotechnical report (Appendix A) provides extensive discussion on the expansive characteristics of altered bedrock and the past experience with the existing church building, which showed excessive structural movement even with substantial over-excavation and moisture conditioning beneath footings. With the unpredictable and possible locally severe expansion in altered bedrock in the proposed improvement areas, the more rigorous foundation design and PCC slab-on-grade support alternate discussed in the June 2014 geotechnical report remains applicable. We recommend PCC drilled piers with belled bottoms and grade beam foundations for the proposed building. A post-tensioned PCC floor slab or conventional floor slab underlain by a geogrid reinforced structural fill mat section (refer to the June 2014 report) is recommended for the building floor slab. The structural fill for the geogrid reinforced mat section shall include imported material.

## Exterior Improvements and Other Geotechnical Considerations

Various exterior structural improvements are proposed between the existing building and new building. The foundations of the shade structures and improvements in the area shall also be founded on PCC drilled piers to limit the potential vertical movement and associated structural distress. The expansive bedrock must be over-excavated through the depths provided in the June 2014 report beneath exterior slabs/pavements and backfilled with structural fill. In areas prone to subsurface moisture intrusion (e.g., areas near water features, irrigated lawns, and areas near the toe of the slope), additional depths of structural fill separation should be considered for adequate performance.

Based on the architectural displays for the project, the landscape features for the project are expected to include water features such as ponds and water courses. Migration of water from these landscape features into subgrade and foundation soils will cause additional expansive movements to the improvements. Landscape design with elimination of water features and lawn areas is recommended. If it is necessary to incorporate these landscape features, the church shall be aware of the associated risk. As a minimum, the ponds and other water holding features must be properly lined with a geomembrane product to minimize water seepage into subsurface soils.

No irrigated lawn should be located on the upslope area between the building and the western road.

## Codes and Standards

The codes and standards referenced in the 2014 geotechnical investigation report shall be updated to the following that are currently applicable:

- 2018 *IBC* (ICC, 2018), where necessary
- *Standard Specifications for Public Works Construction* (2016)

## Closing

With the exception of the above-described updates, all recommendations and limitations contained in the attached geotechnical report (BEC, 2014; Appendix A) remain applicable.

The recommendations presented in this update and the original report are based on the assumption that sufficient field testing and construction review will be provided during all phases of construction. We should review the final plans and specifications to check for conformance with the intent of our recommendations. Prior to construction, a pre-job conference should be scheduled to include, but not be limited to, the owner, architect, civil engineer, general contractor, earthwork and materials subcontractors, building official, and engineer. The conference will allow parties to review the project plans, specifications, and recommendations presented in this report and discuss applicable material quality and mix design requirements. All quality control reports should be submitted to and reviewed by the engineer.

During construction, we should have the opportunity to provide sufficient on-site observation of preparation and grading, over-excavation, fill placement, foundation installation, and paving. These observations would allow us to verify that the geotechnical conditions are as anticipated and that the contractor's work is in conformance with the approved plans and specifications.

This report has been prepared in accordance with generally accepted geotechnical practices. The analyses and recommendations submitted are based upon field exploration performed at the locations presented in our original geotechnical report. This report does not reflect soils or groundwater variations that may become evident during construction of the proposed improvements, at which time re-evaluation of the recommendations may be necessary.

The client shall be responsible for distribution of this geotechnical investigation to all designers and contractors whose work is related to geotechnical factors. In the event of changes in the design, location, or ownership of the project from the time of this report, recommendations should be reviewed and possibly modified by the geotechnical engineer. If the geotechnical engineer is not accorded the privilege of making this recommended review, he can assume no responsibility for misinterpretation or misapplication of his recommendations or their validity in the event changes have been made in the original design concept without his prior review. The geotechnical engineer makes no other warranties, either express or implied, as to the professional advice provided under the terms of this agreement and included in this report.

We appreciate being of service to you on this project. If you have any questions or require any additional information, please do not hesitate to contact us.

Sincerely,

Black Eagle Consulting, Inc.

PROFESSIONAL ENGINEER-STATE OF NEVADA
PANCHALINGAM
VIMALARAJ
Exp. 6-30-18
CIVIL
No. 19732

Vimalaraj 10/16/18

Vimal P. Vimalaraj, P.E.
Engineering Division Manager

PV:LJJ:cjr

Attachment: Appendix A – 2014 Geotechnical Investigation Report

Copies to: Addressee (3 copies and PDF via email)

## References

American Society of Civil Engineers (ASCE), 2017, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, ASCE Standard ASCE/SEI 7-16.

ASCE, 2018, *ASCE 7 Hazard Tool* at https://asce7hazardtool.online, ASCE/SEI 7-16 seismic load values, accessed August 2018.

Black Eagle Consulting, Inc. (BEC), 2014, *Geotechnical Investigation, Summit 2.0, 7075 Pyramid Highway, Washoe County, Nevada,* Private Consultants Report dated June 19, 2014.

International Code Council (ICC), 2012, *International Building Code (IBC)*.

ICC, 2018, *IBC*.

*Standard Specifications for Public Works Construction*, 2016 (Washoe County, Sparks-Reno, Carson City, Yerington, Nevada).

# APPENDIX A

# 2014 GEOTECHNICAL INVESTIGATION REPORT

Mr. Steve Bond
Summit Christian Church
7075 Pyramid Highway
Sparks, Nevada 89436

June 19, 2014
Project No.: 0412-02-1

L

RE: Geotechnical Investigation
Summit 2.0
Washoe County, Nevada

Dear Mr. Bond:

Black Eagle Consulting, Inc. (BEC) is pleased to present the results of our geotechnical investigation for the above-referenced project. Our investigation consisted of research, field exploration, laboratory testing, and engineering analysis to allow formulation of geotechnical conclusions and recommendations for design and construction of this facility.

The project will involve the design and construction of a new worship center building for Summit Christian Church. The proposed building will be a one-story structure with an approximate total of 54,900 square feet (sf). The building will most likely be a concrete masonry unit (CMU) structure with a Portland cement concrete (PCC) floor slab. The new worship center will be located north of the existing building and the project may include the expansion of the existing building towards the west, into the cut slope. Access road improvements will include asphalt concrete paved entrance and exit roads (north and south of the developed church facilities within the parcel, respectively) to connect the church parking lot to southbound Pyramid Highway. In addition, southbound Pyramid Highway will be widened to include an approximate 600-foot-long deceleration lane and an approximate 1,300-foot-long acceleration lane to facilitate access to and from the church. The acceleration and deceleration lanes will extend from the proposed entrance and exit roads and will be located within the Nevada Department of Transportation's (NDOT's) right-of-way for the Pyramid Highway.

The entire Summit Christian Church facility is underlain at shallow depth by altered volcanic rock, of the Alta Formation. This material is generally expansive everywhere and can be wildly expansive locally, but unpredictably so. Past experience has shown that shallow foundations, even with substantial over-excavation and moisture conditioning beneath footings, are inadequate to prevent excessive structural movement in this area. It is our recommendation that the proposed new worship center and any addition to the west, be supported on drilled shaft foundations designed to resist the uplift forces of the expansive bedrock. In addition, the concrete floor should consist of a post-tension slab-on-ground or, at least, a geogrid reinforced fill mat. Other alternates are discussed, but they are likely too impractical or of significantly higher risk for foundation movement.

We appreciate having the opportunity to work with you on this project. If you have any questions regarding the content of the attached report, please do not hesitate to contact me.

Sincerely,

Black Eagle Consulting, Inc.

PROFESSIONAL ENGINEER - STATE OF NEVADA
ROBERT D.
HUNTER
Exp. 6-30-15
GEOLOGICAL
No. 9343

6.19.14

Dal Hunter, Ph.D. P.E.
Senior Consultant

Copies to: Addressee (2 copies and PDF via email)

DH:kad

# Table of Contents

T

# Introduction

Presented herein are the results of the Black Eagle Consulting, Inc.'s (BEC's) geotechnical investigation, laboratory testing, and associated geotechnical design recommendations for the proposed Summit 2.0 project to be located at 7075 Pyramid Highway in Washoe County, Nevada. These recommendations are based on surface and subsurface conditions encountered in our explorations, and on details of the proposed project as described in this report. The objectives of this study were to:

1. Determine general soil, bedrock, and ground water conditions pertaining to design and construction of the proposed worship center building and access roads.

2. Determine subgrade soil and ground water conditions associated with the proposed deceleration and acceleration lanes on Nevada State Route 443 (the Pyramid Highway).

3. Provide recommendations for design and construction of the project, as related to these geotechnical conditions.

The area covered by this report is shown on Plate 1 (Plot Plan). Our investigation included field exploration, laboratory testing, and engineering analysis to determine the physical and mechanical properties of the various on-site materials. Results of our field exploration and testing programs are included in this report and, along with our experience on previous phases, form the basis for all conclusions and recommendations.

The services described above were conducted in accordance with the BEC Professional Geotechnical Agreement dated February 21, 2014, which was signed by Mr. Christopher Winslow of Summit Christian Church.

# Project Description

The proposed worship center and access road expansion site lies on a trapezoidal-shaped parcel of approximately 30 acres located at 7075 Pyramid Highway in Washoe County, Nevada. The site is entirely contained in the southeast quarter of Section 16, Township 20 North, Range 20 East, Mount Diablo Meridian. The parcel is bordered to the north and west by undeveloped land, to the south by a residential neighborhood, and to the east by the Pyramid Highway. The site presently hosts the first phase of the site development, which includes a 33,000±-square-foot (sf) sanctuary building (constructed in two stages) with associated parking lots and drives. Access to the site is obtained from the Pyramid Highway via the existing paved asphalt concrete driveway to the church (western extension of Golden View Drive).

## Structure/Development Information

The overall project will involve the construction of a one-story worship center building, new access roads, acceleration/deceleration lanes on the Pyramid Highway, and other associated improvements. Improvements to the Pyramid Highway will lie within the Nevada Department of Transportation (NDOT) right-of-way and must adhere to NDOT design and construction standards.

The proposed worship center building will be located north of the existing church and will be connected to the existing building. The new facility will be a tall one-story structure with an approximate total of 54,900 sf. The building will most likely be a concrete masonry unit (CMU) structure with a Portland cement concrete (PCC) floor slab. The sanctuary floor will be both sloping and stepped. A clear span of 170 feet is planned for the sanctuary, with side columns on 30-foot centers loaded to 100 to 150 kips dead plus real live loads. Outside the sanctuary, column loads of 60 to 70 kips are anticipated, probably on 25-foot centers. Perimeter wall loads will be around 2 kips per lineal foot with roof loads mostly carried by the columns.

We are recommending that foundation support for the proposed building be provided by cast-in-place drilled shafts and grade beams to counter the uplift forces from highly expansive altered bedrock at this site (refer to Geotechnical Design Recommendations). The floor slab would, ideally, be post-tensioned to minimize deformation and cracking from differential uplift. Due to cost constraints, other, higher risk, foundation and floor alternates are presented, but none are inexpensive. Because of the steep slopes surrounding the property, free-standing retaining walls will likely be required along the west and possibly north sides of the new building.

## Grading Concepts

Finished floor elevation will match the existing building at 4,993.5 feet above mean sea level. Grading to this elevation will require cuts in the range of 6 to 20 feet or more, depending on actual existing ground elevation. Acceleration/deceleration lanes will primarily be in cut, while site access drives will require both minor cuts and fills. The acceleration/deceleration lane will infringe on existing 2H:1V (horizontal to vertical) cut slopes in some areas, particularly south of the entrance. Widening of the highway will require increasing the lower section of the slope to 1.5H:1V in these areas.

# Site Conditions

## Existing Improvements

Proposed Addition Site

The site currently hosts a 33,000-sf, two-story, sanctuary building that was built in two phases. The initial building was constructed in 2001 with a contiguous addition in 2004. The proposed worship center will adjoin the existing building on its north side. Paved parking facilities are situated to the west, south, east, and northeast of the existing building. Two Washoe County Utilities Division water tanks are located toward the southwest corner of the property. The tanks are accessed by an unimproved road that extends from the southwest corner of the existing paved parking facilities.

The location proposed for the worship center is currently a graded gravel parking area, which sits approximately 6 to 20 feet above the planned finished floor grade of the structure. An existing gravel access road lies just inside the northern property line. An unimproved pathway following the natural topography of the slope runs along the southern portion of the property, the proposed route of the future access drive. Both existing roadways follow the toes of the respective slopes that extend from parking facilities.

## Topography

Previous development phases have created a level building pad using excess material from the original grading. The future building lies in an area previously filled for the existing gravel surfaced overflow parking lot. Clay soils appear to have been stripped from the surface, prior to fill operations.

The undisturbed native slopes along the north, west, and south borders of the site range from about 10 to 30 percent. A well-defined, natural drainage course is located at the north end of the site and will be within the vicinity of a proposed retaining wall.

## Vegetation

The undisturbed portions of the site are sparsely vegetated with native shrubs, predominately sagebrush, rabbit brush, and grasses. Modest landscaping is present around the development, including a small lawn on the west side of the original building. Drip line irrigation is used for most landscaping, with sprinklers on the lawn.

# Exploration

## Drilling

Exploration Drilling

The worship center site was explored on March 20 and 21, 2014 by drilling 6 test borings. The borings were drilled using 6-inch-outside-diameter (O.D.), 3¼-inch-inside-diameter (I.D.), hollow-stem augers and a truck-mounted CME 55 soils sampling drill rig. The maximum depth of exploration was 51.5 feet below the existing ground surface. The locations of the test borings are shown on Plate 1.

The fill and bedrock materials (all native soils appear to have been removed during previous grading operations) were sampled in-place every 2 to 5 feet by use of a standard, 2-inch O.D., split-spoon sampler driven by a 140-pound automatic drive hammer with a 30-inch stroke. The number of blows to drive the sampler the final 12 inches of an 18-inch penetration (Standard Penetration Test [SPT] - American Society for Testing and Materials [ASTM] D 1586) into undisturbed soil is an indication of the density and consistency of the material.

A 3½-inch O.D., split-spoon sampler (ASTM D 3550) was also used to sample materials containing gravel or where approximate in-place densities of subsurface materials were required. Sampling methods used were similar to the SPT but also included the use of 2½-inch-diameter, 6-inch-long, brass sampling tubes placed inside the split-spoon sampler. Because of the larger diameter of the sampler, blowcounts are typically higher than those obtained with the SPT and should not be directly equated to SPT blowcounts. The logs indicate the type of sampler used for each sample.

Due to the relatively small diameter of the samplers, the maximum particle size that could be obtained was approximately 1.25 inches with the SPT tubes and 2.5 inches with the Modified California tubes. The final logs do not, therefore, adequately represent the actual quantity or presence of cobbles or boulders, particularly in the highly altered but variable volcanic rock.

## Test Pits

The Summit 2.0 acceleration/deceleration lanes and access road locations were explored on March 13, 2014 by excavating 12 test pits using a CAT® 430 D rubber tire backhoe. Locations of the test pits are shown on Plate 1. The maximum depth of exploration was 12 feet below the existing ground surface. Bulk samples for index testing were collected from the trench wall sides at specific depths in each soil horizon. Pocket penetrometer testing was performed in exposed, fine-grained soil strata to evaluate in-place, unconfined compressive strength for evaluating trench stability. The test pits were backfilled immediately after exploration. Backfill was loosely placed and the area re-graded to the extent possible with equipment on hand.


Test Pit Exploration

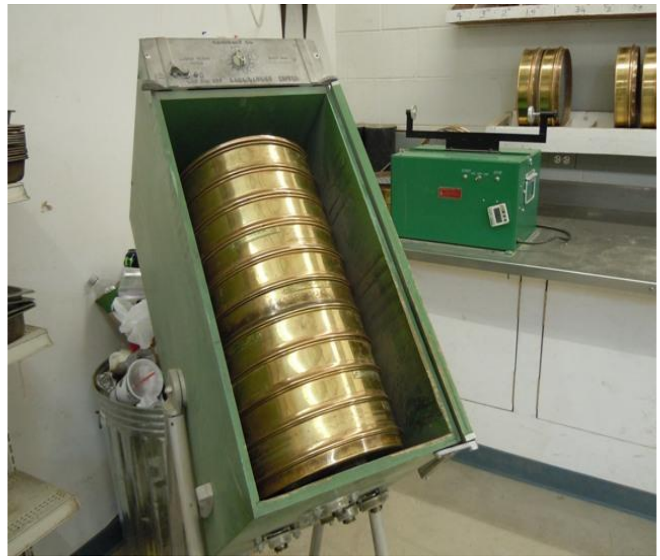
## Material Classification

Materials were identified and logged in the field in accordance with ASTM D 2488 by a registered engineer or a technician with a bachelor's degree in geotechnical engineering. During drilling and test pitting, representative bulk samples were placed in sealed plastic bags and returned to our Reno, Nevada laboratory for testing. Additional soil classification was subsequently performed in accordance with ASTM 2487 (Unified Soil Classification System [USCS]) upon completion of laboratory testing as described in the **Laboratory Testing** section. Logs of the test pits (borings) are presented as Plate 2 (Exploration Logs), and a USCS chart has been included as Plate 3 (Graphic Soils Classification Chart).

The altered bedrock present at this site is difficult to classify since the material is often chemically weathered to soil-like consistency in specific locations and can be vastly different a few feet or even inches away.

# Laboratory Testing

All soils testing performed in the BEC soils laboratory is conducted in general accordance with the standards and methodologies described in Volume 4.08 of the ASTM Standards.


Grain Size Analysis

## Index Tests

Samples of each significant material type were analyzed to determine their in-situ moisture content (ASTM D 2216), grain size distribution (ASTM D 422), and plasticity index (ASTM D 4318). The results of these tests are shown on Plate 4 (Index Test Results). Test results were used to classify the material according to ASTM D 2487 and to verify field logs, which were then updated as appropriate. Classification in this manner provides an indication of the materials' mechanical properties and can be correlated with standard penetration testing and published charts (Bowles, 1996; Naval Facilities Engineering Command [NAVFAC], 1986a and b) to evaluate bearing capacity, lateral earth pressures, and settlement potential.

## R-Value Tests

Resistance value testing (R-Value) (ASTM D 2844) was performed on representative samples of subgrade soil in areas of the proposed acceleration and deceleration lanes along the Pyramid Highway. R-value testing is a measure of subgrade strength and expansion potential and is used in design of flexible pavements. Results of the R-value tests are shown on Plate 5 (R-Value Test Results).

## Expansion Index Tests

Expansion index (EI) testing was performed on two representative samples of the altered volcanic rock obtained from our borings. Testing was conducted in accordance with ASTM D4829 and provides an indication of the expansion potential of the specific sample, at in-place moisture. Expansion index test results are presented as Plate 6 (Laboratory Test Data Summary Table).

## Chemical Tests

Chemical testing was performed on representative samples of site foundation soils in a 1993 report (SEA, Inc., 1993) to evaluate the site materials' potential to corrode steel and PCC in contact with the ground. The samples were tested for soluble sulfates. Since gypsum ($CaSO_4 \cdot 2H_2O$) is common in altered volcanic rock and has been observed in earlier test pits, soluble sulfate could sporadically affect concrete.

# Geologic and General Soil Conditions

The site has been mapped by the Nevada Bureau of Mines and Geology (NBMG) (Bell and Bonham, 1987) as located in Quaternary alluvial fan deposits of the Pyramid Lake Highway. The unit is described as *gray, volcanic, sandy, pebble to cobble gravel.* These deposits are derived from altered volcanic rocks of the Alta Formation in the mountain range separating Sun Valley and Spanish Springs Valley.

The materials encountered during our exploration generally matched the description provided by the NBMG. Altered bedrock lies at shallow depths in the western (upper) portions of the site, overlain by alluvial fan deposits closer to the Pyramid Highway. The near surface soils, where present, exhibit a well-developed and characteristic argillic horizon (expansive fat clay) that is typically 4 to 5 feet thick or more in this area. This horizon was formed by in-place chemical weathering of the underlying alluvial fan and volcanic rock.

The fat clay is described as moist, brown, slightly moist to moist, firm to very stiff, with 57 to 90 percent high-plasticity fines, 10 to 32 percent fine to coarse sand, and 0 to 11 percent subangular to angular gravel up to 3 inches in diameter. Other coarse-grained material that overlies the altered bedrock is described as brown to dark brown, slightly moist to moist, loose to very dense, with 15 to 40 percent non-plastic to medium plasticity fines, 30 to 50 percent fine to coarse sand, and 10 to 50 percent rounded to angular gravel up to 3 inches in diameter.

An 8- to 18-inch fill layer was encountered along the shoulder of the existing Pyramid Highway south of the church. This fill is described as dark grayish-brown, moist, medium dense, with 10 percent non-plastic fines, 30 to 50 percent fine to coarse sand, and 40 to 60 percent rounded to angular gravel up to 3 inches in diameter. The cleaner, non-plastic gravel (test pits TP-04 and TP-06) may also be fill since it lacks the characteristic clay component of native materials.

The surfacing encountered within the existing parking area of the future worship center is an approximate 3- to 6-inch-thick layer of gravel and recycled asphalt pavement. The gravel overlies fill 2.5 to 5 feet or more in depth that is described as gray to brown, slightly moist to moist, very dense, with 15 to 25 percent non-plastic to low plasticity fines, 35 to 50 percent fine to coarse sand, and 30 to 50 percent angular gravel up to 1 inch in diameter. The fill likely represents selected excess site materials from previous grading and appears to be of good quality.

The altered bedrock is described as brown, gray, orange, and white with pockets of purple, tan, rust, and yellow coloring, slightly moist, medium dense to very dense (very stiff to hard), with 20 to 80 percent medium to high plasticity fines, 20 to 73 percent fine to coarse sand, and 0 to 50 percent subangular to angular gravel up to 3 inches in diameter. The bedrock is often so chemically weathered that it is difficult to distinguish from clay-rich soils. This geologic unit (Alta Formation) consists of andesitic volcanic rock which has been altered by hydrothermal activity, similar to what is currently present at Steamboat in South Reno or Yellowstone National Park. The mechanical properties of the altered rock are highly variable and unpredictable over distances of a few feet, vertically and horizontally. Where the alteration is to montmorillonite clay, the material is extremely expansive.

Cobbles and boulders were encountered both in the units overlying the altered bedrock, as well as core stones within the altered rock itself. The cobbles and boulders observed had maximum diameters of up to 2 feet and account for up to 20 percent of the total soil mass.

Ground water was not encountered during exploration and is expected to lie at a depth that will not affect design or construction of this project.

# Geologic Hazards

## Seismicity

Much of the Western United States is a region of moderate to intense seismicity related to movement of crustal masses (plate tectonics). By far, the most active regions, outside of Alaska, are in the vicinity of the San Andreas Fault system of western California. Other seismically active areas include the Wasatch Front in Salt Lake City, Utah, which forms the eastern boundary of the Basin and Range physiographic province, and the eastern front of the Sierra Nevada Mountains, which is the western margin of the province. The Reno-Sparks area lies along the eastern base of the Sierra Nevadas, within the western extreme of the Basin and Range. It must be recognized that there are probably few regions in the United States not underlain at some depth by older bedrock faults. Even areas within the interior of North America have a history of strong seismic activity.

The Truckee Meadows lies within an area with a high potential for strong earthquake shaking. Seismicity within the Reno-Sparks area is considered about average for the western Basin and Range Province (Ryall and Douglas, 1976). It is generally accepted that a maximum credible earthquake in this area would be in the range of magnitude 7 to 7.5 along the frontal fault system of the Eastern Sierra Nevadas. The most active segment of this fault system in the Reno area is located at the base of the mountains near Thomas Creek, Whites Creek, and Mt. Rose Highway, about 10 miles southwest of the project.

## Faults

An earthquake hazards map is not available for the project area. The published geologic hazards map (Bell and Bonham, 1987) shows three northeast-trending faults on the site. The three faults were trenched on this parcel during a 1993 investigation (SEA, Inc.) to expose the subsurface features. All three of the faults were identified in the subsurface as clearly visible shear zones. The morphology of the faults demonstrated that they were much older than Holocene, as evidenced by the well-developed argillic horizon overlying the scarps and lack of any evidence that the fault trace extends to the surface. No evidence of disruption or of movement was noted in the argillic horizon overlying the fault zones. It is generally accepted that even the most rudimentary, argillic horizon in this climate typically takes 11,000 years to develop. Well-developed argillic layers, such as those present here, are at least 50,000 years old. The United States Geological Survey (USGS, 2011), database shows these faults as less than 1.6 million years, the oldest of their categories. For these reasons the faults are thought to be much older than Holocene and are considered only potentially active, at most.

The Nevada Earthquake Safety Council (NESC, 1998) has developed and adopted the criteria for evaluation of Quaternary age earthquake faults. *Holocene Active Faults* are defined as those with evidence of movement within the past 10,000 years (Holocene time). Those faults with evidence of displacement during the last 130,000 years are termed *Late Quaternary Active Faults*. A *Quaternary Active Fault* is one that has moved within the last 1.6 million years. An *Inactive Fault* is a fault *without recognized activity within Quaternary time* (last 1.6 million years). Holocene Active Faults normally require that occupied structures be set back a minimum of 50 feet (100-foot-wide zone) from the ground surface fault trace. An *Occupied Structure* is considered *a building, as defined by the International Building Code, which is expected to have a human occupancy rate of more than 2,000 hours per year.*

The setback from Quaternary Active Faults is left to the judgment of the geologist/engineer; however, no *Critical Facility* is permitted to be placed over the trace of a Late Quaternary Active Fault. A *Critical Facility* is defined as *a building or structure that is considered critical to the function of the community or the project under consideration. Examples include, but are not limited to, hospitals, fire stations, emergency management operations centers, and schools.*

Based on the previously discussed findings there are no requirements for building setback from these potentially active faults. No faults were observed in the exposed cuts made during original grading, such that the faults lie either east or west of the existing building and its proposed additions.

Recurrence intervals for Nevada earthquakes along faults that have been studied are estimated to be in the range of 6,000 to 18,000 years in western Nevada (Bell, 1984). The very active eastern boundary faults of the Sierra Nevada Mountains may have a shorter recurrence interval of 1,000 to 2,000 years.

## Ground Motion and Liquefaction

Mapping by the USGS (2013a) indicates that there is a 2 percent probability that a *bedrock* ground acceleration of 0.54g will be exceeded in any 50-year interval. No amplification of ground motion would be expected during an earthquake due to shallow bedrock.

Because the site area is underlain by dense granular and cohesive soils over bedrock, liquefaction is not possible.

## Flood Plains

The Federal Emergency Management Agency (FEMA) has identified the site as lying in unshaded Zone X, or outside the limits of a 500-year flood plain (FEMA, 2009).

## Other Geologic Hazards

A moderate potential for dust generation is present if grading is performed in dry weather. Expansive clay soils are present across undisturbed areas of the site and are underlain by highly expansive but unpredictable altered volcanic rock. No other geologic hazards were identified.

# Discussion and Recommendations

## General Information

The entire Summit Christian Church facility lies in an area underlain at shallow depth by altered volcanic rock, of the Alta Formation. This material is generally expansive everywhere and can be wildly expansive locally, but unpredictably so. This expansive potential is exacerbated by the need to cut down to match existing finished floor elevations. Expansive bedrock will be exposed that had been previously buried at depths that preserve a relatively dry but uniform moisture content. By exposing these materials to any source of water (ex: precipitation, runoff, irrigation, or broken pipe, typically) extreme levels of expansion can occur, resulting in serious distress to overlying improvements.

Past experience has shown that shallow foundations, even with substantial over-excavation and moisture conditioning beneath footings, are inadequate to prevent excessive structural movement in this area. Existing buildings have exhibited over 4 inches of uplift (heave) along west wall footings, decreasing eastward to about one inch, with greater depth to bedrock. It is our recommendation that the proposed new worship center be supported on drilled shaft foundations designed to resist the uplift forces of the expansive bedrock. In addition the concrete floor should consist of a post-tension slab-on-ground designed to tolerate high edge lift.

The recommendations provided herein, and particularly under Geotechnical Design Recommendations, Civil Engineering and Construction Recommendations, and Quality Control, are intended to minimize risks of structural distress related to consolidation or expansion of native soils, altered rock and/or structural fills. These recommendations, along with proper design and construction of the structure and associated improvements, work together as a system to improve overall performance. If any aspect of this system is ignored or poorly implemented, the performance of the project will suffer. Sufficient quality control should be performed to verify that the recommendations presented in this report are followed.

Structural areas referred to in this report include all areas of buildings, concrete slabs, asphalt pavements, as well as pads for any minor structures. The term engineer, as presented below, pertains to the civil or geological engineer that has prepared the geotechnical engineering report for the project or who serves as a qualified geotechnical professional on behalf of the owner.

All compaction requirements presented in this report are relative to ASTM D 1557. For the purposes of this project:

- Fine-grained soils are defined as those with more than 40 percent by weight passing the number 200 sieve, and a plastic index lower than 15.
- Clay soils are defined as those with more than 30 percent passing the number 200 sieve, and a plastic index greater than 15.
- Granular soils are those not defined by the above criteria.

Any evaluation of the site for the presence of surface or subsurface hazardous substances is beyond the scope of this investigation. When suspected hazardous substances are encountered during routine geotechnical investigations, they are noted in the exploration logs and immediately reported to the client. No such substances were revealed during our exploration.

# Geotechnical Design Recommendations

## Seismic Design Parameters

The 2012 *International Building Code* (*IBC*, International Code Council [ICC], 2012), adopted by Washoe County, requires a detailed soils evaluation to a depth of 100 feet to develop appropriate soils criteria. However, the code states that a Site Class D may be used as a default value when the soil properties are not known in sufficient detail to determine the soil profile type. The Site Class D soil profile is for stiff soils with a shear velocity between 600 and 1,200 feet per second (fps), or with an N value (SPT) between 15 and 50 or an undrained shear strength between 1,000 and 2,000 pounds per square foot (psf). Based on the average R-Value and the geology at the Summit Christian Church, it is our opinion that the default Site Class D is appropriate. With that assumption, the recommended seismic design criteria are presented in Table 1 (Seismic Design Criteria Using 2012 *International Building Code*).

| TABLE 1 - SEISMIC DESIGN CRITERIA USING 2012 *INTERNATIONAL BUILDING CODE* (USGS, 2013b) | |
|---|---|
| Approximate Latitude | 39.596 |
| Approximate Longitude | -119.7405 |
| Spectral Response at Short Periods, $S_s$, percent of gravity | 146.5 |
| Spectral Response at 1-Second Period, $S_1$, percent of gravity | 49.2 |
| Site Class | D |
| Site Coefficient $F_a$, decimal | 1.00 |
| Site Coefficient $F_v$, decimal | 1.50 |
| Site Adjusted Spectral Response at Short Periods, $S_{MS}$, percent of gravity | 146.5 |
| Site Adjusted Spectral Response at Long Periods, $S_{M1}$, percent of gravity | 74.2 |
| Design Spectral Response at Short Periods, $S_{DS}$, percent of gravity | 97.7 |
| Design Spectral Response at Long Periods, $S_{D1}$, percent of gravity | 49.4 |

Past experience has shown that shallow foundations, even with substantial over-excavation and replacement beneath footings, are inadequate to prevent excessive structural movement in this area. Both existing buildings have exhibited over 4 inches of upward vertical movement along west wall footings, decreasing eastward to about one inch, with greater depth to bedrock. Our extensive exploration for the proposed project indicates expansive bedrock under the entire new building footprint. It is our recommendation that the proposed new worship center be supported on drilled shafts (pier and grade beam) foundations designed to resist the uplift forces of the expansive bedrock. A two-story building would clearly decrease foundation and floor slab costs for this site. Several alternate mitigation approaches are presented in order of increasing risk.

## Foundation Design Alternates

### Pier and Grade Beam Foundations (Recommended Alternate)

Black Eagle Consulting, Inc. will provide an addendum letter with geotechnical shaft design parameters once structural loads, both vertical and lateral are available. In terms of controlling uplift potential it would be best to space the shafts as widely as practical to increase their downward load. The use of belled shafts, while somewhat more specialized (costly) than straight shafts, will allow soil overburden to be included in the uplift resistance calculations thereby significantly reducing the required depth of drilling. Grade beams must be separated from the ground surface by a minimum 6-inch void, which can be filled with void forms or compressible foam.

For preliminary structural and cost evaluation, an 18-inch-diameter 20-foot-deep drilled shaft with a 3.5-foot-diameter bell at the bottom could support a compressive load of 120 kips or more in these materials. The bottom of the bell would need to be cleaned of loose material to provide end bearing. For a free-head condition, the ground line shaft could handle a 20-kip lateral load with a 50-kip-foot moment with lateral deflection of one inch or less. For a fixed-head condition the lateral load could exceed the structural capacity of a 2-foot-diameter shaft with little ground line deflection. For pier and grade beam foundations the shafts are generally between the fixed and free-head condition. Actual analysis would be complicated and could justify just using the conservative free-head condition for design, if it provides adequate lateral resistance.

Shaft design will require close coordination and several iterations with the structural engineer to arrive at a practical spacing and diameter that controls potential uplift movements.

### Spread Footings and Conventional Slab-on-Grade with Pre-Saturation

Foundation movement at the site occurs when altered bedrock gains moisture from precipitation and/or landscape irrigation. After two to three years the material has normally absorbed all the water it can and additional foundation movement becomes minimal. Below the first few feet, bedrock has not generally experienced much moisture over the last 10,000 years. Grading cuts to depth generally just lower the pad into material with higher remaining expansion potential.

One possible solution to this problem would be to uniformly pre-saturate the subsurface materials to a considerable depth. This could be done just beneath the footings, with the building still incorporating a post-tensioned slab-on-ground floor or it could be done under the entire footprint so that a conventional concrete slab-on-grade could be used. We anticipate that this alternate would still be very costly and would carry some risk that the saturation will not be thorough enough. There can be no guarantee that the water will penetrate everywhere it needs to, however, the probability seems reasonably high.

To properly pre-saturate the site, 6- to 8-inch-diameter borings would need to be advanced on approximate 5-foot centers to depths of 25 feet. Each boring would be backfilled with compacted drain rock and filled with water about 70 times (1.3 million gallons or more) to allow saturation of the subsurface areas between each drill site. If this system is even to be considered, a pilot test program should be run with a number of boreholes, primarily to determine how long the process would take. Slow permeability rate material could take months or even years to complete saturation.

Foundation recommendations for a site mitigated in this manner are provided below.

Individual column footings and continuous wall footings underlain by at least 3 feet of structural fill and properly saturated native materials can be designed for a net maximum allowable bearing pressure of 3,000 psf and should have minimum footing widths of 24 and 12 inches, respectively. The net allowable bearing pressure is the pressure at the base of the footing in excess of the adjacent overburden pressure. This allowable bearing value should be used for dead plus ordinary live loads. Ordinary live loads are that portion of the design live load which will be present during the majority of the life of the structure. Design live loads are loads which are produced by the use and occupancy of the building, such as by moveable objects, including people or equipment, as well as snow loads. This bearing value may be increased by one-third for total loads. Total loads are defined as the maximum load imposed by the required combinations of dead load, design live loads, snow loads, and wind or seismic loads.

With this allowable bearing pressure, total foundation settlement of approximately ¾-inch should be anticipated. Some foundation heave is still possible but should be less than what has been experienced in previous phases. Differential settlement between footings with similar loads, dimensions, and base elevations should not exceed about ½ inch. The majority of the anticipated movement will occur during the construction period as loads are applied.

Lateral loads, such as wind or seismic, may be resisted by passive soil pressure and friction on the bottom of the footing. The recommended coefficient of base friction is 0.40 and has been reduced by a factor of 1.5 on the ultimate soil strength. Design values for active and passive equivalent fluid pressures are 38 and 405 pounds per square foot per foot of depth, respectively. These design values are based on spread footings bearing on and backfilled with structural fill. All exterior footings should be placed a minimum two feet below adjacent finish grade for frost protection.

If loose, soft, wet, or disturbed materials are encountered at the foundation subgrade, these soils should be removed to expose undisturbed altered rock and the resulting over-excavation backfilled with compacted structural fill. The base of all excavations should be dry and free of loose soils at the time of concrete placement.

### Spread Footings with Aggregate Piers (Not Recommended)

Perimeter grade beam and isolated interior footings could be supported on a series of aggregate piers. Aggregate piers are constructed by boring a 3-foot diameter hole at designed intervals along the footings and backfilling the borings with compacted drain rock. Uplift is resisted by placing a steel plate at the bottom of the boring and attaching the plate to the grade beam with steel tendons. Such piers could generally support approximately 4000 psf or more and would need to be spaced accordingly for the grade beams and column footings. Between the piers, the grade beam would need to be isolated from native materials by void forms or compressible foam. In addition, some water would need to be pumped down to the bottom of the aggregate piers to fully saturate bearing materials prior to placement of structural loads. We anticipate the column depths in the range of 20 to 25 feet would be required. A post-tensioned slab-on-ground floor would still be preferred. It is our understanding that aggregate piers have not been used to resist expansive materials such that no real performance records are available. Given the cost of uplift-resistant aggregate piers reportedly approach that of drilled shafts, the risks do not seem worthy.

### Spread Footings with Vertical Moisture Barriers (Not Recommended)

Some success has been documented by placing vertical moisture barriers in trenches around the outside perimeter of standard spread footings. This technique has been used in clay soils which have far more uniform and predictable expansive properties than the altered bedrock at this site. The vertical barriers do not prevent or even reduce the amount of foundation movement that would occur without the barrier. Rather the longer path for water migration provides for more uniform moisture distribution and, therefore, less differential movement. It is not known how effective this method would be in the altered rock, where expansion often occurs in localized zones, as opposed to uniformly throughout the soils profile in clay. This alternate was considered but rejected.

## Post-Tensioned Floor Slab Design Parameters

Any remaining near-surface clay soils will be fully removed by the anticipated site grading to reach design elevation and match the finished floor of existing buildings. The building will bear directly in altered bedrock under the entire footprint with none of the isolating effect of the alluvium that underlies much of the existing buildings. As such site conditions are extremely severe for conventional slab-on-grade concrete floors, a post-tensioned slab-on-ground floor system is strongly preferred but is probably not practical because of the complex floor shape. Nevertheless, Table 2 (Post-Tensioned Floor Slab Design Parameters) provides the recommended post-tensioned floor slab design criteria. Design parameters were determined in accordance with those procedures recommended by the Post-Tensioning Institute (2004), however these procedures have been developed for clay soils, not expansive bedrock, so that geotechnical judgment is heavily involved.

| TABLE 2 - POST-TENSIONED FLOOR SLAB DESIGN PARAMETERS | |
|---|---|
| Design Parameter | Value |
| Type of Clay | Smectite (Montmorillonite) |
| Moisture Distance - Edge Lift Condition | 8.0 Feet |
| Moisture Distance - Center Lift Condition | 9.0 Feet |
| Recommended Differential Movement - Edge Lift Condition, yME | 4.6 Inches |
| Recommended Differential Movement - Center Lift Condition, yMC | -2.0 Inch |

Documented edge lift movements on the two previous structures have exceeded 4.5 inches such that these values are by no means overly conservative. It must be recognized that post-tensioned floor slabs do not prevent all differential movement but rather spread the movement over a larger area making it less noticeable. Some consideration should be given to structural connection between the post-tensioned slab and the perimeter grade beams.

Lateral loads, such as wind or seismic, may be resisted by passive soil pressure and friction between the floor slab and underlying aggregate base. The recommended coefficient of base friction is 0.40 and has been reduced by a factor of 1.5 on the ultimate soil strength. The interior floor will require a moisture barrier system. Installation shall conform to the specifications provided for a Class B vapor restraint (ASTM E 1745-97). The vapor barrier shall consist of placing a 10-mil-thick StegoRap® vapor barrier or approved equal directly on a properly prepared subgrade surface. A 4-inch-thick layer of aggregate base shall be placed over the vapor barrier and be compacted with a vibratory plate. This configuration is common practice in the arid climate of Northern Nevada.

As an alternate, a 4-inch-thick layer of aggregate base can be placed on a properly prepared subgrade and covered by the moisture barrier, with the concrete placed directly on the vapor barrier, per American Concrete Institute (ACI, 2008) standards. For this case, however, the aggregate base will need to be densified to 95 percent relative compaction and the slab shall be wet-cured for a minimum of 7 days. This alternative requires significant effort by the floor slab contractor and is not common practice in this area.

## Geogrid Mat Alternate

One alternative to the post-tensioned slab solution would be to place the floor slab on a mat of structural fill reinforced with geo-grid. For this alternate the pad would be over-excavated to a depth of 3 feet below proposed subgrade (bottom of aggregate base). The surface at the excavation would be soaked, compacted, and smoothed prior to placement of a geo-grid such as Tensar TX-140S®. Three layers of geo-grid should be included in the backfill with the final layer of grid 12 inches below the aggregate base section. The purpose of the geo-grid is to create a stable mass that would help dissipate uplift of the underlying altered rock and decrease differential movement that could result in severe cracking of the floor slab.

The higher quality (not altered to clay) material from mass excavation should be selectively stockpiled for backfill with the geogrid. If the good material is not stockpiled or is unavailable, imported structural fill will be required (Table 13 - Guideline Specification for Imported Structural Fill).

## Retaining Wall Design Parameters

Rigid retaining walls are not recommended for this site due to the expansive subsurface materials. Rockery walls are the most tolerant of foundation movement and are often the least expensive retaining system anyway. The maximum height of any single rockery wall shall be 8 feet in areas of fill and 10 feet in areas of cut. Walls may be terraced for greater retained heights. All terraced walls shall be constructed so that the back face of the lower wall is separated from the front face of the upper wall by a horizontal distance no less than 1.25 times the height of the lower wall to prevent surcharging of the lower wall; the end result is a slope of approximately 1.25H:1V. No improvements shall extend over rockery wall backfill to prevent distress from differential settlement.

Large block segmented walls such as Ultra-Block or Redi-Rock should perform adequately but have the potential to develop some gaps related to foundation movement. One other downside is that cut areas must be over-cut to allow for geogrid reinforcement of backfill behind walls taller than about 5 feet to accommodate much wider gravity walls.

All rockery or segmented retaining walls must be fully drained, largely to prevent staining from water that would daylight on the wall face. Because the altered bedrock disintegrates with moisture, a geotextile, such as Mirafi® 140N, is required to separate drain rock from these materials. A geotextile should also be placed at the top of the drain rock, behind the wall, to separate the drain rock from overlying backfill.

Table 3 (Lateral Earth Pressure Values [Equivalent Fluid Density]) provides design parameters for fully drained retaining walls with vertical back faces, horizontal or sloping backfill, and no surcharge loads next to the top of the wall.

**TABLE 3 - LATERAL EARTH PRESSURE VALUES (EQUIVALENT FLUID DENSITY), pcf**

| Retained Slope | Static | | Dynamic | |
|---|---|---|---|---|
| | Active* | Passive** | Active* | Passive** |
| Level | 35 | 220 | 46 | 220 |
| 2.5H:1V | 44 | 450 | 77 | 450 |

*For walls that are free to yield at least 0.2 percent of the wall height.
**The values presented have been reduced from the ultimate passive resistance values by 67 and 50 percent to limit deflection under static and dynamic conditions, respectively.

Lateral loads will be resisted by friction along the base of retaining wall footings and by passive resistance against buried foundation walls. Foundation wall footings, cast directly on properly compacted structural fill, may be designed using a coefficient of base friction of 0.40. This factor has been reduced by a factor of 1.5 on the ultimate soil strength.

## Portland Cement Concrete Mix Design Parameters

Soluble sulfate is known to be present on this site from earlier testing (SEA, Inc., 1993) and from observed gypsum in test pits.

| TABLE 4 - SULFATE EXPOSURE CLASS* | | | | |
|---|---|---|---|---|
| | | | **Water-Soluble Sulfate ($SO_4$) in Soil, Percent by Weight** | **Dissolved Sulfate ($SO_4$) in Water, ppm** |
| **S Sulfate** | Not Applicable | S0 | $SO_4 < 0.10$ | $SO_4 < 150$ |
| | Moderate | S1 | $0.10 \leq SO_4 < 0.20$ | $150 \leq SO_4 < 1{,}500$ Seawater |
| | Severe | S2 | $0.20 \leq SO_4 \leq 2.00$ | $1{,}500 \leq SO_4 \leq 10{,}000$ |
| | Very Severe | S3 | $SO_4 > 2.00$ | $SO_4 > 10{,}000$ |
| *From Table 4.2.1 Exposure Categories and Classes. ACI 318, *Buildings Code and Comments.* | | | | |

Concrete in contact with the site foundation soils should be designed for Class S1 Sulfate exposure. Therefore, Type II cement can be used for all concrete work. Concrete mix designs for this project shall incorporate a minimum 28-day unconfined compressive strength of 4000 pounds per square inch (psi) and a maximum water to cement ratio of 0.50.

## Portland Cement Concrete Rigid Pavement and Floor Slabs

The structural section for exterior concrete shall be a minimum of 4 inches of 4,000 psi concrete overlying 6 inches of Type 2, Class B, aggregate base (*Standard Specification for Public Works Construction [SSPWC],* 2012). Concrete driveways should use at least 6 inches of concrete. Valley gutters shall include at least 6 inches of fibermesh concrete (4,000 psi). All exterior concrete flatwork should be underlain by 2.5 feet of structural fill, per Table 10 (Required Thickness of Structural Fill Between Expansive Materials and Improvements). Refer to Portland Cement Concrete Flatwork for aggregate base requirements.

Interior concrete slab-on-grade floors will require a moisture barrier system. Installation shall conform to the specifications provided for a Class B vapor restraint (ASTM E 1745-97). The vapor barrier shall consist of placing a 15-mil-thick StegoRap® vapor barrier or approved equal directly on a properly prepared subgrade surface. A 4-inch-thick layer of aggregate base shall be placed over the vapor barrier and compacted with a vibratory plate.

## Private Asphalt Concrete Pavement Design

Paved areas subject to truck traffic shall consist of 4 inches of asphalt concrete underlain by 6 inches of Type 2, Class B, aggregate base (SSPWC, 2012). Paved areas restricted to automobile parking can consist of 3 inches of asphalt concrete underlain by 6 inches of aggregate base. All structural sections should be underlain by, at least, 2 feet of structural fill, per Table 10.

## Pyramid Highway Acceleration and Deceleration Lanes

The Pyramid Highway lies within NDOT right-of-way and must adhere to their design and construction standards. In general, NDOT requires a pavement structural section design but the new section must match the existing section if it exceeds the design. In this case, the Pyramid Highway is a major thoroughfare with daily, two-way traffic in the range of 30,000 to 40,000 vehicles per day (NDOT, 2001). Only a very small percentage of this traffic and a few trucks will enter and exit the church over a 20 year design life, such that matching the existing section would seem excessive. The design structural section is presented below.

### Design Equivalent Single Axle Load (ESAL)

We understand that no traffic study has been conducted for Summit Christian Church over the last 10 years. As a consequence, we based our pavement evaluation on assumed traffic generation taken from the *Trip Generation Manual* (Institute of Transportation Engineers, 2007). The *Trip Generation Manual* provides average trips for weekdays, Saturdays, and Sundays for churches based on the total square footage of the buildings. We have selected a conservative median rather than average values, as summarized below in Table 5 (Daily Two-Way Trip Generation Summary per 1,000 Square Feet [Church]).

| TABLE 5 - DAILY TWO-WAY TRIP GENERATION SUMMARY PER 1,000 SQUARE FEET (CHURCH) | | | |
|---|---|---|---|
| **Day** | **Average** | **Median** | **Design Value (Vehicles per Day)** |
| Weekdays | 9.11 | 17.28 | 17.3 |
| Saturday | 10.37 | 29.6 | 29.6 |
| Sunday | 36.63 | 66.3 | 66.3 |
| Average Daily Two-Way Traffic | | = (5).(17.3)+29.6+66.3 / 7<br>= 26 Vehicles per Day (vpd) per 1,000 sf | |
| Total Two-Way Vehicles per Day | | = (26 Vehicles per Day).(33,000+51,060 sf) / 1,000 sf<br>= 2,186 vpd | |

Our traffic assumptions for calculation of the 20-year design equivalent single-axle load ($ESAL_{20}$) are summarized below in Table 6 (Design Data - Pyramid Highway Deceleration/Acceleration $ESAL_{20}$)

| TABLE 6 - DESIGN DATA – PYRAMID HIGHWAY DECELERATION/ACCELERATION $ESAL_{20}$ | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2015 Average Daily Traffic[1]** | **Assumed Truck Percentage** | **Assumed Average Truck Factor** | **Percent Trucks in Design Lane** | **Design Life (Years)** | **Average Annual Growth (%)** | **20-Year Growth Factor** | **Design $ESAL_{20}$** |
| 2,186 | 2 | 0.52 | 50 | 20 | 2 | 24.30 | 50,411 |
| [1] Two-way | | | | | | | |

## General Design Criteria

The general parameters necessary for design of flexible pavements were obtained from the 1997 *NDOT Pavement Structural Design and Policy Manual*. Table 7 (General Design Parameters) presents the values used in our analysis:

| TABLE 7 - GENERAL DESIGN PARAMETERS | | |
|---|---|---|
| **Flexible Pavement Design Parameters** | **Value** | **Notes** |
| Reliability | 80% | US Highways |
| Standard Deviation | 0.45 | |
| Initial Serviceability Index | 4.5 | |
| Terminal Serviceability Index | 2.5 | |
| Resilient Modulus, $M_R$ – Base (psi[1]) | 26,500 | |
| Drainage Coefficient, $m_i$ | 1.0 | |
| **Structural Layer Coefficients, $a_i$** | **Value** | **Notes** |
| PBS[2] – Open Graded | 0.0 | |
| PBS – Dense Graded | 0.35 | Type 2, 2C, and 3 |
| Aggregate Base | 0.1 | Type 1, Class B |

[1] psi = pounds per square inch.

[2] PBS = Plant Mix Bituminous Surface.

### Subgrade Strength

Black Eagle Consulting, Inc. conducted two R-Value tests on samples collected along the deceleration/acceleration alignment. The results of the testing range from 12 for the thick surface clay to 17 for the clayey sand with gravel alluvium. For design purposes, an R-value of 17 was selected. Clay soils (R-Value of 12) require over-excavation and replacement to mitigate expansion potential (refer to Site Preparation and Table 10).

The design R-value was converted to the roadbed resilient modulus ($M_{rr}$) using an equation for the best fit line derived from Figure 6.2 of the NDOT *Pavement Structural Design and Policy Manual* (NDOT, 1997).

Design R-Value: $R_v = 17$

$$\text{Log } M = (.0143R_v) + \log(17.43)$$

$$\text{Log } M = 1.4129 \qquad M_p = 10^{\log M} \qquad M_p = 30.507 \text{ (in Mpa)}$$

$$M_{rr} = M_p * 145.03 \qquad M_{rr} = 4{,}424 \text{ (in psi)}$$

### Flexible Pavement Design

Our analysis utilized the American Association of State Highway and Transportation Officials (AASHTO) design methodology (AASHTO, 1993), and the NDOT *Pavement*

*Structural Design and Policy Manual* (NDOT, 1997). The calculations, including all assumptions made, are presented in MathCad format in Appendix A (Flexible Pavement Design Calculations). The recommended structural section is summarized below in Table 8 (Structural Sections – Pyramid Highway).

| TABLE 8 - STRUCTURAL SECTIONS – PYRAMID HIGHWAY | | | | |
|---|---|---|---|---|
| **Alternate Section** | **Open Graded Thicknesses (inches)** | **PBS[1] (inches)** | **Type 1, Aggregate Class B Base Thickness (inches)** | **Minimum Over-Excavation of Clay Subgrade[2]** |
| Calculated | 3/4 | 3.26<br>3.36 | 12.36<br>12.0 | 2.0 Feet Minimum |
| Recommended Minimum | 3/4 | 5.0 | 8.0 | 2.0 Feet Minimum |

[1] PBS = Plant Mix Bituminous Surface
[2] Where present; requires field evaluation of subgrade.

Expansive clay soil is present along about half of the alignment but appears to be localized or sporadic. Where present, clay soils must be over-excavated an additional 2 feet to protect the structural section from expansive pressure. The over-excavation should be backfilled with non-expansive structural fill meeting NDOT requirements for select borrow and must have a minimum R-Value of 45 (NDOT, 2001; Section 203.02.05). Aggregate base and decomposed granitic sand easily meet these specifications. A geotextile meeting the specifications of Table 10 should be placed between the 12-inch aggregate base section and the structural fill.

### Project Materials

The following materials should be specified for NDOT right-of-way on this project:

| TABLE 9 - SPECIFIED MATERIAL | | | |
|---|---|---|---|
| **Open Grade** | 3/8-inch - PG64-28NV | | |
| **PBS** | Type 2 - PG64-28NV | | |
| **Aggregate Base** | Type 1, Class B | | |
| **Non-Woven Geotextile** | | | |
| **Property** | **Test Method** | **Units** | **Requirement** |
| Survivability | AASHTO M288 | Not Applicable | Class 2 |
| Permittivity | ASTM D4491 | $Sec^{-1}$ | ≥ 0.5 |
| Apparent Opening Size (AOS) | ASTM D4751 | U.S. Sieve No. | 100 ≤ AOS ≤ 60 |
| Ultraviolet Stability at 500 hrs. | ASTM D4355 | % Strength Retained | ≥ 50 |
| AASHTO = American Association of State Highway and Transportation Officials<br>ASTM = American Society for Testing and Materials | | | |

All materials should be placed in accordance with NDOT *Standard Specifications for Road and Bridge Construction* (2001) with the geotextile directly under the 12-inch aggregate base section.

## Pavement Drainage Design Parameters

Pavement design is mostly a function of heavy truck traffic and subgrade strength. Inherent in the selection of design subgrade strength is the assumption that the subgrade will not become saturated. Subgrade strength drops dramatically when moisture increases even slightly more than the selected design value. This is essentially true for any material other than clean sands and gravels and is more critical in fine-grained and clay soils than in granular soils. Soils at this site are considered to be of high moisture sensitivity. If irrigated, landscaping is to be placed adjacent to the pavement section, we recommend that edge drains be constructed directly behind the curb, or along the edge of the asphalt where curbs and gutters are not used. This recommendation includes both center median and edge or back face of curb/sidewalk areas with irrigated landscaping and is particularly important where irrigated grades slope toward the street section. If proper drainage is not provided, increased maintenance costs and premature pavement (subgrade) failure will result.

The edge drain shall extend at least 12 inches below the street subgrade and can consist of either a narrow trench backfilled with Class B or C drain rock or a synthetic edge drain product such as Mirafi® Miradrain G100N or approved equal. Drain rock shall be separated from native soil backfill by a geotextile such as Mirafi® 140N or equal. In cohesionless soils the fabric shall also be placed on the upslope side, between the native soils and the drain rock/backfill. The edge drain shall be tied into the storm drain or drain rock backfill around the storm drain. In some cases utility trenches located behind the street could be utilized as edge drains, if designed and constructed with that intent.

### Slope Stability

Stability of cut and filled surfaces involves two separate aspects. The first concerns global slope stability related to mass wasting, landslides, or the en masse downward movement of soil or rock. Global stability of cut and fill slopes is dependent upon shear strength, unit weight, moisture content, and slope angle. The *IBC* (ICC, 2012) adopted by Washoe County allows cut and fill slopes up to 2H:1V in the type of materials present at this site. The exploration and testing program conducted during this investigation confirms 2H:1V slopes will be stable everywhere. Slopes up to 1.5H:1V will be globally stable in the granular alluvial materials south of the entrance. Even the clay soils would be stable at this configuration as long as they are drained to avoid possible saturation. Widening of the Pyramid Highway will require that lower sections of some 2H:1V cut slopes be steepened to 1.5H:1V south of the entrance drive. If slopes steeper than 1.5H:1V are necessary, site-specific exploration testing and slope stability analysis will be needed. Slopes as steep as 1H:1V may be possible.

The second aspect relates to erosional stability and is discussed in the Slope Stability and Erosion Control section.

## Civil Engineering and Construction Recommendations

### Site Preparation

All vegetation shall be stripped and grubbed from structural areas and removed from the site. A stripping depth of 0.2 feet is anticipated along the acceleration/deceleration lanes and access roads, with minor grubbing elsewhere.

The test pits were excavated by backhoe at the approximate locations shown on the site plan. Locations were determined in the field by approximate means. All test pits were backfilled upon completion of the field portion of our study. The backfill was compacted to the extent possible with equipment on hand. However, the backfill was not compacted to the requirements presented herein under Mass Grading. If structures, concrete flatwork, pavement, utilities, or other improvements are to be located in the vicinity of any of the test pits, the backfill should be removed and recompacted in accordance with the requirements contained in the soils report. Failure to properly compact backfill could result in excessive settlement of improvements located over test pits.

Surficial clay soils and altered bedrock on this site will exhibit severe shrink-swell with changes in moisture content. Clay soils are common, but sporadic along the Pyramid Highway and site access roads and must be identified during grading. Proposed grading within the building pad will fully remove any remaining surficial clay (and existing fill) but will expose even more problematic expansive bedrock. Failure to recognize and properly mitigate expansive materials will result in damage to improvements. Clay and altered bedrock shall be separated from improvements by structural fill in order to decrease potential shrink-swell movements. The minimum separation is presented in Table 10.

**TABLE 10 - REQUIRED THICKNESS OF STRUCTURAL FILL BETWEEN EXPANSIVE MATERIALS AND IMPROVEMENTS**

| Improvement | Minimum Separation |
|---|---|
| Footings | Not Applicable[1] |
| Floor Slabs | Not Applicable[2] |
| Exterior Concrete Slabs, including curbs, gutters, sidewalk | 2.5 feet[3] |
| Asphalt Pavements | 2.0 feet[3] |

[1] Deep foundation recommended; see discussion under **Foundation Design Alternates**.
[2] Post-tensioned slab recommended; see discussions under **Foundation Design Alternates** and **Post-Tensioned Floor Slab Design Parameters**.
[3] Excludes aggregate base section.

The required separation may be achieved by any combination of site filling or over-excavation and replacement. Depending on final design elevations, considerable over-excavation could be required.

Expansive materials to be left in place and covered with fill shall be moisture-conditioned to 2 to 4 percent over optimum for a minimum depth of 12 inches. This moisture level will significantly decrease the magnitude of shrink-swell movements in the upper foot of clay. The high moisture content must be maintained by periodic surface wetting, or other methods, until the surface is covered by at least one lift of fill.

If allowed to dry out, subsequent expansion of clay soils beneath foundations and floor slabs could significantly exceed the design criteria set forth previously.

V-ditches along the Pyramid Highway will need to be relocated for the acceleration/deceleration lanes. Existing v-ditches, which are to be abandoned and are located in structural areas, will require over-excavation to remove organic material and soft, wet, fine-grained soils. The over-excavation shall extend to a depth of at least one to three feet below the ditch bottom, unless granular soils are encountered at shallower depth. The width of over-excavation will be dependent upon the extent of soft, wet soils that cannot be compacted. Ditch bottoms may require stabilization in accordance with later recommendations. Backfill should consist of structural fill meeting NDOT specifications for select borrow.

All areas to receive structural fill or structural loading shall be densified to, at least, 90 percent relative compaction. Where less than 70 percent passes the ¾-inch sieve, soils are too coarse for standard density testing techniques. In this case, as will generally occur here, a proof-rolling of a minimum five single passes with a minimum 10-ton roller in mass grading, or five complete passes with hand compactors in footing trenches is recommended. This alternate has proved to provide adequate project performance, as long as all other geotechnical recommendations are closely followed. In all cases, the final surface shall be smooth, firm, and exhibit no signs of deflection.

If wet weather construction is anticipated, surface soils, particularly clays and highly altered rock, may be well above optimum moisture and impossible to compact. In some situations, moisture conditioning may be possible by scarifying the top 12 inches of subgrade and allowing it to air dry to near-optimum moisture, prior to compaction. Where this procedure is ineffective or where construction schedules preclude delays, mechanical stabilization will be necessary. Mechanical stabilization may be achieved by over-excavation and/or placement of an initial 12- to 18-inch-thick lift of 12-inch-minus, 3-inch-plus, well graded, angular rock fill. The more angular and well graded the rock is, the more effective it will be. This fill shall be densified with large equipment, such as a self-propelled sheeps-foot or a large loader, until no further deflection is noted. Additional lifts of rock may be necessary to achieve adequate stability. The use of a separator geotextile will prevent mud from pumping up between the rocks, thereby increasing rock-to-rock contact and decreasing the required thickness of stabilizing fill. The separator geotextile shall meet or exceed the following minimum properties presented in Table 11 (Minimum Required Properties for Separator Geotextile).

| TABLE 11 - MINIMUM REQUIRED PROPERTIES FOR SEPARATOR GEOTEXTILE | |
|---|---|
| Trapezoid Strength (ASTM D 4533) | 80 x 80 lbs. |
| Puncture Strength (ASTM D 4833) | 500 lbs. |
| Grab Tensile Strength/Elongation (ASTM D 4632) | 200 x 200 @ 50 % |

As an alternate to rock fill, a geotextile/gravel system may be used for stabilization. Aggregate base (*SSPWC*, 2012), Class C or D drain rock (*SSPWC*, 2012), or pit run gravels shall be placed above the geotextile. Regardless of which alternate is selected, a test section is recommended to determine the required thickness of stabilization.

## Trenching and Excavation

The lower areas of the site should easily be trenched with conventional excavators. Trenching will become more difficult upslope and/or with greater depths to the presence of the highly variable altered volcanic rock. Some hoe ram and rock-bucket work should be anticipated in trenching, particularly approaching the building pad, but anywhere below the surface clay and alluvium at this site.

Temporary trenches with near-vertical sidewalls should be stable to a depth of approximately 4 feet. Temporary trenches are defined as those that will be open for less than 48 hours. Excavations to greater depths will require shoring or laying back of sidewalls to maintain adequate stability. Regulations contained in Part 1926, Subpart P, of Title 29 of the Code of Federal Regulations (CFR, 2010) require that temporary sidewall slopes be no greater than those presented in Table 12 (Maximum Allowable Temporary Slopes).

| TABLE 12 - MAXIMUM ALLOWABLE TEMPORARY SLOPES | |
|---|---|
| **Soil or Rock Type** | **Maximum Allowable Slopes[1] for Deep Excavations less than 20 Feet Deep[2]** |
| Stable Rock | Vertical (90 degrees) |
| Type A[3] | 3H:4V (53 degrees) |
| Type B | 1H:1V (45 degrees) |
| Type C | 3H:2V (34 degrees) |
| *Notes:* | |
| *1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.* | |
| *2. Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.* | |
| *3. A short-term (open 24 hours or less) maximum allowable slope of 1H:2V (63 degrees) is allowed in excavation in Type A soils that are 12 feet or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet in depth shall be 3H:4V (53 degrees).* | |

The State of Nevada, Department of Industrial Relations, Division of Occupational Safety and Health Administration (OSHA), has adopted and strictly enforces these regulations, including the classification system and the maximum slopes. In general, Type A soils are cohesive, non-fissured soils, with an unconfined compressive strength of 1.5 tons per square foot (tsf) or greater. Type B are cohesive soils with an unconfined compressive strength between 0.5 and 1.5 tsf. Type C soils have an unconfined compressive strength below 0.5 tsf. Numerous additional factors and exclusions are included in the formal definitions. The client, owner, design engineer, and contractor shall refer to Appendix A and B of Subpart P of the previously referenced Federal Register for complete definitions and requirements on sloping and benching of trench sidewalls. Appendices C through F of Subpart P apply to requirements and methodologies for shoring.

On the basis of our exploration, the site materials are predominately Type A clays or bedrock with the properties of Type A clay. Any area in question shall be considered Type C, unless specifically examined by the engineer during construction. All trenching shall be performed and stabilized in accordance with local, state, and OSHA standards.

## Mass Grading

The proposed building site will require significant cuts to achieve design grade so that the finished floor can match existing structures. The excavation will be entirely in altered bedrock of the Alta Formation. The Alta Formation can range from extremely hard bedrock that requires blasting, to soft clay where it has been severely altered by hydrothermal activity. Our borings were advanced by a powerful auger drill rig with some, but not excessive, effort. No zones of drilling refusal were encountered. Blow counts from the drilling were high but did not indicate fresh, hard bedrock. We anticipate that the excavation can be made with large bulldozers but that locally hard rock requiring a hoe ram or even blasting could be present. Excavations for the previous buildings did not require these techniques.

Native clay soils shall be placed as fill only in nonstructural areas. Native granular soils will be suitable for structural fill, provided particles larger than 4 inches are removed. Field testing of the auger cuttings suggests that much of the rock will not be suitable for structural fill without careful segregation and selective stockpiling. It is likely that sufficient material can be segregated for the minor structural fill needs on this project.

Oversized rock can be placed in the bottom of nonstructural fills, if any, or on slopes. In non-structural fills, oversized rocks must be scattered in such a manner as to preclude development of voids between the particles (nesting). On-site rock will not be suitable for rip-rap since it decomposes with moisture.

If imported structural fill is required on this project, we recommend it satisfy the specifications presented in Table 13.

| TABLE 13 - GUIDELINE SPECIFICATION FOR IMPORTED STRUCTURAL FILL | | |
|---|---|---|
| **Sieve Size** | **Percent by Weight Passing** | |
| 4 Inch | 100 | |
| 3/4 Inch | 70 – 100 | |
| No. 40 | 15 – 60 | |
| No. 200 | 5 – 25 | |
| **Percent Passing No. 200 Sieve** | **Maximum Liquid Limit** | **Maximum Plastic Index** |
| 5 – 10 | 50 | 20 |
| 11 – 20 | 40 | 15 |
| 21 – 25 | 35 | 10 |

These recommendations are intended as guidelines to specify a readily available, prequalified material. Adjustments to the recommended limits can be provided to allow the use of other granular, non-expansive material. Any such adjustments must be made and approved by the engineer, in writing, prior to importing fill to the site.

Any fill placed on hillsides steeper than 5H:1V shall be keyed into existing materials in equipment wide benches. The maximum vertical separation between benches shall be 8 feet.

Any structural fill within the building area shall be placed in maximum 8-inch-thick (loose) lifts, each densified to, at least, 95 percent relative compaction. All other structural fill shall be densified to a minimum 90 percent relative compaction. Nonstructural fill shall be densified to, at least, 85 percent relative compaction to minimize consolidation and erosion. This is particularly important for yard areas since soil consolidation can cause water to pond in the drainage swales. Loose yard fill also allows water to infiltrate the backfill rather than flowing to the swale. Both of these conditions can contribute to foundation moisture (refer to Site Drainage).

Commonly, the site materials will have greater than 30 percent retained on the ¾-inch sieve, such that standard density testing is not valid. These materials will be treated as rock fills with a maximum lift thickness and maximum particle size of 12 inches. A proof-rolling program of at least five single passes of a minimum CAT® 815 roller or approved equal in mass grading or at least five complete passes with hand compactors in footing trenches is recommended. If a CAT® 825 or larger compactor is used, it could be possible to increase both lift thickness and particle size to a maximum of 18 inches.

Properly constructed rock fills have a long history of excellent performance in northern Nevada. For this project, the maximum particle size contained in rock fill placed during mass grading to within 4 feet of finished subgrade elevation should be 18 inches with a maximum lift height of 18 inches. Within 4 feet of subgrade elevations, the rock fill should exhibit a maximum particle size of 12 inches, and a maximum lift height of 12 inches. As an alternate, the owner may wish to restrict the maximum particle size to 6 inches in the upper 2 feet to facilitate fine grading and trenching. Acceptance of this rock fill is based upon observation of particle size, lift thickness, moisture content, and applied compactive effort. Compaction must continue to the satisfaction of the engineer. In all cases, the finished surface shall be firm and show no signs of deflection.

Grading shall not be performed with or on frozen soils.

## Utility Trench Backfill

Maximum particle size in trench backfill shall be 4 inches. Bedding and initial backfill 12 inches over the pipe will require import and shall conform to the requirements of the utility having jurisdiction. Bedding and initial backfill shall be densified to at least 90 percent relative compaction. Native granular soil will provide adequate final backfill as long as oversized particles are excluded, and shall be placed in maximum 8-inch-thick loose lifts that are compacted to a minimum of 90 percent relative compaction in all structural areas.

When drain rock is used as trench backfill, it shall be considered a rock backfill (greater than 30 percent retained on the ¾-inch sieve) and shall be placed in maximum 12-inch-thick loose lifts, with each lift densified by at least five complete passes with approved compaction equipment and until no deflection is observed. A separator geotextile, such as Mirafi® 140N, shall be placed between the drain rock and any native soil backfill.

## Rockery Walls

All rockery walls shall be constructed by a qualified and experienced contractor in a battered configuration. Walls may be terraced in areas for greater retained heights (refer to **Retaining Wall Design Parameters**) provided the offset recommendations discussed previously are satisfied. If rockery walls retain fill slopes, the fill shall be overbuilt and then cut back to the back of wall construction. Native bedrock is unsuitable for reuse in rockery walls.

## Subsidence and Shrinkage

Where the native clay soil is to remain in place, subsidence of about 0.1 foot should be anticipated from construction traffic. Subsidence of granular alluvial or altered bedrock soils exposed in cut should be negligible. Granular alluvial soils excavated and recompacted in structural fills should experience quantity shrinkage of approximately 10 percent, including removal of oversized particles. In other words, one cubic yard (cy) of excavated granular alluvium will generate about 0.9 cy of structural fill at 90 percent relative compaction. Altered bedrock will be highly variable in shrinkage properties but there should be a sufficient quantity of usable material so that quantities are not an issue.

## Slope Stability and Erosion Control

As noted previously in the **Slope Stability** section, there are two aspects to slope stability. The first relates to overall global stability of the slope with respect to mass failure. The second aspect of stability involves erosion potential and is dependent on numerous factors involving grain size distribution, cohesion, moisture content, slope angle, and the velocity of the water or wind on the ground surface. Washoe County requires erosion control of cut and fill slopes 5H:1V or steeper. Slopes between 2.5H:1V and 5H:1V could be stabilized by hydroseeding but altered bedrock slopes do not readily support vegetation. Top soil, turf reinforcement mats and temporary irrigation may be needed. Slopes steeper than 2.5H:1V may require mechanical stabilization on this site since the altered rock decomposes with moisture. The County may accept other methods of stabilization on slopes steeper than 2.5H:1V if it can be shown that the altered rock is stable.

The bottom of existing 2H:1V slopes along the Pyramid Highway will be steepened to 1.5H:1V in order to accommodate the new lanes, specifically the acceleration lane. The Nevada Department of Transportation prefers to avoid rip-rap of slopes that comprise roadside V-ditches because of maintenance issues. Slopes of 1.5H:1V can be stabilized with a heavy turf reinforcement mat, such as Propex Landlok® 450, topsoil, seeding, and temporary irrigation. Slopes steeper than 1.5H:1V would require rip-rap in most cases. Final slope stabilities should be designed by a landscape architect with their design taking precedence over our recommendations.

Dust potential at this site will be moderate during dry periods. Temporary (during construction) and permanent (after construction) erosion control will be required for all disturbed areas. The contractor shall prevent dust from being generated during construction in compliance with all applicable city, county, state, and federal regulations. The contractor shall submit an acceptable dust control plan to the Washoe County District Health Department prior to starting site preparation or earthwork. Project specifications should include an indemnification by the contractor of the owner and engineer for any dust generation during the construction period. The owner will be responsible for mitigation of dust after accepting the project.

In order to minimize erosion and downstream impacts to sedimentation from this site, best management practices with respect to storm water discharge shall be implemented at this site.

## Site Drainage

### Surface Drainage

Adequate surface drainage shall be provided so moisture is directed away from the structure. A system of roof drains and downspouts is recommended to collect roof drainage and direct it well away from the foundations unless pavement extends to the walls. If roof runoff is allowed directly over paver stones, especially where they will be subjected to vehicle loading, rutting of the paver stone system could be experienced due to saturation of the subgrade materials.

If planters are to be located adjacent to foundation areas, they shall be lined and sloped to drain away from the foundation to improve foundation performance. Raised planters bearing directly on pavement would be preferred. Planters are defined as localized landscaped and irrigated areas lying within 10 feet of the building perimeter and confined by decorative structures such as rock, wood, or brick.

The ponding of water on finish grade or at the edge of pavements shall be prevented by grading the site in accordance with *IBC* (ICC, 2012) requirements.

## Portland Cement Concrete Flatwork

All concrete slabs shall be directly underlain Type 2, Class B, aggregate base (*SSPWC*, 2012). The thickness of base material shall be 6 inches beneath curb and gutters, 4 inches beneath sidewalks and 4 inches beneath floor slabs and private flatwork. Aggregate base courses shall be densified to at least 95 percent relative compaction. All exterior concrete flatwork should be underlain by 2.5 feet of structural fill, per Table 10.

The Reno/Sparks area is a region with exceptionally low relative humidity. As a consequence, concrete flatwork is prone to excessive shrinking and curling. Concrete mix proportions and construction techniques, including the addition of water and improper curing, can adversely affect the finished quality of concrete and result in cracking, curling, and spalling of slabs. We recommend that all placement and curing be performed in accordance with procedures outlined by the ACI (2008) and this report. Special considerations shall be given to concrete placed and cured during hot or cold weather temperatures, or low humidity conditions.

Proper control joints and reinforcement shall be provided for conventional floor slabs to minimize any damage resulting from shrinkage as discussed below. In particular, crack-control joints shall be installed on maximum 10-foot-centers and shall be installed to a minimum depth of 25 percent of the slab thickness. Saw-cuts, zip strips, and/or trowel joints are acceptable; however, saw-cut joints must be installed as soon as initial set allows and prior to the development of internal stresses that will result in a random crack pattern. If trowel joints are used, they will need to be grouted over prior to installation of floor coverings.

Rolls of welded wire mesh (WWM) are not recommended for use since vertically centered placement of rolled WWM within a floor slab is difficult to achieve. All reinforcing steel and WWM shall be centered in the floor slab through the use of concrete dobies or approved equivalent. Reinforcement recommendations provided by the project structural engineer will supersede those presented here.

The base layer that overlies the moisture barrier membrane shall remain compacted and a uniform thickness maintained during the concrete pour, as its intended purpose is to facilitate even curing of the concrete and to minimize curling of the slab. Extra attention shall be given during construction to ensure that rebar reinforcement and equipment do not damage the integrity of the vapor barrier. Care must be taken so that concrete discharge does not scour the base material from the vapor barrier. This can be accomplished by maintaining the discharge hose in the concrete and allowing the concrete to flow out over the base layer.

## Private Asphalt Concrete

All asphalt pavement shall be directly underlain by Type 2, Class B, aggregate base (*SSPWC*, 2012). All aggregate base beneath asphalt pavements shall be densified to, at least, 95 percent relative compaction. All structural sections should be underlain by, at least, 2 feet of structural fill, per Table 10.

Asphalt concrete pavements have been designed for a standard 20-year life expectancy with the design assumptions presented under Private Asphalt Concrete Pavement Design. Due to the local climate and available construction aggregates, a 20-year performance life requires diligent maintenance. Between 15 and 20 years after initial construction (average 17 years), major rehabilitation (structural overlay or reconstruction) is often necessary if maintenance has been lax. To achieve maximum performance life, maintenance must include regular crack sealing, seal coats, and patching as needed. Crack filling is commonly necessary every year or at least every other year. Seal coats, typically with a Type II slurry seal, are generally needed every 3 to 6 years, depending on surface wear. Failure to provide thorough maintenance will significantly reduce pavement design life and performance.

## Pyramid Highway Improvements

All construction within the NDOT right-of-way shall conform to NDOT specifications with respect to materials, placement and inspection/testing requirements.

# Anticipated Construction Problems

Depending on the season of construction soft, wet, surface material may make it difficult for construction equipment to travel and operate. Some difficulty will also be encountered in mass grading and trenching due to the presence of altered bedrock of variable hardness.

# Quality Control

All plans and specifications should be reviewed for conformance with this geotechnical report and approved by the engineer prior to submitting them to the building department for review.

The recommendations presented in this report are based on the assumption that sufficient field testing and construction review will be provided during all phases of construction. We should review the final plans and specifications to check for conformance with the intent of our recommendations. Prior to construction, a pre-job conference should be scheduled to include, but not be limited to, the owner, architect, civil engineer, the general contractor, earthwork and materials subcontractors, building official, and engineer. The conference will allow parties to review the project plans, specifications, and recommendations presented in this report and discuss applicable material quality and mix design requirements. All quality control reports should be submitted to and reviewed by the engineer.

During construction, we should have the opportunity to provide sufficient on-site observation of preparation and grading, over-excavation, fill placement, foundation installation, and paving. These observations would allow us to verify that the geotechnical conditions are as anticipated and that the contractor's work is in conformance with the approved plans and specifications.

# Standard Limitations Clause

This report has been prepared in accordance with generally accepted geotechnical practices. The analyses and recommendations submitted are based on field exploration performed at the locations shown on Plate 1 of this report. This report does not reflect soils variations that may become evident during the construction period, at which time re-evaluation of the recommendations may be necessary. We recommend our firm be retained to perform construction observation in all phases of the project related to geotechnical factors to ensure compliance with our recommendations. The owner shall be responsible for distributing this geotechnical investigation to all designers and contractors whose work is related to geotechnical factors.

Equilibrium water level readings were made on the date shown on Plate 2 of this report. Fluctuations in the water table may occur due to rainfall, temperature, seasonal runoff or adjacent irrigation practices. Construction planning should be based on assumptions of possible variations in the water table.

This report has been produced to provide information allowing the architect or engineer to design the project. The owner is responsible for distributing this report to all designers and contractors whose work is affected by geotechnical aspects. In the event there are changes in the design, location, or ownership of the project from the time this report is issued, recommendations should be reviewed and possibly modified by the engineer. If the engineer is not granted the opportunity to make this recommended review, he or she can assume no responsibility for misinterpretation or misapplication of his or her recommendations or their validity in the event changes have been made in the original design concept without his or her prior review. The engineer makes no other warranties, either expressed or implied, as to the professional advice provided under the terms of this agreement and included in this report.

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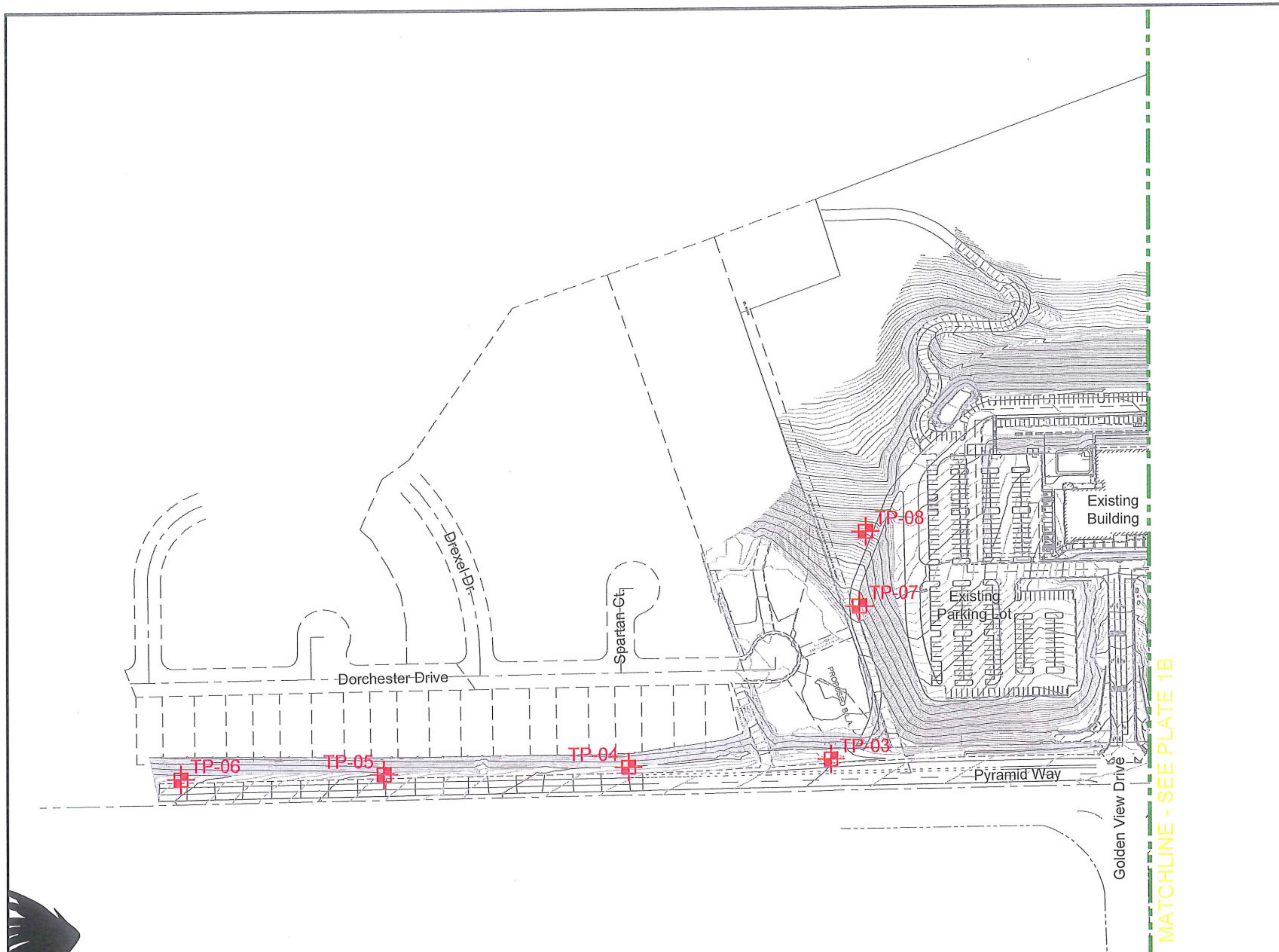
# PLATES




SCALE: 1"=200'
1' CONTOUR INTERVAL

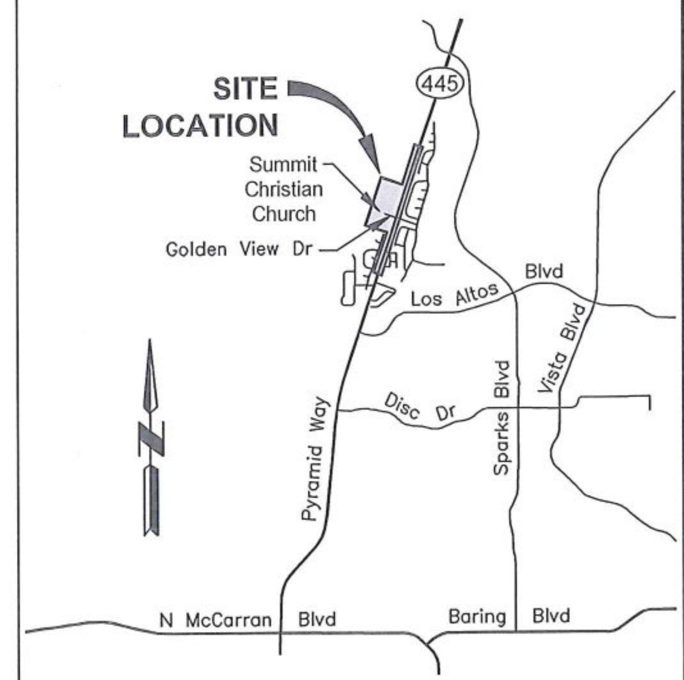
LEGEND

TP-01 APPROXIMATE TEST PIT LOCATION

B-01 APPROXIMATE BORING LOCATION

NOTES

1. BASE MAP PROVIDED BY CFA, INC.




SITE LOCATION MAP
N.T.S.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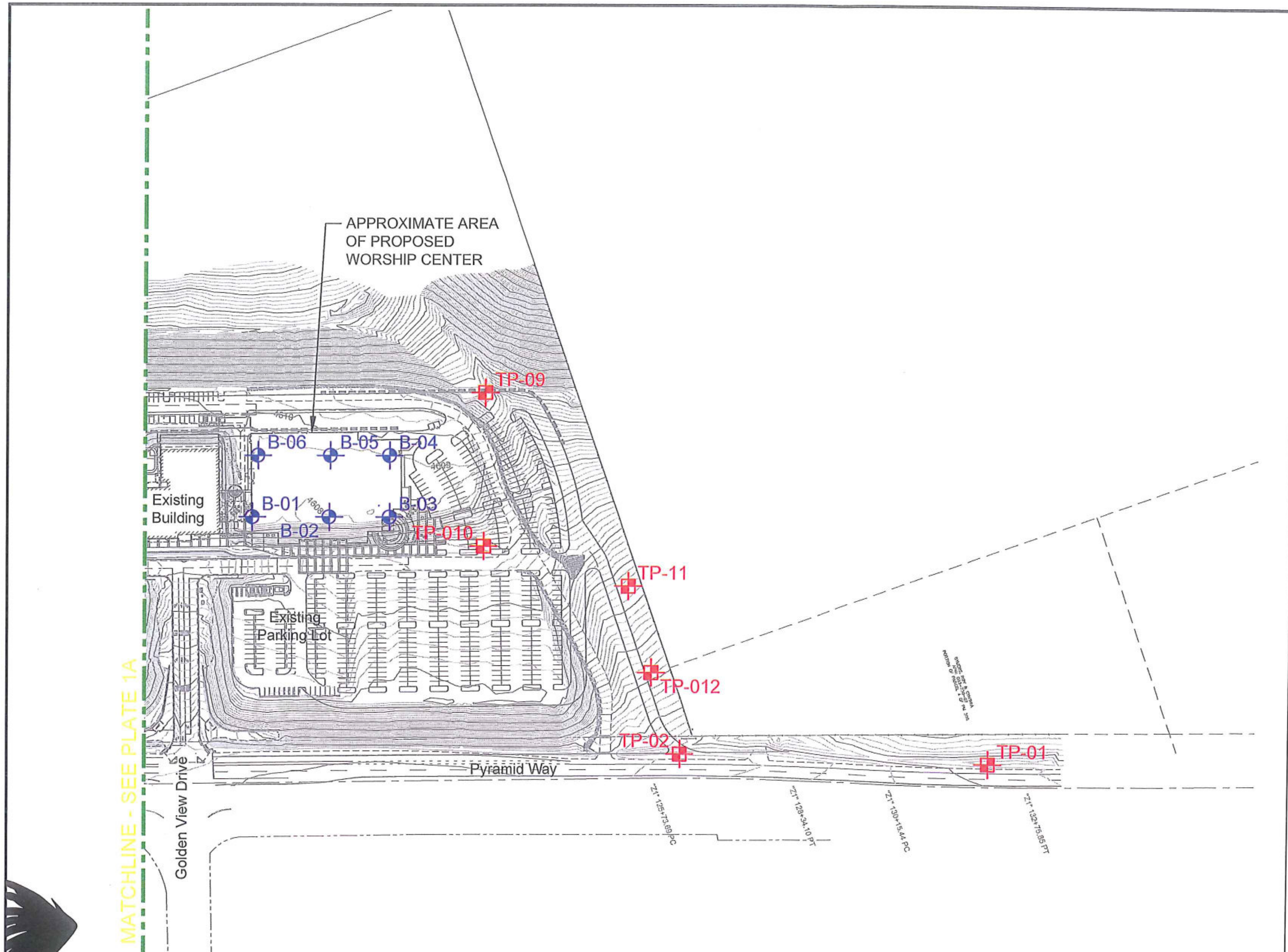
Facsimile: 775/359-7766


SUMMIT CHRISTIAN CHURCH
PLOT PLAN
SUMMIT 2.0
WASHOE COUNTY, NEVADA

Project No.
0412-02-1

Plate 1A




SCALE: 1"=200'
1' CONTOUR INTERVAL

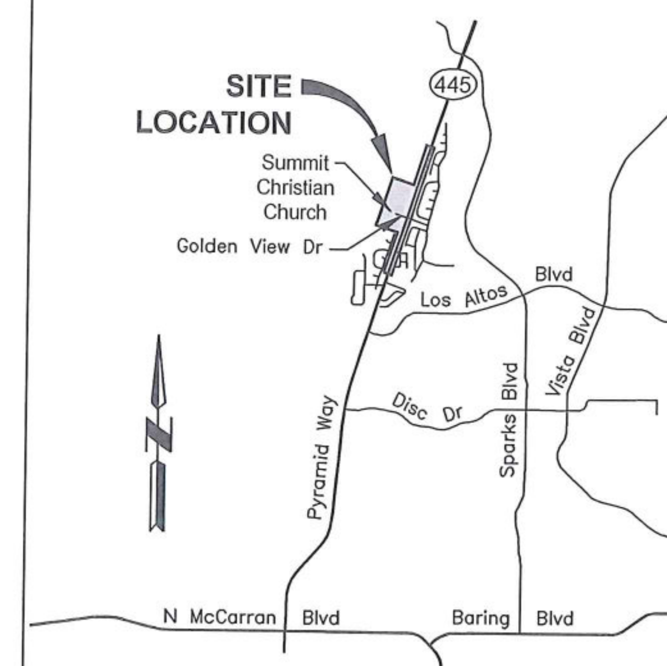
LEGEND

TP-01 APPROXIMATE TEST PIT LOCATION

B-01 APPROXIMATE BORING LOCATION

NOTES

1. BASE MAP PROVIDED BY CFA, INC.




SITE LOCATION MAP
N.T.S.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SUMMIT CHRISTIAN CHURCH

PLOT PLAN

SUMMIT 2.0

WASHOE COUNTY, NEVADA

Project No.
0412-02-1

Plate 1B

# BORING LOG

| | | | |
|---|---|---|---|
| BORING NO.: | B-01 | DATE: | 3/20/2014 |
| TYPE OF RIG: | CME 75 | DEPTH TO GROUND WATER (ft): | NE |
| LOGGED BY: | JW | GROUND ELEVATION (ft): | NA |

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX |
|---|---|---|---|---|
| A | SPT | 54 | | |
| B | SPT | 54 | | |
| C | SPT | 31 | | |
| D | SPT | 24 | | |
| E | SPT | 54 | | |
| F | SPT | 81 | | |
| G | SPT | 50@5.5" | | |
| H | SPT | 36 | 22.5 | 18 |

| USCS SYMBOL | DESCRIPTION |
|---|---|
| GW | **Gravel Surfacing** Approximate 4 to 6-inch-thick layer of gravel and recycled asphalt pavement surfacing throughout area of soil boring. |
| GM | **Silty Gravel with Sand** Brown, moist, very dense, with an estimated 15% non-plastic to low plasticity fines, 35% fine to coarse sand, and 50% angular gravel up to 1 inch in diameter. Fill. |
| SC | **Altered bedrock**excavated as Clayey Sand with Gravel. Light grey with orange, slightly moist, very dense, with an estimated 30% low-plasticity fines, 55% fine to coarse sand, and 15% angular to subangular gravel up to 1 inch in diameter. |
| SC | **Altered bedrock** excavated as Clayey Sand with Gravel. Light grey with orange, slightly moist, very dense, with an estimated 25% low-plasticity fines, 60% fine to coarse sand, and 15% angular to subangular gravel up to 1 inch in diameter. |
| SC | Zone of less **altered bedrock** excavated as Silty Sand with Gravel. Light grey to brown, slightly moist, medium dense, with an estimated 25% low-plasticity fines, 55% fine to coarse sand, and 25% angular to subangular gravel up to 1 inch in diameter. Little recovery from sample tube. Difficult drilling starting at 10.5 feet below the ground surface. |
| SC | Zone of less **altered bedrock** excavated as Silty Sand with Gravel. Light grey to brown, slightly moist, very dense, with an estimated 20% non-plastic to low-plasticity fines, 40% fine to coarse sand, and 40% angular to subangular gravel up to 1 inch in diameter. Difficult drilling, sample contanined mostly crushed rock. |
| SC | **Altered bedrock** excavated as Clayey Sand with Gravel. Grey to light brown with pockets of light purple, slightly moist, very dense, with an estimated 25% medium to high plasticity fines, 40% fine to coarse sand, and 35% angular to subangular gravel up to 1 inch in diameter. Sample contained crushed and altered rock. |
| SC | **Altered bedrock** excavated as Clayey Sand with Gravel. Orange to light brown, slightly moist, very dense, with an estimated 40% medium to high plasticity fines, 35% fine to coarse sand, and 25% angular gravel up to 1 inch in diameter. |
| SM | **Altered bedrock** excavated as Silty Sand. Orange to light brown, slightly moist to moist, dense, with 27% medium plasticity fines, and 73% fine to coarse sand. |

DEPTH (ft): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24

LITHOLOGY

BORING_LOG 0412021.GPJ BLKEAGLE.GDT 4/25/2014

| | | |
|---|---|---|
| Black Eagle Consulting, Inc.<br>1345 Capital Blvd., Suite A<br>Reno, Nevada 89502-7140<br>(775) 359-6600 | **Summit Christian Church**<br>**Summit 2.0**<br>**Sparks, Nevada** | PROJECT NO.: 0412-02-1<br>PLATE: 2<br>SHEET 1 OF 2 |

# BORING LOG

BORING NO.: B-01
TYPE OF RIG: CME 75
LOGGED BY: JW

DATE: 3/20/2014
DEPTH TO GROUND WATER (ft): NE
GROUND ELEVATION (ft): NA

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX | DEPTH (ft) | USCS SYMBOL | LITHOLOGY | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| I | SPT | 74 | | | 26–30 | GC | | Less **altered bedrock** excavated as Clayey Gravel with Sand. Orange to light brown, slightly moist to moist, very dense, with an estimated 20% medium to high plasticity fines, 30% fine to coarse sand, and 40% angular gravel up to 1 inch in diameter. Sample contained crushed rock with pockets of dark brown highly alterered material that had properties of medium to high plasticity clay. |
| J | SPT | 50 | | | 30–31.5 | SC | | Less **altered bedrock** excavated as Clayey Sand with Gravel. Light grey to orange to light brown, slightly moist to moist, very dense, with an estimated 20% medium to high plasticity fines, 40% fine to coarse sand, and 40% angular gravel up to 1 inch in diameter. Sample contained crushed rock with pockets of dark brown highly alterered material that had properties of medium to high plasticity clay. |

Depth scale (ft): 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48




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PROJECT NO.: 0412-02-1
PLATE: 2

# BORING LOG

BORING NO.: B-02 | DATE: 3/20/2014

TYPE OF RIG: CME 75 | DEPTH TO GROUND WATER (ft): NE

LOGGED BY: JW | GROUND ELEVATION (ft): NA

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX |
|---|---|---|---|---|
| A | SPT | 18 | | |
| B | SPT | 18 | | |
| C | SPT | 18 | | |
| D | MC | 33 | | |
| E | SPT | 20 | | |
| F | MC | 38 | | |
| G | SPT | 23 | | |
| H | MC | 49 | | |

| DEPTH (ft) | USCS SYMBOL | DESCRIPTION |
|---|---|---|
| 0–0.5 | GW | **Gravel Surfacing** 3 to 6-inch-thick layer of gravel and recycled asphalt pavement surfacing withing the area of soil boring. |
| 0.5–5 | GM | **Silty Gravel with Sand** Brown, moist, very dense, with an estimated 15% non-plastic to low plasticity fines, 35% fine to coarse sand, and 50% angular gravel up to 1 inch in diameter. Fill. |
| 5–7.5 | CH | **Altered bedrock** sampled as Fat Clay with Sand. Light brownish orange, slightly moist, stiff, with an estimated 60% medium to high plasticity fines, 30% fine to coarse sand, and 10% angular gravel up to 1 inch in diameter. A portion of the gravel and sand particles break down to material with characterisitcs similar to fat clay. |
| 7.5–10 | CH | **Altered bedrock** sampled as Fat Clay with Sand. Tan to orange, slightly moist, very stiff, with an estimated 60% medium to high plasticity fines, 40% fine to coarse sand, and trace amounts angular gravel up to 0.25 inches in diameter. Altered bedrock easily breaks down under mechanical agitation and exposure to moisture. |
| 10–12.5 | CH | **Altered bedrock** sampled as Fat Clay with Sand. Tan to orange, slightly moist, very stiff, with an estimated 55% medium to high plasticity fines and 45% fine to medium sand. Altered bedrock easily breaks down under mechanical agitation and exposure to moisture. |
| 12.5–15 | CH | **Altered bedrock** sampled as Fat Clay with Sand. White to orange, slightly moist, very stiff, with an estimated 65% medium to high plasticity fines and 35% fine to medium sand. Altered bedrock easily breaks down under mechanical agitation and exposure to moisture. |
| 15–20 | CH | **Altered bedrock** sampled as Fat Clay with Sand. White to light brown with streaks of rust coloring, slightly moist, very stiff, with an estimated 55% medium to high plasticity fines and 45% fine to medium sand. Altered bedrock easily breaks down under mechanical agitation and exposure to moisture. |
| 20–25 | CH | **Altered bedrock** sampled as Fat Clay with Sand. Light brown to brown, slightly moist, hard, with an estimated 55% medium to high plasticity fines, 40% fine to coarse sand, and 5% angular gravel up to 0.25 inches in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |

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PROJECT NO.: 0412-02-1

PLATE: 2

# BORING LOG

BORING NO.: B-02
TYPE OF RIG: CME 75
LOGGED BY: JW

DATE: 3/20/2014
DEPTH TO GROUND WATER (ft): NE
GROUND ELEVATION (ft): NA

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX | DEPTH (ft) | USCS SYMBOL | LITHOLOGY | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| I | SPT | 24 | | | 26 | CH | | **Altered bedrock** sampled as Fat Clay with Sand. Light brown to brown, slightly moist, very stiff, with an estimated 55% medium to high plasticity fines and 45% fine to coarse sand. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| | | | | | 28 | | | |
| J | SPT | 29 | | | 30 | | | |
| | | | | | 32 | | | |
| | | | | | 34 | | | |
| | | | | | 36 | | | |
| | | | | | 38 | | | |
| | | | | | 40 | | | |
| | | | | | 42 | | | |
| | | | | | 44 | | | |
| | | | | | 46 | | | |
| | | | | | 48 | | | |

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PROJECT NO.: 0412-02-1
PLATE: 2

# BORING LOG

BORING NO.: B-03
TYPE OF RIG: CME 75
LOGGED BY: JW

DATE: 3/20/2014
DEPTH TO GROUND WATER (ft): NE
GROUND ELEVATION (ft): NA

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX | DEPTH (ft) | USCS SYMBOL | LITHOLOGY | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | | | | 0–2 | SM | | **Silty Sand with Gravel** Grey to brown, slighly moist, very dense, with an estimated 20% non-plastic to low plasticity fines, 50% fine to coarse sand, and 30% angular gravel up to 1 inch in diameter. Fill |
| A | SPT | 51 | | | 2–5 | CH | | **Altered bedrock** sampled as Fat Clay with Sand. Tan to light brown, slightly moist, hard, with an estimated 75% medium to high plasticity fines and 25% fine to medium sand. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| B | SPT | 33 | | | 5–7.5 | CH | | **Altered bedrock** sampled as Sandy Fat Clay. Tan to orange, slightly moist, hard, with an estimated 50% medium to high plasticity fines, 40% fine to coarse sand, and 5% angular gravel up to 0.25 inches in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| C | SPT | 33 | | | 7.5–10 | CH | | **Altered bedrock** sampled as Sandy Fat Clay with Gravel. Grey to tan, slightly moist, hard, with an estimated 55% medium to high plasticity fines, 30% fine to medium sand and 15% angular gravel up to 1 inch in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| D | SPT | 45 | | | 10–12.5 | CH | | **Altered bedrock** sampled as Sandy Fat Clay with Gravel. Tan with streaks of rust coloring, slightly moist, hard, with an estimated 55% medium to high plasticity fines, 30% fine to medium sand, and 15% angular gravel up to 1 inch in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| E | SPT | 25 | | | 12.5–15 | CH | | **Altered bedrock** sampled as Fat Clay with Sand. White to tan with streaks of rust coloring, slightly moist, very stiff, with an estimated 80% medium to high plasticity fines and 20% fine to medium sand. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| F | SPT | 20 | | | 15–17.5 | CH | | **Altered bedrock** sampled as Sandy Fat Clay. White to tan with streaks of rust coloring, slightly moist, very stiff, with an estimated 70% medium to high plasticity fines and 30% fine to medium sand. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| G | SPT | 14 | | | 17.5–22.5 | CH | | **Altered bedrock** sampled as Sandy Fat Clay. White to tan, slightly moist, very stiff becoming stiff, with an estimated 60% medium to high plasticity fines and 40% fine to medium sand. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| H | SPT | 39 | | | | | | |
| I | SPT | 33 | | | 22.5– | CH | | **Altered bedrock** sampled as Fat Clay with Sand. White to tan |

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PROJECT NO.: 0412-02-1
PLATE: 2
SHEET 1 OF 2

# BORING LOG

BORING NO.: B-03 | DATE: 3/20/2014

TYPE OF RIG: CME 75 | DEPTH TO GROUND WATER (ft): NE

LOGGED BY: JW | GROUND ELEVATION (ft): NA

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX | DEPTH (ft) | USCS SYMBOL | LITHOLOGY | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| J | SPT | 58 | | | 26 | | | with, slightly moist, hard, with an estimated 75% medium to high plasticity fines and 25% fine to medium sand. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| K | SPT | 34 | 24.4 | 39 | 28 | SC | | **Altered bedrock** sampled as Clayey Sand. White to tan with streaks of rust coloring, slightly moist, very stiff, with 42% high plasticity fines, and 58% fine to medium sand. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| L | SPT | 37 | | | 30 | | | |
| | | | | | 32 | | | |
| | | | | | 34 | | | |
| | | | | | 36 | | | |
| | | | | | 38 | | | |
| | | | | | 40 | | | |
| | | | | | 42 | | | |
| | | | | | 44 | | | |
| | | | | | 46 | | | |
| | | | | | 48 | | | |



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PROJECT NO.: 0412-02-1

PLATE: 2

# BORING LOG

BORING NO.: B-04

TYPE OF RIG: CME 75

LOGGED BY: JW

DATE: 3/20/2014

DEPTH TO GROUND WATER (ft): NE

GROUND ELEVATION (ft): NA

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX |
|---|---|---|---|---|
| A | SPT | 50@3" | | |
| B | SPT | 26 | | |
| C | SPT | 48 | | |
| D | SPT | 79 | | |
| E | SPT | 65 | | |
| F | SPT | 54 | | |
| G | SPT | 38 | | |
| H | SPT | 72 | | |

DEPTH (ft): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24

USCS SYMBOL: SM, CH, CH, SC, CH, SC, CH, SC, CH

LITHOLOGY

DESCRIPTION

**Silty Sand with Gravel** Grey to brown, slighly moist, very dense, with an estimated 25% non-plastic to low plasticity fines, 45% fine to coarse sand, and 30% angular gravel up to 1 inch in diameter. Fill.

**Altered bedrock** sampled as Sandy Fat Clay. Light grey to light purple, slightly moist, very stiff, with an estimated 60% medium to high plasticity fines, 35% fine to coarse sand, and 5% angular gravel up to 0.25 inches in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture.

**Altered bedrock** sampled as Sandy Fat Clay with Gravel. Grey to tan, slightly moist, very stiff, with an estimated 60% medium to high plasticity fines, 35% fine to medium sand and 5% angular gravel up to 1 inch in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture.

**Altered bedrock** sampled as Clayey Sand. Dark grey to dark purple, slightly moist, dense, with an estimated 45% medium to high plasticity fines, 45% fine to medium sand and 10% angular gravel up to 1 inch in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture.

**Altered bedrock** sampled as Sandy Fat Clay. Light grey to light purple, slightly moist, hard, with an estimated 60% medium to high plasticity fines and 40% fine to medium sand. Altered bedrock breaks down under mechanical agitation and exposure to moisture.

Crushed, **altered bedrock** sampled as Clayey Sand. Dark grey to dark purple, slightly moist, very dense, with an estimated 40% medium to high plasticity fines, 50% fine to medium sand and 10% angular gravel up to 1 inch in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture.

**Altered bedrock** sampled as Sandy Fat Clay. Light grey to purple, slightly moist, hard, with an estimated 55% medium to high plasticity fines and 35% fine to medium sand. Altered bedrock breaks down under mechanical agitation and exposure to moisture.

Crushed, **altered bedrock** sampled as Clayey Sand with Gravel. Dark brown to dark purple, slightly moist, very dense, with an estimated 35% medium to high plasticity fines, 50% fine to coarse sand, and 15% angular gravel up to 1 inch in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture.



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PROJECT NO.: 0412-02-1

PLATE: 2

# BORING LOG

BORING NO.: B-04

DATE: 3/20/2014

TYPE OF RIG: CME 75

DEPTH TO GROUND WATER (ft): NE

LOGGED BY: JW

GROUND ELEVATION (ft): NA

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX | DEPTH (ft) | USCS SYMBOL | LITHOLOGY | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| I | SPT | 20 | | | 26 | CH | | **Altered bedrock** sampled as Sandy Fat Clay. Light grey to purple, slightly moist, hard becoming very stiff, with an estimated 50% medium to high plasticity fines, 45% fine to coarse sand, and 5% angular gravel up to 0.25 inches in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| J | SPT | 40 | | | 28 | | | **Altered bedrock** sampled as Sandy Fat Clay. Light grey to purple, slightly moist, hard, with an estimated 60% medium to high plasticity fines and 40% fine to coarse sand. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| K | SPT | 60 | | | 30 | | | |
| | | | | | 32 | | | |
| | | | | | 34 | | | |
| | | | | | 36 | | | |
| | | | | | 38 | | | |
| | | | | | 40 | | | |
| | | | | | 42 | | | |
| | | | | | 44 | | | |
| | | | | | 46 | | | |
| | | | | | 48 | | | |



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**Sparks, Nevada**

PROJECT NO.: 0412-02-1

PLATE: 2

# BORING LOG

BORING NO.: B-05 | DATE: 3/21/2014

TYPE OF RIG: CME 75 | DEPTH TO GROUND WATER (ft): NE

LOGGED BY: JW | GROUND ELEVATION (ft): NA

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX | DEPTH (ft) | USCS SYMBOL | LITHOLOGY | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | | | | 0 | GW | | **Gravel Surfacing** 3 to 6-inch-thick layer of gravel and recycled asphalt pavement surfacing withing the area of soil boring. |
| | | | | | 2, 4 | GM | | **Silty Gravel with Sand** Brown, moist, very dense, with an estimated 15% non-plastic to low plasticity fines, 35% fine to coarse sand, and 50% angular gravel up to 1 inch in diameter. Fill. |
| A | SPT | 39 | | | 6, 8 | CH | | **Altered bedrock** sampled as Fat Clay with Sand. Light brown with purple, slightly moist, hard, with an estimated 70% medium to high plasticity fines and 30% fine to medium sand. The altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| B | SPT | 90 | | | 10 | SC | | Crushed, **altered bedrock** sampled as Clayey Sand. Brown to purple, slightly moist, very dense, with an estimated 40% medium to high plasticity fines, 50% fine to coarse sand, and 10% angular gravel up to 0.25 inches in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| C | SPT | 50 | | | 12, 14 | SC | | Crushed, **altered bedrock** sampled as Clayey Sand. Dark brown to dark purple, slightly moist, dense, with an estimated 45% medium to high plasticity fines, 50% fine to coarse sand, and 5% angular gravel up to 0.25 inches in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| D | SPT | 33 | | | 16 | SC | | Crushed, **altered bedrock** sampled as Clayey Sand. Dark brown to dark purple, slightly moist, dense, with an estimated 40% medium to high plasticity fines, 60% fine to coarse sand, and trace amounts of angular gravel up to 1 inch in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| E | SPT | 30 | 30.5 | 39 | 18 | | | |
| F | SPT | 36 | | | 20, 22 | SM | | **Altered bedrock** sampled as SIlty Sand. Light brown with purple, slightly moist, hard, with 28% high plasticity fines, and 72% fine to coarse sand. The altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| G | SPT | 30 | | | 24 | | | Crushed, **altered bedrock** sampled as Clayey Sand. Dark brown to grey with yellow specks of coloring, slightly moist, dense to very dense, with an estimated 40% low to medium plasticity fines, 50% fine to coarse sand, and 10% angular gravel up to 0.25 |

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**Sparks, Nevada**

PROJECT NO.: 0412-02-1

PLATE: 2

# BORING LOG

| | | | |
|---|---|---|---|
| BORING NO.: | B-05 | DATE: | 3/21/2014 |
| TYPE OF RIG: | CME 75 | DEPTH TO GROUND WATER (ft): | NE |
| LOGGED BY: | JW | GROUND ELEVATION (ft): | NA |

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX | DEPTH (ft) | USCS SYMBOL | LITHOLOGY | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| H | SPT | 57 | | | 26 | SC | | inches in diameter. Altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| I | SPT | 34 | | | 28 | CH | | **Altered bedrock** sampled as Sandy Fat Clay. Dark brown to light grey and light purple, slightly moist, hard, with an estimated 60% medium to high plasticity fines and 35% fine to coarse sand, and 5% angular gravel up to 0.25 inches in diameter. The altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| J | SPT | 30 | | | 30 | SC | | Crushed, **altered bedrock** sampled as Clayey Sand with Gravel. Grey, slightly moist, dense to very dense, with an estimated 35% low to medium plasticity fines, 40% fine to coarse sand, and 25% angular gravel up to 0.5 inches in diameter. A portion of the altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| | | | | | 32 | | | |
| | | | | | 34 | | | |
| K | SPT | 94 | | | 36 | | | |
| | | | | | 38 | | | |
| L | SPT | 82 | | | 40 | SC | | Crushed, **altered bedrock** sampled as Clayey Sand with Gravel. Grey to dark brown and dark purple, slightly moist, dense to very dense, with an estimated 45% medium plasticity fines, 40% fine to coarse sand, and 15% angular gravel up to 0.5 inches in diameter. A portion of the altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| | | | | | 42 | | | |
| | | | | | 44 | | | |
| M | SPT | 38 | | | 46 | CH | | **Altered bedrock** sampled as Sandy Fat Clay. Dark brown to light grey and light purple, slightly moist, hard, with an estimated 65% medium to high plasticity fines and 30% fine to coarse sand, and 5% angular gravel up to 0.25 inches in diameter. The altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| | | | | | 48 | | | |

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PROJECT NO.: 0412-02-1
PLATE: 2

# BORING LOG

| | | | |
|---|---|---|---|
| BORING NO.: | B-05 | DATE: | 3/21/2014 |
| TYPE OF RIG: | CME 75 | DEPTH TO GROUND WATER (ft): | NE |
| LOGGED BY: | JW | GROUND ELEVATION (ft): | NA |

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX | DEPTH (ft) | USCS SYMBOL | LITHOLOGY | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| N | SPT | 63 | | | | | | |
| | | | | | 52 | | | |
| | | | | | 54 | | | |
| | | | | | 56 | | | |
| | | | | | 58 | | | |
| | | | | | 60 | | | |
| | | | | | 62 | | | |
| | | | | | 64 | | | |
| | | | | | 66 | | | |
| | | | | | 68 | | | |
| | | | | | 70 | | | |
| | | | | | 72 | | | |
| | | | | | 74 | | | |



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PROJECT NO.: 0412-02-1

PLATE: 2

# BORING LOG

| | | | |
|---|---|---|---|
| BORING NO.: | B-06 | DATE: | 3/21/2014 |
| TYPE OF RIG: | CME 75 | DEPTH TO GROUND WATER (ft): | NE |
| LOGGED BY: | JW | GROUND ELEVATION (ft): | NA |

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX | DEPTH (ft) | USCS SYMBOL | LITHOLOGY | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | | | | 0 | GW | | **Gravel Surfacing** 3 to 6-inch-thick layer of gravel and recycled asphalt pavement surfacing withing the area of soil boring. |
| | | | | | 2 | GM | | **Silty Gravel with Sand** Brown, moist, very dense, with an estimated 15% non-plastic to low plasticity fines, 35% fine to coarse sand, and 50% angular gravel up to 1 inch in diameter. Fill. |
| A | SPT | 25 | | | 4–8 | CH | | **Altered bedrock** sampled as Fat Clay with Sand. Light brown to light purple, slightly moist, very stiff, with an estimated 70% medium to high plasticity fines and 30% fine to coarse sand. The altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| B | SPT | 17 | | | 8–12.5 | CH | | **Altered bedrock** sampled as Sandy Fat Clay. Dark brown to dark purple, slightly moist, very stiff to hard, with an estimated 50% medium to high plasticity fines and 40% fine to coarse sand, and 10% angular gravel up to 0.5 inches in diameter. The altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| C | SPT | 43 | | | | | | |
| D | SPT | 37 | | | 12.5–15 | CH | | **Altered bedrock** sampled as Sandy Fat Clay. Grey, slightly moist, very stiff to hard, with an estimated 60% medium to high plasticity fines and 40% fine to coarse sand, and trace amounts of angular gravel up to 0.25 inches in diameter. The altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| E | SPT | 33 | | | 15–20 | CH | | **Altered bedrock** sampled as Fat Clay with Sand. Dark brown to dark purple, slightly moist, hard, with an estimated 70% medium to high plasticity fines and 30% fine to coarse sand. The altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| F | MC | 54 | | | | | | |
| G | SPT | 36 | | | 20–22.5 | SM | | **Altered bedrock** sampled as Silty Sand. Dark brown to dark grey, slightly moist, hard, with 38% high plasticity fines, and 62% fine to coarse sand. The altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| H | MC | 71 | 31.1 | 25 | 22.5– | | | **Altered bedrock** sampled as Sandy Fat Clay. Grey to light purple with streaks of orange, black, and rust coloring. Slightly moist, hard, with an estimated 60% medium to high plasticity fines and 40% fine to coarse sand, and trace amounts of angular |


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PROJECT NO.: 0412-02-1

PLATE: 2

# BORING LOG

| | | | |
|---|---|---|---|
| BORING NO.: | B-06 | DATE: | 3/21/2014 |
| TYPE OF RIG: | CME 75 | DEPTH TO GROUND WATER (ft): | NE |
| LOGGED BY: | JW | GROUND ELEVATION (ft): | NA |

| SAMPLE NO. | SAMPLE TYPE | BLOWS/12 inches | MOISTURE (%) | PLASTICITY INDEX | DEPTH (ft) | USCS SYMBOL | LITHOLOGY | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| I | SPT | 33 | | | 26 | CH | | gravel up to 0.25 inches in diameter. The altered bedrock breaks down under mechanical agitation and exposure to moisture. |
| J | MC | 66 | | | 28 | | | |
| K | SPT | 55 | | | 30 | | | |
| | | | | | 32 | | | |
| | | | | | 34 | | | |
| | | | | | 36 | | | |
| | | | | | 38 | | | |
| | | | | | 40 | | | |
| | | | | | 42 | | | |
| | | | | | 44 | | | |
| | | | | | 46 | | | |
| | | | | | 48 | | | |

BORING_LOG 0412021.GPJ BLKEAGLE.GDT 4/25/2014

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PROJECT NO.: 0412-02-1

PLATE: 2

# LOG OF TEST PIT TP-01

Date Excavated: 3/13/2014 Logged by: MW

Equipment: Cat 430 D Surface Elevation (ft) NA

Depth to Ground Water: NE
Comments: N 4386689 E 264981 UTM NAD83

| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | | | | SP-SM | **Poorly Graded Sand with Silt and Gravel** Dark grayish-brown, moist, medium dense, with an estimated 10% non-plastic fines, 50% fine to coarse sand, and 40% rounded to angular gravel up to 2 inches in diameter. This layer contains pieces of broken asphalt. Fill layer. |
| B | | | 21.3 | 38 | 5 | CH | **Fat Clay with Sand** Brown, moist, stiff, with 77% high plasticity fines, 21% fine to coarse sand, and 2% subangular gravel up to 3 inches in diameter. Bulk sample. |
| | | | | | 10 | | |

# LOG OF TEST PIT TP-02

Date Excavated: 3/13/2014 Logged by: MW

Equipment: Cat 430 D Surface Elevation (ft) NA

Depth to Ground Water: NE
Comments: N 4386549 E 264925 UTM NAD83

| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | | | | GP-GM | **Poorly Graded Gravel with Silt and Sand** Dark grayish-brown, moist, medium dense, with an estimated 10% non-plastic fines, 40% fine to coarse sand, and 50% rounded to angular gravel up to 2 inches in diameter. This layer contains pieces of broken asphalt. Fill layer. |
| B | | | | | 5 | SC | **Clayey Sand with Gravel** Brown, moist, medium dense with an estimated 40% medium plasticity fines, 40% fine to coarse sand, and 20% rounded to subangular gravel up to 3 inches in diameter. This layer contains cobbles and boulders up to 1.5 feet in diameter accounting for 10%of the total soil mass (tsm) [with the majority between 3-6 inches in diameter]. |
| | | | | | 10 | | |

BEC-TP1 0412021.GPJ LAGNNN07.GDT 4/28/2014

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# LOG OF TEST PIT TP-03

Date Excavated: 3/13/2014 | Logged by: MW

Equipment: Cat 430 D | Surface Elevation (ft) NA

Depth to Ground Water: NE
Comments: N 4386105 E 264756 UTM NAD83

| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | | | | GP-GM | **Poorly Graded Gravel with Silt and Sand** Dark grayish-brown, moist, medium dense, with an estimated 10% non-plastic fines, 30% fine to coarse sand, and 60% rounded to angular gravel up to 2 inches in diameter. This layer contains pieces of broken asphalt. Fill layer. Bulk sample. |
| B | | | 26.7 | 38 | 5 | CH | **Sandy Fat Clay** Brown, moist, firm to stiff, with 76% high plasticity fines, 20% fine to coarse sand, and 4% rounded to subangular graqvel up to 2 inches in diameter. Pocket penetrometer reading of 1.67 tons per square foot (tsf). Bulk sample. |
| | | | | | 10 | | |

# LOG OF TEST PIT TP-04

Date Excavated: 3/13/2014 | Logged by: MW

Equipment: Cat 430 D | Surface Elevation (ft) NA

Depth to Ground Water: NE
Comments: N 4385998 E 264718 UTM NAD83

| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | | | | GP-GM | **Poorly Graded Gravel with Silt and Sand** Dark grayish-brown, moist, medium dense, with an estimated 10% non-plastic fines, 30% fine to coarse sand, and 60% rounded to angular gravel up to 3 inches in diameter. This layer contains pieces of broken asphalt. Fill layer. |
| B | | | | | | GM | **Silty Gravel with Sand** Brown, slightly moist, medium dense, with an estimated 20% non-plastic fines, 30% fine to coarse sand, and 50% angular gravel up to 3 inches in diameter. This layer contains cobbles and boulders up to 1.5 feet in diameter accounting for 20% of the tsm (with the majority between 6-9 inches in diameter). Bulk sample. |
| C | | | | | 5 | SC | **Clayey Sand with Gravel** Brown, slightly most, dense, with an estimated 25% low plasticity fines, 45% fine to coarse sand, and 30% rounded to angular gravel up to 3 inches in diameter. This layer contains cobbles up to 8 inches in diameter accounting for 5% of the tsm (with the majority between 3-6 inches in diameter). |
| | | | | | 10 | | |



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# LOG OF TEST PIT TP-05

Date Excavated: 3/13/2014 | Logged by: MW

Equipment: Cat 430 D | Surface Elevation (ft) NA

Depth to Ground Water: NE
Comments: N 4285849 E 264663 UTM NAD83

| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | | | | GP-GM | **Poorly Graded Gravel with Silt and Sand** Dark grayish-brown, moist, medium dense, with an estimated 10% non-plastic fines, 30% fine to coarse sand, and 60% rounded to angular gravel up to 3 inches in diameter. This layer contains pieces of broken asphalt. Fill layer. |
| B | | | 16.4 | 21 | 5 | SC | **Clayey Sand with Gravel** Brown, slightly most, medium dense to dense, with 29% medium plasticity fines, 44% fine to coarse sand, and 27% rounded to angular gravel up to 3 inches in diameter. This layer contains cobbles up to 8 inches in diameter accounting for 5% of the tsm (with the majority between 3-6 inches in diameter). Bulk sample. |
| | | | | | 10 | | |

# LOG OF TEST PIT TP-06

Date Excavated: 3/13/2014 | Logged by: MW

Equipment: Cat 430 D | Surface Elevation (ft) NA

Depth to Ground Water: NE
Comments: N 4385751 E 264629 UTM NAD83

| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | | | | GP-GM | **Poorly Graded Gravel with Silt and Sand** Dark grayish-brown, moist, medium dense, with an estimated 10% non-plastic fines, 30% fine to coarse sand, and 60% rounded to angular gravel up to 3 inches in diameter. This layer contains pieces of broken asphalt. Fill layer. |
| B | | | | | 5 | GM | **Silty Gravel with Sand** Brown, slightly moist, medium dense to dense, with an estimated 20% non-plastic fines, 30% fine to coarse sand, and 50% angular gravel up to 3 inches in diameter. This layer contains cobbles and boulders up to 1.25 feet in diameter accounting for 20% of the tsm (with the majority between 6-9 inches in diameter). |
| | | | | | 10 | | |



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# LOG OF TEST PIT TP-07

Date Excavated: 3/13/2014 | Logged by: MW

Equipment: Cat 430 D | Surface Elevation (ft) NA

Depth to Ground Water: NE
Comments: N 4386057 E 264676 UTM NAD83

| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | 13.1 | 35 | 0–5 | CH | **Sandy Fat Clay** Brown, slightly moist, stiff to very stiff, with 57% high plasticity fines, 32% fine to coarse sand, and 11% subrounded to angular gravel up to 3 inches in diameter. This layer contains cobbles up to 12 inches in diameter accounting for 5% of the tsm (with the majority between 6-9 inches in diameter). Bulk sample. |
| B | | | | | 10 | GC | Encountered a layer of **altered bedreock** that was excavated as a Clayey Gravel with Sand and is described as being brown with white, slightly moist, dense to very dense, with an estimated 30% medium plasticity fines, 20% fine to coarse sand, and 50% angular gravel up to 3 inches in diameter. This layer contains cobbles up to 12 inches in diameter accounting for 20% of the tsm (with the majority between 3-6 inches in diameter). Digging refusal was encountered at a depth of 8 feet due to the density of the bedrock material. |

# LOG OF TEST PIT TP-08

Date Excavated: 3/13/2014 | Logged by: MW

Equipment: Cat 430 D | Surface Elevation (ft) NA

Depth to Ground Water: NE
Comments: N 4386176 E 264639 UTM NAD83

| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | | | | SC | **Clayey Sand** Brown, slightly moist, loose, with an estimated 40% medium plasticity fines, 50% fine to coarse sand, and 10% subrounded to angular gravel up to 3 inches in diameter. This layer contains a small amount of fine roots. |
| B | | | | | 5 | GC | Encountered a layer of **altered bedrock** that was excavated as a Clayey Gravel with Sand and is described as being light gray, slightly moist, dense to very dense, with an estimated 20% low plasticity fines, 30% fine to coarse sand, and 50% angular gravel up to 3 inches in diameter. This layer contains cobbles and boulders up to 2 feet in diameter accounting for 50% of the tsm. Bulk sample. |
| C | | | | | 10 | GC | Encountered a layer of **altered bedrock** material that was excavated as a Clayey Gravel with Sand and is described as being light grayish-brown, slightly moist, very dense, with an estimated 25% low to medium plasticity fines, 40% fine to coarse sand, 45% angular gravel up to 3 inches in diameter. This layer contains cobbles up to 9 inches in diameter accounting for 20% of the tsm (with the majority between 3-6 inches in diameter). |



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**Sparks, Nevada 0412-02-1 Plate 2**

# LOG OF TEST PIT TP-09

Date Excavated: 3/13/2014 | Logged by: MW

Equipment: Cat 430 D | Surface Elevation (ft) NA

Depth to Ground Water: NE
Comments: N 4386509 E 264679 UTM NAD83

| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | | | | SC | **Clayey Sand** Dark brown, slightly moist, loose to medium dense, with an estimated 40% low plasticity fines, 50% fine to coarse sand, and 10% angular gravel up to 3 inches in diameter. This layer contains cobbles and boulders up to 2.5 feet in diameter accting for 10% of the tsm (with the majority between 1.5-2.5 feet in diameter). |
| B | | | 32.2 | 104 | 5<br>10 | CH | **Fat Clay** White, yellow, gray, orange, purple, and brown, slightly moist, stiff to very stiff, with 90% high plasticity fines, and 10% fine sand. This layer is characterized by irregular color veining and material with a waxy texture. **Altered bedrock** was encountered at a depth of 9 feet in the uphill side of the test pit and slopped at a constant angle to a depth of 12 feet in at the downhill side of the test pit where digging refusal was encountered. Pocket penetrometer reading of 3.67 tsf. Bulk sample and ring sample taken at 3.5 feet. |

# LOG OF TEST PIT TP-10

Date Excavated: 3/13/2014 | Logged by: MW

Equipment: Cat 430 D | Surface Elevation (ft) NA

Depth to Ground Water: NE
Comments: N 4386472 E 264767 UTM NAD83

| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | | | | CH | **Sandy Fat Clay** Dark brown, slightly moist, stiff to very stiff, with an estimated 70% high plasticity fines, and 30% fine sand. Pocket penetrometer reading of 4.5 tsf. |
| B | | | | | 5 | SC | **Clayey Sand with Gravel** Brown, slightly moist, dense to very dense, with an estimated 35% medium plasticity fines, 35% fine to coarse sand, and 30% subrounded to angular gravel up to 3 inches in diameter. This layer contains cobbles up to 12 inches in diameter accounting for 15% of the tsm (with the majority between 3-6 inches in diameter). |
| | | | | | 10 | | |

BEC-TP1 0412021.GPJ LAGNNN07.GDT 4/28/2014

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## LOG OF TEST PIT TP-11

Date Excavated: 3/13/2014 Logged by: MW

Equipment: Cat 430 D Surface Elevation (ft) NA

Depth to Ground Water: NE

Comments: N 4386529 E 264812 UTM NAD83

| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | | | 5 | GC | **Clayey Gravel with Sand** Dark brown to brown, moist to slightly moist, medium dense to very dense with an estimated 25% low plasticity fines, 35% fine to coarse sand, and 40% angular gravel up to 3 inches in diameter. This layer contains cobbles and boulders up to 2 feet in diameter accounting for 20% of the tsm (with the majority between 3-6 inches in diameter). Digging refusal encountered at a depth of 8 feet due to a large boulder or bedrock material. Bulk sample. |
| | | | | | 10 | | |

## LOG OF TEST PIT TP-12

Date Excavated: 3/13/2014 Logged by: MW

Equipment: Cat 430 D Surface Elevation (ft) NA

Depth to Ground Water: NE

Comments: N 4386529 E 264866 UTM NAD83

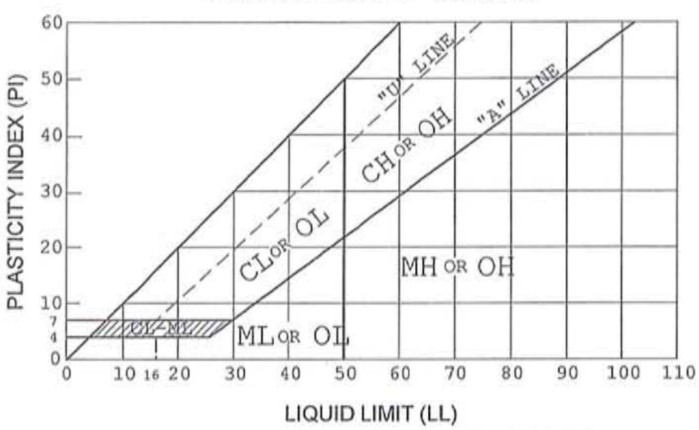
| SAMPLE NUMBER | SAMPLE | POCKET PEN. (tsf) | MOISTURE (%) | PI | DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| A | | | | | | SC | **Clayey Sand with Gravel** Dark brown, moist, loose to medium dense, with an estimated 40% medium plasticity fines, 35% fine to coarse sand, and 25% angular gravel up to 3 inches in diameter. This layer contains cobbles up to 6 inches in diameter accounting for less than 5% of the tsm. Bulk sample. |
| B | | | | | 5 | GC | **Clayey Gravel with Sand** Brown, slightly moist, dense to very dense, with an estimted 25% low plasticity fines, 35% fine to coarse sand, and 40% angular gravel up to 3 inches in diameter. This layer contains cobbles and boulders up to 15 inches in diameter accounting for 20% of the tsm (with the majority between 3-6 inches in diameter). Digging refusal ancountered at a depth of 7.5 feet due to a large boulder or bedrock material. |
| | | | | | 10 | | |

# SOIL CLASSIFICATION CHART

| MAJOR DIVISIONS | | | SYMBOLS GRAPH | SYMBOLS LETTER | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS<br>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | GRAVEL AND GRAVELLY SOILS<br>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | CLEAN GRAVELS (LITTLE OR NO FINES) | | GW | WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | | | GP | POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES) | | GM | SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES |
| | | | | GC | CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES |
| | SAND AND SANDY SOILS<br>MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE | CLEAN SANDS (LITTLE OR NO FINES) | | SW | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | | | SP | POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES |
| | | SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES) | | SM | SILTY SANDS, SAND - SILT MIXTURES |
| | | | | SC | CLAYEY SANDS, SAND - CLAY MIXTURES |
| FINE GRAINED SOILS<br>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE | SILTS AND CLAYS | LIQUID LIMIT LESS THAN 50 | | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | | | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | | | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| | SILTS AND CLAYS | LIQUID LIMIT GREATER THAN 50 | | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS |
| | | | | CH | INORGANIC CLAYS OF HIGH PLASTICITY |
| | | | | OH | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS |
| HIGHLY ORGANIC SOILS | | | | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |
| FILL MATERIAL | | | | -- | FILL MATERIAL, NON-NATIVE |

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

# PLASTICITY CHART




FOR CLASSIFICATION OF FINE-GRAINED SOILS AND FINE-GRAINED FRACTION OF COARSE-GRAINED SOILS

## EXPLORATION SAMPLE TERMINOLOGY

| Sample Type | Sample Symbol | Sample Code |
|---|---|---|
| Auger Cuttings | | Auger |
| Bulk (Grab) Sample | | Grab |
| Modified California Sampler | | MC |
| Shelby Tube | | SH or ST |
| Standard Penetration Test | | SPT |
| Split Spoon | | SS |
| No Sample | | |

## GRAIN SIZE TERMINOLOGY

| Component of Sample | Size Range |
|---|---|
| Boulders | Over 12 in. (300mm) |
| Cobbles | 12 in. to 3 in. (300mm to 75mm) |
| Gravel | 3 in. to #4 sieve (75mm to 2mm) |
| Sand | # 4 to #200 sieve (2mm to 0.074mm) |
| Silt or Clay | Passing #200 sieve (0.074mm) |

## RELATIVE DENSITY OF GRANULAR SOILS

| N - Blows/ft | Relative Density |
|---|---|
| 0 - 4 | Very Loose |
| 5 - 10 | Loose |
| 11 - 30 | Medium Dense |
| 31 - 50 | Dense |
| greater than 50 | Very Dense |

## CONSISTENCY OF COHESIVE SOILS

| Unconfined Compressive Strength, psf | N - Blows/ft | Consistency |
|---|---|---|
| less than 500 | 0 - 1 | Very Soft |
| 500 - 1,000 | 2 - 4 | Soft |
| 1,000 - 2,000 | 5 - 8 | Firm |
| 2,000 - 4,000 | 9 - 15 | Stiff |
| 4,000 - 8,000 | 16 - 30 | Very Stiff |
| 8,000 - 16,000 | 31 - 60 | Hard |
| greater than 16,000 | greater than 60 | Very Hard |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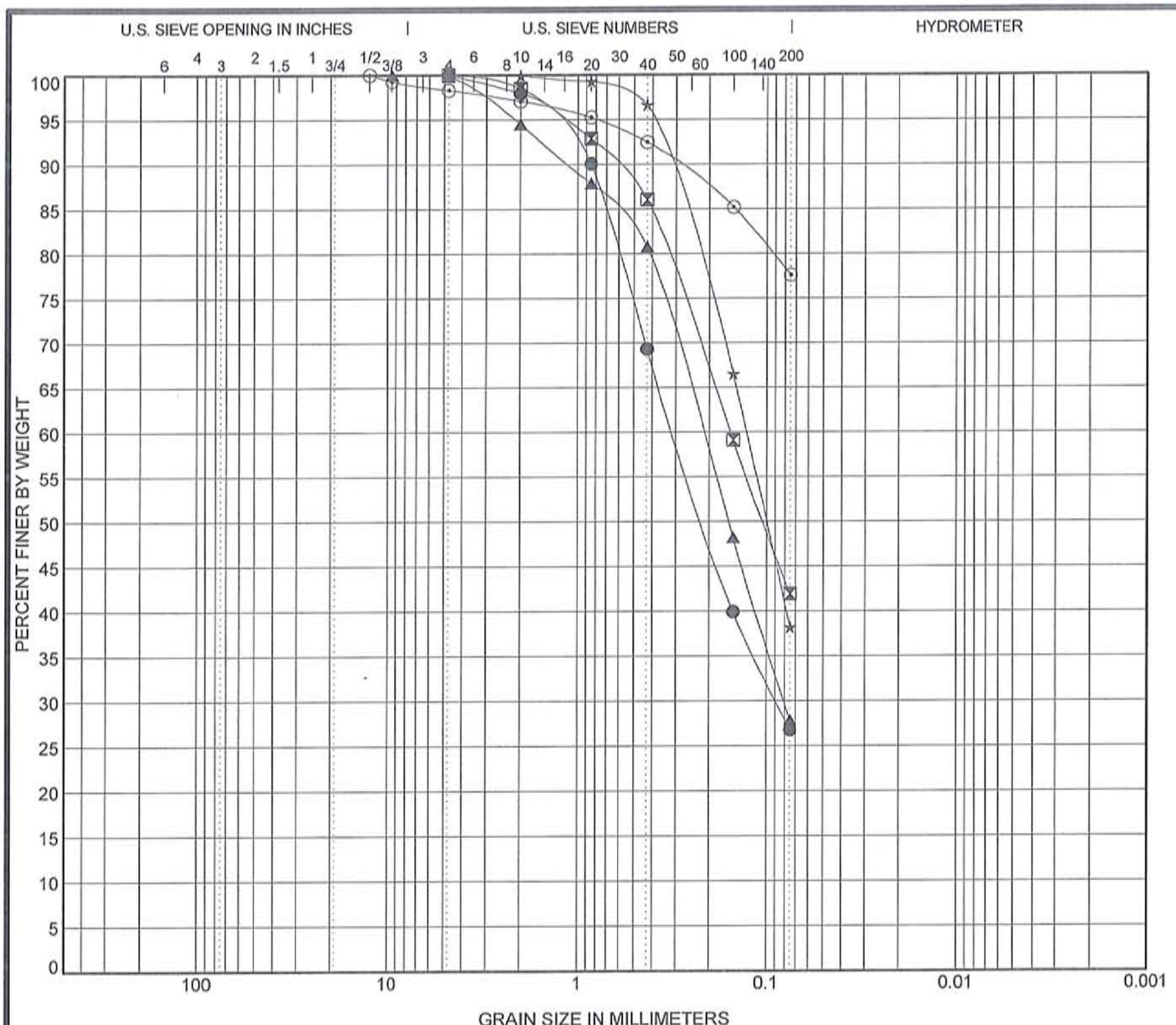
## USCS Soil Classification Chart

Project: Summit 2.0
Location: Sparks, Nevada
Project Number: 0412-02-1 Plate: 3




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen Identification | | USCS Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● B-01 | 20.0' | SILTY SAND (SM) | 45 | 27 | 18 | | |
| ⊠ B-03 | 27.5' | CLAYEY SAND (SC) | 69 | 30 | 39 | | |
| ▲ B-05 | 17.5' | SILTY SAND (SM) | 75 | 36 | 39 | | |
| ★ B-06 | 22.5' | SILTY SAND (SM) | 61 | 36 | 25 | | |
| ⊙ TP-01 | 0.8' | FAT CLAY with SAND (CH) | 71 | 33 | 38 | | |

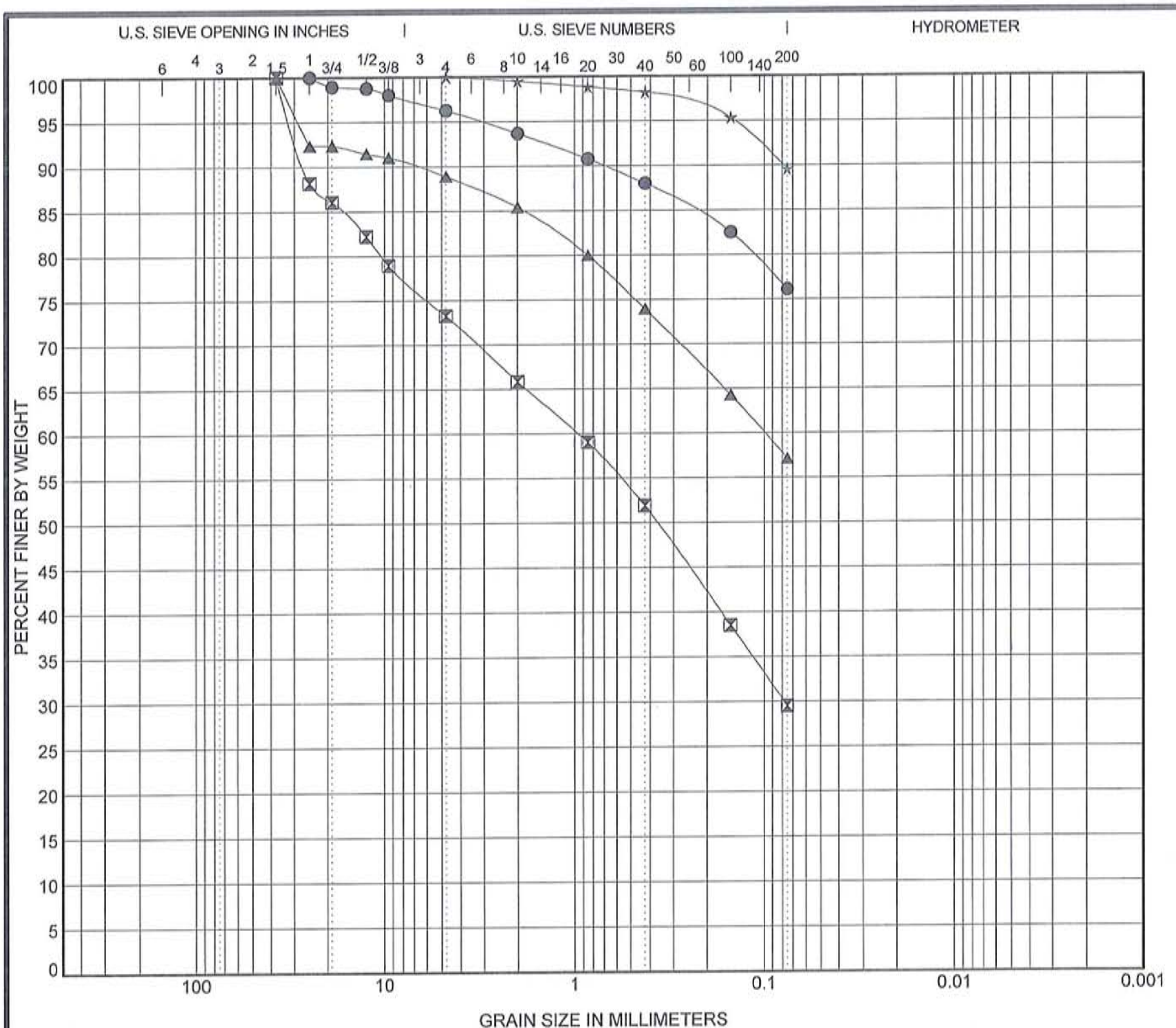
| Specimen Identification | | D100 | D60 | D30 | D10 | MC % | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|
| ● B-01 | 20.0' | 4.75 | 0.305 | 0.089 | | 22.5 | 0.0 | 73.2 | 26.8 | |
| ⊠ B-03 | 27.5' | 4.75 | 0.155 | | | 24.4 | 0.0 | 58.1 | 41.9 | |
| ▲ B-05 | 17.5' | 9.5 | 0.219 | 0.081 | | 30.5 | 0.2 | 72.0 | 27.9 | |
| ★ B-06 | 22.5' | 4.75 | 0.128 | | | 31.1 | 0.0 | 61.8 | 38.2 | |
| ⊙ TP-01 | 0.8' | 12.5 | | | | 21.3 | 1.7 | 20.7 | 77.6 | |

Black Eagle Consulting, Inc.
1345 Capital Blvd., Suite A
Reno, Nevada 89502-7140
Telephone: (775) 359-6600
Fax: (775) 359-7766

# GRAIN SIZE DISTRIBUTION

Project: Summit 2.0
Location: Sparks, Nevada
Project Number: 0412-02-1 Plate: 4a

US_GRAIN_SIZE2 0412021.GPJ US_LAB.GDT 3/31/2014




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen Identification | | | USCS Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | TP-03 | 0.8' | FAT CLAY with SAND (CH) | 62 | 24 | 38 | | |
| ⊠ | TP-05 | 1.0' | CLAYEY SAND with GRAVEL (SC) | 46 | 25 | 21 | | |
| ▲ | TP-07 | 0.0' | SANDY FAT CLAY (CH) | 56 | 21 | 35 | | |
| ★ | TP-09 | 2.5' | FAT CLAY (CH) | 143 | 39 | 104 | | |

| Specimen Identification | | | D100 | D60 | D30 | D10 | MC % | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | TP-03 | 0.8' | 25 | | | | 26.7 | 3.7 | 20.2 | 76.1 | |
| ⊠ | TP-05 | 1.0' | 37.5 | 0.961 | 0.078 | | 16.4 | 26.7 | 43.7 | 29.5 | |
| ▲ | TP-07 | 0.0' | 37.5 | 0.099 | | | 13.1 | 11.1 | 31.8 | 57.1 | |
| ★ | TP-09 | 2.5' | 4.75 | | | | 32.2 | 0.0 | 10.4 | 89.6 | |

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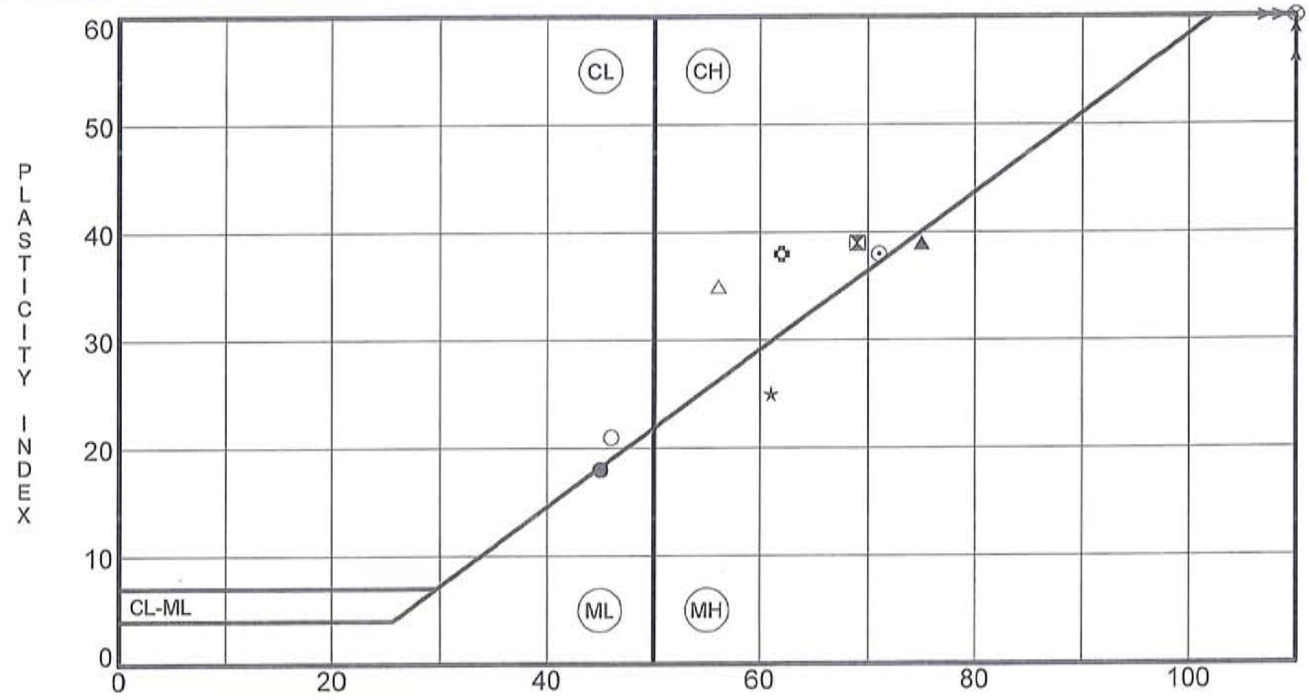
## GRAIN SIZE DISTRIBUTION

Project: Summit 2.0
Location: Sparks, Nevada
Project Number: 0412-02-1 Plate: 4b




Specimen Depth in Feet.

| | Specimen Identification | | | LL | PL | PI | Fines | USCS Classification |
|---|---|---|---|---|---|---|---|---|
| ● | B-01 | H | 20.0' | 45 | 27 | 18 | 27 | SILTY SAND (SM) |
| ⊠ | B-03 | K | 27.5' | 69 | 30 | 39 | 42 | CLAYEY SAND (SC) |
| ▲ | B-05 | E | 17.5' | 75 | 36 | 39 | 28 | SILTY SAND (SM) |
| ★ | B-06 | H | 22.5' | 61 | 36 | 25 | 38 | SILTY SAND (SM) |
| ⊙ | TP-01 | B | 0.8' | 71 | 33 | 38 | 78 | FAT CLAY with SAND (CH) |
| ✪ | TP-03 | B | 0.8' | 62 | 24 | 38 | 76 | FAT CLAY with SAND (CH) |
| ○ | TP-05 | B | 1.0' | 46 | 25 | 21 | 30 | CLAYEY SAND with GRAVEL (SC) |
| △ | TP-07 | A | 0.0' | 56 | 21 | 35 | 57 | SANDY FAT CLAY (CH) |
| ⊗ | TP-09 | B | 2.5' | 143 | 39 | 104 | 90 | FAT CLAY (CH) |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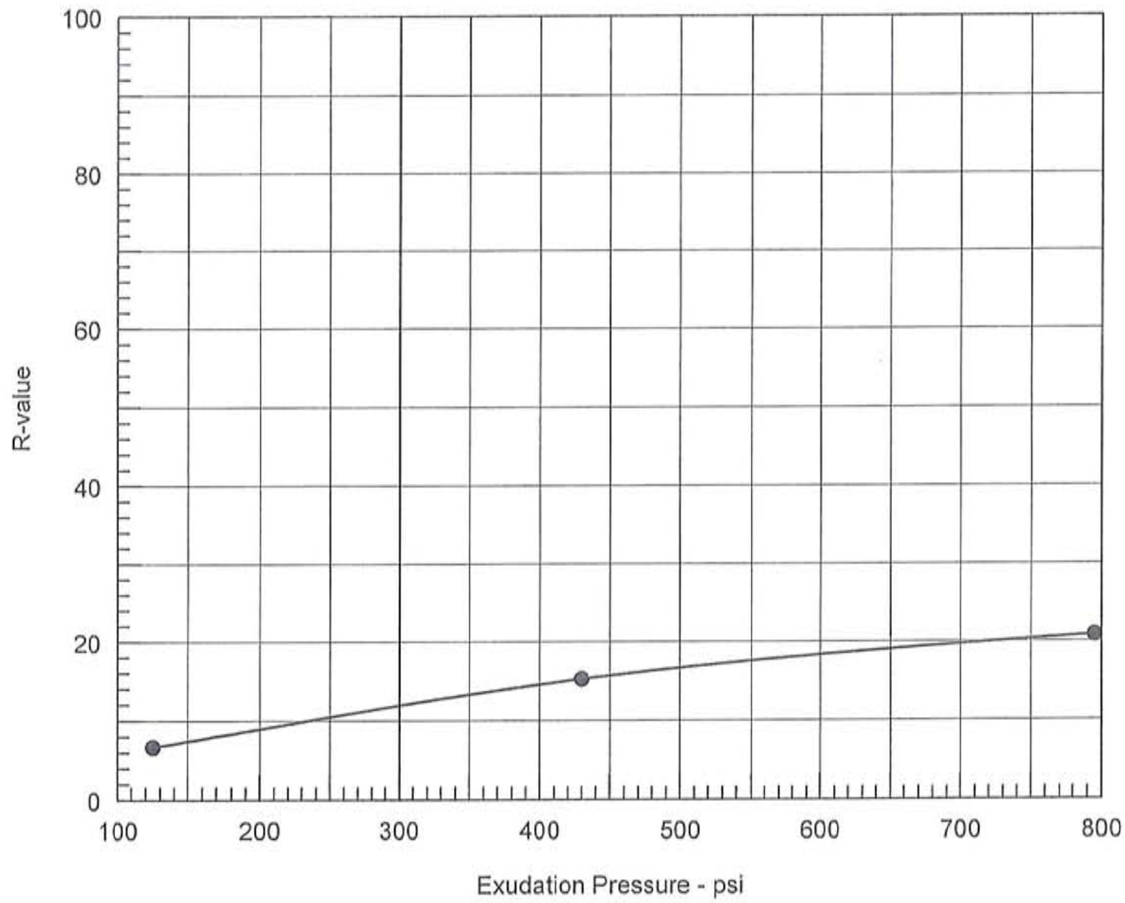
## ATTERBERG LIMITS RESULTS

Project: Summit 2.0
Location: Sparks, Nevada
Project Number: 0412-02-1 Plate: 4c

# R-VALUE TEST REPORT




**Resistance R-Value and Expansion Pressure - ASTM D 2844**

| No. | Compact. Pressure psi | Density pcf | Moist. % | Expansion Pressure psi | Horizontal Press. psi @ 160 psi | Sample Height in. | Exud. Pressure psi | R Value | R Value Corr. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 130 | 90.4 | 30.9 | 0.76 | 110 | 2.45 | 795 | 21 | 21 |
| 2 | 100 | 88.1 | 31.6 | 0.45 | 120 | 2.50 | 430 | 15 | 15 |
| 3 | 50 | 86.5 | 32.8 | 0.15 | 140 | 2.52 | 125 | 7 | 7 |
| | | | | | | | | | |

| Test Results | Material Description |
|---|---|
| **R-value at 300 psi exudation pressure =** 12 | Fat Clay with Sand |

**Project No.:** 0412-02-1
**Project:** Summit 2.0
**Source of Sample:** TP-01 **Depth:** 0.75'
**Sample Number:** B
**Date:** 3/20/2014

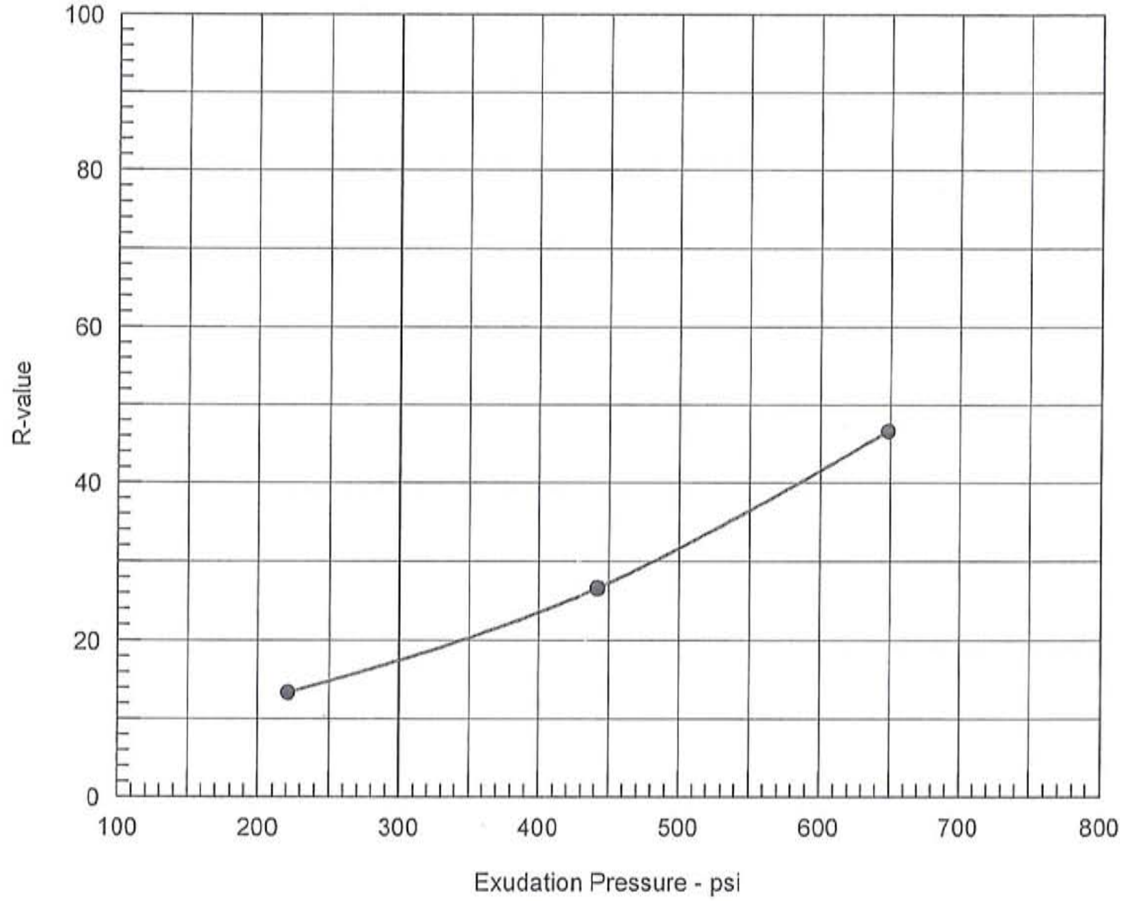
**Tested by:** A. Dapra
**Checked by:** G. Bomberger
**Remarks:**
Laboratory Number 3694

R-VALUE TEST REPORT

**BLACK EAGLE CONSULTING, INC.**

**Figure** 5a

# R-VALUE TEST REPORT




**Resistance R-Value and Expansion Pressure - ASTM D 2844**

| No. | Compact. Pressure psi | Density pcf | Moist. % | Expansion Pressure psi | Horizontal Press. psi @ 160 psi | Sample Height in. | Exud. Pressure psi | R Value | R Value Corr. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | 103.9 | 21.8 | 0.06 | 126 | 2.57 | 221 | 13 | 13 |
| 2 | 180 | 105.8 | 20.9 | 0.15 | 100 | 2.59 | 442 | 25 | 27 |
| 3 | 250 | 108.0 | 19.7 | 0.24 | 69 | 2.56 | 649 | 45 | 47 |
| | | | | | | | | | |

| Test Results | Material Description |
|---|---|
| **R-value at 300 psi exudation pressure =** 17 | Clayey Sand with Gravel |

**Project No.:** 0412-02-1

**Project:** Summit 2.0

**Source of Sample:** TP-05 **Depth:** 1.0'

**Sample Number:** B

**Date:** 4/24/2014

**Tested by:** A. Dapra

**Checked by:** G. Bomberger

**Remarks:**
Laboratory Number 3694

R-VALUE TEST REPORT

**BLACK EAGLE CONSULTING, INC.**

**Figure** 5b

# LABORATORY TEST DATA SUMMARY TABLE

Project: Summit Church 2.0 Project Number: 0412-02-1

Client: Summit Church

Log Number: 3703 Date Tested: 03/24/14 Tested By: A. Hampel

## TEST DATA

| SAMPLE | NORMAL LOAD (psf) | DRY DENSITY (pcf) | MOISTURE CONTENT (%) | ASTM D4829 EXPANSION INDEX |
|---|---|---|---|---|
| B-06 F 17.5' | 500 | 83.9 | 25.9 | 6 |
| B-06 J 27.5' | 1,500 | 81.2 | 15.7 | 19 |

**BLACK EAGLE CONSULTING, INC.**
1345 CAPITAL BOULEVARD, SUITE A
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PHONE (775) 359-6600
FAX (775) 359-7766

Respectfully Submitted By:

Gary Bomberger, E.I.
Assistant Division Manager – Materials Testing
Date: March 28, 2014

# APPENDICES

# APPENDIX A

# Flexible Pavement Design Calculations

**ROAD NAME**: Pyramid Highway Acceleration/Deceleration Lanes for Summit Christian Church

# STRUCTURAL SECTION DESIGN for FLEXIBLE PAVEMENT USING AASHTO/NDOT LAYERED METHOD

**REFERENCES:**

1.) AASHTO, 1993 : *Design manual for design of rigid and flexible pavements*

2.) Nevada Dept. of Transportation, (NDOT) 1997: *Pavement structural section design and policy manual*

**GENERAL DESIGN DATA:**

Base Resilient Modulus: $M_{rb} := 26500$ psi (NDOT standard for Minimum R-Value of 70)

Reliability: $R := 80$ (Upper end for State Highway, mid range for Interstate; per Ref. 2

Standard Deviation: $S_o := .45$

Initial Serviceability Index: $P_o := 4.5$

Terminal Serviceability Index: $P_t := 2.5$

Change in Serviceability: $\Delta PSI := P_o - P_t$ $\quad \Delta PSI = 2$

Drainage Coefficient: $m_i := 1.0$

20 Year Design Equivalent Single Axle Load: $ESAL_{20} := 50411$ (Refer to Appendix A)

**ROADBED RESILIENT MODULUS (NDOT Conversion, per Reference 2):**

Design R-Value: $R_v := 17$

$$\mathrm{logM} := (.0143 \cdot R_v) + \log(17.43)$$

$$\mathrm{logM} = 1.4844 \qquad M_p := 10^{\mathrm{logM}} \qquad M_p = 30.5069 \qquad (\text{in Mpa})$$

$$M_{rr} := M_p \cdot 145.03 \qquad M_{rr} = 4.4244 \times 10^3 \;\; (\text{in psi})$$

**CALCULATION OF LAYERED STRUCTURAL NUMBERS, SNx:**

**Surface Course**

SNx to start iteration: $SN_1 := 3$

$M_{rb} = 2.65 \times 10^4$ $ESAL_{20} = 5.0411 \times 10^4$

$M_{rr} = 4.4244 \times 10^3$

Interpolate Value for $Z_R$ for the selected Reliability, R:

$$r := \begin{pmatrix} 50 \\ 60 \\ 70 \\ 80 \\ 90 \\ 95 \\ 99 \\ 99.9 \end{pmatrix} \qquad z := \begin{pmatrix} .000 \\ -.253 \\ -.524 \\ -.841 \\ -1.28 \\ -1.64 \\ -2.32 \\ -3.09 \end{pmatrix}$$

$Z_R := \text{linterp}(r, z, R)$ $Z_R = -0.841$

$$SN_1 := \text{root}\left[Z_R \cdot S_o + 9.36 \cdot \log(SN_1 + 1) - 0.20 + \frac{\log\left(\frac{\Delta PSI}{4.2 - 1.5}\right)}{0.40 + \frac{1094}{(SN_1 + 1)^{5.19}}} + 2.32 \cdot \log(M_{rb}) - 8.07 - \log(ESAL_{20}), SN_1\right]$$

$SN_1 = 1.141$

**Base Course**



SNx to start iteration: $SN_2 := 3$

$$SN_2 := \mathrm{root}\left[ Z_R \cdot S_o + 9.36 \cdot \log(SN_2 + 1) - 0.20 + \frac{\log\left(\frac{\Delta PSI}{4.2 - 1.5}\right)}{0.40 + \frac{1094}{(SN_2 + 1)^{5.19}}} + 2.32 \cdot \log(M_{rr}) - 8.07 - \log(ESAL_{20}), SN_2 \right]$$

$SN_2 = 2.377$

**PAVEMENT THICKNESS DESIGN:**

Layer Coefficients from Reference 2:

| Material Type | Coefficient | | |
|---|---|---|---|
| Plantmix Surface (PBS): | 0.35 | $PBS := 0.35$ | |
| Plantmix Base | 0.32 | $PB := 0.32$ | |
| Foamed AC Base (FB): | 0.28 | $FB := 0.28$ | (Requires Mix Design) |
| Roadbed Modification (RM): | 0.18 | $RM := 0.18$ | (Requires Mix Design) |
| Type 2 Base (AB): | 0.10 | $AB := 0.10$ | |
| Borrow (SF): | 0.07 | $SF := 0.07$ | |

Calculate Maximum Structural Number for **Aggregate Base** and Thickness of Aggregate Base:

$SN_{ab} := SN_2 - SN_1$ $\quad SN_{ab} = 1.236$

$D_{ab} := \frac{SN_{ab}}{AB}$ $\quad D_{ab} = 12.36$ inches

$sn_{ab} := 12 \cdot AB$ $\quad sn_{ab} = 1.2$ (actual value used after rounding base thickness down to to 12 to increase PBS thickness.

Calculate Maximum Structural Number for **Plant Bituminous Surface** and Thickness of Plant Bituminous Surface:



$SN_{pbs} := SN_2 - sn_{ab}$ $\qquad SN_{pbs} = 1.141$

$D_{pbs} := \dfrac{SN_2 - sn_{ab}}{PBS}$ $\qquad D_{pbs} = 3.26$

**So, design requires 3.5 inches of PBS over 12 inches of aggregate base. Recommend a minimum 5 inches of PBS in this application. This keeps PBS to 2 lifts and reduces AB to 8 inches which can be placed in a single lift.**

December 16, 2019

Washoe County
Community Services Department
1001 E. 9th Street
Reno, NV 89512

RE: Hydrology Letter in support of Special Use Permit Application for Summit Christian Church Phase 4.0 Expansion, 7075 Pyramid Hwy, Washoe County, NV (APN 083-730-13)

Dear Ms. Heeran,

Dyer Engineering Consultants, Inc. is currently working with J7 Architecture to perform preliminary Civil Engineering design for the Summit Christian Church Phase 4.0 expansion located at the above referenced address in Washoe County, Nevada. The site consists of an existing facility, parking, landscape, lighting and associated utilities. The new facility will be for a new 1500-seat worship center. This letter outlines the existing and proposed drainage conditions for the project site.

The site currently drains along both the natural (undeveloped) and developed portions of the site from west to east and eventually enters the existing system of roadside ditches, culverts and storm drain piping along Pyramid Highway.

From a hydrology standpoint, the site was master planned approximately 17 years ago for full build out of all infrastructure. This includes mitigation of peak flows (at full, future build out of the site) to match un-developed conditions by intercepting off-site flows from the hillside to the west and directing into an existing detention pond (located near the loop road, on the southwest portion of the developed site).

In 2015-2016, the latest phase of development was completed, and included mass grading of the north end of the site, construction of interior loop road, and construction of a deceleration lane (entry road on north end of site) and acceleration lane (exit road from south end of site) within NDOT right-of-way along Pyramid Highway.

All historical hydrology reports, both for the master planned future full build out of the site, and the NDOT highway improvements, are still applicable and require no changes. For reference, included with this submittal package are the two final hydrology reports that are currently on file at NDOT headquarters (the reports attached were provided by NDOT). These same reports were also submitted to Washoe County as part of the grading/site improvements permit in 2015.

With respect to modification of the existing drainage on the north end of the site, currently there are two existing drainages:

1) Existing natural drainage that outlets from the hillside located at the north/northeast portion of site, which become more "braided" and less concentrated as it reaches the north portion of the site, essentially behaving as sheet flow before crossing the eastern property line.
2) Existing roadside rip-rap lined swale on north side of north entry road that outlets into a rip-rap dissipater, then combines with the natural drainage described above, before sheet flowing across the eastern property line into NDOT roadside ditch.

The two above drainages will be combined into one rip-rap lined ditch adjacent to the private entry road on the north, to accommodate placement of +/- 30,000 CY of fill in the shape of a "natural" mound. This single, combined drainage will also outlet into a new rip-rap dissipater to create sheet flow, with similar characteristics as the existing condition, before exiting the site into NDOT roadside ditch. The average overall and peak flows will not be changed from the existing condition, only the routing will be modified such that they are combined sooner upstream before dissipating into sheet flow. Exact sizing of the new ditch ditch geometry, rip-rap and dissapator will be completed as part of our final design, but is shown as a preliminary design in this Special Use Permit application package. Preliminary open channel modeling is indicating we will have an approximate depth of 18-inches and width of 3-feet, with +/- 6-inch rip-rap, for the peak condition of +/- 68 cfs (100-year storm event, reference page 3 of 11 of Summit Church Drainage Report, dated July 21, 2015, and Sheet H1, of reference Historical Master Planned report, dated July 2003).

These referenced historical reports and drainage data demonstrate that the currently proposed Phase 4.0 Worship Center improvements are feasible and will not introduce any detrimental drainage conditions related to the proposed development, while also meeting current Washoe County code requirements.

Please call me at 775-420-4549 with any questions or concerns regarding this project.

Best Regards,

PROFESSIONAL ENGINEER STATE OF NEVADA
LONNIE J. JOHNSON
Exp: 6-30-21
CIVIL
No. 19440

12-16-2019

Lonnie Johnson, P.E.
Vice President – Principal

Attachments:
1) Drainage Report for Summit Christian Church, dated July 21, 2015
2) Addendum to the Drainage Report for Summit Christian Church, dated July 28, 2015

# ADDENDUM TO THE DRAINAGE REPORT
## FOR
# SUMMIT CHRISTIAN CHURCH
# WASHOE COUNTY, NEVADA

PREPARED BY:
CFA, INC.
1150 CORPORATE BOULEVARD
RENO, NV 89502
(775) 856-1150

**JULY 2015**

PROFESSIONAL ENGINEER - STATE OF NEVADA
LONNIE J. JOHNSON
Exp: 6-30-17
CIVIL
No. 19440

7-28-15

cfa

**RATIONAL METHOD HYDROLOGY**
**CITY OF RENO IDF CURVES**
**WASHOE COUNTY, NV**
**SUMMIT CHRISTIAN CHURCH - PHASE 3 IMPROVEMENTS**

| DESIGN POINT | DRAINAGE SUB-AREA | AREA (acres) | C 25-YR. | C 100-YR. | WATERSHED LENGTH (ft) | VELOCITY (ft/sec) | Tc (min) | INTENSITY (in/hr) 25-YR | INTENSITY (in/hr) 100-YR | PEAK RUNOFF (cfs) **25-YR** | PEAK RUNOFF (cfs) **100-YR** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **INDIVIDUAL AREAS - PROPOSED BASINS** | | | | | | | | | | | |
| SOUTH CORRIDOR (SOUTH & WEST SIDES OF SITE) | **A1** | 2.57 | 0.40 | 0.50 | 666 | 2 | 15.55 | 1.74 | 2.57 | **2.23** | **3.30** |
| | **A2** | 15.53 | 0.40 | 0.50 | 1029 | 2 | 18.57 | 1.63 | 2.40 | **12.63** | **18.65** |
| | **DETENTION POND** | --- | --- | --- | --- | --- | --- | --- | --- | **-9.86** | **21.95** |
| | **A3** | 2.04 | 0.40 | 0.50 | 443 | 2 | 13.69 | 1.85 | 2.73 | **1.89** | **2.79** |
| | **A4** | 1.30 | 0.51 | 0.60 | 531 | 2 | 14.42 | 1.81 | 2.68 | **1.40** | **2.07** |
| | | | | | | | | | | | |
| OUTFLOW ((A1+A2)+DETENTION POND; FOR 25 YEAR ONLY) | **S1** | **---** | | | | | | | | **5.00** | **21.95** |
| | | | | | | | | | | | |
| SOUTH CORRIDOR TO 36" RCP AT ~STA. "C" 110+50 at S.R. FIRE ROAD | **A5** | 2.72 | 0.50 | 0.59 | 1123 | 2 | 19.36 | 1.59 | 2.35 | **2.55** | **3.77** |
| STA. "C" 107+75 TO PROP. MH 1 - TYPE 4 AT | **A6** | 0.58 | 0.72 | 0.79 | 330 | 2 | 12.75 | 1.93 | 2.84 | **0.87** | **1.29** |
| SPRING RIDGE SUBDIVISION AT 36" RCP | **A7** | 57.80 | 0.65 | 0.78 | 1600 | 2 | 23.33 | 1.44 | 2.12 | **64.74** | **95.67** |
| DRAINAGE CHANNEL ADJACENT TO PYRAMID HIGHWAY ACCELERATION LANE - STA. "C" 94+30 - STA. "C" 105+00 | **A8** | 1.79 | 0.68 | 0.75 | 1012 | 2 | 5.00 | 2.77 | 4.09 | **3.71** | **5.48** |
| | | | | | | | | | | | |

**RATIONAL METHOD HYDROLOGY**
**CITY OF RENO IDF CURVES**
**WASHOE COUNTY, NV**
**SUMMIT CHRISTIAN CHURCH - PHASE 3 IMPROVEMENTS**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SOUTHWEST PARKING AREA & EX. CHURCH BUILDING - SOUTH AND WEST OF CHURCH BUILDING | **B1** | 0.36 | 0.85 | 0.87 | 243 | 2 | 12.02 | 1.96 | 2.89 | **0.62** | **0.91** |
| | **B2** | 0.21 | 0.40 | 0.50 | 188 | 2 | 11.56 | 2.00 | 2.95 | **0.21** | **0.31** |
| | **B3** | 0.95 | 0.74 | 0.80 | 263 | 2 | 12.19 | 1.96 | 2.89 | **1.49** | **2.20** |
| | **B4** | 0.57 | 0.80 | 0.86 | 210 | 2 | 11.75 | 2.00 | 2.95 | **0.97** | **1.43** |
| **TOTAL** | | **2.09** | | | | | | | | **3.29** | **4.86** |
| | | | | | | | | | | | |
| SOUTH SITE DRIVE AND EASTERN PARKING AREA | **C** | 1.91 | 0.84 | 0.90 | 753 | 2 | 16.28 | 1.70 | 2.51 | **2.91** | **4.30** |
| **TOTAL** | | **1.91** | | | | | | | | **2.91** | **4.30** |
| | | | | | | | | | | | |
| NORTHEAST CORNER OF EXISTING CHURCH BUILDING | **D1** | 0.18 | 0.85 | 0.87 | 125 | 3 | 10.70 | 2.07 | 3.06 | **0.32** | **0.47** |
| SKY BRIDGE AND SOUTH ARTERIAL AREAS | **D2** | 1.11 | 0.66 | 0.74 | 466 | 2 | 13.88 | 1.85 | 2.73 | **1.51** | **2.23** |
| PROPOSED BUILDING | **D3** | 1.04 | 0.85 | 0.87 | 150 | 3 | 10.83 | 2.07 | 3.06 | **1.87** | **2.76** |
| E. SIDE OF PROPOSED BUILDING | **D4** | 0.26 | 0.87 | 0.92 | 208 | 3 | 11.16 | 2.04 | 3.00 | **0.48** | **0.71** |
| **TOTAL** | | **2.58** | | | | | | | | **4.19** | **6.17** |
| | | | | | | | | | | | |
| EAST ENTRANCE & BASINS ALONG PYRAMID HIGHWAY | **E1** | 0.74 | 0.59 | 0.67 | 507 | 2 | 14.22 | 1.81 | 2.68 | **0.89** | **1.32** |
| | **E2** | 0.81 | 0.60 | 0.68 | 479 | 2 | 13.99 | 1.85 | 2.73 | **1.03** | **1.51** |
| | **E3** | 0.94 | 0.58 | 0.66 | 263 | 2 | 12.19 | 1.96 | 2.89 | **1.23** | **1.81** |
| | **E4** | 1.16 | 0.58 | 0.66 | 420 | 2 | 13.50 | 1.85 | 2.73 | **1.41** | **2.08** |
| | **E5** | 1.02 | 0.84 | 0.89 | 252 | 3 | 11.40 | 2.04 | 3.00 | **1.86** | **2.74** |
| | **E6** | 0.48 | 0.85 | 0.90 | 246 | 3 | 11.37 | 2.04 | 3.00 | **0.88** | **1.29** |
| **TOTAL** | | **5.15** | | | | | | | | **7.29** | **10.75** |
| | | | | | | | | | | | |

**RATIONAL METHOD HYDROLOGY**
**CITY OF RENO IDF CURVES**
**WASHOE COUNTY, NV**
**SUMMIT CHRISTIAN CHURCH - PHASE 3 IMPROVEMENTS**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STA. "C" 114+05 ON PYRAMID HIGHWAY (Sum of: B1-B4, C, D1-D2, 1/2 D3, 3/4 D4, E1-E5) | **S2** | **10.67** | | | | | | | | **15.74** | **23.23** |
| 36" RCP UNDER S. EGRESS (Sum of: S2 & A1-A4, Minus the Reduction - 25 year only) | **S3** | **32.11** | | | | | | | | **24.03** | **50.04** |
| 36" RCP AT FIRE ROAD (Sum of: S3+A5) | **S4** | **34.83** | | | | | | | | **26.59** | **53.81** |
| 36" RCP at MH-1 TIE-IN (Sum of: S4+A6) | **S5** | **35.41** | | | | | | | | **27.46** | **55.10** |
| 42" ADS Pipe in NDOT ROW (Sum of: S5+A7) | **S6** | **93.21** | | | | | | | | **92.20** | **150.77** |
| OPEN CHANNEL FLOW AT DUAL 24" CULVERTS AT SPRING RIDGE DRIVE INTERSECTION (Sum of: S6+A8) | **S7** | **95.00** | | | | | | | | **95.92** | **156.26** |

**RATIONAL METHOD HYDROLOGY**
**CITY OF RENO IDF CURVES**
**WASHOE COUNTY, NV**
**SUMMIT CHRISTIAN CHURCH - PHASE 3 IMPROVEMENTS**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NORTH SLOPE, FUTURE NORTH WEST & NORTH EAST PARKING LOT & NORTH NDOT CORRIDOR | **F1** | 0.46 | 0.56 | 0.64 | 232 | 2 | 11.93 | 2.00 | 2.95 | **0.59** | **0.87** |
| | **F2** | 0.75 | 0.53 | 0.61 | 245 | 2 | 12.04 | 1.96 | 2.89 | **0.91** | **1.34** |
| | **F3** | 0.56 | 0.46 | 0.56 | 456 | 2 | 13.80 | 1.85 | 2.73 | **0.58** | **0.85** |
| | **F4** | 0.21 | 0.88 | 0.93 | 370 | 3 | 12.06 | 1.96 | 2.89 | **0.39** | **0.57** |
| | **F5** | 0.71 | 0.81 | 0.87 | 207 | 3 | 11.15 | 2.04 | 3.00 | **1.25** | **1.84** |
| | **F6** | 0.70 | 0.85 | 0.90 | 268 | 3 | 11.49 | 2.04 | 3.00 | **1.29** | **1.90** |
| | **F7** | 0.98 | 0.81 | 0.87 | 276 | 3 | 11.53 | 2.00 | 2.95 | **1.70** | **2.51** |
| | **F8** | 0.67 | 0.75 | 0.81 | 465 | 3 | 12.58 | 1.93 | 2.84 | **1.05** | **1.55** |
| **TOTAL** | | **5.04** | | | | | | | | **7.75** | **11.43** |
| 24" RCP @ NDOT N. INGRESS ROADWAY (Sum of: 1/4 D4, 1/2 D3, E6, F1-F8) | **N1** | **6.10** | | | | | | | | **9.68** | **14.28** |
| | | | | | | | | | | | |
| WEST & NORTH SIDE OF NORTH CORRIDOR | **G1** | 1.49 | 0.40 | 0.50 | 736 | 2 | 16.13 | 1.70 | 2.51 | **1.27** | **1.87** |
| | **G2** | 4.31 | 0.40 | 0.50 | 709 | 2 | 15.91 | 1.74 | 2.57 | **3.75** | **5.54** |
| | **G3** | 1.26 | 0.48 | 0.57 | 359 | 2 | 12.99 | 1.93 | 2.84 | **1.40** | **2.06** |
| | **G4** | 1.84 | 0.49 | 0.58 | 929 | 2 | 17.74 | 1.66 | 2.46 | **1.77** | **2.61** |
| (Sum of G1-G4) | **N2** | **8.90** | | | | | | | | **8.18** | **12.08** |
| | | | | | | | | | | | |
| NDOT ROW - NORTH DECELERATION LANE | **G5** | 0.46 | 0.70 | 0.77 | 270 | 2 | 12.25 | 1.96 | 2.89 | **0.69** | **1.02** |
| | **G6** | 1.11 | 0.61 | 0.69 | 545 | 2 | 14.54 | 1.78 | 2.62 | **1.36** | **2.00** |
| **TOTAL** | **G5+G6** | **1.57** | | | | | | | | **2.05** | **3.02** |
| | | | | | | | | | | | |
| 36" CMP @ CROSSING ON PYRAMID HIGHWAY @ N. END (Sum of: N1+N2+G5+G6) | **N3** | **16.57** | | | | | | | | **19.91** | **29.38** |

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 6 CROSS SECTION C-C: STATION "C" 106+50 CHANNEL (UPSTREAM OF PROPOSED 36-INCH DIAMETER RCP AT MH-1)

Flow line elevation at Station "C" 106+50 = 4549.48

Existing elevation of center of travel lane adjacent to channel (feet) = 4551.00

Estimated 25-year storm flow peak runoff (cfs) = 27.46

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4550.94

Estimated 100-year storm flow peak runoff (cfs) = 55.10

Calculated water surface elevation in channel for 100-year peak runoff (feet) =4551.14

# X-Section for Cross Section "C-C" at Station "C" 106+50 - 25 year

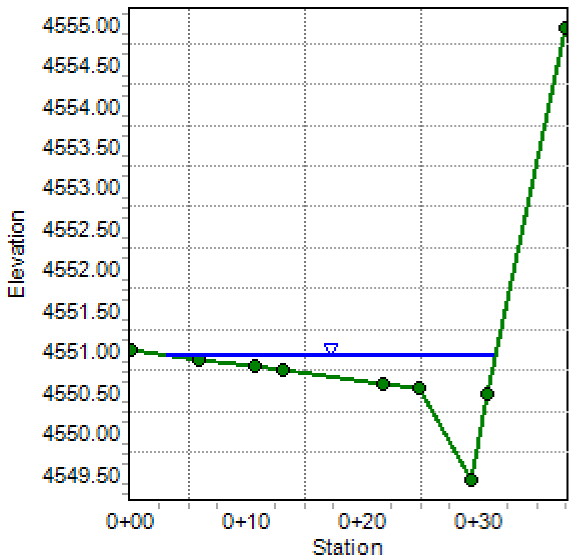
## Project Description

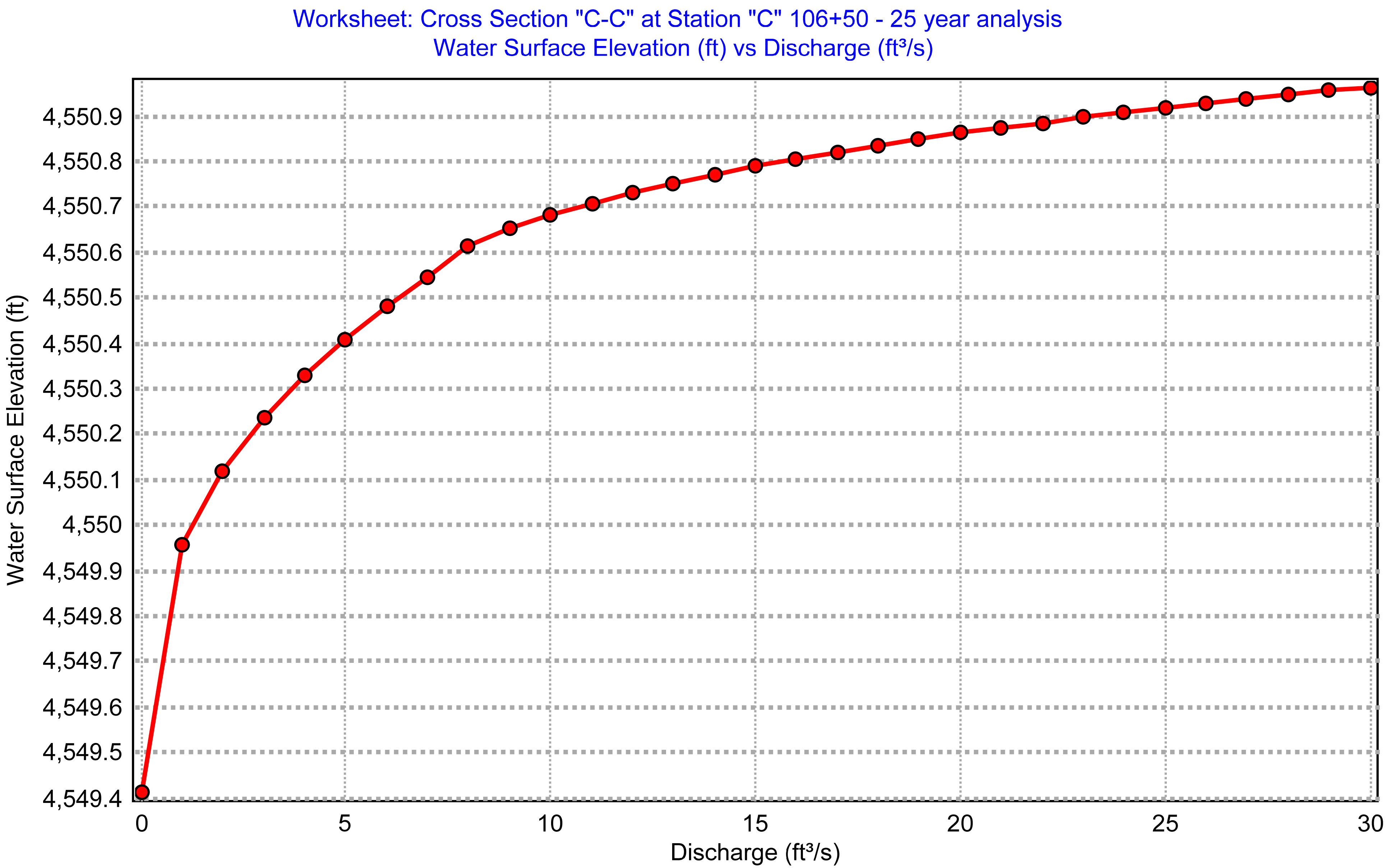
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.00000 | % |
| Normal Depth | 1.53 | ft |
| Discharge | 27.46 | $ft^3/s$ |

## Cross Section Image





Worksheet: Cross Section "C-C" at Station "C" 106+50 - 25 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,550.9
4,550.8
4,550.7
4,550.6
4,550.5
4,550.4
4,550.3
4,550.2
4,550.1
4,550
4,549.9
4,549.8
4,549.7
4,549.6
4,549.5
4,549.4
0
5
10
15
20
25
30
Discharge (ft³/s)

# Report for Cross Section "C-C" at Station "C" 106+50 - 25 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.00000 | % |
| Discharge | 27.46 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4551.00 |
| 0+06 | 4550.89 |
| 0+11 | 4550.81 |
| 0+13 | 4550.77 |
| 0+22 | 4550.60 |
| 0+25 | 4550.54 |
| 0+29 | 4549.41 |
| 0+31 | 4550.48 |
| 0+38 | 4554.95 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4551.00) | (0+06, 4550.89) | 0.013 |
| (0+06, 4550.89) | (0+11, 4550.81) | 0.013 |
| (0+11, 4550.81) | (0+13, 4550.77) | 0.013 |
| (0+13, 4550.77) | (0+22, 4550.60) | 0.013 |
| (0+22, 4550.60) | (0+25, 4550.54) | 0.013 |
| (0+25, 4550.54) | (0+29, 4549.41) | 0.035 |
| (0+29, 4549.41) | (0+31, 4550.48) | 0.069 |
| (0+31, 4550.48) | (0+38, 4554.95) | 0.069 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |

# Report for Cross Section "C-C" at Station "C" 106+50 - 25 year analysis

## Options

| | |
|---|---|
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.53 | ft |
| Elevation Range | 4549.41 to 4554.95 ft | |
| Flow Area | 10.22 | ft² |
| Wetted Perimeter | 28.97 | ft |
| Hydraulic Radius | 0.35 | ft |
| Top Width | 28.34 | ft |
| Normal Depth | 1.53 | ft |
| Critical Depth | 1.46 | ft |
| Critical Slope | 0.01638 | ft/ft |
| Velocity | 2.69 | ft/s |
| Velocity Head | 0.11 | ft |
| Specific Energy | 1.64 | ft |
| Froude Number | 0.79 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.53 | ft |
| Critical Depth | 1.46 | ft |
| Channel Slope | 1.00000 | % |
| Critical Slope | 0.01638 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel:  4550.94 feet

# X-Section for Cross Section "C-C" at Station "C" 106+50 - 100 year

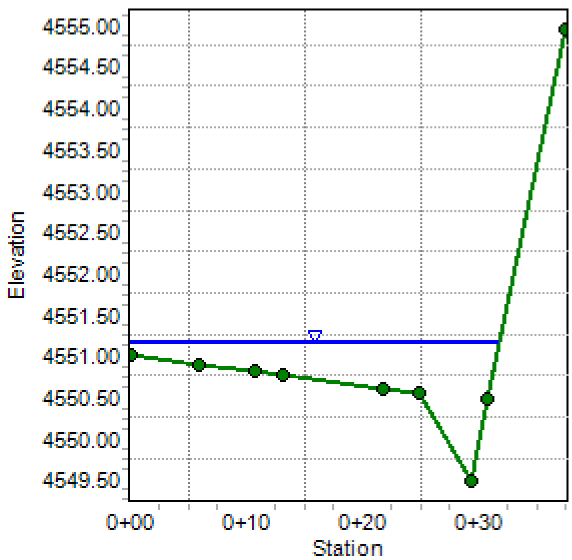
## Project Description

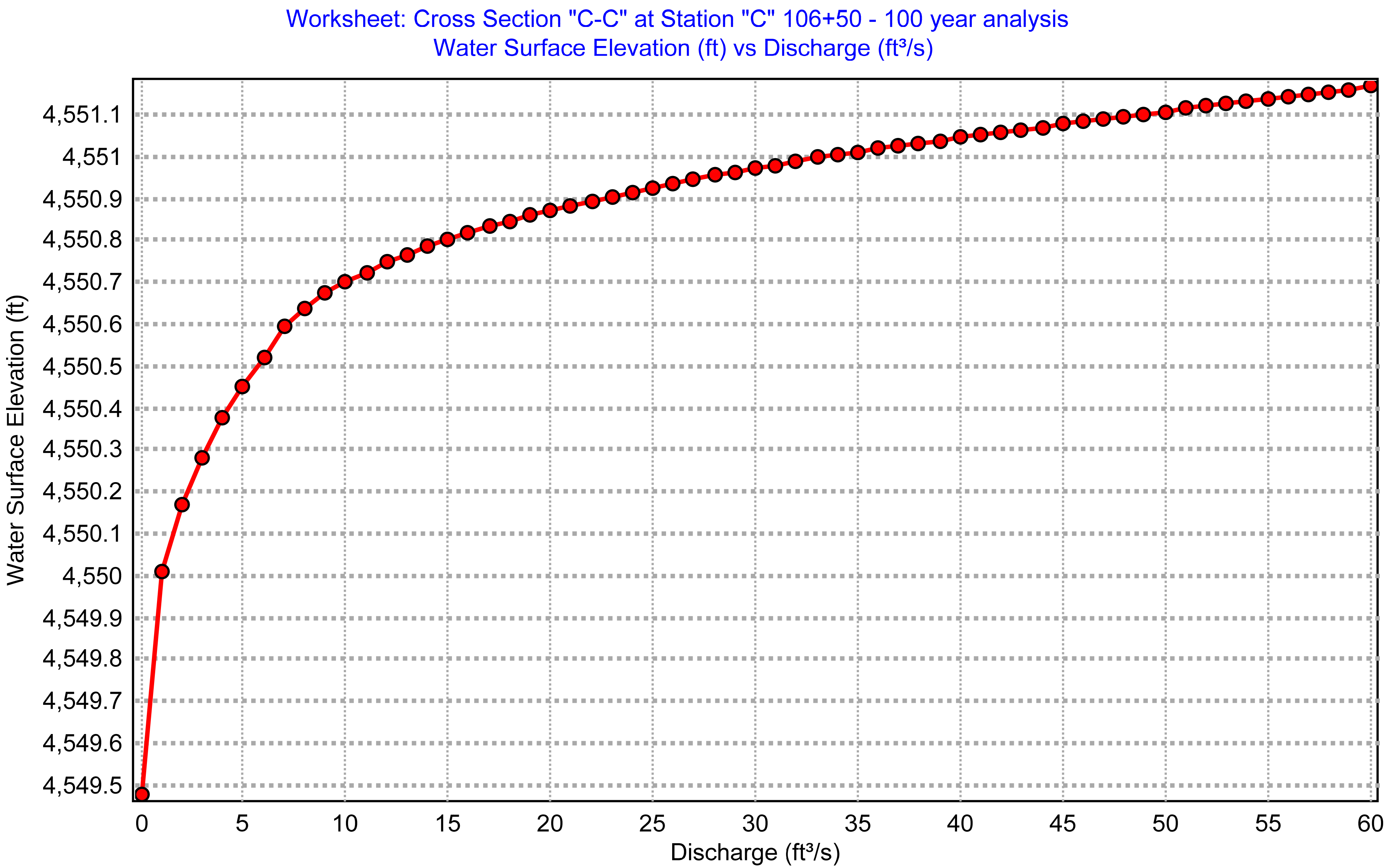
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.00000 | % |
| Normal Depth | 1.66 | ft |
| Discharge | 55.10 | ft³/s |

## Cross Section Image





Worksheet: Cross Section "C-C" at Station "C" 106+50 - 100 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,551.1
4,551
4,550.9
4,550.8
4,550.7
4,550.6
4,550.5
4,550.4
4,550.3
4,550.2
4,550.1
4,550
4,549.9
4,549.8
4,549.7
4,549.6
4,549.5
0
5
10
15
20
25
30
35
40
45
50
55
60
Discharge (ft³/s)

# Report for Cross Section "C-C" at Station "C" 106+50 - 100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.00000 | % |
| Discharge | 55.10 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4551.00 |
| 0+06 | 4550.89 |
| 0+11 | 4550.81 |
| 0+13 | 4550.77 |
| 0+22 | 4550.60 |
| 0+25 | 4550.54 |
| 0+29 | 4549.48 |
| 0+31 | 4550.48 |
| 0+38 | 4554.95 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4551.00) | (0+06, 4550.89) | 0.013 |
| (0+06, 4550.89) | (0+11, 4550.81) | 0.013 |
| (0+11, 4550.81) | (0+13, 4550.77) | 0.013 |
| (0+13, 4550.77) | (0+22, 4550.60) | 0.013 |
| (0+22, 4550.60) | (0+25, 4550.54) | 0.013 |
| (0+25, 4550.54) | (0+29, 4549.48) | 0.035 |
| (0+29, 4549.48) | (0+31, 4550.48) | 0.069 |
| (0+31, 4550.48) | (0+38, 4554.95) | 0.069 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |

# Report for Cross Section "C-C" at Station "C" 106+50 - 100 year

## Options

| | |
|---|---|
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.66 | ft |
| Elevation Range | 4549.48 to 4554.95 ft | | |
| Flow Area | | 16.12 | ft² |
| Wetted Perimeter | | 32.57 | ft |
| Hydraulic Radius | | 0.49 | ft |
| Top Width | | 31.80 | ft |
| Normal Depth | | 1.66 | ft |
| Critical Depth | | 1.60 | ft |
| Critical Slope | | 0.01443 | ft/ft |
| Velocity | | 3.42 | ft/s |
| Velocity Head | | 0.18 | ft |
| Specific Energy | | 1.84 | ft |
| Froude Number | | 0.85 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.66 | ft |
| Critical Depth | 1.60 | ft |
| Channel Slope | 1.00000 | % |
| Critical Slope | 0.01443 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel: 4551.14 feet

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 8 CROSS SECTION D-D: STATION "C" 101+52 - CHANNEL ADJACENT TO PYRAMID HIGHWAY ACCELERATION LANE

Flow line elevation at Station "C" 101+52 = 4542.45

Existing elevation of center of travel lane adjacent to channel (feet) = 4543.99

Estimated 25-year storm flow peak runoff (cfs) = 3.71 *(Time of concentration = 5 minutes)*

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4543.52

Estimated 100-year storm flow peak runoff (cfs) = 5.48 *(Time of concentration = 5 minutes)*

Calculated water surface elevation in channel for 100-year peak runoff (feet) = 4543.61

# X-Section for Cross Section "D-D" at Station "C" 101+52 - 25 year

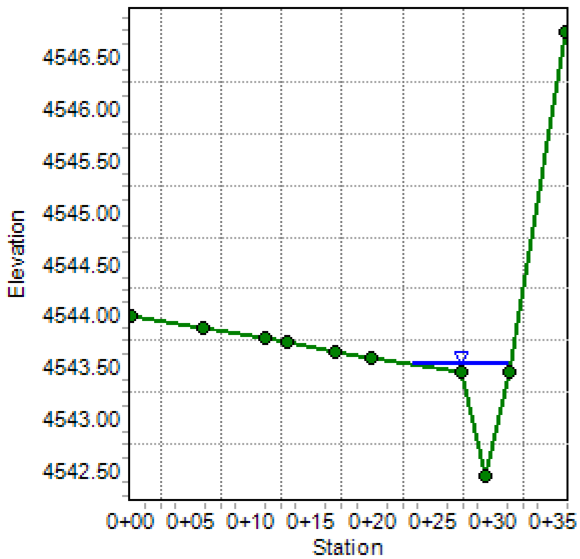
## Project Description

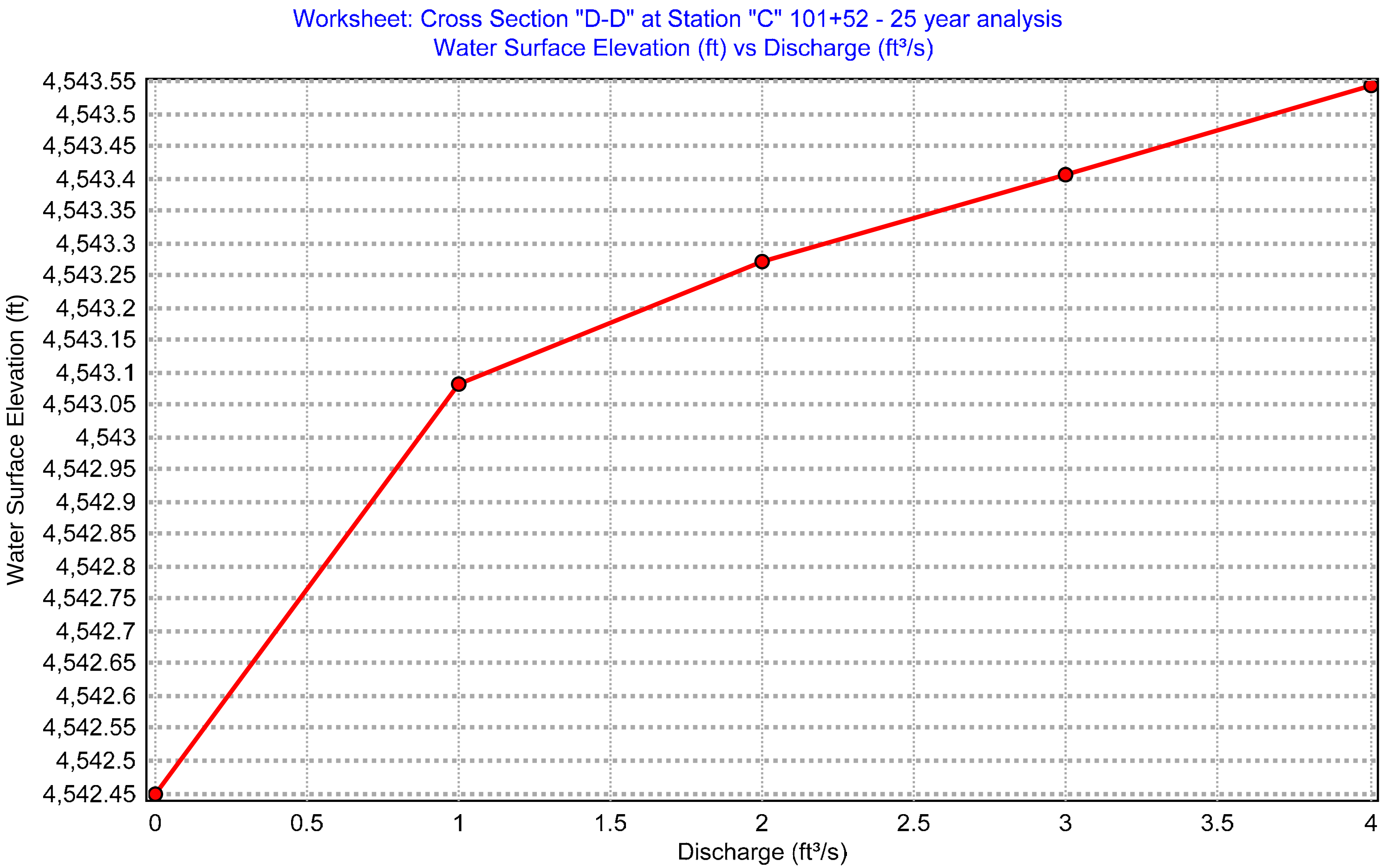
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Normal Depth | 1.07 | ft |
| Discharge | 3.71 | ft³/s |

## Cross Section Image





Worksheet: Cross Section "D-D" at Station "C" 101+52 - 25 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,543.55
4,543.5
4,543.45
4,543.4
4,543.35
4,543.3
4,543.25
4,543.2
4,543.15
4,543.1
4,543.05
4,543
4,542.95
4,542.9
4,542.85
4,542.8
4,542.75
4,542.7
4,542.65
4,542.6
4,542.55
4,542.5
4,542.45
0
0.5
1
1.5
2
2.5
3
3.5
4
Discharge (ft³/s)

# Report for Cross Section "D-D" at Station "C" 101+52 - 25 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Discharge | 3.71 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4543.99 |
| 0+06 | 4543.87 |
| 0+11 | 4543.77 |
| 0+13 | 4543.73 |
| 0+17 | 4543.64 |
| 0+20 | 4543.58 |
| 0+27 | 4543.45 |
| 0+29 | 4542.45 |
| 0+31 | 4543.45 |
| 0+36 | 4546.73 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4543.99) | (0+06, 4543.87) | 0.013 |
| (0+06, 4543.87) | (0+11, 4543.77) | 0.013 |
| (0+11, 4543.77) | (0+13, 4543.73) | 0.013 |
| (0+13, 4543.73) | (0+17, 4543.64) | 0.013 |
| (0+17, 4543.64) | (0+20, 4543.58) | 0.013 |
| (0+20, 4543.58) | (0+27, 4543.45) | 0.035 |
| (0+27, 4543.45) | (0+29, 4542.45) | 0.069 |
| (0+29, 4542.45) | (0+31, 4543.45) | 0.069 |
| (0+31, 4543.45) | (0+36, 4546.73) | 0.069 |

# Report for Cross Section "D-D" at Station "C" 101+52 - 25 year analysis

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.07 | ft |
| Elevation Range | 4542.45 to 4546.73 ft | | |
| Flow Area | | 2.41 | ft² |
| Wetted Perimeter | | 8.52 | ft |
| Hydraulic Radius | | 0.28 | ft |
| Top Width | | 8.02 | ft |
| Normal Depth | | 1.07 | ft |
| Critical Depth | | 0.73 | ft |
| Critical Slope | | 0.07393 | ft/ft |
| Velocity | | 1.54 | ft/s |
| Velocity Head | | 0.04 | ft |
| Specific Energy | | 1.11 | ft |
| Froude Number | | 0.49 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.07 | ft |
| Critical Depth | 0.73 | ft |
| Channel Slope | 1.80000 | % |
| Critical Slope | 0.07393 | ft/ft |

## Messages

Notes

# Report for Cross Section "D-D" at Station "C" 101+52 - 25 year analysis

## Messages

Calculated Water Surface Elevation in Channel: 4543.52 feet
Time of concentration considered = 5 minutes

# X-Section for Cross Section "D-D" at Station "C" 101+52 - 100 year

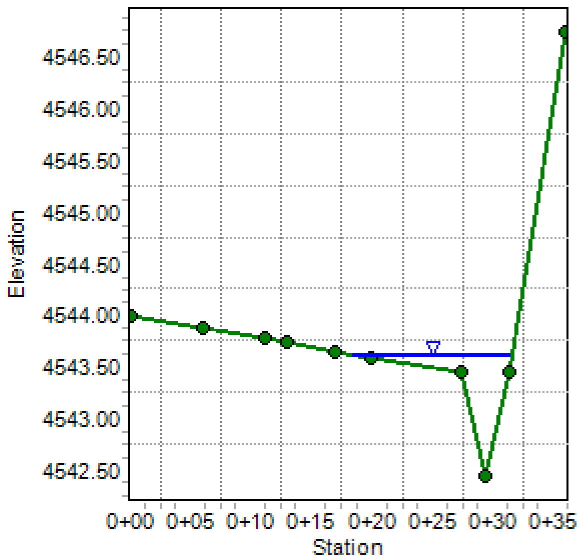
## Project Description

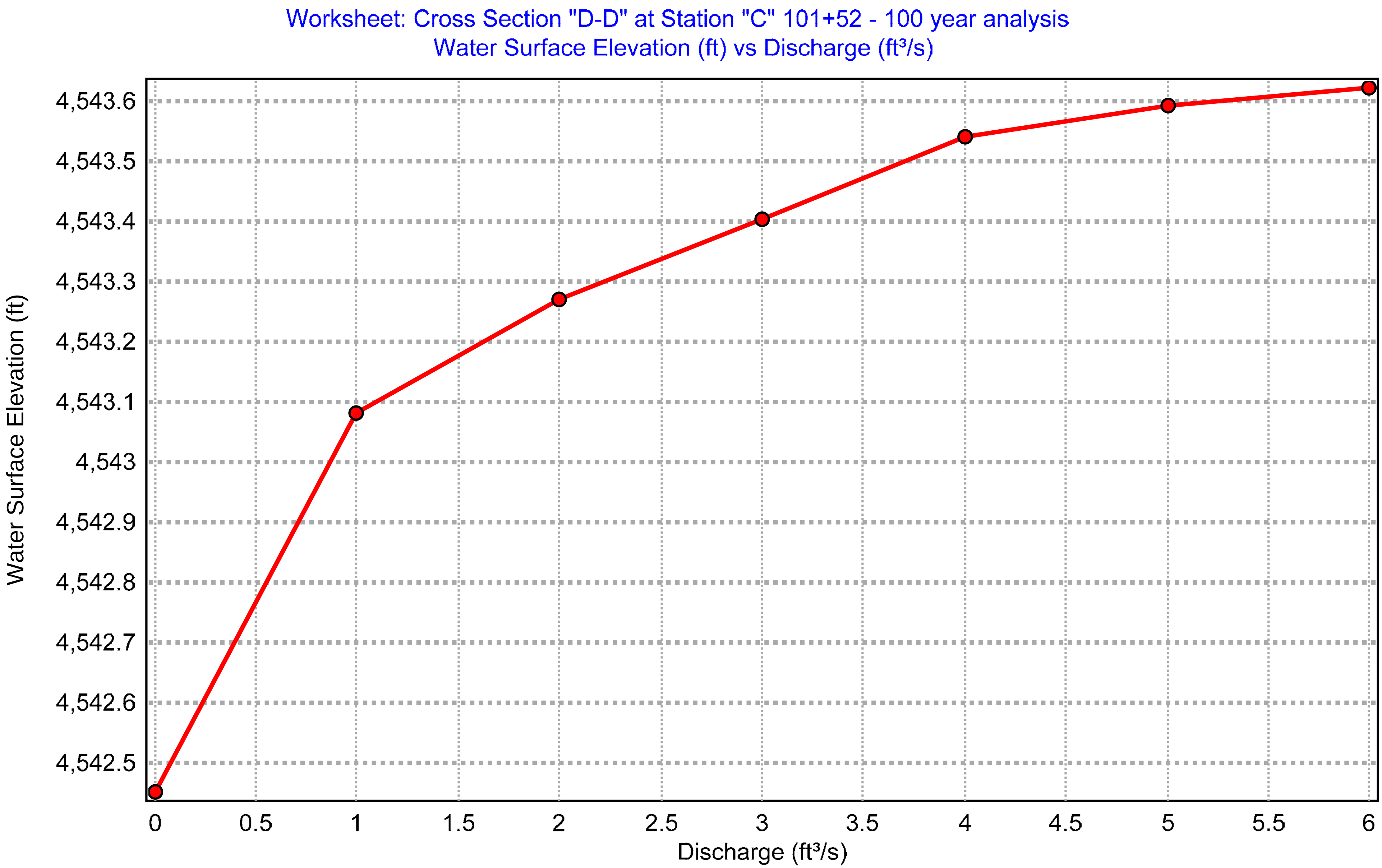
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Normal Depth | 1.16 | ft |
| Discharge | 5.48 | ft³/s |

## Cross Section Image





Worksheet: Cross Section "D-D" at Station "C" 101+52 - 100 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,543.6
4,543.5
4,543.4
4,543.3
4,543.2
4,543.1
4,543
4,542.9
4,542.8
4,542.7
4,542.6
4,542.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Discharge (ft³/s)

# Report for Cross Section "D-D" at Station "C" 101+52 - 100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Discharge | 5.48 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4543.99 |
| 0+06 | 4543.87 |
| 0+11 | 4543.77 |
| 0+13 | 4543.73 |
| 0+17 | 4543.64 |
| 0+20 | 4543.58 |
| 0+27 | 4543.45 |
| 0+29 | 4542.45 |
| 0+31 | 4543.45 |
| 0+36 | 4546.73 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4543.99) | (0+06, 4543.87) | 0.013 |
| (0+06, 4543.87) | (0+11, 4543.77) | 0.013 |
| (0+11, 4543.77) | (0+13, 4543.73) | 0.013 |
| (0+13, 4543.73) | (0+17, 4543.64) | 0.013 |
| (0+17, 4543.64) | (0+20, 4543.58) | 0.013 |
| (0+20, 4543.58) | (0+27, 4543.45) | 0.035 |
| (0+27, 4543.45) | (0+29, 4542.45) | 0.069 |
| (0+29, 4542.45) | (0+31, 4543.45) | 0.069 |
| (0+31, 4543.45) | (0+36, 4546.73) | 0.069 |

# Report for Cross Section "D-D" at Station "C" 101+52 - 100 year

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.16 | ft |
| Elevation Range | 4542.45 to 4546.73 ft | | |
| Flow Area | | 3.37 | ft² |
| Wetted Perimeter | | 13.60 | ft |
| Hydraulic Radius | | 0.25 | ft |
| Top Width | | 13.08 | ft |
| Normal Depth | | 1.16 | ft |
| Critical Depth | | 0.86 | ft |
| Critical Slope | | 0.05261 | ft/ft |
| Velocity | | 1.63 | ft/s |
| Velocity Head | | 0.04 | ft |
| Specific Energy | | 1.20 | ft |
| Froude Number | | 0.56 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.16 | ft |
| Critical Depth | 0.86 | ft |
| Channel Slope | 1.80000 | % |
| Critical Slope | 0.05261 | ft/ft |

## Messages

Notes

# Report for Cross Section "D-D" at Station "C" 101+52 - 100 year

## Messages

Calculated Water Surface Elevation in Channel: 4543.61 feet
Time of concentration considered = 5 minutes

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 9 Cross Section E-E: Station “C” 97+68 - Channel Adjacent to Pyramid Highway Acceleration Lane

Flow line elevation at Station “C” 97+68 = 4534.82

Existing elevation of center of travel lane adjacent to channel (feet) = 4536.47

Estimated 25-year storm flow peak runoff (cfs) = 3.71 *(Time of concentration = 5 minutes)*

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4535.68

Estimated 100-year storm flow peak runoff (cfs) = 5.48 *(Time of concentration = 5 minutes)*

Calculated water surface elevation in channel for 100-year peak runoff (feet) = 4535.81

# X-Section for Cross Section "E-E" at Station "C" 97+68 - 25 year

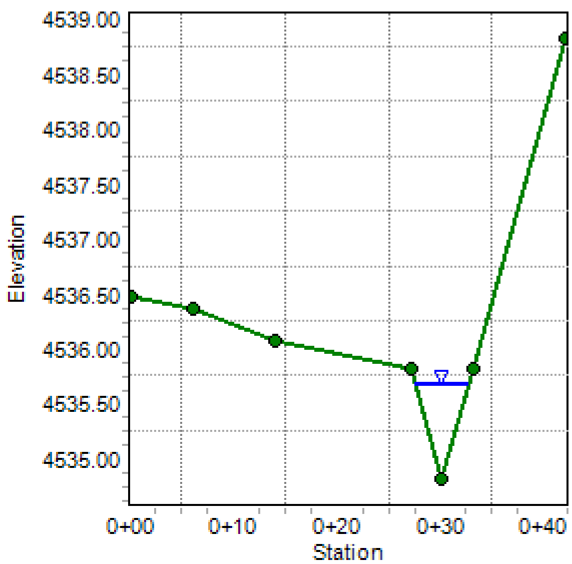
## Project Description

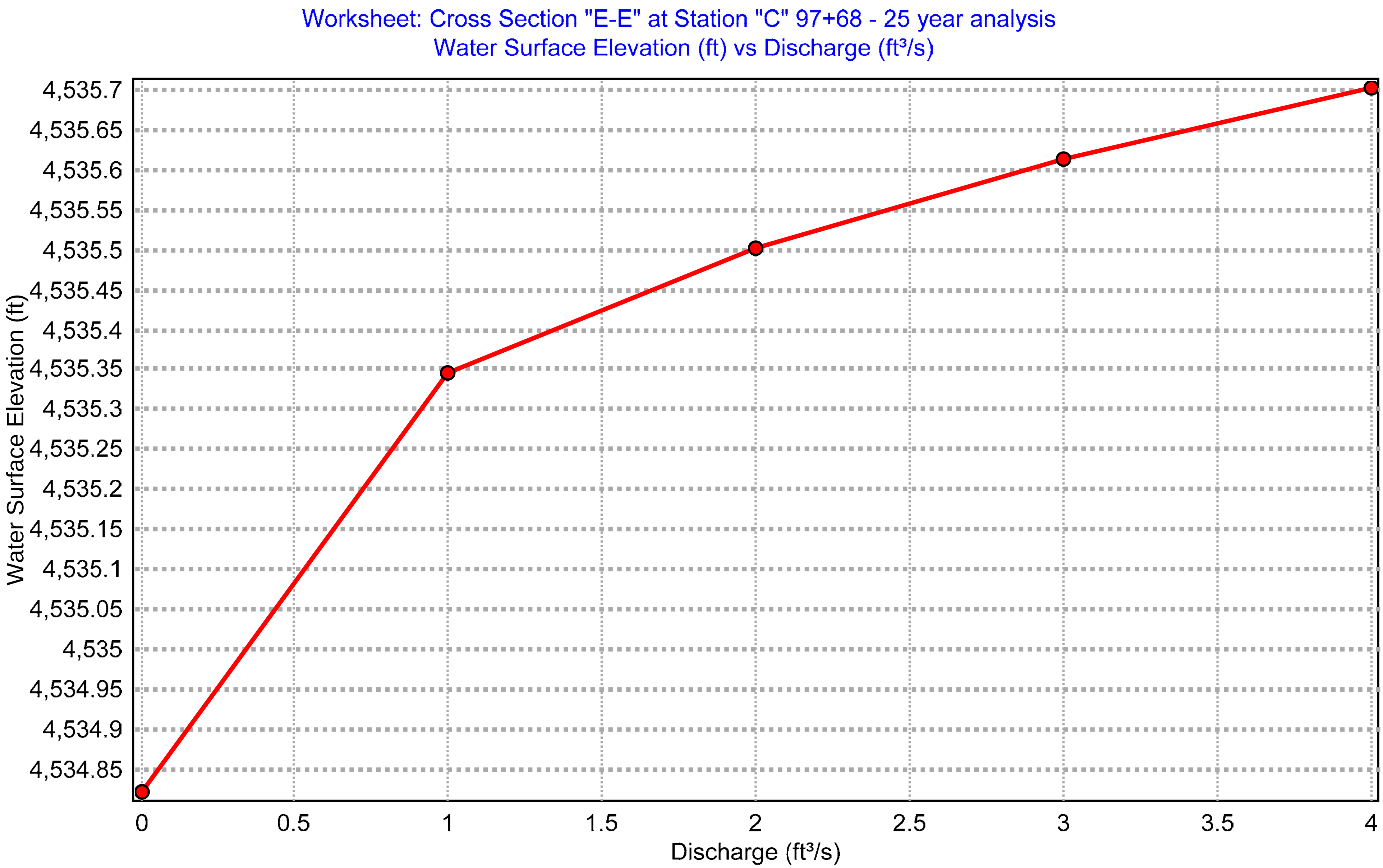
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Normal Depth | 0.86 | ft |
| Discharge | 3.71 | $ft^3/s$ |

## Cross Section Image




Worksheet: Cross Section "E-E" at Station "C" 97+68 - 25 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,535.7
4,535.65
4,535.6
4,535.55
4,535.5
4,535.45
4,535.4
4,535.35
4,535.3
4,535.25
4,535.2
4,535.15
4,535.1
4,535.05
4,535
4,534.95
4,534.9
4,534.85
0
0.5
1
1.5
2
2.5
3
3.5
4
Discharge (ft³/s)

# Report for Cross Section "E-E" at Station "C" 97+68 - 25 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Discharge | 3.71 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4536.47 |
| 0+06 | 4536.36 |
| 0+14 | 4536.08 |
| 0+27 | 4535.82 |
| 0+30 | 4534.82 |
| 0+33 | 4535.82 |
| 0+42 | 4538.82 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4536.47) | (0+06, 4536.36) | 0.013 |
| (0+06, 4536.36) | (0+14, 4536.08) | 0.013 |
| (0+14, 4536.08) | (0+27, 4535.82) | 0.035 |
| (0+27, 4535.82) | (0+30, 4534.82) | 0.069 |
| (0+30, 4534.82) | (0+33, 4535.82) | 0.069 |
| (0+33, 4535.82) | (0+42, 4538.82) | 0.035 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.86 | ft |

# Report for Cross Section "E-E" at Station "C" 97+68 - 25 year analysis

## Results

| | | |
|---|---|---|
| Elevation Range | 4534.82 to 4538.82 ft | |
| Flow Area | 2.22 | ft² |
| Wetted Perimeter | 5.43 | ft |
| Hydraulic Radius | 0.41 | ft |
| Top Width | 5.16 | ft |
| Normal Depth | 0.86 | ft |
| Critical Depth | 0.62 | ft |
| Critical Slope | 0.10969 | ft/ft |
| Velocity | 1.67 | ft/s |
| Velocity Head | 0.04 | ft |
| Specific Energy | 0.90 | ft |
| Froude Number | 0.45 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.86 | ft |
| Critical Depth | 0.62 | ft |
| Channel Slope | 2.00000 | % |
| Critical Slope | 0.10969 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel: 4535.68 feet
Time of concentration considered = 5 minutes

# X-Section for Cross Section "E-E" at Station "C" 97+68 - 100 year

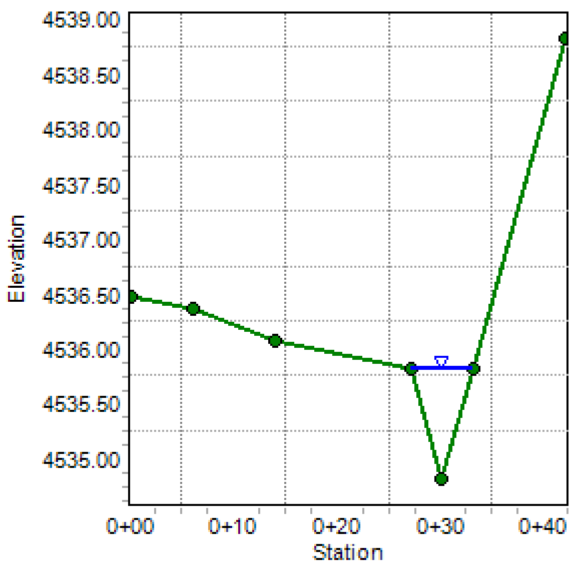
## Project Description

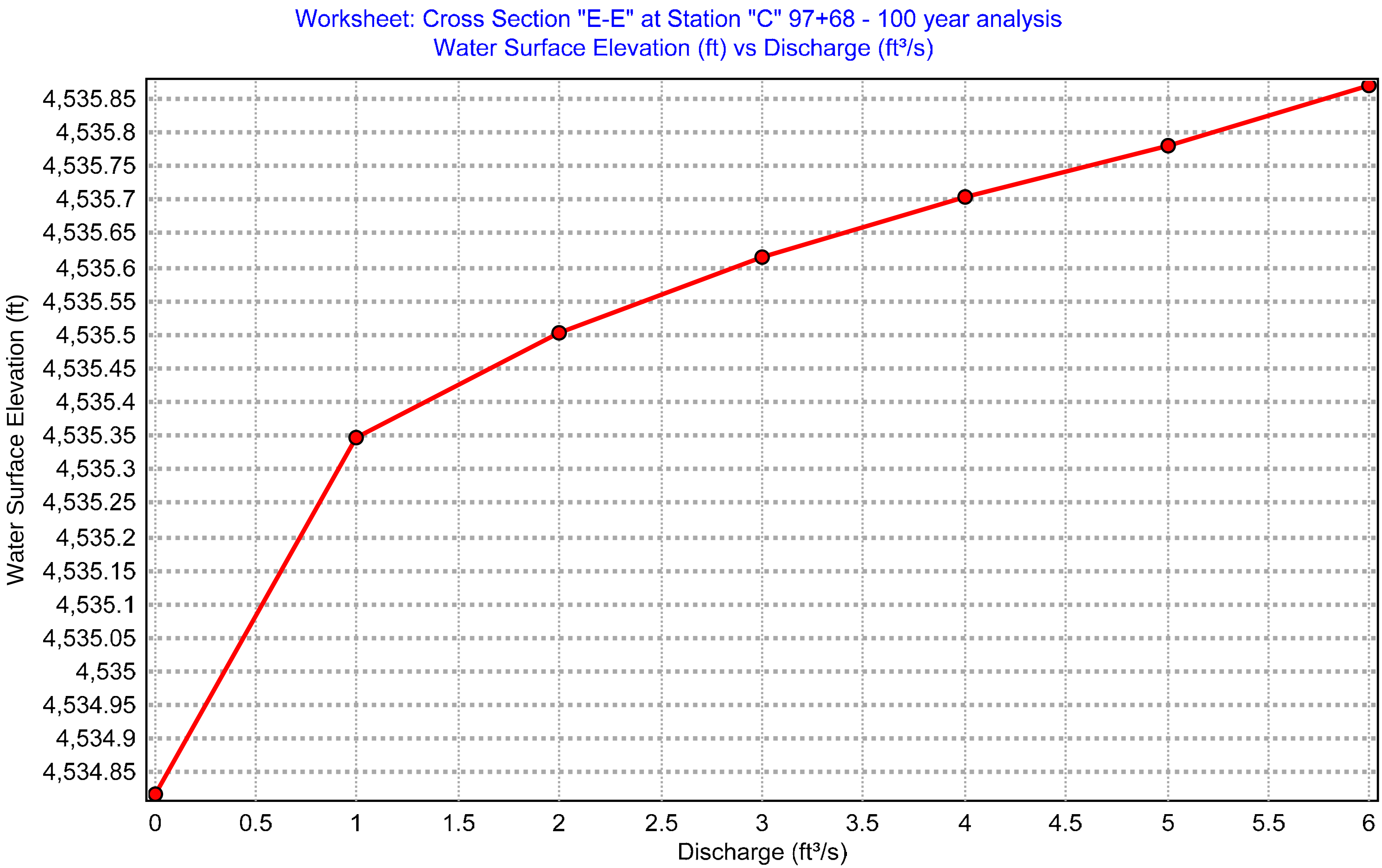
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Normal Depth | 0.99 | ft |
| Discharge | 5.48 | ft³/s |

## Cross Section Image




Worksheet: Cross Section "E-E" at Station "C" 97+68 - 100 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,535.85
4,535.8
4,535.75
4,535.7
4,535.65
4,535.6
4,535.55
4,535.5
4,535.45
4,535.4
4,535.35
4,535.3
4,535.25
4,535.2
4,535.15
4,535.1
4,535.05
4,535
4,534.95
4,534.9
4,534.85
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Discharge (ft³/s)

# Report for Cross Section "E-E" at Station "C" 97+68 - 100 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Discharge | 5.48 | ft³/s |
| Section Definitions | | |

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4536.47 |
| 0+06 | 4536.36 |
| 0+14 | 4536.08 |
| 0+27 | 4535.82 |
| 0+30 | 4534.82 |
| 0+33 | 4535.82 |
| 0+42 | 4538.82 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4536.47) | (0+06, 4536.36) | 0.013 |
| (0+06, 4536.36) | (0+14, 4536.08) | 0.013 |
| (0+14, 4536.08) | (0+27, 4535.82) | 0.035 |
| (0+27, 4535.82) | (0+30, 4534.82) | 0.069 |
| (0+30, 4534.82) | (0+33, 4535.82) | 0.069 |
| (0+33, 4535.82) | (0+42, 4538.82) | 0.035 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.99 | ft |

# Report for Cross Section "E-E" at Station "C" 97+68 - 100 year analysis

## Results

| | | |
|---|---|---|
| Elevation Range | 4534.82 to 4538.82 ft | |
| Flow Area | 2.97 | ft² |
| Wetted Perimeter | 6.29 | ft |
| Hydraulic Radius | 0.47 | ft |
| Top Width | 5.97 | ft |
| Normal Depth | 0.99 | ft |
| Critical Depth | 0.73 | ft |
| Critical Slope | 0.10414 | ft/ft |
| Velocity | 1.85 | ft/s |
| Velocity Head | 0.05 | ft |
| Specific Energy | 1.05 | ft |
| Froude Number | 0.46 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.99 | ft |
| Critical Depth | 0.73 | ft |
| Channel Slope | 2.00000 | % |
| Critical Slope | 0.10414 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel:  4535.81 feet
Time of concentration considered = 5 minutes

# DRAINAGE REPORT
FOR
# SUMMIT CHRISTIAN CHURCH
# WASHOE COUNTY, NEVADA

cfa

# DRAINAGE REPORT
## FOR
# SUMMIT CHRISTIAN CHURCH
# WASHOE COUNTY, NEVADA

PREPARED BY:
CFA, INC.
1150 CORPORATE BOULEVARD
RENO, NV 89502
(775) 856-1150

**JULY 2015**

PROFESSIONAL ENGINEER-STATE OF NEVADA
LONNIE J. JOHNSON
Exp: 6-30-17
CIVIL
No. 19440

7-21-15

## INTRODUCTION

This report presents the storm water drainage plan for the proposed site improvements at the Summit Christian Church (SCC), located at 7075 Pyramid Highway, Sparks, NV 89436 in Washoe County, Nevada (APN No. 083-730-08). The project is located on the west side of Pyramid Highway at Golden View Drive, approximately 2.5 miles north of McCarran Boulevard (Ref. Figure 1, Vicinity Map, Appendix A). The 36-acre site has been partially developed in the initial phases of construction, consisting of a 35,000 square foot interim sanctuary building with associated parking and walkways, a primary access road from Pyramid Highway, and a fire department access/site access road. The purpose of this study is to compare the existing generated 5-year, 25-year, and 100-year flows to the proposed increased site development to mitigate any increase in flows for the 5-year, 25-year, and 100-year storms per Washoe County and NDOT requirements.

## SITE DESCRIPTION

The 36-acre site is located in Section 16, Township 20 North, Range 20 East, MDM. The property is bordered by Pyramid Highway on the east and by undeveloped land on the south, west, and north sides. The site has been partially developed with access roads, parking areas, and a 35,000-square-foot building. The undeveloped portion of the site has a moderate eastward slope of approximately 10 percent and increases to over 30 percent in some areas. A majority of the developable area of the parcel to be constructed is sparsely vegetated and the topography is relatively flat with slopes ranging from 0% to 2%. The site has been rough graded as part of the future anticipated construction of a future new building expansion with additional parking, and a fire department access/site access road was installed on the north boundary of the site. According to the geotechnical investigation prepared by Black Eagle Consulting (June 19, 2014), native soils consist primarily of highly expansive clays underlain by clayey sands and gravels. Vegetation consists of grasses and sparse sagebrush.

## PROJECT DESCRIPTION

The initial construction of the Summit Christian Church site consisted of a 35,000 square foot interim sanctuary building with associated parking and walkways, rough grading for future expansion and temporary site detention, as well as construction of a fire department access/site access roads on the north boundary of the site from Pyramid Highway. The next phase of construction augments the 35,000 square foot interim sanctuary building with improved roadway site vehicular circulation and access, on-site grading, and upgraded on- and off-site drainage piping and hydrological improvements that include NDOT's Right-of-Way. Reconstruction of the existing parking lot area on the south and southeast will include parking space and landscaping improvements and include additional walkways. A portion of the northern half of the site will be graded for future development of a proposed building addition and increased parking. Remaining areas of the property to the south, west and north of the site will remain undeveloped due to the steep existing grades. The proposed Phase 3 improvements, the proposed future development of the new building addition, and increased additional paved parking areas on-site are included in the hydrological analysis and design of this phase of construction.

With the increased number of church members, modifications to the site vehicular circulation system are needed. The proposed modifications of the vehicular circulation system include:

- A deceleration lane is to be constructed in the south bound lane of Pyramid Highway and will enter the site at the existing fire department access/site access road on the north end of the property. The deceleration lane will begin approximately 750 feet to the north of the start of the radius of the entrance. The lane will continue west onto the site at the north end from the east property line and continue as a site ingress at a slope of approximately 9.0% up to the proposed parking lot area. The deceleration lane has been designed to meet NDOT's standards when constructed.
- An on-site loop road will continue around the west perimeter of the property, continuing from the proposed north ingress road and continue over to the south end of the site, creating a large "loop" to access the south parking lot. Grading of a majority of the loop road will remain as it is in existing condition, specifically west of the existing building, with removal of parking spaces for improved and safer vehicular travel.
- From the on-site loop road, patrons will be able to leave the site at the south end from a proposed site egress, consisting of slopes ranging from approximately 3.0% to 10.0% at the southeast corner of the property. The egress will route traffic out of the site to a south bound acceleration lane for vehicles to merge onto Pyramid Highway. The acceleration lane has been designed to meet NDOT's standards when constructed. The acceleration lane will allow vehicles to travel approximately 900 feet before reaching a 300 foot roadway section taper to merge into traffic on Pyramid Highway. A 42-inch diameter ADS N-12 WT IB pipe is proposed to be installed along the west side of Pyramid Highway to intercept the proposed site improvement storm water runoff flows and runoff from the Spring Ridge Subdivision to the west of Pyramid Highway. A drainage swale/channel has been incorporated into the full acceleration lane design for the tie-in to the western slope to intercept flows off of Pyramid Highway and divert storm water flows from Pyramid Highway into the existing public drainage system downstream at existing dual 24-inch culverts at Spring Ridge Drive. The proposed 42-inch diameter ADS N-12 WT IB pipe begins at the

termination of an existing 36-inch culvert from the Spring Ridge Subdivision until it reaches a proposed outlet structure that will drain into the existing 24” dual RCP and CMP culverts, where it will divert the storm water flows collected into the existing public drainage system.

## FLOOD ZONE

According to FIRM Index Map # 32031C3051G dated March 16th, 2009; Panel 3015G, the proposed project lies within Zone X unshaded, indicating areas determined by FEMA to be outside the limits of the 500-year flood plain (Ref. FIRM Map, Appendix B). Flood zones were previously located with reference to the FEMA Flood Insurance Rate Map, Panels 3003 and 3005, dated September 30, 1994 in CFA’s Master Drainage Report for the initial site development and construction dated July, 2003. (Ref. Master Drainage Report for Summit Christian Church, Appendix C).

## EXISTING DRAINAGE SYSTEM

### Off-site Drainage:

The existing drainage system, constructed in the initial phases of the project, consists of curb and gutter, storm drain catch basins, a detention pond located in the southwest corner of the site, graded and rip-rapped drainage swales, and a storm drain system. CFA generated a Master Drainage Report for the initial site development and construction dated July, 2003. (Ref. Master Drainage Report for Summit Christian Church, Appendix C).

Off-site flows from the slopes west of the project site develop storm water runoff event flows that have previously been included in the currently established drainage system. A summary of the peak flows leaving the site in existing conditions is as follows:

Table 1 - Drainage Summary

| Basin | Event | Existing (cfs) |
|---|---|---|
| A | 25 year | 24 |
| A | 100 year | 41 |
| B | 25 year | 34 |
| B | 100 year | 68 |

Basin A drains toward the south and Basin B to the north along Pyramid Highway (Ref. Master Drainage Report for Summit Christian Church, Appendix C, for Master Hydrology Map Basin Areas). A detention pond was constructed at the southwest corner of the site to intercept some of these off-site flows. A two-stage outlet structure controls the outflow so that, when the flows reach Pyramid Highway, overall increases are substantially mitigated in the 25-year storm.. The pond is designed to perform as follows:

Table 2 - Pond Performance Summary

| Event | Inflow (cfs) | Outflow (cfs) | Max Stage (ft) |
|---|---|---|---|
| 25 year | 11 | 5 | 4604.2 |
| 100 year | 23 | 23 | 4605.1 |

Graded rip-rapped intercept swales at the highest point of the cut slopes were constructed along the west side of the developed site. The swales were installed along the north and south sides of the fire department access/site access road to mitigate storm water runoff flows from the west and to discharge them into the natural drainages for infiltration to the north and into the detention pond on the south side of the site. The rip-rapped intercept swales have been designed for the 25-year and 100-year design storms using the Rational Method.

Any off-site flows not intercepted by the drainage swales or detention basin sheet flow to existing drainage channels that exist along the property line along the west side of Pyramid Highway. Most of the drainage channel area south of the project site appears to not have been maintained for a period of time and currently demonstrates problems in transporting storm water runoff downstream.

On-site Drainage:

The existing storm drain system from the on-site flows divert to existing on-site curb inlets, storm drains, and storm drain infrastructure, which have been sized for the 5-year storm event flows. The storm water runoff discharges into drainage channels along the west side of Pyramid Highway along the east property line. Existing drainage channels along the west side of Pyramid Highway that front the property line currently divert storm water runoff to existing downstream public storm water infrastructure.

## PROPOSED DRAINAGE SYSTEM

With the previously described site improvements, construction of Phase 3 of this project will generate a proposed on-site drainage system consisting of modification of existing curb and gutter in improved parking areas, installation of new curb and gutter, storm drain piping, redirected and regraded rip-rapped intercept swales, and new landscaped areas throughout the site.

### On-site Drainage:

The on-site drainage for the site improvements will sheet flow away from the existing building, sheet flow over the existing and proposed reconstructed parking areas at moderate slopes of 1.5% - 5.1%, and travel to curb and gutter sections, where the flow will be diverted into the proposed on-site storm drain infrastructure system, where flow will be transported downstream into the public storm water infrastructure, via designed pipe systems or rip-rap intercept swales. In some areas, on-site drainage will sheet flow over the paved surfaces and into on-site natural drainage swales where the flows will then be infiltrated into the existing vegetation. Some on-site drainage is anticipated to travel off-site to the existing NDOT right-of way. Also, on-site landscaping islands throughout the parking areas and landscaping throughout the site will help intercept and infiltrate any storm water runoff flows on site. The proposed on-site flows diverting to existing on-site curb inlets, storm drains, and the storm drain infrastructure, were sized for the 5-year storm event using the Rational Method.

### Off-site Drainage:

#### North Ingress/Deceleration Lane

A proposed north deceleration lane has been designed to carry traffic off of Pyramid Highway into the church site. The existing fire road and 24-inch reinforced concrete pipe culvert under the fire road will be removed. With this design; however, it is anticipated that off-site storm water runoff flows that divert to the north will be intercepted in a similar manner as the existing conditions. Some on-site storm water runoff flows are anticipated to travel to on-site graded rip-rapped intercept swales at the highest point of the cut slopes along the west side of the developed site and discharge into the natural drainage channels where they will be infiltrated into the existing vegetation. Any on-site and off-site peak runoff flows that reach the NDOT right-of-way, will be intercepted through drainage swales and a proposed culvert, and be carried to the public storm water infrastructure system. A proposed 24-inch diameter reinforced concrete pipe will be installed under the proposed north deceleration lane to divert storm water runoff off-site flows from the north side of the site to the downstream public storm drain infrastructure system. Any regraded and/or reconstructed rip rapped intercept swales were designed for the 25-year and 100-year design storms using the Rational Method. Calculations of the off-site drainage peak runoff flows are included in Appendix E. A summary of the storm water runoff flow elevations was generated and is provided in Appendix H. Culvert and channel analysis using the proposed 25-year and 100-year peak runoff flows was conducted using Flow Master and Culvert Pro software. Analysis reports are included in Appendix H.

South Egress/Acceleration Lane

With the installation of the south acceleration lane on Pyramid Highway, a drainage swale, several proposed culverts, and a 42-inch diameter ADS N-12 WT IB pipe are proposed to be installed along the west side of Pyramid Highway. The 42-inch storm drain has been designed downstream (south) from the site along the west side of Pyramid Highway to intercept any additional proposed site improvement storm water runoff flows, as well as, any existing storm water runoff from the Spring Ridge Subdivision to the west of Pyramid Highway (Ref. Hydrology Analysis & Report, Prepared for Spring Ridge Subdivision, by Mountain West Engineering, dated May, 1993, and Amended Washoe County Engineering Hydrology Reports by Mountain West Engineering, dated August 23, 1993 and November 19, 1993, respectively, Appendix D). The 42-inch diameter ADS N-12 WT IB pipe was designed to carry a 25-year storm water runoff event using the Rational Method with over 40 percent of full pipe capacity remaining. The 42-inch diameter ADS N-12 WT IB pipe design will also carry a 100-year storm water runoff event, using the Rational Method, with 15 percent of full pipe capacity remaining.

For the proposed acceleration lane, three (3) proposed culverts and a drainage swale/channel has been incorporated into the design to tie-in to the western slope. The three (3) culverts consist of:

- A 36-inch diameter reinforced concrete pipe under the south egress acceleration lane.
- An upgraded 36-inch diameter reinforced concrete pipe at the Spring Ridge Fire Road to replace an existing 18-inch reinforced concrete pipe.
- A 36-inch diameter reinforced concrete pipe at the tie-in to the proposed manhole (MH-1, Type 4) structure at Station “A” 16+00.01. This system will connect to the proposed 42-inch diameter ADS N-12 WT IB pipe to carry upstream flows which outlet into an open channel upstream of the dual 24-inch RCP & CMP culverts at the Spring Ridge Drive intersection.

The drainage swale has been developed to carry the 25 year minimum design storm runoff return frequency with the limitation of allowing submergence of ½ of the adjacent main travel lane (Lane #2), per NDOT requirements. Several analyses along the roadway from various selected locations were conducted of the channel designed using the computer program Flow Master to determine if the channel could carry the 25 year storm event flows and meet NDOT's requirements. Each culvert was analyzed for capacity and upstream headwater elevations using CulvertPro software. Upon analysis of these locations and reviewing the proposed and existing grades of the ditch and the roadway sections, it was found that the spread of the storm flows in certain locations will submerge ½ of the adjacent travel lane, but will not exceed this limitation. Calculations of flow rates used assume upstream flows are not diverted through the two existing 18-inch culverts that cross Pyramid Highway along this path. This assumption was made due to the recent observation of downstream capacity limitations caused by a downsizing to a 12-inch storm drain line on the east side of Pyramid Highway in this vicinity. Although some drainage through these two existing 18-inch culverts will occur, we have assumed that during 25-year or larger storm events, no drainage will occur through these 18-inch culverts. A summary, along with calculations of the channel and culvert capacities using Flow Master and CulvertPro are provided in Appendix H.

## HYDROLOGY

The proposed Phase 3 improvements, as well as, the proposed future development of the new building addition and increased additional paved parking areas on-site have been taken into consideration and included in the hydrological analysis and design. Peak flows for the on-site watersheds were estimated for the 25-year and 100-year design storm water runoff events using the Rational Method (Ref. Rational Method Hydrology Proposed Sub-Basin Calculations, Appendix E). The proposed on-site surface drainage system, as well as, the off-site drainage systems and storm drain infrastructure within NDOT Right-of-Ways were designed for the 25-year runoff event (Ref. Rational Method Hydrology Proposed Sub-Basin Calculations, Appendix E, Flow Master Proposed Storm Drain Pipe Design & Channel Flow Calculations for On-Site Storm Flows, Appendix F, and Flow Master Proposed Storm Drain Pipe Design & Channel Flow Calculations for Storm Flows Contributing to NDOT Right-of-Way, Appendix H). Proposed drainage areas were broken into sub-basins for reference and ease of calculations (Ref. Proposed Hydrology Basin Site Plans – Southern Half of Site & Northern Half of Site, Appendix G). Reconstruction of the rip-rapped intercept swales were sized for the 100-year storm event. The C-values for the site vary from area to area with respect to development. The C-values increase as the site is developed with impermeable surfaces (i.e., roof of the new church building in future phase, pavement for the additional parking lot area in future phase, etc.).

The increase in storm water runoff flows compared to the existing site conditions is negligible. Storm drain piping removed and replaced due to site improvements was sized in accordance with the 25-year storm water runoff events. It was found that when piping was replaced, the same kind and size of pipe were adequate to service possible storm water flow events. Future site improvements to the site were included in the design and analysis of the proposed storm drain infrastructure system, both on-site and for the NDOT right-of-way, and the proposed pipe designs were found adequate for the 25-year storm event.

## RATIONAL METHOD

The Rational Method is used to estimate the peak runoff resulting from a rain storm of given intensity and frequency falling on a specific watershed. The peak flow is expressed as:

$$Q = C\,i\,A$$

where
$Q$ = Peak rate of runoff, cubic feet per second
$C$ = Runoff coefficient
$i$ = Average rainfall intensity, inches per hour
$A$ = Watershed area, acres

Washoe County allows the use of the Rational Method for drainage basins that are not complex and have small drainage areas that are 100 acres or less. Runoff computations are made using criteria provided by the Truckee Meadows Regional Drainage Manual, dated April 30, 2009. Runoff coefficients were determined from Table 701 in the Truckee Meadows Regional Drainage Manual. Rainfall intensities were determined from the rainfall intensity-duration-frequency (IDF) curves from NOAA ATLAS 14, Volume 1 (2006). The initial time of concentration, $T_{c(1)}$, is calculated by the formula:

$$T_{c(1)} = 10 \text{ or } \frac{L}{60 \times V} \text{ (whichever is greater)}$$

where
$T_{c(1)}$ = Initial time of concentration, minutes
$L$ = Length from uppermost point of watershed to design point, feet
$V$ = Channel or overland velocity, feet per second

The initial time of concentration models build-up and sheet flow conditions in the uppermost part of the watershed. Except for very small impervious watersheds, the minimum build-up time of 10 minutes is assumed. Therefore, for the first design point, the time of concentration is determined by adding travel time to the build-up time as follows:

$$T_{c(1)} = 10 + \frac{L}{60 \times V}$$

The time of concentration at successive points downstream is calculated by adding total travel time to the initial build-up time:

$$T_{c(n)} = 10 + \sum \frac{L}{60 \times V}$$

where

| | | |
|---|---|---|
| where | $T_{c(n)}$ | = Time of concentration at design point, minutes |
| | $\sum \frac{L}{60 \times V}$ | = Total travel time to design point, minutes |
| | L | = Length of flow path between design points, feet |
| | V | = Velocity, feet per second |

Velocities used are 2 - 3 fps for surface flow and 3 - 5 fps for channel and conduit flow.

Rational Method calculations are performed using a spreadsheet containing the appropriate IDF curves and routing parameters. The peak flow for each drainage area is determined based on the runoff coefficient, initial time of concentration, and area (Ref. Rational Method Hydrology Proposed Sub-Basin Calculations, Appendix E).

## CONCLUSION

The site can be developed as planned with respect to storm water drainage without adverse impact to adjacent or downstream properties, in the assumption that the NDOT capacities downstream of our site on both the north and south ends are adequate. On the north end, on-site and off-site flows accumulate at an existing 36-inch culvert crossing Pyramid Highway. We have been unable to verify through field survey and through requests for as-builts from NDOT and Washoe County, and neither have produced a definitive layout of the final outlet point for this 36-inch culvert. In discussions with Brian Matthews (NDOT Headquarters), it has been agreed that for the purposes of our site development, it is fair to assume this 36-inch culvert has the capacity of a typical 36-inch reinforced concrete pipe with minimal slope and flared-end entry losses. In this scenario, all standards are met and the adjacent travel lane is not submerged.

Additionally, on the south end of our site (as discussed in the South Egress/Acceleration Lane Section above), we have observed limitations in the downstream capacity of the two existing 18-inch culverts crossing Pyramid Highway, south of the Golden View Drive intersection. Therefore, we have designed our system of culverts and roadside ditches to carry the peak flows of the 25-year storm event, while submerging ½ of the adjacent travel lane or less. In our analysis, it should be noted that we do submerge our proposed acceleration lane on the south of the project. Since the acceleration lane only serves the Summit Church site, it was discussed with NDOT hydraulics that the design will allow mainline travel lane (Lane #2) submergence of ½ the lane.

Lastly, at the outlet of our proposed 42-inch pipe, all flows converge and enter the existing dual 24-inch culverts at the Spring Ridge Drive intersection. After culvert analysis at this point, we estimate that flows will spill over Spring Ridge Drive during the 25-year event in both the existing and proposed conditions. This has been identified as an existing downstream capacity limitation within the NDOT storm drainage infrastructure. At this point, at the Spring Ridge Drive intersection, there will be submergence of lanes beyond the ½ lane target during the 25-year event.

REFERENCES

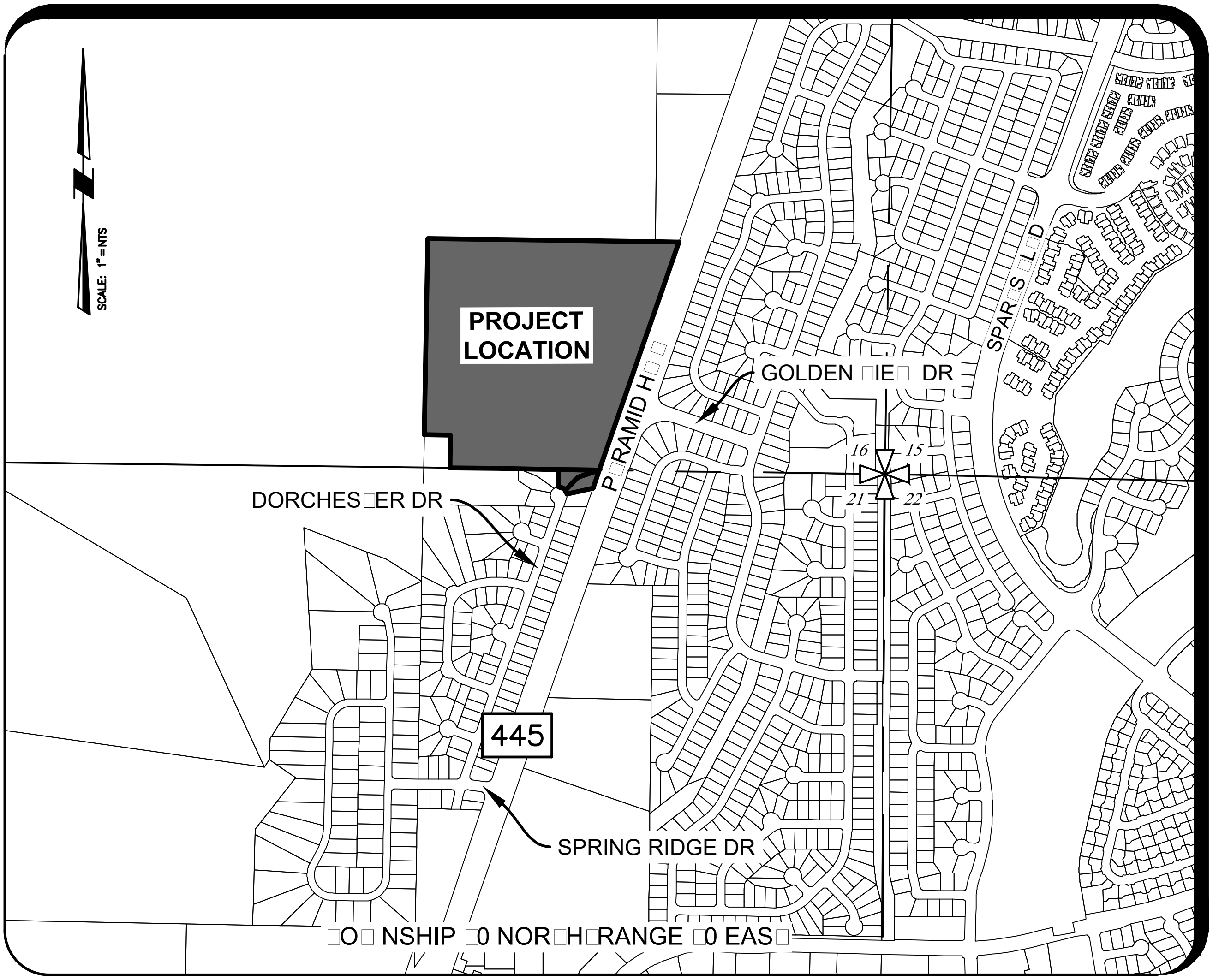
Black Eagle Consulting, Geotechnical Investigation, Summit 2.0, 7075 Pyramid Highway, Washoe County, June 19, 2014.

NOAA Atlas 14. Volume 1 Version 5.0. (2006). Silver Spring, Maryland

Truckee Meadows Regional Drainage Manual. (April 30, 2009). Reno/Sparks/Washoe County: Washoe County

Washoe County, Washoe County Hydrologic Criteria and Drainage Design Manual (Final Draft Report), December 1996.

# APPENDIX A
## VICINITY MAP




# VICINITY MAP
NOT TO SCALE

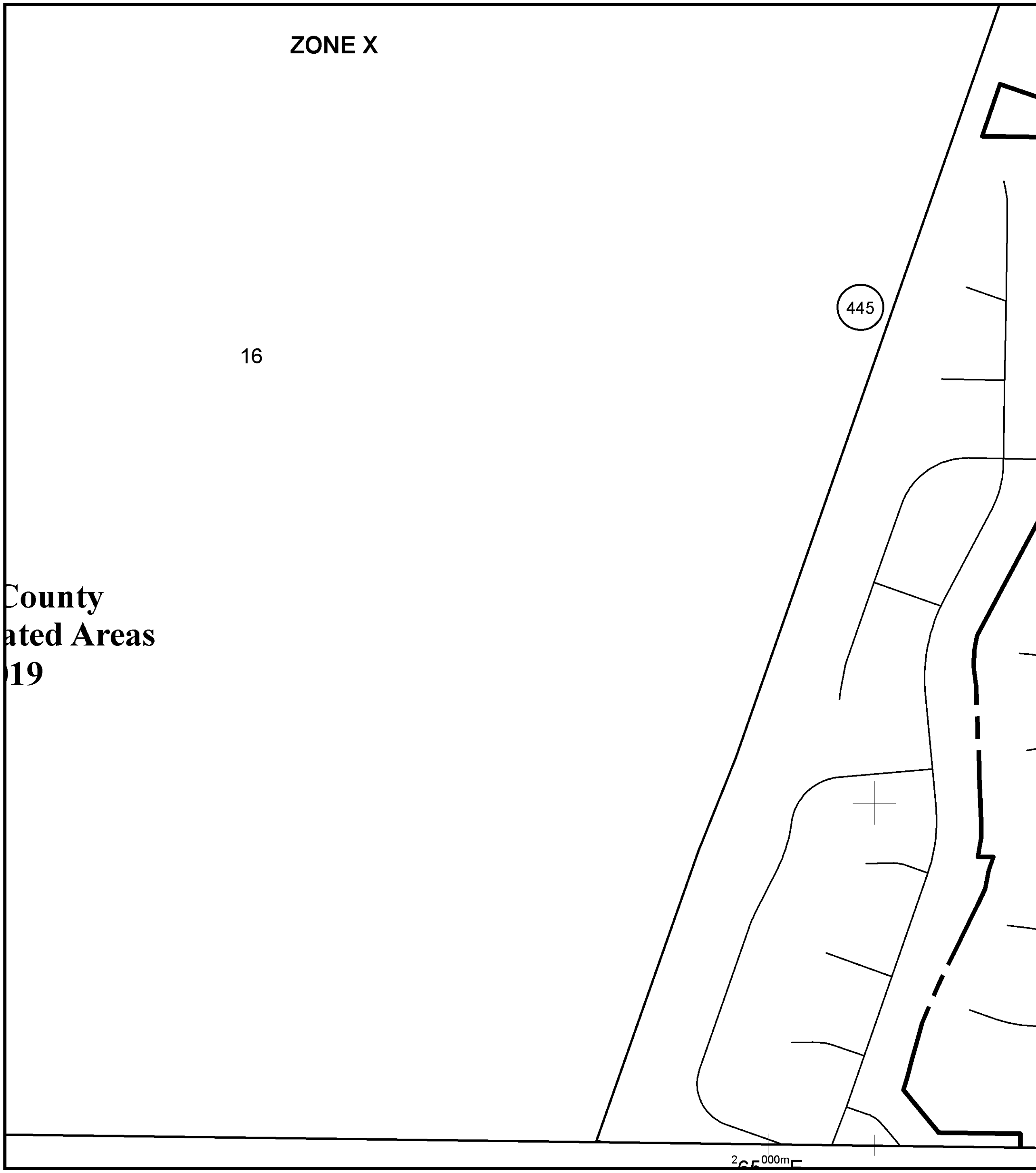
□:□PRO□EC□S□0□00□0□D□ G□ENGR□SHEE□S□H□DRO□PHASE □IMP□D□ G □□HERMES□ □□□□0□□ □:□□AM

cfa
□□□0 CORPORA□E □L□D□
RENO□N□ □□□0□
□□□□□□□□□□□□0

PLA□E □
□ICINI□□ MAP
S□MMI□ CHRIS□IAN CH□RCH

SHEET
OF

# APPENDIX B
## FIRM MAP




ational Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 3051G

# FIRM
## FLOOD INSURANCE RATE MAP

**WASHOE COUNTY, NEVADA AND INCORPORATED AREAS**

**PANEL 3051 OF 3475**

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| SPARKS, CITY OF | 320021 | 3051 | G |
| WASHOE COUNTY | 320019 | 3051 | G |

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

**MAP NUMBER 32031C3051G**

**MAP REVISED MARCH 16, 2009**

**Federal Emergency Management Agency**

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

# APPENDIX C

CFA MASTER DRAINAGE REPORT
FOR SUMMIT CHRISTIAN CHURCH
JULY 2003

# MASTER DRAINAGE REPORT
## FOR
# SUMMIT CHRISTIAN CHURCH

# MASTER DRAINAGE REPORT
# FOR
# SUMMIT CHRISTIAN CHURCH

**SPANISH SPRINGS VALLEY**

**WASHOE COUNTY, NEVADA**

PREPARED FOR:
FYSO
P.O. BOX 34600
RENO, NV 89533

PREPARED BY:
CFA, INC.
1150 CORPORATE BOULEVARD
RENO, NV 89502
(775) 856-1150

**JULY 2003**

## INTRODUCTION

This report presents a master drainage plan for the 36-acre Summit Christian Church site in Washoe County, Nevada. The project is located on the west side of Pyramid Highway at Golden View Drive, approximately 2.5 miles north of McCarran Boulevard. The initial phase of the project has already been constructed, including a 20,000 square foot interim sanctuary building with associated parking and walkways, as well as the primary access road from Pyramid Highway. Temporary detention has been provided in the overflow parking area north of the entrance road. The purpose of this study is to generate 5-year and 100-year flows for the proposed development, and to size a permanent detention facility to mitigate increased flows in the 25-year and 100-year storms per NDOT requirements. Curb inlets and storm drains along access roads are sized for the 5-year flows.

## PROJECT DESCRIPTION

The initial phase of the proposed Summit Christian Church consists of a 20,000 square foot interim sanctuary building, to be augmented by a 40,000 square foot permanent sanctuary and a classroom/administration building to the north, and pre-school classrooms and a family life center to the south. The buildings will be served by paved parking areas, access drives, and walkways. A significant portion (more than 50%) of the property will remain undeveloped due to the steep existing grades. See Plate 1 - Vicinity Map.

## SITE DESCRIPTION

The 36-acre site is located in Section 16, Township 20 North, Range 20 East, MDM. The property is bordered by Pyramid Highway on the east and by undeveloped land on the south, west, and north sides. The site has been partially developed with access roads, parking areas, and a 20,000-square-foot building. The undeveloped site has a moderate eastward slope of approximately 10 to over 30 percent. According to the geotechnical investigation prepared by Black Eagle Consulting (November 2000), native soils consist primarily of highly expansive clays underlain by clayey sands and gravels. Vegetation consists of grasses and sparse sagebrush.

## FLOOD ZONE

The proposed project lies in an unshaded Zone X, indicating areas determined by FEMA to be outside the limits of the 500-year flood plain. Flood zones were located with reference to the FEMA Flood Insurance Rate Map, Panels 3003 and 3005, dated 30 September 1994.
See Plate 2 – Flood Zone Map.

## EXISTING DRAINAGE SYSTEM

The existing drainage system consists of curb and gutter, catch basins, and a storm drain system constructed with the initial phase of the project. The storm drain system discharges to Pyramid Highway. The storm drain system has been stubbed past the initial improvements. At the time of our site visit, no graded drainage swales were evident above the cut slopes or along the tank access road. It appears that off-site flows will sheet flow across the property. Temporary detention is provided in the graded area north of the entrance road.

Off-site drainage basins A and B were developed by Nimbus (September 2001) (Ref. Figure 2) and were modified by CFA to conform to the present site plan. Times of concentration were recalculated. Nimbus performed a hydrologic analysis using HEC-1 to demonstrate that increased flows were substantially mitigated in the 100-year storm and partially mitigated in the 25-year storm.

## PROPOSED DRAINAGE SYSTEM

The proposed drainage system consists of curb and gutter, catch basins, and a storm drain system designed for the 5-year storm, and ditches sized for the 100-year storm. The construction plans for the current phase include ditches not constructed with the initial phase, including intercept ditches at tops of cut slopes. These intercept ditches discharge into the natural drainages on the north and south sides of the site.

A detention pond is proposed at the southwest corner of the site to intercept some of the off-site flows. A two-stage outlet structure will control the outflow so that, when the flows reach Pyramid Highway, overall increases are substantially mitigated in the 100-year storm and partially mitigated in the 25-year storm in conformance with the present conditions. The pond is designed to perform as follows:

Table 1 - Pond Performance Summary

| Event | Inflow (cfs) | Outflow (cfs) | Max Stage (ft) |
|---|---|---|---|
| 25 year | 11 | 5 | 4604.2 |
| 100 year | 23 | 23 | 4605.1 |

A summary of the peak flows leaving the site in existing and proposed conditions is as follows:

Table 2 - Drainage Summary

| Basin | Event | Existing (cfs) | Proposed (cfs) | Change (cfs) |
|---|---|---|---|---|
| A | 25 year | 19 | 24 | +5 |
| A | 100 year | 39 | 41 | +2 |
| B | 25 year | 34 | 34 | 0 |
| B | 100 year | 69 | 68 | -1 |

Basin A drains toward the south and Basin B to the north along Pyramid Highway. The site is located at a local high point in the road. The existing condition is pre-project (historic) and the proposed condition is post-project, full buildout, with detention. The 5 cfs increase in the 25-year storm in Basin A, a 26% increase, is comparable to the 31% increase in this basin as per the Nimbus study.

**HYDROLOGY**

Major drainage basins, including off-site basins A and B and the proposed detention pond, were analyzed using HEC-1. The computations are presented in Appendix B. Times of concentration and runoff coefficients were calculated using methods given in the Washoe County Hydrologic Criteria and Drainage Design Manual (December 1996). Muskingum-Cunge routing parameters were estimated based on professional opinions of slope and ground cover.

The on-site drainage system including individual catch basin flows was analyzed using the Rational Method as adopted by Washoe County. The tributary drainage basins were determined to be in Zone I. Rational Method calculations are performed using a spreadsheet containing the appropriate IDF curves and routing parameters. Hydrologic tabling is done in two parts. In Part A, the peak flow for each drainage area is determined based on the runoff coefficient, initial time of concentration, and area. These flows are used to locate and size the drainage inlets. In Part B, flows are accumulated starting with the initial subarea and proceeding downstream. At each design point travel time is added and the peak flow is computed using the average runoff coefficient, the time of concentration at that point, and the total tributary area. These cumulative flows are used in the design of interceptor channels and storm drains where applicable.

**REFERENCES**

Nimbus Engineers, Conceptual Drainage Report, Summit Christian Church, Washoe County, Nevada, September 2001.

Black Eagle Consulting, Geotechnical Investigation, Summit Christian Church, Spanish Springs Valley, November 2000.

Washoe County, Washoe County Hydrologic Criteria and Drainage Design Manual (Final Draft Report), December 1996.

**CONCLUSIONS**

1. Summit Christian Church can be developed as planned without adverse impact to neighboring or downstream properties.

2. The proposed detention storage reduces peak flows in the 25 and 100-year storm events.

# APPENDIX A

## RATIONAL METHOD CALCULATIONS
## HEC-1 DATA SUMMARY

VERSION: 12-02-1996

STANDARD FORM 2

# WASHOE COUNTY

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## TIME OF CONCENTRATION

**DEVELOPMENT** SUMMIT CHRISTIAN CHURCH - MASTER

**CALCULATED BY** TAH **DATE** 6/26/2003

| SUB-BASIN DATA | | | | INITIAL / OVERLAND TIME ($t_i$) | | | TRAVEL TIME ($t_t$) | | | | $t_c$ ($t_i + t_t$) | $t_c$ URBANIZED BASINS CHECK | | FINAL $t_c$ | FINAL $t_c$ | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Desig: (1) | R (2) | Area Ac (3) | Urban? Y / N | Length Ft (4) | Slope % (5) | $t_i$ Min (6) | Length Ft (7) | Slope % (8) | Vel. FPS (9) | $t_t$ Min (10) | $t_c$ Min (11) | Tot Len Ft (12) | $t_c$=(L/180)+10 Min (13) | Min (14) | Hr | |
| A | 0.67 | 33.6 | N | 300 | 23.0 | 4.7 | 1700 | 21.0 | 4.6 | 6.2 | 10.9 | 2000 | 21.1 | 10.9 | 0.18 | |
| B | 0.67 | 97.8 | N | 300 | 10.0 | 6.2 | 3900 | 12.0 | 3.5 | 18.8 | 25.0 | 4200 | 33.3 | 25.0 | 0.42 | |
| | | | | | | | | | | | | | | | | |
| A1 | 0.67 | 11.7 | N | 300 | 23.0 | 4.7 | 1000 | 20.0 | 4.5 | 3.7 | 8.4 | 1300 | 17.2 | 10.0 | 0.17 | |
| A2 | 0.67 | 5.1 | N | 300 | 20.0 | 4.9 | 850 | 18.0 | 4.2 | 3.3 | 8.3 | 1150 | 16.4 | 10.0 | 0.17 | |
| A3 | 0.67 | 1.0 | N | 100 | 33.0 | 2.4 | 470 | 0.8 | 0.9 | 8.8 | 11.2 | 570 | 13.2 | 11.2 | 0.19 | |
| A4 | 0.67 | 2.2 | N | 280 | 21.0 | 4.7 | 200 | 10.0 | 3.2 | 1.1 | 5.7 | 480 | 12.7 | 10.0 | 0.17 | |
| A5 | 0.67 | 1.1 | N | 280 | 16.0 | 5.1 | 560 | 9.0 | 3.0 | 3.1 | 8.3 | 840 | 14.7 | 10.0 | 0.17 | |
| B1 | 0.67 | 1.5 | N | 300 | 15.0 | 5.4 | 500 | 11.0 | 3.3 | 2.5 | 7.9 | 800 | 14.4 | 10.0 | 0.17 | |
| B2 | 0.64 | 89.1 | N | 300 | 10.0 | 6.7 | 3900 | 12.0 | 3.5 | 18.8 | 25.4 | 4200 | 33.3 | 25.4 | 0.42 | |
| CDE | 0.87 | 5.2 | Y | 40 | 2.0 | 2.1 | 1300 | 4.0 | 4.1 | 5.3 | 7.4 | 1340 | 17.4 | 7.4 | 0.12 | |
| F | 0.89 | 1.1 | Y | 260 | 4.0 | 3.8 | 0 | 0.0 | 0.0 | 0.0 | 3.8 | 260 | 11.4 | 5.0 | 0.08 | |
| G | 0.75 | 2.5 | Y | 20 | 3.0 | 2.0 | 540 | 6.0 | 5.0 | 1.8 | 3.8 | 560 | 13.1 | 5.0 | 0.08 | |
| H | 0.89 | 1.6 | Y | 350 | 7.0 | 3.7 | 0 | 0.0 | 0.0 | 0.0 | 3.7 | 350 | 11.9 | 5.0 | 0.08 | |
| I | 0.75 | 1.4 | Y | 110 | 27.0 | 2.2 | 360 | 0.5 | 1.4 | 4.2 | 6.4 | 470 | 12.6 | 6.4 | 0.11 | |
| J | 0.87 | 3.1 | Y | 100 | 33.0 | 1.3 | 720 | 3.0 | 3.5 | 3.4 | 4.7 | 820 | 14.6 | 5.0 | 0.08 | |
| K | 0.89 | 2.2 | Y | 330 | 4.0 | 4.3 | 0 | 0.0 | 0.0 | 0.0 | 4.3 | 330 | 11.8 | 5.0 | 0.08 | |
| L | 0.75 | 1.8 | Y | 95 | 28.0 | 2.0 | 430 | 0.5 | 1.4 | 5.0 | 7.0 | 525 | 12.9 | 7.0 | 0.12 | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

(9) Travel time velocity curves from Figure 701:

Non-urban = "nearly bare and untilled"

Urban = "paved area (sheet flow) and shallow gutter flow"

$$t_i = 1.8\,(1.1 - R)\,L^{1/2} / S^{1/3}$$

**SCS HYDROLOGIC DATA SUMMARY**

**SUMMIT CHRISTIAN CHURCH - MASTER DRAINAGE PLAN**

| Watershed | Design | Area | Area | Pervious Areas | | | | Pct | Comp | Runoff | Area | Routing | | | | | Routed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Point | (Ac) | (sq mi) | HSG | Cover | Cond. | CN | Imp. | CN | Coeff R | Tc (hr) | P/U | L(ft) | S(%) | V(fps) | Tt(hr) | to |
| A | 1 | 33.6 | 0.053 | D | | | 80 | 0 | 80 | 0.67 | 0.18 | | | | | | |
| B | 2 | 97.8 | 0.153 | D | | | 80 | 0 | 80 | 0.67 | 0.42 | | | | | | |
| | | | | | | | | | | | | | | | | | |
| A1 | 1.2 | 6.5 | 0.010 | D | | | 80 | 0 | 80 | 0.67 | 0.17 | U | 400 | 10.0 | 5.1 | 0.02 | P1 |
| A2 | P1 | 11.3 | 0.018 | D | | | 80 | 0 | 80 | 0.67 | 0.17 | | | | | | |
| A3 | P1 | 1 | 0.002 | D | | | 80 | 0 | 80 | 0.67 | 0.19 | | | | | | |
| P1 OUT | | | | | | | | | | | | U | 600 | 9.0 | 4.8 | 0.03 | 1 |
| A4 | 1.1 | 2.2 | 0.003 | D | | | 80 | 0 | 80 | 0.67 | 0.17 | U | 600 | 9.0 | 4.8 | 0.03 | 1 |
| A5 | 1 | 1.1 | 0.002 | D | | | 80 | 0 | 80 | 0.67 | 0.17 | | | | | | |
| B1 | 2.1 | 1.5 | 0.002 | D | | | 80 | 0 | 80 | 0.67 | 0.17 | U | 760 | 9.0 | 4.8 | 0.04 | 2 |
| B2 | 2 | 89.1 | 0.139 | D | | | 80 | 0 | 80 | 0.67 | 0.42 | | | | | | |
| CDE | 1.3 | 5.2 | 0.008 | D | | | 80 | 85 | 95 | 0.87 | 0.12 | P | 360 | 0.5 | 1.4 | 0.07 | 1 |
| F | 1.5 | 1.1 | 0.002 | D | | | 80 | 95 | 97 | 0.89 | 0.08 | P | 240 | 12.0 | 7.0 | 0.01 | 1.4 |
| | | | | | | | | | | | | P | 100 | 0.5 | 1.4 | 0.02 | 1.3 |
| | | | | | | | | | | | | P | 360 | 0.5 | 1.4 | 0.07 | 1 |
| G | 1.4 | 2.5 | 0.004 | D | | | 80 | 35 | 86 | 0.75 | 0.08 | P | 100 | 0.5 | 1.4 | 0.02 | 1.3 |
| | | | | | | | | | | | | P | 360 | 0.5 | 1.4 | 0.07 | 1 |
| H | 1.6 | 1.6 | 0.003 | D | | | 80 | 95 | 97 | 0.89 | 0.08 | P | 360 | 8.0 | 5.7 | 0.02 | 1 |
| | | | | | | | | | | | | | | | | | |
| I | 1 | 1.4 | 0.002 | D | | | 80 | 35 | 86 | 0.75 | 0.11 | | | | | | |
| J | 2.4 | 3.1 | 0.005 | D | | | 80 | 85 | 95 | 0.87 | 0.08 | U | 450 | 8.0 | 4.6 | 0.03 | 2 |
| K | 2.3 | 2.2 | 0.003 | D | | | 80 | 95 | 97 | 0.89 | 0.08 | P | 330 | 10.0 | 6.4 | 0.01 | 2.2 |
| | | | | | | | | | | | | P | 170 | 2.0 | 2.9 | 0.02 | 2 |
| L | 2.2 | 1.8 | 0.003 | D | | | 80 | 35 | 86 | 0.75 | 0.12 | P | 170 | 2.0 | 2.9 | 0.02 | 2 |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

NOTES:

1. HSG = Hydrologic Soil Group
2. P/U = Paved/Unpaved swale
3. R = .0132*CN - 0.39

# RATIONAL METHOD HYDROLOGY
# WASHOE COUNTY IDF CURVES (ZONE I)
# SUMMIT CHRISTIAN CHURCH - STORM DRAIN SYSTEM

| DESIGN POINT | DRAINAGE SUB-AREA | AREA (acres) | RUNOFF COEFF 5-YR | RUNOFF COEFF 100-YR* | Tc (min) | INTENSITY (in/hr) 5-YR | INTENSITY (in/hr) 100-YR | PEAK RUNOFF (cfs) **5-YR** | PEAK RUNOFF (cfs) **100-YR** |
|---|---|---|---|---|---|---|---|---|---|
| **PART A: INDIVIDUAL DRAINAGE AREAS** | | | | | | | | | |
| | A3 | 0.96 | 0.40 | 0.50 | 5.00 | 2.15 | 5.73 | **0.83** | **2.77** |
| | C1 | 0.38 | 0.90 | 0.92 | 5.00 | 2.15 | 5.73 | **0.74** | **2.01** |
| | C2 | 0.50 | 0.85 | 0.89 | 5.00 | 2.15 | 5.73 | **0.91** | **2.54** |
| | C3 | 0.63 | 0.85 | 0.89 | 5.00 | 2.15 | 5.73 | **1.15** | **3.20** |
| | C4 | 0.38 | 0.80 | 0.85 | 5.00 | 2.15 | 5.73 | **0.65** | **1.84** |
| | C5 | 1.04 | 0.60 | 0.68 | 5.00 | 2.15 | 5.73 | **1.34** | **4.06** |
| | D1 | 0.20 | 0.90 | 0.92 | 5.00 | 2.15 | 5.73 | **0.39** | **1.06** |
| | D2 | 1.09 | 0.85 | 0.89 | 5.00 | 2.15 | 5.73 | **1.99** | **5.53** |
| | D3 | 0.31 | 0.85 | 0.89 | 5.00 | 2.15 | 5.73 | **0.57** | **1.57** |
| | E1 | 0.74 | 0.85 | 0.89 | 5.00 | 2.15 | 5.73 | **1.35** | **3.75** |
| | | | | | | | | | |

* C100 computed as (C10)^0.75

| DESIGN POINT | DRAINAGE SUB-AREA | AREA (acres) | RUNOFF COEFF 5-YR | RUNOFF COEFF 100-YR | Tt (min) | INTENSITY (in/hr) 5-YR | INTENSITY (in/hr) 100-YR | PEAK RUNOFF (cfs) **5-YR** | PEAK RUNOFF (cfs) **100-YR** |
|---|---|---|---|---|---|---|---|---|---|
| **PART B: CUMULATIVE AREAS** | | | | | | | | | |
| | C2-C4 | 1.51 | 0.84 | 0.88 | 5.00 | 2.15 | 5.73 | **2.72** | **7.57** |
| | C1-C5 | 2.93 | 0.76 | 0.81 | 5.00 | 2.15 | 5.73 | **4.80** | **13.65** |
| | +D1-D3, E1 | 5.27 | 0.80 | 0.85 | 5.00 | 2.15 | 5.73 | **9.09** | **25.56** |
| | | | | | | | | | |
| | D1-D3 | 1.60 | 0.86 | 0.89 | 5.00 | 2.15 | 5.73 | **2.95** | **8.16** |
| | | | | | | | | | |
| | | | | | | | | | |

**Universal Rating Table - Outlet Structure (36" diameter)**

| **INPUT DATA (Horizontal Grate)** | | **INPUT DATA (Vertical Opening)** | |
|---|---|---|---|
| Barrel diameter, ft | 3 | Width, ft | 1.50 |
| Ht. Rim to Inlet IE (ft) | 4.0 | Height, ft | 0.50 |
| Clear opening, % | 80 | Clear opening, % | 80 |
| Weir coefficient | 3.5 | Weir coefficient | 3.0 |
| Orifice coefficient | 0.6 | Orifice coefficient | 0.6 |

**FORMULAS:**

Q weir = CLH^1.5

Q orifice = CA*(2gH)^0.5

(For vertical orifice, H is measured to center of flow)

**RATING TABLE**

| | Vertical opening | | Horizontal opening | | |
|---|---|---|---|---|---|
| **WSEL** | Weir/Orifice | Q vert | Weir/Orifice | Q horiz | **Q total** |
| **0.00** | Weir | 0.0 | --- | 0.0 | **0.0** |
| **0.50** | Orifice | 1.4 | --- | 0.0 | **1.4** |
| **0.75** | Orifice | 2.0 | --- | 0.0 | **2.0** |
| **1.00** | Orifice | 2.5 | --- | 0.0 | **2.5** |
| **1.25** | Orifice | 2.9 | --- | 0.0 | **2.9** |
| **1.50** | Orifice | 3.2 | --- | 0.0 | **3.2** |
| **1.75** | Orifice | 3.5 | --- | 0.0 | **3.5** |
| **2.00** | Orifice | 3.8 | --- | 0.0 | **3.8** |
| **2.25** | Orifice | 4.1 | --- | 0.0 | **4.1** |
| **2.50** | Orifice | 4.3 | --- | 0.0 | **4.3** |
| **2.75** | Orifice | 4.6 | --- | 0.0 | **4.6** |
| **3.00** | Orifice | 4.8 | --- | 0.0 | **4.8** |
| **3.25** | Orifice | 5.0 | --- | 0.0 | **5.0** |
| **3.50** | Orifice | 5.2 | --- | 0.0 | **5.2** |
| **3.75** | Orifice | 5.4 | --- | 0.0 | **5.4** |
| **4.00** | Orifice | 5.6 | Weir | 0.0 | **5.6** |
| **4.25** | Orifice | 5.8 | Weir | 4.1 | **9.9** |
| **4.50** | Orifice | 6.0 | Weir | 11.7 | **17.6** |
| **4.75** | Orifice | 6.1 | Weir | 21.4 | **27.6** |
| **5.00** | Orifice | 6.3 | Weir | 33.0 | **39.3** |
| **5.25** | Orifice | 6.5 | Orifice | 30.4 | **36.9** |
| **5.50** | Orifice | 6.6 | Orifice | 33.3 | **40.0** |
| **5.75** | Orifice | 6.8 | Orifice | 36.0 | **42.8** |
| **6.00** | Orifice | 6.9 | Orifice | 38.5 | **45.4** |
| **6.25** | Orifice | 7.1 | Orifice | 40.8 | **47.9** |
| **6.50** | Orifice | 7.2 | Orifice | 43.1 | **50.3** |

**RAINFALL DISTRIBUTION FOR SCS UNIT HYDROGRAPH METHOD**
Washoe County Hydrologic Criteria and Drainage Design Manual
**Summit Christian Church**

**Input Data from Southwest Semiarid Precipitation Frequency Study (SSPFS, 1996)**

| | 2 Year | | |
|---|---|---|---|
| Duration | 1 hr | 6 hr | 24 hr |
| Depth | 0.4 | 0.7 | 1.1 |

**Computed Rainfall Distribution**

| 2 Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RGF | | | 1.00 | | | 1.00 | | 1.00 |
| Duration | 5 min | 15 min | 1 hr | 2 hr | 3 hr | 6 hr | 12 hr | 24 hr |
| Depth | 0.13 | 0.24 | 0.40 | 0.49 | 0.56 | 0.70 | 0.90 | 1.10 |

| 5 Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RGF | | | 1.36 | | | 1.30 | | 1.28 |
| Duration | 5 min | 15 min | 1 hr | 2 hr | 3 hr | 6 hr | 12 hr | 24 hr |
| Depth | 0.18 | 0.33 | 0.54 | 0.65 | 0.74 | 0.91 | 1.16 | 1.41 |

| 10 Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RGF | | | 1.72 | | | 1.52 | | 1.50 |
| Duration | 5 min | 15 min | 1 hr | 2 hr | 3 hr | 6 hr | 12 hr | 24 hr |
| Depth | 0.23 | 0.41 | 0.69 | 0.80 | 0.89 | 1.06 | 1.36 | 1.65 |

| 25 Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RGF | | | 2.32 | | | 1.81 | | 1.79 |
| Duration | 5 min | 15 min | 1 hr | 2 hr | 3 hr | 6 hr | 12 hr | 24 hr |
| Depth | 0.31 | 0.56 | 0.93 | 1.03 | 1.11 | 1.27 | 1.62 | 1.97 |

| 50 Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RGF | | | 2.91 | | | 2.04 | | 2.01 |
| Duration | 5 min | 15 min | 1 hr | 2 hr | 3 hr | 6 hr | 12 hr | 24 hr |
| Depth | 0.38 | 0.70 | 1.16 | 1.24 | 1.30 | 1.43 | 1.82 | 2.21 |

| 100 Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RGF | | | 3.62 | | | 2.26 | | 2.22 |
| Duration | 5 min | 15 min | 1 hr | 2 hr | 3 hr | 6 hr | 12 hr | 24 hr |
| Depth | 0.48 | 0.87 | 1.45 | 1.49 | 1.52 | 1.58 | 2.01 | 2.44 |

**HEC-1 ROUTING DATA**

**SUMMIT CHRISTIAN CHURCH - MASTER DRAINAGE PLAN**

| From | To | Routing | | | | | Muskingum Parameters | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | P/U | L(ft) | S(%) | V(fps) | $T_t$ (hr) | $V_w$ (fps) | K (hr) | X | NSTPS |
| 1.5 | 1.4 | P | 240 | 12.0 | 7.0 | 0.01 | 10.6 | 0.01 | 0.45 | 0.1 |
| 1.4 | 1.3 | P | 100 | 0.5 | 1.4 | 0.02 | 2.2 | 0.01 | 0.20 | 0.1 |
| 1.3 | 1 | P | 360 | 0.5 | 1.4 | 0.07 | 2.2 | 0.05 | 0.20 | 0.4 |
| 1.2 | 1.1 | U | 400 | 10.0 | 3.2 | 0.04 | 4.7 | 0.02 | 0.45 | 0.3 |
| 1.1 | 1 | U | 600 | 9.0 | 3.0 | 0.06 | 4.5 | 0.04 | 0.45 | 0.4 |
| 1.6 | 1 | P | 360 | 8.0 | 5.7 | 0.02 | 8.6 | 0.01 | 0.44 | 0.1 |
| 2.4 | 2 | U | 450 | 8.0 | 2.8 | 0.04 | 4.2 | 0.03 | 0.45 | 0.4 |
| 2.3 | 2.2 | P | 330 | 10.0 | 6.4 | 0.01 | 9.6 | 0.01 | 0.45 | 0.1 |
| 2.2 | 2 | P | 170 | 2.0 | 2.9 | 0.02 | 4.3 | 0.01 | 0.30 | 0.1 |
| 2.1 | 2 | U | 760 | 9.0 | 3.0 | 0.07 | 4.5 | 0.05 | 0.45 | 0.6 |
| | | | | | | | | | | |

NOTES:

Computation interval (hr) 0.08

1. P = Paved, U = Unpaved (swale)
2. $V_w$ = Velocity of flood wave = 1.5 x V
3. Muskingum K = L/3600$V_w$
4. Muskingum X varies from 0 (max attenuation, level pool reservoir, mild slope)
   to 0.5 (no attenuation, pure translation, steep slope)
   Estimate as 0.5*(1-1/(S+1))
5. NSTPS computed such that AMSKK / NSTPS / dT is the average of 1 / 2(1-X) and 1 / 2X.

# APPENDIX B

## HEC-1 RUN (EXISTING)

```
1***************************************
       ***************************************
 *                                      *
       *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
       *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998              *
       *    HYDROLOGIC ENGINEERING CENTER    *
 *          VERSION 4.1                 *
       *         609 SECOND STREET           *
 *                                      *
       *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   27JUN03  TIME  10:32:00   *
       *          (916) 756-1104             *
 *                                      *
       *                                      *
 ***************************************
       ***************************************
```

```
X     X  XXXXXXX   XXXXX
X
X     X  X        X     X
XX
X     X  X        X
X
XXXXXXX  XXXX     X        XXXXX
X
X     X  X        X
X
X     X  X        X     X
X
X     X  XXXXXXX   XXXXX
XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
1                                                         HEC-1 INPUT
                           PAGE  1

          LINE
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                          *DIAGRAM
```

```
              1           ID
**************************************************************************
              2           ID       SUMMIT CHRISTIAN CHURCH - CFA 6-03 MASTER
DRAINAGE REPORT
              3           ID       UNDEVELOPED CONDITIONS

              4           ID       FILE NAME: SCC25U.DAT

              5           ID
**************************************************************************
              6           ID       25 YEAR 24 HOUR EVENT

              7           IT       5                    289

              8           IO       4       0


              9           KK       A    WATERSHED A UNDEVELOPED

             10           BA   0.053

             11           PH       4      .2     .31     .56     .93    1.03    1.11
   1.27    1.62    1.97
             12           LS               80

             13           UD     .18


             14           KK       B    WATERSHED B UNDEVELOPED

             15           BA   0.153

             16           LS               80

             17           UD     .42

                          *
.....1.......2.......3.......4.......5.......6.......7.......8.......9......10
             18           ZZ

1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     9          A
                .
                .
    14          .           B

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
        ***************************************
 *                                       *
        *                                        *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
        *    U.S. ARMY CORPS OF ENGINEERS     *
 *               JUN   1998              *
        *    HYDROLOGIC ENGINEERING CENTER    *
 *            VERSION 4.1                *
        *          609 SECOND STREET          *
```

```
 *                                       *
       *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   27JUN03  TIME  10:32:00   *
       *           (916) 756-1104            *
 *                                       *
       *                                     *
 *****************************************
       ***************************************
```

```
***************************************************************************
                                SUMMIT CHRISTIAN CHURCH - CFA 6-03 MASTER DRAINAGE
REPORT
                                UNDEVELOPED CONDITIONS

                                FILE NAME: SCC25U.DAT

***************************************************************************
                                25 YEAR 24 HOUR EVENT


    8 IO          OUTPUT CONTROL VARIABLES
                        IPRNT           4  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN           5  MINUTES IN COMPUTATION INTERVAL
                        IDATE      1    0  STARTING DATE
                        ITIME        0000  STARTING TIME
                           NQ         289  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE      2    0  ENDING DATE
                       NDTIME        0000  ENDING TIME
                       ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   24.00 HOURS

           ENGLISH UNITS
                DRAINAGE AREA          SQUARE MILES
                PRECIPITATION DEPTH    INCHES
                LENGTH, ELEVATION      FEET
                FLOW                   CUBIC FEET PER SECOND
                STORAGE VOLUME         ACRE-FEET
                SURFACE AREA           ACRES
                TEMPERATURE            DEGREES FAHRENHEIT


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
    9 KK     *         A  *             WATERSHED A UNDEVELOPED

             *            *
```

```
              **************

                 SUBBASIN RUNOFF DATA

   10 BA           SUBBASIN CHARACTERISTICS
                         TAREA          .05  SUBBASIN AREA

                   PRECIPITATION DATA

   11 PH                                  DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                     .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                                          STORM AREA =     .20

   12 LS           SCS LOSS RATE
                         STRTL          .50  INITIAL ABSTRACTION
                        CRVNBR        80.00  CURVE NUMBER
                         RTIMP          .00  PERCENT IMPERVIOUS AREA

   13 UD           SCS DIMENSIONLESS UNITGRAPH
                          TLAG          .18  LAG

                                                                       ***

                                                                 UNIT HYDROGRAPH
                                                            13 END-OF-PERIOD ORDINATES
                  32.      101.      112.       78.       39.       22.       12.
   6.        3.        2.
                   1.        1.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   14 KK      *         B  *              WATERSHED B UNDEVELOPED

              *            *
              **************

                 SUBBASIN RUNOFF DATA

   15 BA           SUBBASIN CHARACTERISTICS
                         TAREA          .15  SUBBASIN AREA

                   PRECIPITATION DATA

   11 PH                                  DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                     .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00
```

```
                                                          STORM AREA =     .20

   16 LS          SCS LOSS RATE
                        STRTL          .50  INITIAL ABSTRACTION
                       CRVNBR        80.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

   17 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .42  LAG

                                                                        ***

                                                                  UNIT HYDROGRAPH
                                                             27 END-OF-PERIOD ORDINATES
                         14.        42.        88.       135.       158.       159.       142.
  118.       86.       62.
                         46.        35.        26.        19.        15.        11.         8.
    6.        4.        3.
                          2.         2.         1.         1.         1.         0.         0.
1
                                                                  RUNOFF SUMMARY
                                                          FLOW IN CUBIC FEET PER SECOND
                                                       TIME IN HOURS,  AREA IN SQUARE MILES

                                              PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM
PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION      FLOW     PEAK
           AREA      STAGE     MAX STAGE
+                                                                 6-HOUR     24-HOUR
72-HOUR

          HYDROGRAPH AT
+                                A        19.   12.25           2.          1.
  1.        .05

          HYDROGRAPH AT
+                                B        34.   12.50           7.          2.
  2.        .15


 *** NORMAL END OF HEC-1 ***
```

```
1***************************************
       **************************************
 *                                       *
       *                                    *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
       *    U.S. ARMY CORPS OF ENGINEERS    *
 *              JUN   1998               *
       *    HYDROLOGIC ENGINEERING CENTER   *
 *           VERSION 4.1                 *
       *          609 SECOND STREET         *
 *                                       *
       *       DAVIS, CALIFORNIA 95616      *
 *  RUN DATE   27JUN03  TIME  10:32:15   *
       *           (916) 756-1104           *
 *                                       *
       *                                    *
 ***************************************
       **************************************
```

```
                                                  X     X  XXXXXXX   XXXXX
X
                                                  X     X  X         X     X
XX
                                                  X     X  X         X
X
                                                  XXXXXXX  XXXX      X        XXXXX
X
                                                  X     X  X         X
X
                                                  X     X  X         X     X
X
                                                  X     X  XXXXXXX   XXXXX
XXX
```

            THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

            THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
            THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
            NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
            DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
            KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
1                                                                  HEC-1 INPUT
                                    PAGE  1

           LINE
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                                   *DIAGRAM
```

```
              1            ID
***************************************************************************
              2            ID       SUMMIT CHRISTIAN CHURCH - CFA 6-03 MASTER
DRAINAGE REPORT
              3            ID       UNDEVELOPED CONDITIONS

              4            ID       FILE NAME: SCC00U.DAT

              5            ID
***************************************************************************
              6            ID       100 YEAR 24 HOUR EVENT

              7            IT       5                    289

              8            IO       4       0


              9            KK       A    WATERSHED A UNDEVELOPED

             10            BA   0.053

             11            PH       1      .2     .48     .87    1.45    1.49    1.52
   1.58    2.01    2.44
             12            LS              80

             13            UD     .18


             14            KK       B    WATERSHED B UNDEVELOPED

             15            BA   0.153

             16            LS              80

             17            UD     .42

                           *
.....1.......2.......3.......4.......5.......6.......7.......8.......9......10
             18            ZZ

1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     9           A
                 .
                 .
    14           .           B

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
        ***************************************
 *                                       *
        *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
        *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998               *
        *    HYDROLOGIC ENGINEERING CENTER    *
 *             VERSION 4.1               *
        *          609 SECOND STREET          *
```

```
 *                                        *
       *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   27JUN03  TIME  10:32:15   *
       *           (916) 756-1104             *
 *                                        *
       *                                      *
 *****************************************
       ***************************************
```

```
***************************************************************************
                                SUMMIT CHRISTIAN CHURCH - CFA 6-03 MASTER DRAINAGE
REPORT
                                UNDEVELOPED CONDITIONS

                                FILE NAME: SCC00U.DAT

***************************************************************************
                                100 YEAR 24 HOUR EVENT


    8 IO          OUTPUT CONTROL VARIABLES
                        IPRNT           4  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN           5  MINUTES IN COMPUTATION INTERVAL
                        IDATE      1    0  STARTING DATE
                        ITIME        0000  STARTING TIME
                           NQ         289  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE      2    0  ENDING DATE
                       NDTIME        0000  ENDING TIME
                       ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL      .08 HOURS
                      TOTAL TIME BASE   24.00 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
                SURFACE AREA          ACRES
                TEMPERATURE           DEGREES FAHRENHEIT


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             *************
             *           *
    9 KK     *         A  *              WATERSHED A UNDEVELOPED

             *           *
```

```
              **************

                 SUBBASIN RUNOFF DATA

   10 BA           SUBBASIN CHARACTERISTICS
                         TAREA          .05  SUBBASIN AREA

                   PRECIPITATION DATA

   11 PH                                DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                     .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                     STORM AREA =     .20

   12 LS           SCS LOSS RATE
                         STRTL          .50  INITIAL ABSTRACTION
                        CRVNBR        80.00  CURVE NUMBER
                         RTIMP          .00  PERCENT IMPERVIOUS AREA

   13 UD           SCS DIMENSIONLESS UNITGRAPH
                          TLAG          .18  LAG

                                                                ***

                                                          UNIT HYDROGRAPH
                                                     13 END-OF-PERIOD ORDINATES
                  32.      101.      112.       78.       39.       22.       12.
   6.        3.        2.
                   1.        1.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   14 KK      *         B  *              WATERSHED B UNDEVELOPED

              *            *
              **************

                 SUBBASIN RUNOFF DATA

   15 BA           SUBBASIN CHARACTERISTICS
                         TAREA          .15  SUBBASIN AREA

                   PRECIPITATION DATA

   11 PH                                DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                     .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00
```

```
                                                            STORM AREA =     .20

   16 LS          SCS LOSS RATE
                        STRTL          .50  INITIAL ABSTRACTION
                       CRVNBR        80.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

   17 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .42  LAG

                                                                         ***

                                                                   UNIT HYDROGRAPH
                                                              27 END-OF-PERIOD ORDINATES
                     14.        42.        88.       135.       158.       159.       142.
  118.        86.        62.
                     46.        35.        26.        19.        15.        11.         8.
    6.         4.         3.
                      2.         2.         1.         1.         1.         0.         0.
1
                                                                   RUNOFF SUMMARY
                                                           FLOW IN CUBIC FEET PER SECOND
                                                        TIME IN HOURS,  AREA IN SQUARE MILES

                                               PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM
PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION      FLOW     PEAK
           AREA      STAGE     MAX STAGE
+                                                                  6-HOUR     24-HOUR
72-HOUR

          HYDROGRAPH AT
+                                   A        39.   12.25           4.          1.
  1.        .05

          HYDROGRAPH AT
+                                   B        69.   12.50          11.          3.
  3.        .15


 *** NORMAL END OF HEC-1 ***
```

# APPENDIX C

## HEC-1 RUN (PROPOSED 25-YEAR)

```
1***************************************
        **************************************
 *                                       *
        *                                    *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
        *    U.S. ARMY CORPS OF ENGINEERS     *
 *               JUN   1998              *
        *    HYDROLOGIC ENGINEERING CENTER    *
 *          VERSION 4.1                  *
        *         609 SECOND STREET           *
 *                                       *
        *      DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   27JUN03  TIME  10:25:28   *
        *          (916) 756-1104             *
 *                                       *
        *                                    *
 ***************************************
        **************************************
```

```
                                                       X     X  XXXXXXX   XXXXX
X
                                                       X     X  X        X     X
XX
                                                       X     X  X        X
X
                                                       XXXXXXX  XXXX     X        XXXXX
X
                                                       X     X  X        X
X
                                                       X     X  X        X     X
X
                                                       X     X  XXXXXXX   XXXXX
XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
1                                                                 HEC-1 INPUT
                                    PAGE  1

           LINE
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                                   *DIAGRAM
```

```
            1            ID
***************************************************************************
            2            ID       SUMMIT CHRISTIAN CHURCH - CFA 6-03 MASTER
DRAINAGE REPORT
            3            ID       DEVELOPED CONDITIONS

            4            ID       FILE NAME: SCC25D.DAT

            5            ID
***************************************************************************
            6            ID       25 YEAR 24 HOUR EVENT

            7            IT       5                     289

            8            IO       4       0

                         *


            9            KK      A1    WATERSHED A1

           10            BA   0.010

           11            PH       4      .2     .31     .56     .93    1.03    1.11
   1.27    1.62    1.97
           12            LS              80

           13            UD     .17

                         *


           14            KK    RTA1    ROUTE A1 TO P1

           15            RM       1     .02     .45

                         *


           16            KK      A2    WATERSHED A2

           17            BA   0.018

           18            LS              80

           19            UD     .17

                         *


           20            KK      A3    WATERSHED A3

           21            BA   0.002

           22            LS              80

           23            UD     .19

                         *


           24            KK   COMP1    COMBINE A1, A2, A3 AT P1 (DETENTION POND)
```

```
                25           HC        3
                             *

                26           KK       P1    DETENTION POND P1
                27           RS        1    STOR       0
                28           SA        0   0.032   0.073
                29           SE   600.5   601.0   605.0
                30           SQ     0.0     1.4     3.2     4.3     5.2     5.6    17.6
  39.3
                31           SE   600.5   601.0   602.0   603.0   604.0   604.5   605.0
 605.5
                             *
                32           KM             NEGLECT TRAVEL TIME P1 TO 1.1
                             *

                33           KK       A4    WATERSHED A4
                34           BA   0.003
                35           LS               80
                36           UD     .17
                             *
1                                                    HEC-1 INPUT
                              PAGE  2

         LINE
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                37           KK   COM11    COMBINE A1, A2, A3, A4 AT 1.1
                38           HC        2
                             *

                39           KK      RTA    ROUTE A1, A2, A3, A4 TO 1
                40           RM        1     .04     .45
                             *

                41           KK       A5    WATERSHED A5
                42           BA   0.002
                43           LS               80
                44           UD     .17
```

```
               *

45             KK   COMA1    COMBINE A1, A2, A3, A4, A5 AT 1
46             HC       2
               *

47             KK     CDE    WATERSHEDS C, D, E
48             BA   0.008
49             LS              95
50             UD     .12
               *

51             KK       F    WATERSHED F
52             BA   0.002
53             LS              97
54             UD     .08
               *

55             KK     RTF    ROUTE F TO 1.4
56             RM       1     .01     .45
               *

57             KK       G    WATERSHED G
58             BA   0.004
59             LS              86
60             UD     .08
               *

61             KK   COM14    COMBINE F, G AT 1.4
62             HC       2
               *

63             KK    RTFG    ROUTE F, G TO 1.3
64             RM       1     .01     .20
               *
```

```
          65            KK   COM13    COMBINE CDE, F, G AT 1.3
          66            HC       2
                        *
1                                                      HEC-1 INPUT
                         PAGE  3

        LINE
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          67            KK    RTCG    ROUTE CDE, F, G TO 1
          68            RM       1     .05     .20
                        *

          69            KK       H    WATERSHED H
          70            BA   0.003
          71            LS              97
          72            UD     .08
                        *

          73            KK     RTH    ROUTE H TO 1
          74            RM       1     .01     .44
                        *

          75            KK       I    WATERSHED I
          76            BA   0.002
          77            LS              86
          78            UD     .11
                        *

          79            KK    COM1    COMBINE A, CDE, F, G, H, I AT 1
          80            HC       4
                        *

          81            KK      B1    WATERSHED B1
          82            BA   0.002
          83            LS              80
```

```
          84            UD      .17
                        *

          85            KK    RTB1    ROUTE B1 TO 2
          86            RM       1     .05     .45
                        *

          87            KK      B2    WATERSHED B2
          88            BA   0.139
          89            LS               80
          90            UD      .42
                        *

          91            KK   COMB2    COMBINE B1, B2 AT 2
          92            HC       2
                        *

          93            KK       J    WATERSHED J
          94            BA   0.005
          95            LS               95
          96            UD      .08
                        *
1                                                          HEC-1 INPUT
                         PAGE  4

         LINE
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          97            KK     RTJ    ROUTE J TO 2
          98            RM      .4     .03     .45
                        *

          99            KK       K    WATERSHED K
         100            BA   0.003
         101            LS               97
         102            UD      .08
                        *
```

```
          103            KK     RTK    ROUTE K TO 2.2
          104            RM      .1     .01     .45
                         *

          105            KK       L    WATERSHED L
          106            BA   0.003
          107            LS               86
          108            UD     .12
                         *

          109            KK   COM22    COMBINE K, L AT 2.2
          110            HC       2
                         *

          111            KK    RTKL    ROUTE K, L TO 2
          112            RM      .1     .01     .30
                         *

          113            KK    COM2    COMBINE B, J, K, L AT 2
          114            HC       3
                         *
.....1.......2.......3.......4.......5.......6.......7.......8.......9......10
          115            ZZ

1
                    SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     9          A1
                 V
                 V
    14        RTA1
                 .
                 .
    16           .           A2
                 .            .
                 .            .
    20           .            .           A3
                 .            .            .
                 .            .            .
    24       COMP1........................
                 V
```

```
             V
26          P1
             .
             .
33           .          A4
             .           .
             .           .
37       COM11............
             V
             V
39         RTA
             .
             .
41           .          A5
             .           .
             .           .
45       COMA1............
             .
             .
47           .         CDE
             .           .
             .           .
51           .           .           F
             .           .           V
             .           .           V
55           .           .         RTF
             .           .           .
             .           .           .
57           .           .           .           G
             .           .           .           .
             .           .           .           .
61           .           .       COM14............
             .           .           V
             .           .           V
63           .           .        RTFG
             .           .           .
             .           .           .
65           .       COM13............
             .           V
             .           V
67           .        RTCG
             .           .
             .           .
69           .           .           H
             .           .           V
             .           .           V
73           .           .         RTH
             .           .           .
             .           .           .
75           .           .           .           I
             .           .           .           .
             .           .           .           .
79        COM1....................................
             .
             .
81           .          B1
             .           V
             .           V
85           .        RTB1
             .           .
             .           .
87           .           .          B2
             .           .           .
```

```
                  .           .           .
   91             .       COMB2...........
                  .           .
                  .           .
   93             .           .          J
                  .           .          V
                  .           .          V
   97             .           .        RTJ
                  .           .          .
                  .           .          .
   99             .           .          .           K
                  .           .          .           V
                  .           .          .           V
  103             .           .          .         RTK
                  .           .          .           .
                  .           .          .           .
  105             .           .          .           .           L
                  .           .          .           .           .
                  .           .          .           .           .
  109             .           .          .       COM22............
                  .           .          .           V
                  .           .          .           V
  111             .           .          .        RTKL
                  .           .          .           .
                  .           .          .           .
  113             .        COM2.......................

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
        ***************************************
 *                                        *
        *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
        *    U.S. ARMY CORPS OF ENGINEERS     *
 *             JUN   1998                 *
        *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1                  *
        *          609 SECOND STREET          *
 *                                        *
        *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   27JUN03  TIME  10:25:28    *
        *           (916) 756-1104            *
 *                                        *
        *                                     *
 *****************************************
        ***************************************
```

```
**************************************************************************
                                SUMMIT CHRISTIAN CHURCH - CFA 6-03 MASTER DRAINAGE
REPORT
                                DEVELOPED CONDITIONS

                                FILE NAME: SCC25D.DAT

**************************************************************************
                                25 YEAR 24 HOUR EVENT
```

```
  8 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           4  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         289  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      2    0  ENDING DATE
                     NDTIME        0000  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL      .08 HOURS
                       TOTAL TIME BASE   24.00 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
                SURFACE AREA          ACRES
                TEMPERATURE           DEGREES FAHRENHEIT


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  9 KK       *        A1  *             WATERSHED A1

             *            *
             **************

                SUBBASIN RUNOFF DATA

 10 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

 11 PH                               DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                  .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                                      STORM AREA =     .20

 12 LS          SCS LOSS RATE
                      STRTL         .50  INITIAL ABSTRACTION
                     CRVNBR       80.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 13 UD          SCS DIMENSIONLESS UNITGRAPH
```

```
                    TLAG          .17  LAG

                                                             ***

                                                        UNIT HYDROGRAPH
                                                    12 END-OF-PERIOD ORDINATES
              7.        21.        22.        14.         7.         4.         2.
   1.         1.         0.
              0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   14 KK     *      RTA1  *              ROUTE A1 TO P1

             *            *
             **************

                HYDROGRAPH ROUTING DATA

   15 RM          MUSKINGUM ROUTING
                        NSTPS          1 NUMBER OF SUBREACHES
                        AMSKK        .02 MUSKINGUM K
                            X        .45 MUSKINGUM X

                                                             ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTA1.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   16 KK     *        A2  *              WATERSHED A2

             *            *
             **************

                SUBBASIN RUNOFF DATA

   17 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .02  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                   DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00
```

```
                                                         STORM AREA =     .20

   18 LS          SCS LOSS RATE
                        STRTL         .50  INITIAL ABSTRACTION
                       CRVNBR       80.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   19 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .17  LAG

                                                                       ***

                                                                UNIT HYDROGRAPH
                                                           12 END-OF-PERIOD ORDINATES
                 12.        38.        39.        24.        12.         7.         3.
   2.         1.         1.
                  0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   20 KK     *        A3  *              WATERSHED A3
             *            *
             **************

                SUBBASIN RUNOFF DATA

   21 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                                         STORM AREA =     .20

   22 LS          SCS LOSS RATE
                        STRTL         .50  INITIAL ABSTRACTION
                       CRVNBR       80.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   23 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .19  LAG

                                                                       ***

                                                                UNIT HYDROGRAPH
                                                           13 END-OF-PERIOD ORDINATES
                  1.         4.         4.         3.         2.         1.         1.
   0.         0.         0.
                  0.         0.         0.
```

```
 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
   24 KK     *     COMP1  *             COMBINE A1, A2, A3 AT P1 (DETENTION POND)

             *            *
             **************

   25 HC          HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                        ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
   26 KK     *        P1  *             DETENTION POND P1

             *            *
             **************
                                        NEGLECT TRAVEL TIME P1 TO 1.1


                HYDROGRAPH ROUTING DATA

   27 RS          STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        STOR  TYPE OF INITIAL CONDITION
                       RSVRIC         .00  INITIAL CONDITION
                            X         .00 WORKING R AND D COEFFICIENT

   28 SA                 AREA          .0         .0         .1

   29 SE          ELEVATION      600.50     601.00     605.00

   30 SQ          DISCHARGE          0.         1.         3.         4.         5.
  6.       18.       39.

   31 SE          ELEVATION      600.50     601.00     602.00     603.00     604.00
604.50    605.00    605.50

                                                                        ***

                                                          COMPUTED STORAGE-ELEVATION DATA

             STORAGE         .00        .01        .21
           ELEVATION      600.50     601.00     605.00

                                                      COMPUTED STORAGE-OUTFLOW-ELEVATION
DATA

             STORAGE         .00        .01        .04        .09        .14        .17
```

```
   .21        .25
              OUTFLOW        .00      1.40      3.20      4.30      5.20      5.60
  17.60     39.30
            ELEVATION     600.50    601.00    602.00    603.00    604.00    604.50
 605.00    605.50

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS
BETWEEN        6. TO       39.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR
OUTFLOWS GREATER THAN PEAK INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING
STORAGE (USE A LONGER REACH.)


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   33 KK     *        A4  *             WATERSHED A4
             *            *
             **************

                SUBBASIN RUNOFF DATA

   34 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                                       STORM AREA =     .20

   35 LS          SCS LOSS RATE
                        STRTL         .50  INITIAL ABSTRACTION
                       CRVNBR       80.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   36 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .17  LAG

                                                                           ***

                                                                     UNIT HYDROGRAPH
                                                                12 END-OF-PERIOD ORDINATES
                  2.         6.         6.         4.         2.         1.         1.
   0.         0.         0.
                  0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***
```

```
             **************
             *            *
   37 KK     *     COM11  *             COMBINE A1, A2, A3, A4 AT 1.1
             *            *
             **************

   38 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                          ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   39 KK     *       RTA  *             ROUTE A1, A2, A3, A4 TO 1
             *            *
             **************

                HYDROGRAPH ROUTING DATA

   40 RM          MUSKINGUM ROUTING
                        NSTPS         1 NUMBER OF SUBREACHES
                        AMSKK       .04 MUSKINGUM K
                            X       .45 MUSKINGUM X

                                                                          ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTA.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   41 KK     *        A5  *             WATERSHED A5
             *            *
             **************

                SUBBASIN RUNOFF DATA

   42 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
```

```
2-DAY   4-DAY   7-DAY  10-DAY
                   .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                                      STORM AREA =     .20

   43 LS          SCS LOSS RATE
                        STRTL         .50  INITIAL ABSTRACTION
                       CRVNBR       80.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   44 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .17  LAG

                                                                          ***

                                                                    UNIT HYDROGRAPH
                                                               12 END-OF-PERIOD ORDINATES
                  1.        4.        4.        3.        1.        1.        0.
   0.        0.        0.
                  0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   45 KK     *     COMA1  *            COMBINE A1, A2, A3, A4, A5 AT 1

             *            *
             **************

   46 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                          ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   47 KK     *       CDE  *            WATERSHEDS C, D, E

             *            *
             **************

                SUBBASIN RUNOFF DATA

   48 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
```

```
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                               STORM AREA =     .20

   49 LS          SCS LOSS RATE
                        STRTL          .11  INITIAL ABSTRACTION
                       CRVNBR        95.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

   50 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .12  LAG

                                                                    ***

                                                              UNIT HYDROGRAPH
                                                          9 END-OF-PERIOD ORDINATES
                 12.       24.       15.        6.        3.        1.        0.
   0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   51 KK     *         F  *              WATERSHED F

             *            *
             **************

                SUBBASIN RUNOFF DATA

   52 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                               STORM AREA =     .20

   53 LS          SCS LOSS RATE
                        STRTL          .06  INITIAL ABSTRACTION
                       CRVNBR        97.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

   54 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .08  LAG

                                                                    ***

                                                              UNIT HYDROGRAPH
```

```
                                                          7 END-OF-PERIOD ORDINATES
                  6.         6.         2.         1.         0.         0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   55 KK     *       RTF  *             ROUTE F TO 1.4
             *            *
             **************

                HYDROGRAPH ROUTING DATA

   56 RM          MUSKINGUM ROUTING
                        NSTPS         1 NUMBER OF SUBREACHES
                        AMSKK       .01 MUSKINGUM K
                            X       .45 MUSKINGUM X

                                                                           ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTF.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   57 KK     *         G  *             WATERSHED G
             *            *
             **************

                SUBBASIN RUNOFF DATA

   58 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......    ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                                             STORM AREA =     .20

   59 LS          SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA
```

```
   60 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .08  LAG

                                                                          ***

                                                                    UNIT HYDROGRAPH
                                                                7 END-OF-PERIOD ORDINATES
                 12.       13.        4.        1.        0.        0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   61 KK     *    COM14   *            COMBINE F, G AT 1.4
             *            *
             **************

   62 HC          HYDROGRAPH COMBINATION
                        ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                          ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   63 KK     *     RTFG   *            ROUTE F, G TO 1.3
             *            *
             **************

                HYDROGRAPH ROUTING DATA

   64 RM          MUSKINGUM ROUTING
                        NSTPS          1 NUMBER OF SUBREACHES
                        AMSKK        .01 MUSKINGUM K
                            X        .20 MUSKINGUM X

                                                                          ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTFG.
      ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   65 KK     *    COM13   *            COMBINE CDE, F, G AT 1.3
             *            *
```

```
          **************

   66 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                          ***



 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
   67 KK  *      RTCG  *             ROUTE CDE, F, G TO 1

          *            *
          **************

               HYDROGRAPH ROUTING DATA

   68 RM          MUSKINGUM ROUTING
                        NSTPS         1 NUMBER OF SUBREACHES
                        AMSKK       .05 MUSKINGUM K
                            X       .20 MUSKINGUM X

                                                                          ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTCG.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).



 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
   69 KK  *         H  *             WATERSHED H

          *            *
          **************

               SUBBASIN RUNOFF DATA

   70 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                                      STORM AREA =     .20

   71 LS          SCS LOSS RATE
```

```
                          STRTL          .06  INITIAL ABSTRACTION
                         CRVNBR        97.00  CURVE NUMBER
                          RTIMP          .00  PERCENT IMPERVIOUS AREA

   72 UD           SCS DIMENSIONLESS UNITGRAPH
                           TLAG          .08  LAG

                                                                          ***

                                                                    UNIT HYDROGRAPH
                                                                7 END-OF-PERIOD ORDINATES
                     9.        9.        3.        1.        0.        0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   73 KK     *       RTH  *             ROUTE H TO 1

             *            *
             **************

                 HYDROGRAPH ROUTING DATA

   74 RM           MUSKINGUM ROUTING
                         NSTPS         1 NUMBER OF SUBREACHES
                         AMSKK       .01 MUSKINGUM K
                             X       .44 MUSKINGUM X

                                                                          ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTH.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   75 KK     *         I  *             WATERSHED I

             *            *
             **************

                 SUBBASIN RUNOFF DATA

   76 BA           SUBBASIN CHARACTERISTICS
                         TAREA          .00  SUBBASIN AREA

                   PRECIPITATION DATA

   11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
```

```
                        .31       .56       .93    1.03     1.11     1.27     1.62     1.97
.00      .00      .00      .00

                                                              STORM AREA =      .20

   77 LS          SCS LOSS RATE
                        STRTL          .33  INITIAL ABSTRACTION
                       CRVNBR        86.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

   78 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .11  LAG

                                                                          ***

                                                                    UNIT HYDROGRAPH
                                                                9 END-OF-PERIOD ORDINATES
                  4.          6.          3.          1.          1.          0.          0.
   0.          0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   79 KK     *      COM1  *             COMBINE A, CDE, F, G, H, I AT 1

             *            *
             **************

   80 HC          HYDROGRAPH COMBINATION
                        ICOMP            4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                          ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   81 KK     *        B1  *             WATERSHED B1

             *            *
             **************

                SUBBASIN RUNOFF DATA

   82 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                      DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......    ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
```

```
                       .31      .56      .93    1.03     1.11     1.27     1.62     1.97
.00      .00      .00      .00

                                                          STORM AREA =      .20

   83 LS          SCS LOSS RATE
                        STRTL          .50  INITIAL ABSTRACTION
                       CRVNBR        80.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

   84 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .17  LAG

                                                                          ***

                                                                UNIT HYDROGRAPH
                                                           12 END-OF-PERIOD ORDINATES
                  1.         4.         4.         3.         1.         1.         0.
   0.         0.         0.
                  0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   85 KK     *      RTB1  *             ROUTE B1 TO 2

             *            *
             **************

                HYDROGRAPH ROUTING DATA

   86 RM          MUSKINGUM ROUTING
                        NSTPS          1 NUMBER OF SUBREACHES
                        AMSKK        .05 MUSKINGUM K
                            X        .45 MUSKINGUM X

                                                                          ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTB1.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   87 KK     *        B2  *             WATERSHED B2

             *            *
             **************

                SUBBASIN RUNOFF DATA

   88 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .14  SUBBASIN AREA
```

```
                    PRECIPITATION DATA

   11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                    ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                    5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                      .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                                  STORM AREA =     .20

   89 LS            SCS LOSS RATE
                          STRTL         .50  INITIAL ABSTRACTION
                         CRVNBR       80.00  CURVE NUMBER
                          RTIMP         .00  PERCENT IMPERVIOUS AREA

   90 UD            SCS DIMENSIONLESS UNITGRAPH
                           TLAG         .42  LAG

                                                                         ***

                                                                   UNIT HYDROGRAPH
                                                              27 END-OF-PERIOD ORDINATES
                   13.       38.       80.      123.      144.      144.      129.
 107.       78.       56.
                   42.       32.       24.       18.       13.       10.        7.
   5.        4.        3.
                    2.        2.        1.        1.        1.        0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   91 KK      *     COMB2  *             COMBINE B1, B2 AT 2

              *            *
              **************

   92 HC            HYDROGRAPH COMBINATION
                          ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                         ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   93 KK      *         J  *             WATERSHED J

              *            *
              **************

                  SUBBASIN RUNOFF DATA
```

```
   94 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                       DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                                        STORM AREA =     .20

   95 LS          SCS LOSS RATE
                        STRTL         .11  INITIAL ABSTRACTION
                       CRVNBR       95.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   96 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .08  LAG

                                                                          ***

                                                                UNIT HYDROGRAPH
                                                            7 END-OF-PERIOD ORDINATES
                 16.        16.         5.         2.         1.         0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   97 KK     *       RTJ  *              ROUTE J TO 2

             *            *
             **************

                HYDROGRAPH ROUTING DATA

   98 RM          MUSKINGUM ROUTING
                        NSTPS         1 NUMBER OF SUBREACHES
                        AMSKK       .03 MUSKINGUM K
                            X       .45 MUSKINGUM X

                                                                          ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTJ.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
```

```
   99 KK      *         K  *             WATERSHED K
              *            *
              **************

                 SUBBASIN RUNOFF DATA

  100 BA           SUBBASIN CHARACTERISTICS
                         TAREA         .00  SUBBASIN AREA

                   PRECIPITATION DATA

   11 PH                                 DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                     .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                                     STORM AREA =     .20

  101 LS           SCS LOSS RATE
                         STRTL         .06  INITIAL ABSTRACTION
                        CRVNBR       97.00  CURVE NUMBER
                         RTIMP         .00  PERCENT IMPERVIOUS AREA

  102 UD           SCS DIMENSIONLESS UNITGRAPH
                          TLAG         .08  LAG

                                                                 ***

                                                            UNIT HYDROGRAPH
                                                        7 END-OF-PERIOD ORDINATES
                   9.        9.        3.        1.        0.        0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  103 KK      *       RTK  *             ROUTE K TO 2.2
              *            *
              **************

                 HYDROGRAPH ROUTING DATA

  104 RM           MUSKINGUM ROUTING
                         NSTPS          1 NUMBER OF SUBREACHES
                         AMSKK       .01 MUSKINGUM K
                             X       .45 MUSKINGUM X

                                                                 ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTK.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).
```

```
 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  105 KK     *         L  *              WATERSHED L
             *            *
             **************

                SUBBASIN RUNOFF DATA

  106 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                DEPTHS FOR   4-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .31     .56     .93    1.03    1.11    1.27    1.62    1.97
.00     .00     .00     .00

                                                    STORM AREA =     .20

  107 LS          SCS LOSS RATE
                        STRTL          .33  INITIAL ABSTRACTION
                       CRVNBR        86.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

  108 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .12  LAG

                                                                          ***

                                                                UNIT HYDROGRAPH
                                                            9 END-OF-PERIOD ORDINATES
                  5.        9.        6.        2.        1.        0.        0.
   0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  109 KK     *     COM22  *              COMBINE K, L AT 2.2
             *            *
             **************

  110 HC          HYDROGRAPH COMBINATION
                        ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                          ***
```

```
 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  111 KK     *      RTKL  *             ROUTE K, L TO 2
             *            *
             **************

                HYDROGRAPH ROUTING DATA

  112 RM          MUSKINGUM ROUTING
                        NSTPS         1 NUMBER OF SUBREACHES
                        AMSKK       .01 MUSKINGUM K
                            X       .30 MUSKINGUM X

                                                                          ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTKL.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  113 KK     *      COM2  *             COMBINE B, J, K, L AT 2
             *            *
             **************

  114 HC          HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                          ***
1
                                                                    RUNOFF SUMMARY
                                                            FLOW IN CUBIC FEET PER SECOND
                                                         TIME IN HOURS,  AREA IN SQUARE MILES

                                                PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM
PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION     FLOW     PEAK
           AREA      STAGE     MAX STAGE
+                                                                   6-HOUR     24-HOUR
72-HOUR

          HYDROGRAPH AT
+                              A1         4.   12.25           0.           0.
  0.        .01

          ROUTED TO
+                            RTA1         4.   12.25           0.           0.
  0.        .01

          HYDROGRAPH AT
+                              A2         7.   12.25           1.           0.
  0.        .02
```

```
          HYDROGRAPH AT
+                                A3          1.   12.25           0.          0.
  0.         .00
          3 COMBINED AT
+                             COMP1         11.   12.25           1.          0.
  0.         .03
          ROUTED TO
+                                P1          5.   12.50           1.          0.
  0.         .03
+
                      604.22      12.50
          HYDROGRAPH AT
+                                A4          1.   12.25           0.          0.
  0.         .00
          2 COMBINED AT
+                             COM11          6.   12.42           2.          0.
  0.         .03
          ROUTED TO
+                               RTA          6.   12.50           2.          0.
  0.         .03
          HYDROGRAPH AT
+                                A5          1.   12.25           0.          0.
  0.         .00
          2 COMBINED AT
+                             COMA1          6.   12.42           2.          1.
  1.         .04
          HYDROGRAPH AT
+                               CDE         10.   12.17           1.          0.
  0.         .01
          HYDROGRAPH AT
+                                 F          3.   12.08           0.          0.
  0.         .00
          ROUTED TO
+                               RTF          3.   12.17           0.          0.
  0.         .00
          HYDROGRAPH AT
+                                 G          3.   12.17           0.          0.
  0.         .00
          2 COMBINED AT
+                             COM14          6.   12.17           1.          0.
  0.         .01
          ROUTED TO
+                              RTFG          6.   12.17           1.          0.
  0.         .01
          2 COMBINED AT
+                             COM13         16.   12.17           1.          0.
  0.         .01
```

```
           ROUTED TO
+                             RTCG         14.   12.25          1.          0.
  0.         .01
           HYDROGRAPH AT
+                                H          4.   12.08          0.          0.
  0.         .00
           ROUTED TO
+                              RTH          4.   12.17          0.          0.
  0.         .00
           HYDROGRAPH AT
+                                I          1.   12.17          0.          0.
  0.         .00
           4 COMBINED AT
+                             COM1         24.   12.25          4.          1.
  1.         .05
           HYDROGRAPH AT
+                               B1          1.   12.25          0.          0.
  0.         .00
           ROUTED TO
+                             RTB1          1.   12.33          0.          0.
  0.         .00
           HYDROGRAPH AT
+                               B2         31.   12.50          6.          2.
  2.         .14
           2 COMBINED AT
+                            COMB2         31.   12.50          6.          2.
  2.         .14
           HYDROGRAPH AT
+                                J          6.   12.08          1.          0.
  0.         .00
           ROUTED TO
+                              RTJ          7.   12.17          1.          0.
  0.         .00
           HYDROGRAPH AT
+                                K          4.   12.08          0.          0.
  0.         .00
           ROUTED TO
+                              RTK          4.   12.17          0.          0.
  0.         .00
           HYDROGRAPH AT
+                                L          2.   12.17          0.          0.
  0.         .00
           2 COMBINED AT
+                            COM22          7.   12.17          1.          0.
  0.         .01
           ROUTED TO
+                             RTKL          7.   12.17          1.          0.
  0.         .01
```

```
          3 COMBINED AT
+                            COM2        34.   12.50           8.           2.
  2.         .15
```

*** NORMAL END OF HEC-1 ***

# APPENDIX D

## HEC-1 RUN (PROPOSED 100-YEAR)

```
1***************************************
        **************************************
 *                                       *
        *                                    *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
        *    U.S. ARMY CORPS OF ENGINEERS     *
 *               JUN   1998              *
        *    HYDROLOGIC ENGINEERING CENTER    *
 *             VERSION 4.1               *
        *         609 SECOND STREET           *
 *                                       *
        *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   27JUN03  TIME  10:25:39   *
        *          (916) 756-1104             *
 *                                       *
        *                                    *
 ***************************************
        **************************************
```

```
                                                 X     X  XXXXXXX   XXXXX
X
                                                 X     X  X        X     X
XX
                                                 X     X  X        X
X
                                                 XXXXXXX  XXXX     X        XXXXX
X
                                                 X     X  X        X
X
                                                 X     X  X        X     X
X
                                                 X     X  XXXXXXX   XXXXX
XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
1                                                               HEC-1 INPUT
                                    PAGE  1

           LINE
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                                   *DIAGRAM
```

```
           1            ID
*************************************************************************
           2            ID       SUMMIT CHRISTIAN CHURCH - CFA 6-03 MASTER
DRAINAGE REPORT
           3            ID       DEVELOPED CONDITIONS

           4            ID       FILE NAME: SCC00D.DAT

           5            ID
*************************************************************************
           6            ID       100 YEAR 24 HOUR EVENT

           7            IT       5                    289

           8            IO       4       0

                        *


           9            KK      A1    WATERSHED A1

          10            BA   0.010

          11            PH       1      .2     .48     .87    1.45    1.49    1.52
   1.58    2.01    2.44
          12            LS              80

          13            UD     .17

                        *


          14            KK    RTA1    ROUTE A1 TO P1

          15            RM       1     .02     .45

                        *


          16            KK      A2    WATERSHED A2

          17            BA   0.018

          18            LS              80

          19            UD     .17

                        *


          20            KK      A3    WATERSHED A3

          21            BA   0.002

          22            LS              80

          23            UD     .19

                        *


          24            KK   COMP1    COMBINE A1, A2, A3 AT P1 (DETENTION POND)
```

```
            25           HC        3
                         *

            26           KK       P1    DETENTION POND P1
            27           RS        1    STOR       0
            28           SA        0   0.032   0.073
            29           SE   600.5   601.0   605.0
            30           SQ     0.0     1.4     3.2     4.3     5.2     5.6    17.6
    39.3
            31           SE   600.5   601.0   602.0   603.0   604.0   604.5   605.0
   605.5
                         *
            32           KM             NEGLECT TRAVEL TIME P1 TO 1.1
                         *

            33           KK       A4    WATERSHED A4
            34           BA   0.003
            35           LS               80
            36           UD     .17
                         *
1                                                      HEC-1 INPUT
                          PAGE  2

          LINE
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            37           KK   COM11    COMBINE A1, A2, A3, A4 AT 1.1
            38           HC        2
                         *

            39           KK      RTA    ROUTE A1, A2, A3, A4 TO 1
            40           RM        1     .04     .45
                         *

            41           KK       A5    WATERSHED A5
            42           BA   0.002
            43           LS               80
            44           UD     .17
```

```
              *

45            KK   COMA1    COMBINE A1, A2, A3, A4, A5 AT 1
46            HC       2
              *

47            KK     CDE    WATERSHEDS C, D, E
48            BA   0.008
49            LS                 95
50            UD     .12
              *

51            KK       F    WATERSHED F
52            BA   0.002
53            LS                 97
54            UD     .08
              *

55            KK     RTF    ROUTE F TO 1.4
56            RM       1      .01     .45
              *

57            KK       G    WATERSHED G
58            BA   0.004
59            LS                 86
60            UD     .08
              *

61            KK   COM14    COMBINE F, G AT 1.4
62            HC       2
              *

63            KK    RTFG    ROUTE F, G TO 1.3
64            RM       1      .01     .20
              *
```

```
              65            KK   COM13    COMBINE CDE, F, G AT 1.3
              66            HC       2
                            *
1                                                            HEC-1 INPUT
                             PAGE  3

          LINE
 ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

              67            KK    RTCG    ROUTE CDE, F, G TO 1
              68            RM       1     .05     .20
                            *

              69            KK       H    WATERSHED H
              70            BA   0.003
              71            LS              97
              72            UD     .08
                            *

              73            KK     RTH    ROUTE H TO 1
              74            RM       1     .01     .44
                            *

              75            KK       I    WATERSHED I
              76            BA   0.002
              77            LS              86
              78            UD     .11
                            *

              79            KK    COM1    COMBINE A, CDE, F, G, H, I AT 1
              80            HC       4
                            *

              81            KK      B1    WATERSHED B1
              82            BA   0.002
              83            LS              80
```

```
               84            UD      .17
                             *

               85            KK    RTB1    ROUTE B1 TO 2
               86            RM       1     .05     .45
                             *

               87            KK      B2    WATERSHED B2
               88            BA   0.139
               89            LS                80
               90            UD      .42
                             *

               91            KK   COMB2    COMBINE B1, B2 AT 2
               92            HC       2
                             *

               93            KK       J    WATERSHED J
               94            BA   0.005
               95            LS                95
               96            UD      .08
                             *
1                                                        HEC-1 INPUT
                              PAGE  4

             LINE
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

               97            KK     RTJ    ROUTE J TO 2
               98            RM      .4     .03     .45
                             *

               99            KK       K    WATERSHED K
              100            BA   0.003
              101            LS                97
              102            UD      .08
                             *
```

```
           103            KK      RTK    ROUTE K TO 2.2
           104            RM       .1     .01     .45
                          *

           105            KK        L    WATERSHED L
           106            BA   0.003
           107            LS               86
           108            UD      .12
                          *

           109            KK   COM22    COMBINE K, L AT 2.2
           110            HC        2
                          *

           111            KK    RTKL    ROUTE K, L TO 2
           112            RM       .1     .01     .30
                          *

           113            KK    COM2    COMBINE B, J, K, L AT 2
           114            HC        3
                          *
.....1.......2.......3.......4.......5.......6.......7.......8.......9......10
           115            ZZ

1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     9          A1
                 V
                 V
    14        RTA1
                 .
                 .
    16           .           A2
                 .            .
                 .            .
    20           .            .           A3
                 .            .            .
                 .            .            .
    24       COMP1........................
                 V
```

```
             V
26          P1
             .
             .
33           .          A4
             .           .
             .           .
37       COM11............
             V
             V
39         RTA
             .
             .
41           .          A5
             .           .
             .           .
45       COMA1............
             .
             .
47           .         CDE
             .           .
             .           .
51           .           .           F
             .           .           V
             .           .           V
55           .           .         RTF
             .           .           .
             .           .           .
57           .           .           .           G
             .           .           .           .
             .           .           .           .
61           .           .       COM14............
             .           .           V
             .           .           V
63           .           .        RTFG
             .           .           .
             .           .           .
65           .       COM13............
             .           V
             .           V
67           .        RTCG
             .           .
             .           .
69           .           .           H
             .           .           V
             .           .           V
73           .           .         RTH
             .           .           .
             .           .           .
75           .           .           .           I
             .           .           .           .
             .           .           .           .
79        COM1....................................
             .
             .
81           .          B1
             .           V
             .           V
85           .        RTB1
             .           .
             .           .
87           .           .          B2
             .           .           .
```

```
                 .           .           .
  91             .       COMB2............
                 .           .
                 .           .
  93             .           .           J
                 .           .           V
                 .           .           V
  97             .           .         RTJ
                 .           .           .
                 .           .           .
  99             .           .           .           K
                 .           .           .           V
                 .           .           .           V
 103             .           .           .         RTK
                 .           .           .           .
                 .           .           .           .
 105             .           .           .           .           L
                 .           .           .           .           .
                 .           .           .           .           .
 109             .           .           .       COM22............
                 .           .           .           V
                 .           .           .           V
 111             .           .           .        RTKL
                 .           .           .           .
                 .           .           .           .
 113             .        COM2.......................

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
        **************************************
 *                                       *
        *                                    *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
        *    U.S. ARMY CORPS OF ENGINEERS     *
 *             JUN   1998                *
        *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1                 *
        *          609 SECOND STREET          *
 *                                       *
        *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   27JUN03  TIME  10:25:39   *
        *           (916) 756-1104            *
 *                                       *
        *                                    *
 *****************************************
        **************************************




*************************************************************************
                                SUMMIT CHRISTIAN CHURCH - CFA 6-03 MASTER DRAINAGE
REPORT
                                DEVELOPED CONDITIONS

                                FILE NAME: SCC00D.DAT

*************************************************************************
                                100 YEAR 24 HOUR EVENT
```

```
  8 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           4  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         289  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      2    0  ENDING DATE
                     NDTIME        0000  ENDING TIME
                     ICENT           19  CENTURY MARK

                COMPUTATION INTERVAL      .08 HOURS
                     TOTAL TIME BASE   24.00 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  9 KK     *        A1  *              WATERSHED A1

           *            *
           **************

              SUBBASIN RUNOFF DATA

 10 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

 11 PH                               DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                  .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                      STORM AREA =     .20

 12 LS          SCS LOSS RATE
                      STRTL         .50  INITIAL ABSTRACTION
                     CRVNBR       80.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 13 UD          SCS DIMENSIONLESS UNITGRAPH
```

```
                     TLAG          .17  LAG

                                                                 ***

                                                            UNIT HYDROGRAPH
                                                        12 END-OF-PERIOD ORDINATES
                 7.        21.        22.        14.         7.         4.         2.
   1.        1.        0.
                 0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   14 KK     *      RTA1  *              ROUTE A1 TO P1

             *            *
             **************

                HYDROGRAPH ROUTING DATA

   15 RM          MUSKINGUM ROUTING
                        NSTPS          1 NUMBER OF SUBREACHES
                        AMSKK        .02 MUSKINGUM K
                            X        .45 MUSKINGUM X

                                                                 ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTA1.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   16 KK     *        A2  *              WATERSHED A2

             *            *
             **************

                SUBBASIN RUNOFF DATA

   17 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .02  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                  DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00
```

```
                                                  STORM AREA =     .20

   18 LS          SCS LOSS RATE
                        STRTL         .50  INITIAL ABSTRACTION
                       CRVNBR       80.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   19 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .17  LAG

                                                                ***

                                                          UNIT HYDROGRAPH
                                                     12 END-OF-PERIOD ORDINATES
                 12.        38.        39.        24.        12.         7.         3.
   2.         1.         1.
                  0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   20 KK    *        A3  *              WATERSHED A3
            *            *
            **************

                SUBBASIN RUNOFF DATA

   21 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                 DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                  STORM AREA =     .20

   22 LS          SCS LOSS RATE
                        STRTL         .50  INITIAL ABSTRACTION
                       CRVNBR       80.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   23 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .19  LAG

                                                                ***

                                                          UNIT HYDROGRAPH
                                                     13 END-OF-PERIOD ORDINATES
                  1.         4.         4.         3.         2.         1.         1.
   0.         0.         0.
                  0.         0.         0.
```

```
 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
   24 KK     *     COMP1  *            COMBINE A1, A2, A3 AT P1 (DETENTION POND)
             *            *
             **************

   25 HC          HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                          ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
   26 KK     *        P1  *            DETENTION POND P1
             *            *
             **************
                                       NEGLECT TRAVEL TIME P1 TO 1.1

                HYDROGRAPH ROUTING DATA

   27 RS          STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        STOR  TYPE OF INITIAL CONDITION
                       RSVRIC         .00  INITIAL CONDITION
                            X         .00 WORKING R AND D COEFFICIENT

   28 SA                 AREA          .0         .0         .1

   29 SE          ELEVATION      600.50     601.00     605.00

   30 SQ          DISCHARGE          0.         1.         3.         4.         5.
  6.        18.        39.

   31 SE          ELEVATION      600.50     601.00     602.00     603.00     604.00
604.50     605.00     605.50

                                                                          ***

                                                           COMPUTED STORAGE-ELEVATION DATA

             STORAGE        .00        .01        .21
           ELEVATION     600.50     601.00     605.00

                                                       COMPUTED STORAGE-OUTFLOW-ELEVATION
DATA

             STORAGE        .00        .01        .04        .09        .14        .17
```

```
   .21       .25
             OUTFLOW        .00      1.40      3.20      4.30      5.20      5.60
 17.60     39.30
           ELEVATION     600.50    601.00    602.00    603.00    604.00    604.50
605.00    605.50

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS
BETWEEN        6. TO       39.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR
OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING
STORAGE (USE A LONGER REACH.)


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   33 KK     *        A4  *             WATERSHED A4

             *            *
             **************

                SUBBASIN RUNOFF DATA

   34 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                    STORM AREA =     .20

   35 LS          SCS LOSS RATE
                        STRTL         .50  INITIAL ABSTRACTION
                       CRVNBR       80.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   36 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .17  LAG

                                                                          ***


                                                                  UNIT HYDROGRAPH
                                                             12 END-OF-PERIOD ORDINATES
                  2.         6.         6.         4.         2.         1.         1.
   0.        0.        0.
                  0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***
```

```
             **************
             *            *
   37 KK     *     COM11  *             COMBINE A1, A2, A3, A4 AT 1.1
             *            *
             **************

   38 HC           HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                           ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   39 KK     *       RTA  *             ROUTE A1, A2, A3, A4 TO 1
             *            *
             **************

                 HYDROGRAPH ROUTING DATA

   40 RM           MUSKINGUM ROUTING
                        NSTPS         1 NUMBER OF SUBREACHES
                        AMSKK       .04 MUSKINGUM K
                            X       .45 MUSKINGUM X

                                                                           ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTA.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   41 KK     *        A5  *             WATERSHED A5
             *            *
             **************

                 SUBBASIN RUNOFF DATA

   42 BA           SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                   PRECIPITATION DATA

   11 PH                                 DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
```

```
2-DAY   4-DAY   7-DAY  10-DAY
                    .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                        STORM AREA =     .20

   43 LS          SCS LOSS RATE
                        STRTL         .50  INITIAL ABSTRACTION
                       CRVNBR       80.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   44 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .17  LAG

                                                                          ***

                                                                    UNIT HYDROGRAPH
                                                              12 END-OF-PERIOD ORDINATES
                  1.         4.         4.         3.         1.         1.         0.
   0.         0.         0.
                  0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   45 KK     *    COMA1   *            COMBINE A1, A2, A3, A4, A5 AT 1

             *            *
             **************

   46 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                          ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   47 KK     *      CDE   *            WATERSHEDS C, D, E

             *            *
             **************

                SUBBASIN RUNOFF DATA

   48 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
```

```
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                   STORM AREA =     .20

   49 LS          SCS LOSS RATE
                        STRTL         .11  INITIAL ABSTRACTION
                       CRVNBR       95.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   50 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .12  LAG

                                                                ***

                                                           UNIT HYDROGRAPH
                                                     9 END-OF-PERIOD ORDINATES
                 12.       24.       15.        6.        3.        1.        0.
   0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   51 KK     *         F  *             WATERSHED F

             *            *
             **************

                SUBBASIN RUNOFF DATA

   52 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                   DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                   STORM AREA =     .20

   53 LS          SCS LOSS RATE
                        STRTL         .06  INITIAL ABSTRACTION
                       CRVNBR       97.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   54 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .08  LAG

                                                                ***

                                                           UNIT HYDROGRAPH
```

```
                                                           7 END-OF-PERIOD ORDINATES
                  6.        6.        2.        1.        0.        0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   55 KK     *       RTF  *             ROUTE F TO 1.4
             *            *
             **************

                HYDROGRAPH ROUTING DATA

   56 RM          MUSKINGUM ROUTING
                        NSTPS         1 NUMBER OF SUBREACHES
                        AMSKK       .01 MUSKINGUM K
                            X       .45 MUSKINGUM X

                                                                          ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTF.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   57 KK     *         G  *             WATERSHED G
             *            *
             **************

                SUBBASIN RUNOFF DATA

   58 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                               DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                      STORM AREA =     .20

   59 LS          SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA
```

```
  60 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG         .08  LAG

                                                                  ***

                                                            UNIT HYDROGRAPH
                                                        7 END-OF-PERIOD ORDINATES
                 12.       13.        4.        1.        0.        0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  61 KK      *     COM14  *            COMBINE F, G AT 1.4

             *            *
             **************

  62 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  63 KK      *      RTFG  *            ROUTE F, G TO 1.3

             *            *
             **************

               HYDROGRAPH ROUTING DATA

  64 RM          MUSKINGUM ROUTING
                       NSTPS         1 NUMBER OF SUBREACHES
                       AMSKK       .01 MUSKINGUM K
                           X       .20 MUSKINGUM X

                                                                  ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTFG.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  65 KK      *     COM13  *            COMBINE CDE, F, G AT 1.3

             *            *
```

```
            **************

   66 HC           HYDROGRAPH COMBINATION
                         ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                            ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   67 KK    *      RTCG  *             ROUTE CDE, F, G TO 1

            *            *
            **************

                 HYDROGRAPH ROUTING DATA

   68 RM           MUSKINGUM ROUTING
                         NSTPS          1 NUMBER OF SUBREACHES
                         AMSKK        .05 MUSKINGUM K
                             X        .20 MUSKINGUM X

                                                                            ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTCG.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   69 KK    *         H  *             WATERSHED H

            *            *
            **************

                 SUBBASIN RUNOFF DATA

   70 BA           SUBBASIN CHARACTERISTICS
                         TAREA          .00  SUBBASIN AREA

                   PRECIPITATION DATA

   11 PH                                    DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                     .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                       STORM AREA =     .20

   71 LS           SCS LOSS RATE
```

```
                 STRTL          .06  INITIAL ABSTRACTION
                CRVNBR        97.00  CURVE NUMBER
                 RTIMP          .00  PERCENT IMPERVIOUS AREA

   72 UD          SCS DIMENSIONLESS UNITGRAPH
                  TLAG          .08  LAG

                                                                ***

                                                          UNIT HYDROGRAPH
                                                      7 END-OF-PERIOD ORDINATES
              9.        9.        3.        1.        0.        0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   73 KK     *       RTH  *              ROUTE H TO 1
             *            *
             **************

               HYDROGRAPH ROUTING DATA

   74 RM          MUSKINGUM ROUTING
                      NSTPS         1 NUMBER OF SUBREACHES
                      AMSKK       .01 MUSKINGUM K
                          X       .44 MUSKINGUM X

                                                                ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTH.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   75 KK     *         I  *              WATERSHED I
             *            *
             **************

               SUBBASIN RUNOFF DATA

   76 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                               DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
```

```
                        .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
 .00     .00     .00     .00

                                                       STORM AREA =     .20

   77 LS          SCS LOSS RATE
                        STRTL          .33  INITIAL ABSTRACTION
                       CRVNBR        86.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

   78 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .11  LAG

                                                                  ***

                                                            UNIT HYDROGRAPH
                                                        9 END-OF-PERIOD ORDINATES
                  4.        6.        3.        1.        1.        0.        0.
   0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   79 KK     *      COM1  *              COMBINE A, CDE, F, G, H, I AT 1

             *            *
             **************

   80 HC          HYDROGRAPH COMBINATION
                        ICOMP            4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   81 KK     *        B1  *              WATERSHED B1

             *            *
             **************

                SUBBASIN RUNOFF DATA

   82 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
 ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
 2-DAY   4-DAY   7-DAY  10-DAY
```

```
                     .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
 .00     .00     .00     .00

                                                      STORM AREA =     .20

   83 LS          SCS LOSS RATE
                        STRTL          .50  INITIAL ABSTRACTION
                       CRVNBR        80.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

   84 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .17  LAG

                                                                         ***

                                                            UNIT HYDROGRAPH
                                                       12 END-OF-PERIOD ORDINATES
                  1.        4.        4.        3.        1.        1.        0.
   0.        0.        0.
                  0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   85 KK     *      RTB1  *             ROUTE B1 TO 2

             *            *
             **************

                HYDROGRAPH ROUTING DATA

   86 RM          MUSKINGUM ROUTING
                        NSTPS         1 NUMBER OF SUBREACHES
                        AMSKK       .05 MUSKINGUM K
                            X       .45 MUSKINGUM X

                                                                         ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTB1.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   87 KK     *        B2  *             WATERSHED B2

             *            *
             **************

                SUBBASIN RUNOFF DATA

   88 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .14  SUBBASIN AREA
```

```
                    PRECIPITATION DATA

   11 PH                                DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                    ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                    5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                      .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                        STORM AREA =     .20

   89 LS            SCS LOSS RATE
                          STRTL          .50  INITIAL ABSTRACTION
                         CRVNBR        80.00  CURVE NUMBER
                          RTIMP          .00  PERCENT IMPERVIOUS AREA

   90 UD            SCS DIMENSIONLESS UNITGRAPH
                           TLAG          .42  LAG

                                                                          ***

                                                                    UNIT HYDROGRAPH
                                                               27 END-OF-PERIOD ORDINATES
                   13.         38.         80.        123.        144.        144.        129.
 107.        78.        56.
                   42.         32.         24.         18.         13.         10.          7.
   5.         4.         3.
                    2.          2.          1.          1.          1.          0.          0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   91 KK     *     COMB2  *             COMBINE B1, B2 AT 2

             *            *
             **************

   92 HC            HYDROGRAPH COMBINATION
                          ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                          ***


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   93 KK     *         J  *             WATERSHED J

             *            *
             **************

                  SUBBASIN RUNOFF DATA
```

```
   94 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                      DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                         STORM AREA =     .20

   95 LS          SCS LOSS RATE
                        STRTL         .11  INITIAL ABSTRACTION
                       CRVNBR       95.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   96 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .08  LAG

                                                                          ***

                                                                    UNIT HYDROGRAPH
                                                                7 END-OF-PERIOD ORDINATES
                 16.       16.        5.        2.        1.        0.        0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   97 KK     *       RTJ  *              ROUTE J TO 2

             *            *
             **************

                HYDROGRAPH ROUTING DATA

   98 RM          MUSKINGUM ROUTING
                        NSTPS         1 NUMBER OF SUBREACHES
                        AMSKK       .03 MUSKINGUM K
                            X       .45 MUSKINGUM X

                                                                          ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTJ.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
```

```
   99 KK      *          K  *              WATERSHED K

              *             *
              **************

                 SUBBASIN RUNOFF DATA

  100 BA           SUBBASIN CHARACTERISTICS
                         TAREA          .00  SUBBASIN AREA

                   PRECIPITATION DATA

   11 PH                                    DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                     .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                      STORM AREA =     .20

  101 LS           SCS LOSS RATE
                         STRTL          .06  INITIAL ABSTRACTION
                        CRVNBR        97.00  CURVE NUMBER
                         RTIMP          .00  PERCENT IMPERVIOUS AREA

  102 UD           SCS DIMENSIONLESS UNITGRAPH
                          TLAG          .08  LAG

                                                                        ***

                                                                  UNIT HYDROGRAPH
                                                              7 END-OF-PERIOD ORDINATES
                   9.         9.         3.         1.         0.         0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *             *
  103 KK      *       RTK   *              ROUTE K TO 2.2

              *             *
              **************

                 HYDROGRAPH ROUTING DATA

  104 RM           MUSKINGUM ROUTING
                         NSTPS          1 NUMBER OF SUBREACHES
                         AMSKK        .01 MUSKINGUM K
                             X        .45 MUSKINGUM X

                                                                        ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTK.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).
```

```
 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  105 KK     *         L  *              WATERSHED L
             *            *
             **************

                SUBBASIN RUNOFF DATA

  106 BA          SUBBASIN CHARACTERISTICS
                        TAREA          .00  SUBBASIN AREA

                  PRECIPITATION DATA

   11 PH                                DEPTHS FOR   1-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............
........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR
2-DAY   4-DAY   7-DAY  10-DAY
                    .48     .87    1.45    1.49    1.52    1.58    2.01    2.44
.00     .00     .00     .00

                                                    STORM AREA =     .20

  107 LS          SCS LOSS RATE
                        STRTL          .33  INITIAL ABSTRACTION
                       CRVNBR        86.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

  108 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG          .12  LAG

                                                                          ***

                                                                UNIT HYDROGRAPH
                                                            9 END-OF-PERIOD ORDINATES
                  5.         9.         6.         2.         1.         0.         0.
   0.         0.


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  109 KK     *     COM22  *              COMBINE K, L AT 2.2
             *            *
             **************

  110 HC          HYDROGRAPH COMBINATION
                        ICOMP            2  NUMBER OF HYDROGRAPHS TO COMBINE
                                                                          ***
```

```
 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  111 KK     *      RTKL  *             ROUTE K, L TO 2

             *            *
             **************

                HYDROGRAPH ROUTING DATA

  112 RM          MUSKINGUM ROUTING
                        NSTPS         1 NUMBER OF SUBREACHES
                        AMSKK       .01 MUSKINGUM K
                            X       .30 MUSKINGUM X

                                                                          ***
 ***** WARNING *****  POSSIBLE INSTABILITIES IN THE MUSKINGUM ROUTING FOR REACH
RTKL.
       ADJUST NSTPS AND/OR COMPUTATION INTERVAL TO MEET CRITERIA IN USER MANUAL).


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  113 KK     *      COM2  *             COMBINE B, J, K, L AT 2

             *            *
             **************

  114 HC          HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                          ***
1
                                                                    RUNOFF SUMMARY
                                                            FLOW IN CUBIC FEET PER SECOND
                                                         TIME IN HOURS,  AREA IN SQUARE MILES

                                                PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM
PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION     FLOW     PEAK
           AREA      STAGE     MAX STAGE
+                                                                   6-HOUR     24-HOUR
72-HOUR

          HYDROGRAPH AT
+                               A1         8.   12.25           1.          0.
  0.        .01

          ROUTED TO
+                             RTA1         8.   12.25           1.          0.
  0.        .01

          HYDROGRAPH AT
+                               A2        14.   12.25           1.          0.
  0.        .02
```

```
          HYDROGRAPH AT
+                            A3         1.   12.25          0.          0.
  0.        .00
          3 COMBINED AT
+                         COMP1        23.   12.25          2.          1.
  1.        .03
          ROUTED TO
+                            P1        23.   12.33          2.          1.
  1.        .03
+
                    605.12      12.33
          HYDROGRAPH AT
+                            A4         2.   12.25          0.          0.
  0.        .00
          2 COMBINED AT
+                         COM11        25.   12.33          2.          1.
  1.        .03
          ROUTED TO
+                           RTA        24.   12.42          2.          1.
  1.        .03
          HYDROGRAPH AT
+                            A5         2.   12.25          0.          0.
  0.        .00
          2 COMBINED AT
+                         COMA1        25.   12.42          3.          1.
  1.        .04
          HYDROGRAPH AT
+                           CDE        16.   12.17          1.          0.
  0.        .01
          HYDROGRAPH AT
+                             F         4.   12.08          0.          0.
  0.        .00
          ROUTED TO
+                           RTF         5.   12.17          0.          0.
  0.        .00
          HYDROGRAPH AT
+                             G         6.   12.17          0.          0.
  0.        .00
          2 COMBINED AT
+                         COM14        10.   12.17          1.          0.
  0.        .01
          ROUTED TO
+                          RTFG        11.   12.17          1.          0.
  0.        .01
          2 COMBINED AT
+                         COM13        26.   12.17          2.          1.
  1.        .01
```

```
          ROUTED TO
+                                RTCG       24.   12.25        2.          1.
  1.        .01

          HYDROGRAPH AT
+                                   H        7.   12.08        1.          0.
  0.        .00

          ROUTED TO
+                                 RTH        7.   12.17        1.          0.
  0.        .00

          HYDROGRAPH AT
+                                   I        3.   12.17        0.          0.
  0.        .00

          4 COMBINED AT
+                                COM1       41.   12.25        5.          2.
  2.        .05

          HYDROGRAPH AT
+                                  B1        2.   12.25        0.          0.
  0.        .00

          ROUTED TO
+                                RTB1        1.   12.33        0.          0.
  0.        .00

          HYDROGRAPH AT
+                                  B2       63.   12.50       10.          3.
  3.        .14

          2 COMBINED AT
+                               COMB2       64.   12.50       10.          3.
  3.        .14

          HYDROGRAPH AT
+                                   J       10.   12.08        1.          0.
  0.        .00

          ROUTED TO
+                                 RTJ       11.   12.17        1.          0.
  0.        .00

          HYDROGRAPH AT
+                                   K        7.   12.08        1.          0.
  0.        .00

          ROUTED TO
+                                 RTK        7.   12.17        1.          0.
  0.        .00

          HYDROGRAPH AT
+                                   L        4.   12.17        0.          0.
  0.        .00

          2 COMBINED AT
+                               COM22       11.   12.17        1.          0.
  0.        .01

          ROUTED TO
+                                RTKL       11.   12.17        1.          0.
  0.        .01
```

```
          3 COMBINED AT
+                  COM2        68.   12.50          12.          4.
  4.        .15

 *** NORMAL END OF HEC-1 ***
```


A1
A2
A3
A4
A5
B1
B2
C1
C2
C3
C4
C5
D1
D2
D3
E1
F1
G1
G2
G3
H1
I1
J1
J2
J3
J4
K1
L1
L2
P1
DETENTION POND
INFLOW
$Q_{25}$ = 11 cfs
$Q_{100}$ = 23 cfs
OUTFLOW
$Q_{25}$ = 5 cfs
$Q_{100}$ = 23 cfs
$Q_{25}$ = 4 cfs
$Q_{100}$ = 8 cfs
1.2
$Q_{25}$ = 7 cfs
$Q_{100}$ = 14 cfs
$Q_{25}$ = 1 cfs
$Q_{100}$ = 2 cfs
2.1
1.1
2.4
$Q_{25}$ = 4 cfs
$Q_{100}$ = 7 cfs
1.6
$Q_{25}$ = 3 cfs
$Q_{100}$ = 4 cfs
1.5
$Q_{25}$ = 4 cfs
$Q_{100}$ = 7 cfs
2.3
$Q_{25}$ = 6 cfs
$Q_{100}$ = 25 cfs
1
$Q_{25}$ = 19 cfs
$Q_{100}$ = 34 cfs
UNDEVELOPED
$Q_{25}$ = 19 cfs
$Q_{100}$ = 39 cfs
DEVELOPED
$Q_{25}$ = 24 cfs
$Q_{100}$ = 41 cfs
1.3
$Q_{25}$ = 6 cfs
$Q_{100}$ = 10 cfs
1.4
2.2
$Q_{25}$ = 7 cfs
$Q_{100}$ = 11 cfs
$Q_{25}$ = 25 cfs
$Q_{100}$ = 64 cfs
2
UNDEVELOPED
$Q_{25}$ = 34 cfs
$Q_{100}$ = 69 cfs
DEVELOPED
$Q_{25}$ = 34 cfs
$Q_{100}$ = 68 cfs
SCALE: 1" = 40'
WARNING:
ALL DESIGNS AND DRAWINGS AS INSTRUMENTS OF SERVICE ARE COPYRIGHT BY THE ENGINEER UNDER PROVISIONS OF NRS 623. UNAUTHORIZED DUPLICATION OF DESIGNS OR DISTRIBUTION OF DRAWINGS IS PROHIBITED.
Wed, 08 Apr 2015-9:44am <BHermes>
File: R:\X\projects\03005.00\Dwg\Hydro\HYDRO.dwg
BY
REVISIONS
DATE
MARK
STATUS OF PLANS
☒ PRELIMINARY DATE: 6/24/03
☒ INITIAL SUBMITTAL DATE: 7/2/03
☐ FINAL SUBMITTAL DATE:
PLANS ARE PRELIMINARY AND SUBJECT TO CHANGE UNTIL STAMPED AND SIGNED APPROVED BY ALL APPROPRIATE GOVERNING AGENCIES.
PLANNERS • ENGINEERS • LANDSCAPE ARCHITECTS
SURVEYORS • CONSTRUCTION INSPECTION
1150 CORPORATE BLVD. RENO, NV 89502
(775) 856-1150 FAX: (775) 856-1160
SUMMIT CHRISTIAN CHURCH
MASTER HYDROLOGY MAP
WASHOE COUNTY
NEVADA
JOB NO. 03-005.00
DESIGNED BY: TAH
DRAWN BY: TAH
SHEET
H1
OF
1

# APPENDIX D

HYDROLOGY ANALYSIS & REPORT WITH AMENDMENTS
SPRING RIDGE SUBDIVISION
BY: MOUNTAIN WEST ENGINEERING
MAY 1993

KETURN TO WASHOE COUNTY ENGINEERING

**mountain west** consulting

civil engineering • planning • landscape design

Amended Spring Ridge Unit I Phase I

November 19, 1993

Kirk Nicholas
**Washoe County Engineering**
1001 E. Ninth Street
Reno, NV 89520

RE: **Hydrology Report- Amendment**
**Amended Spring Ridge Subdivision**

Dear Kirk:

Per your request, please accept this letter as an amendment to the above referenced report. As a result of the delineation of the interceptor ditch at the west property boundary in Phases 1 and 2, we have re-calculated the storm drainage flows tributary to the effected catch basins. Since the majority of the flows will be directed to the catch basin located at Sta "N" 1+45 on Noble Court, the net increase was calculated at that inlet point. Subsequently, the storm drainage pipes were re-calculated down stream of that inlet point also.

Attached are revised storm drainage calculations which reflect the new design criteria, these changes have been revised on the Improvement Plans.

Should you have any questions, please call

Sincerely,
mountain west consulting

Joe L. Murin, P.E.

REGISTERED PROFESSIONAL ENGINEER - STATE OF NEVADA
JOE L. MURIN
CIVIL
No. 3574

# SPRING RIDGE

## - REVISED SD CALC'S -

I. CHECK CATCH BASINS FOR INCREASE PEAK FLOWS

w/o CONSTRUCTION OF INTERCEPTOR DITCH @ WEST PL.

FROM SHEET 1 :

OFFSITE: $A = 25^{\pm}$ ACRES
$C = 0.45$

ONSITE: $A = 4.75^{\pm}$ ACRES
$C = 0.50$

$\therefore$ $C_{WEIGHTED} = 0.46$

$\therefore$ $Q_{10} = 7.5$ CFS, $Q_{100} = 13.7$ CFS → NEW FLOWS AT CATCH BASIN STA "N" 1+45 -16' R

REVISE TO TWO (2) TYPE I CB TO SATISFY INLET CAPACITY

CONNECT CB'S w/ 12"$\phi$ PVC

CHECK 12"$\phi$ LATERAL CAPACITY TO SDMH D-2

ASSUME INLET CONTROL, MOST CONSERVATIVE
$L = 60 \pm$ LF   $H = 3.58$ FT   $r_H = 0.25$
$S = 0.043$ FT/FT   $K_e = 0.5$ (FLUSH, SQ)

$\therefore$ $V = 9.9$ fps → $Q_{MAX} = 7.8$ CFS > 7.5 CFS

12"$\phi$ RCP LATERAL IS ADEQUATE

# SPRING RIDGE

## - REVISED SD CALC'S -

II CHECK SD REACH BETWEN SDMH D-2 AND SDMH SR-2

$Q_{10}$ = 10.2 CFS

S = 0.0194 FT/FT
n = 0.014 RCP

$D_{REQ'D}$ = 1.34' = 16"

REVISE TO 18"ϕ RCP

III CHECK SD REACH BETWEEN SDMH SR-2 AND SDMH SR-1

$Q_{10}$ = 12.3 CFS

S = 0.0307 FT/FT
n = 0.014 RCP

$D_{REQ'D}$ = 1.32' = 15.8"

REVISE TO 18"ϕ RCP

DTP

**mountain west** consulting

civil engineering • planning • landscape design

August 17, 1993

Kirk Nicholas
**Washoe County Engineering**
*1001 E. Ninth Street*
Reno, NV 89520

RE: **Amended Spring Ridge Subdivision**
**Hydrology addendum**

Dear Kirk:

Per our conversation, with respect to the revision to remove the "V" ditch at the westerly property line of the above referenced Improvement Plans, we feel that the decision not to include this ditch as part of the improvements will not adversely impact the subdivision or lots along the subject property line. Due to the relatively low flow volume (11 cfs at 100 year storm) over a length in excess of 1300 feet, the flows which will cross the westerly property line will not be of significant volume or velocity to cause damage to property or person. The logical location for a future ditch should be on the westerly side of the adjacent land owner, when that land develops.

Sincerely,
**mountain west consulting**

Joe L. Murin, P.E.

mountainwest consulting

civil engineering • planning • landscape design

# LETTER OF TRANSMITTAL

TO: WASHOE COUNTY ENGINEERING

DATE: 8/18/93

RE: SPRING RIDGE UNIT 1, PH. 1,2,3

ATTN: KIRK NICHOLAS

PLEASE FIND ENCLOSED THE FOLLOWING:

| QTY | DESCRIPTION |
|---|---|
| 1 | ~~[illegible]~~ |
| 1 copy | NDOT APPROVAL LTR. |
| | |
| | |
| | |

REMARKS: PER YOUR REQUEST

BY: [signature]

TED ERKAN.

ABOVE MATERIAL RECEIVED BY: ______________ DATE: ______

p.o. box 21450 reno, nevada 89515-1450 (702) 329-7077

# HYDROLOGY ANALYSIS & REPORT

Prepared for

# SPRING RIDGE SUBDIVISION

Reno, Nevada

Prepared by


MOUNTAIN WEST CONSULTING
499 W. Plumb, Suite 4
Reno, Nevada 89509
(702) 329-7077


May 1993

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
CIVIL
6-2-93
No. 3574

## INTRODUCTION:

The following report represents the hydrologic conditions relative to the proposed Spring Ridge Subdivision located west of the Pyramid Highway, in Spanish Springs, Washoe County, Nevada. Addressed in this report, are both mitigation of increased peak flows with respect to the ten (10) and one hundred (100) year storm events in addition to the perpetuation of existing off-site flows which historically traverse the site.

The Spring Ridge Subdivision will create 103 lots of 6000 sf minimum lot area. The site is currently unoccupied.

## EXISTING CONDITIONS:

The site is located adjacent to the Pyramid Highway, on the west side of the road. Presently, the site is unoccupied and is covered with native grasses and shrubs. In addition to the flows which are generated on the proposed site, two (2) off-site watersheds also contribute storm flows to the Spring Ridge site via natural topography. These watersheds are shown in Plate 1 of this report. Flows from these two (2) watersheds, along with the existing Spring Ridge flows, are intercepted by the Pyramid highway roadside ditch. From this location they are channeled south, to an existing 6' X 8' RCP culvert crossing which passes flows under the Pyramid Highway.

## PROPOSED CONDITIONS:

The Spring Ridge Subdivision Improvements mitigate and perpetuate the flows from the off-site watersheds in addition to properly collecting and conveying storm flows within the Subdivision.

The off-site flows ~~form~~ from Watershed #1, as shown on Plate 1, shall be piped through the Subdivision by a 30" RCP pipe which has been sized to pass the one hundred (100) year storm flows. These flows will be directed through the Subdivision in the pipe where they are discharged to the roadside ditch at the emergency access road location, adjacent to the Pyramid Highway. This ditch will be improved to meet the flow requirements of both the subdivision and off-site flows. The roadside ditch is the historic location of discharge for the flows as detailed above. Thus, the ditch improvements shall extend to the culvert crossing located south of the project.

The storm flows generated in watershed #2 (please refer to Plate 1) will be intercepted by the proposed interceptor ditch located at the west edge of the property. This ditch will collect and transmit flows around the project, discharging in the Pyramid Highway roadside ditch, their historic path.

Flows on-site shall be collected utilizing catch basins at low points within the grading and piping the flows to the highway right of way and the improved roadside ditch.

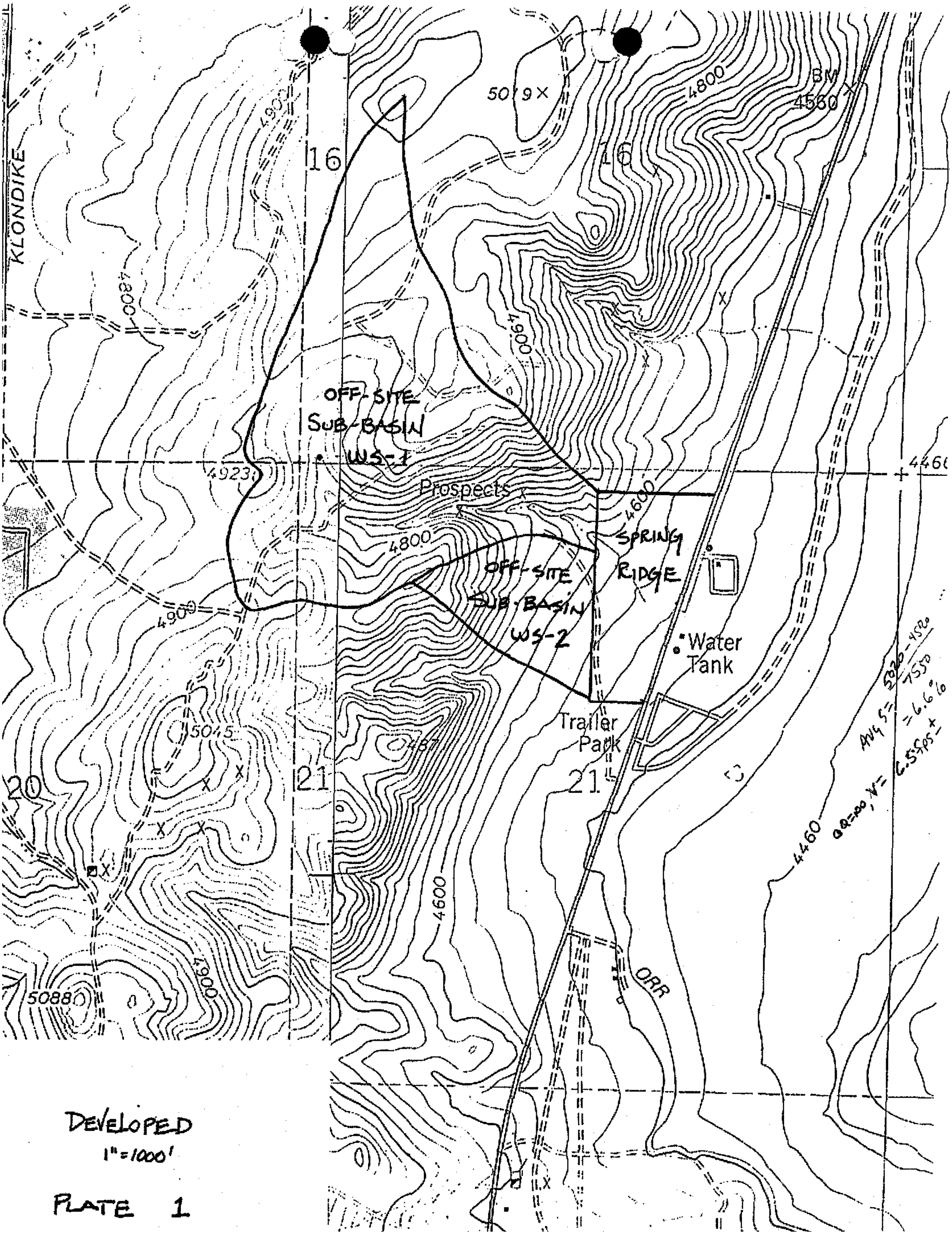
For specific calculations on any portion of the storm drainage improvements, please refer to the Appendix of this report.

**SUMMERY:**

Based on this information contained within this design and analysis, the proposed improvements will mitigate the storm flows from the project and perpetuate the existing drainage from off-site watersheds to the historic flow paths. All drainage improvements were designed in accordance with Washoe County Public Works standards and requirements. The Spring Ridge Subdivision is located in a FEMA Zone C flood area, area of minimum flooding potential.

10 YR RETENSION ?

TIM #23 - UPGRADE NDOT PIPES? #7 on DAVE'S APRIL 12, 91 LETTER




DEVELOPED

1" = 1000'

PLATE 1

# APPENDIX

## I. ASSUMPTIONS:

a) $Q = CiA$ (RATIONAL METHOD)

b) $t_c = \frac{L}{V \times 60} = 7550/(4)(60) = 31.45$ MIN $\approx$ 30 MIN

c) WITH $t_c = 30$ MIN

$i_{10} = 0.55$ IN/HR
$i_{100} = 1.00$ IN/HR
FROM CURVE B, WASHOE COUNTY IDF CURVES

PREVIOUS REPORT = 1.3

Vel 6.5 fps $t_c = 20$ min $i_{100} = 1.3$

## II FLOWS FROM RELATIVE WATERSHEDS:

| DESCRIPTION | A (ACRES) | C | $Q_{10}$ (CFS) | $Q_{100}$ (CFS) | |
|---|---|---|---|---|---|
| WS-1 | 162 | 0.45 | 40 | 73 | PREVIOUS REPORT 95 cfs |
| WS-2 | 25 | 0.45 | 6 | 11 | " " 14.5 |

## III CHANNEL SECTION DESIGN - DREXEL DRIVE

$Q = 73$ CFS
$S = 3.3\% = 0.033$ FT/FT
$n = 0.018$ (SMOOTH EARTH)

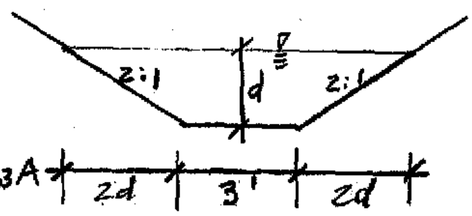
TRY 3' WIDE CHANNEL (TRAPAZOIDAL)

TM #20
TO BE PIPED

$A = 3d + 2d^2$
$P = 3 + 4.47d$

FROM MANNINGS:

$$73 = \frac{1.49}{0.018}\left(\frac{3d+2d^2}{3+4.47d}\right)^{2/3}\sqrt{0.033}\,A$$

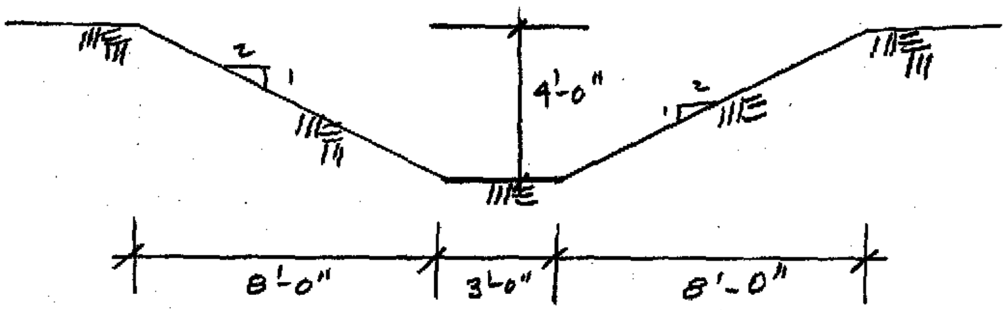



SIMPLIFY TO:

$$4.85 = \left(\frac{3d+2d^2}{3+4.47d}\right)^{2/3}(3d+2d^2)$$

$d = 1.12$ FEET

## III CHANNEL – DREXEL DR. CONT'D




@ 4'
A = 44
P = 20.9
$Q = \frac{1.49}{.018}(44)\left(\frac{94}{20.9}\right)^{.67}\sqrt{.05} = 1086$
V = 24 fps

@ 1½'
A = 7.8
P = 8.4
$Q = \frac{1.49}{.018}(7.8)\left(\frac{7.8}{8.4}\right)^{.67}\sqrt{.033} = 111.6$
V = 14.2 fps

## IV INLET DESIGN

$Q_{100} = 73$ CFS
$K_e = 0.10$ (FLUSH CONCRETE)

TRY 30"Ø RCP INLET, A = 4.91 SF, $n = 0.014$, $r_H = 0.625$, L = 45 FEET

$V_{REQ'D}$ @ 73 CFS = 14.8 fps — TOO HI – SAFETY – EROSION

ASSUME INLET CONTROL (MOST CONSERVATIVE)

SOLVE FOR TOTAL HEAD REQ'D TO PASS $Q_{100}$

$H_T$ = VELOCITY HEAD + ENTRANCE LOSSES + FRICTION

$$H_T = \frac{(14.86)^2}{2g}(1.1) + \frac{(14.86)^2(0.014)^2(45)}{2.21(0.625)^{4/3}}$$

$$H_T = 5.42'$$

TOTAL AVAILABLE HEAD PER IMPROVEMENT PLANS, $H_D$

$$H_D = 1.5' + 45(0.1044) = \boxed{6.2 \text{ FEET} > 5.42} \text{ OK}$$

## V PIPE DESIGN - DREXEL TO EMERGENCY ACCESS

FROM IV $V_{REQ'D}$ = [redacted] FPS

TRY 30" RCP: SOLVE FOR MINIMUM SLOPE REQ'D TO PASS 73 CFS

FROM MANNINGS:

$$14.8 = \frac{1.49}{0.014}(0.625)^{2/3}\sqrt{S}$$

$$S = 0.036 \text{ FT/FT} = 3.6\%$$

MIN. DESIGN SLOPE = 4.56% > 3.6%

∴ UNPRESSURED FLOW OK

$\boxed{\text{USE } 30"\phi \text{ CL III RCP}}$

## VI DETERMINE CATCH BASIN FLOWS:

UNIT #3; a) CB @ NORTH RT. - DREXEL / DORCHESTER

$A = 7.2$ AC. $t_c = 10$ MIN

$C = 0.45$ $i_{10} = 0.7$ "/HR $i_{100} = 0.95$ "/HR

$Q = CiA$ (RATIONAL METHOD)

$$\boxed{\begin{array}{l} Q_{10} = 2.3 \text{ CFS} \\ Q_{100} = 3.1 \text{ CFS} \end{array}}$$

b) CB @ SOUTH RT. - DREXEL / DORCHESTER

$A = 1.13$ AC. $i_{10} = 0.7$ IN/hr

$C = 0.5$ $i = 0.95$ IN/HR

$t_c = 10$ MIN

$$\boxed{\begin{array}{l} Q_{10} = 0.4 \text{ CFS} \\ Q_{100} = 0.5 \text{ CFS} \end{array}}$$

c) CB @ EMERGENCY ACCESS

$A = 1.0$ AC $i_{10} = 0.7$ IN/HR

$C = 0.5$ $i_{100} = 0.95$ IN/HR

$t_c = 10$ min

$$\boxed{\begin{array}{l} Q_{10} = 0.4 \text{ CFS} \\ Q_{100} = 0.5 \text{ CFS} \end{array}}$$

## VII PIPE DESIGN - SDMH 3-5 TO SDMH 3-6

$Q = 73$ CFS $+ 2.3 + 0.4 + 0.4 = 76.1$ CFS

$Q_{TOTAL} = 76$ CFS

$S = 2.49\%$

$n = 0.014$

$$D = 1.33 \left( \frac{(0.014)(76)}{\sqrt{0.0249}} \right)^{3/8} = 32.6'' \quad \boxed{\text{USE } 36'' \phi \text{ RCP}}$$

## VIII CATCH BASINS - UNIT 1

a) CB @ STA "D" 1+00 (16' LT)

$A = 0.77$ AC. $t_c = 10$ min

$C = 0.50$ $i_{10} = 0.7$ in/hr $i_{100} = 0.95$ in/hr.

$$\boxed{\begin{aligned} Q_{10} &= 0.3 \text{ CFS} \\ Q_{100} &= 0.4 \text{ CFS} \end{aligned}}$$

b) CB @ STA "D" 1+00 (16' RT)

$A = 0.18$ AC

$C = 0.5$

$$\boxed{\begin{aligned} Q_{10} &= 0.1 \text{ CFS} \\ Q_{100} &= 0.1 \text{ CFS} \end{aligned}}$$

## VIII CATCH BASINS (CONT'D)

c) CB @ STA "D" 2+84.96 (16' LT)

A = 2.5± AC  $t_c$ = 10 min
C = 0.45

| |
|---|
| $Q_{10}$ = 0.8 CFS |
| $Q_{100}$ = 1.1 CFS |

d) CB @ STA "N" 1+45 (16' R)

A = 4.75± AC  $t_c$ = 10 min
C = 0.50

| |
|---|
| $Q_{10}$ = 1.7 CFS |
| $Q_{100}$ = 2.3 CFS |

E) CB @ STA "D" 3+11.08 (16' RT)

A = 1.5 ± AC.  $t_c$ = 11 min
C = 0.55

| |
|---|
| $Q_{10}$ = 0.6 CFS |
| $Q_{100}$ = 0.8 CFS |

## IX CATCH BASINS UNIT 2

a) CB @ STA "D" 18+59.01 (16' LT)

A = 4.08 ± AC  $t_c$ = 10 min
C = 0.45

| |
|---|
| $Q_{10}$ = 1.3 CFS |
| $Q_{100}$ = 1.7 CFS |

ROADSIDE [illegible]TCH - PYRAMID HWY

$Q = 76$ CFS $\quad n = 0.018$

$S = 0.0199$ FT/FT

TRY 3' WIDE TRAPEZOIDAL CHANNEL ; 2:1 SIDE SLOPES

$A = 3d + 2d^2$

$P = 3 + 4.47d$

$$76 = \frac{1.49}{0.018}\left(\frac{3d+2d^2}{3+4.47d}\right)^{2/3}\sqrt{0.0199}\,(3d+2d^2)$$

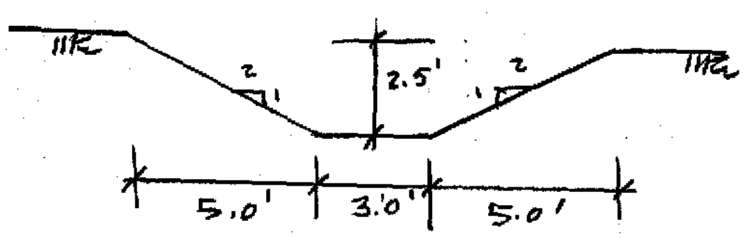
$$6.5 = \left(\frac{3d+2d^2}{3+4.47d}\right)^{2/3}(3d+2d^2)$$

$d = 1.31'$

*ADD 1.0' FOR FREEBOARD

$\boxed{\text{USE } D = 2.5'}$

$v = ?$




(PYRAMID) ROAD SIDE DITCH DETAIL

NTS.

$n = .035$

$Q = 51.4 \quad V = 5.7$

$Q = 150 \quad V = 7.5$

$Q = 54 \quad V = 3.9$

$n = .018$

@ 1.5'

$Q = \frac{1.49}{.018}(9)\left(\frac{9}{9.7}\right)^{.67}\sqrt{.02} = 100 \quad V = 11$ fps

@ 2.5'

$Q$ [illegible] $V = 19.6$ fps

@ 1'

$Q = 106 \quad V = 7.6$ fps

A = 6

P = 14.2

R = .4[illegible]

.37

## INTERCEPTER DITCH - WEST ℄ OF SUBDIVISION

$Q_{100} = 11$ CFS

$n = 0.018$ (EARTH)

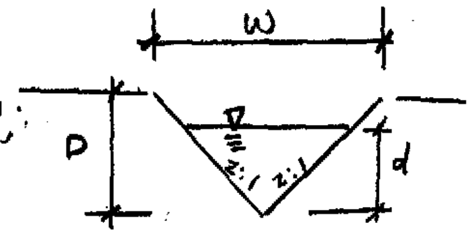
$S = 2.0\%$ (MIN)

USE "V" DITCH, 2:1 SIDE SLOPES

$A = 2d^2$

$P_w = 4.47d$

$r_H = \dfrac{2d^2}{4.47d}$




FROM MANNINGS; SOLVE FOR d:

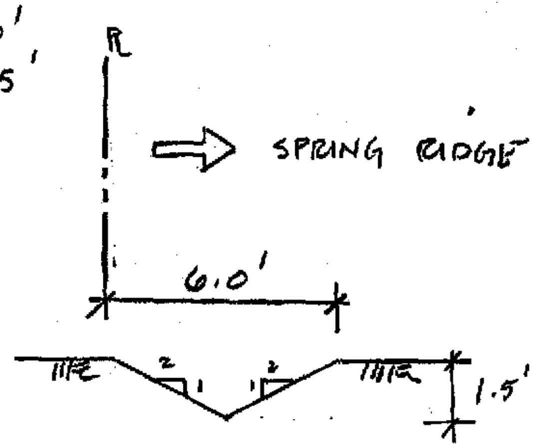
$$0.94 \cdot \left(\frac{2d^2}{4.47d}\right)^{2/3} (2d^2)$$

$d = 1.01'$

USE 0.5' FREE BOARD

$\therefore$ W = 6'

D = 1.5'




"V" DITCH DETAIL

NTS

AT 1.5 DEPTH

$Q = \frac{1.49}{.018}(4.5)\left(\frac{4.5}{6.7}\right)^{.67}\sqrt{.02} = 40$ cfs $v = 8.89$ fps

Q @ n = .035 — v = 4.7 fps

AT 1' DEPTH

$Q = \frac{1.49}{.018}(2)\left(\frac{2}{4.5}\right)^{.67}\sqrt{.02} = 13.6$ cfs

$v = 6.8$ fps

## I SD LINE SIZES

a) SDMH D-3 TO SDMH D-2

$Q_{10} = 1.3$ CFS  $n = 0.014$ (RCP)

$S = 0.0395$ FT/FT

$$D = 1.33 \left( \frac{0.014 (1.3)}{\sqrt{0.0395}} \right)^{3/8} (12) = 7.2''$$

$\boxed{\text{USE } 12'' \phi \text{ RCP}}$

b) SDMH D-2 TO SDMH SR-2

$Q_{10} = 1.3 + 0.8 + 0.6 + 1.7 = 4.4$ CFS

$n = 0.014$ (RCP)

$S = 0.0194$ FT/FT

$D = 11.7''$ $\boxed{\text{– USE } 12'' \phi \text{ RCP}}$

c) SDMH D-1 TO SDMH SR-2

$Q = 0.3 + 0.1$ CFS $= 0.4$ CFS

$S = 0.005$

$N = 0.014$ (RCP)

$D \approx 6.2''$

$\boxed{\text{USE } 12'' \phi \text{ RCP}}$

d) SDMH SR-2 TO SDMH SR-1

$Q = 4.4 + 0.4 = 4.8$ CFS

$n = 0.014$

$S = 0.0307$

$D = 11.1'' \approx 12''$ $\boxed{\text{USE } 12'' \phi \text{ RCP}}$

mountain west consulting

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August 3, 1993

Kirk Nicholas
**Washoe County Engineering**
1001 E. Ninth Street
Reno, NV 89520

RE: **Hydrology Report**
**Amended Spring Ridge Subdivision**

Dear Kirk:

Per your request, please accept this letter as an addition to the above referenced report. This letter addresses the discrepancy if flow volumes originally calculated in the original subdivision hydrology report in contrast to the lower flow volume calculated in the Amended subdivision hydrology report.

The hydrology report submitted with the Amended Spring Ridge Subdivision, we feel is more representative of the actual hydrologic conditions of both the on-site and off-site areas. This is due to the fact that the original hydrology report utilized a "lag-time" duration which was too short for the characteristics of this watershed. Due to this shorter "lag-time", a higher rainfall intensity was used, and therefore larger flow volumes were calculated. The recent Amended Spring Ridge Subdivision hydrology report utilized a more representative "lag-time" which was greater than that of the original report, and therefore yielded a slightly lower rainfall intensity, and thus a slightly lower flow volume.

Lastly, a hydrology statement performed by Nimbus Engineers, dated February 24, 1987, for Transwestern Engineers had raised some questions as to flow volumes for the above referenced subdivision. It is our opinion that this hydrology report is non-representative of the Spring Ridge Subdivision or of the tributary off-site watersheds.

Sincerely,
**mountain west consulting**

Joe L. Murin, P.E.

p.o. box 21450 reno, nevada 89515-1450 (702) 329-7077

A. OPTION 1: PIPE FLOWS THROUGH SUBDIVISION
(ZONE 1 FLOWS)

REGISTERED PROFESSIONAL ENGINEER
JOE L. MURIN
CIVIL
5-3-91
No. 3574
STATE OF NEVADA

B. ANALYSIS
ASSUME:
1. Q=CIA
2. C FOR S > 5.0% = 0.45

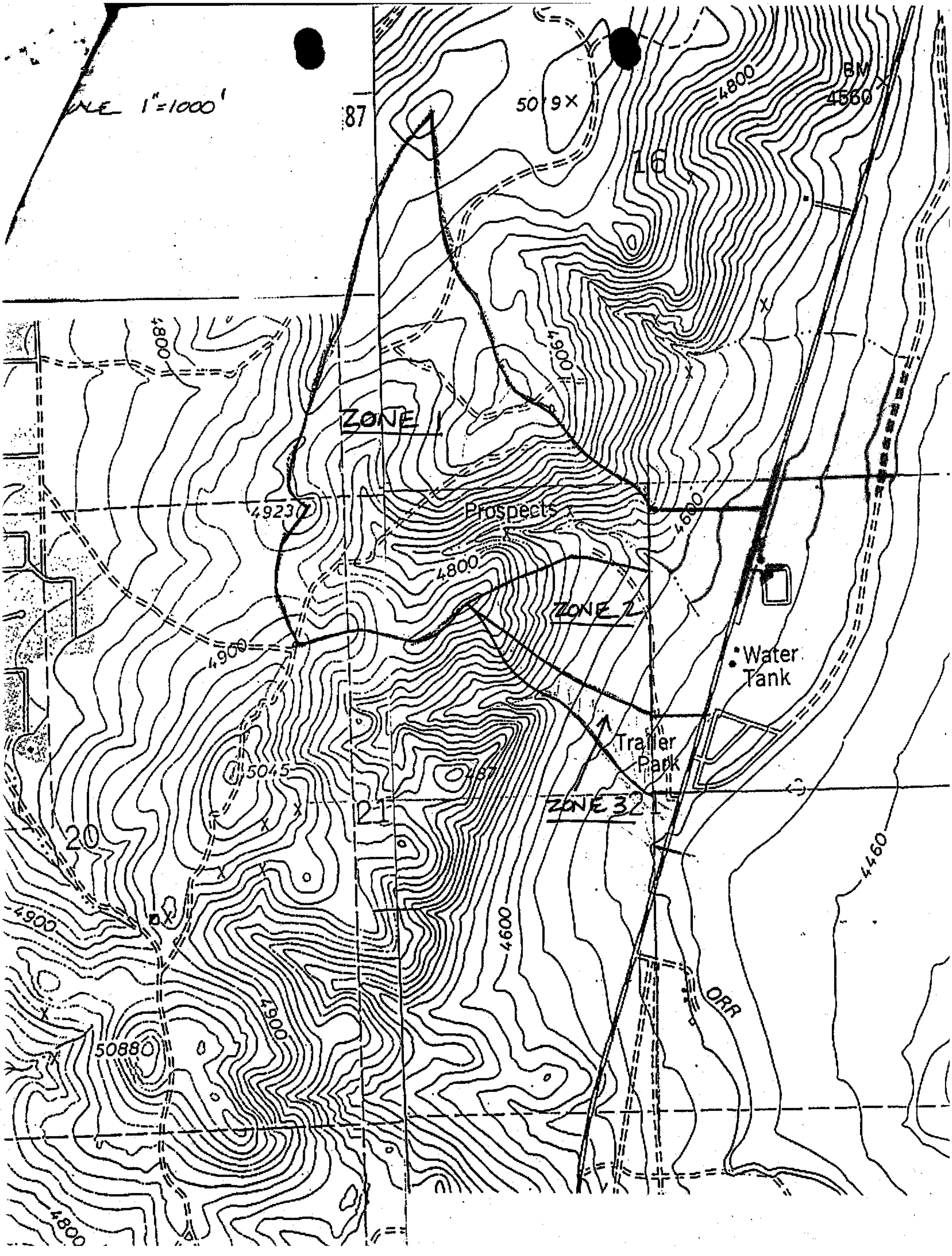
| DESCRIPION | AC | i (IN/HR) | C | $Q_{100}$ (CFS) |
|---|---|---|---|---|
| FLOOD ZONE 1 | 161.62 ± | 1.3 | 0.45 | 94.55 |
| FLOOD ZONE 2 | 24.79 ± | 1.3 | 0.45 | 14.50 |
| FLOOD ZONE 3 | 11.94 ± | 1.3 | 0.45 | 6.98 |
| SPRING RIDGE (ALL UNITS) | 28.13 ± | 1.3 | *0.50 | 18.28 |

*NOTE: THIS IS A WEIGHTED VALUE FOR SUBDIVISIONS

C. RESULT: FROM MANNINGS

1. FLAIRED END SECTION TO SDMH D-6 (DORCHESTER)
   907 LF ± 36"ϕ CL III RCP
2. SDMH D-6 TO SDMH 2 (WORST CASE SLOPE = 0.8%)
   784 LF ± 42"ϕ CL III RCP
3. SDMH 2 TO SDMH SR-2
   115 LF ± 42"ϕ CL III RCP
4. SDMH SR-2 TO OUTFALL
   850 LF ± 42"ϕ CL III RCP
5. ZONE 2 & 3 FLOWS CARRIED BY ON-SITE "V" DITCH TO CULVERT

PREV. REPORT



SCALE 1"=1000'
87
5019 X
4800
BM 4560
16
4900
4800
ZONE 1
4923
Prospects
4600
4800
ZONE 2
4900
Water Tank
Trailer Park
5045
ZONE 3
21
20
4460
4900
4600
4900
ORR
5088
4800

Nimbus Engineers
240 Linden St., Suite B • Reno, NV 89502
Mail: P.O. Box 10220 • Reno, NV 89510
(702) 689-8630

February 24, 1987

INFO

Gus Nunez
Transwestern Engineers
240 Linden Street
Reno, Nevada 89502

RE: Spring Ridge Hydrology Statement (Nimbus Job #8704)

Dear Gus:

Please find attached the hydrology statement requested for the proposed Spring Ridge Subdivision located in the NE 1/4 of Section 21, R20N, T20E. The attached statement summarizes the calculated discharges for onsite and offsite flows and the assumptions and methods used.

If you have any questions or need additional information please do not hesitate to call Mark Forest or myself.

Sincerely,

Peggy Bowker

Margaret (Peggy) Bowker, P.E.
Principal Engineer

| Post-It™ brand fax transmittal memo 7671 | # of pages ▸ 4 |
|---|---|
| To MT. WEST. | From W.C. P.W |
| Co. TED | Co. KIRK |
| Dept. 3235572 | Phone # |
| Fax # FYI | Fax # |

## SKY RIDGE SUBDIVISION

## HYDROLOGY STATEMENT

Both onsite and offsite 10 and 100 year discharges were calculated for this development. The offsite discharges were calculated with the Corps of Engineers computer program HEC-1. The model used for these basins is identical to the model used for Basins 27 and 29 in the Washoe County Flood Insurance Study recently performed by Boyle Engineers and revised by Nimbus Engineers. These basins are shown on the aerial photo attached as Figure 1. These watersheds drain to the Pyramid Highway where the runoff is collected in a drainage channel adjacent to the roadway and concentrates at a culvert 1000 feet southwest of the project. These discharges were calculated using proposed conditions. For the purpose of drainage design for the onsite improvements, the proposed condition includes a future residential development of equal size and density adjacent to this development to the west.

The onsite peak discharges for the 10 and 100 year events were calculated using the rational method (Q = CiA). A value for C of 0.35 was used for the natural condition and 0.55 for the proposed condition.

The following table summarizes the results for proposed conditions for all areas;

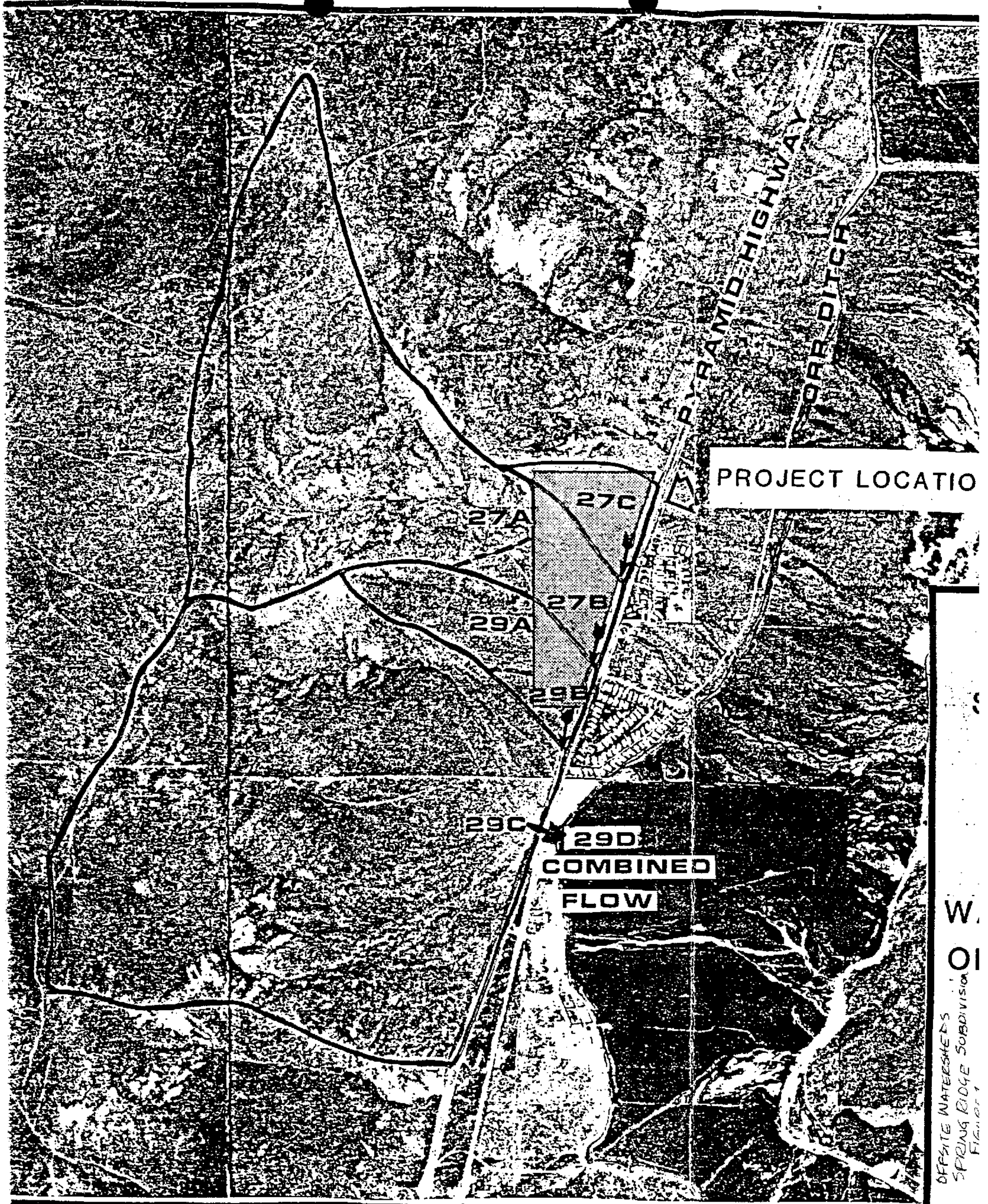
TABLE 1 - SUMMARY OF RESULTS

ONSITE AREAS

| CONC. POINT | AREA (AC) | C | i(10 YR) (IN/HR) | i(100 YR) (IN/HR) | Q10 (CFS) | Q100 (CFS) |
|---|---|---|---|---|---|---|
| 1 | 5.91 | .42 | 2.6 | 5.6 | | |
| 2 | 1.59 | .55 | | | 7 | 14 |
| 3 | 2.68 | .55 | | | 2 | 5 |
| 4 | 5.22 | .50 | | | 4 | 8 |
| 5 | 1.40 | .55 | | | 7 | 15 |
| 6 | 1.38 | .55 | | | 2 | 4 |
| 7 | 1.10 | .55 | | | 2 | 4 |
| 8 | 2.17 | .55 | | | 2 | 3 |
| 9 | 4.14 | .55 | | | 3 | 7 |
| 10 | 0.97 | .55 | | | 6 | 13 |
| 11 | 0.74 | .55 | | | 1 | 3 |
| 12 | 0.26 | .55 | | | 1 | 2 |
| 13 | 0.20 | .55 | | | 1 | 1 |
| 14 | 0.15 | .55 | | | 1 | 1 |
| 15 | 0.51 | .55 | | | 1 | 1 |
| | | | | | 1 | 2 |

OFFSITE AREAS

| CONC. POINT | AREA (SQ MI) | CN | IMPERVIOUS (%) | LAG (HR) | Q10 (CFS) | Q100 (CFS) |
|---|---|---|---|---|---|---|
| 27A | 0.25 | 81 | 3 | 0.45 | 47 | 124 |
| 27B | 0.28 | 81 | 6 | 0.50 | 52 | 130 |
| 27C | 0.022 | 81 | 30 | 0.10 | 13 | 26 |
| 27B & C COMBINED AT 27C | | | | | 54 | 135 |
| 29A | 0.032 | 81 | 8 | 0.10 | 15 | 35 |
| 29B | 0.051 | 81 | 16 | 0.14 | 23 | 51 |
| 29C | 0.462 | 81 | 0 | 0.35 | 94 | 255 |
| ALL BASIN COMBINED AT CULVERT 1000 FT SOUTH | | | | | 153 | 398 |



PYRAMID HIGHWAY
ORR DITCH
PROJECT LOCATIO
27C
27A
27B
29A
29B
29C
29D
COMBINED
FLOW
WA
OI
OFFSITE WATERSHEDS
SPRING RIDGE SUBDIVISION


1" = 1000

# APPENDIX E

## RATIONAL METHOD HYDROLOGY
## PROPOSED SUB-BASIN CALCULATIONS

**RATIONAL METHOD HYDROLOGY**
**CITY OF RENO IDF CURVES**
**WASHOE COUNTY, NV**
**SUMMIT CHRISTIAN CHURCH - PHASE 3 IMPROVEMENTS**

| DESIGN POINT | DRAINAGE SUB-AREA | AREA (acres) | C 25-YR. | C 100-YR. | WATERSHED LENGTH (ft) | VELOCITY (ft/sec) | Tc (min) | INTENSITY (in/hr) 25-YR | INTENSITY (in/hr) 100-YR | PEAK RUNOFF (cfs) **25-YR** | PEAK RUNOFF (cfs) **100-YR** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **INDIVIDUAL AREAS - PROPOSED BASINS** | | | | | | | | | | | |
| SOUTH CORRIDOR (SOUTH & WEST SIDES OF SITE) | **A1** | 2.57 | 0.40 | 0.50 | 666 | 2 | 15.55 | 1.74 | 2.57 | **2.23** | **3.30** |
| | **A2** | 15.53 | 0.40 | 0.50 | 1029 | 2 | 18.57 | 1.63 | 2.40 | **12.63** | **18.65** |
| | **DETENTION POND** | --- | --- | --- | --- | --- | --- | --- | --- | **-9.86** | **21.95** |
| | **A3** | 2.04 | 0.40 | 0.50 | 443 | 2 | 13.69 | 1.85 | 2.73 | **1.89** | **2.79** |
| | **A4** | 1.30 | 0.51 | 0.60 | 531 | 2 | 14.42 | 1.81 | 2.68 | **1.40** | **2.07** |
| | | | | | | | | | | | |
| OUTFLOW ((A1+A2)+DETENTION POND; FOR 25 YEAR ONLY) | **S1** | **---** | | | | | | | | **5.00** | **21.95** |
| | | | | | | | | | | | |
| SOUTH CORRIDOR TO 36" RCP AT ~STA. "C" 110+50 at S.R. FIRE ROAD | **A5** | 2.72 | 0.50 | 0.59 | 1123 | 2 | 19.36 | 1.59 | 2.35 | **2.55** | **3.77** |
| STA. "C" 107+75 TO PROP. MH 1 - TYPE 4 AT | **A6** | 0.58 | 0.72 | 0.79 | 330 | 2 | 12.75 | 1.93 | 2.84 | **0.87** | **1.29** |
| SPRING RIDGE SUBDIVISION AT 36" RCP | **A7** | 57.80 | 0.65 | 0.78 | 1600 | 2 | 23.33 | 1.44 | 2.12 | **64.74** | **95.67** |
| DRAINAGE CHANNEL ADJACENT TO PYRAMID HIGHWAY ACCELERATION LANE - STA. "C" 94+30 - STA. "C" 105+00 | **A8** | 1.79 | 0.68 | 0.75 | 1012 | 2 | 18.43 | 1.63 | 2.40 | **2.18** | **3.22** |
| | | | | | | | | | | | |

**RATIONAL METHOD HYDROLOGY**
**CITY OF RENO IDF CURVES**
**WASHOE COUNTY, NV**
**SUMMIT CHRISTIAN CHURCH - PHASE 3 IMPROVEMENTS**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SOUTHWEST PARKING AREA & EX. CHURCH BUILDING - SOUTH AND WEST OF CHURCH BUILDING | **B1** | 0.36 | 0.85 | 0.87 | 243 | 2 | 12.02 | 1.96 | 2.89 | **0.62** | **0.91** |
| | **B2** | 0.21 | 0.40 | 0.50 | 188 | 2 | 11.56 | 2.00 | 2.95 | **0.21** | **0.31** |
| | **B3** | 0.95 | 0.74 | 0.80 | 263 | 2 | 12.19 | 1.96 | 2.89 | **1.49** | **2.20** |
| | **B4** | 0.57 | 0.80 | 0.86 | 210 | 2 | 11.75 | 2.00 | 2.95 | **0.97** | **1.43** |
| **TOTAL** | | **2.09** | | | | | | | | **3.29** | **4.86** |
| | | | | | | | | | | | |
| SOUTH SITE DRIVE AND EASTERN PARKING AREA | **C** | 1.91 | 0.84 | 0.90 | 753 | 2 | 16.28 | 1.70 | 2.51 | **2.91** | **4.30** |
| **TOTAL** | | **1.91** | | | | | | | | **2.91** | **4.30** |
| | | | | | | | | | | | |
| NORTHEAST CORNER OF EXISTING CHURCH BUILDING | **D1** | 0.18 | 0.85 | 0.87 | 125 | 3 | 10.70 | 2.07 | 3.06 | **0.32** | **0.47** |
| SKY BRIDGE AND SOUTH ARTERIAL AREAS | **D2** | 1.11 | 0.66 | 0.74 | 466 | 2 | 13.88 | 1.85 | 2.73 | **1.51** | **2.23** |
| PROPOSED BUILDING | **D3** | 1.04 | 0.85 | 0.87 | 150 | 3 | 10.83 | 2.07 | 3.06 | **1.87** | **2.76** |
| E. SIDE OF PROPOSED BUILDING | **D4** | 0.26 | 0.87 | 0.92 | 208 | 3 | 11.16 | 2.04 | 3.00 | **0.48** | **0.71** |
| **TOTAL** | | **2.58** | | | | | | | | **4.19** | **6.17** |
| | | | | | | | | | | | |
| EAST ENTRANCE & BASINS ALONG PYRAMID HIGHWAY | **E1** | 0.74 | 0.59 | 0.67 | 507 | 2 | 14.22 | 1.81 | 2.68 | **0.89** | **1.32** |
| | **E2** | 0.81 | 0.60 | 0.68 | 479 | 2 | 13.99 | 1.85 | 2.73 | **1.03** | **1.51** |
| | **E3** | 0.94 | 0.58 | 0.66 | 263 | 2 | 12.19 | 1.96 | 2.89 | **1.23** | **1.81** |
| | **E4** | 1.16 | 0.58 | 0.66 | 420 | 2 | 13.50 | 1.85 | 2.73 | **1.41** | **2.08** |
| | **E5** | 1.02 | 0.84 | 0.89 | 252 | 3 | 11.40 | 2.04 | 3.00 | **1.86** | **2.74** |
| | **E6** | 0.48 | 0.85 | 0.90 | 246 | 3 | 11.37 | 2.04 | 3.00 | **0.88** | **1.29** |
| **TOTAL** | | **5.15** | | | | | | | | **7.29** | **10.75** |

**RATIONAL METHOD HYDROLOGY**
**CITY OF RENO IDF CURVES**
**WASHOE COUNTY, NV**
**SUMMIT CHRISTIAN CHURCH - PHASE 3 IMPROVEMENTS**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STA. "C" 114+05 ON PYRAMID HIGHWAY (Sum of: B1-B4, C, D1-D2, 1/2 D3, 3/4 D4, E1-E5) | **S2** | **10.67** | | | | | | | | **15.74** | **23.23** |
| 36" RCP UNDER S. EGRESS (Sum of: S2 & A1-A4, Minus the Reduction - 25 year only) | **S3** | **32.11** | | | | | | | | **24.03** | **50.04** |
| 36" RCP AT FIRE ROAD (Sum of: S3+A5) | **S4** | **34.83** | | | | | | | | **26.59** | **53.81** |
| 36" RCP at MH-1 TIE-IN (Sum of: S4+A6) | **S5** | **35.41** | | | | | | | | **27.46** | **55.10** |
| 42" ADS Pipe in NDOT ROW (Sum of: S5+A7) | **S6** | **93.21** | | | | | | | | **92.20** | **150.77** |
| OPEN CHANNEL FLOW AT DUAL 24" CULVERTS AT SPRING RIDGE DRIVE INTERSECTION (Sum of: S6+A8) | **S7** | **95.00** | | | | | | | | **94.38** | **153.99** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NORTH SLOPE, FUTURE NORTH WEST & NORTH EAST PARKING LOT & NORTH NDOT CORRIDOR | **F1** | 0.46 | 0.56 | 0.64 | 232 | 2 | 11.93 | 2.00 | 2.95 | **0.59** | **0.87** |
| | **F2** | 0.75 | 0.53 | 0.61 | 245 | 2 | 12.04 | 1.96 | 2.89 | **0.91** | **1.34** |
| | **F3** | 0.56 | 0.46 | 0.56 | 456 | 2 | 13.80 | 1.85 | 2.73 | **0.58** | **0.85** |
| | **F4** | 0.21 | 0.88 | 0.93 | 370 | 3 | 12.06 | 1.96 | 2.89 | **0.39** | **0.57** |
| | **F5** | 0.71 | 0.81 | 0.87 | 207 | 3 | 11.15 | 2.04 | 3.00 | **1.25** | **1.84** |
| | **F6** | 0.70 | 0.85 | 0.90 | 268 | 3 | 11.49 | 2.04 | 3.00 | **1.29** | **1.90** |
| | **F7** | 0.98 | 0.81 | 0.87 | 276 | 3 | 11.53 | 2.00 | 2.95 | **1.70** | **2.51** |
| | **F8** | 0.67 | 0.75 | 0.81 | 465 | 3 | 12.58 | 1.93 | 2.84 | **1.05** | **1.55** |
| **TOTAL** | | **5.04** | | | | | | | | **7.75** | **11.43** |
| 24" RCP @ NDOT N. INGRESS ROADWAY (Sum of: 1/4 D4, 1/2 D3, E6, F1-F8) | **N1** | **6.10** | | | | | | | | **9.68** | **14.28** |
| WEST & NORTH SIDE OF NORTH CORRIDOR | **G1** | 1.49 | 0.40 | 0.50 | 736 | 2 | 16.13 | 1.70 | 2.51 | **1.27** | **1.87** |
| | **G2** | 4.31 | 0.40 | 0.50 | 709 | 2 | 15.91 | 1.74 | 2.57 | **3.75** | **5.54** |
| | **G3** | 1.26 | 0.48 | 0.57 | 359 | 2 | 12.99 | 1.93 | 2.84 | **1.40** | **2.06** |
| | **G4** | 1.84 | 0.49 | 0.58 | 929 | 2 | 17.74 | 1.66 | 2.46 | **1.77** | **2.61** |
| (Sum of G1-G4) | **N2** | **8.90** | | | | | | | | **8.18** | **12.08** |
| NDOT ROW - NORTH DECELERATION LANE | **G5** | 0.46 | 0.70 | 0.77 | 270 | 2 | 12.25 | 1.96 | 2.89 | **0.69** | **1.02** |
| | **G6** | 1.11 | 0.61 | 0.69 | 545 | 2 | 14.54 | 1.78 | 2.62 | **1.36** | **2.00** |
| **TOTAL** | **G5+G6** | **1.57** | | | | | | | | **2.05** | **3.02** |
| 36" CMP @ CROSSING ON PYRAMID HIGHWAY @ N. END (Sum of: N1+N2+G5+G6) | **N3** | **16.57** | | | | | | | | **19.91** | **29.38** |

# APPENDIX F

## FLOWMASTER PROPOSED STORM DRAIN PIPE DESIGN & CHANNEL FLOW CALCULATIONS FOR ON-SITE STORM FLOWS

# Cross Section for 24" RCP at SW Detention Pond - 25 year analysis

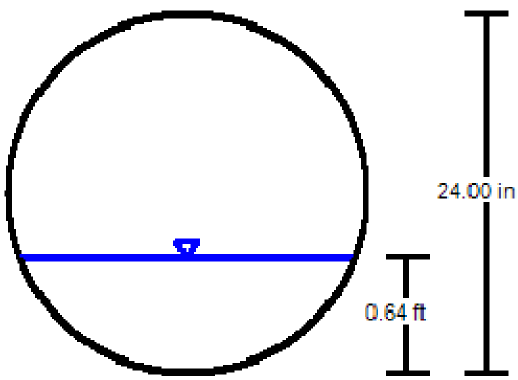
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 1.00000 | % |
| Normal Depth | 0.64 | ft |
| Diameter | 24.00 | in |
| Discharge | 5.00 | ft³/s |

## Cross Section Image




# Report for 24" RCP at SW Detention Pond - 25 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 1.00000 | % |
| Diameter | 24.00 | in |
| Discharge | 5.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.64 | ft |
| Flow Area | 0.86 | ft² |
| Wetted Perimeter | 2.40 | ft |
| Hydraulic Radius | 0.36 | ft |
| Top Width | 1.87 | ft |
| Critical Depth | 0.79 | ft |
| Percent Full | 31.9 | % |
| Critical Slope | 0.00455 | ft/ft |
| Velocity | 5.78 | ft/s |
| Velocity Head | 0.52 | ft |
| Specific Energy | 1.16 | ft |
| Froude Number | 1.50 | |
| Maximum Discharge | 24.33 | ft³/s |
| Discharge Full | 22.62 | ft³/s |
| Slope Full | 0.00049 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 31.95 | % |
| Downstream Velocity | Infinity | ft/s |

# Report for 24" RCP at SW Detention Pond - 25 year analysis

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.64 | ft |
| Critical Depth | 0.79 | ft |
| Channel Slope | 1.00000 | % |
| Critical Slope | 0.00455 | ft/ft |

# Cross Section for 24" RCP at SW Detention Pond - 100 year analysis

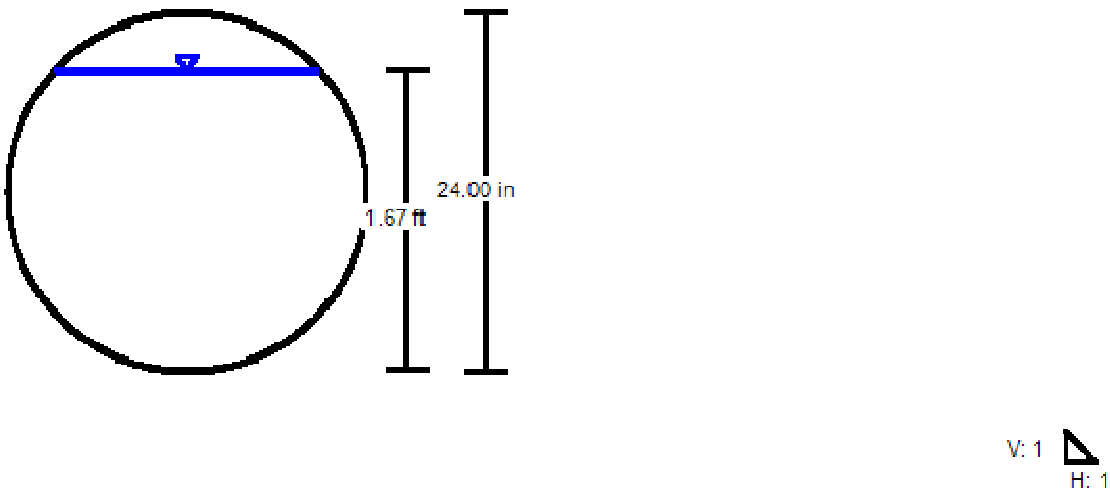
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 1.00000 | % |
| Normal Depth | 1.67 | ft |
| Diameter | 24.00 | in |
| Discharge | 23.00 | ft³/s |

## Cross Section Image



# Report for 24" RCP at SW Detention Pond - 100 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 1.00000 | % |
| Diameter | 24.00 | in |
| Discharge | 23.00 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.67 | ft |
| Flow Area | 2.80 | $ft^2$ |
| Wetted Perimeter | 4.61 | ft |
| Hydraulic Radius | 0.61 | ft |
| Top Width | 1.48 | ft |
| Critical Depth | 1.71 | ft |
| Percent Full | 83.6 | % |
| Critical Slope | 0.00968 | ft/ft |
| Velocity | 8.20 | ft/s |
| Velocity Head | 1.05 | ft |
| Specific Energy | 2.72 | ft |
| Froude Number | 1.05 | |
| Maximum Discharge | 24.33 | $ft^3/s$ |
| Discharge Full | 22.62 | $ft^3/s$ |
| Slope Full | 0.01034 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 83.56 | % |
| Downstream Velocity | Infinity | ft/s |

# Report for 24" RCP at SW Detention Pond - 100 year analysis

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.67 | ft |
| Critical Depth | 1.71 | ft |
| Channel Slope | 1.00000 | % |
| Critical Slope | 0.00968 | ft/ft |

# Cross Section for 24" RCP - Bee Hive to MH-34-25 year analysis

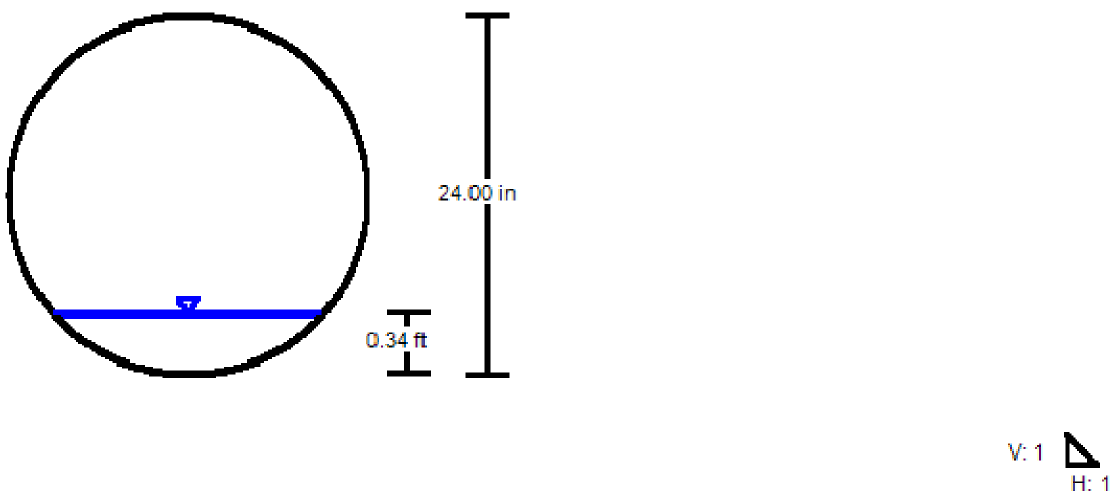
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 12.60000 | % |
| Normal Depth | 0.34 | ft |
| Diameter | 24.00 | in |
| Discharge | 5.00 | ft³/s |

## Cross Section Image



# Report for 24" RCP - Bee Hive to MH-34-25 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 12.60000 | % |
| Diameter | 24.00 | in |
| Discharge | 5.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.34 | ft |
| Flow Area | 0.35 | ft² |
| Wetted Perimeter | 1.70 | ft |
| Hydraulic Radius | 0.21 | ft |
| Top Width | 1.50 | ft |
| Critical Depth | 0.79 | ft |
| Percent Full | 16.9 | % |
| Critical Slope | 0.00455 | ft/ft |
| Velocity | 14.23 | ft/s |
| Velocity Head | 3.15 | ft |
| Specific Energy | 3.48 | ft |
| Froude Number | 5.18 | |
| Maximum Discharge | 86.38 | ft³/s |
| Discharge Full | 80.30 | ft³/s |
| Slope Full | 0.00049 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 16.91 | % |
| Downstream Velocity | Infinity | ft/s |

# Report for 24" RCP - Bee Hive to MH-34-25 year analysis

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.34 | ft |
| Critical Depth | 0.79 | ft |
| Channel Slope | 12.60000 | % |
| Critical Slope | 0.00455 | ft/ft |

# Cross Section for 24" RCP - Bee Hive to MH-34-100 year analysis

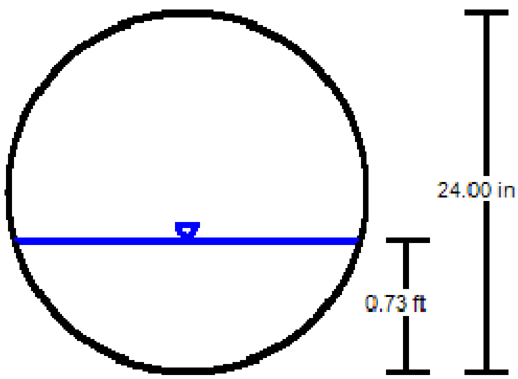
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 12.60000 | % |
| Normal Depth | 0.73 | ft |
| Diameter | 24.00 | in |
| Discharge | 23.00 | ft³/s |

## Cross Section Image




# Report for 24" RCP - Bee Hive to MH-34-100 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 12.60000 | % |
| Diameter | 24.00 | in |
| Discharge | 23.00 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.73 | ft |
| Flow Area | 1.04 | ft² |
| Wetted Perimeter | 2.60 | ft |
| Hydraulic Radius | 0.40 | ft |
| Top Width | 1.93 | ft |
| Critical Depth | 1.71 | ft |
| Percent Full | 36.6 | % |
| Critical Slope | 0.00968 | ft/ft |
| Velocity | 22.06 | ft/s |
| Velocity Head | 7.56 | ft |
| Specific Energy | 8.30 | ft |
| Froude Number | 5.29 | |
| Maximum Discharge | 86.38 | ft³/s |
| Discharge Full | 80.30 | ft³/s |
| Slope Full | 0.01034 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 36.63 | % |
| Downstream Velocity | Infinity | ft/s |

# Report for 24" RCP - Bee Hive to MH-34-100 year analysis

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.73 | ft |
| Critical Depth | 1.71 | ft |
| Channel Slope | 12.60000 | % |
| Critical Slope | 0.00968 | ft/ft |

# Cross Section for 24" RCP - MH-34 to Outlet - 25 year analysis

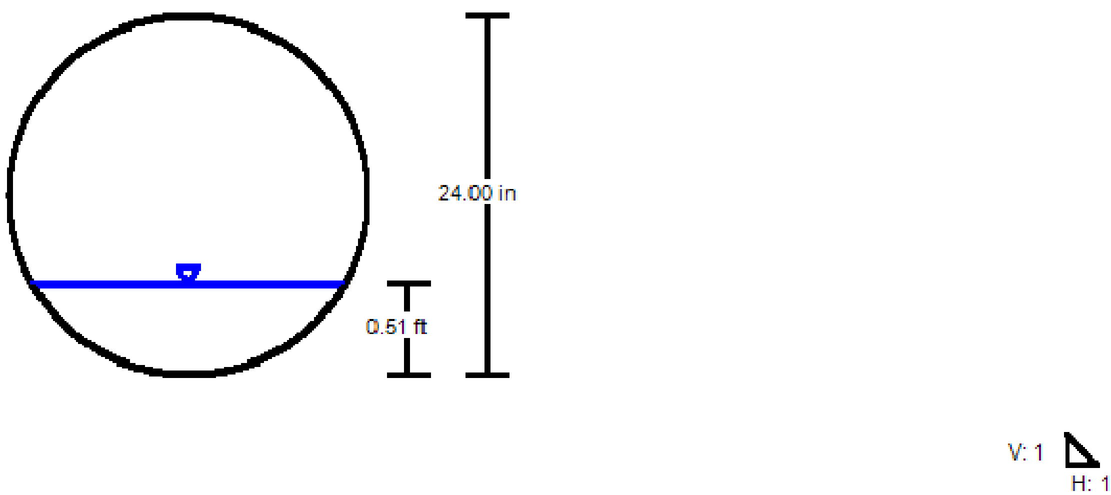
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 2.40000 | % |
| Normal Depth | 0.51 | ft |
| Diameter | 24.00 | in |
| Discharge | 5.00 | ft³/s |

## Cross Section Image



# Report for 24" RCP - MH-34 to Outlet - 25 year analysis

## Project Description

| | | | |
|---|---|---|---|
| Friction Method | Manning Formula | | |
| Solve For | Normal Depth | | |

## Input Data

| | | | |
|---|---|---|---|
| Roughness Coefficient | | 0.013 | |
| Channel Slope | | 2.40000 | % |
| Diameter | | 24.00 | in |
| Discharge | | 5.00 | ft³/s |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 0.51 | ft |
| Flow Area | | 0.63 | ft² |
| Wetted Perimeter | | 2.12 | ft |
| Hydraulic Radius | | 0.30 | ft |
| Top Width | | 1.74 | ft |
| Critical Depth | | 0.79 | ft |
| Percent Full | | 25.5 | % |
| Critical Slope | | 0.00455 | ft/ft |
| Velocity | | 7.91 | ft/s |
| Velocity Head | | 0.97 | ft |
| Specific Energy | | 1.48 | ft |
| Froude Number | | 2.32 | |
| Maximum Discharge | | 37.70 | ft³/s |
| Discharge Full | | 35.04 | ft³/s |
| Slope Full | | 0.00049 | ft/ft |
| Flow Type | SuperCritical | | |

## GVF Input Data

| | | | |
|---|---|---|---|
| Downstream Depth | | 0.00 | ft |
| Length | | 0.00 | ft |
| Number Of Steps | | 0 | |

## GVF Output Data

| | | | |
|---|---|---|---|
| Upstream Depth | | 0.00 | ft |
| Profile Description | | | |
| Profile Headloss | | 0.00 | ft |
| Average End Depth Over Rise | | 0.00 | % |
| Normal Depth Over Rise | | 25.52 | % |
| Downstream Velocity | | Infinity | ft/s |

# Report for 24" RCP - MH-34 to Outlet - 25 year analysis

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.51 | ft |
| Critical Depth | 0.79 | ft |
| Channel Slope | 2.40000 | % |
| Critical Slope | 0.00455 | ft/ft |

# Cross Section for 24" RCP - MH-34 to Outlet - 100 year analysis

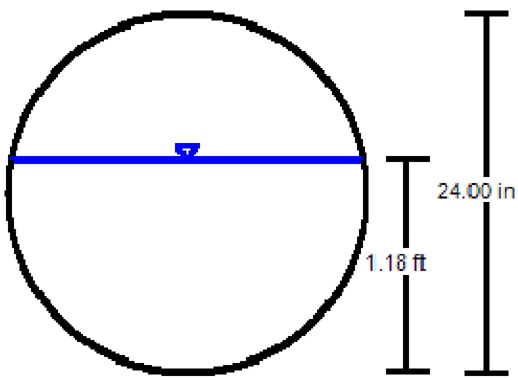
## Project Description

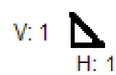
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 2.40000 | % |
| Normal Depth | 1.18 | ft |
| Diameter | 24.00 | in |
| Discharge | 23.00 | $ft^3/s$ |

## Cross Section Image



# Worksheet for 24" RCP - MH-34 to Outlet - 100 year analysis

## Project Description

| | | | |
|---|---|---|---|
| Friction Method | Manning Formula | | |
| Solve For | Normal Depth | | |

## Input Data

| | | | |
|---|---|---|---|
| Roughness Coefficient | | 0.013 | |
| Channel Slope | | 2.40000 | % |
| Diameter | | 24.00 | in |
| Discharge | | 23.00 | ft³/s |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.18 | ft |
| Flow Area | | 1.93 | ft² |
| Wetted Perimeter | | 3.51 | ft |
| Hydraulic Radius | | 0.55 | ft |
| Top Width | | 1.97 | ft |
| Critical Depth | | 1.71 | ft |
| Percent Full | | 59.1 | % |
| Critical Slope | | 0.00968 | ft/ft |
| Velocity | | 11.90 | ft/s |
| Velocity Head | | 2.20 | ft |
| Specific Energy | | 3.38 | ft |
| Froude Number | | 2.12 | |
| Maximum Discharge | | 37.70 | ft³/s |
| Discharge Full | | 35.04 | ft³/s |
| Slope Full | | 0.01034 | ft/ft |
| Flow Type | SuperCritical | | |

## GVF Input Data

| | | | |
|---|---|---|---|
| Downstream Depth | | 0.00 | ft |
| Length | | 0.00 | ft |
| Number Of Steps | | 0 | |

## GVF Output Data

| | | | |
|---|---|---|---|
| Upstream Depth | | 0.00 | ft |
| Profile Description | | | |
| Profile Headloss | | 0.00 | ft |
| Average End Depth Over Rise | | 0.00 | % |
| Normal Depth Over Rise | | 59.10 | % |
| Downstream Velocity | | Infinity | ft/s |

# Worksheet for 24" RCP - MH-34 to Outlet - 100 year analysis

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.18 | ft |
| Critical Depth | 1.71 | ft |
| Channel Slope | 2.40000 | % |
| Critical Slope | 0.00968 | ft/ft |

# X-Section for South Egress Road N. Channel at 24" RCP outlet-25 year

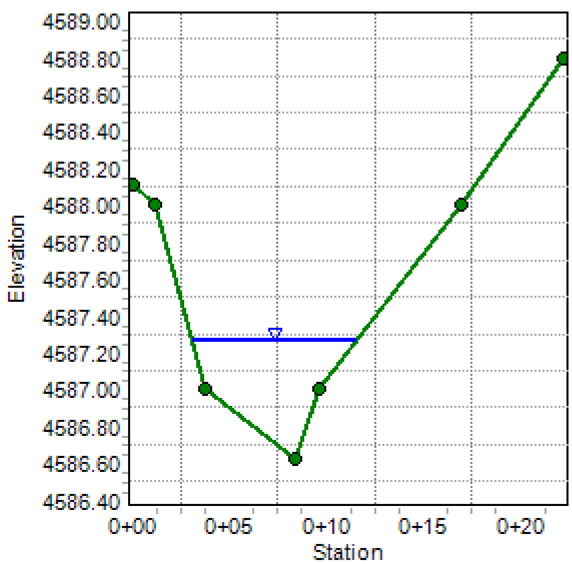
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

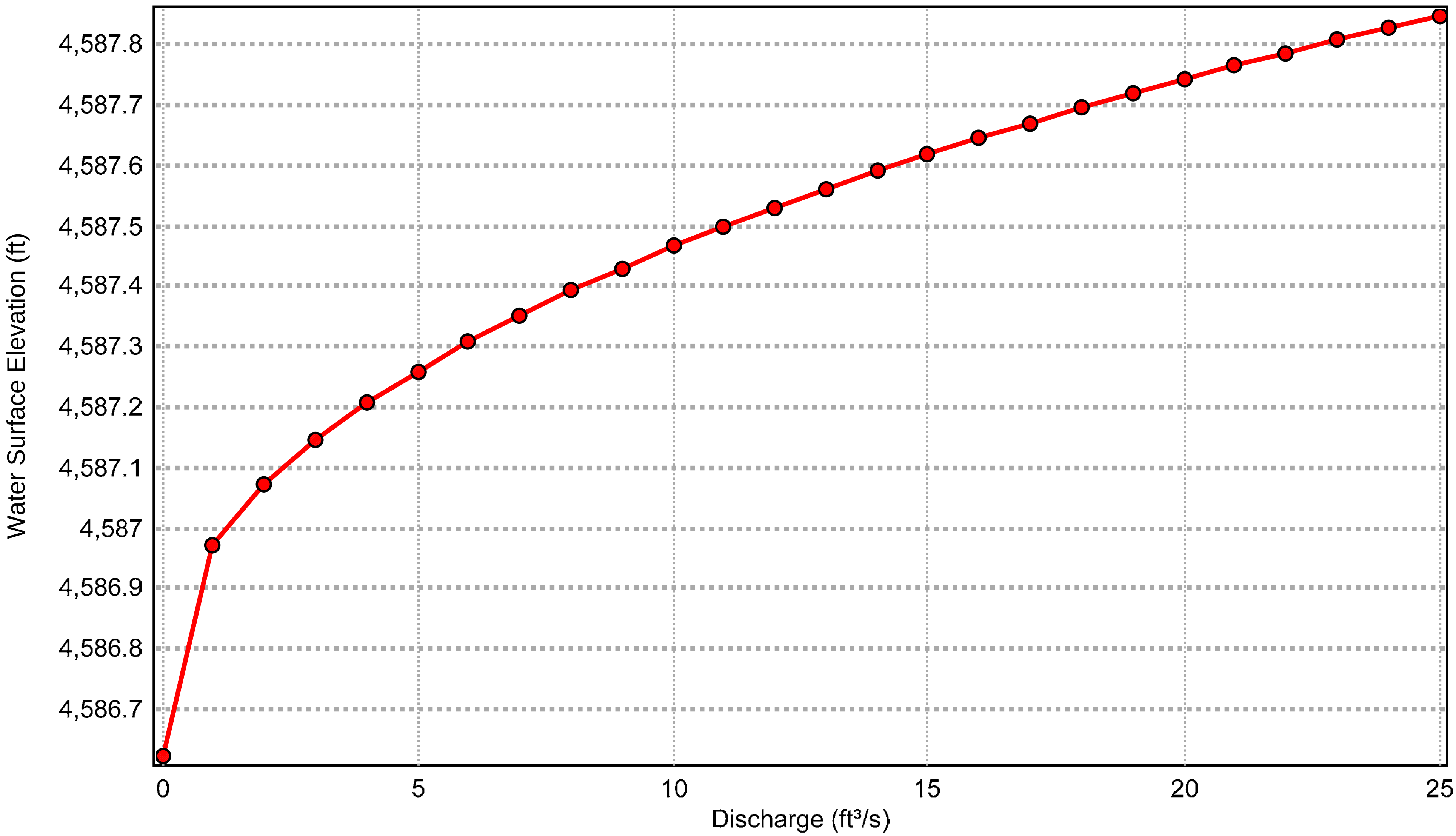
## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.46000 | % |
| Normal Depth | 0.64 | ft |
| Discharge | 5.00 | $ft^3/s$ |

## Cross Section Image



Worksheet: South Egress Road N. Channel at 24" RCP outlet-25 year
Water Surface Elevation (ft) vs Discharge (ft³/s)



## Report for South Egress Road N. Channel at 24" RCP outlet-25 year

### Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

### Input Data

| | | |
|---|---|---|
| Channel Slope | 2.46000 | % |
| Discharge | 5.00 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4588.11 |
| 0+01 | 4588.00 |
| 0+04 | 4587.00 |
| 0+08 | 4586.62 |
| 0+10 | 4587.00 |
| 0+17 | 4588.00 |
| 0+22 | 4588.80 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4588.11) | (0+01, 4588.00) | 0.069 |
| (0+01, 4588.00) | (0+04, 4587.00) | 0.069 |
| (0+04, 4587.00) | (0+08, 4586.62) | 0.069 |
| (0+08, 4586.62) | (0+10, 4587.00) | 0.069 |
| (0+10, 4587.00) | (0+17, 4588.00) | 0.069 |
| (0+17, 4588.00) | (0+22, 4588.80) | 0.069 |

### Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

### Results

| | | |
|---|---|---|
| Normal Depth | 0.64 | ft |

# Report for South Egress Road N. Channel at 24" RCP outlet-25 year

## Results

| | | |
|---|---|---|
| Elevation Range | 4586.62 to 4588.80 ft | |
| Flow Area | 2.99 | $ft^2$ |
| Wetted Perimeter | 8.62 | ft |
| Hydraulic Radius | 0.35 | ft |
| Top Width | 8.48 | ft |
| Normal Depth | 0.64 | ft |
| Critical Depth | 0.48 | ft |
| Critical Slope | 0.11156 | ft/ft |
| Velocity | 1.67 | ft/s |
| Velocity Head | 0.04 | ft |
| Specific Energy | 0.68 | ft |
| Froude Number | 0.50 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.64 | ft |
| Critical Depth | 0.48 | ft |
| Channel Slope | 2.46000 | % |
| Critical Slope | 0.11156 | ft/ft |

## Messages

Notes

Calculated water surface elevation in channel = 4587.26 feet

# X-Section for South Egress Road N. Channel at 24" RCP outlet-100

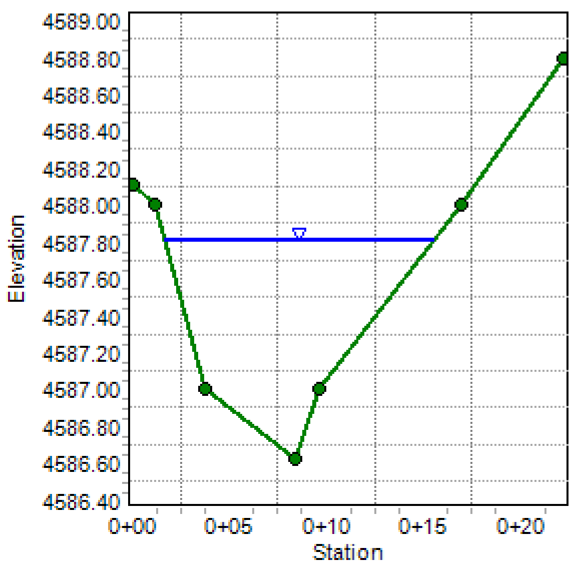
## Project Description

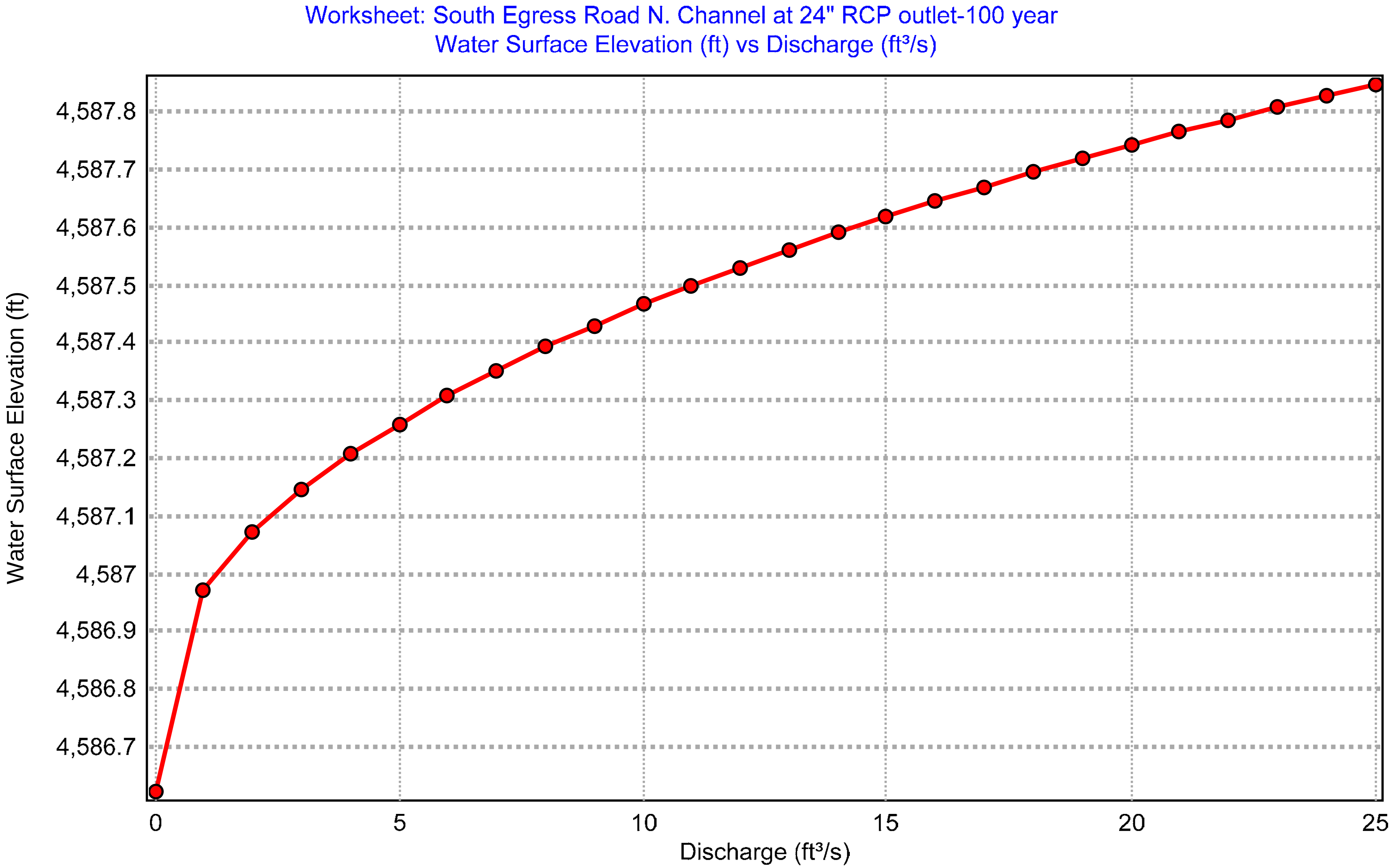
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.46000 | % |
| Normal Depth | 1.19 | ft |
| Discharge | 23.00 | ft³/s |

## Cross Section Image




Worksheet: South Egress Road N. Channel at 24" RCP outlet-100 year
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,587.8
4,587.7
4,587.6
4,587.5
4,587.4
4,587.3
4,587.2
4,587.1
4,587
4,586.9
4,586.8
4,586.7
0
5
10
15
20
25
Discharge (ft³/s)

# Report for South Egress Road N. Channel at 24" RCP outlet-100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.46000 | % |
| Discharge | 23.00 | ft³/s |
| Section Definitions | | |

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4588.11 |
| 0+01 | 4588.00 |
| 0+04 | 4587.00 |
| 0+08 | 4586.62 |
| 0+10 | 4587.00 |
| 0+17 | 4588.00 |
| 0+22 | 4588.80 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4588.11) | (0+01, 4588.00) | 0.069 |
| (0+01, 4588.00) | (0+04, 4587.00) | 0.069 |
| (0+04, 4587.00) | (0+08, 4586.62) | 0.069 |
| (0+08, 4586.62) | (0+10, 4587.00) | 0.069 |
| (0+10, 4587.00) | (0+17, 4588.00) | 0.069 |
| (0+17, 4588.00) | (0+22, 4588.80) | 0.069 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.19 | ft |

# Report for South Egress Road N. Channel at 24" RCP outlet-100 year

## Results

| | | |
|---|---|---|
| Elevation Range | 4586.62 to 4588.80 ft | |
| Flow Area | 9.13 | $ft^2$ |
| Wetted Perimeter | 14.18 | ft |
| Hydraulic Radius | 0.64 | ft |
| Top Width | 13.90 | ft |
| Normal Depth | 1.19 | ft |
| Critical Depth | 0.91 | ft |
| Critical Slope | 0.08908 | ft/ft |
| Velocity | 2.52 | ft/s |
| Velocity Head | 0.10 | ft |
| Specific Energy | 1.29 | ft |
| Froude Number | 0.55 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.19 | ft |
| Critical Depth | 0.91 | ft |
| Channel Slope | 2.46000 | % |
| Critical Slope | 0.08908 | ft/ft |

## Messages

Notes

Calculated water surface elevation in channel = 4587.81 feet

# X-Section for N. Channel along S. Egress Road - 25 year

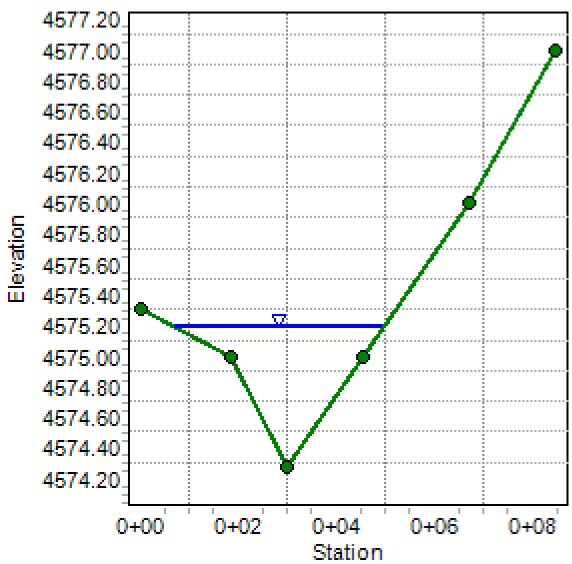
## Project Description

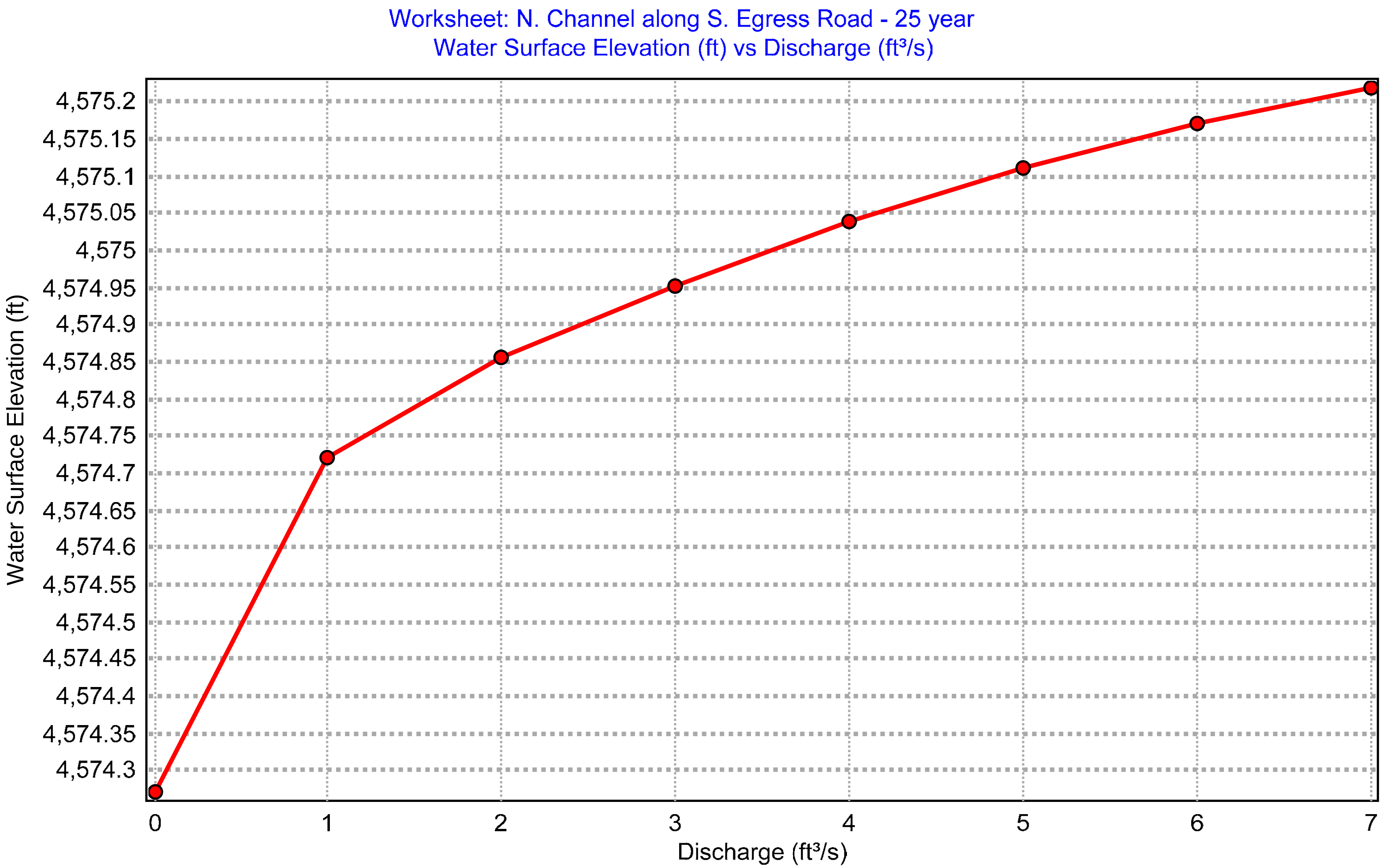
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 13.10000 | % |
| Normal Depth | 0.92 | ft |
| Discharge | 6.40 | ft³/s |

## Cross Section Image




Worksheet: N. Channel along S. Egress Road - 25 year
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,575.2
4,575.15
4,575.1
4,575.05
4,575
4,574.95
4,574.9
4,574.85
4,574.8
4,574.75
4,574.7
4,574.65
4,574.6
4,574.55
4,574.5
4,574.45
4,574.4
4,574.35
4,574.3
0
1
2
3
4
5
6
7
Discharge (ft³/s)

# Report for N. Channel along S. Egress Road - 25 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 13.10000 | % |
| Discharge | 6.40 | ft³/s |
| Section Definitions | | |

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4575.31 |
| 0+02 | 4575.00 |
| 0+03 | 4574.27 |
| 0+05 | 4575.00 |
| 0+07 | 4576.00 |
| 0+08 | 4577.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4575.31) | (0+02, 4575.00) | 0.069 |
| (0+02, 4575.00) | (0+03, 4574.27) | 0.069 |
| (0+03, 4574.27) | (0+05, 4575.00) | 0.069 |
| (0+05, 4575.00) | (0+07, 4576.00) | 0.069 |
| (0+07, 4576.00) | (0+08, 4577.00) | 0.069 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.92 | ft |
| Elevation Range | 4574.27 to 4577.00 ft | |
| Flow Area | 1.65 | ft² |

# Report for N. Channel along S. Egress Road - 25 year

## Results

| | | | |
|---|---|---|---|
| Wetted Perimeter | | 4.68 | ft |
| Hydraulic Radius | | 0.35 | ft |
| Top Width | | 4.25 | ft |
| Normal Depth | | 0.92 | ft |
| Critical Depth | | 0.95 | ft |
| Critical Slope | | 0.10695 | ft/ft |
| Velocity | | 3.89 | ft/s |
| Velocity Head | | 0.23 | ft |
| Specific Energy | | 1.16 | ft |
| Froude Number | | 1.10 | |
| Flow Type | Supercritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.92 | ft |
| Critical Depth | 0.95 | ft |
| Channel Slope | 13.10000 | % |
| Critical Slope | 0.10695 | ft/ft |

## Messages

Notes

Calculated water surface elevation in channel = 4575.19 feet

# Cross Section for N. Channel along S. Egress Road - 100 year

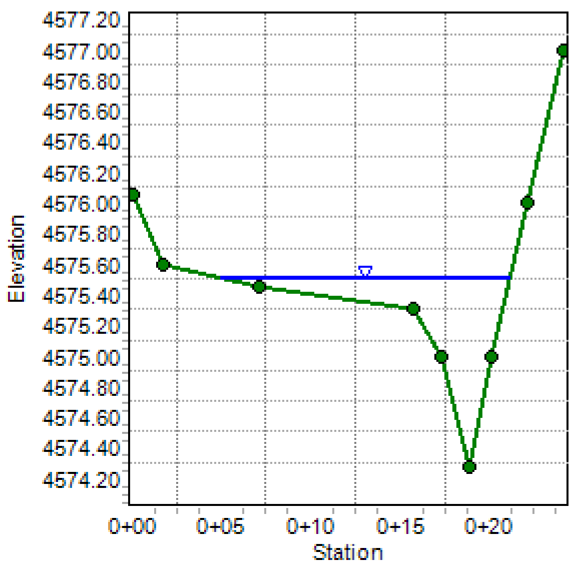
## Project Description

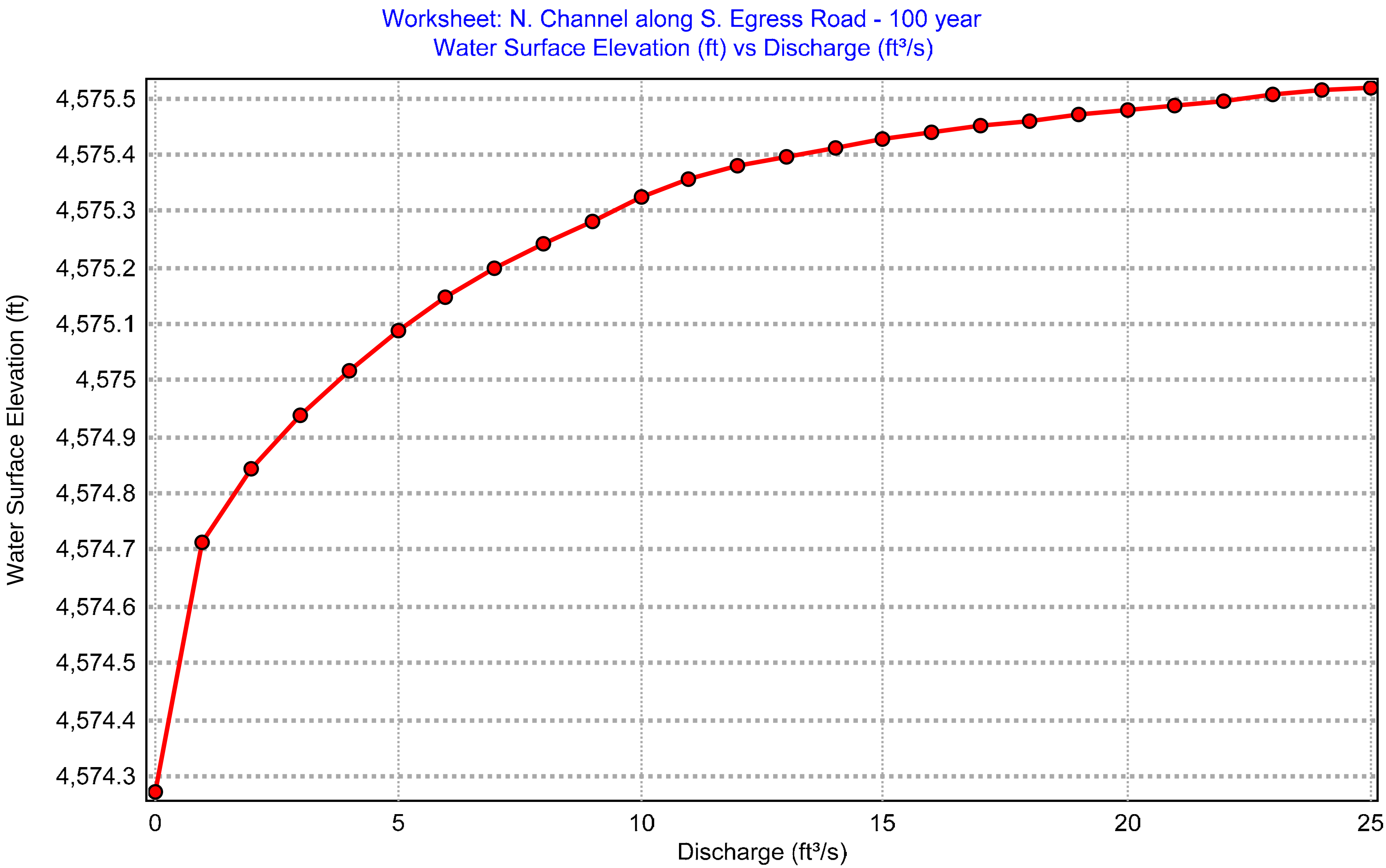
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 13.10000 | % |
| Normal Depth | 1.23 | ft |
| Discharge | 23.00 | $ft^3/s$ |

## Cross Section Image




Worksheet: N. Channel along S. Egress Road - 100 year
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,575.5
4,575.4
4,575.3
4,575.2
4,575.1
4,575
4,574.9
4,574.8
4,574.7
4,574.6
4,574.5
4,574.4
4,574.3
0
5
10
15
20
25
Discharge (ft³/s)

# Report for N. Channel along S. Egress Road - 100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 13.10000 | % |
| Discharge | 23.00 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4576.05 |
| 0+02 | 4575.59 |
| 0+07 | 4575.45 |
| 0+16 | 4575.31 |
| 0+17 | 4575.00 |
| 0+19 | 4574.27 |
| 0+20 | 4575.00 |
| 0+22 | 4576.00 |
| 0+24 | 4577.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4576.05) | (0+02, 4575.59) | 0.013 |
| (0+02, 4575.59) | (0+07, 4575.45) | 0.013 |
| (0+07, 4575.45) | (0+16, 4575.31) | 0.013 |
| (0+16, 4575.31) | (0+17, 4575.00) | 0.069 |
| (0+17, 4575.00) | (0+19, 4574.27) | 0.069 |
| (0+19, 4574.27) | (0+20, 4575.00) | 0.069 |
| (0+20, 4575.00) | (0+22, 4576.00) | 0.069 |
| (0+22, 4576.00) | (0+24, 4577.00) | 0.069 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |

# Report for N. Channel along S. Egress Road - 100 year

## Options

| | |
|---|---|
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.23 | ft |
| Elevation Range | 4574.27 to 4577.00 ft | |
| Flow Area | 4.42 | ft² |
| Wetted Perimeter | 16.67 | ft |
| Hydraulic Radius | 0.26 | ft |
| Top Width | 16.17 | ft |
| Normal Depth | 1.23 | ft |
| Critical Depth | 1.37 | ft |
| Critical Slope | 0.03895 | ft/ft |
| Velocity | 5.21 | ft/s |
| Velocity Head | 0.42 | ft |
| Specific Energy | 1.66 | ft |
| Froude Number | 1.76 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.23 | ft |
| Critical Depth | 1.37 | ft |
| Channel Slope | 13.10000 | % |
| Critical Slope | 0.03895 | ft/ft |

## Messages

Notes

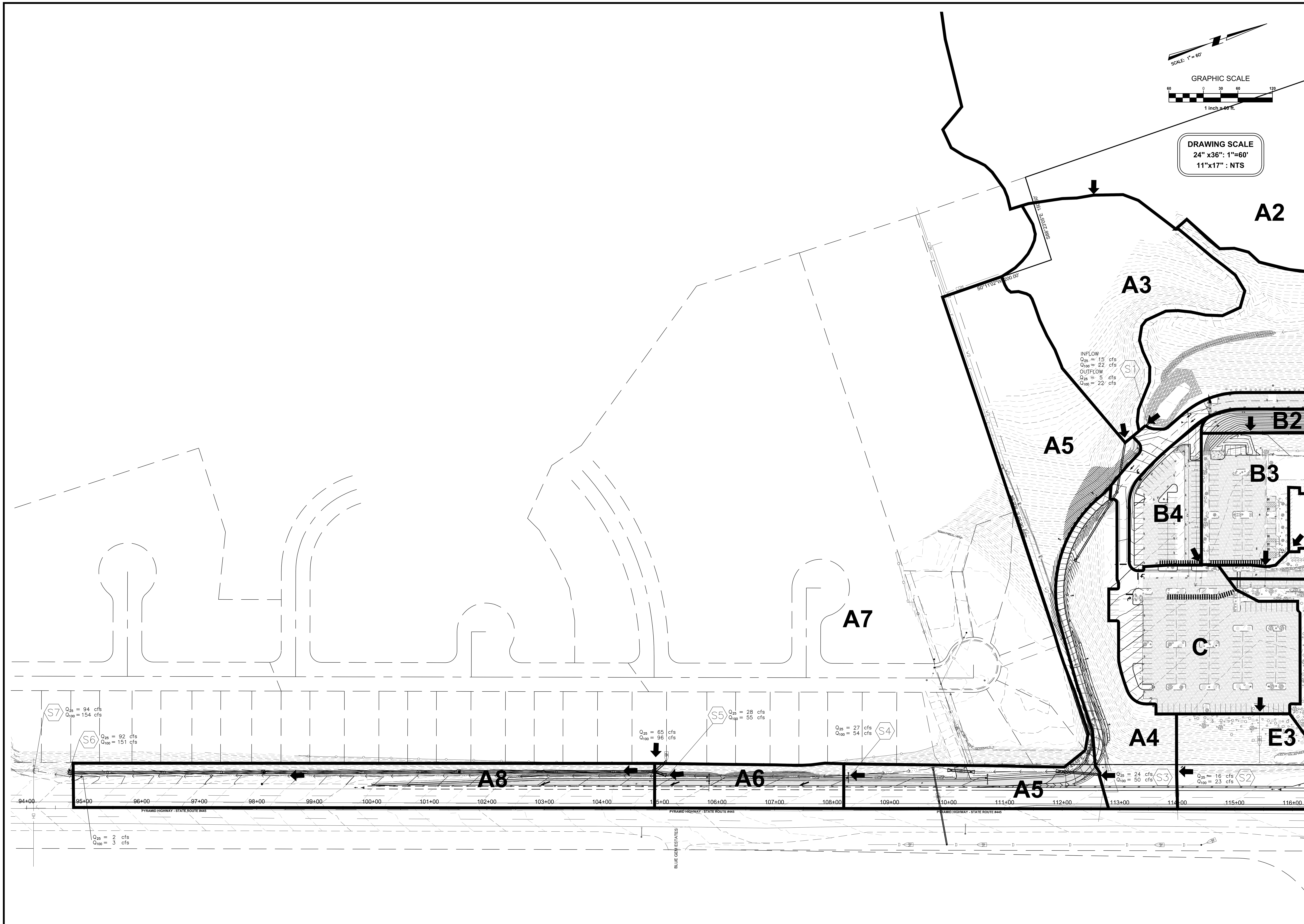
Calculated water surface elevation in channel = 4575.50 feet

# APPENDIX G

## PROPOSED HYDROLOGY BASIN SITE PLAN MAPS

## SOUTHERN HALF OF SITE

## NORTHERN HALF OF SITE




PROPOSED H□DROLOG□ □ASIN SI□E PLAN □SO□□HERN HALF

SCALE: □" □ □0□



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PROPOSED H□DROLOG□ □ASIN
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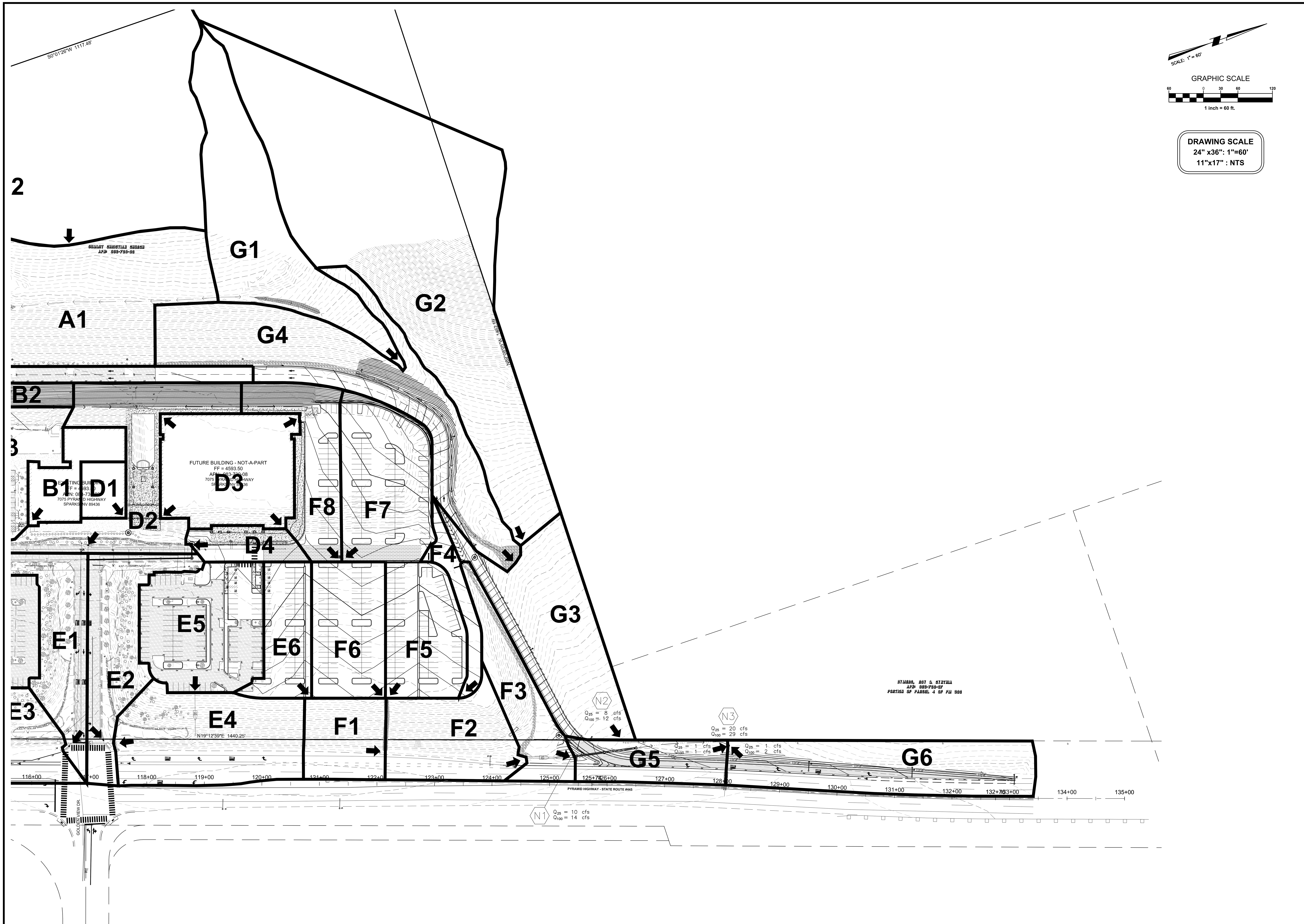


PROPOSED H□DROLOG□ □ASIN SI□E PLAN □NOR□HERN HALF

SCALE: □" □ □0□

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# APPENDIX H

## FLOWMASTER & CULVERTPRO
## PROPOSED STORM DRAIN PIPE DESIGN
## & CHANNEL FLOW CALCULATIONS
## FOR STORM FLOWS CONTRIBUTING TO
## NDOT RIGHT-OF-WAY

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# NORTH DECELERATION LANE INGRESS

## 1 PROPOSED 24-INCH RCP CULVERT ANALYSIS – STATION “C” 125+39

Headwater depth elevation – 25 year peak runoff (feet) = 4557.12

Headwater depth elevation – 100 year peak runoff (feet) = 4557.71

Tailwater depth elevation – 25 year peak runoff (feet) = 0.65

Tailwater depth elevation – 100 year peak runoff (feet) = 0.75

Existing elevation of center of travel lane adjacent to inlet (feet) = 4559.08

Estimated 25-Year storm flow peak runoff (cfs) = 9.68

Estimated 100-Year storm flow peak runoff (cfs) = 14.28

CulvertPro

Main Hydraulics Rational Method SCS Method Culvert Length Tailwater

**Culvert Hydraulics**

**US Units | SI Units**

**Information Panel**

Culvert Shape: Round
Diameter: 24 inches

Inputs - Diagram

Culvert Length: 103 ft
Flow: 9.68 $ft^3/s$
Tailwater Depth: 0.65 ft

Upstream Invert Elevation: 4555.45 ft
Downstream Invert Elevation: 4553.90 ft
Culvert Burial: 1.09 ft
Manning's n of Culvert: 0.013
Entrance Loss Coefficient: 0.5
End Section: Conforming to Slope

Manning's n table
Entrance Loss Coefficients

Calculate

**Results**

Headwater = 4557.124 ft
Upstream Velocity = 5.39 ft/s
Downstream Velocity = 8.03 ft/s

Flow Profile = S2n
Inlet Control Headwater = 4557.124 ft
Outlet Control Headwater = 4556.048 ft
Normal Depth = 0.816 ft
Critical Depth = 1.11 ft
View Report

# Culvert Hydraulics Report

**Inputs**

Flow: 9.68 $ft^3/s$
Channel Flow Depth: 0.65 ft

Upstream Invert: 4555.45 ft
Downstream Invert: 4553.9 ft
Burial: 1.09 ft
Culvert Length: 103 ft

**Basic Outputs**

Normal Depth: 0.816 ft
Critical Depth: 1.11 ft

Flow Classification: S2n

**Gradually Varied Flow Analysis Results**

Upstream Velocity Head: 0.147 ft
Entrance Loss: 0.074 ft

Upstream Depth: ft
Inlet Velocity: 5.39 ft/s

Downstream Depth: ft
Outlet Velocity: 8.03 ft/s

Headwater: 4557.124 ft

CulvertPro

Main Hydraulics Rational Method SCS Method Culvert Length Tailwater

**Culvert Hydraulics**

**US Units | SI Units**

**Information Panel**

Culvert Shape: Round

Diameter: 24 inches

Inputs - Diagram

Culvert Length: 103 ft

Flow: 14.28 $ft^3/s$

Tailwater Depth: 0.75 ft

Upstream Invert Elevation: 4555.45 ft

Downstream Invert Elevation: 4553.90 ft

Culvert Burial: 1.09 ft

Manning's n of Culvert: 0.013

Entrance Loss Coefficient: 0.5

End Section: Conforming to Slope

Manning's n table

Entrance Loss Coefficients

Calculate

**Results**

Headwater = 4557.706 ft
Upstream Velocity = 6.27 ft/s
Downstream Velocity = 8.89 ft/s

Flow Profile = S2n
Inlet Control Headwater = 4557.706 ft
Outlet Control Headwater = 4556.628 ft
Normal Depth = 1.02 ft
Critical Depth = 1.36 ft
View Report

# Culvert Hydraulics Report

**Inputs**

Flow: 14.28 $ft^3/s$
Channel Flow Depth: 0.75 ft

Upstream Invert: 4555.45 ft
Downstream Invert: 4553.9 ft
Burial: 1.09 ft
Culvert Length: 103 ft

**Basic Outputs**

Normal Depth: 1.02 ft
Critical Depth: 1.36 ft

Flow Classification: S2n

**Gradually Varied Flow Analysis Results**

Upstream Velocity Head: 0.321 ft
Entrance Loss: 0.16 ft

Upstream Depth: ft
Inlet Velocity: 6.27 ft/s

Downstream Depth: ft
Outlet Velocity: 8.89 ft/s

Headwater: 4557.706 ft

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# NORTH DECELERATION LANE INGRESS

## 2 STATION “C” 126+50 – CHANNEL DOWNSTREAM OF PROPOSED 24-INCH RCP

Flow line elevation of proposed 24-inch diameter flared end section outlet (feet) = 4553.90

Existing elevation of center of travel lane adjacent to channel (feet) = 4558.66

Estimated 25-year storm flow peak runoff (cfs) = 18.55

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4555.64

Estimated 100-year storm flow peak runoff (cfs) = 27.38

Calculated water surface elevation in channel for 100-year peak runoff (feet) =4555.74

# X-Section for Channel Adj. to Decel. Lane - Sta. "C" 126+50 - 25 year

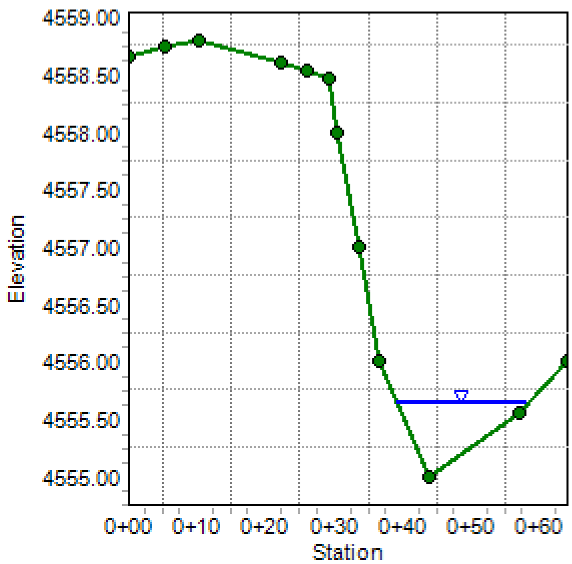
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

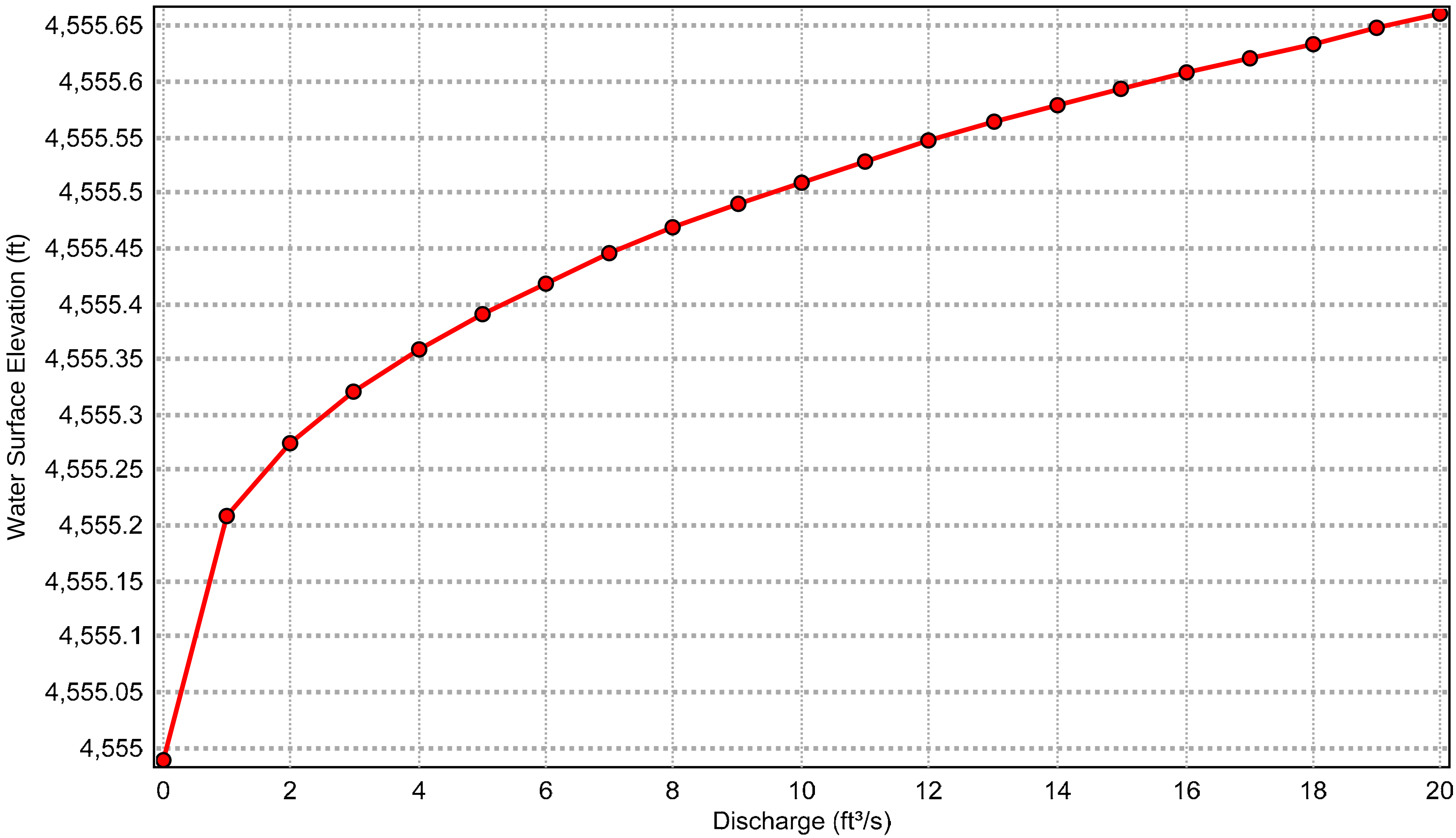
## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Normal Depth | 0.65 | ft |
| Discharge | 18.55 | ft³/s |

## Cross Section Image



Worksheet: Channel Adj. to Decel. Lane - Sta. "C" 126+50 - 25 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)



# Report for Channel Adj. to Decel. Lane - Sta. "C" 126+50 - 25 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Discharge | 18.55 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4558.66 |
| 0+05 | 4558.75 |
| 0+10 | 4558.80 |
| 0+22 | 4558.61 |
| 0+26 | 4558.53 |
| 0+29 | 4558.47 |
| 0+31 | 4558.00 |
| 0+34 | 4557.00 |
| 0+37 | 4556.00 |
| 0+44 | 4554.99 |
| 0+57 | 4555.56 |
| 0+64 | 4556.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4558.66) | (0+05, 4558.75) | 0.013 |
| (0+05, 4558.75) | (0+10, 4558.80) | 0.013 |
| (0+10, 4558.80) | (0+22, 4558.61) | 0.013 |
| (0+22, 4558.61) | (0+26, 4558.53) | 0.013 |
| (0+26, 4558.53) | (0+29, 4558.47) | 0.035 |
| (0+29, 4558.47) | (0+31, 4558.00) | 0.069 |
| (0+31, 4558.00) | (0+34, 4557.00) | 0.069 |
| (0+34, 4557.00) | (0+37, 4556.00) | 0.069 |
| (0+37, 4556.00) | (0+44, 4554.99) | 0.035 |

# Report for Channel Adj. to Decel. Lane - Sta. "C" 126+50 - 25 year

## Input Data

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+44, 4554.99) | (0+57, 4555.56) | 0.035 |
| (0+57, 4555.56) | (0+64, 4556.00) | 0.035 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 0.65 | ft |
| Elevation Range | 4554.99 to 4558.80 ft | | |
| Flow Area | | 6.43 | ft² |
| Wetted Perimeter | | 19.27 | ft |
| Hydraulic Radius | | 0.33 | ft |
| Top Width | | 19.21 | ft |
| Normal Depth | | 0.65 | ft |
| Critical Depth | | 0.62 | ft |
| Critical Slope | | 0.02633 | ft/ft |
| Velocity | | 2.89 | ft/s |
| Velocity Head | | 0.13 | ft |
| Specific Energy | | 0.78 | ft |
| Froude Number | | 0.88 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.65 | ft |

# Report for Channel Adj. to Decel. Lane - Sta. "C" 126+50 - 25 year

## GVF Output Data

| | | |
|---|---|---|
| Critical Depth | 0.62 | ft |
| Channel Slope | 2.00000 | % |
| Critical Slope | 0.02633 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel: 4555.64 feet

# X-Section for Channel Adj. to Decel. Lane - Sta. "C" 126+50 - 100 year

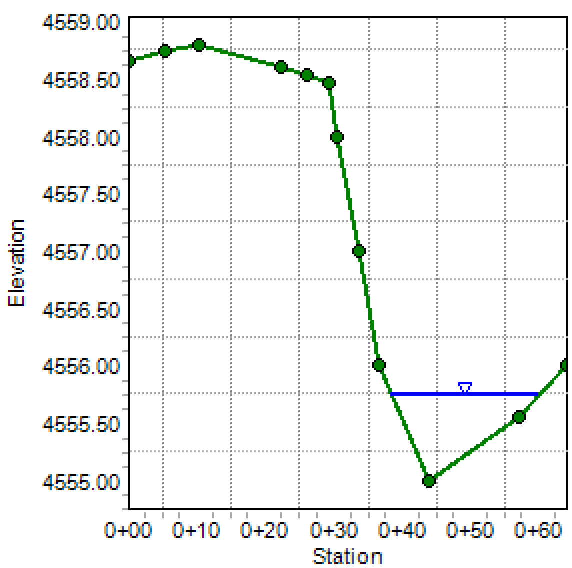
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

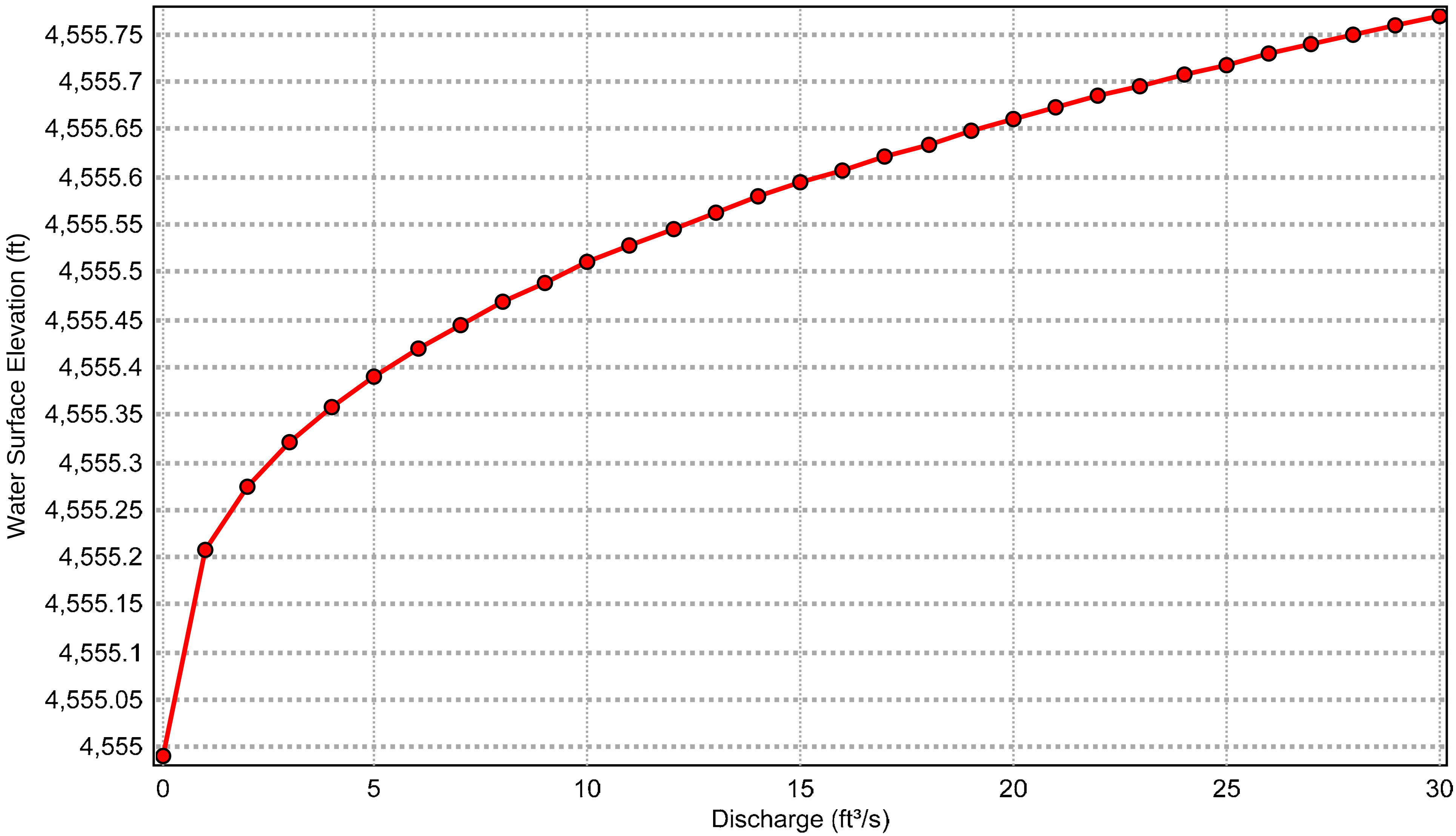
## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Normal Depth | 0.75 | ft |
| Discharge | 27.38 | ft³/s |

## Cross Section Image



Worksheet: Channel Adj. to Decel. Lane - Sta. "C" 126+50 - 100 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)



# Report for Channel Adj. to Decel. Lane - Sta. "C" 126+50 - 100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Discharge | 27.38 | ft³/s |
| Section Definitions | | |

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4558.66 |
| 0+05 | 4558.75 |
| 0+10 | 4558.80 |
| 0+22 | 4558.61 |
| 0+26 | 4558.53 |
| 0+29 | 4558.47 |
| 0+31 | 4558.00 |
| 0+34 | 4557.00 |
| 0+37 | 4556.00 |
| 0+44 | 4554.99 |
| 0+57 | 4555.56 |
| 0+64 | 4556.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4558.66) | (0+05, 4558.75) | 0.013 |
| (0+05, 4558.75) | (0+10, 4558.80) | 0.013 |
| (0+10, 4558.80) | (0+22, 4558.61) | 0.013 |
| (0+22, 4558.61) | (0+26, 4558.53) | 0.013 |
| (0+26, 4558.53) | (0+29, 4558.47) | 0.035 |
| (0+29, 4558.47) | (0+31, 4558.00) | 0.069 |
| (0+31, 4558.00) | (0+34, 4557.00) | 0.069 |
| (0+34, 4557.00) | (0+37, 4556.00) | 0.069 |
| (0+37, 4556.00) | (0+44, 4554.99) | 0.035 |

# Report for Channel Adj. to Decel. Lane - Sta. "C" 126+50 - 100 year

## Input Data

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+44, 4554.99) | (0+57, 4555.56) | 0.035 |
| (0+57, 4555.56) | (0+64, 4556.00) | 0.035 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 0.75 | ft |
| Elevation Range | 4554.99 to 4558.80 ft | | |
| Flow Area | | 8.50 | ft² |
| Wetted Perimeter | | 21.64 | ft |
| Hydraulic Radius | | 0.39 | ft |
| Top Width | | 21.57 | ft |
| Normal Depth | | 0.75 | ft |
| Critical Depth | | 0.72 | ft |
| Critical Slope | | 0.02482 | ft/ft |
| Velocity | | 3.22 | ft/s |
| Velocity Head | | 0.16 | ft |
| Specific Energy | | 0.91 | ft |
| Froude Number | | 0.90 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.75 | ft |

# Report for Channel Adj. to Decel. Lane - Sta. "C" 126+50 - 100 year

## GVF Output Data

| | | |
|---|---|---|
| Critical Depth | 0.72 | ft |
| Channel Slope | 2.00000 | % |
| Critical Slope | 0.02482 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel:  4555.74 feet

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 1 STATION “C” 114+05 CHANNEL (UPSTREAM OF EXISTING 18-INCH DIAMETER RCP CROSSING PYRAMID HIGHWAY, NORTH OF SITE EGRESS ACCELERATION LANE)

Flow line elevation at existing 18-inch diameter RCP inlet (feet) = 4554.06

Existing elevation of center of travel lane adjacent to channel (feet) = 4557.12

Estimated 25-year storm flow peak runoff (cfs) = 15.74

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4556.56

Estimated 100-year storm flow peak runoff (cfs) = 23.23

Calculated water surface elevation in channel for 100-year peak runoff (feet) =4556.78

# X-Section for Channel Adj. to Pyramid Hwy-Sta. "C" 114+05-25 year

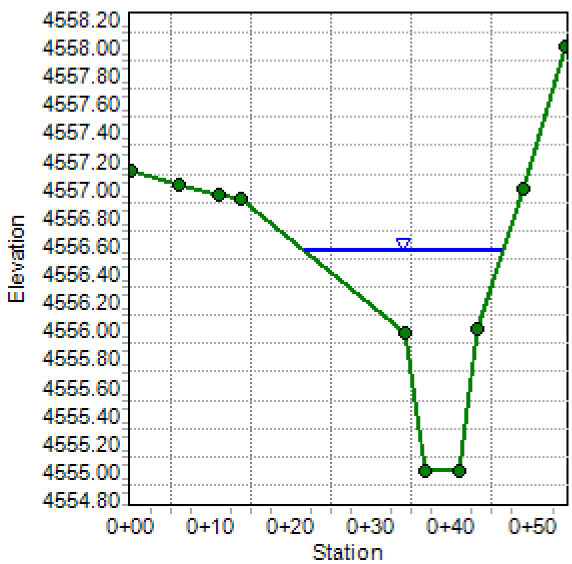
## Project Description

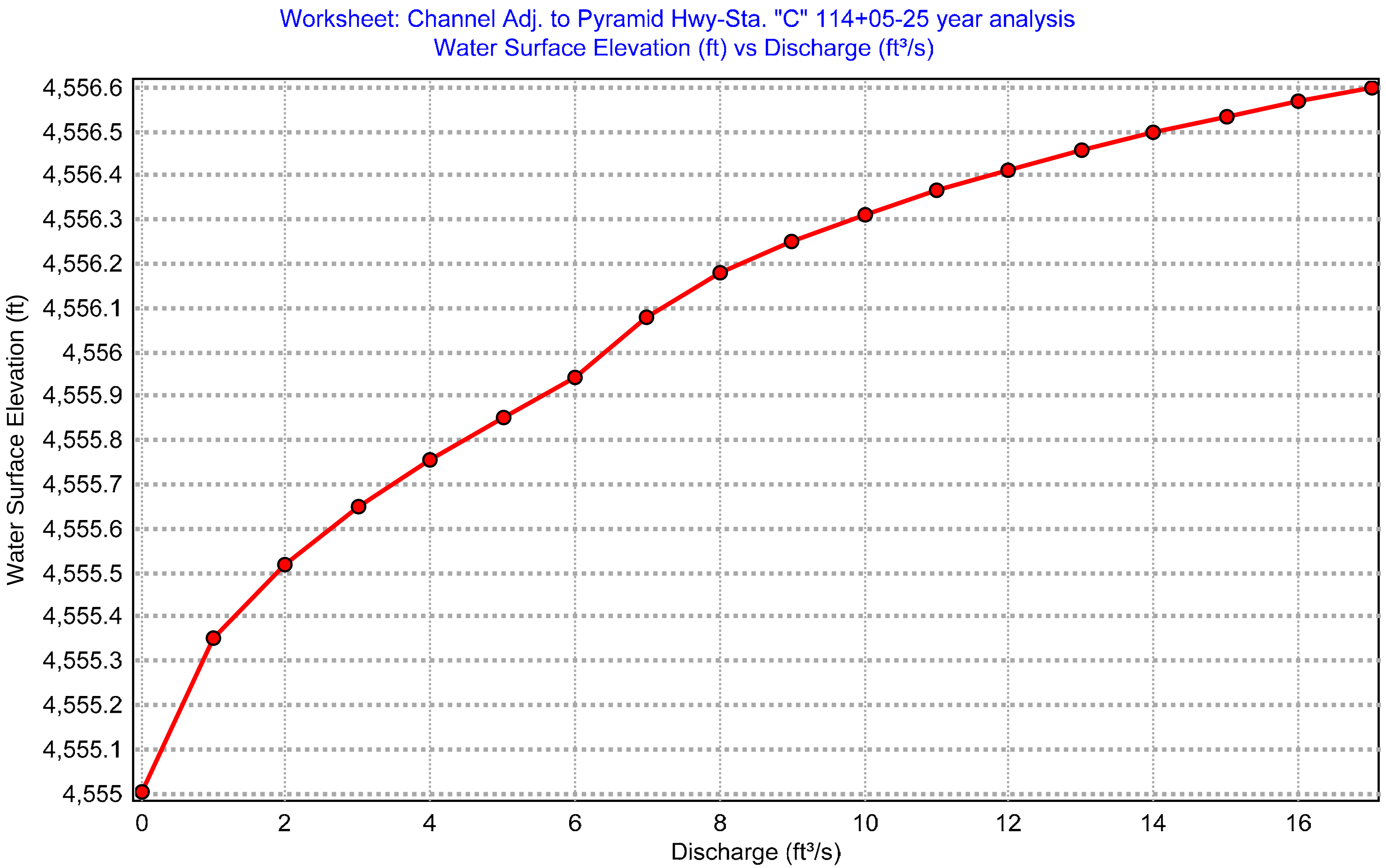
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.10000 | % |
| Normal Depth | 1.56 | ft |
| Discharge | 15.74 | ft³/s |

## Cross Section Image





Worksheet: Channel Adj. to Pyramid Hwy-Sta. "C" 114+05-25 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
4,556.6
4,556.5
4,556.4
4,556.3
4,556.2
4,556.1
4,556
4,555.9
4,555.8
4,555.7
4,555.6
4,555.5
4,555.4
4,555.3
4,555.2
4,555.1
4,555
Water Surface Elevation (ft)
0
2
4
6
8
10
12
14
16
Discharge (ft³/s)

# Report for Channel Adj. to Pyramid Hwy-Sta. "C" 114+05-25 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.10000 | % |
| Discharge | 15.74 | $ft^3/s$ |
| Section Definitions | | |

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4557.12 |
| 0+06 | 4557.03 |
| 0+11 | 4556.96 |
| 0+14 | 4556.92 |
| 0+34 | 4555.98 |
| 0+37 | 4555.00 |
| 0+41 | 4555.00 |
| 0+43 | 4556.00 |
| 0+49 | 4557.00 |
| 0+54 | 4558.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4557.12) | (0+06, 4557.03) | 0.013 |
| (0+06, 4557.03) | (0+11, 4556.96) | 0.013 |
| (0+11, 4556.96) | (0+14, 4556.92) | 0.013 |
| (0+14, 4556.92) | (0+34, 4555.98) | 0.035 |
| (0+34, 4555.98) | (0+37, 4555.00) | 0.035 |
| (0+37, 4555.00) | (0+41, 4555.00) | 0.035 |
| (0+41, 4555.00) | (0+43, 4556.00) | 0.035 |
| (0+43, 4556.00) | (0+49, 4557.00) | 0.035 |
| (0+49, 4557.00) | (0+54, 4558.00) | 0.035 |

# Report for Channel Adj. to Pyramid Hwy-Sta. "C" 114+05-25 year

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.56 | ft |
| Elevation Range | 4555.00 to 4558.00 ft | | |
| Flow Area | | 15.87 | ft² |
| Wetted Perimeter | | 25.00 | ft |
| Hydraulic Radius | | 0.63 | ft |
| Top Width | | 24.55 | ft |
| Normal Depth | | 1.56 | ft |
| Critical Depth | | 0.68 | ft |
| Critical Slope | | 0.02322 | ft/ft |
| Velocity | | 0.99 | ft/s |
| Velocity Head | | 0.02 | ft |
| Specific Energy | | 1.57 | ft |
| Froude Number | | 0.22 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.56 | ft |
| Critical Depth | 0.68 | ft |
| Channel Slope | 0.10000 | % |
| Critical Slope | 0.02322 | ft/ft |

## Messages

Notes

# Report for Channel Adj. to Pyramid Hwy-Sta. "C" 114+05-25 year

## Messages

Calculated Water Surface Elevation in Channel:  4556.56 feet

# X-Section for Channel Adj. to Pyramid Hwy-Sta. "C" 114+05-100 year

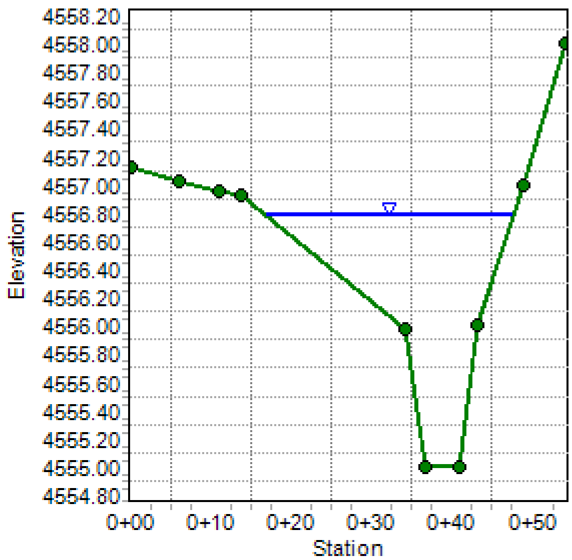
## Project Description

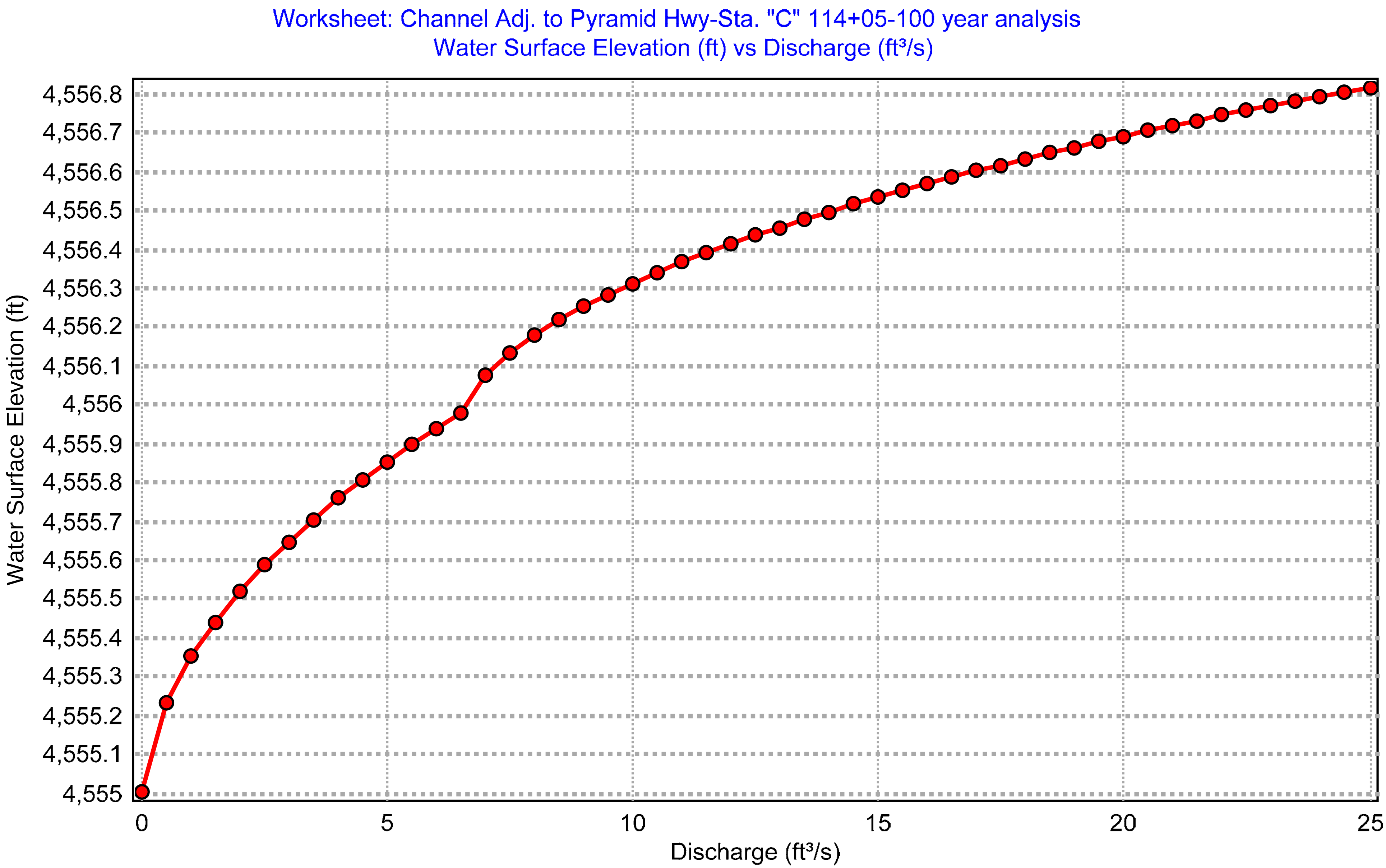
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.10000 | % |
| Normal Depth | 1.78 | ft |
| Discharge | 23.23 | ft³/s |

## Cross Section Image




Worksheet: Channel Adj. to Pyramid Hwy-Sta. "C" 114+05-100 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,556.8
4,556.7
4,556.6
4,556.5
4,556.4
4,556.3
4,556.2
4,556.1
4,556
4,555.9
4,555.8
4,555.7
4,555.6
4,555.5
4,555.4
4,555.3
4,555.2
4,555.1
4,555
0
5
10
15
20
25
Discharge (ft³/s)

# Report for Channel Adj. to Pyramid Hwy-Sta. "C" 114+05-100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.10000 | % |
| Discharge | 23.23 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4557.12 |
| 0+06 | 4557.03 |
| 0+11 | 4556.96 |
| 0+14 | 4556.92 |
| 0+34 | 4555.98 |
| 0+37 | 4555.00 |
| 0+41 | 4555.00 |
| 0+43 | 4556.00 |
| 0+49 | 4557.00 |
| 0+54 | 4558.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4557.12) | (0+06, 4557.03) | 0.013 |
| (0+06, 4557.03) | (0+11, 4556.96) | 0.013 |
| (0+11, 4556.96) | (0+14, 4556.92) | 0.013 |
| (0+14, 4556.92) | (0+34, 4555.98) | 0.035 |
| (0+34, 4555.98) | (0+37, 4555.00) | 0.035 |
| (0+37, 4555.00) | (0+41, 4555.00) | 0.035 |
| (0+41, 4555.00) | (0+43, 4556.00) | 0.035 |
| (0+43, 4556.00) | (0+49, 4557.00) | 0.035 |
| (0+49, 4557.00) | (0+54, 4558.00) | 0.035 |

# Report for Channel Adj. to Pyramid Hwy-Sta. "C" 114+05-100 year

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.78 | ft |
| Elevation Range | 4555.00 to 4558.00 ft | | |
| Flow Area | | 21.84 | ft² |
| Wetted Perimeter | | 30.97 | ft |
| Hydraulic Radius | | 0.71 | ft |
| Top Width | | 30.49 | ft |
| Normal Depth | | 1.78 | ft |
| Critical Depth | | 0.85 | ft |
| Critical Slope | | 0.02194 | ft/ft |
| Velocity | | 1.06 | ft/s |
| Velocity Head | | 0.02 | ft |
| Specific Energy | | 1.79 | ft |
| Froude Number | | 0.22 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.78 | ft |
| Critical Depth | 0.85 | ft |
| Channel Slope | 0.10000 | % |
| Critical Slope | 0.02194 | ft/ft |

## Messages

Notes

# Report for Channel Adj. to Pyramid Hwy-Sta. "C" 114+05-100 year

## Messages

Calculated Water Surface Elevation in Channel: 4556.78 feet

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 2 Analysis of Proposed 36-inch RCP Culvert – Station "C" 112+60

Headwater depth elevation – 25 year peak runoff (feet) = 4555.35

Headwater depth elevation – 100 year peak runoff (feet) = 4557.36

Tailwater depth elevation – 25 year peak runoff (feet) = 1.49

Tailwater depth elevation – 100 year peak runoff (feet) = 1.89

Existing elevation of center of travel lane adjacent to inlet (feet) = 4556.12

Estimated 25-Year storm flow peak runoff (cfs) = 24.03

Estimated 100-Year storm flow peak runoff (cfs) = 50.04

CulvertPro

Main Hydraulics Rational Method SCS Method Culvert Length Tailwater

**Culvert Hydraulics** **US Units | SI Units** **Information Panel**

Culvert Shape: Round

Diameter: 36 inches

Inputs - Diagram

Culvert Length: 64 ft

Flow: 24.03 $ft^3/s$

Tailwater Depth: 1.49 ft

Upstream Invert Elevation: 4553.0C ft

Downstream Invert Elevation: 4551.7C ft

Culvert Burial: 1.0 ft

Manning's n of Culvert: 0.013

Entrance Loss Coefficient: 0.5

End Section: Conforming to Slope

Manning's n table

Entrance Loss Coefficients

Calculate

**Results**

Headwater = 4555.353 ft
Upstream Velocity = 6.37 ft/s
Downstream Velocity = 11.2 ft/s

Flow Profile = S2n
Inlet Control Headwater = 4555.353 ft
Outlet Control Headwater = 4554.542 ft
Normal Depth = 1.03 ft
Critical Depth = 1.58 ft
View Report

# Culvert Hydraulics Report

**Inputs**

Flow: 24.03 $ft^3/s$
Channel Flow Depth: 1.49 ft

Upstream Invert: 4553 ft
Downstream Invert: 4551.7 ft
Burial: 1 ft
Culvert Length: 64 ft

**Basic Outputs**

Normal Depth: 1.03 ft
Critical Depth: 1.58 ft

Flow Classification: S2n

**Gradually Varied Flow Analysis Results**

Upstream Velocity Head: 0.179 ft
Entrance Loss: 0.09 ft

Upstream Depth: ft
Inlet Velocity: 6.37 ft/s

Downstream Depth: ft
Outlet Velocity: 11.2 ft/s

Headwater: 4555.353 ft

CulvertPro

Main Hydraulics Rational Method SCS Method Culvert Length Tailwater

**Culvert Hydraulics**

**US Units | SI Units**

**Information Panel**

Culvert Shape: Round

Diameter: 36 inches

Inputs - Diagram

Culvert Length: 64 ft

Flow: 50.04 $ft^3/s$

Tailwater Depth: 1.89 ft

Upstream Invert Elevation: 4553.0C ft

Downstream Invert Elevation: 4551.7C ft

Culvert Burial: 1.0 ft

Manning's n of Culvert: 0.013

Entrance Loss Coefficient: 0.5

End Section: Conforming to Slope

Manning's n table

Entrance Loss Coefficients

Calculate

**Results**

Headwater = 4557.357 ft
Upstream Velocity = 8.6 ft/s
Downstream Velocity = 13.6 ft/s

Flow Profile = S2n
Inlet Control Headwater = 4557.357 ft
Outlet Control Headwater = 4556.115 ft
Normal Depth = 1.55 ft
Critical Depth = 2.3 ft
View Report

# Culvert Hydraulics Report

**Inputs**

Flow: 50.04 ft³/s
Channel Flow Depth: 1.89 ft

Upstream Invert: 4553 ft
Downstream Invert: 4551.7 ft
Burial: 1 ft
Culvert Length: 64 ft

**Basic Outputs**

Normal Depth: 1.55 ft
Critical Depth: 2.3 ft

Flow Classification: S2n

**Gradually Varied Flow Analysis Results**

Upstream Velocity Head: 0.778 ft
Entrance Loss: 0.389 ft

Upstream Depth: ft
Inlet Velocity: 8.6 ft/s

Downstream Depth: ft
Outlet Velocity: 13.6 ft/s

Headwater: 4557.357 ft

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 3 STATION "C" 111+00 CHANNEL (UPSTREAM OF PROPOSED 36-INCH DIAMETER RCP AT SPRING RIDGE FIRE ROAD)

Flow line elevation at Station "C" 111+00 (feet) = 4552.65

Existing elevation of center of travel lane adjacent to channel (feet) = 4555.55

Estimated 25-year storm flow peak runoff (cfs) = 26.59

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4554.14

Estimated 100-year storm flow peak runoff (cfs) = 53.81

Calculated water surface elevation in channel for 100-year peak runoff (feet) =4554.54

# X-Section for Channel Adj. to Accel. Lane - Sta. "C" 111+00-25 year

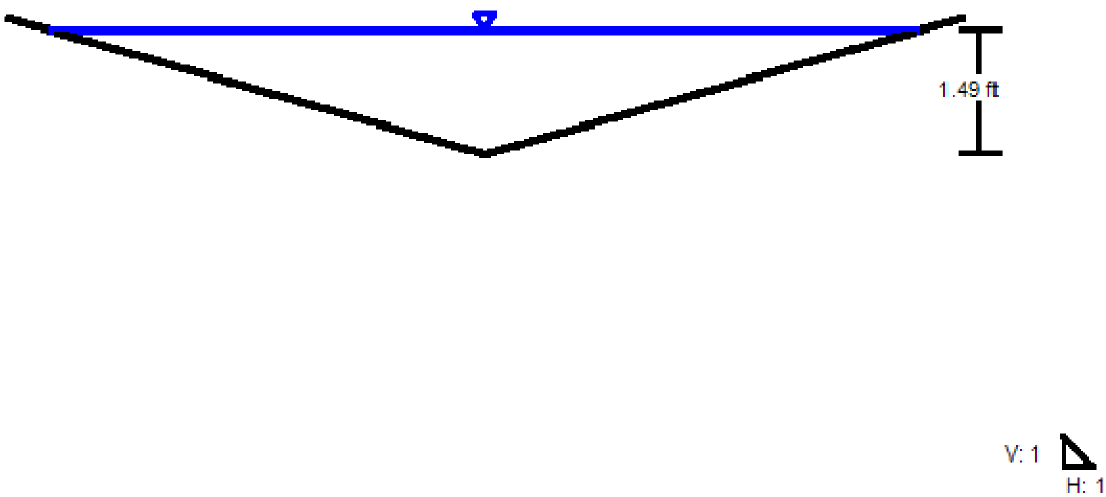
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.035 | |
| Channel Slope | 1.00000 | % |
| Normal Depth | 1.49 | ft |
| Left Side Slope | 3.50 | ft/ft (H:V) |
| Right Side Slope | 3.50 | ft/ft (H:V) |
| Discharge | 26.59 | $ft^3/s$ |

## Cross Section Image



# Report for Channel Adj. to Accel. Lane - Sta. "C" 111+00-25 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.035 | |
| Channel Slope | 1.00000 | % |
| Left Side Slope | 3.50 | ft/ft (H:V) |
| Right Side Slope | 3.50 | ft/ft (H:V) |
| Discharge | 26.59 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.49 | ft |
| Flow Area | 7.81 | $ft^2$ |
| Wetted Perimeter | 10.87 | ft |
| Hydraulic Radius | 0.72 | ft |
| Top Width | 10.46 | ft |
| Critical Depth | 1.29 | ft |
| Critical Slope | 0.02176 | ft/ft |
| Velocity | 3.40 | ft/s |
| Velocity Head | 0.18 | ft |
| Specific Energy | 1.67 | ft |
| Froude Number | 0.69 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.49 | ft |
| Critical Depth | 1.29 | ft |
| Channel Slope | 1.00000 | % |
| Critical Slope | 0.02176 | ft/ft |

# X-Section for Channel Adj. to Accel. Lane - Sta. "C" 111+00-100 year

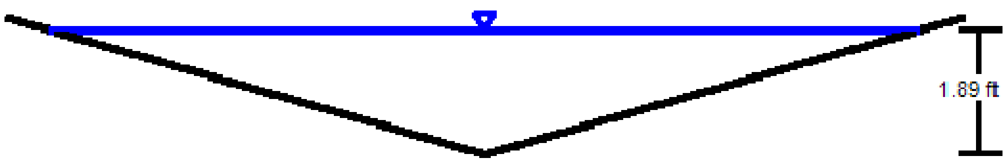
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.035 | |
| Channel Slope | 1.00000 | % |
| Normal Depth | 1.89 | ft |
| Left Side Slope | 3.50 | ft/ft (H:V) |
| Right Side Slope | 3.50 | ft/ft (H:V) |
| Discharge | 50.04 | ft³/s |

## Cross Section Image




# Report for Channel Adj. to Accel. Lane - Sta. "C" 111+00-100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.035 | |
| Channel Slope | 1.00000 | % |
| Left Side Slope | 3.50 | ft/ft (H:V) |
| Right Side Slope | 3.50 | ft/ft (H:V) |
| Discharge | 50.04 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.89 | ft |
| Flow Area | 12.55 | $ft^2$ |
| Wetted Perimeter | 13.79 | ft |
| Hydraulic Radius | 0.91 | ft |
| Top Width | 13.26 | ft |
| Critical Depth | 1.66 | ft |
| Critical Slope | 0.02000 | ft/ft |
| Velocity | 3.99 | ft/s |
| Velocity Head | 0.25 | ft |
| Specific Energy | 2.14 | ft |
| Froude Number | 0.72 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.89 | ft |
| Critical Depth | 1.66 | ft |
| Channel Slope | 1.00000 | % |
| Critical Slope | 0.02000 | ft/ft |

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 4 ANALYSIS OF PROPOSED 36-INCH RCP CULVERT AT SPRING RIDGE FIRE ROAD – STATION "C" 110+50

Headwater depth elevation – 25 year peak runoff (feet) = 4552.33

Headwater depth elevation – 100 year peak runoff (feet) = 4554.41

Tailwater depth elevation – 25 year peak runoff (feet) = 1.71

Tailwater depth elevation – 100 year peak runoff (feet) = 2.23

Existing elevation of center of travel lane adjacent to inlet (feet) = 4554.37

Estimated 25-Year storm flow peak runoff (cfs) = 26.59

Estimated 100-Year storm flow peak runoff (cfs) = 53.81

CulvertPro

Main Hydraulics Rational Method SCS Method Culvert Length Tailwater

**Culvert Hydraulics**

**US Units | SI Units**

**Information Panel**

Culvert Shape: Round

Diameter: 36 inches

Inputs - Diagram

Culvert Length: 33.3 ft

Flow: 26.59 $ft^3/s$

Tailwater Depth: 1.71 ft

Upstream Invert Elevation: 4549.65 ft

Downstream Invert Elevation: 4548.74 ft

Culvert Burial: 1.5 ft

Manning's n of Culvert: 0.013

Entrance Loss Coefficient: 0.5

End Section: Conforming to Slope

Manning's n table

Entrance Loss Coefficients

Calculate

**Results**

Headwater = 4552.332 ft
Upstream Velocity = 3.76 ft/s
Downstream Velocity = 3.76 ft/s

Flow Profile = S1f
Inlet Control Headwater = 4552.157 ft
Outlet Control Headwater = 4552.332 ft
Normal Depth = 1 ft
Critical Depth = 1.67 ft
View Report

# Culvert Hydraulics Report

**Inputs**

Flow: 26.59 $ft^3/s$
Channel Flow Depth: 1.71 ft

Upstream Invert: 4549.65 ft
Downstream Invert: 4548.74 ft
Burial: 1.5 ft
Culvert Length: 33.3 ft

**Basic Outputs**

Normal Depth: 1 ft
Critical Depth: 1.67 ft

Flow Classification: S1f

**Gradually Varied Flow Analysis Results**

Upstream Velocity Head: 0.22 ft
Entrance Loss: 0.11 ft

Upstream Depth: ft
Inlet Velocity: 3.76 ft/s

Downstream Depth: ft
Outlet Velocity: 3.76 ft/s

Headwater: 4552.332 ft

CulvertPro

Main Hydraulics Rational Method SCS Method Culvert Length Tailwater

**Culvert Hydraulics** **US Units | SI Units** **Information Panel**

Culvert Shape: Round

Diameter: 36 inches

Inputs - Diagram

Culvert Length: 33.3 ft

Flow: 53.81 $ft^3/s$

Tailwater Depth: 2.23 ft

Upstream Invert Elevation: 4549.65 ft

Downstream Invert Elevation: 4548.74 ft

Culvert Burial: 1.5 ft

Manning's n of Culvert: 0.013

Entrance Loss Coefficient: 0.5

End Section: Conforming to Slope

Manning's n table

Entrance Loss Coefficients

Calculate

**Results**

Headwater = 4554.41 ft
Upstream Velocity = 8.94 ft/s
Downstream Velocity = 15.5 ft/s

Flow Profile = S1f
Inlet Control Headwater = 4554.41 ft
Outlet Control Headwater = 4554.035 ft
Normal Depth = 1.48 ft
Critical Depth = 2.38 ft
View Report

# Culvert Hydraulics Report

**Inputs**

Flow: 53.81 $ft^3/s$
Channel Flow Depth: 2.23 ft

Upstream Invert: 4549.65 ft
Downstream Invert: 4548.74 ft
Burial: 1.5 ft
Culvert Length: 33.3 ft

**Basic Outputs**

Normal Depth: 1.48 ft
Critical Depth: 2.38 ft

Flow Classification: S1f

**Gradually Varied Flow Analysis Results**

Upstream Velocity Head: 0.9 ft
Entrance Loss: 0.45 ft

Upstream Depth: ft
Inlet Velocity: 8.94 ft/s

Downstream Depth: ft
Outlet Velocity: 15.5 ft/s

Headwater: 4554.41 ft

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 5 Station "C" 109+90 – Channel Downstream of Proposed 36-inch Diameter RCP at Spring Ridge Fire Road

Flow line elevation at Station "C" 109+90 (feet) = 4550.15

Existing elevation of center of travel lane adjacent to channel (feet) = 4553.90

Estimated 25-year storm flow peak runoff (cfs) = 26.59

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4551.86

Estimated 100-year storm flow peak runoff (cfs) = 53.81

Calculated water surface elevation in channel for 100-year peak runoff (feet) =4552.38

# X-Section for Channel Adj. to Accel. Lane - Sta. "C" 109+90-25 year

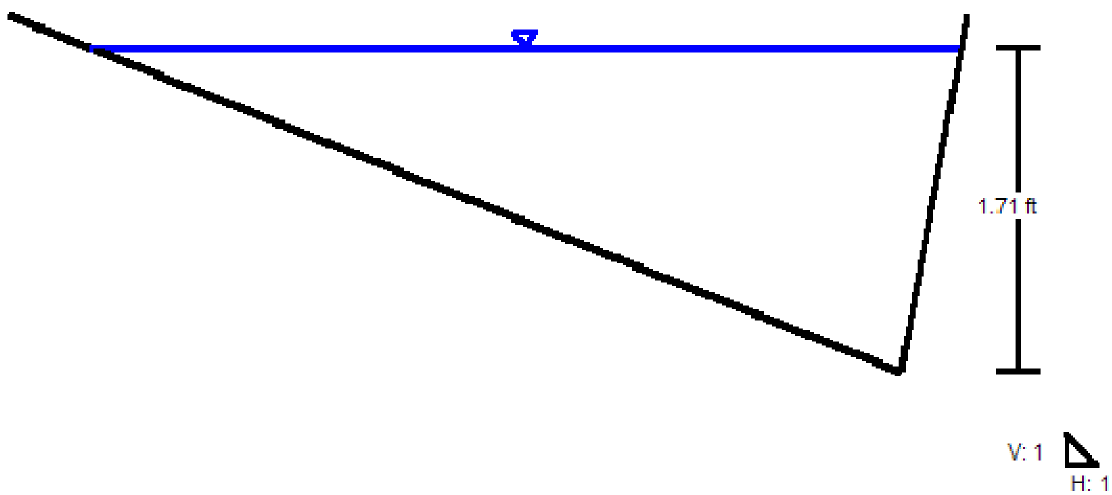
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.035 | |
| Channel Slope | 4.79000 | % |
| Normal Depth | 1.71 | ft |
| Left Side Slope | 2.50 | ft/ft (H:V) |
| Right Side Slope | 0.19 | ft/ft (H:V) |
| Discharge | 26.59 | ft³/s |

## Cross Section Image



# Report for Channel Adj. to Accel. Lane - Sta. "C" 109+90-25 year

## Project Description

| | | |
|---|---|---|
| Friction Method | Manning Formula | |
| Solve For | Normal Depth | |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.035 | |
| Channel Slope | 4.79000 | % |
| Left Side Slope | 2.50 | ft/ft (H:V) |
| Right Side Slope | 0.19 | ft/ft (H:V) |
| Discharge | 26.59 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.71 | ft |
| Flow Area | 3.94 | $ft^2$ |
| Wetted Perimeter | 6.35 | ft |
| Hydraulic Radius | 0.62 | ft |
| Top Width | 4.60 | ft |
| Critical Depth | 1.89 | ft |
| Critical Slope | 0.02796 | ft/ft |
| Velocity | 6.75 | ft/s |
| Velocity Head | 0.71 | ft |
| Specific Energy | 2.42 | ft |
| Froude Number | 1.29 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.71 | ft |
| Critical Depth | 1.89 | ft |
| Channel Slope | 4.79000 | % |
| Critical Slope | 0.02796 | ft/ft |

# X-Section for Channel Adj. to Accel. Lane - Sta. "C" 109+90-100 year

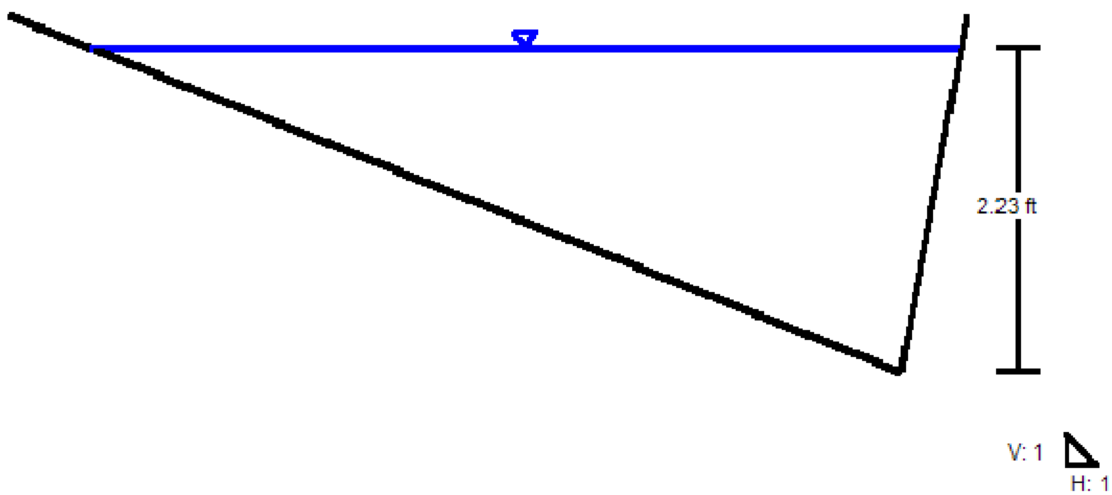
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.035 | |
| Channel Slope | 4.79000 | % |
| Normal Depth | 2.23 | ft |
| Left Side Slope | 2.50 | ft/ft (H:V) |
| Right Side Slope | 0.19 | ft/ft (H:V) |
| Discharge | 53.81 | ft³/s |

## Cross Section Image



# Report for Channel Adj. to Accel. Lane - Sta. "C" 109+90-100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.035 | |
| Channel Slope | 4.79000 | % |
| Left Side Slope | 2.50 | ft/ft (H:V) |
| Right Side Slope | 0.19 | ft/ft (H:V) |
| Discharge | 53.81 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 2.23 | ft |
| Flow Area | 6.68 | $ft^2$ |
| Wetted Perimeter | 8.27 | ft |
| Hydraulic Radius | 0.81 | ft |
| Top Width | 5.99 | ft |
| Critical Depth | 2.51 | ft |
| Critical Slope | 0.02545 | ft/ft |
| Velocity | 8.06 | ft/s |
| Velocity Head | 1.01 | ft |
| Specific Energy | 3.24 | ft |
| Froude Number | 1.35 | |
| Flow Type | Supercritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 2.23 | ft |
| Critical Depth | 2.51 | ft |
| Channel Slope | 4.79000 | % |
| Critical Slope | 0.02545 | ft/ft |

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 6 STATION "C" 107+75 CHANNEL (UPSTREAM OF PROPOSED 36-INCH DIAMETER RCP AT MH-1)

Flow line elevation upstream at Station "C" 107+75 = 4550.44

Existing elevation of center of travel lane adjacent to channel (feet) = 4552.06

Estimated 25-year storm flow peak runoff (cfs) = 27.46

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4552.04

Estimated 100-year storm flow peak runoff (cfs) = 55.10

Calculated water surface elevation in channel for 100-year peak runoff (feet) =4552.25

# X-Section for Channel Adj. to Pyramid Hwy-Sta. "C" 107+75-25 year

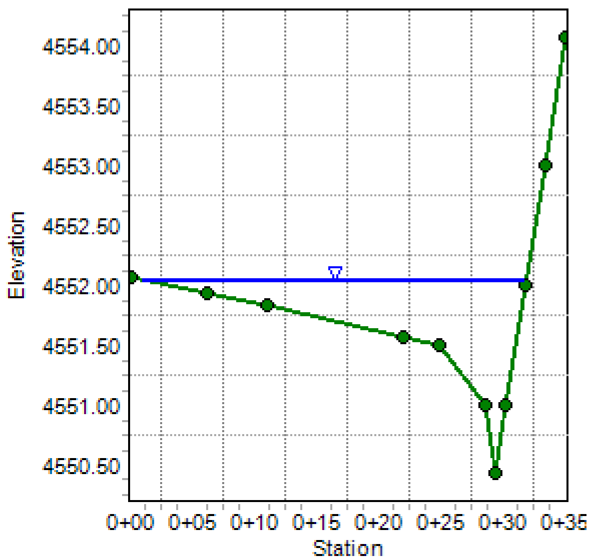
## Project Description

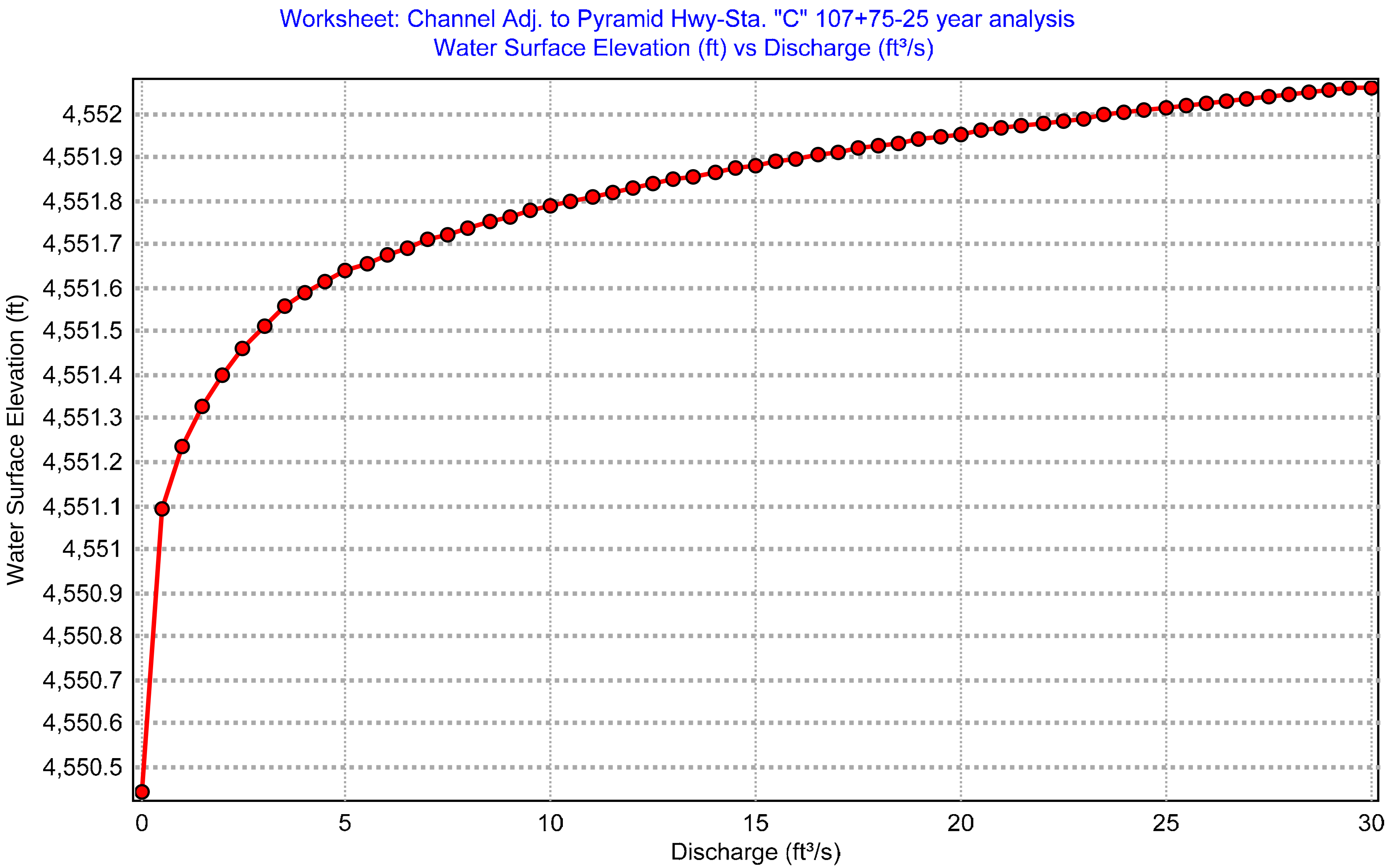
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.70000 | % |
| Normal Depth | 1.60 | ft |
| Discharge | 27.46 | $ft^3/s$ |

## Cross Section Image




Worksheet: Channel Adj. to Pyramid Hwy-Sta. "C" 107+75-25 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,552
4,551.9
4,551.8
4,551.7
4,551.6
4,551.5
4,551.4
4,551.3
4,551.2
4,551.1
4,551
4,550.9
4,550.8
4,550.7
4,550.6
4,550.5
0
5
10
15
20
25
30
Discharge (ft³/s)

# Report for Channel Adj. to Pyramid Hwy-Sta. "C" 107+75-25 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.70000 | % |
| Discharge | 27.46 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4552.06 |
| 0+06 | 4551.93 |
| 0+11 | 4551.83 |
| 0+22 | 4551.56 |
| 0+25 | 4551.50 |
| 0+28 | 4551.00 |
| 0+29 | 4550.44 |
| 0+30 | 4551.00 |
| 0+32 | 4552.00 |
| 0+33 | 4553.00 |
| 0+35 | 4554.06 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4552.06) | (0+06, 4551.93) | 0.013 |
| (0+06, 4551.93) | (0+11, 4551.83) | 0.013 |
| (0+11, 4551.83) | (0+22, 4551.56) | 0.013 |
| (0+22, 4551.56) | (0+25, 4551.50) | 0.013 |
| (0+25, 4551.50) | (0+28, 4551.00) | 0.035 |
| (0+28, 4551.00) | (0+29, 4550.44) | 0.069 |
| (0+29, 4550.44) | (0+30, 4551.00) | 0.069 |
| (0+30, 4551.00) | (0+32, 4552.00) | 0.069 |
| (0+32, 4552.00) | (0+33, 4553.00) | 0.069 |
| (0+33, 4553.00) | (0+35, 4554.06) | 0.069 |

# Report for Channel Adj. to Pyramid Hwy-Sta. "C" 107+75-25 year

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.60 | ft |
| Elevation Range | 4550.44 to 4554.06 ft | | |
| Flow Area | | 12.21 | ft² |
| Wetted Perimeter | | 31.42 | ft |
| Hydraulic Radius | | 0.39 | ft |
| Top Width | | 30.73 | ft |
| Normal Depth | | 1.60 | ft |
| Critical Depth | | 1.45 | ft |
| Critical Slope | | 0.01858 | ft/ft |
| Velocity | | 2.25 | ft/s |
| Velocity Head | | 0.08 | ft |
| Specific Energy | | 1.68 | ft |
| Froude Number | | 0.63 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.60 | ft |
| Critical Depth | 1.45 | ft |
| Channel Slope | 0.70000 | % |
| Critical Slope | 0.01858 | ft/ft |

## Messages

Notes

# Report for Channel Adj. to Pyramid Hwy-Sta. "C" 107+75-25 year

## Messages

Calculated Water Surface Elevation in Channel: 4552.04 feet

# X-Section for Channel Adj. to Pyramid Hwy-Sta. "C" 107+75-100 year

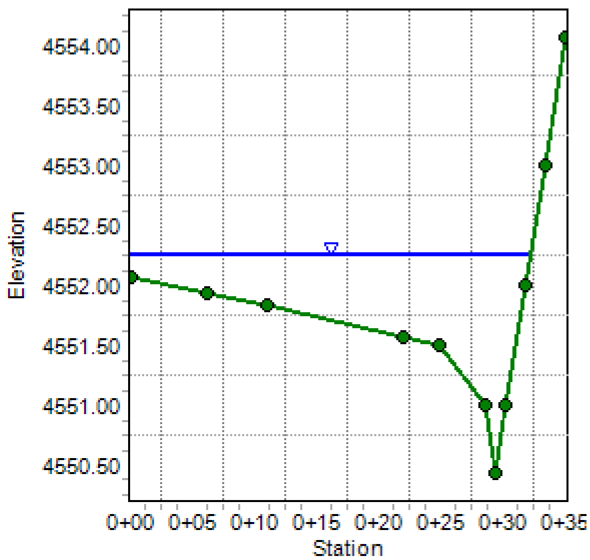
## Project Description

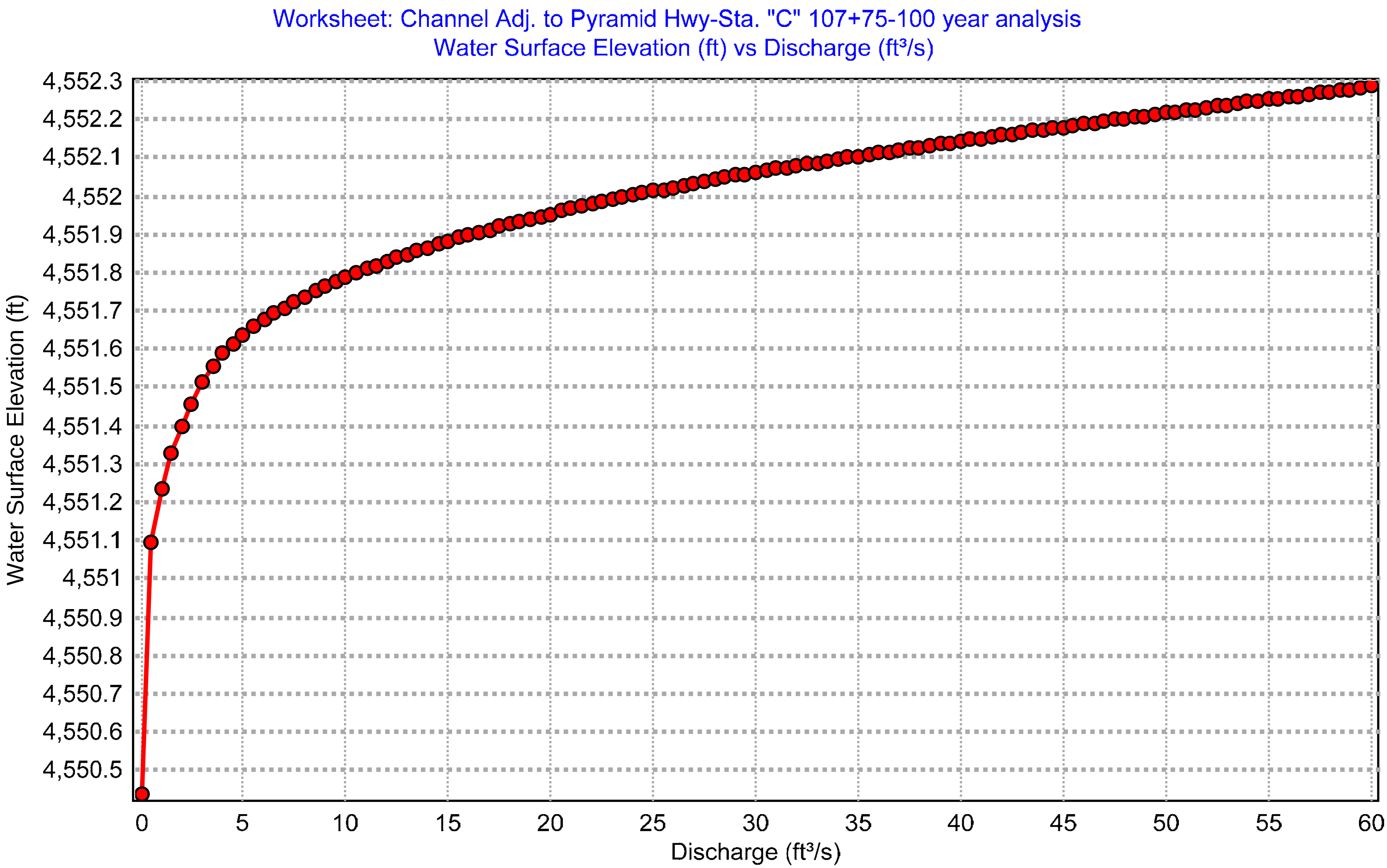
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.70000 | % |
| Normal Depth | 1.81 | ft |
| Discharge | 55.10 | $ft^3/s$ |

## Cross Section Image





Worksheet: Channel Adj. to Pyramid Hwy-Sta. "C" 107+75-100 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,552.3
4,552.2
4,552.1
4,552
4,551.9
4,551.8
4,551.7
4,551.6
4,551.5
4,551.4
4,551.3
4,551.2
4,551.1
4,551
4,550.9
4,550.8
4,550.7
4,550.6
4,550.5
0
5
10
15
20
25
30
35
40
45
50
55
60
Discharge (ft³/s)

# Report for Channel Adj. to Pyramid Hwy-Sta. "C" 107+75-100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.70000 | % |
| Discharge | 55.10 | $ft^3/s$ |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4552.06 |
| 0+06 | 4551.93 |
| 0+11 | 4551.83 |
| 0+22 | 4551.56 |
| 0+25 | 4551.50 |
| 0+28 | 4551.00 |
| 0+29 | 4550.44 |
| 0+30 | 4551.00 |
| 0+32 | 4552.00 |
| 0+33 | 4553.00 |
| 0+35 | 4554.06 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4552.06) | (0+06, 4551.93) | 0.013 |
| (0+06, 4551.93) | (0+11, 4551.83) | 0.013 |
| (0+11, 4551.83) | (0+22, 4551.56) | 0.013 |
| (0+22, 4551.56) | (0+25, 4551.50) | 0.013 |
| (0+25, 4551.50) | (0+28, 4551.00) | 0.035 |
| (0+28, 4551.00) | (0+29, 4550.44) | 0.069 |
| (0+29, 4550.44) | (0+30, 4551.00) | 0.069 |
| (0+30, 4551.00) | (0+32, 4552.00) | 0.069 |
| (0+32, 4552.00) | (0+33, 4553.00) | 0.069 |
| (0+33, 4553.00) | (0+35, 4554.06) | 0.069 |

# Report for Channel Adj. to Pyramid Hwy-Sta. "C" 107+75-100 year

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.81 | ft |
| Elevation Range | 4550.44 to 4554.06 ft | | |
| Flow Area | | 19.05 | ft² |
| Wetted Perimeter | | 33.04 | ft |
| Hydraulic Radius | | 0.58 | ft |
| Top Width | | 32.10 | ft |
| Normal Depth | | 1.81 | ft |
| Critical Depth | | 1.67 | ft |
| Critical Slope | | 0.01737 | ft/ft |
| Velocity | | 2.89 | ft/s |
| Velocity Head | | 0.13 | ft |
| Specific Energy | | 1.94 | ft |
| Froude Number | | 0.66 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.81 | ft |
| Critical Depth | 1.67 | ft |
| Channel Slope | 0.70000 | % |
| Critical Slope | 0.01737 | ft/ft |

## Messages

Notes

## Report for Channel Adj. to Pyramid Hwy-Sta. "C" 107+75-100 year

### Messages

Calculated Water Surface Elevation in Channel:  4552.25 feet

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 7 ANALYSIS OF PROPOSED 36-INCH RCP CULVERT AT PROPOSED MH-1, TYPE 4 STATION "C" 105+00

Headwater depth elevation – 25 year peak runoff (feet) = 4549.16

Headwater depth elevation – 100 year peak runoff (feet) = 4551.24

Tailwater depth elevation – 25 year peak runoff (feet) = 2.02

Tailwater depth elevation – 100 year peak runoff (feet) = 2.98

Existing elevation of center of travel lane adjacent to inlet (feet) = 4549.39

Estimated 25-Year storm flow peak runoff (cfs) = 27.46

Estimated 100-Year storm flow peak runoff (cfs) = 55.10

CulvertPro

Main Hydraulics Rational Method SCS Method Culvert Length Tailwater

**Culvert Hydraulics** **US Units | SI Units** **Information Panel**

Culvert Shape: Round
Diameter: 36 inches

Inputs - Diagram

Culvert Length: 11 ft
Flow: 27.46 $ft^3/s$
Tailwater Depth: 2.02 ft

Upstream Invert Elevation: 4546.0C ft
Downstream Invert Elevation: 4545.27 ft
Culvert Burial: 1.5 ft
Manning's n of Culvert: 0.013
Entrance Loss Coefficient: 0.5
End Section: Conforming to Slope

Manning's n table
Entrance Loss Coefficients

Calculate

**Results**

Headwater = 4549.16 ft
Upstream Velocity = 3.88 ft/s
Downstream Velocity = 3.88 ft/s

Flow Profile = S1f
Inlet Control Headwater = 4548.56 ft
Outlet Control Headwater = 4549.16 ft
Normal Depth = 0.811 ft
Critical Depth = 1.69 ft
View Report

# Culvert Hydraulics Report

**Inputs**

Flow: 27.46 ft$^3$/s
Channel Flow Depth: 2.02 ft

Upstream Invert: 4546 ft
Downstream Invert: 4545.27 ft
Burial: 1.5 ft
Culvert Length: 11 ft

**Basic Outputs**

Normal Depth: 0.811 ft
Critical Depth: 1.69 ft

Flow Classification: S1f

**Gradually Varied Flow Analysis Results**

Upstream Velocity Head: 0.234 ft
Entrance Loss: 0.117 ft

Upstream Depth: ft
Inlet Velocity: 3.88 ft/s

Downstream Depth: ft
Outlet Velocity: 3.88 ft/s

Headwater: 4549.16 ft

# X-Section for 42" ADS N-12WT IB Pipe - 25 year analysis

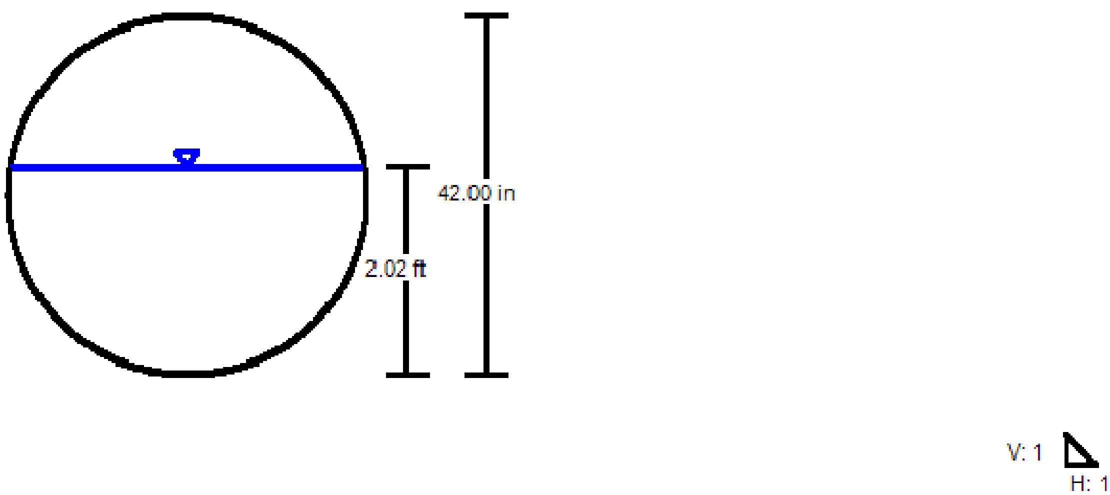
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.012 | |
| Channel Slope | 1.80000 | % |
| Normal Depth | 2.02 | ft |
| Diameter | 42.00 | in |
| Discharge | 92.20 | ft³/s |

## Cross Section Image



# Report for 42" ADS N-12WT IB Pipe - 25 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.012 | |
| Channel Slope | 1.80000 | % |
| Diameter | 42.00 | in |
| Discharge | 92.20 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 2.02 | ft |
| Flow Area | 5.74 | ft² |
| Wetted Perimeter | 6.03 | ft |
| Hydraulic Radius | 0.95 | ft |
| Top Width | 3.46 | ft |
| Critical Depth | 2.97 | ft |
| Percent Full | 57.6 | % |
| Critical Slope | 0.00674 | ft/ft |
| Velocity | 16.07 | ft/s |
| Velocity Head | 4.01 | ft |
| Specific Energy | 6.03 | ft |
| Froude Number | 2.20 | |
| Maximum Discharge | 157.29 | ft³/s |
| Discharge Full | 146.22 | ft³/s |
| Slope Full | 0.00716 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 57.60 | % |
| Downstream Velocity | Infinity | ft/s |

# Report for 42" ADS N-12WT IB Pipe - 25 year analysis

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 2.02 | ft |
| Critical Depth | 2.97 | ft |
| Channel Slope | 1.80000 | % |
| Critical Slope | 0.00674 | ft/ft |

CulvertPro

Main Hydraulics Rational Method SCS Method Culvert Length Tailwater

**Culvert Hydraulics**

**US Units | SI Units**

**Information Panel**

Culvert Shape: Round
Diameter: 36 inches

Culvert Length: 11 ft
Flow: 55.10 $ft^3/s$
Tailwater Depth: 2.98 ft

Upstream Invert Elevation: 4546.0C ft
Downstream Invert Elevation: 4545.27 ft
Culvert Burial: 1.5 ft
Manning's n of Culvert: 0.013
Entrance Loss Coefficient: 0.5
End Section: Conforming to Slope

Calculate

Inputs - Diagram

Manning's n table
Entrance Loss Coefficients

**Results**

Headwater = 4551.24 ft
Upstream Velocity = 7.8 ft/s
Downstream Velocity = 7.8 ft/s

Flow Profile = S1f
Inlet Control Headwater = 4550.904 ft
Outlet Control Headwater = 4551.24 ft
Normal Depth = 1.17 ft
Critical Depth = 2.41 ft
View Report

# Culvert Hydraulics Report

**Inputs**

Flow: 50.1 $ft^3/s$
Channel Flow Depth: 2.86 ft

Upstream Invert: 4546 ft
Downstream Invert: 4545.27 ft
Burial: 1.5 ft
Culvert Length: 11 ft

**Basic Outputs**

Normal Depth: 1.11 ft
Critical Depth: 2.3 ft

Flow Classification: S1f

**Gradually Varied Flow Analysis Results**

Upstream Velocity Head: 0.78 ft
Entrance Loss: 0.39 ft

Upstream Depth: ft
Inlet Velocity: 7.09 ft/s

Downstream Depth: ft
Outlet Velocity: 7.09 ft/s

Headwater: 4550.862 ft

# X-Section for 42" ADS N-12WT IB Pipe - 100 year analysis

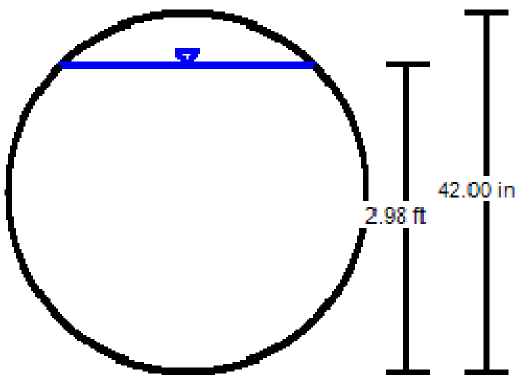
## Project Description

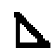
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.012 | |
| Channel Slope | 1.80000 | % |
| Normal Depth | 2.98 | ft |
| Diameter | 42.00 | in |
| Discharge | 150.77 | ft³/s |

## Cross Section Image



# Report for 42" ADS N-12WT IB Pipe - 100 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.012 | |
| Channel Slope | 1.80000 | % |
| Diameter | 42.00 | in |
| Discharge | 150.77 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 2.98 | ft |
| Flow Area | 8.72 | ft² |
| Wetted Perimeter | 8.22 | ft |
| Hydraulic Radius | 1.06 | ft |
| Top Width | 2.49 | ft |
| Critical Depth | 3.39 | ft |
| Percent Full | 85.1 | % |
| Critical Slope | 0.01681 | ft/ft |
| Velocity | 17.28 | ft/s |
| Velocity Head | 4.64 | ft |
| Specific Energy | 7.62 | ft |
| Froude Number | 1.63 | |
| Maximum Discharge | 157.29 | ft³/s |
| Discharge Full | 146.22 | ft³/s |
| Slope Full | 0.01914 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 85.08 | % |
| Downstream Velocity | Infinity | ft/s |

# Report for 42" ADS N-12WT IB Pipe - 100 year analysis

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 2.98 | ft |
| Critical Depth | 3.39 | ft |
| Channel Slope | 1.80000 | % |
| Critical Slope | 0.01681 | ft/ft |

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 8 STATION “C” 101+60 – CHANNEL ADJACENT TO PYRAMID HIGHWAY ACCELERATION LANE

Flow line elevation at Station “C” 101+60 = 4543.39

Existing elevation of center of travel lane adjacent to channel (feet) = 4544.04

Estimated 25-year storm flow peak runoff (cfs) = 2.18

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4543.63

Estimated 100-year storm flow peak runoff (cfs) = 3.22

Calculated water surface elevation in channel for 100-year peak runoff (feet) = 4543.66

# X-Section for Channel Adj. to Pyramid Hwy-Sta. "C"101+60 - 25 year

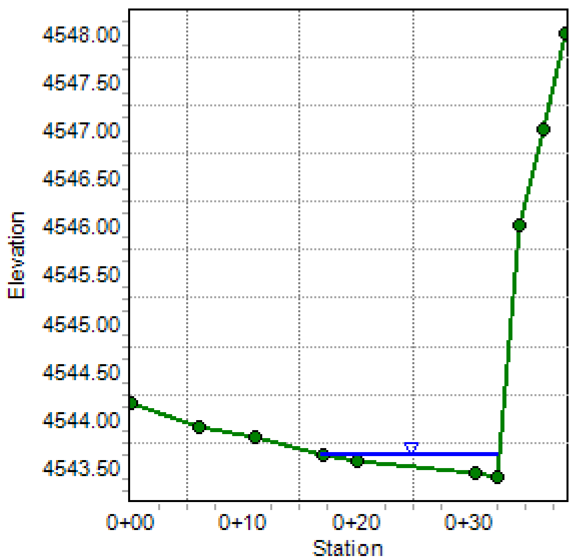
## Project Description

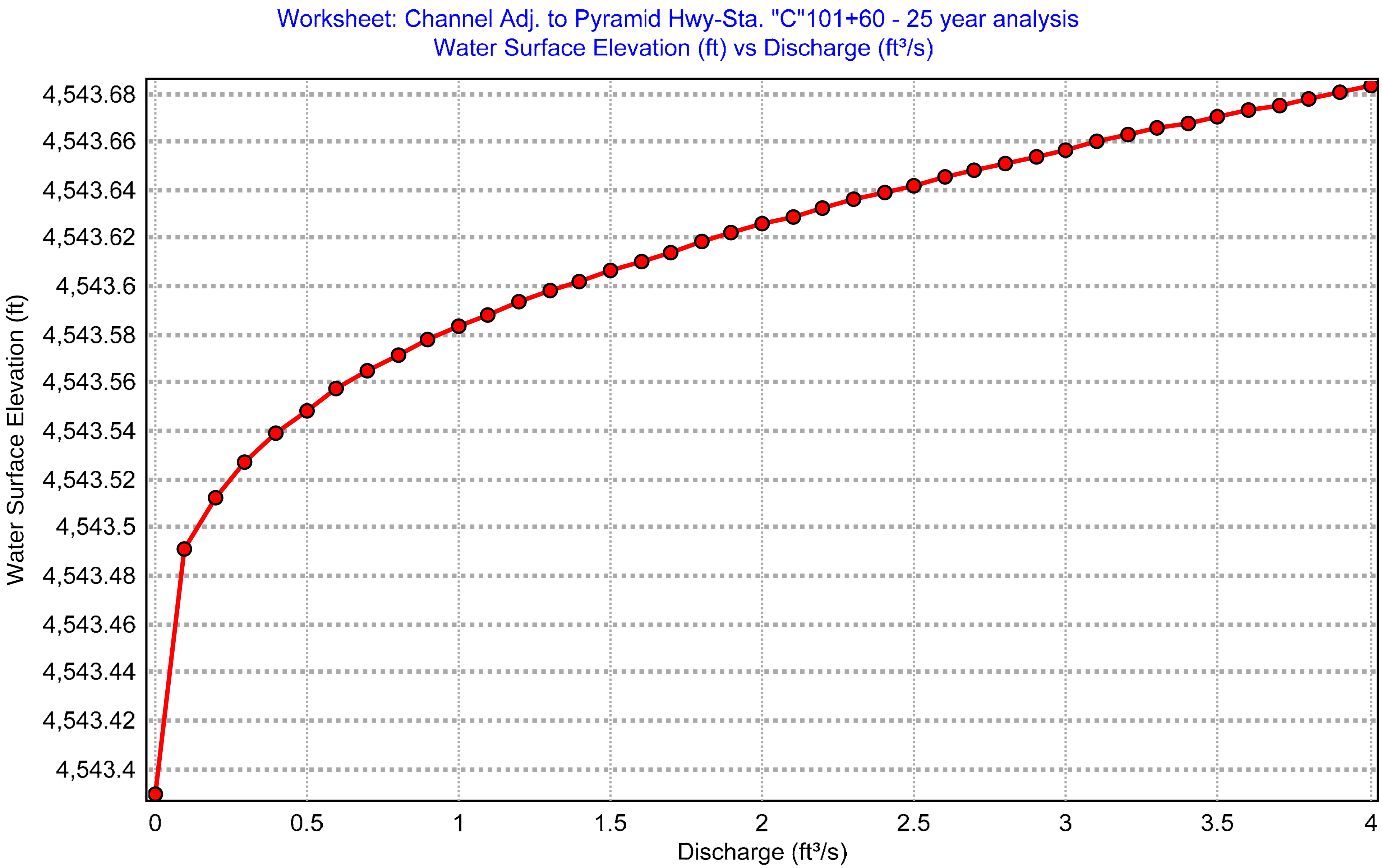
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Normal Depth | 0.24 | ft |
| Discharge | 2.18 | $ft^3/s$ |

## Cross Section Image




Worksheet: Channel Adj. to Pyramid Hwy-Sta. "C"101+60 - 25 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,543.68
4,543.66
4,543.64
4,543.62
4,543.6
4,543.58
4,543.56
4,543.54
4,543.52
4,543.5
4,543.48
4,543.46
4,543.44
4,543.42
4,543.4
0
0.5
1
1.5
2
2.5
3
3.5
4
Discharge (ft³/s)

# Report for Channel Adj. to Pyramid Hwy-Sta. "C"101+60 - 25 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Discharge | 2.18 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4544.17 |
| 0+06 | 4543.92 |
| 0+11 | 4543.82 |
| 0+17 | 4543.63 |
| 0+20 | 4543.57 |
| 0+30 | 4543.45 |
| 0+32 | 4543.39 |
| 0+34 | 4546.00 |
| 0+36 | 4547.00 |
| 0+38 | 4548.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4544.17) | (0+06, 4543.92) | 0.013 |
| (0+06, 4543.92) | (0+11, 4543.82) | 0.013 |
| (0+11, 4543.82) | (0+17, 4543.63) | 0.013 |
| (0+17, 4543.63) | (0+20, 4543.57) | 0.013 |
| (0+20, 4543.57) | (0+30, 4543.45) | 0.035 |
| (0+30, 4543.45) | (0+32, 4543.39) | 0.069 |
| (0+32, 4543.39) | (0+34, 4546.00) | 0.069 |
| (0+34, 4546.00) | (0+36, 4547.00) | 0.069 |
| (0+36, 4547.00) | (0+38, 4548.00) | 0.069 |

# Report for Channel Adj. to Pyramid Hwy-Sta. "C"101+60 - 25 year

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.24 | ft |
| Elevation Range | 4543.39 to 4548.00 ft | |
| Flow Area | 1.81 | ft² |
| Wetted Perimeter | 15.81 | ft |
| Hydraulic Radius | 0.11 | ft |
| Top Width | 15.69 | ft |
| Normal Depth | 0.24 | ft |
| Critical Depth | 0.20 | ft |
| Critical Slope | 0.05021 | ft/ft |
| Velocity | 1.20 | ft/s |
| Velocity Head | 0.02 | ft |
| Specific Energy | 0.26 | ft |
| Froude Number | 0.62 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.24 | ft |
| Critical Depth | 0.20 | ft |
| Channel Slope | 1.80000 | % |
| Critical Slope | 0.05021 | ft/ft |

## Messages

Notes

# Report for Channel Adj. to Pyramid Hwy-Sta. "C"101+60 - 25 year

## Messages

Calculated Water Surface Elevation in Channel: 4543.63 feet

# X-Section for Channel Adj. to Pyramid Hwy-Sta."C"101+60 - 100 year

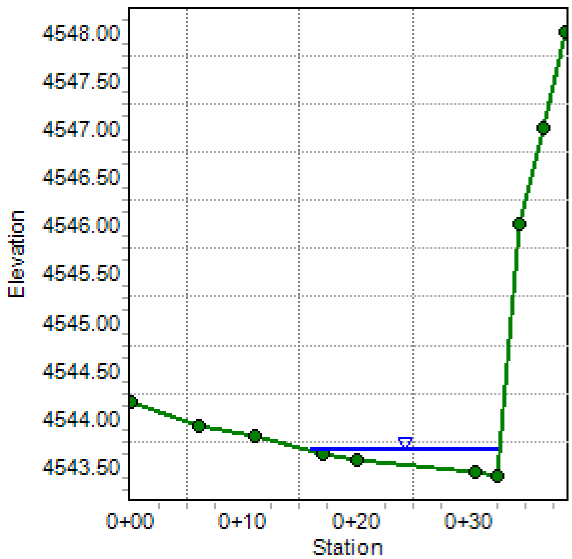
## Project Description

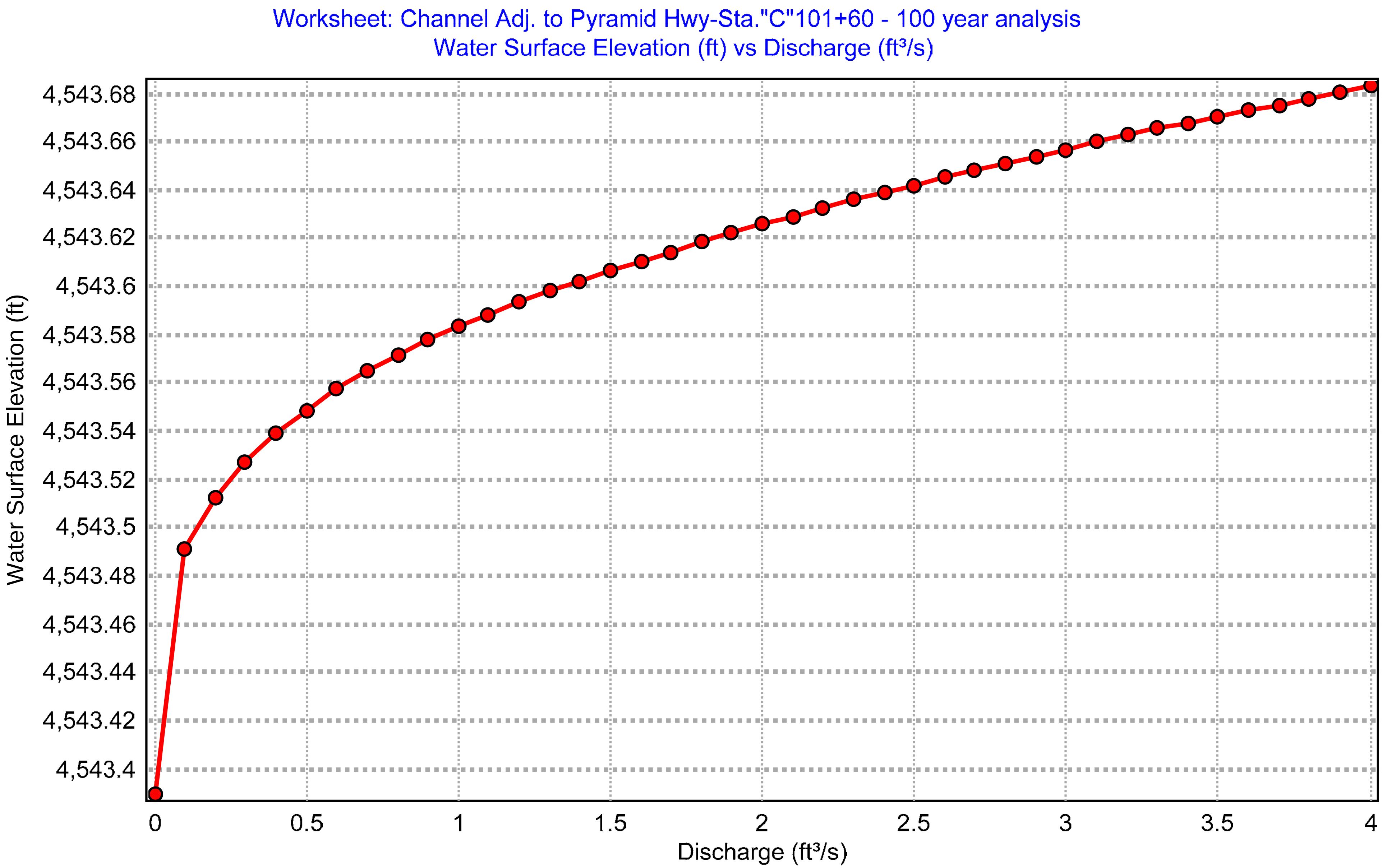
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Normal Depth | 0.27 | ft |
| Discharge | 3.22 | $ft^3/s$ |

## Cross Section Image





Worksheet: Channel Adj. to Pyramid Hwy-Sta."C"101+60 - 100 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
Discharge (ft³/s)
4,543.68
4,543.66
4,543.64
4,543.62
4,543.6
4,543.58
4,543.56
4,543.54
4,543.52
4,543.5
4,543.48
4,543.46
4,543.44
4,543.42
4,543.4
0
0.5
1
1.5
2
2.5
3
3.5
4

# Report for Channel Adj. to Pyramid Hwy-Sta."C"101+60 - 100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Discharge | 3.22 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4544.17 |
| 0+06 | 4543.92 |
| 0+11 | 4543.82 |
| 0+17 | 4543.63 |
| 0+20 | 4543.57 |
| 0+30 | 4543.45 |
| 0+32 | 4543.39 |
| 0+34 | 4546.00 |
| 0+36 | 4547.00 |
| 0+38 | 4548.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4544.17) | (0+06, 4543.92) | 0.013 |
| (0+06, 4543.92) | (0+11, 4543.82) | 0.013 |
| (0+11, 4543.82) | (0+17, 4543.63) | 0.013 |
| (0+17, 4543.63) | (0+20, 4543.57) | 0.013 |
| (0+20, 4543.57) | (0+30, 4543.45) | 0.035 |
| (0+30, 4543.45) | (0+32, 4543.39) | 0.069 |
| (0+32, 4543.39) | (0+34, 4546.00) | 0.069 |
| (0+34, 4546.00) | (0+36, 4547.00) | 0.069 |
| (0+36, 4547.00) | (0+38, 4548.00) | 0.069 |

# Report for Channel Adj. to Pyramid Hwy-Sta."C"101+60 - 100 year

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 0.27 | ft |
| Elevation Range | 4543.39 to 4548.00 ft | | |
| Flow Area | | 2.32 | ft² |
| Wetted Perimeter | | 16.82 | ft |
| Hydraulic Radius | | 0.14 | ft |
| Top Width | | 16.69 | ft |
| Normal Depth | | 0.27 | ft |
| Critical Depth | | 0.23 | ft |
| Critical Slope | | 0.04489 | ft/ft |
| Velocity | | 1.39 | ft/s |
| Velocity Head | | 0.03 | ft |
| Specific Energy | | 0.30 | ft |
| Froude Number | | 0.66 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.27 | ft |
| Critical Depth | 0.23 | ft |
| Channel Slope | 1.80000 | % |
| Critical Slope | 0.04489 | ft/ft |

## Messages

Notes

# Report for Channel Adj. to Pyramid Hwy-Sta."C"101+60 - 100 year

## Messages

Calculated Water Surface Elevation in Channel: 4543.66 feet

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 9 STATION "C" 95+60 – CHANNEL ADJACENT TO PYRAMID HIGHWAY ACCELERATION LANE

Flow line elevation at Station "C" 95+60 = 4531.67

Existing elevation of center of travel lane adjacent to channel (feet) = 4532.16

Estimated 25-year storm flow peak runoff (cfs) = 2.18

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4531.87

Estimated 100-year storm flow peak runoff (cfs) = 3.22

Calculated water surface elevation in channel for 100-year peak runoff (feet) = 4531.90

# X-Section for Channel Adj. to Pyramid Hwy-Sta. "C"95+60 - 25 year

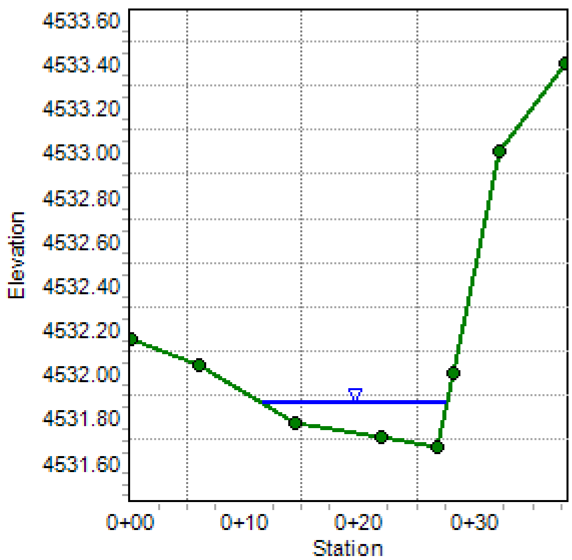
## Project Description

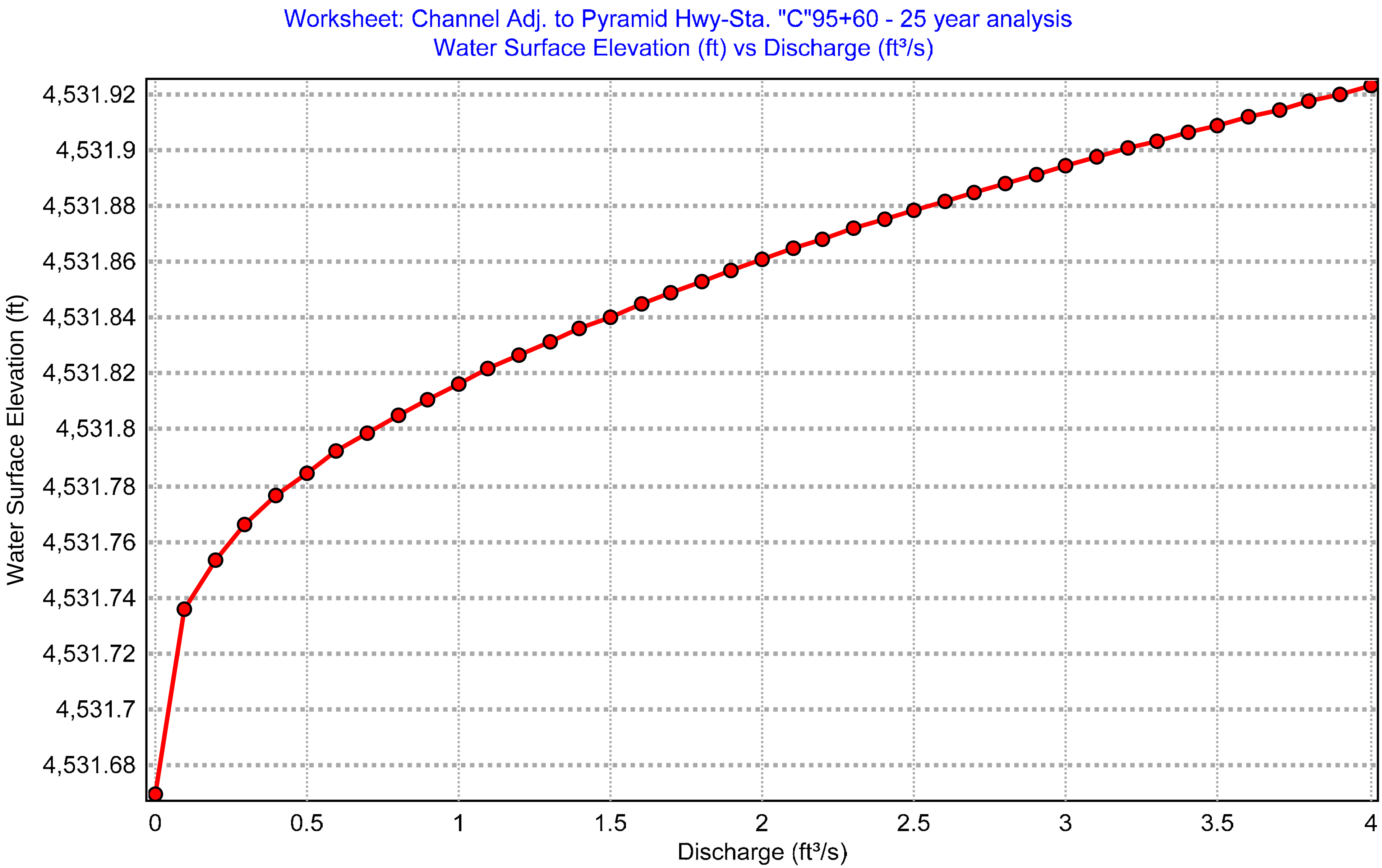
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Normal Depth | 0.20 | ft |
| Discharge | 2.18 | $ft^3/s$ |

## Cross Section Image




Worksheet: Channel Adj. to Pyramid Hwy-Sta. "C"95+60 - 25 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,531.92
4,531.9
4,531.88
4,531.86
4,531.84
4,531.82
4,531.8
4,531.78
4,531.76
4,531.74
4,531.72
4,531.7
4,531.68
0
0.5
1
1.5
2
2.5
3
3.5
4
Discharge (ft³/s)

# Report for Channel Adj. to Pyramid Hwy-Sta. "C"95+60 - 25 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Discharge | 2.18 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4532.16 |
| 0+06 | 4532.04 |
| 0+14 | 4531.78 |
| 0+22 | 4531.71 |
| 0+27 | 4531.67 |
| 0+28 | 4532.00 |
| 0+32 | 4533.00 |
| 0+38 | 4533.40 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4532.16) | (0+06, 4532.04) | 0.013 |
| (0+06, 4532.04) | (0+14, 4531.78) | 0.013 |
| (0+14, 4531.78) | (0+22, 4531.71) | 0.035 |
| (0+22, 4531.71) | (0+27, 4531.67) | 0.069 |
| (0+27, 4531.67) | (0+28, 4532.00) | 0.069 |
| (0+28, 4532.00) | (0+32, 4533.00) | 0.035 |
| (0+32, 4533.00) | (0+38, 4533.40) | 0.035 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

# Report for Channel Adj. to Pyramid Hwy-Sta. "C"95+60 - 25 year

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 0.20 | ft |
| Elevation Range | 4531.67 to 4533.40 ft | | |
| Flow Area | | 2.00 | ft² |
| Wetted Perimeter | | 16.12 | ft |
| Hydraulic Radius | | 0.12 | ft |
| Top Width | | 16.10 | ft |
| Normal Depth | | 0.20 | ft |
| Critical Depth | | 0.15 | ft |
| Critical Slope | | 0.07537 | ft/ft |
| Velocity | | 1.09 | ft/s |
| Velocity Head | | 0.02 | ft |
| Specific Energy | | 0.22 | ft |
| Froude Number | | 0.54 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.20 | ft |
| Critical Depth | 0.15 | ft |
| Channel Slope | 2.00000 | % |
| Critical Slope | 0.07537 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel: 4531.87 feet

# X-Section for Channel Adj. to Pyramid Hwy-Sta. "C"95+60 - 100 year

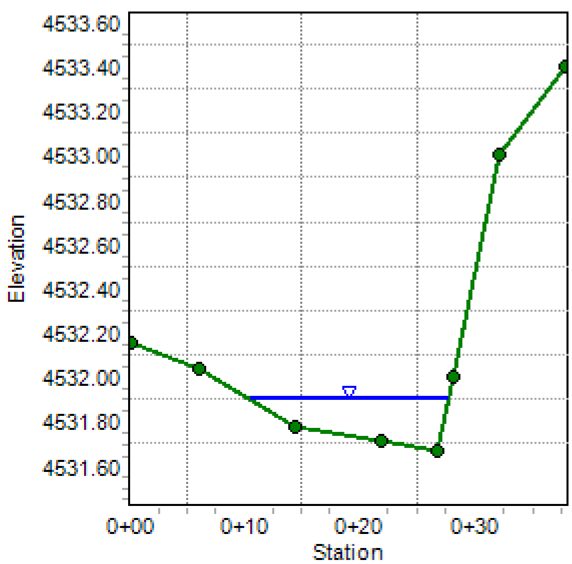
## Project Description

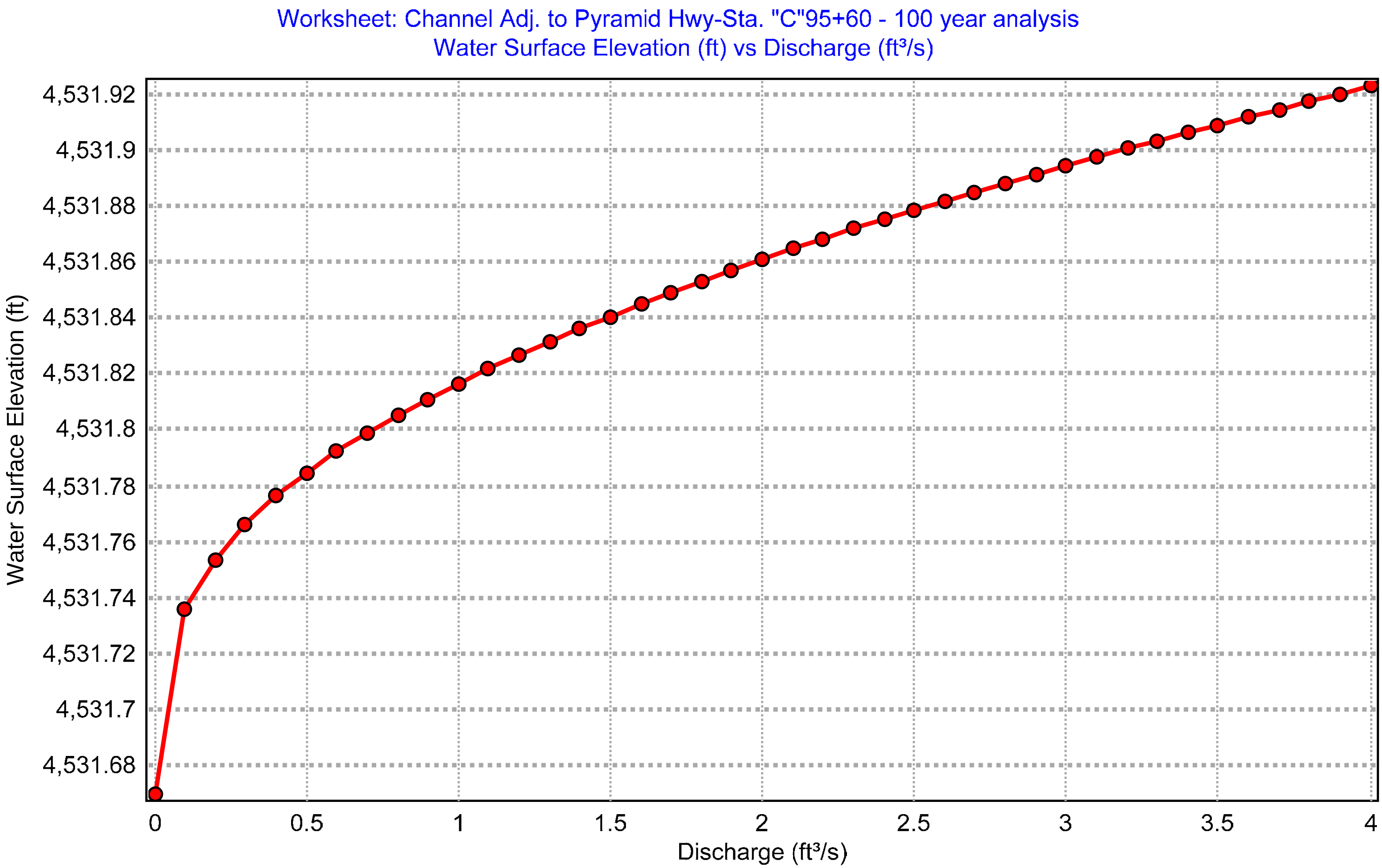
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Normal Depth | 0.23 | ft |
| Discharge | 3.22 | ft³/s |

## Cross Section Image




Worksheet: Channel Adj. to Pyramid Hwy-Sta. "C"95+60 - 100 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,531.92
4,531.9
4,531.88
4,531.86
4,531.84
4,531.82
4,531.8
4,531.78
4,531.76
4,531.74
4,531.72
4,531.7
4,531.68
0
0.5
1
1.5
2
2.5
3
3.5
4
Discharge (ft³/s)

# Report for Channel Adj. to Pyramid Hwy-Sta. "C"95+60 - 100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Discharge | 3.22 | ft³/s |
| Section Definitions | | |

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4532.16 |
| 0+06 | 4532.04 |
| 0+14 | 4531.78 |
| 0+22 | 4531.71 |
| 0+27 | 4531.67 |
| 0+28 | 4532.00 |
| 0+32 | 4533.00 |
| 0+38 | 4533.40 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4532.16) | (0+06, 4532.04) | 0.013 |
| (0+06, 4532.04) | (0+14, 4531.78) | 0.013 |
| (0+14, 4531.78) | (0+22, 4531.71) | 0.035 |
| (0+22, 4531.71) | (0+27, 4531.67) | 0.069 |
| (0+27, 4531.67) | (0+28, 4532.00) | 0.069 |
| (0+28, 4532.00) | (0+32, 4533.00) | 0.035 |
| (0+32, 4533.00) | (0+38, 4533.40) | 0.035 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

# Report for Channel Adj. to Pyramid Hwy-Sta. "C"95+60 - 100 year

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 0.23 | ft |
| Elevation Range | 4531.67 to 4533.40 ft | | |
| Flow Area | | 2.56 | ft² |
| Wetted Perimeter | | 17.33 | ft |
| Hydraulic Radius | | 0.15 | ft |
| Top Width | | 17.30 | ft |
| Normal Depth | | 0.23 | ft |
| Critical Depth | | 0.18 | ft |
| Critical Slope | | 0.06684 | ft/ft |
| Velocity | | 1.26 | ft/s |
| Velocity Head | | 0.02 | ft |
| Specific Energy | | 0.26 | ft |
| Froude Number | | 0.58 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.23 | ft |
| Critical Depth | 0.18 | ft |
| Channel Slope | 2.00000 | % |
| Critical Slope | 0.06684 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel: 4531.90 feet

# Addendum to the Drainage Report
## for
# Summit Christian Church
# Washoe County, Nevada

Prepared by:
CFA, Inc.
1150 Corporate Boulevard
Reno, NV 89502
(775) 856-1150

**July 2015**

PROFESSIONAL ENGINEER STATE OF NEVADA
LONNIE J. JOHNSON
Exp: 6-30-17
CIVIL
No. 19440

7-28-15

# RATIONAL METHOD HYDROLOGY
# CITY OF RENO IDF CURVES
# WASHOE COUNTY, NV
# SUMMIT CHRISTIAN CHURCH - PHASE 3 IMPROVEMENTS

| DESIGN POINT | DRAINAGE SUB-AREA | AREA (acres) | C 25-YR. | C 100-YR. | WATERSHED LENGTH (ft) | VELOCITY (ft/sec) | Tc (min) | INTENSITY (in/hr) 25-YR | INTENSITY (in/hr) 100-YR | PEAK RUNOFF (cfs) **25-YR** | PEAK RUNOFF (cfs) **100-YR** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **INDIVIDUAL AREAS - PROPOSED BASINS** | | | | | | | | | | | |
| SOUTH CORRIDOR (SOUTH & WEST SIDES OF SITE) | **A1** | 2.57 | 0.40 | 0.50 | 666 | 2 | 15.55 | 1.74 | 2.57 | **2.23** | **3.30** |
| | **A2** | 15.53 | 0.40 | 0.50 | 1029 | 2 | 18.57 | 1.63 | 2.40 | **12.63** | **18.65** |
| | **DETENTION POND** | --- | --- | --- | --- | --- | --- | --- | --- | **-9.86** | **21.95** |
| | **A3** | 2.04 | 0.40 | 0.50 | 443 | 2 | 13.69 | 1.85 | 2.73 | **1.89** | **2.79** |
| | **A4** | 1.30 | 0.51 | 0.60 | 531 | 2 | 14.42 | 1.81 | 2.68 | **1.40** | **2.07** |
| OUTFLOW ((A1+A2)+DETENTION POND; FOR 25 YEAR ONLY) | **S1** | **---** | | | | | | | | **5.00** | **21.95** |
| SOUTH CORRIDOR TO 36" RCP AT ~STA. "C" 110+50 at S.R. FIRE ROAD | **A5** | 2.72 | 0.50 | 0.59 | 1123 | 2 | 19.36 | 1.59 | 2.35 | **2.55** | **3.77** |
| STA. "C" 107+75 TO PROP. MH 1 - TYPE 4 AT | **A6** | 0.58 | 0.72 | 0.79 | 330 | 2 | 12.75 | 1.93 | 2.84 | **0.87** | **1.29** |
| SPRING RIDGE SUBDIVISION AT 36" RCP | **A7** | 57.80 | 0.65 | 0.78 | 1600 | 2 | 23.33 | 1.44 | 2.12 | **64.74** | **95.67** |
| DRAINAGE CHANNEL ADJACENT TO PYRAMID HIGHWAY ACCELERATION LANE - STA. "C" 94+30 - STA. "C" 105+00 | **A8** | 1.79 | 0.68 | 0.75 | 1012 | 2 | 5.00 | 2.77 | 4.09 | **3.71** | **5.48** |

## RATIONAL METHOD HYDROLOGY
## CITY OF RENO IDF CURVES
## WASHOE COUNTY, NV
## SUMMIT CHRISTIAN CHURCH - PHASE 3 IMPROVEMENTS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SOUTHWEST PARKING AREA & EX. CHURCH BUILDING - SOUTH AND WEST OF CHURCH BUILDING | **B1** | 0.36 | 0.85 | 0.87 | 243 | 2 | 12.02 | 1.96 | 2.89 | **0.62** | **0.91** |
| | **B2** | 0.21 | 0.40 | 0.50 | 188 | 2 | 11.56 | 2.00 | 2.95 | **0.21** | **0.31** |
| | **B3** | 0.95 | 0.74 | 0.80 | 263 | 2 | 12.19 | 1.96 | 2.89 | **1.49** | **2.20** |
| | **B4** | 0.57 | 0.80 | 0.86 | 210 | 2 | 11.75 | 2.00 | 2.95 | **0.97** | **1.43** |
| **TOTAL** | | **2.09** | | | | | | | | **3.29** | **4.86** |
| SOUTH SITE DRIVE AND EASTERN PARKING AREA | **C** | 1.91 | 0.84 | 0.90 | 753 | 2 | 16.28 | 1.70 | 2.51 | **2.91** | **4.30** |
| **TOTAL** | | **1.91** | | | | | | | | **2.91** | **4.30** |
| NORTHEAST CORNER OF EXISTING CHURCH BUILDING | **D1** | 0.18 | 0.85 | 0.87 | 125 | 3 | 10.70 | 2.07 | 3.06 | **0.32** | **0.47** |
| SKY BRIDGE AND SOUTH ARTERIAL AREAS | **D2** | 1.11 | 0.66 | 0.74 | 466 | 2 | 13.88 | 1.85 | 2.73 | **1.51** | **2.23** |
| PROPOSED BUILDING | **D3** | 1.04 | 0.85 | 0.87 | 150 | 3 | 10.83 | 2.07 | 3.06 | **1.87** | **2.76** |
| E. SIDE OF PROPOSED BUILDING | **D4** | 0.26 | 0.87 | 0.92 | 208 | 3 | 11.16 | 2.04 | 3.00 | **0.48** | **0.71** |
| **TOTAL** | | **2.58** | | | | | | | | **4.19** | **6.17** |
| EAST ENTRANCE & BASINS ALONG PYRAMID HIGHWAY | **E1** | 0.74 | 0.59 | 0.67 | 507 | 2 | 14.22 | 1.81 | 2.68 | **0.89** | **1.32** |
| | **E2** | 0.81 | 0.60 | 0.68 | 479 | 2 | 13.99 | 1.85 | 2.73 | **1.03** | **1.51** |
| | **E3** | 0.94 | 0.58 | 0.66 | 263 | 2 | 12.19 | 1.96 | 2.89 | **1.23** | **1.81** |
| | **E4** | 1.16 | 0.58 | 0.66 | 420 | 2 | 13.50 | 1.85 | 2.73 | **1.41** | **2.08** |
| | **E5** | 1.02 | 0.84 | 0.89 | 252 | 3 | 11.40 | 2.04 | 3.00 | **1.86** | **2.74** |
| | **E6** | 0.48 | 0.85 | 0.90 | 246 | 3 | 11.37 | 2.04 | 3.00 | **0.88** | **1.29** |
| **TOTAL** | | **5.15** | | | | | | | | **7.29** | **10.75** |

# RATIONAL METHOD HYDROLOGY
# CITY OF RENO IDF CURVES
# WASHOE COUNTY, NV
# SUMMIT CHRISTIAN CHURCH - PHASE 3 IMPROVEMENTS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STA. "C" 114+05 ON PYRAMID HIGHWAY (Sum of: B1-B4, C, D1-D2, 1/2 D3, 3/4 D4, E1-E5) | **S2** | **10.67** | | | | | | | | **15.74** | **23.23** |
| 36" RCP UNDER S. EGRESS (Sum of: S2 & A1-A4, Minus the Reduction - 25 year only) | **S3** | **32.11** | | | | | | | | **24.03** | **50.04** |
| 36" RCP AT FIRE ROAD (Sum of: S3+A5) | **S4** | **34.83** | | | | | | | | **26.59** | **53.81** |
| 36" RCP at MH-1 TIE-IN (Sum of: S4+A6) | **S5** | **35.41** | | | | | | | | **27.46** | **55.10** |
| 42" ADS Pipe in NDOT ROW (Sum of: S5+A7) | **S6** | **93.21** | | | | | | | | **92.20** | **150.77** |
| OPEN CHANNEL FLOW AT DUAL 24" CULVERTS AT SPRING RIDGE DRIVE INTERSECTION (Sum of: S6+A8) | **S7** | **95.00** | | | | | | | | **95.92** | **156.26** |

**RATIONAL METHOD HYDROLOGY**
**CITY OF RENO IDF CURVES**
**WASHOE COUNTY, NV**
**SUMMIT CHRISTIAN CHURCH - PHASE 3 IMPROVEMENTS**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NORTH SLOPE, FUTURE NORTH WEST & NORTH EAST PARKING LOT & NORTH NDOT CORRIDOR | **F1** | 0.46 | 0.56 | 0.64 | 232 | 2 | 11.93 | 2.00 | 2.95 | **0.59** | **0.87** |
| | **F2** | 0.75 | 0.53 | 0.61 | 245 | 2 | 12.04 | 1.96 | 2.89 | **0.91** | **1.34** |
| | **F3** | 0.56 | 0.46 | 0.56 | 456 | 2 | 13.80 | 1.85 | 2.73 | **0.58** | **0.85** |
| | **F4** | 0.21 | 0.88 | 0.93 | 370 | 3 | 12.06 | 1.96 | 2.89 | **0.39** | **0.57** |
| | **F5** | 0.71 | 0.81 | 0.87 | 207 | 3 | 11.15 | 2.04 | 3.00 | **1.25** | **1.84** |
| | **F6** | 0.70 | 0.85 | 0.90 | 268 | 3 | 11.49 | 2.04 | 3.00 | **1.29** | **1.90** |
| | **F7** | 0.98 | 0.81 | 0.87 | 276 | 3 | 11.53 | 2.00 | 2.95 | **1.70** | **2.51** |
| | **F8** | 0.67 | 0.75 | 0.81 | 465 | 3 | 12.58 | 1.93 | 2.84 | **1.05** | **1.55** |
| **TOTAL** | | **5.04** | | | | | | | | **7.75** | **11.43** |
| 24" RCP @ NDOT N. INGRESS ROADWAY (Sum of: 1/4 D4, 1/2 D3, E6, F1-F8) | **N1** | **6.10** | | | | | | | | **9.68** | **14.28** |
| WEST & NORTH SIDE OF NORTH CORRIDOR | **G1** | 1.49 | 0.40 | 0.50 | 736 | 2 | 16.13 | 1.70 | 2.51 | **1.27** | **1.87** |
| | **G2** | 4.31 | 0.40 | 0.50 | 709 | 2 | 15.91 | 1.74 | 2.57 | **3.75** | **5.54** |
| | **G3** | 1.26 | 0.48 | 0.57 | 359 | 2 | 12.99 | 1.93 | 2.84 | **1.40** | **2.06** |
| | **G4** | 1.84 | 0.49 | 0.58 | 929 | 2 | 17.74 | 1.66 | 2.46 | **1.77** | **2.61** |
| (Sum of G1-G4) | **N2** | **8.90** | | | | | | | | **8.18** | **12.08** |
| NDOT ROW - NORTH DECELERATION LANE | **G5** | 0.46 | 0.70 | 0.77 | 270 | 2 | 12.25 | 1.96 | 2.89 | **0.69** | **1.02** |
| | **G6** | 1.11 | 0.61 | 0.69 | 545 | 2 | 14.54 | 1.78 | 2.62 | **1.36** | **2.00** |
| **TOTAL** | **G5+G6** | **1.57** | | | | | | | | **2.05** | **3.02** |
| 36" CMP @ CROSSING ON PYRAMID HIGHWAY @ N. END (Sum of: N1+N2+G5+G6) | **N3** | **16.57** | | | | | | | | **19.91** | **29.38** |

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 6 Cross Section C-C: Station "C" 106+50 Channel (Upstream of Proposed 36-inch Diameter RCP at MH-1)

Flow line elevation at Station "C" 106+50 = 4549.48

Existing elevation of center of travel lane adjacent to channel (feet) = 4551.00

Estimated 25-year storm flow peak runoff (cfs) = 27.46

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4550.94

Estimated 100-year storm flow peak runoff (cfs) = 55.10

Calculated water surface elevation in channel for 100-year peak runoff (feet) =4551.14

# X-Section for Cross Section "C-C" at Station "C" 106+50 - 25 year

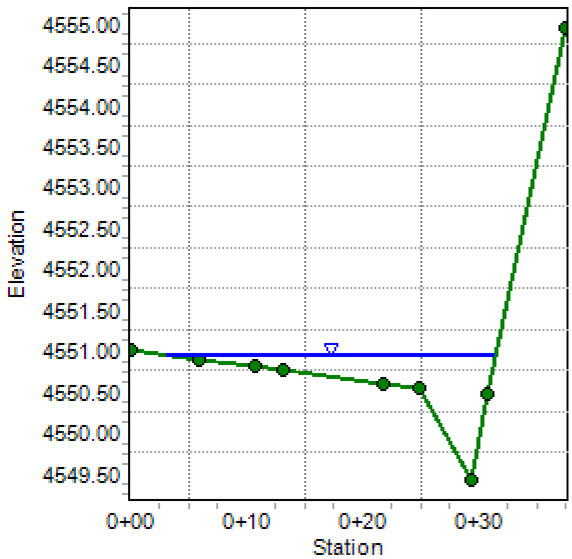
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

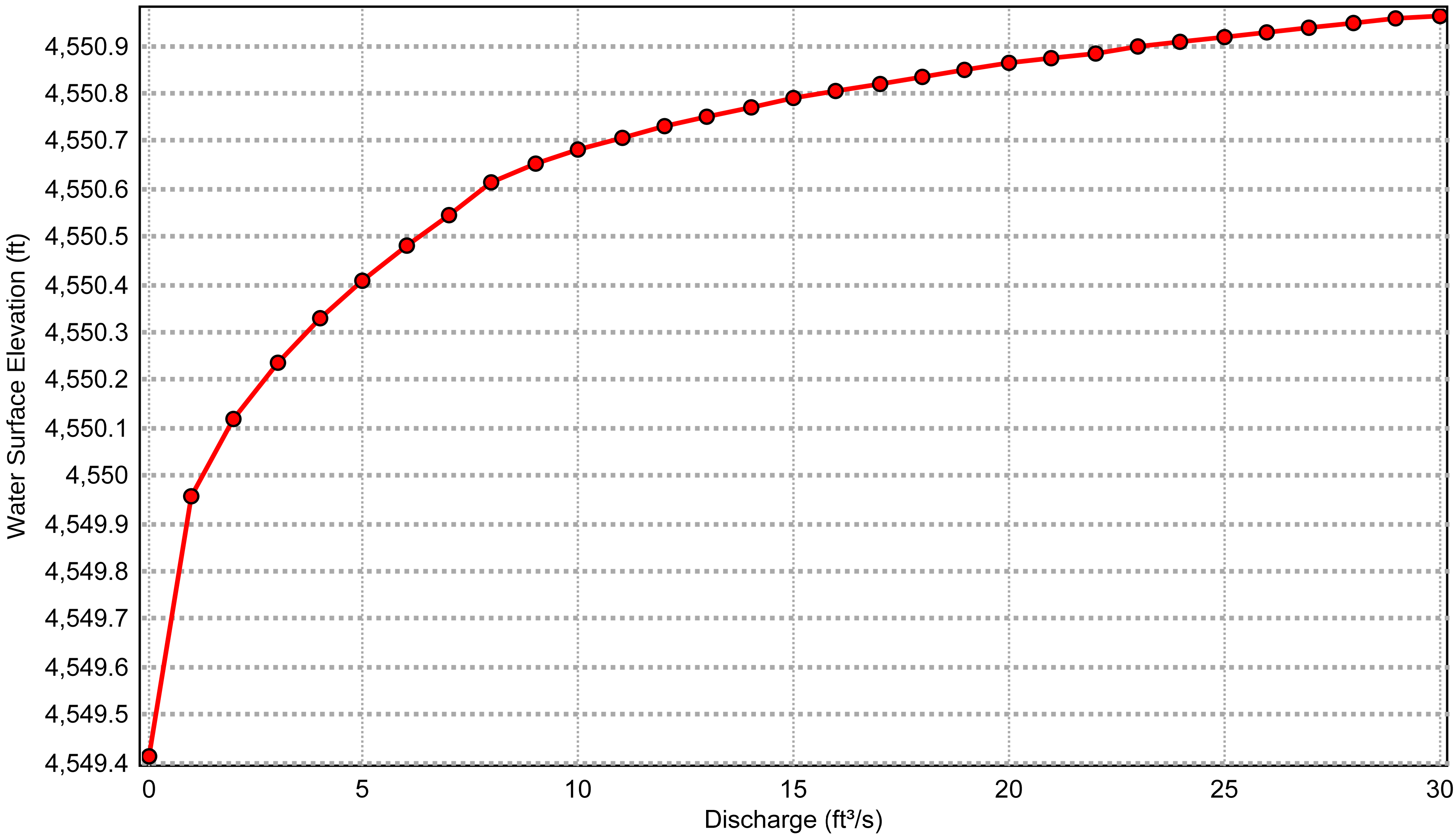
## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.00000 | % |
| Normal Depth | 1.53 | ft |
| Discharge | 27.46 | $ft^3/s$ |

## Cross Section Image



Worksheet: Cross Section "C-C" at Station "C" 106+50 - 25 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)



# Report for Cross Section "C-C" at Station "C" 106+50 - 25 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.00000 | % |
| Discharge | 27.46 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4551.00 |
| 0+06 | 4550.89 |
| 0+11 | 4550.81 |
| 0+13 | 4550.77 |
| 0+22 | 4550.60 |
| 0+25 | 4550.54 |
| 0+29 | 4549.41 |
| 0+31 | 4550.48 |
| 0+38 | 4554.95 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4551.00) | (0+06, 4550.89) | 0.013 |
| (0+06, 4550.89) | (0+11, 4550.81) | 0.013 |
| (0+11, 4550.81) | (0+13, 4550.77) | 0.013 |
| (0+13, 4550.77) | (0+22, 4550.60) | 0.013 |
| (0+22, 4550.60) | (0+25, 4550.54) | 0.013 |
| (0+25, 4550.54) | (0+29, 4549.41) | 0.035 |
| (0+29, 4549.41) | (0+31, 4550.48) | 0.069 |
| (0+31, 4550.48) | (0+38, 4554.95) | 0.069 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |

# Report for Cross Section "C-C" at Station "C" 106+50 - 25 year analysis

## Options

| | |
|---|---|
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.53 | ft |
| Elevation Range | 4549.41 to 4554.95 ft | |
| Flow Area | 10.22 | ft² |
| Wetted Perimeter | 28.97 | ft |
| Hydraulic Radius | 0.35 | ft |
| Top Width | 28.34 | ft |
| Normal Depth | 1.53 | ft |
| Critical Depth | 1.46 | ft |
| Critical Slope | 0.01638 | ft/ft |
| Velocity | 2.69 | ft/s |
| Velocity Head | 0.11 | ft |
| Specific Energy | 1.64 | ft |
| Froude Number | 0.79 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.53 | ft |
| Critical Depth | 1.46 | ft |
| Channel Slope | 1.00000 | % |
| Critical Slope | 0.01638 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel: 4550.94 feet

# X-Section for Cross Section "C-C" at Station "C" 106+50 - 100 year

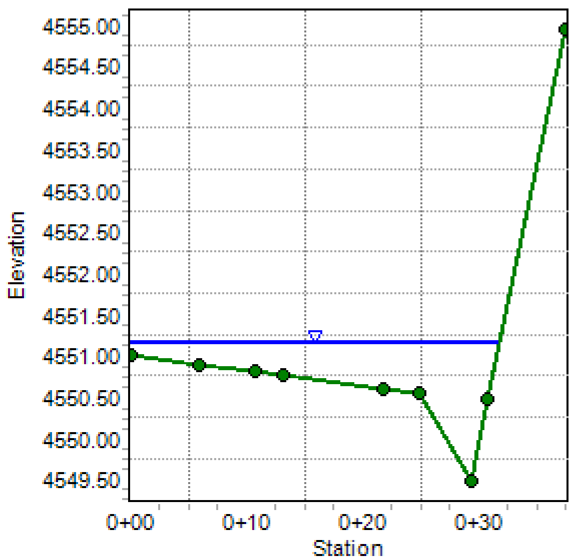
## Project Description

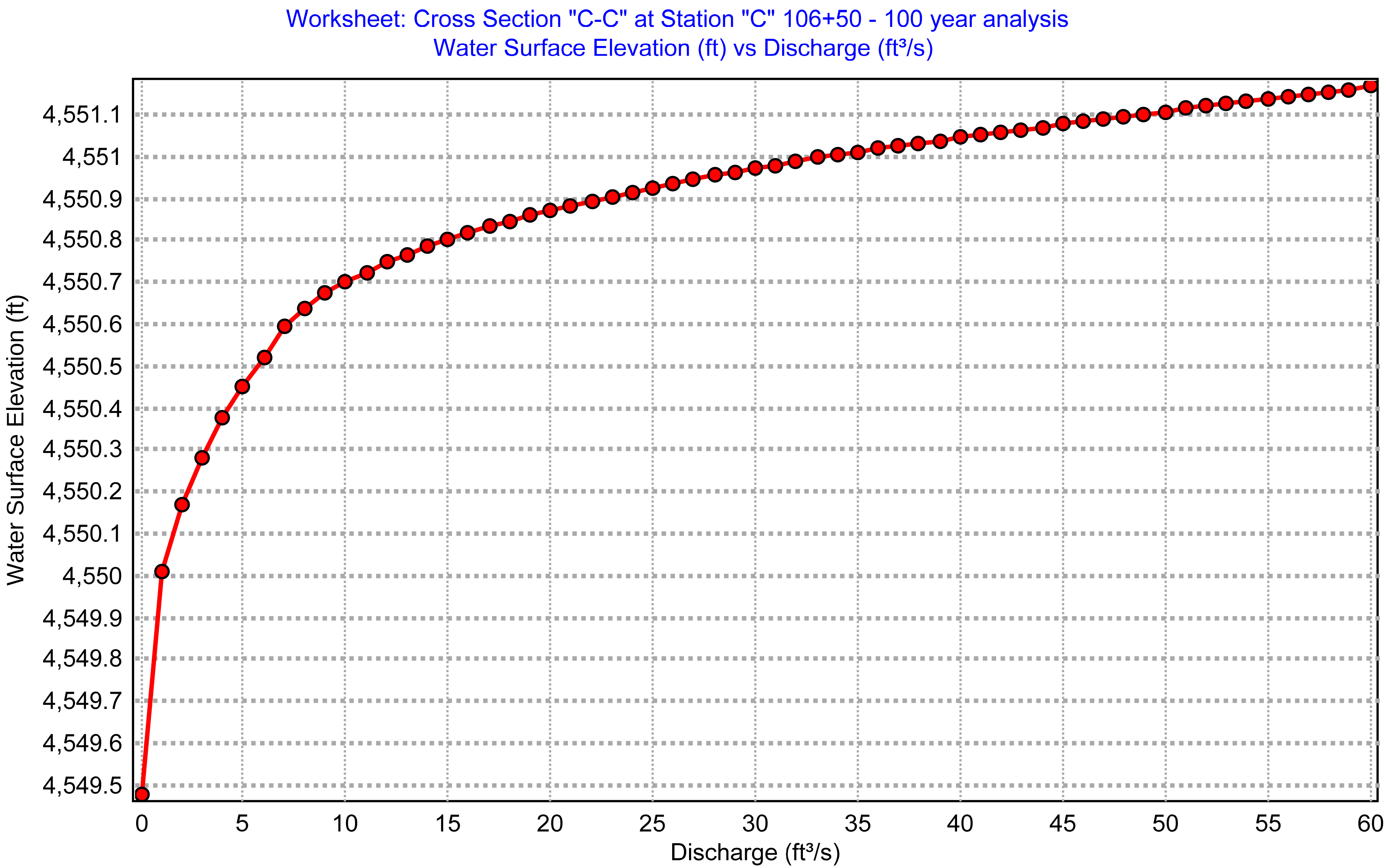
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.00000 | % |
| Normal Depth | 1.66 | ft |
| Discharge | 55.10 | ft³/s |

## Cross Section Image





Worksheet: Cross Section "C-C" at Station "C" 106+50 - 100 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,551.1
4,551
4,550.9
4,550.8
4,550.7
4,550.6
4,550.5
4,550.4
4,550.3
4,550.2
4,550.1
4,550
4,549.9
4,549.8
4,549.7
4,549.6
4,549.5
0
5
10
15
20
25
30
35
40
45
50
55
60
Discharge (ft³/s)

# Report for Cross Section "C-C" at Station "C" 106+50 - 100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.00000 | % |
| Discharge | 55.10 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4551.00 |
| 0+06 | 4550.89 |
| 0+11 | 4550.81 |
| 0+13 | 4550.77 |
| 0+22 | 4550.60 |
| 0+25 | 4550.54 |
| 0+29 | 4549.48 |
| 0+31 | 4550.48 |
| 0+38 | 4554.95 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4551.00) | (0+06, 4550.89) | 0.013 |
| (0+06, 4550.89) | (0+11, 4550.81) | 0.013 |
| (0+11, 4550.81) | (0+13, 4550.77) | 0.013 |
| (0+13, 4550.77) | (0+22, 4550.60) | 0.013 |
| (0+22, 4550.60) | (0+25, 4550.54) | 0.013 |
| (0+25, 4550.54) | (0+29, 4549.48) | 0.035 |
| (0+29, 4549.48) | (0+31, 4550.48) | 0.069 |
| (0+31, 4550.48) | (0+38, 4554.95) | 0.069 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |

# Report for Cross Section "C-C" at Station "C" 106+50 - 100 year

## Options

| | |
|---|---|
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.66 | ft |
| Elevation Range | 4549.48 to 4554.95 ft | |
| Flow Area | 16.12 | ft² |
| Wetted Perimeter | 32.57 | ft |
| Hydraulic Radius | 0.49 | ft |
| Top Width | 31.80 | ft |
| Normal Depth | 1.66 | ft |
| Critical Depth | 1.60 | ft |
| Critical Slope | 0.01443 | ft/ft |
| Velocity | 3.42 | ft/s |
| Velocity Head | 0.18 | ft |
| Specific Energy | 1.84 | ft |
| Froude Number | 0.85 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.66 | ft |
| Critical Depth | 1.60 | ft |
| Channel Slope | 1.00000 | % |
| Critical Slope | 0.01443 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel: 4551.14 feet

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 8 CROSS SECTION D-D: STATION "C" 101+52 - CHANNEL ADJACENT TO PYRAMID HIGHWAY ACCELERATION LANE

Flow line elevation at Station "C" 101+52 = 4542.45

Existing elevation of center of travel lane adjacent to channel (feet) = 4543.99

Estimated 25-year storm flow peak runoff (cfs) = 3.71 *(Time of concentration = 5 minutes)*

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4543.52

Estimated 100-year storm flow peak runoff (cfs) = 5.48 *(Time of concentration = 5 minutes)*

Calculated water surface elevation in channel for 100-year peak runoff (feet) = 4543.61

# X-Section for Cross Section "D-D" at Station "C" 101+52 - 25 year

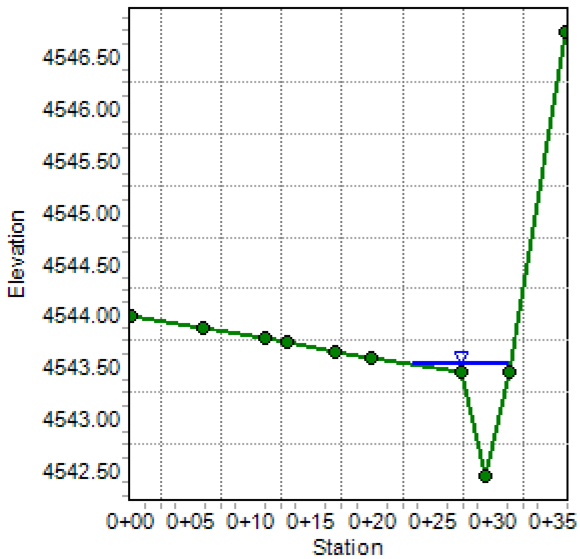
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

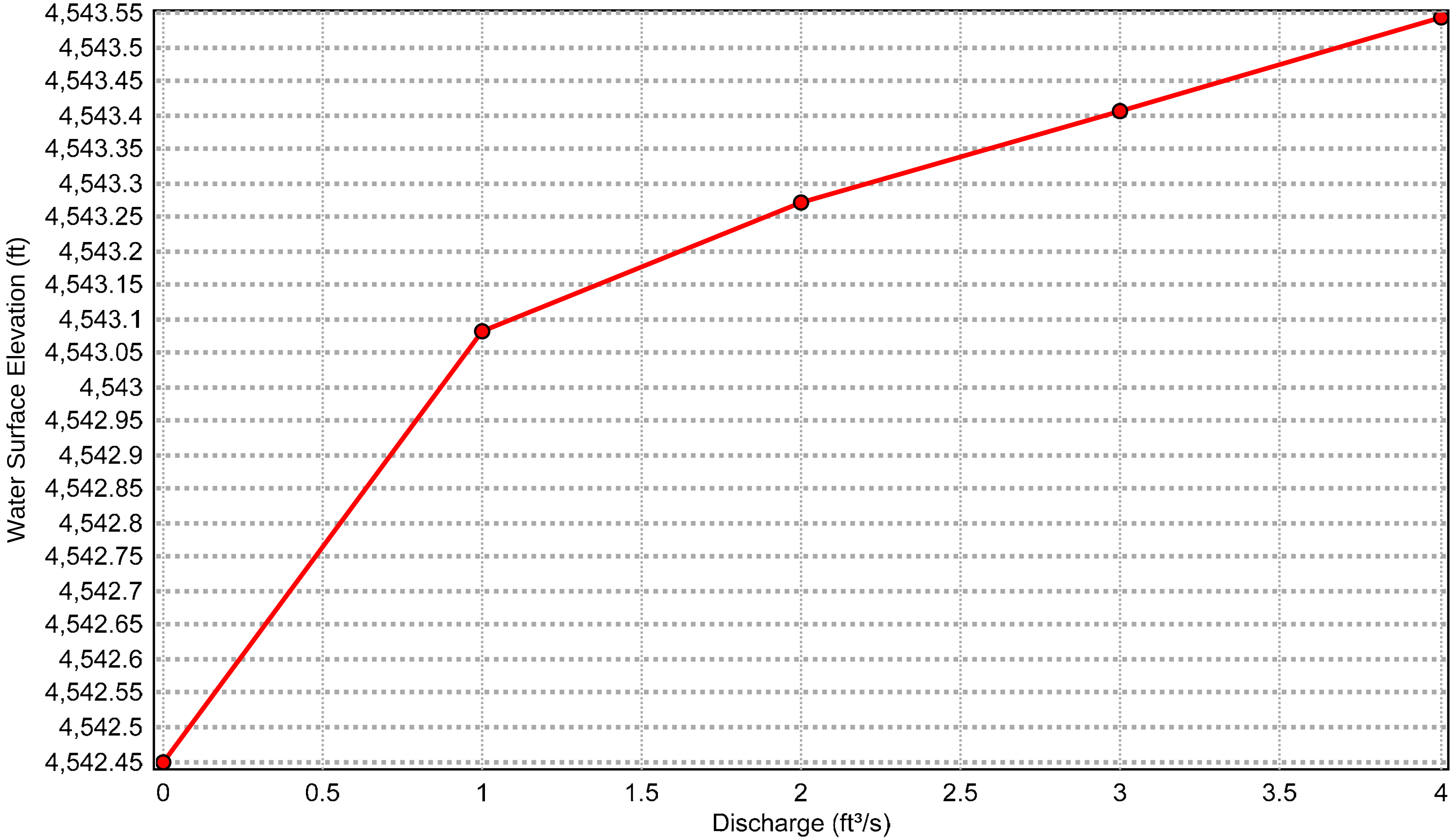
## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Normal Depth | 1.07 | ft |
| Discharge | 3.71 | ft³/s |

## Cross Section Image



Worksheet: Cross Section "D-D" at Station "C" 101+52 - 25 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)



# Report for Cross Section "D-D" at Station "C" 101+52 - 25 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Discharge | 3.71 | ft³/s |
| Section Definitions | | |

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4543.99 |
| 0+06 | 4543.87 |
| 0+11 | 4543.77 |
| 0+13 | 4543.73 |
| 0+17 | 4543.64 |
| 0+20 | 4543.58 |
| 0+27 | 4543.45 |
| 0+29 | 4542.45 |
| 0+31 | 4543.45 |
| 0+36 | 4546.73 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4543.99) | (0+06, 4543.87) | 0.013 |
| (0+06, 4543.87) | (0+11, 4543.77) | 0.013 |
| (0+11, 4543.77) | (0+13, 4543.73) | 0.013 |
| (0+13, 4543.73) | (0+17, 4543.64) | 0.013 |
| (0+17, 4543.64) | (0+20, 4543.58) | 0.013 |
| (0+20, 4543.58) | (0+27, 4543.45) | 0.035 |
| (0+27, 4543.45) | (0+29, 4542.45) | 0.069 |
| (0+29, 4542.45) | (0+31, 4543.45) | 0.069 |
| (0+31, 4543.45) | (0+36, 4546.73) | 0.069 |

# Report for Cross Section "D-D" at Station "C" 101+52 - 25 year analysis

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.07 | ft |
| Elevation Range | 4542.45 to 4546.73 ft | | |
| Flow Area | | 2.41 | ft² |
| Wetted Perimeter | | 8.52 | ft |
| Hydraulic Radius | | 0.28 | ft |
| Top Width | | 8.02 | ft |
| Normal Depth | | 1.07 | ft |
| Critical Depth | | 0.73 | ft |
| Critical Slope | | 0.07393 | ft/ft |
| Velocity | | 1.54 | ft/s |
| Velocity Head | | 0.04 | ft |
| Specific Energy | | 1.11 | ft |
| Froude Number | | 0.49 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.07 | ft |
| Critical Depth | 0.73 | ft |
| Channel Slope | 1.80000 | % |
| Critical Slope | 0.07393 | ft/ft |

## Messages

Notes

# Report for Cross Section "D-D" at Station "C" 101+52 - 25 year analysis

## Messages

Calculated Water Surface Elevation in Channel:  4543.52 feet
Time of concentration considered = 5 minutes

# X-Section for Cross Section "D-D" at Station "C" 101+52 - 100 year

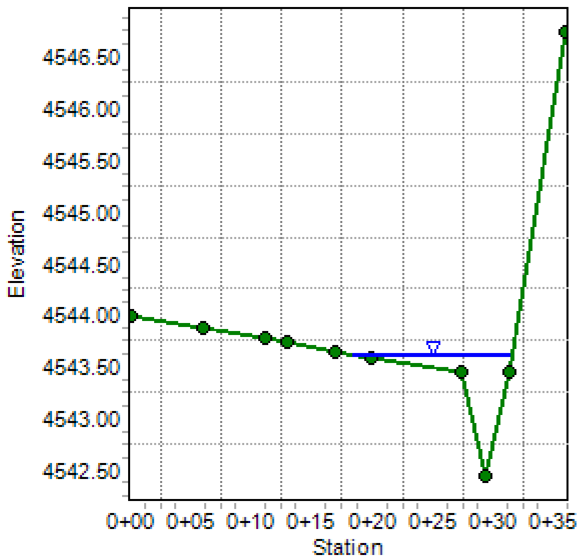
## Project Description

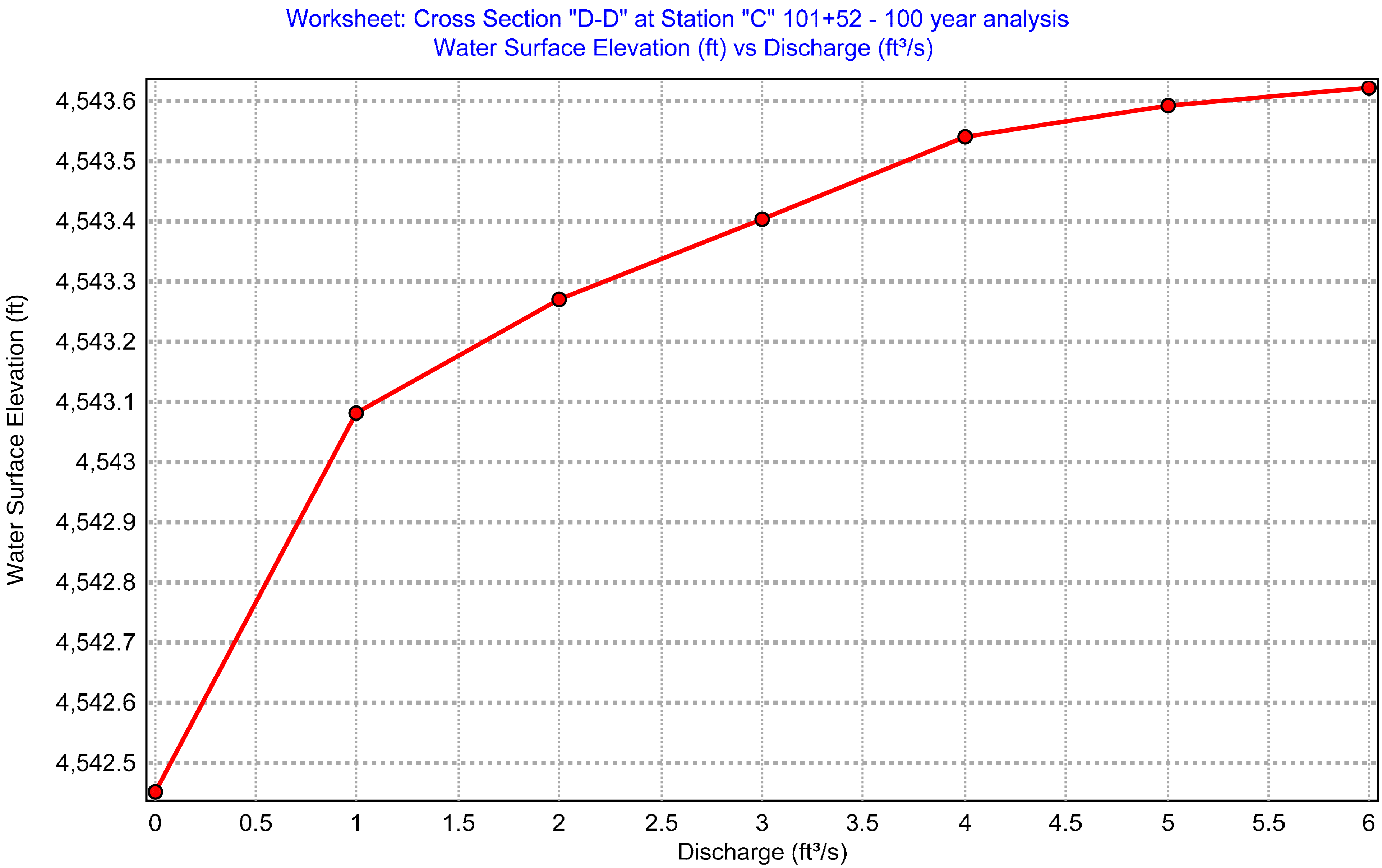
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Normal Depth | 1.16 | ft |
| Discharge | 5.48 | ft³/s |

## Cross Section Image




Worksheet: Cross Section "D-D" at Station "C" 101+52 - 100 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,543.6
4,543.5
4,543.4
4,543.3
4,543.2
4,543.1
4,543
4,542.9
4,542.8
4,542.7
4,542.6
4,542.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Discharge (ft³/s)

# Report for Cross Section "D-D" at Station "C" 101+52 - 100 year

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 1.80000 | % |
| Discharge | 5.48 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4543.99 |
| 0+06 | 4543.87 |
| 0+11 | 4543.77 |
| 0+13 | 4543.73 |
| 0+17 | 4543.64 |
| 0+20 | 4543.58 |
| 0+27 | 4543.45 |
| 0+29 | 4542.45 |
| 0+31 | 4543.45 |
| 0+36 | 4546.73 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4543.99) | (0+06, 4543.87) | 0.013 |
| (0+06, 4543.87) | (0+11, 4543.77) | 0.013 |
| (0+11, 4543.77) | (0+13, 4543.73) | 0.013 |
| (0+13, 4543.73) | (0+17, 4543.64) | 0.013 |
| (0+17, 4543.64) | (0+20, 4543.58) | 0.013 |
| (0+20, 4543.58) | (0+27, 4543.45) | 0.035 |
| (0+27, 4543.45) | (0+29, 4542.45) | 0.069 |
| (0+29, 4542.45) | (0+31, 4543.45) | 0.069 |
| (0+31, 4543.45) | (0+36, 4546.73) | 0.069 |

# Report for Cross Section "D-D" at Station "C" 101+52 - 100 year

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.16 | ft |
| Elevation Range | 4542.45 to 4546.73 ft | | |
| Flow Area | | 3.37 | ft² |
| Wetted Perimeter | | 13.60 | ft |
| Hydraulic Radius | | 0.25 | ft |
| Top Width | | 13.08 | ft |
| Normal Depth | | 1.16 | ft |
| Critical Depth | | 0.86 | ft |
| Critical Slope | | 0.05261 | ft/ft |
| Velocity | | 1.63 | ft/s |
| Velocity Head | | 0.04 | ft |
| Specific Energy | | 1.20 | ft |
| Froude Number | | 0.56 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.16 | ft |
| Critical Depth | 0.86 | ft |
| Channel Slope | 1.80000 | % |
| Critical Slope | 0.05261 | ft/ft |

## Messages

Notes

# Report for Cross Section "D-D" at Station "C" 101+52 - 100 year

## Messages

Calculated Water Surface Elevation in Channel:  4543.61 feet
Time of concentration considered = 5 minutes

# PYRAMID HIGHWAY - NDOT RIGHT OF WAY

# SOUTH ACCELERATION LANE EGRESS

## 9 CROSS SECTION E-E: STATION "C" 97+68 - CHANNEL ADJACENT TO PYRAMID HIGHWAY ACCELERATION LANE

Flow line elevation at Station "C" 97+68 = 4534.82

Existing elevation of center of travel lane adjacent to channel (feet) = 4536.47

Estimated 25-year storm flow peak runoff (cfs) = 3.71 *(Time of concentration = 5 minutes)*

Calculated water surface elevation in channel for 25-year peak runoff (feet) = 4535.68

Estimated 100-year storm flow peak runoff (cfs) = 5.48 *(Time of concentration = 5 minutes)*

Calculated water surface elevation in channel for 100-year peak runoff (feet) = 4535.81

# X-Section for Cross Section "E-E" at Station "C" 97+68 - 25 year

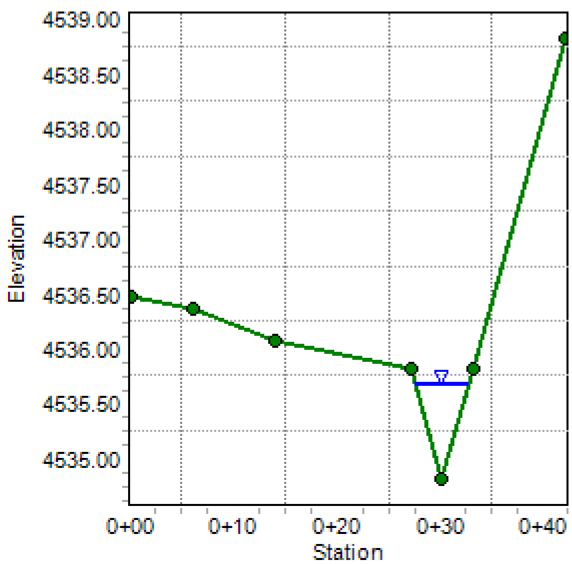
## Project Description

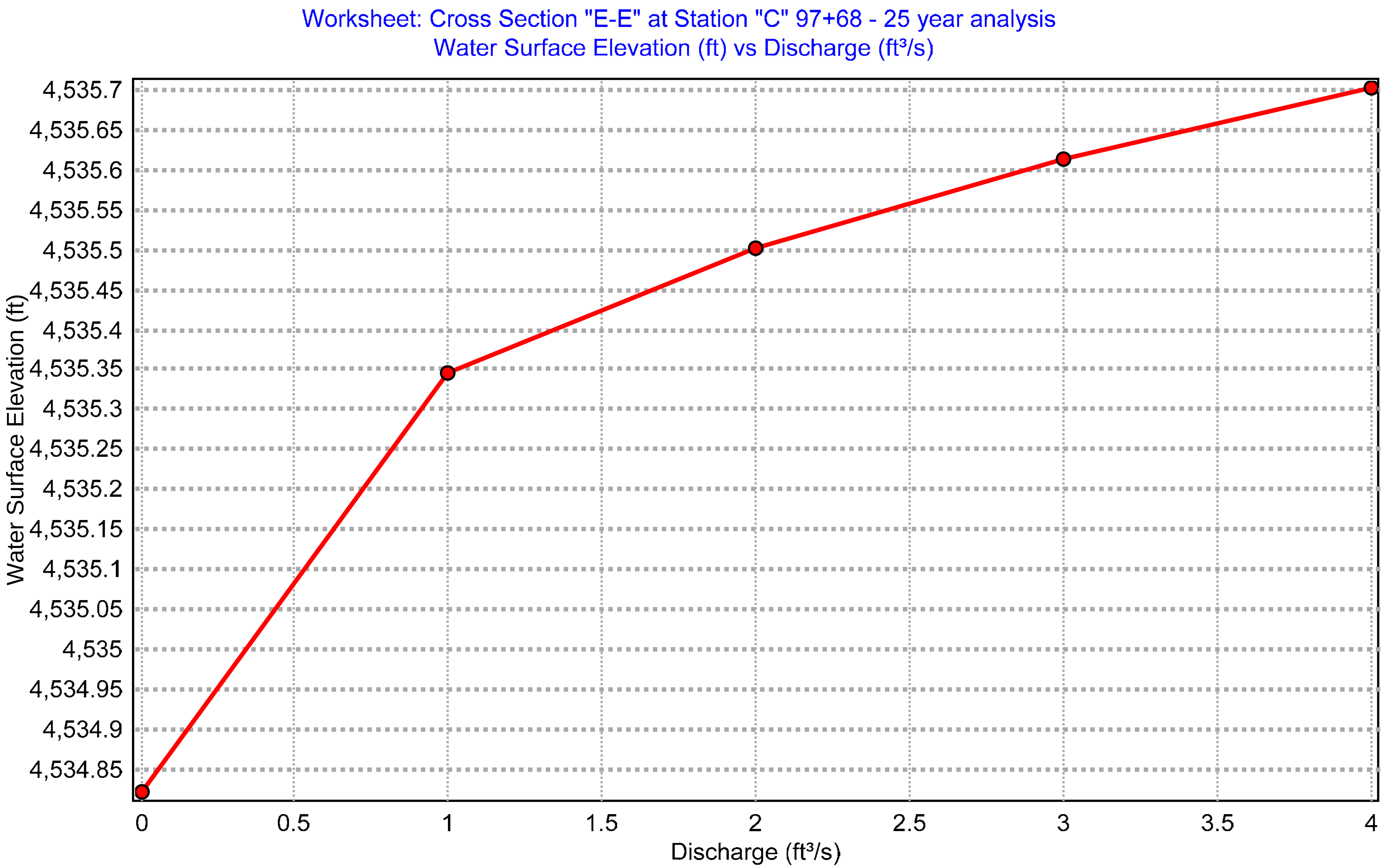
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Normal Depth | 0.86 | ft |
| Discharge | 3.71 | ft³/s |

## Cross Section Image





Worksheet: Cross Section "E-E" at Station "C" 97+68 - 25 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,535.7
4,535.65
4,535.6
4,535.55
4,535.5
4,535.45
4,535.4
4,535.35
4,535.3
4,535.25
4,535.2
4,535.15
4,535.1
4,535.05
4,535
4,534.95
4,534.9
4,534.85
0
0.5
1
1.5
2
2.5
3
3.5
4
Discharge (ft³/s)

# Report for Cross Section "E-E" at Station "C" 97+68 - 25 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Discharge | 3.71 | ft³/s |
| Section Definitions | | |

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4536.47 |
| 0+06 | 4536.36 |
| 0+14 | 4536.08 |
| 0+27 | 4535.82 |
| 0+30 | 4534.82 |
| 0+33 | 4535.82 |
| 0+42 | 4538.82 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4536.47) | (0+06, 4536.36) | 0.013 |
| (0+06, 4536.36) | (0+14, 4536.08) | 0.013 |
| (0+14, 4536.08) | (0+27, 4535.82) | 0.035 |
| (0+27, 4535.82) | (0+30, 4534.82) | 0.069 |
| (0+30, 4534.82) | (0+33, 4535.82) | 0.069 |
| (0+33, 4535.82) | (0+42, 4538.82) | 0.035 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.86 | ft |

# Report for Cross Section "E-E" at Station "C" 97+68 - 25 year analysis

## Results

| | | |
|---|---|---|
| Elevation Range | 4534.82 to 4538.82 ft | |
| Flow Area | 2.22 | ft² |
| Wetted Perimeter | 5.43 | ft |
| Hydraulic Radius | 0.41 | ft |
| Top Width | 5.16 | ft |
| Normal Depth | 0.86 | ft |
| Critical Depth | 0.62 | ft |
| Critical Slope | 0.10969 | ft/ft |
| Velocity | 1.67 | ft/s |
| Velocity Head | 0.04 | ft |
| Specific Energy | 0.90 | ft |
| Froude Number | 0.45 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.86 | ft |
| Critical Depth | 0.62 | ft |
| Channel Slope | 2.00000 | % |
| Critical Slope | 0.10969 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel: 4535.68 feet
Time of concentration considered = 5 minutes

# X-Section for Cross Section "E-E" at Station "C" 97+68 - 100 year

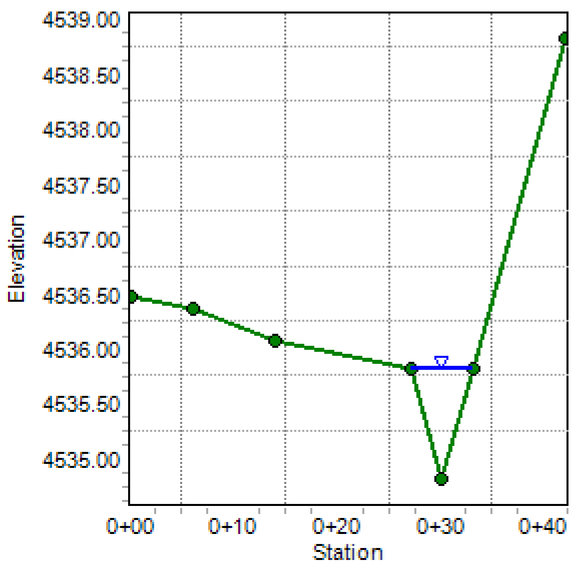
## Project Description

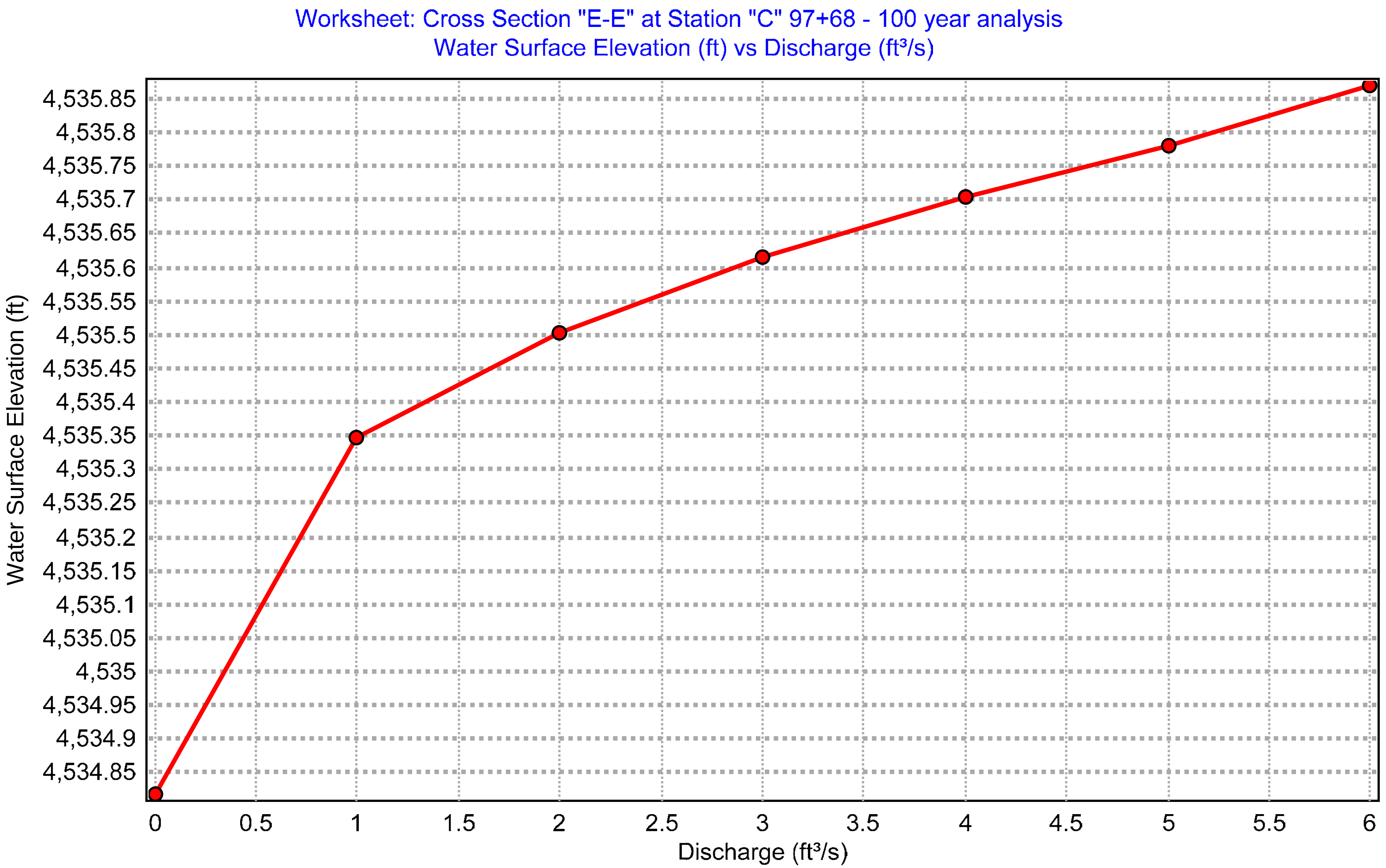
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Normal Depth | 0.99 | ft |
| Discharge | 5.48 | ft³/s |

## Cross Section Image




Worksheet: Cross Section "E-E" at Station "C" 97+68 - 100 year analysis
Water Surface Elevation (ft) vs Discharge (ft³/s)
Water Surface Elevation (ft)
4,535.85
4,535.8
4,535.75
4,535.7
4,535.65
4,535.6
4,535.55
4,535.5
4,535.45
4,535.4
4,535.35
4,535.3
4,535.25
4,535.2
4,535.15
4,535.1
4,535.05
4,535
4,534.95
4,534.9
4,534.85
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Discharge (ft³/s)

# Report for Cross Section "E-E" at Station "C" 97+68 - 100 year analysis

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 2.00000 | % |
| Discharge | 5.48 | ft³/s |
| Section Definitions | | |

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 4536.47 |
| 0+06 | 4536.36 |
| 0+14 | 4536.08 |
| 0+27 | 4535.82 |
| 0+30 | 4534.82 |
| 0+33 | 4535.82 |
| 0+42 | 4538.82 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 4536.47) | (0+06, 4536.36) | 0.013 |
| (0+06, 4536.36) | (0+14, 4536.08) | 0.013 |
| (0+14, 4536.08) | (0+27, 4535.82) | 0.035 |
| (0+27, 4535.82) | (0+30, 4534.82) | 0.069 |
| (0+30, 4534.82) | (0+33, 4535.82) | 0.069 |
| (0+33, 4535.82) | (0+42, 4538.82) | 0.035 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.99 | ft |

# Report for Cross Section "E-E" at Station "C" 97+68 - 100 year analysis

## Results

| | | |
|---|---|---|
| Elevation Range | 4534.82 to 4538.82 ft | |
| Flow Area | 2.97 | $ft^2$ |
| Wetted Perimeter | 6.29 | ft |
| Hydraulic Radius | 0.47 | ft |
| Top Width | 5.97 | ft |
| Normal Depth | 0.99 | ft |
| Critical Depth | 0.73 | ft |
| Critical Slope | 0.10414 | ft/ft |
| Velocity | 1.85 | ft/s |
| Velocity Head | 0.05 | ft |
| Specific Energy | 1.05 | ft |
| Froude Number | 0.46 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.99 | ft |
| Critical Depth | 0.73 | ft |
| Channel Slope | 2.00000 | % |
| Critical Slope | 0.10414 | ft/ft |

## Messages

Notes

Calculated Water Surface Elevation in Channel: 4535.81 feet
Time of concentration considered = 5 minutes

**SOLAEGUI**
**ENGINEERS, LTD**

# SUMMIT CHRISTIAN CHURCH EXPANSION

## TRAFFIC ANALYSIS

JUNE 2018

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
PAUL W. SOLAEGUI
CIVIL
No. 7163

6-5-18
EXP 6-30-18


Prepared by:
Solaegui Engineers, Ltd.
715 H Street
Sparks, Nevada 89431
(775) 358-1004

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# SUMMIT CHRISTIAN CHURCH EXPANSION

# TRAFFIC ANALYSIS

## EXECUTIVE SUMMARY

Summit Christian Church is located in the City of Sparks, Nevada. The project site is located west of Pyramid Highway opposite Golden View Drive. The expansion will occur in two phases north of the existing building. The purpose of this study is to address the project expansion's impact upon the adjacent street network. The Pyramid Highway intersections with Los Altos Parkway, Golden View Drive, and Sparks Boulevard/Highland Ranch Parkway have been identified for peak hour capacity analysis for the existing, existing plus phase 1, 2021 base, and 2021 base plus phase 1 and 2 scenarios. The peak hour analysis is for the standard weekday AM and PM peak hours and the Sunday AM peak hour. Phase 1 is anticipated to build out in one year and phase 2 is anticipated to build out by 2021.

Summit Christian Church currently includes a single building containing a chapel with ±1,000 seats. The proposed expansion will include the construction of a new church building with additional parking lots and the repurposing of the existing church building. The phase 1 expansion will include a net increase of 300 seats and the phase 2 expansion will include 500 additional seats. Phase 1 is expected to generate 183 total weekday trips, 9 weekday AM peak hour trips, 8 weekday PM peak hour trips, 555 total Sunday trips, and 183 Sunday AM peak hour trips. Phase 2 is expected to generate 305 total weekday trips, 14 weekday AM peak hour trips, 14 weekday PM peak hour trips, 925 total Sunday trips, and 305 Sunday AM peak hour trips.

Traffic generated by the expanded Summit Christian Church will have some impact on the adjacent street network. The following recommendations are made to mitigate project traffic impacts.

It is recommended that any required signing, striping, or traffic control improvements comply with Nevada Department of Transportation (NDOT) and City of Sparks requirements.

It is recommended that traffic signal timing adjustments at the Highway/Golden View Drive intersection continue to be coordinated with City of Sparks staff during Sunday special events.

# INTRODUCTION

## STUDY AREA

Summit Christian Church is located in the City of Sparks, Nevada. The project site is located west of Pyramid Highway opposite Golden View Drive. The approximate location of the project site is shown in Figure 1. The expansion will occur in two phases north of the existing building. The purpose of this study is to address the project expansion's impact upon the adjacent street network. The Pyramid Highway intersections with Los Altos Parkway, Golden View Drive, and Sparks Boulevard/Highland Ranch Parkway have been identified for peak hour capacity analysis for the existing, existing plus phase 1, 2021 base, and 2021 base plus phase 1 and 2 scenarios. The peak hour analysis is for the standard weekday AM and PM peak hours and the Sunday AM peak hour. Phase 1 is anticipated to build out in one year and phase 2 is anticipated to build out by 2021.

## EXISTING AND PROPOSED LAND USES

Summit Christian Church currently includes a single building containing a chapel with ±1,000 seats and associated parking lots and access roadways. Adjacent properties generally consist of residential dwelling units to the south and east and undeveloped land to the north and west. The proposed expansion will include the construction of a new church building with additional parking lots and the repurposing of the existing church building. The phase 1 expansion will include a net increase of 300 seats and phase 2 expansion will include 500 additional seats.

## EXISTING AND PROPOSED ROADWAYS AND INTERSECTIONS

Pyramid Highway is a four-lane roadway with two through lanes in each direction in the vicinity of the key intersections. The speed limit is posted for 55 miles per hour in the vicinity of the site. Roadway improvements generally include bicycle lanes and paved shoulders with white striped edge lines on both sides of the roadway. The roadway contains raised center medians north and south of Los Altos Parkway and north of Sparks Boulevard and striped left turn lanes north and south of at Golden View Drive and south of Sparks Boulevard. A center barrier rail exists between Golden View Drive and Sparks Boulevard.

Los Altos Parkway is a four-lane roadway with two through lanes in each direction east and west of Pyramid Highway. The speed limit is posted for 35 miles per hour east of Pyramid Highway. Roadway improvements include curb, gutter, sidewalk, and bike lanes on both sides of the street and a raised center median. Median openings with left turn pockets exist at major intersections.

Golden View Drive is a two-lane roadway with one through lane in each direction east of Pyramid Highway. The speed limit is posted for 25 miles per hour. Roadway improvements include curb and gutter on both sides of the streets and a striped centerline. The main access roadway for the church exists west of Pyramid Highway opposite Golden View Drive. The main access roadway contains one ingress lane and three egress lanes. Roadway improvements include curb and gutter on both sides of the streets and a striped centerline.

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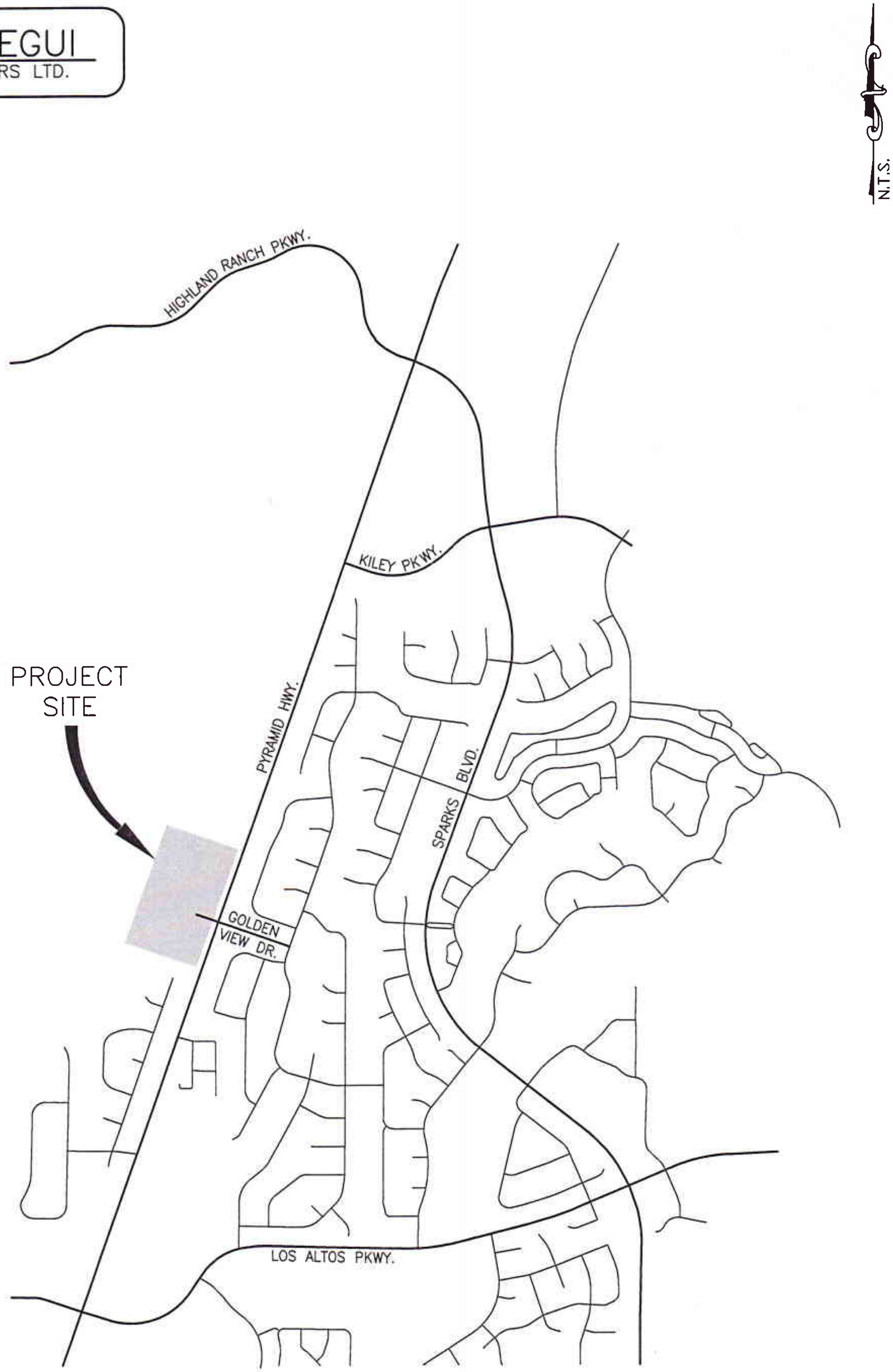


SUMMIT CHRISTIAN CHURCH EXPANSION

VICINITY MAP
FIGURE 1

Sparks Boulevard is a four-lane roadway with two through lanes in each direction east of Pyramid Highway. The speed limit is posted for 40 miles per hour. Roadway improvements include curb, gutter, sidewalk, and bike lanes on both sides of the street and a raised center median. Median openings with left turn pockets exist at major intersections.

Highland Ranch Parkway is a two-lane roadway with one through lane in each direction west of Pyramid Highway. The speed limit is posted for 45 miles per hour. Roadway improvements include paved and graded shoulders with white striped edgelines and a yellow striped centerline.

The Pyramid Highway/Los Altos Parkway intersection is a signalized four-leg intersection with protected phasing for all left turn movements. The north and south approaches each contain dual left turn lanes, two through lanes, and one right turn lane. The east approach contains dual left turn lanes, one through lane, and one free right turn lane with a northbound acceleration lane. The west approach contains dual left turn lanes, one through lane, and one right turn lane. The intersection contains raised corner islands with pedestrian ramps in all quadrants and pedestrian crosswalks across all approaches.

The Pyramid Highway/Golden View Drive intersection is a signalized four-leg intersection with protected phasing for the northbound and southbound left turn movements. The north and south approaches each contain one left turn lane, two through lanes, and one right turn lane. The west approach contains one left turn lane, one through lane, and one right turn lane. The east approach contains one left turn lane and one shared through-right turn lane. The intersection contains pedestrian ramps in all quadrants and pedestrian crosswalks across all approaches.

The Pyramid Highway/Sparks Boulevard/Highland Ranch Parkway intersection is a signalized four-leg intersection with protected phasing for all left turn movements. The north approach contains dual left turn lanes, two through lanes, and one right turn lane. The south approach contains one left turn lane, two through lanes, and one right turn lane. The east approach contains dual left turn lanes, one through lane, and one free right turn lane with a northbound acceleration lane. The west approach contains one left turn lane and one shared through-right turn lane with a southbound acceleration lane. The intersection contains raised corner islands with pedestrian ramps in all quadrants and pedestrian crosswalks across all approaches.

## TRIP GENERATION

In order to assess the magnitude of traffic impacts of the proposed expansion on the adjacent street network, trip generation rates and peak hours had to be determined. Trip generation rates were obtained from the *Ninth Edition of ITE Trip Generation* (2012) for Land Use 560 "Church". Trip generation was calculated for a typical weekday and the weekday peak hours occurring between 7:00 AM and 9:00 AM and 4:00 PM and 6:00 PM which correspond to the peak hours of adjacent street traffic. Trip generation was also calculated for a typical Sunday and the Sunday peak hour occurring between 9:45 AM and 10:45 AM which corresponds to the peak hour of the church.

The proposed church expansion will include the construction of a new church building and the repurposing of the existing building. Phase 1 will include a 300 seat expansion and the phase 2 expansion will include 500 additional seats. Table 1 shows a summary of the weekday and Sunday average daily traffic (ADT) and peak hour volumes generated by phases 1 and 2.

TABLE 1
TRIP GENERATION

| ITE LAND USE | WEEKDAY | | | | | SUNDAY | | |
|---|---|---|---|---|---|---|---|---|
| | ADT | AM IN | AM OUT | PM IN | PM OUT | ADT | AM IN | AM OUT |
| Phase 1 - Church (300 Seats) | 183 | 6 | 3 | 4 | 4 | 555 | 91 | 92 |
| Phase 2 - Church (500 Seats) | 305 | 9 | 5 | 7 | 7 | 925 | 152 | 153 |
| Phase 1 and 2 | 488 | 15 | 8 | 11 | 11 | 1480 | 243 | 245 |

# TRIP DISTRIBUTION AND ASSIGNMENT

The distribution of the project traffic to the key intersections was based on existing peak hour traffic patterns. The anticipated trip distribution is shown on Figure 2. The project trips were subsequently assigned to the key intersections based on this trip distribution. Figure 3A shows the phase 1 trip assignment at the key intersections and Figure 3B shows the phase 2 trip assignment.

# EXISTING AND PROJECTED TRAFFIC VOLUMES

Figure 4 shows the existing traffic volumes at the key intersections and accesses for the weekday and Sunday peak hours. The existing weekday peak hour traffic volumes at the Pyramid Highway/Sparks Boulevard/Highland Ranch Parkway intersection were obtained from traffic counts conducted in September of 2017. The peak hour traffic volumes at the remaining intersections were obtained from traffic counts conducted in April of 2018. Figure 5 shows the existing plus phase 1 traffic volumes at the key intersections during the weekday and Sunday peak hours. The existing plus phase 1 traffic volumes were obtained by adding the project trips shown on Figure 3A to the existing traffic volumes shown on Figure 4. Figure 6 shows the 2021 base traffic volumes at the key intersections during the weekday and Sunday peak hours. The 2021 base traffic volumes were estimated by applying a 2.4% average annual growth rate to the existing traffic volumes. The growth rate was derived from 3-year historic traffic count data obtained from the Nevada Department of Transportation's *2016 Annual Traffic Report* for count stations on Pyramid Highway, Sparks Boulevard, and Highland Ranch Parkway. Figure 7 shows the 2021 base plus phase 1 and 2 traffic volumes at the key intersections during the weekday and Sunday peak hours. The 2021 base plus phase 1 and 2 traffic volumes were obtained by adding the project trips shown on Figures 3A and 3B to the 2021 base traffic volumes shown on Figure 6.

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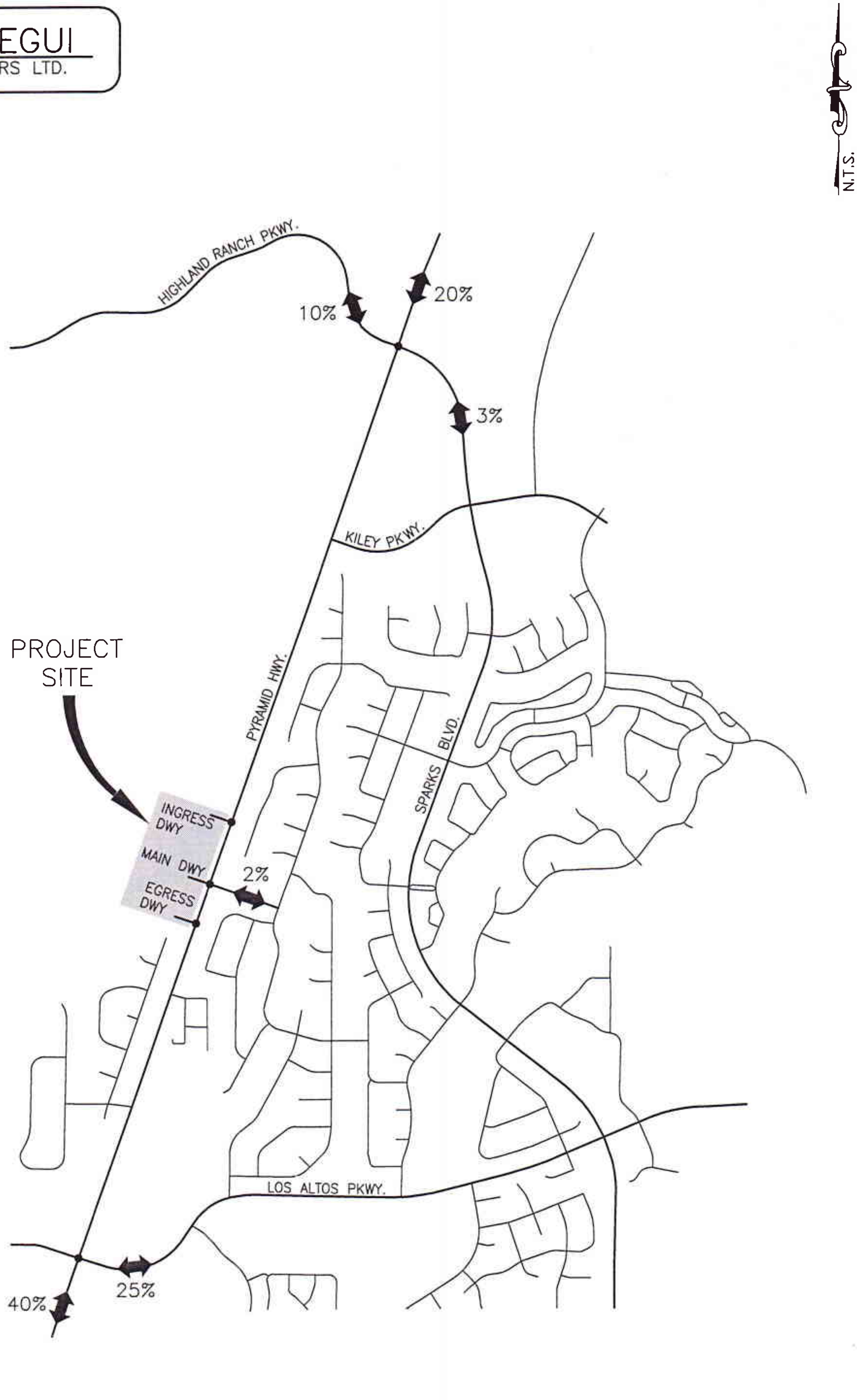


SUMMIT CHRISTIAN CHURCH EXPANSION

TRIP DISTRIBUTION
FIGURE 2

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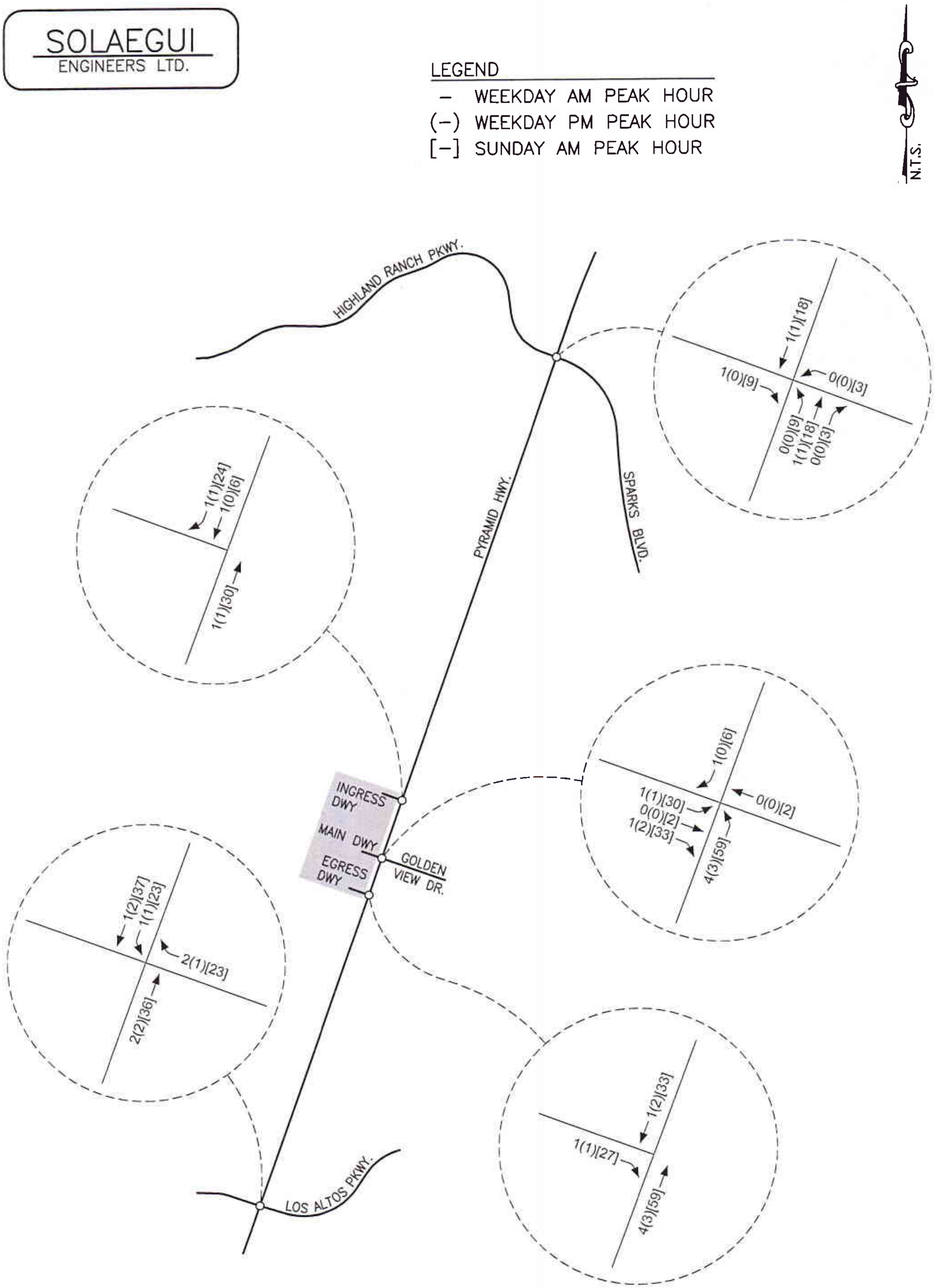
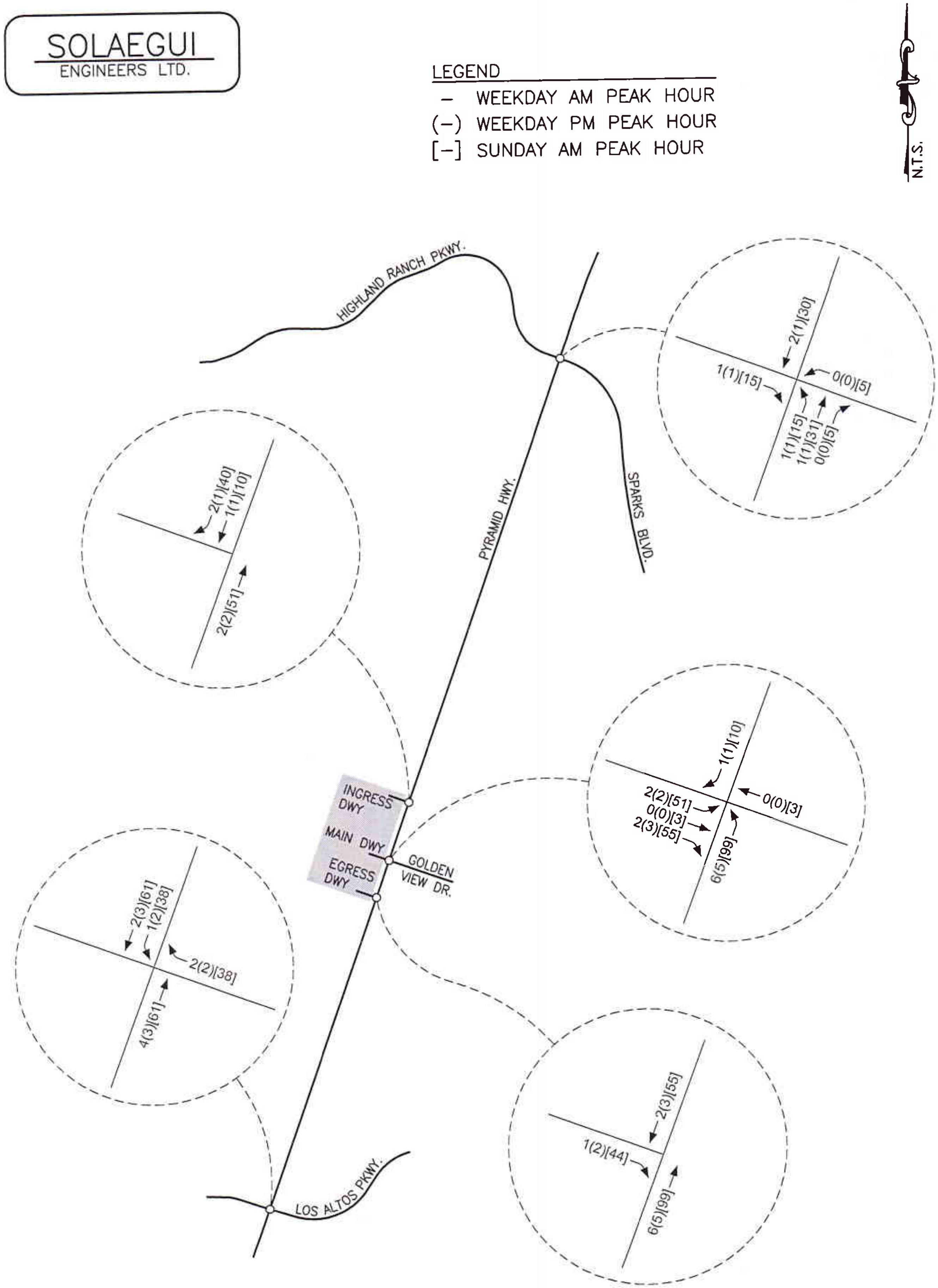



SUMMIT CHRISTIAN CHURCH EXPANSION

PHASE 1 TRIP ASSIGNMENT

FIGURE 3A




SUMMIT CHRISTIAN CHURCH EXPANSION

PHASE 2 TRIP ASSIGNMENT
FIGURE 3B

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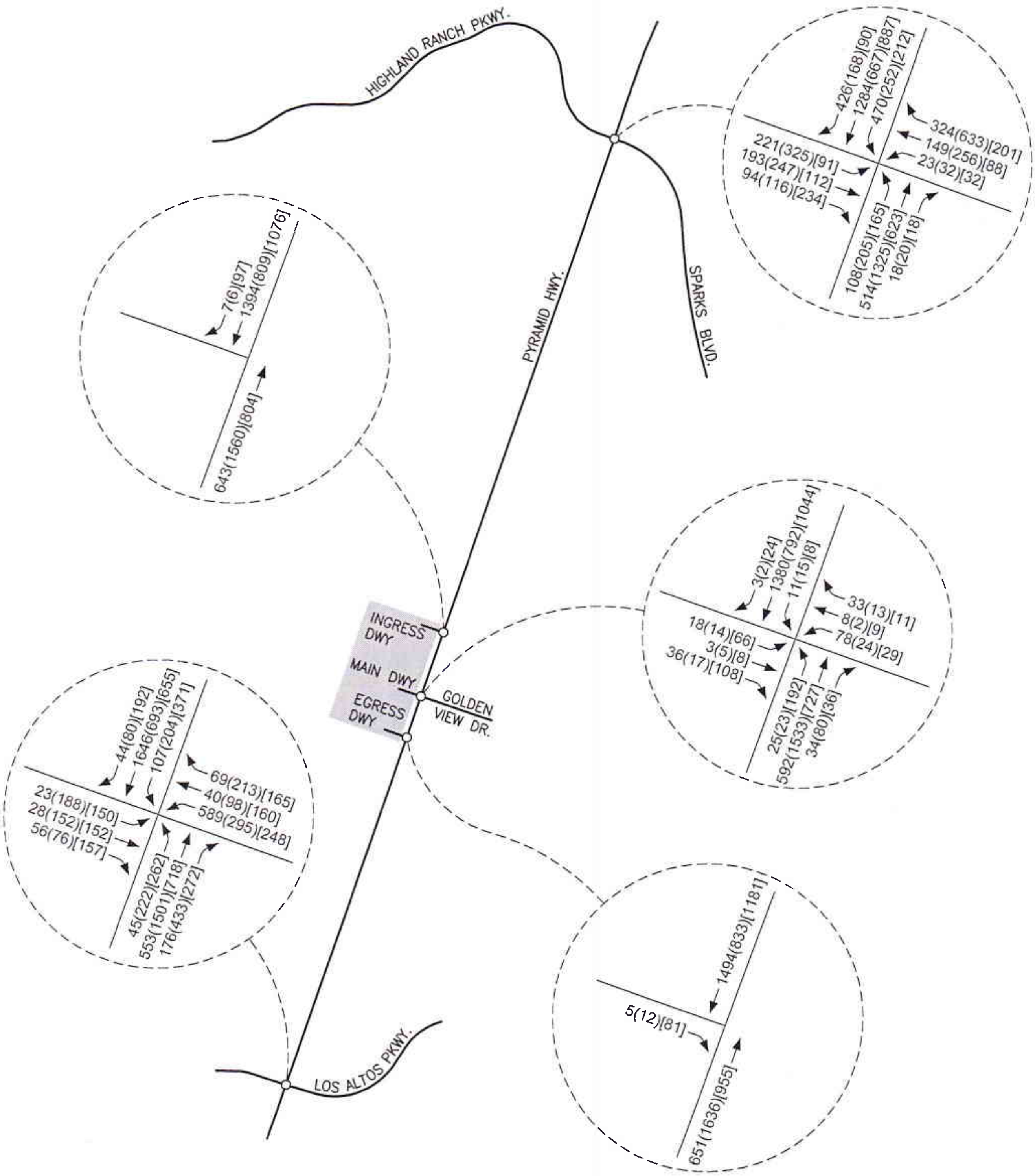
LEGEND
– WEEKDAY AM PEAK HOUR
(–) WEEKDAY PM PEAK HOUR
[–] SUNDAY AM PEAK HOUR

N.T.S.




SUMMIT CHRISTIAN CHURCH EXPANSION

EXISTING TRAFFIC VOLUMES
FIGURE 4

SOLAEGUI
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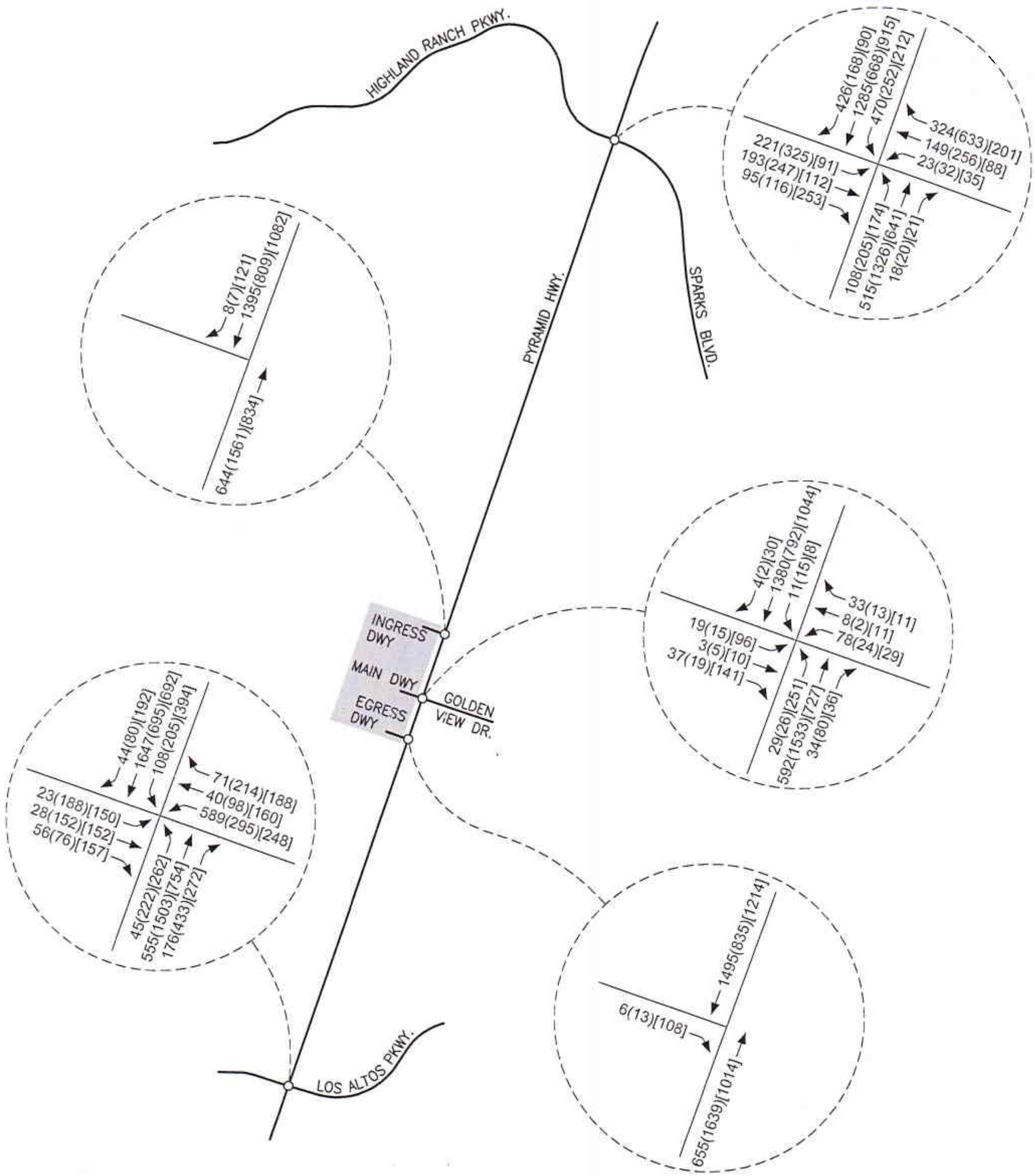
LEGEND
– WEEKDAY AM PEAK HOUR
(–) WEEKDAY PM PEAK HOUR
[–] SUNDAY AM PEAK HOUR

N.T.S.



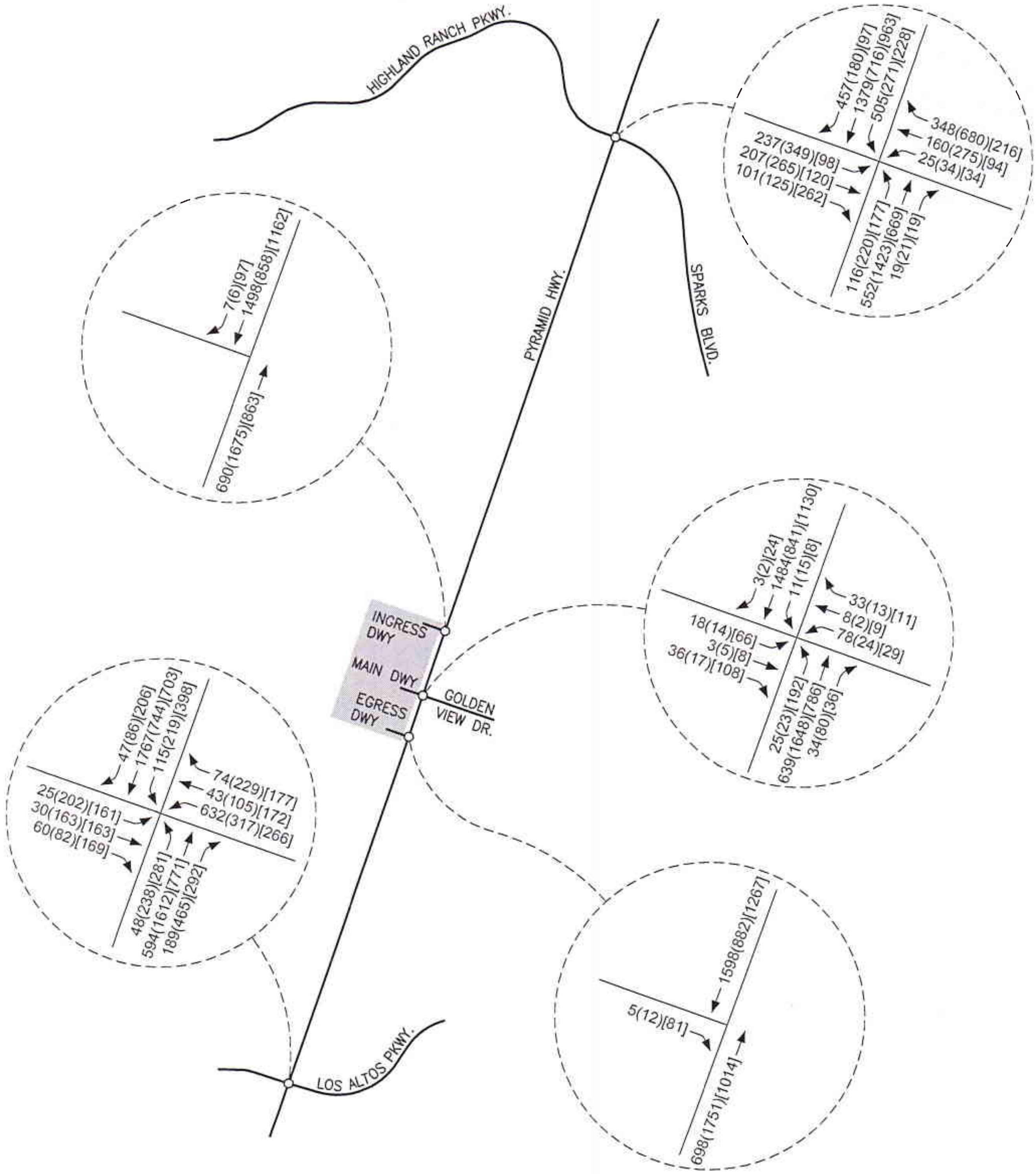

SUMMIT CHRISTIAN CHURCH EXPANSION

EXISTING PLUS PHASE 1 TRAFFIC VOLUMES
FIGURE 5

SOLAEGUI
ENGINEERS LTD.

LEGEND
– WEEKDAY AM PEAK HOUR
(–) WEEKDAY PM PEAK HOUR
[–] SUNDAY AM PEAK HOUR

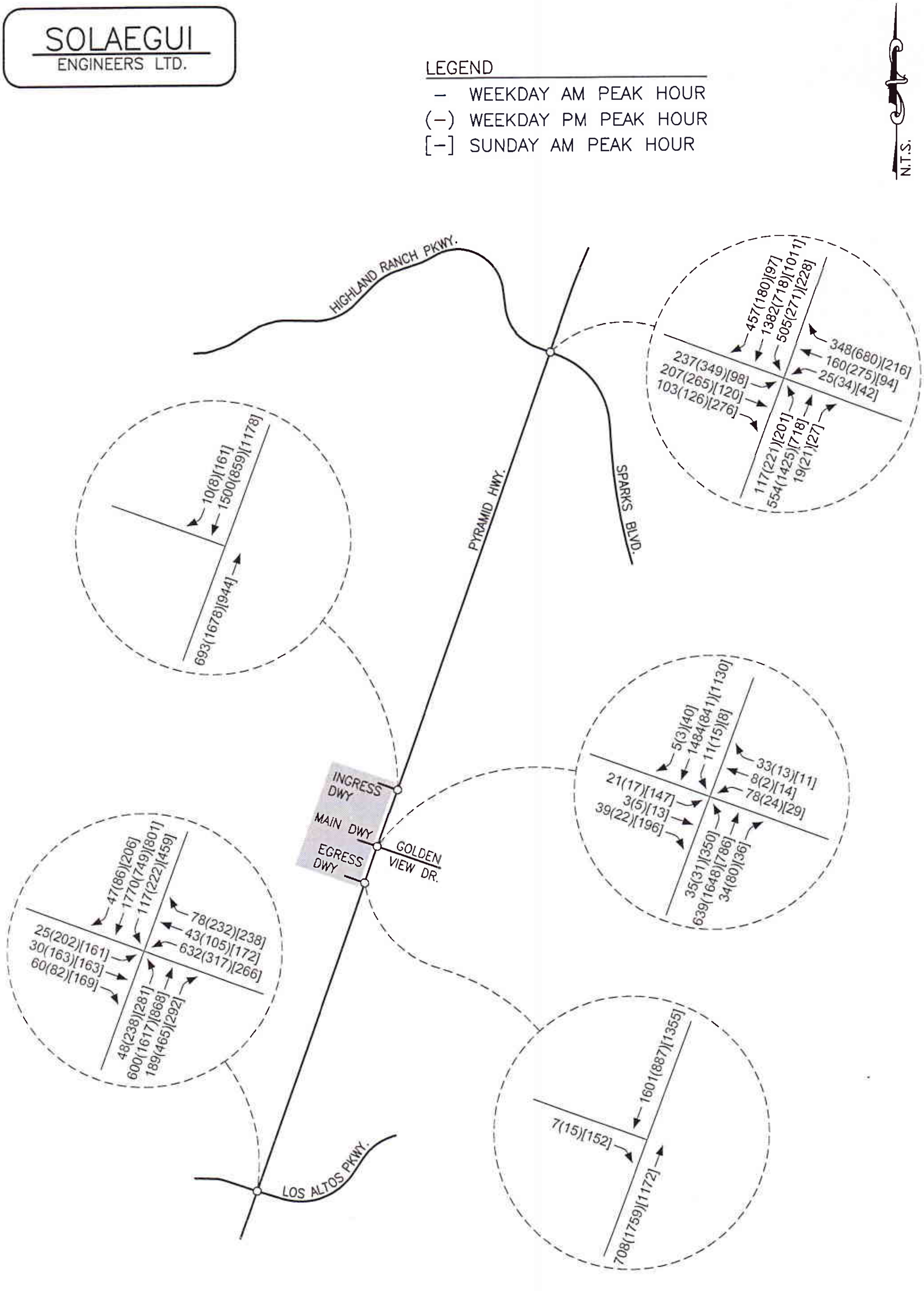
N.T.S.




SUMMIT CHRISTIAN CHURCH EXPANSION

2021 BASE TRAFFIC VOLUMES
FIGURE 6

SOLAEGUI
ENGINEERS LTD.




SUMMIT CHRISTIAN CHURCH EXPANSION

2021 BASE PLUS PHASE 1 AND 2 TRAFFIC VOLUMES
FIGURE 7

# INTERSECTION CAPACITY ANALYSIS

The key intersections were analyzed for capacity based on procedures presented in the *Highway Capacity Manual (6th Edition)*, prepared by the Transportation Research Board, for signalized intersections using the latest version of the Highway Capacity Software.

The result of capacity analysis is a level of service (LOS) rating for each signalized intersection. Level of service is a qualitative measure of traffic operating conditions where a letter grade "A" through "F", corresponding to progressively worsening traffic operation, is assigned to the signalized intersection.

Level of service for signalized intersections is stated in terms of the average control delay per vehicle for a peak 15 minute analysis period. The level of service criteria for signalized intersections is shown in Table 2.

TABLE 2
LEVEL OF SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS

| LEVEL OF SERVICE | CONTROL DELAY PER VEHICLE (SEC) |
|---|---|
| A | ≤10 |
| B | >10 and ≤20 |
| C | >20 and ≤35 |
| D | >35 and ≤55 |
| E | >55 and ≤80 |
| F | >80 |

Table 3 shows a summary of the level of service and delay results at the key intersections for the existing and existing plus phase 1 scenarios. The intersection capacity worksheets are included in the Appendix.

TABLE 3
INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS
EXSTING AND EXISTING PLUS PHASE 1 SCENARIOS

| INTERSECTION | EXISTING | | | EXISTING + PHASE 1 | | |
|---|---|---|---|---|---|---|
| | WEEKDAY AM | WEEKDAY PM | SUNDAY AM | WEEKDAY AM | WEEKDAY PM | SUNDAY AM |
| Pyramid/Los Altos | D36.4 | D38.8 | C34.5 | D36.4 | D38.9 | C34.5 |
| Pyramid/Sparks/Highland Ranch | C34.4 | D47.7 | C28.2 | C34.4 | D47.7 | C28.4 |
| Pyramid/Golden View | B17.4 | B17.0 | C27.9 | B17.4 | B17.1 | C28.7 |

Table 4 shows a summary of the intersection level of service and delay results for the 2021 base and 2021 base plus Phase 1 and 2 scenarios. The intersection capacity worksheets are included in the Appendix.

| TABLE 4<br>INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS<br>2021 BASE AND 2021 BASE PLUS PHASE 1 AND 2 SCENARIOS | | | | | | |
|---|---|---|---|---|---|---|
| | 2021 BASE | | | 2021 BASE + PHASE 1 AND 2 | | |
| INTERSECTION | WEEKDAY AM | WEEKDAY PM | SUNDAY AM | WEEKDAY AM | WEEKDAY PM | SUNDAY AM |
| Pyramid/Los Altos | D44.4 | D44.1 | D35.3 | D44.6 | D44.4 | D36.2 |
| Pyramid/Sparks/Highland Ranch | D37.2 | D54.6 | C28.9 | D37.3 | D54.6 | C29.5 |
| Pyramid/Golden View | B18.0 | B18.3 | C30.2 | B18.2 | B18.5 | C33.8 |

Pyramid Highway/Los Altos Parkway Intersection

The Pyramid Highway/Los Altos Parkway intersection was analyzed as a signalized four-leg intersection with the existing approach lanes and phasing for all scenarios. The intersection currently operates at LOS D with a delay of 36.4 seconds per vehicle during the weekday AM peak hour, LOS D with a delay of 38.8 seconds per vehicle during the weekday PM peak hour, and LOS C with a delay of 34.5 seconds per vehicle during the Sunday AM peak hour. For the existing plus phase 1 traffic volumes the intersection continues to operate at the same levels of service during the weekday AM, weekday PM, and Sunday AM peak hours with either no or slight increases in delay. For the 2021 base traffic volumes the intersection operates at LOS D with a delay of 44.4 seconds per vehicle during the weekday AM peak hour, LOS D with a delay of 44.1 seconds per vehicle during the weekday PM peak hour, and LOS D with a delay of 35.3 seconds per vehicle during the Sunday AM peak hour. For the 2021 base plus phase 1 and 2 traffic volumes the intersection continues to operate a LOS D during the weekday AM, weekday PM, and Sunday AM peak hours with slight increases in delay.

The project will add traffic to the southbound left turn movement at the Pyramid Highway/Los Altos Parkway intersection. Storage and deceleration requirements were subsequently reviewed for the southbound left turn lane. NDOT's *Access Management System and Standards* (2017 Edition) indicate that storage length should be based on the 95th percentile queue length obtained from operational analysis. The operational analysis for the 2021 base plus phase 1 and 2 traffic volumes indicates a 95th percentile queue length of ±250 feet for the left turn movement. The access management standards also indicate that 515 feet of deceleration length is required for the left turn lane based on the 55 mile per hour speed limit on Pyramid Highway for a total pocket length of 765 feet. The existing southbound left turn lane is approximately 775 feet long which will accommodate the buildout traffic volumes.

Pyramid Highway/Sparks Boulevard/Highland Ranch Parkway Intersection

The Pyramid Highway/Sparks Boulevard/Highland Ranch Parkway intersection was analyzed as a signalized four-leg intersection with the existing approach lanes and phasing for all scenarios. The intersection currently operates at LOS C with a delay of 34.4 seconds per vehicle during the weekday AM peak hour, LOS D with a delay of 47.7 seconds per vehicle during the weekday PM peak hour, and LOS C with a delay of 28.2 seconds per vehicle during the Sunday AM peak hour. For the existing plus phase 1 traffic volumes the intersection continues to operate at the same levels of service during the weekday AM, weekday PM, and Sunday AM peak hours with either no or slight increases in delay. For the 2021 base traffic volumes the intersection operates at LOS D with a delay of 37.2 seconds per vehicle during the weekday AM peak hour, LOS D with a delay of 54.6 seconds per vehicle during the weekday PM peak hour, and LOS C with a delay of 28.9 seconds per vehicle during the Sunday AM peak hour. For the 2021 base plus phase 1 and 2 traffic volumes the intersection continues to operate a LOS D during the weekday AM, weekday PM, and Sunday AM peak hours with either no or slight increases in delay.

The project will add traffic to the northbound left turn movement at the Pyramid Highway/Sparks Boulevard/Highland Ranch Parkway intersection. Storage and deceleration requirements were subsequently reviewed for the northbound left turn lane. NDOT's *Access Management System and Standards* (2017 Edition) indicate that storage length should be based on the 95th percentile queue length obtained from operational analysis. The operational analysis for the 2021 base plus phase 1 and 2 traffic volumes indicates a 95th percentile queue length of ±300 feet for the left turn movement. The access management standards also indicate that 515 feet of deceleration length is required for the left turn pocket based on the 55 mile per hour speed limit on Pyramid Highway for a total length of 815 feet. The existing northbound left turn lane is approximately 825 feet long which will accommodate the buildout traffic volumes.

Pyramid Highway/Golden View Drive Intersection

The Pyramid Highway/Golden View Drive intersection was analyzed as a signalized four-leg intersection with the existing approach lanes and phasing for all scenarios. The intersection currently operates at LOS B with a delay of 17.4 seconds per vehicle during the weekday AM peak hour, LOS B with a delay of 17.0 seconds per vehicle during the weekday PM peak hour, and LOS C with a delay of 27.9 seconds per vehicle during the Sunday AM peak hour. For the existing plus phase 1 traffic volumes the intersection operates at LOS B with a delay of 17.4 seconds per vehicle during the weekday AM peak hour, LOS B with a delay of 17.1 seconds per vehicle during the weekday PM peak hour, and LOS C with a delay of 28.7 seconds per vehicle during the Sunday AM peak hour. For the 2021 base traffic volumes the intersection operates at LOS B with a delay of 18.0 seconds per vehicle during the weekday AM peak hour, LOS B with a delay of 18.3 seconds per vehicle during the weekday PM peak hour, and LOS C with a delay of 30.2 seconds per vehicle during the Sunday AM peak hour. For the 2021 base plus phase 1 and 2 traffic volumes the intersection operates at LOS B with a delay of 18.2 seconds per vehicle during the weekday AM peak hour, LOS B with a delay of 18.5 seconds per vehicle during the weekday PM peak hour, and LOS C with a delay of 33.8 seconds per vehicle during the Sunday AM peak hour.

The project will add traffic to the northbound left turn movement at the Pyramid Highway/Golden View Drive intersection. Storage and deceleration requirements were subsequently reviewed for the northbound left turn lane. NDOT's *Access Management System and Standards* (2017 Edition) indicate that storage length should be based on the 95th percentile queue length obtained from operational analysis. The operational analysis for the 2021 base plus phase 1 and 2 traffic volumes indicates a 95th percentile queue length of ±50 feet for the left turn movement during the weekday AM and PM peak hours and ±370 feet during the Sunday peak hour. The access management standards also indicate that 515 feet of deceleration length is required for the left turn pocket based on the 55 mile per hour speed limit on Pyramid Highway for a total length of 565 feet during the weekday AM and PM peak hours and 885 feet during the Sunday peak hour. The existing northbound left turn lane is approximately 600 feet long which will accommodate the buildout traffic volumes during the weekday AM and PM peak hours but not during the Sunday peak hour.

The 2021 base plus phase 1 and 2 traffic volumes indicate that the northbound left turn movement will serve 350 vehicles during the Sunday peak hour. This Sunday left turn volume exceeds the 300 vehicle per hour rule-of-thumb threshold for dual left turn lanes. However, dual left turn lanes are not recommended due to 1) the intersection operates a satisfactory Sunday LOS C operation with a single northbound left turn lane, 2) a center two-way left turn lane exists south of the northbound left turn pocket which provides additional storage/deceleration length during Sunday services, and 3) the 350 vehicle per hour left turn volume is only anticipated during one or two hours of a typical week. In addition, it is our understanding that church personnel currently work with City of Sparks staff to provide alternate traffic signal timing at the intersection during special Sunday events. It is recommended that traffic signal timing adjustments at the Highway/Golden View Drive intersection continue to be coordinated with City of Sparks staff during the special events.

## TRAFFIC CRASH REVIEW

The Pyramid Highway intersections with Los Altos Parkway, Golden View Drive, and Sparks Boulevard/Highland Ranch Parkway were identified for traffic crash review. Traffic crash data was obtained from Nevada Department of Transportation Traffic Safety Engineering for the September 1, 2014 to September 1, 2017 study period. The traffic crash data is included in the Appendix. The crash data is discussed below for each intersection.

### Pyramid Highway/Los Altos Parkway Intersection

A total of 60 crashes occurred at the Pyramid Highway/Los Altos Parkway intersection during the three-year period with no fatalities reported. The crash type was 33 rear end crashes, 13 angle crashes, 10 non-collisions, 2 sideswipe-overtaking crashes, 1 rear-rear crash, and 1 sideswipe-meeting crash. Based on weekday PM peak hour traffic volumes, the intersection currently experiences 1.3188 accidents per million vehicles entering the intersection. The project is anticipated to increase the occurrence of accidents by 0.0770 accidents per year.

Pyramid Highway/Sparks Boulevard/Highland Ranch Parkway Intersection

A total of 39 crashes occurred at the Pyramid Highway/Sparks Boulevard/Highland Ranch Parkway intersection during the three-year period with no fatalities reported. The crash type was 24 rear end crashes, 11 angle crashes, 2 sideswipe-overtaking crashes, 1 head-on crash, and 1 non-collision. Based on weekday PM peak hour traffic volumes, the intersection currently experiences 0.8388 accidents per million vehicles entering the intersection. The project is anticipated to increase the occurrence of accidents by 0.0184 accidents per year.

Pyramid Highway/Golden View Drive Intersection

A total of 11 crashes occurred at the Pyramid Highway/Golden View Drive intersection during the three-year period with no fatalities reported. The crash type was 7 rear end crashes, 2 non-collisions, 1 angle crash, and 1 head-on crash. Based on weekday PM peak hour traffic volumes, the intersection currently experiences 0.3986 accidents per million vehicles entering the intersection. The project is anticipated to increase the occurrence of accidents by 0.0247 accidents per year.

## SITE PLAN REVIEW

A copy of the site plan for the Summit Christian Church Expansion is included in this submittal. The site plan indicates that project access will be provided from Pyramid Highway at the existing main access roadway aligning with Golden View Drive, the existing right-in only access at the project's north boundary, and the existing right-out only access at the project's south boundary. Approximately 30% of the total entering Sunday peak hour traffic utilizes the right-in only access and approximately 31% of the total exiting Sunday peak hour traffic utilizes the right-out only access. It is anticipated that the increased traffic generated by the proposed expansion will utilize the project accesses at these same percentages. The site plan also indicates that additional parking lots will be constructed on the north side of the project site. The existing project access roadways and the existing and proposed parking lots and aisles are anticipated to provide good access and internal circulation.

## RECOMMENDATIONS

Traffic generated by the expanded Summit Christian Church will have some impact on the adjacent street network. The following recommendations are made to mitigate project traffic impacts.

It is recommended that any required signing, striping, or traffic control improvements comply with Nevada Department of Transportation (NDOT) and City of Sparks requirements.

It is recommended that traffic signal timing adjustments at the Highway/Golden View Drive intersection continue to be coordinated with City of Sparks staff during Sunday special events.

# APPENDIX

Detailed Land Use Data
For 300 Seats of CHURCH 1
( 560 ) Church

Project: New Project
Phase: Phase 1
Description:

Open Date: 5/30/2018
Analysis Date: 5/30/2018

| Day / Period | Total Trips | Pass-By Trips | Avg Rate | Min Rate | Max Rate | Std Dev | Avg Size | % Enter | % Exit | Use Eq. | Equation | R2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weekday Average Daily Trips | 183 | 0 | 0.61 | 0.21 | 0.84 | 0.82 | 534 | 50 | 50 | False | | |
| Saturday Average Daily Trips | 270 | 0 | 0.9 | 0.45 | 1.03 | | 388 | 50 | 50 | False | | |
| Saturday Peak Hour of Generator | 180 | 0 | 0.6 | 0.13 | 0.72 | 0.79 | 758 | 43 | 57 | False | | |
| Sunday Average Daily Trips | 555 | 0 | 1.85 | 0.69 | 2.21 | 1.46 | 534 | 50 | 50 | False | | |
| Sunday Peak Hour of Generator | 183 | 0 | 0.61 | 0.21 | 1.14 | 0.81 | 903 | 50 | 50 | False | | |

Detailed Land Use Data
For 500 Seats of CHURCH 1
( 560 ) Church

Project: New Project
Phase: Phase 1
Description:

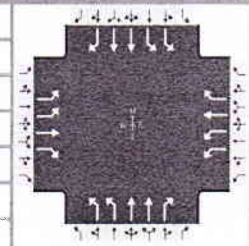
Open Date: 5/30/2018
Analysis Date: 5/30/2018

| Day / Period | Total Trips | Pass-By Trips | Avg Rate | Min Rate | Max Rate | Std Dev | Avg Size | % Enter | % Exit | Use Eq. | Equation | R2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weekday Average Daily Trips | 305 | 0 | 0.61 | 0.21 | 0.84 | 0.82 | 534 | 50 | 50 | False | | |
| Saturday Average Daily Trips | 450 | 0 | 0.9 | 0.45 | 1.03 | | 388 | 50 | 50 | False | | |
| Saturday Peak Hour of Generator | 300 | 0 | 0.6 | 0.13 | 0.72 | 0.79 | 758 | 43 | 57 | False | | |
| Sunday Average Daily Trips | 925 | 0 | 1.85 | 0.69 | 2.21 | 1.46 | 534 | 50 | 50 | False | | |
| Sunday Peak Hour of Generator | 305 | 0 | 0.61 | 0.21 | 1.14 | 0.81 | 903 | 50 | 50 | False | | |

Source: Institute of Transportation Engineers, Trip Generation Manual 9th Edition, 2012

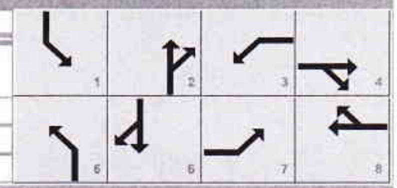
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa18ax.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 23 | 28 | 56 | 589 | 40 | 69 | 45 | 553 | 176 | 107 | 1646 | 44 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 5.0 | 10.0 | 55.0 | 5.0 | 15.0 | 10.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



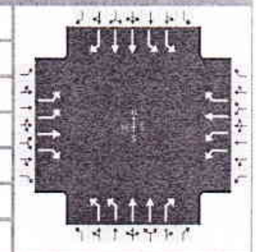
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 10.0 | 15.0 | 25.0 | 30.0 | 10.0 | 60.0 | 20.0 | 70.0 |
| Change Period, ( *Y+R* $_c$ ), s | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 2.8 | 5.7 | 23.6 | 6.8 | 3.6 | | 5.5 | |
| Green Extension Time ( $g_e$ ), s | 0.0 | 0.1 | 0.3 | 0.3 | 0.0 | 0.0 | 0.2 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 1.00 | 0.37 | 1.00 | 0.00 | 1.00 | | 0.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( *v* ), veh/h | 25 | 30 | 50 | 640 | 43 | 75 | 49 | 601 | 148 | 116 | 1789 | 37 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 1730 | 1870 | 1518 | 1730 | 1870 | | 1730 | 1781 | 1557 | 1730 | 1781 | 1558 |
| Queue Service Time ( $g_s$ ), s | 0.8 | 1.8 | 3.7 | 21.6 | 2.3 | | 1.6 | 13.2 | 6.8 | 3.5 | 55.5 | 1.3 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 0.8 | 1.8 | 3.7 | 21.6 | 2.3 | | 1.6 | 13.2 | 6.8 | 3.5 | 55.5 | 1.3 |
| Green Ratio ( *g/C* ) | 0.04 | 0.08 | 0.08 | 0.21 | 0.21 | | 0.04 | 0.46 | 0.46 | 0.17 | 0.54 | 0.54 |
| Capacity ( *c* ), veh/h | 144 | 156 | 126 | 721 | 390 | | 144 | 1632 | 714 | 577 | 1929 | 844 |
| Volume-to-Capacity Ratio ( *X* ) | 0.173 | 0.195 | 0.395 | 0.888 | 0.112 | | 0.339 | 0.368 | 0.207 | 0.202 | 0.928 | 0.044 |
| Back of Queue ( *Q* ), ft/ln ( 95 th percentile) | 16.8 | 39.3 | 66 | 392.7 | 46.7 | | 32.1 | 227.5 | 110.9 | 65.5 | 776.3 | 20.5 |
| Back of Queue ( *Q* ), veh/ln ( 95 th percentile) | 0.7 | 1.5 | 2.6 | 15.5 | 1.8 | | 1.3 | 9.0 | 4.4 | 2.6 | 30.6 | 0.8 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 55.5 | 51.3 | 52.1 | 46.1 | 38.5 | | 55.9 | 21.2 | 19.5 | 43.1 | 25.3 | 12.9 |
| Incremental Delay ( $d_2$ ), s/veh | 0.2 | 0.2 | 0.7 | 12.6 | 0.0 | | 0.5 | 0.6 | 0.7 | 0.1 | 9.3 | 0.1 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | 55.7 | 51.5 | 52.9 | 58.8 | 38.5 | 0.0 | 56.4 | 21.8 | 20.1 | 43.2 | 34.6 | 13.0 |
| Level of Service (LOS) | E | D | D | E | D | A | E | C | C | D | C | B |
| Approach Delay, s/veh / LOS | 53.1 | D | | 51.8 | D | | 23.6 | C | | 34.7 | C | |
| Intersection Delay, s/veh / LOS | 36.4 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.67 | C | 2.61 | C | 2.43 | B | 2.43 | B |
| Bicycle LOS Score / LOS | 0.66 | A | 1.74 | B | 1.15 | A | 2.09 | B |

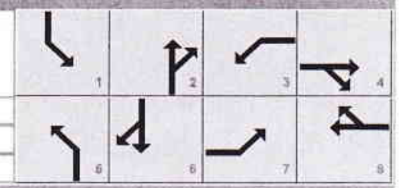
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa18px.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( v ), veh/h | 188 | 152 | 76 | 295 | 98 | 213 | 222 | 1501 | 433 | 204 | 693 | 80 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 130.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 12.0 | 65.0 | 15.0 | 18.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 4.0 | 4.0 | 4.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 |




| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 20.0 | 23.0 | 20.0 | 23.0 | 17.0 | 70.0 | 17.0 | 70.0 |
| Change Period, ( $Y+R_c$ ), s | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 9.2 | 12.9 | 13.7 | 20.0 | 10.8 | | 10.1 | |
| Green Extension Time ( $g_e$ ), s | 0.2 | 0.6 | 0.1 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.05 | 0.34 | 1.00 | 1.00 | 1.00 | | 1.00 | |

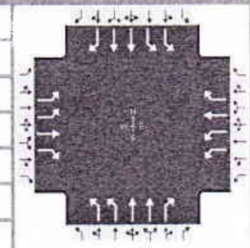
| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( v ), veh/h | 204 | 165 | 61 | 321 | 107 | 232 | 241 | 1632 | 362 | 222 | 753 | 65 |
| Adjusted Saturation Flow Rate ( s ), veh/h/ln | 1730 | 1870 | 1561 | 1730 | 1870 | | 1730 | 1781 | 1558 | 1730 | 1781 | 1558 |
| Queue Service Time ( $g_s$ ), s | 7.2 | 10.9 | 4.5 | 11.7 | 6.8 | | 8.8 | 55.0 | 19.7 | 8.1 | 17.4 | 2.8 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 7.2 | 10.9 | 4.5 | 11.7 | 6.8 | | 8.8 | 55.0 | 19.7 | 8.1 | 17.4 | 2.8 |
| Green Ratio ( *g/C* ) | 0.12 | 0.14 | 0.14 | 0.12 | 0.14 | | 0.09 | 0.50 | 0.50 | 0.09 | 0.50 | 0.50 |
| Capacity ( c ), veh/h | 399 | 259 | 216 | 399 | 259 | | 319 | 1781 | 779 | 319 | 1781 | 779 |
| Volume-to-Capacity Ratio ( X ) | 0.512 | 0.638 | 0.282 | 0.803 | 0.411 | | 0.756 | 0.916 | 0.465 | 0.694 | 0.423 | 0.084 |
| Back of Queue ( Q ), ft/ln ( 95 th percentile) | 144.3 | 232.5 | 80.4 | 240.7 | 143.3 | | 188.4 | 794.5 | 289.9 | 166.5 | 284.3 | 45.8 |
| Back of Queue ( Q ), veh/ln ( 95 th percentile) | 5.7 | 9.2 | 3.2 | 9.5 | 5.6 | | 7.4 | 31.3 | 11.4 | 6.6 | 11.2 | 1.8 |
| Queue Storage Ratio ( RQ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 54.1 | 52.9 | 50.2 | 56.1 | 51.2 | | 57.6 | 30.0 | 21.2 | 57.2 | 20.6 | 17.0 |
| Incremental Delay ( $d_2$ ), s/veh | 0.5 | 4.0 | 0.3 | 10.5 | 0.4 | | 8.9 | 8.9 | 2.0 | 5.4 | 0.7 | 0.2 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( d ), s/veh | 54.5 | 56.9 | 50.5 | 66.6 | 51.5 | 0.0 | 66.5 | 38.9 | 23.2 | 62.6 | 21.3 | 17.2 |
| Level of Service (LOS) | D | E | D | E | D | A | E | D | C | E | C | B |
| Approach Delay, s/veh / LOS | 54.9 | D | | 40.7 | D | | 39.3 | D | | 29.9 | C | |
| Intersection Delay, s/veh / LOS | 38.8 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.75 | C | 2.64 | C | 2.42 | B | 2.45 | B |
| Bicycle LOS Score / LOS | 1.20 | A | 1.57 | B | 2.33 | B | 1.35 | A |

 HCS7™ Streets Version 7.4 Generated: 6/5/2018 9:56:46 AM

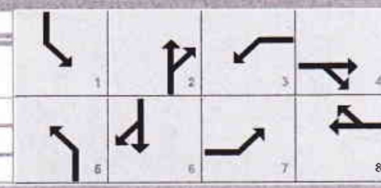
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa18axS.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( v ), veh/h | 150 | 152 | 157 | 248 | 160 | 165 | 262 | 718 | 272 | 371 | 655 | 192 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 17.0 | 5.0 | 47.0 | 11.0 | 2.0 | 18.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |

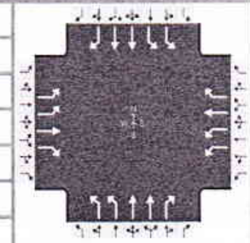


| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 16.0 | 23.0 | 18.0 | 25.0 | 22.0 | 52.0 | 27.0 | 57.0 |
| Change Period, ( $Y+R_c$ ), s | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 7.4 | 11.9 | 10.6 | 15.2 | 11.2 | | 14.3 | |
| Green Extension Time ( $g_e$ ), s | 0.1 | 0.8 | 0.4 | 0.7 | 0.3 | 0.0 | 0.7 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.54 | 0.23 | 0.01 | 0.43 | 0.05 | | 0.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( v ), veh/h | 163 | 165 | 127 | 270 | 174 | 179 | 285 | 780 | 241 | 403 | 712 | 165 |
| Adjusted Saturation Flow Rate ( s ), veh/h/ln | 1730 | 1870 | 1539 | 1730 | 1870 | | 1730 | 1781 | 1556 | 1730 | 1781 | 1557 |
| Queue Service Time ( $g_s$ ), s | 5.4 | 9.9 | 9.2 | 8.6 | 10.3 | | 9.2 | 20.5 | 13.4 | 12.3 | 17.0 | 8.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 5.4 | 9.9 | 9.2 | 8.6 | 10.3 | | 9.2 | 20.5 | 13.4 | 12.3 | 17.0 | 8.1 |
| Green Ratio ( *g/C* ) | 0.09 | 0.15 | 0.15 | 0.15 | 0.17 | | 0.14 | 0.39 | 0.39 | 0.22 | 0.43 | 0.43 |
| Capacity ( c ), veh/h | 317 | 281 | 231 | 519 | 312 | | 490 | 1395 | 609 | 778 | 1543 | 675 |
| Volume-to-Capacity Ratio ( X ) | 0.514 | 0.589 | 0.551 | 0.520 | 0.558 | | 0.581 | 0.560 | 0.396 | 0.518 | 0.461 | 0.245 |
| Back of Queue ( Q ), ft/ln ( 95 th percentile) | 107.5 | 211.1 | 164.6 | 167 | 211.8 | | 178.1 | 335.2 | 219.1 | 220.3 | 282 | 133.1 |
| Back of Queue ( Q ), veh/ln ( 95 th percentile) | 4.2 | 8.3 | 6.5 | 6.6 | 8.3 | | 7.0 | 13.2 | 8.6 | 8.7 | 11.1 | 5.2 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 52.0 | 47.6 | 47.3 | 47.0 | 45.9 | | 48.2 | 28.4 | 26.3 | 40.8 | 24.1 | 21.6 |
| Incremental Delay ( $d_2$ ), s/veh | 0.6 | 2.2 | 1.6 | 0.4 | 1.4 | | 1.2 | 1.6 | 1.9 | 0.3 | 1.0 | 0.9 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( d ), s/veh | 52.6 | 49.8 | 48.9 | 47.4 | 47.3 | 0.0 | 49.3 | 30.1 | 28.2 | 41.1 | 25.1 | 22.4 |
| Level of Service (LOS) | D | D | D | D | D | A | D | C | C | D | C | C |
| Approach Delay, s/veh / LOS | 50.5 | | D | 33.7 | | C | 33.9 | | C | 29.8 | | C |
| Intersection Delay, s/veh / LOS | 34.5 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.67 | C | 2.66 | C | 2.43 | B | 2.49 | B |
| Bicycle LOS Score / LOS | 1.24 | A | 1.52 | B | 1.57 | B | 1.54 | B |

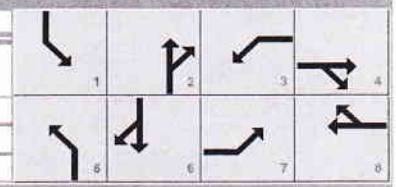
# HCS7 Signalized Intersection Results Summary



| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing + Project | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa18aw.xus | | |
| Project Description | | | | | |

| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 23 | 28 | 56 | 589 | 40 | 71 | 45 | 555 | 176 | 108 | 1647 | 44 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 5.0 | 10.0 | 55.0 | 5.0 | 15.0 | 10.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



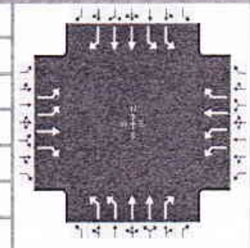

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 10.0 | 15.0 | 25.0 | 30.0 | 10.0 | 60.0 | 20.0 | 70.0 |
| Change Period, ( $Y+R_c$ ), s | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( $MAH$ ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 2.8 | 5.7 | 23.6 | 7.0 | 3.6 | | 5.5 | |
| Green Extension Time ( $g_e$ ), s | 0.0 | 0.1 | 0.3 | 0.3 | 0.0 | 0.0 | 0.2 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 1.00 | 0.37 | 1.00 | 0.00 | 1.00 | | 0.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 25 | 30 | 50 | 640 | 43 | 77 | 49 | 603 | 148 | 117 | 1790 | 37 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1730 | 1870 | 1518 | 1730 | 1870 | | 1730 | 1781 | 1557 | 1730 | 1781 | 1558 |
| Queue Service Time ( $g_s$ ), s | 0.8 | 1.8 | 3.7 | 21.6 | 2.3 | | 1.6 | 13.3 | 6.8 | 3.5 | 55.6 | 1.3 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 0.8 | 1.8 | 3.7 | 21.6 | 2.3 | | 1.6 | 13.3 | 6.8 | 3.5 | 55.6 | 1.3 |
| Green Ratio ( $g/C$ ) | 0.04 | 0.08 | 0.08 | 0.21 | 0.21 | | 0.04 | 0.46 | 0.46 | 0.17 | 0.54 | 0.54 |
| Capacity ( $c$ ), veh/h | 144 | 156 | 126 | 721 | 390 | | 144 | 1632 | 714 | 577 | 1929 | 844 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.173 | 0.195 | 0.395 | 0.888 | 0.112 | | 0.339 | 0.370 | 0.207 | 0.204 | 0.928 | 0.044 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 16.8 | 39.3 | 66 | 392.7 | 46.7 | | 32.1 | 228.8 | 110.9 | 66.2 | 777.1 | 20.5 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 0.7 | 1.5 | 2.6 | 15.5 | 1.8 | | 1.3 | 9.0 | 4.4 | 2.6 | 30.6 | 0.8 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 55.5 | 51.3 | 52.1 | 46.1 | 38.5 | | 55.9 | 21.2 | 19.5 | 43.1 | 25.3 | 12.9 |
| Incremental Delay ( $d_2$ ), s/veh | 0.2 | 0.2 | 0.7 | 12.6 | 0.0 | | 0.5 | 0.6 | 0.7 | 0.1 | 9.3 | 0.1 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 55.7 | 51.5 | 52.9 | 58.8 | 38.5 | 0.0 | 56.4 | 21.8 | 20.1 | 43.2 | 34.7 | 13.0 |
| Level of Service (LOS) | E | D | D | E | D | A | E | C | C | D | C | B |
| Approach Delay, s/veh / LOS | 53.1 | D | | 51.6 | D | | 23.6 | C | | 34.8 | C | |
| Intersection Delay, s/veh / LOS | 36.4 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.67 | C | 2.61 | C | 2.43 | B | 2.43 | B |
| Bicycle LOS Score / LOS | 0.66 | A | 1.74 | B | 1.15 | A | 2.09 | B |

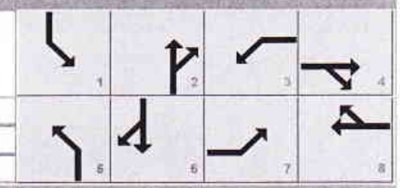
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing + Project | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa18pw.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 188 | 152 | 76 | 295 | 98 | 214 | 222 | 1503 | 433 | 205 | 695 | 80 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 130.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 12.0 | 65.0 | 15.0 | 18.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 4.0 | 4.0 | 4.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 |



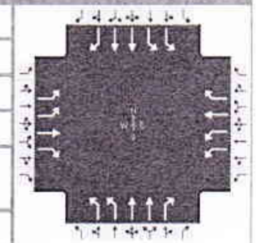
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 20.0 | 23.0 | 20.0 | 23.0 | 17.0 | 70.0 | 17.0 | 70.0 |
| Change Period, ( $Y+R_c$ ), s | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 9.2 | 12.9 | 13.7 | 20.0 | 10.8 | | 10.1 | |
| Green Extension Time ( $g_e$ ), s | 0.2 | 0.6 | 0.1 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.05 | 0.34 | 1.00 | 1.00 | 1.00 | | 1.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( *v* ), veh/h | 204 | 165 | 61 | 321 | 107 | 233 | 241 | 1634 | 362 | 223 | 755 | 65 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 1730 | 1870 | 1561 | 1730 | 1870 | | 1730 | 1781 | 1558 | 1730 | 1781 | 1558 |
| Queue Service Time ( $g_s$ ), s | 7.2 | 10.9 | 4.5 | 11.7 | 6.8 | | 8.8 | 55.1 | 19.7 | 8.1 | 17.5 | 2.8 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 7.2 | 10.9 | 4.5 | 11.7 | 6.8 | | 8.8 | 55.1 | 19.7 | 8.1 | 17.5 | 2.8 |
| Green Ratio ( *g/C* ) | 0.12 | 0.14 | 0.14 | 0.12 | 0.14 | | 0.09 | 0.50 | 0.50 | 0.09 | 0.50 | 0.50 |
| Capacity ( *c* ), veh/h | 399 | 259 | 216 | 399 | 259 | | 319 | 1781 | 779 | 319 | 1781 | 779 |
| Volume-to-Capacity Ratio ( *X* ) | 0.512 | 0.638 | 0.282 | 0.803 | 0.411 | | 0.756 | 0.918 | 0.465 | 0.698 | 0.424 | 0.084 |
| Back of Queue ( *Q* ), ft/ln ( 95 th percentile) | 144.3 | 232.5 | 80.4 | 240.7 | 143.3 | | 188.4 | 796 | 289.9 | 167.8 | 285 | 45.8 |
| Back of Queue ( *Q* ), veh/ln ( 95 th percentile) | 5.7 | 9.2 | 3.2 | 9.5 | 5.6 | | 7.4 | 31.3 | 11.4 | 6.6 | 11.2 | 1.8 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 54.1 | 52.9 | 50.2 | 56.1 | 51.2 | | 57.6 | 30.0 | 21.2 | 57.2 | 20.6 | 17.0 |
| Incremental Delay ( $d_2$ ), s/veh | 0.5 | 4.0 | 0.3 | 10.5 | 0.4 | | 8.9 | 9.0 | 2.0 | 5.6 | 0.7 | 0.2 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | 54.5 | 56.9 | 50.5 | 66.6 | 51.5 | 0.0 | 66.5 | 39.1 | 23.2 | 62.8 | 21.4 | 17.2 |
| Level of Service (LOS) | D | E | D | E | D | A | E | D | C | E | C | B |
| Approach Delay, s/veh / LOS | 54.9 | D | | 40.7 | D | | 39.4 | D | | 30.0 | C | |
| Intersection Delay, s/veh / LOS | 38.9 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.75 | C | 2.64 | C | 2.42 | B | 2.45 | B |
| Bicycle LOS Score / LOS | 1.20 | A | 1.58 | B | 2.33 | B | 1.35 | A |

# HCS7 Signalized Intersection Results Summary

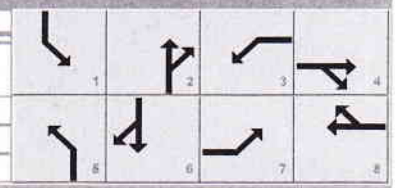
| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing + Phase 1 | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa18awS.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 150 | 152 | 157 | 248 | 160 | 188 | 262 | 754 | 272 | 394 | 692 | 192 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | No | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |

| | | | | | | |
|---|---|---|---|---|---|---|
| Green | 17.0 | 5.0 | 47.0 | 11.0 | 2.0 | 18.0 |
| Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



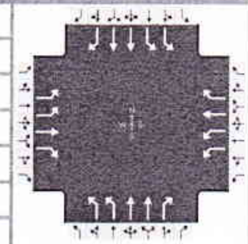

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 16.0 | 23.0 | 18.0 | 25.0 | 22.0 | 52.0 | 27.0 | 57.0 |
| Change Period, ( $Y$+$R_c$ ), s | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 7.4 | 11.9 | 10.6 | 17.3 | 11.2 | | 15.1 | |
| Green Extension Time ( $g_e$ ), s | 0.1 | 0.9 | 0.4 | 0.5 | 0.3 | 0.0 | 0.8 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.54 | 0.24 | 0.01 | 1.00 | 0.05 | | 0.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( *v* ), veh/h | 163 | 165 | 127 | 270 | 174 | 204 | 285 | 820 | 241 | 428 | 752 | 165 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 1730 | 1870 | 1539 | 1730 | 1870 | | 1730 | 1781 | 1556 | 1730 | 1781 | 1557 |
| Queue Service Time ( $g_s$ ), s | 5.4 | 9.9 | 9.2 | 8.6 | 10.3 | | 9.2 | 21.8 | 13.4 | 13.1 | 18.2 | 8.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 5.4 | 9.9 | 9.2 | 8.6 | 10.3 | | 9.2 | 21.8 | 13.4 | 13.1 | 18.2 | 8.1 |
| Green Ratio ( *g/C* ) | 0.09 | 0.15 | 0.15 | 0.15 | 0.17 | | 0.14 | 0.39 | 0.39 | 0.22 | 0.43 | 0.43 |
| Capacity ( *c* ), veh/h | 317 | 281 | 231 | 519 | 312 | | 490 | 1395 | 609 | 778 | 1543 | 675 |
| Volume-to-Capacity Ratio ( *X* ) | 0.514 | 0.589 | 0.551 | 0.520 | 0.558 | | 0.581 | 0.588 | 0.396 | 0.550 | 0.487 | 0.245 |
| Back of Queue ( *Q* ), ft/ln ( 95 th percentile) | 107.5 | 211.1 | 164.6 | 167 | 211.8 | | 178.1 | 353.7 | 219.1 | 233.6 | 299 | 133.1 |
| Back of Queue ( *Q* ), veh/ln ( 95 th percentile) | 4.2 | 8.3 | 6.5 | 6.6 | 8.3 | | 7.0 | 13.9 | 8.6 | 9.2 | 11.8 | 5.2 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 52.0 | 47.6 | 47.3 | 47.0 | 45.9 | | 48.2 | 28.8 | 26.3 | 41.1 | 24.4 | 21.6 |
| Incremental Delay ( $d_2$ ), s/veh | 0.6 | 2.2 | 1.6 | 0.4 | 1.4 | | 1.2 | 1.8 | 1.9 | 0.5 | 1.1 | 0.9 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | 52.6 | 49.8 | 48.9 | 47.4 | 47.3 | 0.0 | 49.3 | 30.7 | 28.2 | 41.6 | 25.5 | 22.4 |
| Level of Service (LOS) | D | D | D | D | D | A | D | C | C | D | C | C |
| Approach Delay, s/veh / LOS | 50.5 | | D | 32.4 | | C | 34.2 | | C | 30.3 | | C |
| Intersection Delay, s/veh / LOS | 34.5 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.67 | C | 2.66 | C | 2.43 | B | 2.49 | B |
| Bicycle LOS Score / LOS | 1.24 | A | 1.56 | B | 1.60 | B | 1.60 | B |

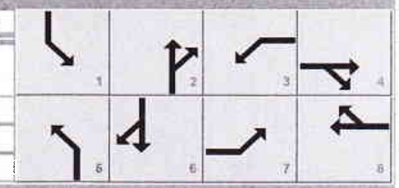
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 Base | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa21ax.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 25 | 30 | 60 | 632 | 43 | 74 | 48 | 594 | 189 | 115 | 1767 | 47 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 5.0 | 10.0 | 55.0 | 5.0 | 15.0 | 10.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



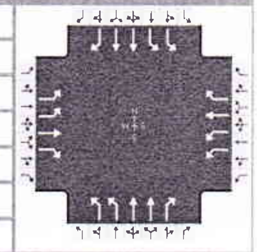
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 10.0 | 15.0 | 25.0 | 30.0 | 10.0 | 60.0 | 20.0 | 70.0 |
| Change Period, ( $Y+R_c$ ), s | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 2.9 | 6.1 | 25.5 | 7.2 | 3.8 | | 5.7 | |
| Green Extension Time ( $g_e$ ), s | 0.0 | 0.2 | 0.0 | 0.4 | 0.0 | 0.0 | 0.2 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 1.00 | 0.52 | 1.00 | 0.00 | 1.00 | | 0.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 27 | 33 | 54 | 687 | 47 | 80 | 52 | 646 | 162 | 125 | 1921 | 40 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1730 | 1870 | 1518 | 1730 | 1870 | | 1730 | 1781 | 1557 | 1730 | 1781 | 1558 |
| Queue Service Time ( $g_s$ ), s | 0.9 | 2.0 | 4.1 | 23.5 | 2.4 | | 1.8 | 14.4 | 7.5 | 3.7 | 64.4 | 1.5 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 0.9 | 2.0 | 4.1 | 23.5 | 2.4 | | 1.8 | 14.4 | 7.5 | 3.7 | 64.4 | 1.5 |
| Green Ratio ( $g/C$ ) | 0.04 | 0.08 | 0.08 | 0.21 | 0.21 | | 0.04 | 0.46 | 0.46 | 0.17 | 0.54 | 0.54 |
| Capacity ( $c$ ), veh/h | 144 | 156 | 126 | 721 | 390 | | 144 | 1632 | 714 | 577 | 1929 | 844 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.189 | 0.209 | 0.430 | 0.953 | 0.120 | | 0.362 | 0.396 | 0.227 | 0.217 | 0.996 | 0.048 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 18.3 | 42.1 | 72.1 | 450.1 | 50.3 | | 34.3 | 244.1 | 122.7 | 70.7 | 952.1 | 22.4 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 0.7 | 1.7 | 2.8 | 17.7 | 2.0 | | 1.4 | 9.6 | 4.8 | 2.8 | 37.5 | 0.9 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 55.5 | 51.3 | 52.3 | 46.9 | 38.6 | | 55.9 | 21.5 | 19.6 | 43.2 | 27.4 | 12.9 |
| Incremental Delay ( $d_2$ ), s/veh | 0.2 | 0.2 | 0.9 | 22.5 | 0.1 | | 0.6 | 0.7 | 0.7 | 0.1 | 19.5 | 0.1 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 55.8 | 51.6 | 53.1 | 69.4 | 38.6 | 0.0 | 56.5 | 22.2 | 20.4 | 43.3 | 46.9 | 13.0 |
| Level of Service (LOS) | E | D | D | E | D | A | E | C | C | D | D | B |
| Approach Delay, s/veh / LOS | 53.3 | D | | 60.8 | E | | 24.0 | C | | 46.0 | D | |
| Intersection Delay, s/veh / LOS | 44.4 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.67 | C | 2.61 | C | 2.43 | B | 2.43 | B |
| Bicycle LOS Score / LOS | 0.68 | A | 1.83 | B | 1.20 | A | 2.21 | B |

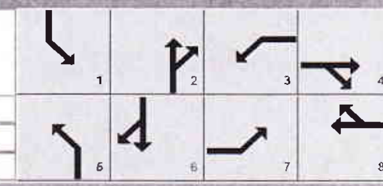
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 Base | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa21px.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( v ), veh/h | 202 | 163 | 82 | 317 | 105 | 229 | 238 | 1612 | 465 | 219 | 744 | 86 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 130.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | | | | | | | |
| Uncoordinated | No | Simult. Gap E/W | On | Green | 12.0 | 65.0 | 15.0 | 18.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Yellow | 4.0 | 4.0 | 4.0 | 4.0 | 0.0 | 0.0 |
| | | | | Red | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 |



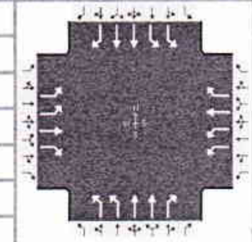

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 20.0 | 23.0 | 20.0 | 23.0 | 17.0 | 70.0 | 17.0 | 70.0 |
| Change Period, ( $Y+R_c$ ), s | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( MAH ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 9.8 | 13.7 | 14.7 | 20.0 | 11.5 | | 10.7 | |
| Green Extension Time ( $g_e$ ), s | 0.2 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.10 | 0.57 | 1.00 | 1.00 | 1.00 | | 1.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( v ), veh/h | 220 | 177 | 67 | 345 | 114 | 249 | 259 | 1752 | 397 | 238 | 809 | 72 |
| Adjusted Saturation Flow Rate ( s ), veh/h/ln | 1730 | 1870 | 1561 | 1730 | 1870 | | 1730 | 1781 | 1558 | 1730 | 1781 | 1558 |
| Queue Service Time ( $g_s$ ), s | 7.8 | 11.7 | 5.1 | 12.7 | 7.3 | | 9.5 | 63.0 | 22.2 | 8.7 | 19.1 | 3.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 7.8 | 11.7 | 5.1 | 12.7 | 7.3 | | 9.5 | 63.0 | 22.2 | 8.7 | 19.1 | 3.1 |
| Green Ratio ( g/C ) | 0.12 | 0.14 | 0.14 | 0.12 | 0.14 | | 0.09 | 0.50 | 0.50 | 0.09 | 0.50 | 0.50 |
| Capacity ( c ), veh/h | 399 | 259 | 216 | 399 | 259 | | 319 | 1781 | 779 | 319 | 1781 | 779 |
| Volume-to-Capacity Ratio ( X ) | 0.550 | 0.684 | 0.312 | 0.863 | 0.441 | | 0.810 | 0.984 | 0.509 | 0.745 | 0.454 | 0.092 |
| Back of Queue ( Q ), ft/ln ( 95 th percentile) | 156.9 | 251.5 | 89.5 | 266.6 | 154.4 | | 206.9 | 950.9 | 320.5 | 184.6 | 306 | 50.6 |
| Back of Queue ( Q ), veh/ln ( 95 th percentile) | 6.2 | 9.9 | 3.6 | 10.5 | 6.1 | | 8.1 | 37.4 | 12.6 | 7.3 | 12.0 | 2.0 |
| Queue Storage Ratio ( RQ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 54.3 | 53.3 | 50.4 | 56.5 | 51.4 | | 57.9 | 32.0 | 21.8 | 57.5 | 21.0 | 17.0 |
| Incremental Delay ( $d_2$ ), s/veh | 0.9 | 6.0 | 0.3 | 16.7 | 0.4 | | 13.5 | 17.9 | 2.4 | 8.2 | 0.8 | 0.2 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( d ), s/veh | 55.3 | 59.3 | 50.7 | 73.2 | 51.8 | 0.0 | 71.4 | 49.9 | 24.2 | 65.7 | 21.9 | 17.3 |
| Level of Service (LOS) | E | E | D | E | D | A | E | D | C | E | C | B |
| Approach Delay, s/veh / LOS | 56.2 | E | | 44.0 | D | | 47.9 | D | | 30.9 | C | |
| Intersection Delay, s/veh / LOS | 44.1 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.75 | C | 2.64 | C | 2.42 | B | 2.45 | B |
| Bicycle LOS Score / LOS | 1.25 | A | 1.66 | B | 2.47 | B | 1.41 | A |

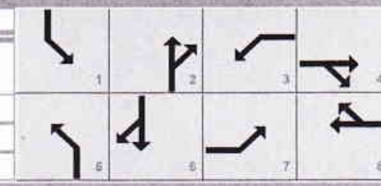
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 Base | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa21axS.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 161 | 163 | 169 | 266 | 172 | 177 | 281 | 771 | 292 | 398 | 703 | 206 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 17.0 | 5.0 | 47.0 | 11.0 | 2.0 | 18.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 16.0 | 23.0 | 18.0 | 25.0 | 22.0 | 52.0 | 27.0 | 57.0 |
| Change Period, ( $Y+R_c$ ), s | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( $MAH$ ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 7.8 | 12.7 | 11.3 | 16.3 | 12.0 | | 15.3 | |
| Green Extension Time ( $g_e$ ), s | 0.1 | 0.8 | 0.4 | 0.7 | 0.3 | 0.0 | 0.8 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.92 | 0.36 | 0.03 | 0.76 | 0.12 | | 0.00 | |

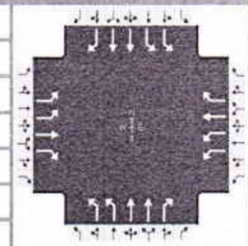
| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 175 | 177 | 140 | 289 | 187 | 192 | 305 | 838 | 263 | 433 | 764 | 180 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1730 | 1870 | 1539 | 1730 | 1870 | | 1730 | 1781 | 1556 | 1730 | 1781 | 1557 |
| Queue Service Time ( $g_s$ ), s | 5.8 | 10.7 | 10.2 | 9.3 | 11.1 | | 10.0 | 22.5 | 14.9 | 13.3 | 18.6 | 8.9 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 5.8 | 10.7 | 10.2 | 9.3 | 11.1 | | 10.0 | 22.5 | 14.9 | 13.3 | 18.6 | 8.9 |
| Green Ratio ( $g/C$ ) | 0.09 | 0.15 | 0.15 | 0.15 | 0.17 | | 0.14 | 0.39 | 0.39 | 0.22 | 0.43 | 0.43 |
| Capacity ( $c$ ), veh/h | 317 | 281 | 231 | 519 | 312 | | 490 | 1395 | 609 | 778 | 1543 | 675 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.552 | 0.632 | 0.607 | 0.557 | 0.600 | | 0.623 | 0.601 | 0.432 | 0.556 | 0.495 | 0.267 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 116.9 | 227.3 | 187.5 | 181.3 | 227.8 | | 193.6 | 362.9 | 238.3 | 235.6 | 304 | 147.2 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 4.6 | 8.9 | 7.4 | 7.1 | 9.0 | | 7.6 | 14.3 | 9.4 | 9.3 | 12.0 | 5.8 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 52.1 | 47.9 | 47.7 | 47.3 | 46.3 | | 48.5 | 29.0 | 26.7 | 41.2 | 24.5 | 21.8 |
| Incremental Delay ( $d_2$ ), s/veh | 1.2 | 3.5 | 3.3 | 0.8 | 2.3 | | 1.8 | 1.9 | 2.2 | 0.5 | 1.1 | 1.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 53.4 | 51.4 | 51.0 | 48.1 | 48.5 | 0.0 | 50.3 | 31.0 | 28.9 | 41.7 | 25.7 | 22.8 |
| Level of Service (LOS) | D | D | D | D | D | A | D | C | C | D | C | C |
| Approach Delay, s/veh / LOS | 52.0 | D | | 34.4 | C | | 34.8 | C | | 30.3 | C | |
| Intersection Delay, s/veh / LOS | 35.3 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.67 | C | 2.66 | C | 2.43 | B | 2.49 | B |
| Bicycle LOS Score / LOS | 1.30 | A | 1.59 | B | 1.65 | B | 1.62 | B |

 HCS7™ Streets Version 7.4 Generated: 6/5/2018 10:00:48 AM

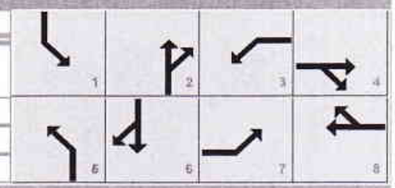
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 w/Buildout | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa21aw.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 25 | 30 | 60 | 632 | 43 | 78 | 48 | 600 | 189 | 117 | 1770 | 47 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 5.0 | 10.0 | 55.0 | 5.0 | 15.0 | 10.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 10.0 | 15.0 | 25.0 | 30.0 | 10.0 | 60.0 | 20.0 | 70.0 |
| Change Period, ( $Y+R_c$ ), s | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( $MAH$ ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 2.9 | 6.1 | 25.5 | 7.5 | 3.8 | | 5.8 | |
| Green Extension Time ( $g_e$ ), s | 0.0 | 0.2 | 0.0 | 0.4 | 0.0 | 0.0 | 0.2 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 1.00 | 0.53 | 1.00 | 0.00 | 1.00 | | 0.00 | |

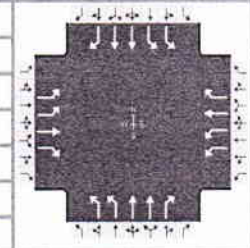
| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 27 | 33 | 54 | 687 | 47 | 85 | 52 | 652 | 162 | 127 | 1924 | 40 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1730 | 1870 | 1518 | 1730 | 1870 | | 1730 | 1781 | 1557 | 1730 | 1781 | 1558 |
| Queue Service Time ( $g_s$ ), s | 0.9 | 2.0 | 4.1 | 23.5 | 2.4 | | 1.8 | 14.6 | 7.5 | 3.8 | 64.6 | 1.5 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 0.9 | 2.0 | 4.1 | 23.5 | 2.4 | | 1.8 | 14.6 | 7.5 | 3.8 | 64.6 | 1.5 |
| Green Ratio ( $g/C$ ) | 0.04 | 0.08 | 0.08 | 0.21 | 0.21 | | 0.04 | 0.46 | 0.46 | 0.17 | 0.54 | 0.54 |
| Capacity ( $c$ ), veh/h | 144 | 156 | 126 | 721 | 390 | | 144 | 1632 | 714 | 577 | 1929 | 844 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.189 | 0.209 | 0.430 | 0.953 | 0.120 | | 0.362 | 0.400 | 0.227 | 0.221 | 0.997 | 0.048 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 18.3 | 42.1 | 72.1 | 450.1 | 50.3 | | 34.3 | 246.4 | 122.7 | 71.9 | 958.6 | 22.4 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 0.7 | 1.7 | 2.8 | 17.7 | 2.0 | | 1.4 | 9.7 | 4.8 | 2.8 | 37.7 | 0.9 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 55.5 | 51.3 | 52.3 | 46.9 | 38.6 | | 55.9 | 21.6 | 19.6 | 43.3 | 27.4 | 12.9 |
| Incremental Delay ( $d_2$ ), s/veh | 0.2 | 0.2 | 0.9 | 22.5 | 0.1 | | 0.6 | 0.7 | 0.7 | 0.1 | 19.9 | 0.1 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 55.8 | 51.6 | 53.1 | 69.4 | 38.6 | 0.0 | 56.5 | 22.3 | 20.4 | 43.3 | 47.3 | 13.0 |
| Level of Service (LOS) | E | D | D | E | D | A | E | C | C | D | D | B |
| Approach Delay, s/veh / LOS | 53.3 | D | | 60.5 | E | | 24.0 | C | | 46.4 | D | |
| Intersection Delay, s/veh / LOS | 44.6 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.67 | C | 2.61 | C | 2.43 | B | 2.43 | B |
| Bicycle LOS Score / LOS | 0.68 | A | 1.84 | B | 1.20 | A | 2.21 | B |

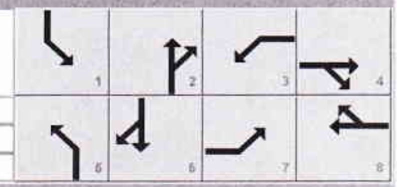
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 w/Buildout | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa21pw.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 202 | 163 | 82 | 317 | 105 | 232 | 238 | 1617 | 465 | 222 | 749 | 86 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 130.0 | Reference Phase | 2 | Green | 12.0 | 65.0 | 15.0 | 18.0 | 0.0 | 0.0 |
| Offset, s | 0 | Reference Point | End | Yellow | 4.0 | 4.0 | 4.0 | 4.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Red | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | | | | | | | |



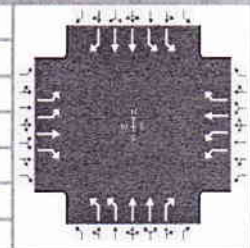

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 20.0 | 23.0 | 20.0 | 23.0 | 17.0 | 70.0 | 17.0 | 70.0 |
| Change Period, ( $Y+R_c$ ), s | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 9.8 | 13.7 | 14.7 | 20.0 | 11.5 | | 10.8 | |
| Green Extension Time ( $g_e$ ), s | 0.2 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.10 | 0.57 | 1.00 | 1.00 | 1.00 | | 1.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 220 | 177 | 67 | 345 | 114 | 252 | 259 | 1758 | 397 | 241 | 814 | 72 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1730 | 1870 | 1561 | 1730 | 1870 | | 1730 | 1781 | 1558 | 1730 | 1781 | 1558 |
| Queue Service Time ( $g_s$ ), s | 7.8 | 11.7 | 5.1 | 12.7 | 7.3 | | 9.5 | 63.3 | 22.2 | 8.8 | 19.3 | 3.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 7.8 | 11.7 | 5.1 | 12.7 | 7.3 | | 9.5 | 63.3 | 22.2 | 8.8 | 19.3 | 3.1 |
| Green Ratio ( $g/C$ ) | 0.12 | 0.14 | 0.14 | 0.12 | 0.14 | | 0.09 | 0.50 | 0.50 | 0.09 | 0.50 | 0.50 |
| Capacity ( $c$ ), veh/h | 399 | 259 | 216 | 399 | 259 | | 319 | 1781 | 779 | 319 | 1781 | 779 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.550 | 0.684 | 0.312 | 0.863 | 0.441 | | 0.810 | 0.987 | 0.509 | 0.756 | 0.457 | 0.092 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 156.9 | 251.5 | 89.5 | 266.6 | 154.4 | | 206.9 | 959.7 | 320.5 | 188.4 | 308 | 50.6 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 6.2 | 9.9 | 3.6 | 10.5 | 6.1 | | 8.1 | 37.8 | 12.6 | 7.4 | 12.1 | 2.0 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 54.3 | 53.3 | 50.4 | 56.5 | 51.4 | | 57.9 | 32.1 | 21.8 | 57.6 | 21.1 | 17.0 |
| Incremental Delay ( $d_2$ ), s/veh | 0.9 | 6.0 | 0.3 | 16.7 | 0.4 | | 13.5 | 18.5 | 2.4 | 8.9 | 0.8 | 0.2 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 55.3 | 59.3 | 50.7 | 73.2 | 51.8 | 0.0 | 71.4 | 50.6 | 24.2 | 66.5 | 21.9 | 17.3 |
| Level of Service (LOS) | E | E | D | E | D | A | E | D | C | E | C | B |
| Approach Delay, s/veh / LOS | 56.2 | E | | 43.8 | D | | 48.5 | D | | 31.2 | C | |
| Intersection Delay, s/veh / LOS | 44.4 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.75 | C | 2.64 | C | 2.42 | B | 2.45 | B |
| Bicycle LOS Score / LOS | 1.25 | A | 1.66 | B | 2.48 | B | 1.42 | A |

# HCS7 Signalized Intersection Results Summary

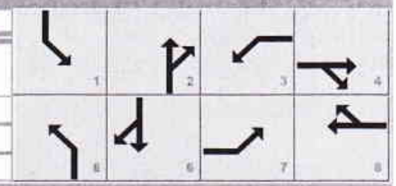
| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 w/Buildout | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Los Altos | File Name | PyLa21awS.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 161 | 163 | 169 | 266 | 172 | 238 | 281 | 868 | 292 | 459 | 801 | 206 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | No | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |

| | | | | | | |
|---|---|---|---|---|---|---|
| Green | 21.0 | 5.0 | 44.0 | 10.0 | 2.0 | 18.0 |
| Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



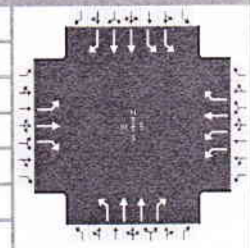
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 15.0 | 23.0 | 17.0 | 25.0 | 26.0 | 49.0 | 31.0 | 54.0 |
| Change Period, ( $Y+R_c$ ), s | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 7.9 | 12.7 | 11.4 | 22.0 | 11.6 | | 17.0 | |
| Green Extension Time ( $g_e$ ), s | 0.1 | 0.9 | 0.3 | 0.0 | 0.5 | 0.0 | 1.0 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 1.00 | 0.40 | 0.08 | 1.00 | 0.00 | | 0.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( *v* ), veh/h | 175 | 177 | 140 | 289 | 187 | 259 | 305 | 943 | 263 | 499 | 871 | 180 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 1730 | 1870 | 1539 | 1730 | 1870 | | 1730 | 1781 | 1555 | 1730 | 1781 | 1556 |
| Queue Service Time ( $g_s$ ), s | 5.9 | 10.7 | 10.2 | 9.4 | 11.1 | | 9.6 | 27.4 | 15.5 | 15.0 | 23.0 | 9.3 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 5.9 | 10.7 | 10.2 | 9.4 | 11.1 | | 9.6 | 27.4 | 15.5 | 15.0 | 23.0 | 9.3 |
| Green Ratio ( *g/C* ) | 0.08 | 0.15 | 0.15 | 0.14 | 0.17 | | 0.18 | 0.37 | 0.37 | 0.26 | 0.41 | 0.41 |
| Capacity ( *c* ), veh/h | 288 | 281 | 231 | 490 | 312 | | 605 | 1306 | 570 | 894 | 1454 | 635 |
| Volume-to-Capacity Ratio ( *X* ) | 0.607 | 0.632 | 0.607 | 0.590 | 0.600 | | 0.505 | 0.723 | 0.461 | 0.558 | 0.599 | 0.284 |
| Back of Queue ( *Q* ), ft/ln ( 95 th percentile) | 120.4 | 227.3 | 187.5 | 184.7 | 227.8 | | 180.8 | 436.6 | 248.9 | 257.4 | 367.3 | 155.7 |
| Back of Queue ( *Q* ), veh/ln ( 95 th percentile) | 4.7 | 8.9 | 7.4 | 7.3 | 9.0 | | 7.1 | 17.2 | 9.8 | 10.1 | 14.5 | 6.1 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 53.1 | 47.9 | 47.7 | 48.2 | 46.3 | | 44.8 | 32.7 | 29.0 | 38.6 | 27.8 | 23.8 |
| Incremental Delay ( $d_2$ ), s/veh | 2.6 | 3.5 | 3.3 | 1.3 | 2.3 | | 0.3 | 3.5 | 2.7 | 0.5 | 1.8 | 1.1 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | 55.7 | 51.4 | 51.0 | 49.5 | 48.5 | 0.0 | 45.1 | 36.2 | 31.6 | 39.0 | 29.6 | 24.9 |
| Level of Service (LOS) | E | D | D | D | D | A | D | D | C | D | C | C |
| Approach Delay, s/veh / LOS | 52.8 | D | | 31.8 | C | | 37.2 | D | | 32.1 | C | |
| Intersection Delay, s/veh / LOS | 36.2 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.67 | C | 2.66 | C | 2.44 | B | 2.49 | B |
| Bicycle LOS Score / LOS | 1.30 | A | 1.70 | B | 1.73 | B | 1.77 | B |

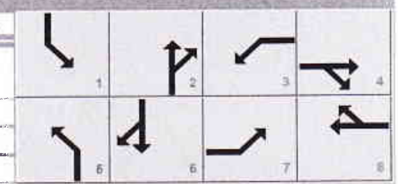
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Sparks | File Name | PySp18ax.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 221 | 193 | 94 | 23 | 149 | 324 | 108 | 514 | 18 | 470 | 1284 | 426 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 14.0 | 3.0 | 50.0 | 5.0 | 11.0 | 17.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



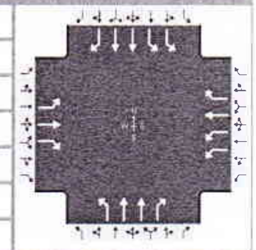

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 21.0 | 33.0 | 10.0 | 22.0 | 19.0 | 55.0 | 22.0 | 58.0 |
| Change Period, ( $Y+R_c$ ), s | 0.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 16.7 | 13.1 | 2.8 | 19.0 | 9.6 | | 18.2 | |
| Green Extension Time ( $g_e$ ), s | 0.2 | 1.4 | 0.0 | 0.0 | 0.1 | 0.0 | 0.5 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.35 | 0.01 | 1.00 | 1.00 | 0.14 | | 0.52 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( *v* ), veh/h | 240 | 210 | 102 | 25 | 162 | 298 | 117 | 559 | 20 | 511 | 1396 | 354 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 1856 | 1949 | | 1730 | 1870 | | 1759 | 1758 | 1537 | 1802 | 1855 | 1602 |
| Queue Service Time ( $g_s$ ), s | 14.7 | 11.1 | | 0.8 | 9.8 | | 7.6 | 13.2 | 0.9 | 16.2 | 40.4 | 19.0 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 14.7 | 11.1 | | 0.8 | 9.8 | | 7.6 | 13.2 | 0.9 | 16.2 | 40.4 | 19.0 |
| Green Ratio ( *g/C* ) | 0.18 | 0.23 | | 0.04 | 0.14 | | 0.12 | 0.42 | 0.42 | 0.18 | 0.44 | 0.44 |
| Capacity ( *c* ), veh/h | 325 | 455 | | 144 | 265 | | 205 | 1465 | 640 | 661 | 1639 | 708 |
| Volume-to-Capacity Ratio ( *X* ) | 0.740 | 0.461 | | 0.173 | 0.611 | | 0.572 | 0.381 | 0.031 | 0.773 | 0.852 | 0.501 |
| Back of Queue ( *Q* ), ft/ln ( 95 th percentile) | 302 | 230.8 | | 16.5 | 208.3 | | 152.5 | 229.9 | 14.7 | 300.5 | 623.1 | 292.7 |
| Back of Queue ( *Q* ), veh/ln ( 95 th percentile) | 11.9 | 9.1 | | 0.7 | 8.2 | | 6.0 | 9.1 | 0.6 | 11.8 | 24.5 | 11.5 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 46.9 | 39.5 | | 55.5 | 48.4 | | 50.2 | 24.3 | 20.7 | 46.6 | 30.0 | 24.0 |
| Incremental Delay ( $d_2$ ), s/veh | 7.7 | 0.3 | | 0.2 | 3.0 | | 2.5 | 0.8 | 0.1 | 5.2 | 5.8 | 2.5 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | 54.6 | 39.8 | 0.0 | 55.7 | 51.4 | 0.0 | 52.6 | 25.0 | 20.8 | 51.8 | 35.8 | 26.5 |
| Level of Service (LOS) | D | D | A | E | D | A | D | C | C | D | D | C |
| Approach Delay, s/veh / LOS | 38.9 | D | | 20.0 | C | | 29.6 | C | | 37.9 | D | |
| Intersection Delay, s/veh / LOS | 34.4 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.45 | B | 2.75 | C | 2.50 | C | 2.11 | B |
| Bicycle LOS Score / LOS | 1.40 | A | 1.29 | A | 1.06 | A | 2.35 | B |

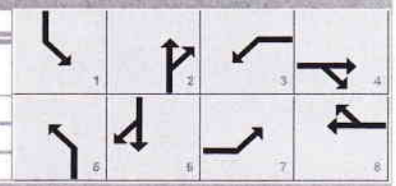
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Sparks | File Name | PySp18px.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 325 | 247 | 116 | 32 | 256 | 633 | 205 | 1325 | 20 | 252 | 667 | 168 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 130.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 12.0 | 10.0 | 47.0 | 6.0 | 15.0 | 20.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



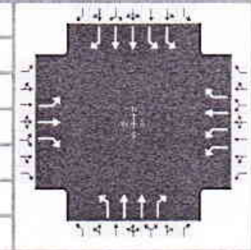
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 26.0 | 40.0 | 11.0 | 25.0 | 27.0 | 62.0 | 17.0 | 52.0 |
| Change Period, ( $Y+R_c$ ), s | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.1 | 3.0 | 3.1 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 26.5 | 17.2 | 3.3 | 22.0 | 16.9 | | 11.7 | |
| Green Extension Time ( $g_e$ ), s | 0.0 | 1.8 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | | 1.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 353 | 268 | 126 | 35 | 278 | 253 | 223 | 1440 | 22 | 274 | 725 | 183 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1856 | 1949 | | 1730 | 1870 | | 1759 | 1758 | 1537 | 1802 | 1855 | 1599 |
| Queue Service Time ( $g_s$ ), s | 24.5 | 15.2 | | 1.3 | 19.2 | | 14.9 | 50.6 | 1.0 | 9.7 | 20.2 | 10.7 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 24.5 | 15.2 | | 1.3 | 19.2 | | 14.9 | 50.6 | 1.0 | 9.7 | 20.2 | 10.7 |
| Green Ratio ( $g/C$ ) | 0.20 | 0.27 | | 0.05 | 0.15 | | 0.21 | 0.44 | 0.44 | 0.09 | 0.36 | 0.36 |
| Capacity ( $c$ ), veh/h | 371 | 525 | | 160 | 288 | | 365 | 1542 | 674 | 333 | 1341 | 578 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.952 | 0.512 | | 0.218 | 0.967 | | 0.610 | 0.934 | 0.032 | 0.823 | 0.540 | 0.316 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 534.6 | 297.8 | | 25.1 | 458.9 | | 270.9 | 764.8 | 17.2 | 217.6 | 349.1 | 190 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 21.0 | 11.7 | | 1.0 | 18.1 | | 10.7 | 30.1 | 0.7 | 8.6 | 13.7 | 7.5 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 51.4 | 40.3 | | 59.7 | 54.7 | | 46.7 | 34.7 | 20.8 | 58.0 | 32.9 | 29.9 |
| Incremental Delay ( $d_2$ ), s/veh | 34.0 | 0.4 | | 0.3 | 43.7 | | 2.2 | 11.8 | 0.1 | 14.4 | 1.6 | 1.4 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 85.4 | 40.6 | 0.0 | 60.0 | 98.4 | 0.0 | 48.9 | 46.5 | 20.9 | 72.4 | 34.5 | 31.3 |
| Level of Service (LOS) | F | D | A | E | F | A | D | D | C | E | C | C |
| Approach Delay, s/veh / LOS | 54.9 | D | | 52.0 | D | | 46.5 | D | | 42.8 | D | |
| Intersection Delay, s/veh / LOS | 47.7 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.45 | B | 2.61 | C | 3.00 | C | 2.12 | B |
| Bicycle LOS Score / LOS | 1.72 | B | 1.42 | A | 1.88 | B | 1.46 | A |

# HCS7 Signalized Intersection Results Summary

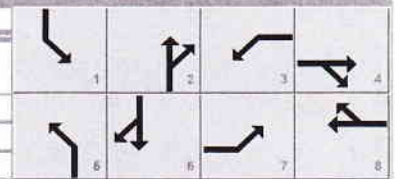
| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Sparks | File Name | PySp18axS.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 91 | 112 | 244 | 32 | 88 | 201 | 165 | 623 | 18 | 212 | 897 | 90 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | No | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |

| | | | | | | |
|---|---|---|---|---|---|---|
| Green | 13.0 | 6.0 | 49.0 | 11.0 | 5.0 | 16.0 |
| Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



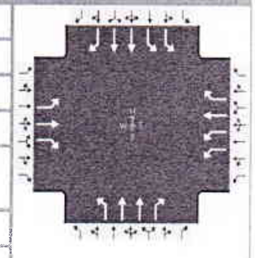

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 21.0 | 26.0 | 16.0 | 21.0 | 24.0 | 60.0 | 18.0 | 54.0 |
| Change Period, ( $Y+R_c$ ), s | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( $MAH$ ), s | 3.1 | 3.3 | 3.0 | 3.3 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 7.6 | 21.2 | 3.1 | 14.4 | 12.9 | | 9.3 | |
| Green Extension Time ( $g_e$ ), s | 0.1 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | 0.2 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 | | 0.41 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 99 | 122 | 265 | 35 | 96 | 164 | 179 | 677 | 20 | 230 | 975 | 98 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1856 | 1949 | | 1730 | 1870 | | 1759 | 1758 | 1538 | 1802 | 1855 | 1601 |
| Queue Service Time ( $g_s$ ), s | 5.6 | 6.6 | | 1.1 | 5.6 | | 10.9 | 15.5 | 0.8 | 7.3 | 25.3 | 4.6 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 5.6 | 6.6 | | 1.1 | 5.6 | | 10.9 | 15.5 | 0.8 | 7.3 | 25.3 | 4.6 |
| Green Ratio ( $g/C$ ) | 0.18 | 0.18 | | 0.09 | 0.13 | | 0.20 | 0.46 | 0.46 | 0.11 | 0.41 | 0.41 |
| Capacity ( $c$ ), veh/h | 325 | 341 | | 317 | 249 | | 352 | 1612 | 705 | 390 | 1515 | 654 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.305 | 0.357 | | 0.110 | 0.384 | | 0.510 | 0.420 | 0.028 | 0.590 | 0.644 | 0.150 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 117.3 | 145.7 | | 21.6 | 117.9 | | 205.1 | 256.4 | 13.4 | 148.7 | 412.2 | 78.8 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 4.6 | 5.7 | | 0.8 | 4.6 | | 8.1 | 10.1 | 0.5 | 5.9 | 16.2 | 3.1 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 43.1 | 43.6 | | 50.0 | 47.5 | | 42.8 | 21.8 | 17.8 | 51.0 | 28.5 | 22.4 |
| Incremental Delay ( $d_2$ ), s/veh | 0.2 | 0.2 | | 0.1 | 0.4 | | 0.5 | 0.8 | 0.1 | 1.6 | 2.1 | 0.5 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 43.3 | 43.8 | 0.0 | 50.1 | 47.9 | 0.0 | 43.3 | 22.6 | 17.9 | 52.6 | 30.6 | 22.9 |
| Level of Service (LOS) | D | D | A | D | D | A | D | C | B | D | C | C |
| Approach Delay, s/veh / LOS | 19.8 | B | | 21.5 | C | | 26.7 | C | | 33.9 | C | |
| Intersection Delay, s/veh / LOS | 28.2 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.60 | C | 2.50 | B | 2.11 | B |
| Bicycle LOS Score / LOS | 1.29 | A | 0.97 | A | 1.21 | A | 1.56 | B |

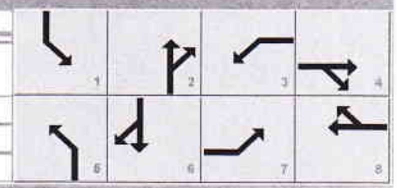
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing + Phase 1 | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Sparks | File Name | PySp18aw.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 221 | 193 | 95 | 23 | 149 | 324 | 108 | 515 | 18 | 470 | 1285 | 426 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 14.0 | 3.0 | 50.0 | 5.0 | 11.0 | 17.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



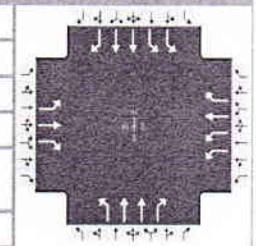

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 21.0 | 33.0 | 10.0 | 22.0 | 19.0 | 55.0 | 22.0 | 58.0 |
| Change Period, ( $Y+R_c$ ), s | 0.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 16.7 | 13.1 | 2.8 | 19.0 | 9.6 | | 18.2 | |
| Green Extension Time ( $g_e$ ), s | 0.2 | 1.4 | 0.0 | 0.0 | 0.1 | 0.0 | 0.5 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.35 | 0.01 | 1.00 | 1.00 | 0.14 | | 0.52 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( *v* ), veh/h | 240 | 210 | 103 | 25 | 162 | 298 | 117 | 560 | 20 | 511 | 1397 | 354 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 1856 | 1949 | | 1730 | 1870 | | 1759 | 1758 | 1537 | 1802 | 1855 | 1602 |
| Queue Service Time ( $g_s$ ), s | 14.7 | 11.1 | | 0.8 | 9.8 | | 7.6 | 13.3 | 0.9 | 16.2 | 40.5 | 19.0 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 14.7 | 11.1 | | 0.8 | 9.8 | | 7.6 | 13.3 | 0.9 | 16.2 | 40.5 | 19.0 |
| Green Ratio ( *g/C* ) | 0.18 | 0.23 | | 0.04 | 0.14 | | 0.12 | 0.42 | 0.42 | 0.18 | 0.44 | 0.44 |
| Capacity ( *c* ), veh/h | 325 | 455 | | 144 | 265 | | 205 | 1465 | 640 | 661 | 1639 | 708 |
| Volume-to-Capacity Ratio ( *X* ) | 0.740 | 0.461 | | 0.173 | 0.611 | | 0.572 | 0.382 | 0.031 | 0.773 | 0.852 | 0.501 |
| Back of Queue ( *Q* ), ft/ln ( 95 th percentile) | 302 | 230.8 | | 16.5 | 208.3 | | 152.5 | 230 | 14.7 | 300.5 | 624.2 | 292.7 |
| Back of Queue ( *Q* ), veh/ln ( 95 th percentile) | 11.9 | 9.1 | | 0.7 | 8.2 | | 6.0 | 9.1 | 0.6 | 11.8 | 24.6 | 11.5 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 46.9 | 39.5 | | 55.5 | 48.4 | | 50.2 | 24.3 | 20.7 | 46.6 | 30.0 | 24.0 |
| Incremental Delay ( $d_2$ ), s/veh | 7.7 | 0.3 | | 0.2 | 3.0 | | 2.5 | 0.8 | 0.1 | 5.2 | 5.8 | 2.5 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | 54.6 | 39.8 | 0.0 | 55.7 | 51.4 | 0.0 | 52.6 | 25.0 | 20.8 | 51.8 | 35.8 | 26.5 |
| Level of Service (LOS) | D | D | A | E | D | A | D | C | C | D | D | C |
| Approach Delay, s/veh / LOS | 38.8 | D | | 20.0 | C | | 29.6 | C | | 38.0 | D | |
| Intersection Delay, s/veh / LOS | 34.4 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.45 | B | 2.75 | C | 2.50 | C | 2.11 | B |
| Bicycle LOS Score / LOS | 1.40 | A | 1.29 | A | 1.06 | A | 2.35 | B |

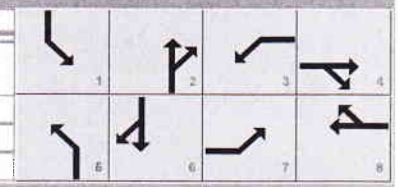
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing + Phase 1 | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Sparks | File Name | PySp18pw.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 325 | 247 | 116 | 32 | 256 | 633 | 205 | 1326 | 20 | 252 | 668 | 168 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 130.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 12.0 | 10.0 | 47.0 | 6.0 | 15.0 | 20.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



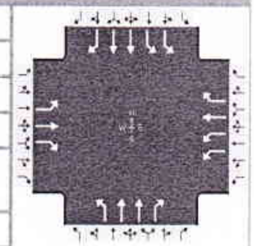
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 26.0 | 40.0 | 11.0 | 25.0 | 27.0 | 62.0 | 17.0 | 52.0 |
| Change Period, ( *Y+R* $_c$ ), s | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.1 | 3.0 | 3.1 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 26.5 | 17.2 | 3.3 | 22.0 | 16.9 | | 11.7 | |
| Green Extension Time ( $g_e$ ), s | 0.0 | 1.8 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | | 1.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( *v* ), veh/h | 353 | 268 | 126 | 35 | 278 | 253 | 223 | 1441 | 22 | 274 | 726 | 183 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 1856 | 1949 | | 1730 | 1870 | | 1759 | 1758 | 1537 | 1802 | 1855 | 1599 |
| Queue Service Time ( $g_s$ ), s | 24.5 | 15.2 | | 1.3 | 19.2 | | 14.9 | 50.7 | 1.0 | 9.7 | 20.2 | 10.7 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 24.5 | 15.2 | | 1.3 | 19.2 | | 14.9 | 50.7 | 1.0 | 9.7 | 20.2 | 10.7 |
| Green Ratio ( *g/C* ) | 0.20 | 0.27 | | 0.05 | 0.15 | | 0.21 | 0.44 | 0.44 | 0.09 | 0.36 | 0.36 |
| Capacity ( *c* ), veh/h | 371 | 525 | | 160 | 288 | | 365 | 1542 | 674 | 333 | 1341 | 578 |
| Volume-to-Capacity Ratio ( *X* ) | 0.952 | 0.512 | | 0.218 | 0.967 | | 0.610 | 0.935 | 0.032 | 0.823 | 0.541 | 0.316 |
| Back of Queue ( *Q* ), ft/ln ( 95 th percentile) | 534.6 | 297.8 | | 25.1 | 458.9 | | 270.9 | 767 | 17.2 | 217.6 | 349.8 | 190 |
| Back of Queue ( *Q* ), veh/ln ( 95 th percentile) | 21.0 | 11.7 | | 1.0 | 18.1 | | 10.7 | 30.2 | 0.7 | 8.6 | 13.8 | 7.5 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 51.4 | 40.3 | | 59.7 | 54.7 | | 46.7 | 34.7 | 20.8 | 58.0 | 32.9 | 29.9 |
| Incremental Delay ( $d_2$ ), s/veh | 34.0 | 0.4 | | 0.3 | 43.7 | | 2.2 | 11.9 | 0.1 | 14.4 | 1.6 | 1.4 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | 85.4 | 40.6 | 0.0 | 60.0 | 98.4 | 0.0 | 48.9 | 46.6 | 20.9 | 72.4 | 34.5 | 31.3 |
| Level of Service (LOS) | F | D | A | E | F | A | D | D | C | E | C | C |
| Approach Delay, s/veh / LOS | 54.9 | D | | 52.0 | D | | 46.6 | D | | 42.8 | D | |
| Intersection Delay, s/veh / LOS | 47.7 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.45 | B | 2.61 | C | 3.00 | C | 2.12 | B |
| Bicycle LOS Score / LOS | 1.72 | B | 1.42 | A | 1.88 | B | 1.46 | A |

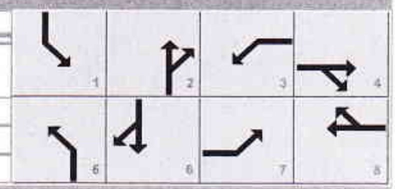
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing + Phase 1 | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Sparks | File Name | PySp18awS.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( v ), veh/h | 91 | 112 | 253 | 35 | 88 | 201 | 174 | 641 | 21 | 212 | 915 | 90 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | | | | | | | |
| Uncoordinated | No | Simult. Gap E/W | On | Green | 13.0 | 6.0 | 49.0 | 11.0 | 5.0 | 16.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| | | | | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |




| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 21.0 | 26.0 | 16.0 | 21.0 | 24.0 | 60.0 | 18.0 | 54.0 |
| Change Period, ( $Y+R_c$ ), s | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( MAH ), s | 3.1 | 3.3 | 3.0 | 3.3 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 7.6 | 22.1 | 3.2 | 14.4 | 13.6 | | 9.3 | |
| Green Extension Time ( $g_e$ ), s | 0.1 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | 0.2 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 | | 0.41 | |

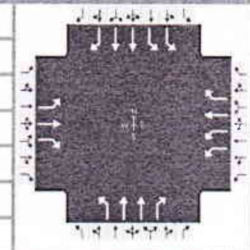
| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( v ), veh/h | 99 | 122 | 275 | 38 | 96 | 164 | 189 | 697 | 23 | 230 | 995 | 98 |
| Adjusted Saturation Flow Rate ( s ), veh/h/ln | 1856 | 1949 | | 1730 | 1870 | | 1759 | 1758 | 1538 | 1802 | 1855 | 1601 |
| Queue Service Time ( $g_s$ ), s | 5.6 | 6.6 | | 1.2 | 5.6 | | 11.6 | 16.1 | 1.0 | 7.3 | 26.0 | 4.6 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 5.6 | 6.6 | | 1.2 | 5.6 | | 11.6 | 16.1 | 1.0 | 7.3 | 26.0 | 4.6 |
| Green Ratio ( g/C ) | 0.18 | 0.18 | | 0.09 | 0.13 | | 0.20 | 0.46 | 0.46 | 0.11 | 0.41 | 0.41 |
| Capacity ( c ), veh/h | 325 | 341 | | 317 | 249 | | 352 | 1612 | 705 | 390 | 1515 | 654 |
| Volume-to-Capacity Ratio ( X ) | 0.305 | 0.357 | | 0.120 | 0.384 | | 0.538 | 0.432 | 0.032 | 0.590 | 0.656 | 0.150 |
| Back of Queue ( Q ), ft/ln ( 95 th percentile) | 117.3 | 145.7 | | 23.6 | 117.9 | | 216.1 | 264.1 | 15.6 | 148.7 | 422.3 | 78.8 |
| Back of Queue ( Q ), veh/ln ( 95 th percentile) | 4.6 | 5.7 | | 0.9 | 4.6 | | 8.5 | 10.4 | 0.6 | 5.9 | 16.6 | 3.1 |
| Queue Storage Ratio ( RQ ) ( 95 th percentile) | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 43.1 | 43.6 | | 50.1 | 47.5 | | 43.0 | 22.0 | 17.9 | 51.0 | 28.7 | 22.4 |
| Incremental Delay ( $d_2$ ), s/veh | 0.2 | 0.2 | | 0.1 | 0.4 | | 0.9 | 0.8 | 0.1 | 1.6 | 2.2 | 0.5 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( d ), s/veh | 43.3 | 43.8 | 0.0 | 50.1 | 47.9 | 0.0 | 43.9 | 22.8 | 18.0 | 52.6 | 30.9 | 22.9 |
| Level of Service (LOS) | D | D | A | D | D | A | D | C | B | D | C | C |
| Approach Delay, s/veh / LOS | 19.4 | B | | 21.8 | C | | 27.1 | C | | 34.1 | C | |
| Intersection Delay, s/veh / LOS | 28.4 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.60 | C | 2.50 | B | 2.11 | B |
| Bicycle LOS Score / LOS | 1.31 | A | 0.98 | A | 1.24 | A | 1.58 | B |

 HCS7™ Streets Version 7.4 Generated: 6/5/2018 10:06:00 AM

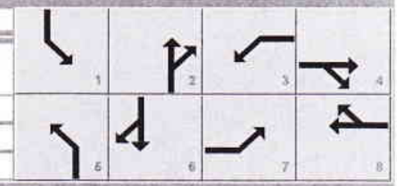
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 Base | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Sparks | File Name | PySp21ax.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( v ), veh/h | 237 | 207 | 101 | 25 | 160 | 348 | 116 | 552 | 19 | 505 | 1379 | 457 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 14.0 | 3.0 | 50.0 | 5.0 | 11.0 | 17.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



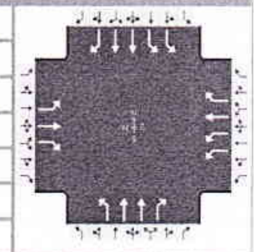

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 21.0 | 33.0 | 10.0 | 22.0 | 19.0 | 55.0 | 22.0 | 58.0 |
| Change Period, ( $Y+R_c$ ), s | 0.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.2 | 3.0 | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 18.0 | 14.0 | 2.9 | 19.0 | 10.2 | | 19.6 | |
| Green Extension Time ( $g_e$ ), s | 0.2 | 1.5 | 0.0 | 0.0 | 0.1 | 0.0 | 0.4 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 1.00 | 0.01 | 1.00 | 1.00 | 0.32 | | 1.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( v ), veh/h | 258 | 225 | 110 | 27 | 174 | 324 | 126 | 600 | 21 | 549 | 1499 | 388 |
| Adjusted Saturation Flow Rate ( s ), veh/h/ln | 1856 | 1949 | | 1730 | 1870 | | 1759 | 1758 | 1537 | 1802 | 1855 | 1602 |
| Queue Service Time ( $g_s$ ), s | 16.0 | 12.0 | | 0.9 | 10.6 | | 8.2 | 14.4 | 1.0 | 17.6 | 45.4 | 21.4 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 16.0 | 12.0 | | 0.9 | 10.6 | | 8.2 | 14.4 | 1.0 | 17.6 | 45.4 | 21.4 |
| Green Ratio ( *g/C* ) | 0.18 | 0.23 | | 0.04 | 0.14 | | 0.12 | 0.42 | 0.42 | 0.18 | 0.44 | 0.44 |
| Capacity ( c ), veh/h | 325 | 455 | | 144 | 265 | | 205 | 1465 | 640 | 661 | 1639 | 708 |
| Volume-to-Capacity Ratio ( X ) | 0.793 | 0.495 | | 0.189 | 0.656 | | 0.614 | 0.410 | 0.032 | 0.831 | 0.915 | 0.548 |
| Back of Queue ( Q ), ft/ln ( 95 th percentile) | 332.4 | 245.8 | | 18 | 225.1 | | 168.1 | 246.1 | 15.5 | 330.1 | 709.7 | 323.6 |
| Back of Queue ( Q ), veh/ln ( 95 th percentile) | 13.1 | 9.7 | | 0.7 | 8.9 | | 6.6 | 9.7 | 0.6 | 13.0 | 27.9 | 12.7 |
| Queue Storage Ratio ( RQ ) ( 95 th percentile) | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 47.4 | 39.9 | | 55.5 | 48.7 | | 50.4 | 24.6 | 20.7 | 47.2 | 31.4 | 24.7 |
| Incremental Delay ( $d_2$ ), s/veh | 11.7 | 0.3 | | 0.2 | 4.6 | | 4.0 | 0.8 | 0.1 | 8.3 | 9.5 | 3.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( d ), s/veh | 59.1 | 40.2 | 0.0 | 55.8 | 53.4 | 0.0 | 54.4 | 25.5 | 20.8 | 55.5 | 40.8 | 27.7 |
| Level of Service (LOS) | E | D | A | E | D | A | D | C | C | E | D | C |
| Approach Delay, s/veh / LOS | 41.0 | D | | 20.6 | C | | 30.2 | C | | 42.1 | D | |
| Intersection Delay, s/veh / LOS | 37.2 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.45 | B | 2.75 | C | 2.50 | C | 2.11 | B |
| Bicycle LOS Score / LOS | 1.47 | A | 1.35 | A | 1.10 | A | 2.50 | B |

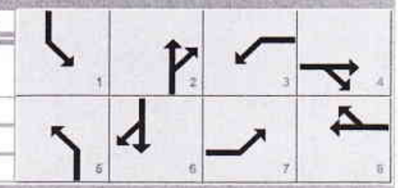
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 Base | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Sparks | File Name | PySp21px.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( v ), veh/h | 349 | 265 | 125 | 34 | 275 | 680 | 220 | 1423 | 21 | 271 | 716 | 180 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 130.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 12.0 | 7.0 | 52.0 | 5.0 | 15.0 | 19.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



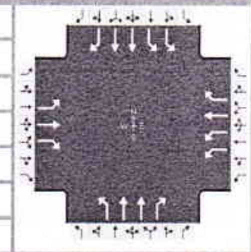

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 25.0 | 39.0 | 10.0 | 24.0 | 24.0 | 64.0 | 17.0 | 57.0 |
| Change Period, ( $Y+R_c$ ), s | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.1 | 3.0 | 3.1 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 27.0 | 18.7 | 3.3 | 21.0 | 18.7 | | 12.5 | |
| Green Extension Time ( $g_e$ ), s | 0.0 | 1.9 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 1.00 | 0.02 | 1.00 | 1.00 | 0.09 | | 1.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( v ), veh/h | 379 | 288 | 136 | 37 | 299 | 304 | 239 | 1547 | 23 | 295 | 778 | 196 |
| Adjusted Saturation Flow Rate ( s ), veh/h/ln | 1856 | 1949 | | 1730 | 1870 | | 1759 | 1758 | 1537 | 1802 | 1855 | 1601 |
| Queue Service Time ( $g_s$ ), s | 25.0 | 16.7 | | 1.3 | 19.0 | | 16.7 | 55.8 | 1.1 | 10.5 | 20.7 | 10.9 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 25.0 | 16.7 | | 1.3 | 19.0 | | 16.7 | 55.8 | 1.1 | 10.5 | 20.7 | 10.9 |
| Green Ratio ( *g/C* ) | 0.19 | 0.26 | | 0.04 | 0.15 | | 0.18 | 0.45 | 0.45 | 0.09 | 0.40 | 0.40 |
| Capacity ( c ), veh/h | 357 | 510 | | 133 | 273 | | 325 | 1596 | 698 | 333 | 1484 | 640 |
| Volume-to-Capacity Ratio ( X ) | 1.063 | 0.565 | | 0.278 | 1.093 | | 0.736 | 0.969 | 0.033 | 0.885 | 0.524 | 0.306 |
| Back of Queue ( Q ), ft/ln ( 95 th percentile) | 654.5 | 324 | | 27 | 563.6 | | 311.5 | 851.9 | 17.4 | 243.3 | 352.4 | 189.9 |
| Back of Queue ( Q ), veh/ln ( 95 th percentile) | 25.8 | 12.8 | | 1.1 | 22.2 | | 12.3 | 33.5 | 0.7 | 9.6 | 13.9 | 7.5 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 52.5 | 41.6 | | 60.7 | 55.5 | | 50.0 | 34.6 | 19.7 | 58.3 | 29.6 | 26.7 |
| Incremental Delay ( $d_2$ ), s/veh | 65.3 | 0.9 | | 0.4 | 81.7 | | 7.5 | 16.3 | 0.1 | 22.9 | 1.3 | 1.2 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( d ), s/veh | 117.8 | 42.5 | 0.0 | 61.2 | 137.2 | 0.0 | 57.5 | 50.9 | 19.8 | 81.2 | 30.9 | 27.9 |
| Level of Service (LOS) | F | D | A | E | F | A | E | D | B | F | C | C |
| Approach Delay, s/veh / LOS | 70.9 | E | | 67.6 | E | | 51.4 | D | | 42.1 | D | |
| Intersection Delay, s/veh / LOS | 54.6 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.45 | B | 2.61 | C | 3.00 | C | 2.11 | B |
| Bicycle LOS Score / LOS | 1.81 | B | 1.54 | B | 1.98 | B | 1.53 | B |

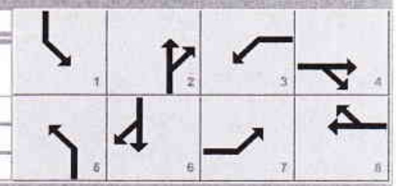
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 Base | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Sparks | File Name | PySp21axS.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 98 | 120 | 262 | 34 | 94 | 216 | 177 | 669 | 19 | 228 | 963 | 97 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 13.0 | 6.0 | 49.0 | 11.0 | 5.0 | 16.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |




| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 21.0 | 26.0 | 16.0 | 21.0 | 24.0 | 60.0 | 18.0 | 54.0 |
| Change Period, ( $Y+R_c$ ), s | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.3 | 3.0 | 3.3 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 8.0 | 22.9 | 3.2 | 15.8 | 13.8 | | 9.9 | |
| Green Extension Time ( $g_e$ ), s | 0.1 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.2 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 | | 0.83 | |

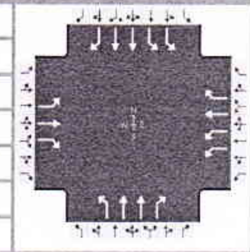
| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 107 | 130 | 285 | 37 | 102 | 180 | 192 | 727 | 21 | 248 | 1047 | 105 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1856 | 1949 | | 1730 | 1870 | | 1759 | 1758 | 1538 | 1802 | 1855 | 1601 |
| Queue Service Time ( $g_s$ ), s | 6.0 | 7.1 | | 1.2 | 6.0 | | 11.8 | 16.9 | 0.9 | 7.9 | 27.9 | 5.0 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 6.0 | 7.1 | | 1.2 | 6.0 | | 11.8 | 16.9 | 0.9 | 7.9 | 27.9 | 5.0 |
| Green Ratio ( $g/C$ ) | 0.18 | 0.18 | | 0.09 | 0.13 | | 0.20 | 0.46 | 0.46 | 0.11 | 0.41 | 0.41 |
| Capacity ( $c$ ), veh/h | 325 | 341 | | 317 | 249 | | 352 | 1612 | 705 | 390 | 1515 | 654 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.328 | 0.382 | | 0.117 | 0.410 | | 0.547 | 0.451 | 0.029 | 0.635 | 0.691 | 0.161 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 126.8 | 156.8 | | 22.9 | 126.4 | | 219.8 | 275.9 | 14.1 | 162.7 | 449.2 | 85.4 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 5.0 | 6.2 | | 0.9 | 5.0 | | 8.7 | 10.9 | 0.6 | 6.4 | 17.7 | 3.4 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 43.3 | 43.8 | | 50.0 | 47.7 | | 43.1 | 22.2 | 17.8 | 51.2 | 29.3 | 22.5 |
| Incremental Delay ( $d_2$ ), s/veh | 0.2 | 0.3 | | 0.1 | 0.4 | | 1.0 | 0.9 | 0.1 | 2.6 | 2.6 | 0.5 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 43.5 | 44.0 | 0.0 | 50.1 | 48.1 | 0.0 | 44.1 | 23.1 | 17.9 | 53.8 | 31.9 | 23.0 |
| Level of Service (LOS) | D | D | A | D | D | A | D | C | B | D | C | C |
| Approach Delay, s/veh / LOS | 19.9 | B | | 21.2 | C | | 27.3 | C | | 35.1 | D | |
| Intersection Delay, s/veh / LOS | 28.9 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.60 | C | 2.50 | B | 2.11 | B |
| Bicycle LOS Score / LOS | 1.35 | A | 1.01 | A | 1.26 | A | 1.64 | B |

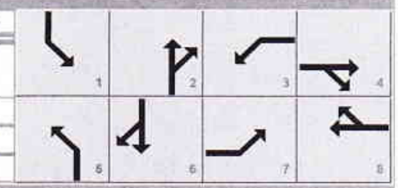
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 w/Buildout | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Sparks | File Name | PySp21pw.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 349 | 265 | 126 | 34 | 275 | 680 | 221 | 1425 | 21 | 271 | 718 | 180 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 130.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 12.0 | 7.0 | 52.0 | 5.0 | 15.0 | 19.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



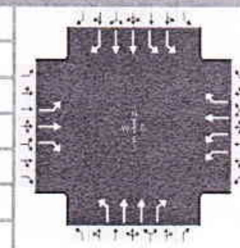
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 25.0 | 39.0 | 10.0 | 24.0 | 24.0 | 64.0 | 17.0 | 57.0 |
| Change Period, ( $Y+R_c$ ), s | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | 3.1 | 3.1 | 3.0 | 3.1 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 27.0 | 18.7 | 3.3 | 21.0 | 18.8 | | 12.5 | |
| Green Extension Time ( $g_e$ ), s | 0.0 | 1.9 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 1.00 | 0.02 | 1.00 | 1.00 | 0.10 | | 1.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 379 | 288 | 137 | 37 | 299 | 304 | 240 | 1549 | 23 | 295 | 780 | 196 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1856 | 1949 | | 1730 | 1870 | | 1759 | 1758 | 1537 | 1802 | 1855 | 1601 |
| Queue Service Time ( $g_s$ ), s | 25.0 | 16.7 | | 1.3 | 19.0 | | 16.8 | 55.9 | 1.1 | 10.5 | 20.8 | 10.9 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 25.0 | 16.7 | | 1.3 | 19.0 | | 16.8 | 55.9 | 1.1 | 10.5 | 20.8 | 10.9 |
| Green Ratio ( *g/C* ) | 0.19 | 0.26 | | 0.04 | 0.15 | | 0.18 | 0.45 | 0.45 | 0.09 | 0.40 | 0.40 |
| Capacity ( $c$ ), veh/h | 357 | 510 | | 133 | 273 | | 325 | 1596 | 698 | 333 | 1484 | 640 |
| Volume-to-Capacity Ratio ( $X$ ) | 1.063 | 0.565 | | 0.278 | 1.093 | | 0.740 | 0.971 | 0.033 | 0.885 | 0.526 | 0.306 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 654.5 | 324 | | 27 | 563.6 | | 313.4 | 855.6 | 17.4 | 243.3 | 353.3 | 189.9 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 25.8 | 12.8 | | 1.1 | 22.2 | | 12.3 | 33.7 | 0.7 | 9.6 | 13.9 | 7.5 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 52.5 | 41.6 | | 60.7 | 55.5 | | 50.1 | 34.7 | 19.7 | 58.3 | 29.6 | 26.7 |
| Incremental Delay ( $d_2$ ), s/veh | 65.3 | 0.9 | | 0.4 | 81.7 | | 7.7 | 16.5 | 0.1 | 22.9 | 1.3 | 1.2 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 117.8 | 42.5 | 0.0 | 61.2 | 137.2 | 0.0 | 57.8 | 51.2 | 19.8 | 81.2 | 31.0 | 27.9 |
| Level of Service (LOS) | F | D | A | E | F | A | E | D | B | F | C | C |
| Approach Delay, s/veh / LOS | 70.8 | E | | 67.6 | E | | 51.7 | D | | 42.1 | D | |
| Intersection Delay, s/veh / LOS | 54.6 | | | | | | D | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.45 | B | 2.61 | C | 3.00 | C | 2.11 | B |
| Bicycle LOS Score / LOS | 1.81 | B | 1.54 | B | 1.98 | B | 1.54 | B |

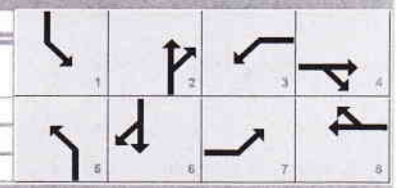
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 w/Buildout | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Sparks | File Name | PySp21awS.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 98 | 120 | 276 | 42 | 94 | 216 | 201 | 718 | 27 | 228 | 1011 | 97 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 13.0 | 6.0 | 49.0 | 11.0 | 5.0 | 16.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 4.0 | 0.0 | 4.0 | 4.0 | 0.0 | 4.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 1.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1.0 |



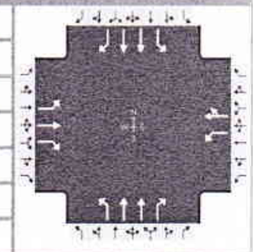
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | 5 | 2 | 1 | 6 |
| Case Number | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | 21.0 | 26.0 | 16.0 | 21.0 | 24.0 | 60.0 | 18.0 | 54.0 |
| Change Period, ( $Y+R_c$ ), s | 0.0 | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 | 5.0 | 5.0 |
| Max Allow Headway ( $MAH$ ), s | 3.1 | 3.3 | 3.0 | 3.3 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | 8.0 | 23.0 | 3.5 | 15.8 | 15.6 | | 9.9 | |
| Green Extension Time ( $g_e$ ), s | 0.1 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.2 | 0.0 |
| Phase Call Probability | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 | | 0.83 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 107 | 130 | 300 | 46 | 102 | 180 | 218 | 780 | 29 | 248 | 1099 | 105 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1856 | 1949 | | 1730 | 1870 | | 1759 | 1758 | 1538 | 1802 | 1855 | 1601 |
| Queue Service Time ( $g_s$ ), s | 6.0 | 7.1 | | 1.5 | 6.0 | | 13.6 | 18.5 | 1.3 | 7.9 | 29.9 | 5.0 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 6.0 | 7.1 | | 1.5 | 6.0 | | 13.6 | 18.5 | 1.3 | 7.9 | 29.9 | 5.0 |
| Green Ratio ( $g/C$ ) | 0.18 | 0.18 | | 0.09 | 0.13 | | 0.20 | 0.46 | 0.46 | 0.11 | 0.41 | 0.41 |
| Capacity ( $c$ ), veh/h | 325 | 341 | | 317 | 249 | | 352 | 1612 | 705 | 390 | 1515 | 654 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.328 | 0.382 | | 0.144 | 0.410 | | 0.621 | 0.484 | 0.042 | 0.635 | 0.725 | 0.161 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 126.8 | 156.8 | | 28.4 | 126.4 | | 250.7 | 296.9 | 20.2 | 162.7 | 477.8 | 85.4 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 5.0 | 6.2 | | 1.1 | 5.0 | | 9.9 | 11.7 | 0.8 | 6.4 | 18.8 | 3.4 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 43.3 | 43.8 | | 50.2 | 47.7 | | 43.8 | 22.6 | 17.9 | 51.2 | 29.8 | 22.5 |
| Incremental Delay ( $d_2$ ), s/veh | 0.2 | 0.3 | | 0.1 | 0.4 | | 2.5 | 1.0 | 0.1 | 2.6 | 3.1 | 0.5 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 43.5 | 44.0 | 0.0 | 50.2 | 48.1 | 0.0 | 46.4 | 23.7 | 18.1 | 53.8 | 32.9 | 23.0 |
| Level of Service (LOS) | D | D | A | D | D | A | D | C | B | D | C | C |
| Approach Delay, s/veh / LOS | 19.3 | B | | 22.0 | C | | 28.3 | C | | 35.8 | D | |
| Intersection Delay, s/veh / LOS | 29.5 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.60 | C | 2.50 | B | 2.11 | B |
| Bicycle LOS Score / LOS | 1.37 | A | 1.03 | A | 1.34 | A | 1.69 | B |

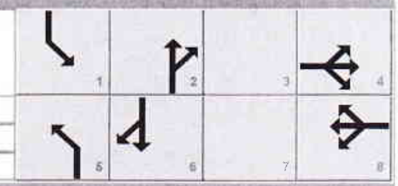
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Golden View | File Name | PyGv18ax.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( *v* ), veh/h | 18 | 3 | 36 | 78 | 8 | 33 | 25 | 592 | 34 | 11 | 1380 | 3 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 15.0 | 75.0 | 20.0 | 0.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 0.0 | 4.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 |



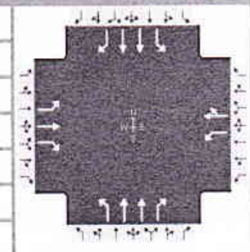
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 15.0 | 80.0 | 15.0 | 80.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.2 | | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 6.4 | | 8.6 | 3.7 | | 2.7 | |
| Green Extension Time ( $g_e$ ), s | | 0.3 | | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 0.00 | | 0.00 | 0.00 | | 0.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( *v* ), veh/h | 20 | 3 | 39 | 85 | 45 | | 27 | 643 | 37 | 12 | 1500 | 3 |
| Adjusted Saturation Flow Rate ( *s* ), veh/h/ln | 1351 | 1870 | 1542 | 1401 | 1596 | | 1781 | 1781 | 1542 | 1781 | 1781 | 1542 |
| Queue Service Time ( $g_s$ ), s | 1.5 | 0.2 | 2.6 | 6.5 | 2.9 | | 1.7 | 9.9 | 1.1 | 0.7 | 32.7 | 0.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 4.4 | 0.2 | 2.6 | 6.6 | 2.9 | | 1.7 | 9.9 | 1.1 | 0.7 | 32.7 | 0.1 |
| Green Ratio ( *g/C* ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.08 | 0.62 | 0.62 | 0.12 | 0.62 | 0.62 |
| Capacity ( *c* ), veh/h | 253 | 312 | 257 | 291 | 266 | | 148 | 2226 | 964 | 223 | 2226 | 964 |
| Volume-to-Capacity Ratio ( *X* ) | 0.077 | 0.010 | 0.152 | 0.291 | 0.167 | | 0.183 | 0.289 | 0.038 | 0.054 | 0.674 | 0.003 |
| Back of Queue ( *Q* ), ft/ln ( 95 th percentile) | 23.3 | 3.7 | 45.6 | 100.8 | 51.1 | | 33.9 | 157.1 | 15.6 | 14 | 433.1 | 1.3 |
| Back of Queue ( *Q* ), veh/ln ( 95 th percentile) | 0.9 | 0.1 | 1.8 | 4.0 | 2.0 | | 1.3 | 6.2 | 0.6 | 0.5 | 17.0 | 0.1 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 44.7 | 41.7 | 42.8 | 44.5 | 42.9 | | 51.2 | 10.3 | 8.6 | 46.2 | 14.6 | 8.5 |
| Incremental Delay ( $d_2$ ), s/veh | 0.0 | 0.0 | 0.1 | 0.2 | 0.1 | | 0.2 | 0.3 | 0.1 | 0.0 | 1.7 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( *d* ), s/veh | 44.8 | 41.7 | 42.9 | 44.7 | 43.0 | | 51.4 | 10.6 | 8.7 | 46.3 | 16.2 | 8.5 |
| Level of Service (LOS) | D | D | D | D | D | | D | B | A | D | B | A |
| Approach Delay, s/veh / LOS | 43.4 | D | | 44.1 | D | | 12.1 | B | | 16.5 | B | |
| Intersection Delay, s/veh / LOS | 17.3 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.88 | B | 2.07 | B |
| Bicycle LOS Score / LOS | 0.59 | A | 0.70 | A | 1.07 | A | 1.74 | B |

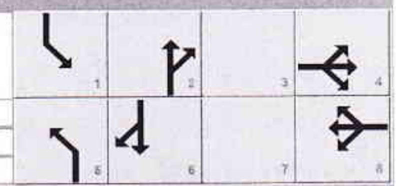
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Golden View | File Name | PyGv18px.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 14 | 5 | 17 | 24 | 2 | 13 | 23 | 1533 | 80 | 15 | 792 | 2 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 15.0 | 75.0 | 20.0 | 0.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 0.0 | 4.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 |



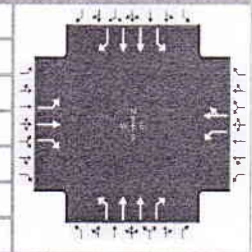

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 15.0 | 80.0 | 15.0 | 80.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( $MAH$ ), s | | 3.2 | | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 4.2 | | 4.2 | 3.6 | | 3.0 | |
| Green Extension Time ( $g_e$ ), s | | 0.1 | | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 0.00 | | 0.00 | 0.00 | | 0.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 15 | 5 | 18 | 26 | 16 | | 25 | 1666 | 87 | 16 | 861 | 2 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1385 | 1870 | 1542 | 1398 | 1579 | | 1781 | 1781 | 1542 | 1781 | 1781 | 1542 |
| Queue Service Time ( $g_s$ ), s | 1.1 | 0.3 | 1.2 | 1.9 | 1.0 | | 1.6 | 39.6 | 2.7 | 1.0 | 14.3 | 0.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 2.2 | 0.3 | 1.2 | 2.2 | 1.0 | | 1.6 | 39.6 | 2.7 | 1.0 | 14.3 | 0.1 |
| Green Ratio ( $g/C$ ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.08 | 0.62 | 0.62 | 0.12 | 0.62 | 0.62 |
| Capacity ( $c$ ), veh/h | 279 | 312 | 257 | 290 | 263 | | 148 | 2226 | 964 | 223 | 2226 | 964 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.055 | 0.017 | 0.072 | 0.090 | 0.062 | | 0.168 | 0.749 | 0.090 | 0.073 | 0.387 | 0.002 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 17.7 | 6.2 | 21.2 | 29.7 | 18.3 | | 31.1 | 512.6 | 38 | 19 | 218.9 | 0.9 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 0.7 | 0.2 | 0.8 | 1.2 | 0.7 | | 1.2 | 20.2 | 1.5 | 0.7 | 8.6 | 0.0 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 43.0 | 41.8 | 42.2 | 42.7 | 42.1 | | 51.1 | 15.9 | 8.9 | 46.4 | 11.1 | 8.4 |
| Incremental Delay ( $d_2$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.2 | 2.4 | 0.2 | 0.1 | 0.5 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 43.0 | 41.8 | 42.2 | 42.8 | 42.1 | | 51.3 | 18.2 | 9.1 | 46.4 | 11.6 | 8.5 |
| Level of Service (LOS) | D | D | D | D | D | | D | B | A | D | B | A |
| Approach Delay, s/veh / LOS | 42.5 | | D | 42.5 | | D | 18.2 | | B | 12.3 | | B |
| Intersection Delay, s/veh / LOS | 17.0 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.88 | B | 2.07 | B |
| Bicycle LOS Score / LOS | 0.55 | A | 0.56 | A | 1.95 | B | 1.21 | A |

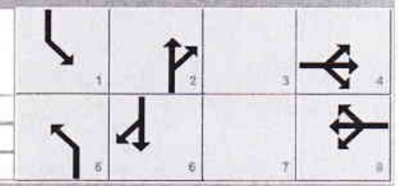
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.90 |
| Urban Street | | Analysis Year | Existing | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Golden View | File Name | PyGv18axS.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( v ), veh/h | 66 | 8 | 108 | 29 | 9 | 11 | 192 | 727 | 36 | 8 | 1044 | 24 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 6.0 | 32.0 | 47.0 | 20.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 0.0 | 4.0 | 4.0 | 4.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 |



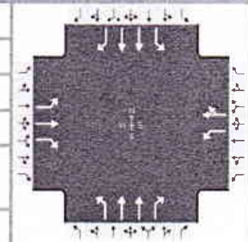

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 43.0 | 89.0 | 6.0 | 52.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.2 | | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 9.0 | | 4.9 | 13.2 | | 2.6 | |
| Green Extension Time ( $g_e$ ), s | | 0.3 | | 0.4 | 0.3 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 0.00 | | 0.00 | 0.00 | | 0.27 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( v ), veh/h | 73 | 9 | 92 | 32 | 22 | | 213 | 808 | 40 | 9 | 1160 | 27 |
| Adjusted Saturation Flow Rate ( s ), veh/h/ln | 1378 | 1870 | 1542 | 1394 | 1674 | | 1781 | 1781 | 1544 | 1781 | 1781 | 1536 |
| Queue Service Time ( $g_s$ ), s | 5.7 | 0.5 | 6.4 | 2.4 | 1.3 | | 11.2 | 10.6 | 1.0 | 0.6 | 35.3 | 1.3 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 7.0 | 0.5 | 6.4 | 2.9 | 1.3 | | 11.2 | 10.6 | 1.0 | 0.6 | 35.3 | 1.3 |
| Green Ratio ( g/C ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.32 | 0.70 | 0.70 | 0.05 | 0.39 | 0.39 |
| Capacity ( c ), veh/h | 274 | 312 | 257 | 287 | 279 | | 564 | 2493 | 1081 | 89 | 1395 | 602 |
| Volume-to-Capacity Ratio ( X ) | 0.267 | 0.029 | 0.359 | 0.112 | 0.080 | | 0.378 | 0.324 | 0.037 | 0.100 | 0.832 | 0.044 |
| Back of Queue ( Q ), ft/ln ( 95 th percentile) | 89.3 | 10.1 | 1 | 36.9 | 25.1 | | 204.9 | 148.1 | 12.1 | 11.5 | 546.8 | 21.2 |
| Back of Queue ( Q ), veh/ln ( 95 th percentile) | 3.5 | 0.4 | 0.0 | 1.5 | 1.0 | | 8.1 | 5.8 | 0.5 | 0.5 | 21.5 | 0.8 |
| Queue Storage Ratio ( RQ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 45.2 | 41.9 | 44.3 | 43.1 | 42.2 | | 31.8 | 7.0 | 5.5 | 54.4 | 32.9 | 22.6 |
| Incremental Delay ( $d_2$ ), s/veh | 0.2 | 0.0 | 0.3 | 0.1 | 0.0 | | 0.2 | 0.3 | 0.1 | 0.2 | 5.9 | 0.1 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( d ), s/veh | 45.4 | 41.9 | 44.6 | 43.1 | 42.3 | | 32.0 | 7.3 | 5.6 | 54.6 | 38.8 | 22.7 |
| Level of Service (LOS) | D | D | D | D | D | | C | A | A | D | D | C |
| Approach Delay, s/veh / LOS | 44.8 | D | | 42.8 | D | | 12.2 | B | | 38.6 | D | |
| Intersection Delay, s/veh / LOS | 27.9 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.87 | B | 2.15 | B |
| Bicycle LOS Score / LOS | 0.78 | A | 0.58 | A | 1.36 | A | 1.47 | A |

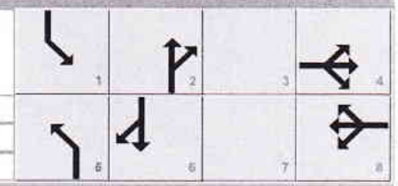
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing + Phase 1 | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Golden View | File Name | PyGv18aw.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 19 | 3 | 37 | 78 | 8 | 33 | 29 | 592 | 34 | 11 | 1380 | 4 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 15.0 | 75.0 | 20.0 | 0.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 0.0 | 4.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 |




| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 15.0 | 80.0 | 15.0 | 80.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( $MAH$ ), s | | 3.2 | | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 6.5 | | 8.6 | 4.0 | | 2.7 | |
| Green Extension Time ( $g_e$ ), s | | 0.3 | | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 0.00 | | 0.00 | 0.00 | | 0.00 | |

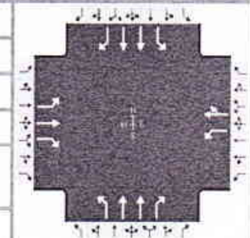
| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 21 | 3 | 40 | 85 | 45 | | 32 | 643 | 37 | 12 | 1500 | 4 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1351 | 1870 | 1542 | 1401 | 1596 | | 1781 | 1781 | 1542 | 1781 | 1781 | 1542 |
| Queue Service Time ( $g_s$ ), s | 1.6 | 0.2 | 2.7 | 6.5 | 2.9 | | 2.0 | 9.9 | 1.1 | 0.7 | 32.7 | 0.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 4.5 | 0.2 | 2.7 | 6.6 | 2.9 | | 2.0 | 9.9 | 1.1 | 0.7 | 32.7 | 0.1 |
| Green Ratio ( $g/C$ ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.08 | 0.62 | 0.62 | 0.12 | 0.62 | 0.62 |
| Capacity ( $c$ ), veh/h | 253 | 312 | 257 | 291 | 266 | | 148 | 2226 | 964 | 223 | 2226 | 964 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.082 | 0.010 | 0.157 | 0.291 | 0.167 | | 0.212 | 0.289 | 0.038 | 0.054 | 0.674 | 0.005 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 24.6 | 3.7 | 46.9 | 100.8 | 51.1 | | 39.4 | 157.1 | 15.6 | 14 | 433.1 | 1.8 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 1.0 | 0.1 | 1.8 | 4.0 | 2.0 | | 1.6 | 6.2 | 0.6 | 0.5 | 17.0 | 0.1 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 44.8 | 41.7 | 42.8 | 44.5 | 42.9 | | 51.3 | 10.3 | 8.6 | 46.2 | 14.6 | 8.5 |
| Incremental Delay ( $d_2$ ), s/veh | 0.1 | 0.0 | 0.1 | 0.2 | 0.1 | | 0.3 | 0.3 | 0.1 | 0.0 | 1.7 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 44.8 | 41.7 | 42.9 | 44.7 | 43.0 | | 51.6 | 10.6 | 8.7 | 46.3 | 16.2 | 8.5 |
| Level of Service (LOS) | D | D | D | D | D | | D | B | A | D | B | A |
| Approach Delay, s/veh / LOS | 43.5 | D | | 44.1 | D | | 12.3 | B | | 16.4 | B | |
| Intersection Delay, s/veh / LOS | 17.4 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.88 | B | 2.07 | B |
| Bicycle LOS Score / LOS | 0.59 | A | 0.70 | A | 1.07 | A | 1.74 | B |

 HCS7™ Streets Version 7.4 Generated: 6/5/2018 10:11:56 AM

# HCS7 Signalized Intersection Results Summary

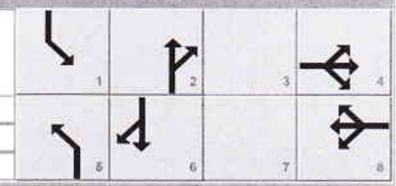
| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | Existing + Phase 1 | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Golden View | File Name | PyGv18pw.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 15 | 5 | 19 | 24 | 2 | 13 | 26 | 1533 | 80 | 15 | 792 | 2 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | No | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |

| | | | | | | |
|---|---|---|---|---|---|---|
| Green | 15.0 | 75.0 | 20.0 | 0.0 | 0.0 | 0.0 |
| Yellow | 0.0 | 4.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| Red | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 |



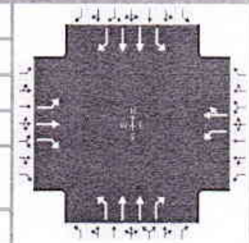

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 15.0 | 80.0 | 15.0 | 80.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( $MAH$ ), s | | 3.2 | | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 4.2 | | 4.2 | 3.8 | | 3.0 | |
| Green Extension Time ( $g_e$ ), s | | 0.1 | | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 0.00 | | 0.00 | 0.00 | | 0.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 16 | 5 | 21 | 26 | 16 | | 28 | 1666 | 87 | 16 | 861 | 2 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1385 | 1870 | 1542 | 1398 | 1579 | | 1781 | 1781 | 1542 | 1781 | 1781 | 1542 |
| Queue Service Time ( $g_s$ ), s | 1.2 | 0.3 | 1.4 | 1.9 | 1.0 | | 1.8 | 39.6 | 2.7 | 1.0 | 14.3 | 0.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 2.2 | 0.3 | 1.4 | 2.2 | 1.0 | | 1.8 | 39.6 | 2.7 | 1.0 | 14.3 | 0.1 |
| Green Ratio ( $g/C$ ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.08 | 0.62 | 0.62 | 0.12 | 0.62 | 0.62 |
| Capacity ( $c$ ), veh/h | 279 | 312 | 257 | 290 | 263 | | 148 | 2226 | 964 | 223 | 2226 | 964 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.058 | 0.017 | 0.080 | 0.090 | 0.062 | | 0.190 | 0.749 | 0.090 | 0.073 | 0.387 | 0.002 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 18.9 | 6.2 | 23.8 | 29.7 | 18.3 | | 35.2 | 512.6 | 38 | 19 | 218.9 | 0.9 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 0.7 | 0.2 | 0.9 | 1.2 | 0.7 | | 1.4 | 20.2 | 1.5 | 0.7 | 8.6 | 0.0 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 43.0 | 41.8 | 42.2 | 42.7 | 42.1 | | 51.2 | 15.9 | 8.9 | 46.4 | 11.1 | 8.4 |
| Incremental Delay ( $d_2$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.2 | 2.4 | 0.2 | 0.1 | 0.5 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 43.1 | 41.8 | 42.3 | 42.8 | 42.1 | | 51.5 | 18.2 | 9.1 | 46.4 | 11.6 | 8.5 |
| Level of Service (LOS) | D | D | D | D | D | | D | B | A | D | B | A |
| Approach Delay, s/veh / LOS | 42.5 | D | | 42.5 | D | | 18.3 | B | | 12.3 | B | |
| Intersection Delay, s/veh / LOS | 17.1 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.88 | B | 2.07 | B |
| Bicycle LOS Score / LOS | 0.56 | A | 0.56 | A | 1.96 | B | 1.21 | A |

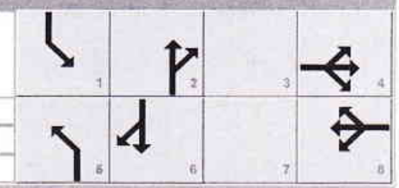
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | | |
|---|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 | |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other | |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.90 | |
| Urban Street | | Analysis Year | Existing + Phase 1 | Analysis Period | 1> 7:00 | |
| Intersection | Pyramid & Golden View | File Name | PyGv18awS.xus | | | |
| Project Description | | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( v ), veh/h | 96 | 10 | 141 | 29 | 11 | 11 | 251 | 727 | 36 | 8 | 1044 | 30 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 6.0 | 32.0 | 47.0 | 20.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 0.0 | 4.0 | 4.0 | 4.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 |



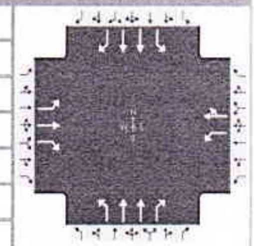

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 43.0 | 89.0 | 6.0 | 52.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.2 | | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 12.0 | | 5.0 | 17.2 | | 2.6 | |
| Green Extension Time ( $g_e$ ), s | | 0.4 | | 0.5 | 0.4 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 0.02 | | 0.00 | 0.00 | | 0.27 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( v ), veh/h | 107 | 11 | 129 | 32 | 24 | | 279 | 808 | 40 | 9 | 1160 | 33 |
| Adjusted Saturation Flow Rate ( s ), veh/h/ln | 1375 | 1870 | 1542 | 1391 | 1690 | | 1781 | 1781 | 1544 | 1781 | 1781 | 1536 |
| Queue Service Time ( $g_s$ ), s | 8.5 | 0.6 | 9.1 | 2.4 | 1.5 | | 15.2 | 10.6 | 1.0 | 0.6 | 35.3 | 1.6 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 10.0 | 0.6 | 9.1 | 3.0 | 1.5 | | 15.2 | 10.6 | 1.0 | 0.6 | 35.3 | 1.6 |
| Green Ratio ( *g/C* ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.32 | 0.70 | 0.70 | 0.05 | 0.39 | 0.39 |
| Capacity ( c ), veh/h | 272 | 312 | 257 | 285 | 282 | | 564 | 2493 | 1081 | 89 | 1395 | 602 |
| Volume-to-Capacity Ratio ( X ) | 0.392 | 0.036 | 0.502 | 0.113 | 0.087 | | 0.494 | 0.324 | 0.037 | 0.100 | 0.832 | 0.055 |
| Back of Queue ( Q ), ft/ln ( 95 th percentile) | 133.7 | 12.7 | 160.5 | 36.9 | 27.6 | | 262.7 | 148.1 | 12.1 | 11.5 | 546.8 | 26.7 |
| Back of Queue ( Q ), veh/ln ( 95 th percentile) | 5.3 | 0.5 | 6.3 | 1.5 | 1.1 | | 10.3 | 5.8 | 0.5 | 0.5 | 21.5 | 1.0 |
| Queue Storage Ratio ( RQ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 46.5 | 41.9 | 45.5 | 43.2 | 42.3 | | 33.2 | 7.0 | 5.5 | 54.4 | 32.9 | 22.7 |
| Incremental Delay ( $d_2$ ), s/veh | 0.3 | 0.0 | 0.6 | 0.1 | 0.0 | | 0.3 | 0.3 | 0.1 | 0.2 | 5.9 | 0.2 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( d ), s/veh | 46.8 | 41.9 | 46.1 | 43.2 | 42.3 | | 33.5 | 7.3 | 5.6 | 54.6 | 38.8 | 22.9 |
| Level of Service (LOS) | D | D | D | D | D | | C | A | A | D | D | C |
| Approach Delay, s/veh / LOS | 46.2 | D | | 42.8 | D | | 13.7 | B | | 38.5 | D | |
| Intersection Delay, s/veh / LOS | 28.7 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.87 | B | 2.15 | B |
| Bicycle LOS Score / LOS | 0.89 | A | 0.58 | A | 1.42 | A | 1.48 | A |

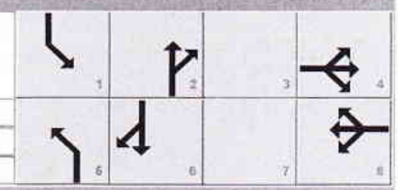
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 Base | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Golden View | File Name | PyGv21ax.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( v ), veh/h | 18 | 3 | 36 | 78 | 8 | 33 | 25 | 639 | 34 | 11 | 1484 | 3 |

| Signal Information | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 15.0 | 75.0 | 20.0 | 0.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 0.0 | 4.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 |



| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 15.0 | 80.0 | 15.0 | 80.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( MAH ), s | | 3.2 | | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 6.4 | | 8.6 | 3.7 | | 2.7 | |
| Green Extension Time ( $g_e$ ), s | | 0.3 | | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 0.00 | | 0.00 | 0.00 | | 0.00 | |

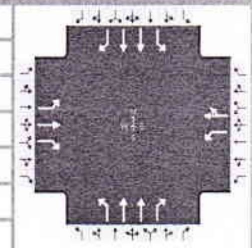
| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( v ), veh/h | 20 | 3 | 39 | 85 | 45 | | 27 | 695 | 37 | 12 | 1613 | 3 |
| Adjusted Saturation Flow Rate ( s ), veh/h/ln | 1351 | 1870 | 1542 | 1401 | 1596 | | 1781 | 1781 | 1542 | 1781 | 1781 | 1542 |
| Queue Service Time ( $g_s$ ), s | 1.5 | 0.2 | 2.6 | 6.5 | 2.9 | | 1.7 | 10.9 | 1.1 | 0.7 | 37.3 | 0.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 4.4 | 0.2 | 2.6 | 6.6 | 2.9 | | 1.7 | 10.9 | 1.1 | 0.7 | 37.3 | 0.1 |
| Green Ratio ( g/C ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.08 | 0.62 | 0.62 | 0.12 | 0.62 | 0.62 |
| Capacity ( c ), veh/h | 253 | 312 | 257 | 291 | 266 | | 148 | 2226 | 964 | 223 | 2226 | 964 |
| Volume-to-Capacity Ratio ( X ) | 0.077 | 0.010 | 0.152 | 0.291 | 0.167 | | 0.183 | 0.312 | 0.038 | 0.054 | 0.725 | 0.003 |
| Back of Queue ( Q ), ft/ln ( 95 th percentile) | 23.3 | 3.7 | 45.6 | 100.8 | 51.1 | | 33.9 | 172.8 | 15.6 | 14 | 485 | 1.3 |
| Back of Queue ( Q ), veh/ln ( 95 th percentile) | 0.9 | 0.1 | 1.8 | 4.0 | 2.0 | | 1.3 | 6.8 | 0.6 | 0.5 | 19.1 | 0.1 |
| Queue Storage Ratio ( RQ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 44.7 | 41.7 | 42.8 | 44.5 | 42.9 | | 51.2 | 10.5 | 8.6 | 46.2 | 15.4 | 8.5 |
| Incremental Delay ( $d_2$ ), s/veh | 0.0 | 0.0 | 0.1 | 0.2 | 0.1 | | 0.2 | 0.4 | 0.1 | 0.0 | 2.1 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( d ), s/veh | 44.8 | 41.7 | 42.9 | 44.7 | 43.0 | | 51.4 | 10.8 | 8.7 | 46.3 | 17.5 | 8.5 |
| Level of Service (LOS) | D | D | D | D | D | | D | B | A | D | B | A |
| Approach Delay, s/veh / LOS | 43.4 | D | | 44.1 | D | | 12.2 | B | | 17.7 | B | |
| Intersection Delay, s/veh / LOS | 18.0 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.88 | B | 2.07 | B |
| Bicycle LOS Score / LOS | 0.59 | A | 0.70 | A | 1.11 | A | 1.83 | B |

 HCS7™ Streets Version 7.4 Generated: 6/5/2018 10:13:07 AM

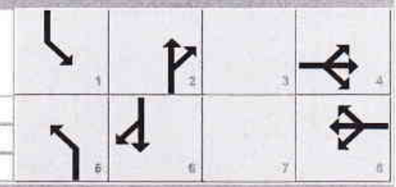
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 Base | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Golden View | File Name | PyGv21px.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( v ), veh/h | 14 | 5 | 17 | 24 | 2 | 13 | 23 | 1648 | 80 | 15 | 841 | 2 |

| Signal Information | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 15.0 | 75.0 | 20.0 | 0.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 0.0 | 4.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 |



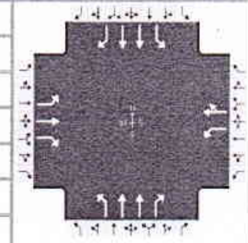

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 15.0 | 80.0 | 15.0 | 80.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.2 | | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 4.2 | | 4.2 | 3.6 | | 3.0 | |
| Green Extension Time ( $g_e$ ), s | | 0.1 | | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 0.00 | | 0.00 | 0.00 | | 0.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( v ), veh/h | 15 | 5 | 18 | 26 | 16 | | 25 | 1791 | 87 | 16 | 914 | 2 |
| Adjusted Saturation Flow Rate ( s ), veh/h/ln | 1385 | 1870 | 1542 | 1398 | 1579 | | 1781 | 1781 | 1542 | 1781 | 1781 | 1542 |
| Queue Service Time ( $g_s$ ), s | 1.1 | 0.3 | 1.2 | 1.9 | 1.0 | | 1.6 | 45.5 | 2.7 | 1.0 | 15.5 | 0.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 2.2 | 0.3 | 1.2 | 2.2 | 1.0 | | 1.6 | 45.5 | 2.7 | 1.0 | 15.5 | 0.1 |
| Green Ratio ( g/C ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.08 | 0.62 | 0.62 | 0.12 | 0.62 | 0.62 |
| Capacity ( c ), veh/h | 279 | 312 | 257 | 290 | 263 | | 148 | 2226 | 964 | 223 | 2226 | 964 |
| Volume-to-Capacity Ratio ( X ) | 0.055 | 0.017 | 0.072 | 0.090 | 0.062 | | 0.168 | 0.805 | 0.090 | 0.073 | 0.411 | 0.002 |
| Back of Queue ( Q ), ft/ln ( 95 th percentile) | 17.7 | 6.2 | 21.2 | 29.7 | 18.3 | | 31.1 | 582.1 | 38 | 19 | 233.7 | 0.9 |
| Back of Queue ( Q ), veh/ln ( 95 th percentile) | 0.7 | 0.2 | 0.8 | 1.2 | 0.7 | | 1.2 | 22.9 | 1.5 | 0.7 | 9.2 | 0.0 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 43.0 | 41.8 | 42.2 | 42.7 | 42.1 | | 51.1 | 17.0 | 8.9 | 46.4 | 11.4 | 8.4 |
| Incremental Delay ( $d_2$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.2 | 3.2 | 0.2 | 0.1 | 0.6 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( d ), s/veh | 43.0 | 41.8 | 42.2 | 42.8 | 42.1 | | 51.3 | 20.2 | 9.1 | 46.4 | 11.9 | 8.5 |
| Level of Service (LOS) | D | D | D | D | D | | D | C | A | D | B | A |
| Approach Delay, s/veh / LOS | 42.5 | D | | 42.5 | D | | 20.1 | C | | 12.5 | B | |
| Intersection Delay, s/veh / LOS | 18.3 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.88 | B | 2.07 | B |
| Bicycle LOS Score / LOS | 0.55 | A | 0.56 | A | 2.06 | B | 1.26 | A |

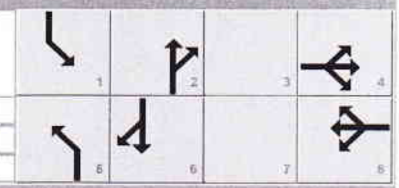
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.90 |
| Urban Street | | Analysis Year | 2021 Base | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Golden View | File Name | PyGv21axS.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 66 | 8 | 108 | 29 | 9 | 11 | 192 | 786 | 36 | 8 | 1130 | 24 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 6.0 | 32.0 | 47.0 | 20.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 0.0 | 4.0 | 4.0 | 4.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 |



| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 43.0 | 89.0 | 6.0 | 52.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( $MAH$ ), s | | 3.2 | | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 9.0 | | 4.9 | 13.2 | | 2.6 | |
| Green Extension Time ( $g_e$ ), s | | 0.3 | | 0.4 | 0.3 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 0.00 | | 0.00 | 0.00 | | 0.27 | |

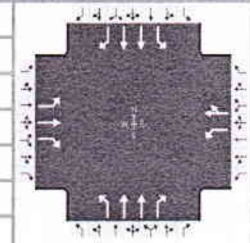
| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 73 | 9 | 92 | 32 | 22 | | 213 | 873 | 40 | 9 | 1256 | 27 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1378 | 1870 | 1542 | 1394 | 1674 | | 1781 | 1781 | 1544 | 1781 | 1781 | 1536 |
| Queue Service Time ( $g_s$ ), s | 5.7 | 0.5 | 6.4 | 2.4 | 1.3 | | 11.2 | 11.7 | 1.0 | 0.6 | 39.8 | 1.3 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 7.0 | 0.5 | 6.4 | 2.9 | 1.3 | | 11.2 | 11.7 | 1.0 | 0.6 | 39.8 | 1.3 |
| Green Ratio ( $g/C$ ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.32 | 0.70 | 0.70 | 0.05 | 0.39 | 0.39 |
| Capacity ( $c$ ), veh/h | 274 | 312 | 257 | 287 | 279 | | 564 | 2493 | 1081 | 89 | 1395 | 602 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.267 | 0.029 | 0.359 | 0.112 | 0.080 | | 0.378 | 0.350 | 0.037 | 0.100 | 0.900 | 0.044 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 89.3 | 10.1 | 1 | 36.9 | 25.1 | | 204.9 | 164.8 | 12.1 | 11.5 | 622.5 | 21.2 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 3.5 | 0.4 | 0.0 | 1.5 | 1.0 | | 8.1 | 6.5 | 0.5 | 0.5 | 24.5 | 0.8 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 45.2 | 41.9 | 44.3 | 43.1 | 42.2 | | 31.8 | 7.2 | 5.5 | 54.4 | 34.3 | 22.6 |
| Incremental Delay ( $d_2$ ), s/veh | 0.2 | 0.0 | 0.3 | 0.1 | 0.0 | | 0.2 | 0.4 | 0.1 | 0.2 | 9.6 | 0.1 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 45.4 | 41.9 | 44.6 | 43.1 | 42.3 | | 32.0 | 7.5 | 5.6 | 54.6 | 43.9 | 22.7 |
| Level of Service (LOS) | D | D | D | D | D | | C | A | A | D | D | C |
| Approach Delay, s/veh / LOS | 44.8 | D | | 42.8 | D | | 12.1 | B | | 43.5 | D | |
| Intersection Delay, s/veh / LOS | 30.2 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.87 | B | 2.15 | B |
| Bicycle LOS Score / LOS | 0.78 | A | 0.58 | A | 1.42 | A | 1.55 | B |

 HCS7™ Streets Version 7.4 Generated: 6/5/2018 10:13:55 AM

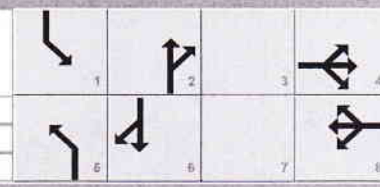
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 w/Buildout | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Golden View | File Name | PyGv21aw.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 21 | 3 | 39 | 78 | 8 | 33 | 35 | 639 | 34 | 11 | 1484 | 5 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 15.0 | 75.0 | 20.0 | 0.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 0.0 | 4.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 |



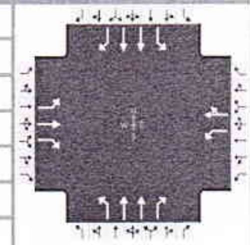
| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 15.0 | 80.0 | 15.0 | 80.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( $MAH$ ), s | | 3.2 | | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 6.6 | | 8.6 | 4.4 | | 2.7 | |
| Green Extension Time ( $g_e$ ), s | | 0.3 | | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 0.00 | | 0.00 | 0.01 | | 0.00 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 23 | 3 | 42 | 85 | 45 | | 38 | 695 | 37 | 12 | 1613 | 5 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1351 | 1870 | 1542 | 1401 | 1596 | | 1781 | 1781 | 1542 | 1781 | 1781 | 1542 |
| Queue Service Time ( $g_s$ ), s | 1.8 | 0.2 | 2.8 | 6.5 | 2.9 | | 2.4 | 10.9 | 1.1 | 0.7 | 37.3 | 0.2 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 4.6 | 0.2 | 2.8 | 6.6 | 2.9 | | 2.4 | 10.9 | 1.1 | 0.7 | 37.3 | 0.2 |
| Green Ratio ( $g/C$ ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.08 | 0.62 | 0.62 | 0.12 | 0.62 | 0.62 |
| Capacity ( $c$ ), veh/h | 253 | 312 | 257 | 291 | 266 | | 148 | 2226 | 964 | 223 | 2226 | 964 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.090 | 0.010 | 0.165 | 0.291 | 0.167 | | 0.256 | 0.312 | 0.038 | 0.054 | 0.725 | 0.006 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 27.2 | 3.7 | 49.5 | 100.8 | 51.1 | | 47.8 | 172.8 | 15.6 | 14 | 485 | 2.2 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 1.1 | 0.1 | 1.9 | 4.0 | 2.0 | | 1.9 | 6.8 | 0.6 | 0.5 | 19.1 | 0.1 |
| Queue Storage Ratio ( $RQ$ ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 44.9 | 41.7 | 42.8 | 44.5 | 42.9 | | 51.5 | 10.5 | 8.6 | 46.2 | 15.4 | 8.5 |
| Incremental Delay ( $d_2$ ), s/veh | 0.1 | 0.0 | 0.1 | 0.2 | 0.1 | | 0.3 | 0.4 | 0.1 | 0.0 | 2.1 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 44.9 | 41.7 | 43.0 | 44.7 | 43.0 | | 51.9 | 10.8 | 8.7 | 46.3 | 17.5 | 8.5 |
| Level of Service (LOS) | D | D | D | D | D | | D | B | A | D | B | A |
| Approach Delay, s/veh / LOS | 43.5 | D | | 44.1 | D | | 12.8 | B | | 17.7 | B | |
| Intersection Delay, s/veh / LOS | 18.2 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.88 | B | 2.07 | B |
| Bicycle LOS Score / LOS | 0.60 | A | 0.70 | A | 1.12 | A | 1.83 | B |

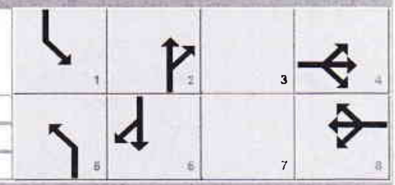
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | PM Peak Hour | PHF | 0.92 |
| Urban Street | | Analysis Year | 2021 w/Buildout | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Golden View | File Name | PyGv21pw.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 17 | 5 | 22 | 24 | 2 | 13 | 31 | 1648 | 80 | 15 | 841 | 3 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 15.0 | 75.0 | 20.0 | 0.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 0.0 | 4.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 |



| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 15.0 | 80.0 | 15.0 | 80.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.2 | | 3.2 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 4.4 | | 4.2 | 4.1 | | 3.0 | |
| Green Extension Time ( $g_e$ ), s | | 0.1 | | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 0.00 | | 0.00 | 0.00 | | 0.00 | |

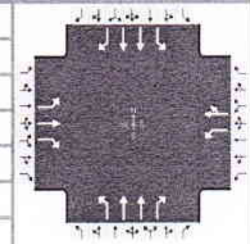
| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 18 | 5 | 24 | 26 | 16 | | 34 | 1791 | 87 | 16 | 914 | 3 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1385 | 1870 | 1542 | 1398 | 1579 | | 1781 | 1781 | 1542 | 1781 | 1781 | 1542 |
| Queue Service Time ( $g_s$ ), s | 1.4 | 0.3 | 1.6 | 1.9 | 1.0 | | 2.1 | 45.5 | 2.7 | 1.0 | 15.5 | 0.1 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 2.4 | 0.3 | 1.6 | 2.2 | 1.0 | | 2.1 | 45.5 | 2.7 | 1.0 | 15.5 | 0.1 |
| Green Ratio ( $g/C$ ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.08 | 0.62 | 0.62 | 0.12 | 0.62 | 0.62 |
| Capacity ( $c$ ), veh/h | 279 | 312 | 257 | 290 | 263 | | 148 | 2226 | 964 | 223 | 2226 | 964 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.066 | 0.017 | 0.093 | 0.090 | 0.062 | | 0.227 | 0.805 | 0.090 | 0.073 | 0.411 | 0.003 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 21.5 | 6.2 | 27.6 | 29.7 | 18.3 | | 42.2 | 582.1 | 38 | 19 | 233.7 | 1.3 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 0.8 | 0.2 | 1.1 | 1.2 | 0.7 | | 1.7 | 22.9 | 1.5 | 0.7 | 9.2 | 0.1 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 43.1 | 41.8 | 42.3 | 42.7 | 42.1 | | 51.4 | 17.0 | 8.9 | 46.4 | 11.4 | 8.5 |
| Incremental Delay ( $d_2$ ), s/veh | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | | 0.3 | 3.2 | 0.2 | 0.1 | 0.6 | 0.0 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 43.2 | 41.8 | 42.4 | 42.8 | 42.1 | | 51.7 | 20.2 | 9.1 | 46.4 | 11.9 | 8.5 |
| Level of Service (LOS) | D | D | D | D | D | | D | C | A | D | B | A |
| Approach Delay, s/veh / LOS | 42.6 | D | | 42.5 | D | | 20.2 | C | | 12.5 | B | |
| Intersection Delay, s/veh / LOS | 18.5 | | | | | | B | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.88 | B | 2.07 | B |
| Bicycle LOS Score / LOS | 0.57 | A | 0.56 | A | 2.06 | B | 1.26 | A |

 HCS7™ Streets Version 7.4 Generated: 6/5/2018 10:14:48 AM

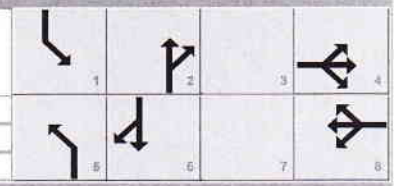
# HCS7 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | Solaegui Engineers | | | Duration, h | 0.25 |
| Analyst | MSH | Analysis Date | May 31, 2018 | Area Type | Other |
| Jurisdiction | NDOT | Time Period | AM Sunday | PHF | 0.90 |
| Urban Street | | Analysis Year | 2021 w/Buildout | Analysis Period | 1> 7:00 |
| Intersection | Pyramid & Golden View | File Name | PyGv21awS.xus | | |
| Project Description | | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand ( $v$ ), veh/h | 147 | 13 | 196 | 29 | 14 | 11 | 350 | 786 | 36 | 8 | 1130 | 40 |

| Signal Information | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cycle, s | 120.0 | Reference Phase | 2 | | | | | | | |
| Offset, s | 0 | Reference Point | End | Green | 7.0 | 32.0 | 46.0 | 20.0 | 0.0 | 0.0 |
| Uncoordinated | No | Simult. Gap E/W | On | Yellow | 0.0 | 4.0 | 4.0 | 4.0 | 0.0 | 0.0 |
| Force Mode | Fixed | Simult. Gap N/S | On | Red | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 |



| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | | 4 | | 8 | 5 | 2 | 1 | 6 |
| Case Number | | 5.0 | | 6.0 | 2.0 | 3.0 | 2.0 | 3.0 |
| Phase Duration, s | | 25.0 | | 25.0 | 44.0 | 88.0 | 7.0 | 51.0 |
| Change Period, ( $Y+R_c$ ), s | | 5.0 | | 5.0 | 5.0 | 5.0 | 0.0 | 5.0 |
| Max Allow Headway ( *MAH* ), s | | 3.4 | | 3.4 | 2.9 | 0.0 | 2.9 | 0.0 |
| Queue Clearance Time ( $g_s$ ), s | | 17.4 | | 5.2 | 24.6 | | 2.6 | |
| Green Extension Time ( $g_e$ ), s | | 0.3 | | 0.8 | 0.6 | 0.0 | 0.0 | 0.0 |
| Phase Call Probability | | 1.00 | | 1.00 | 1.00 | | 1.00 | |
| Max Out Probability | | 1.00 | | 0.00 | 0.00 | | 0.02 | |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate ( $v$ ), veh/h | 163 | 14 | 162 | 32 | 28 | | 389 | 873 | 40 | 9 | 1256 | 44 |
| Adjusted Saturation Flow Rate ( $s$ ), veh/h/ln | 1371 | 1870 | 1542 | 1387 | 1710 | | 1781 | 1781 | 1544 | 1781 | 1781 | 1536 |
| Queue Service Time ( $g_s$ ), s | 13.7 | 0.8 | 11.8 | 2.4 | 1.7 | | 22.6 | 12.0 | 1.0 | 0.6 | 40.3 | 2.2 |
| Cycle Queue Clearance Time ( $g_c$ ), s | 15.4 | 0.8 | 11.8 | 3.2 | 1.7 | | 22.6 | 12.0 | 1.0 | 0.6 | 40.3 | 2.2 |
| Green Ratio ( *g/C* ) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | | 0.32 | 0.69 | 0.69 | 0.06 | 0.38 | 0.38 |
| Capacity ( $c$ ), veh/h | 270 | 312 | 257 | 282 | 285 | | 579 | 2463 | 1068 | 104 | 1365 | 589 |
| Volume-to-Capacity Ratio ( $X$ ) | 0.606 | 0.046 | 0.631 | 0.114 | 0.097 | | 0.672 | 0.355 | 0.037 | 0.086 | 0.920 | 0.076 |
| Back of Queue ( $Q$ ), ft/ln ( 95 th percentile) | 218.4 | 16.8 | 213.9 | 38.4 | 32.6 | | 372.6 | 172.1 | 12.6 | 11.3 | 640 | 36.5 |
| Back of Queue ( $Q$ ), veh/ln ( 95 th percentile) | 8.6 | 0.7 | 8.4 | 1.5 | 1.3 | | 14.7 | 6.8 | 0.5 | 0.4 | 25.2 | 1.4 |
| Queue Storage Ratio ( *RQ* ) ( 95 th percentile) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay ( $d_1$ ), s/veh | 48.9 | 42.0 | 46.6 | 43.3 | 42.4 | | 35.0 | 7.6 | 5.9 | 53.5 | 35.2 | 23.5 |
| Incremental Delay ( $d_2$ ), s/veh | 2.8 | 0.0 | 3.8 | 0.1 | 0.1 | | 2.5 | 0.4 | 0.1 | 0.1 | 11.5 | 0.2 |
| Initial Queue Delay ( $d_3$ ), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay ( $d$ ), s/veh | 51.7 | 42.0 | 50.3 | 43.4 | 42.4 | | 37.5 | 8.0 | 5.9 | 53.6 | 46.7 | 23.7 |
| Level of Service (LOS) | D | D | D | D | D | | D | A | A | D | D | C |
| Approach Delay, s/veh / LOS | 50.6 | D | | 42.9 | D | | 16.7 | B | | 46.0 | D | |
| Intersection Delay, s/veh / LOS | 33.8 | | | | | | C | | | | | |

| Multimodal Results | EB | | WB | | NB | | SB | |
|---|---|---|---|---|---|---|---|---|
| Pedestrian LOS Score / LOS | 2.46 | B | 2.46 | B | 1.87 | B | 2.18 | B |
| Bicycle LOS Score / LOS | 1.05 | A | 0.59 | A | 1.56 | B | 1.57 | B |

INTERSECTION DETAIL
SR445 @ N LOS ALTOS PKWY
01 SEP 14 - 01 SEP 17

| COUNTY: WASHOE | | | | |
|---|---|---|---|---|
| Crash Severity | Crash Date | Crash Year | Crash Time | Primary Street |
| PROPERTY DAMAGE ONLY | 21-Aug-2015 | 2015 | 12:17 PM | N LOS ALTOS PKWY |
| PROPERTY DAMAGE ONLY | 16-Sep-2015 | 2015 | 04:14 PM | N LOS ALTOS PKWY |
| PROPERTY DAMAGE ONLY | 18-Jan-2017 | 2017 | 09:57 PM | N LOS ALTOS PKWY |
| PROPERTY DAMAGE ONLY | 30-May-2016 | 2016 | 03:26 PM | N LOS ALTOS PKWY |
| INJURY CRASH | 21-Oct-2014 | 2014 | 04:40 PM | N LOS ALTOS PKWY |
| PROPERTY DAMAGE ONLY | 1-Dec-2014 | 2014 | 07:16 AM | N LOS ALTOS PKWY |
| PROPERTY DAMAGE ONLY | 9-Jul-2015 | 2015 | 01:20 PM | N LOS ALTOS PKWY |
| INJURY CRASH | 14-Apr-2015 | 2015 | 06:03 PM | N LOS ALTOS PKWY |
| PROPERTY DAMAGE ONLY | 21-Feb-2015 | 2015 | 09:54 AM | N LOS ALTOS PKWY |
| PROPERTY DAMAGE ONLY | 11-Sep-2015 | 2015 | 08:03 AM | N LOS ALTOS PKWY |
| INJURY CRASH | 30-Dec-2015 | 2015 | 10:45 AM | N LOS ALTOS PKWY |
| INJURY CRASH | 5-May-2017 | 2017 | 04:53 PM | N LOS ALTOS PKWY |
| INJURY CRASH | 25-Aug-2017 | 2017 | 08:28 AM | N LOS ALTOS PKWY |
| INJURY CRASH | 25-Jul-2017 | 2017 | 10:40 AM | N LOS ALTOS PKWY |
| INJURY CRASH | 26-Aug-2016 | 2016 | 10:53 PM | SR445 |
| PROPERTY DAMAGE ONLY | 13-Sep-2016 | 2016 | 01:45 PM | SR445 |
| PROPERTY DAMAGE ONLY | 2-Jul-2017 | 2017 | 04:57 PM | SR445 |
| INJURY CRASH | 4-Feb-2016 | 2016 | 09:59 AM | SR445 |
| PROPERTY DAMAGE ONLY | 3-Apr-2016 | 2016 | 03:28 PM | SR445 |
| INJURY CRASH | 24-Sep-2015 | 2015 | 06:19 PM | SR445 |
| PROPERTY DAMAGE ONLY | 22-Dec-2015 | 2015 | 06:37 PM | SR445 |
| PROPERTY DAMAGE ONLY | 8-Apr-2016 | 2016 | 03:40 PM | SR445 |
| PROPERTY DAMAGE ONLY | 31-Dec-2015 | 2015 | 12:05 PM | SR445 |
| PROPERTY DAMAGE ONLY | 30-Dec-2015 | 2015 | 01:55 PM | SR445 |
| PROPERTY DAMAGE ONLY | 16-Feb-2015 | 2015 | 12:00 PM | SR445 |
| PROPERTY DAMAGE ONLY | 22-Apr-2016 | 2016 | 01:56 PM | SR445 |
| INJURY CRASH | 29-Feb-2016 | 2016 | 11:13 AM | SR445 |
| PROPERTY DAMAGE ONLY | 7-Mar-2015 | 2015 | 08:51 PM | SR445 |
| INJURY CRASH | 6-Mar-2015 | 2015 | 02:46 PM | SR445 |
| INJURY CRASH | 13-Dec-2015 | 2015 | 09:56 AM | SR445 |
| PROPERTY DAMAGE ONLY | 30-Jan-2015 | 2015 | 03:00 PM | SR445 |
| INJURY CRASH | 15-Feb-2016 | 2016 | 03:47 PM | SR445 |
| INJURY CRASH | 17-Feb-2016 | 2016 | 11:08 PM | SR445 |
| PROPERTY DAMAGE ONLY | 7-Jan-2016 | 2016 | 04:56 AM | SR445 |
| PROPERTY DAMAGE ONLY | 18-Feb-2015 | 2015 | 12:17 PM | SR445 |
| PROPERTY DAMAGE ONLY | 2-Aug-2016 | 2016 | 11:00 PM | SR445 |
| INJURY CRASH | 17-Dec-2016 | 2016 | 12:00 PM | SR445 |
| INJURY CRASH | 29-Nov-2016 | 2016 | 04:35 PM | SR445 |
| PROPERTY DAMAGE ONLY | 9-Jan-2017 | 2017 | 03:25 PM | SR445 |
| INJURY CRASH | 3-Apr-2017 | 2017 | 01:46 PM | SR445 |
| PROPERTY DAMAGE ONLY | 2-Aug-2017 | 2017 | 01:35 PM | SR445 |
| PROPERTY DAMAGE ONLY | 8-Oct-2016 | 2016 | 07:20 AM | SR445 |
| PROPERTY DAMAGE ONLY | 20-Feb-2016 | 2016 | 12:22 PM | SR445 |
| PROPERTY DAMAGE ONLY | 8-Jun-2017 | 2017 | 03:05 PM | SR445 |
| PROPERTY DAMAGE ONLY | 13-Dec-2016 | 2016 | 05:37 PM | SR445 |
| PROPERTY DAMAGE ONLY | 24-Mar-2015 | 2015 | 12:23 PM | SR445 |

| Distance | Dir | Secondary Street | Weather | Fatalities |
|---|---|---|---|---|
| 100 | E | SR445 | CLEAR | |
| 10 | E | SR445 | CLEAR | |
| 10 | E | SR445 | RAIN | |
| 8 | E | SR445 | CLEAR | |
| | AT INT | SR445 | CLEAR | |
| | AT INT | SR445 | CLOUDY | |
| | AT INT | SR445 | RAIN | |
| | AT INT | SR445 | CLEAR | |
| | AT INT | SR445 | CLEAR | |
| | AT INT | SR445 | CLEAR | |
| | AT INT | SR445 | CLOUDY | |
| | AT INT | SR445 | CLOUDY | |
| | AT INT | SR445 | CLEAR | |
| | AT INT | SR445 | CLEAR | |
| 120 | N | N LOS ALTOS PKWY | CLEAR | |
| 120 | N | N LOS ALTOS PKWY | CLOUDY | |
| 100 | N | N LOS ALTOS PKWY | CLEAR | |
| 50 | N | N LOS ALTOS PKWY | CLOUDY | |
| 40 | N | N LOS ALTOS PKWY | CLOUDY | |
| 30 | N | N LOS ALTOS PKWY | CLEAR | |
| 30 | N | N LOS ALTOS PKWY | CLOUDY | |
| 30 | N | N LOS ALTOS PKWY | CLOUDY | |
| 25 | N | N LOS ALTOS PKWY | CLEAR | |
| 20 | N | N LOS ALTOS PKWY | CLOUDY | |
| 15 | N | N LOS ALTOS PKWY | CLEAR | |
| 12 | N | N LOS ALTOS PKWY | CLOUDY | |
| 3 | N | N LOS ALTOS PKWY | CLEAR | |
| | AT INT | N LOS ALTOS PKWY | CLEAR | |
| | AT INT | N LOS ALTOS PKWY | CLEAR | |
| | AT INT | N LOS ALTOS PKWY | CLOUDY | |
| | AT INT | N LOS ALTOS PKWY | CLEAR | |
| | AT INT | N LOS ALTOS PKWY | CLEAR | |
| | AT INT | N LOS ALTOS PKWY | RAIN | |
| | AT INT | N LOS ALTOS PKWY | SNOW | |
| | AT INT | N LOS ALTOS PKWY | CLEAR | |
| | AT INT | N LOS ALTOS PKWY | CLEAR | |
| | AT INT | N LOS ALTOS PKWY | UNKNOWN | |
| | AT INT | N LOS ALTOS PKWY | CLEAR | |
| | AT INT | N LOS ALTOS PKWY | | |
| | AT INT | N LOS ALTOS PKWY | CLEAR | |
| | AT INT | N LOS ALTOS PKWY | CLOUDY | |
| 5 | S | N LOS ALTOS PKWY | CLEAR | |
| 10 | S | N LOS ALTOS PKWY | CLEAR | |
| 10 | S | N LOS ALTOS PKWY | CLOUDY | |
| 15 | S | N LOS ALTOS PKWY | CLOUDY | |
| 16 | S | N LOS ALTOS PKWY | CLOUDY | |

| Injured | Property Damage Only | Injury Type | Crash Type | Total Vehicles |
|---|---|---|---|---|
| | PDO | | ANGLE | 2 |
| | PDO | | REAR-END | 2 |
| | PDO | | REAR-END | 2 |
| | PDO | | REAR-END | 2 |
| 1 | | C | REAR-END | 3 |
| | PDO | | NON-COLLISION | 1 |
| | PDO | | REAR-END | 2 |
| 1 | | C | REAR-END | 2 |
| | PDO | | REAR-END | 2 |
| | PDO | | REAR-TO-REAR | 2 |
| 1 | | C | REAR-END | 2 |
| 1 | | C | REAR-END | 2 |
| 2 | | C | ANGLE | 2 |
| 1 | | C | REAR-END | 2 |
| 1 | | C | ANGLE | 2 |
| | PDO | | REAR-END | 2 |
| | PDO | | NON-COLLISION | 1 |
| 2 | | C | REAR-END | 2 |
| | PDO | | REAR-END | 2 |
| 1 | | | REAR-END | 2 |
| | PDO | | ANGLE | 2 |
| | PDO | | ANGLE | 2 |
| | PDO | | REAR-END | 2 |
| | PDO | | NON-COLLISION | 2 |
| | PDO | | REAR-END | 2 |
| | PDO | | NON-COLLISION | 3 |
| 1 | | C | REAR-END | 2 |
| | PDO | | SIDESWIPE, MEETING | 2 |
| 1 | | C | ANGLE | 2 |
| 1 | | C | ANGLE | 2 |
| | PDO | | REAR-END | 2 |
| 1 | | C | ANGLE | 2 |
| 1 | | C | ANGLE | 2 |
| | PDO | | NON-COLLISION | 1 |
| | PDO | | REAR-END | 2 |
| | PDO | | ANGLE | 3 |
| 1 | | C | REAR-END | 2 |
| 2 | | C | ANGLE | 2 |
| | PDO | | REAR-END | 2 |
| 1 | | C | REAR-END | 2 |
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| | PDO | | REAR-END | 2 |
| | PDO | | REAR-END | 2 |
| | PDO | | REAR-END | 2 |

| V1 Type | V1 Dir | V1 Driver Age | V1 Lane Num | V1 Action |
|---|---|---|---|---|
| CARRY-ALL | N | | | TURNING RIGHT |
| SEDAN, 4 DOOR | W | 29 | | GOING STRAIGHT |
| SEDAN, 4 DOOR | W | | | GOING STRAIGHT |
| | E | | 1 | GOING STRAIGHT |
| CARRY-ALL | W | 55 | 1 | GOING STRAIGHT |
| HATCHBACK, 2 DOOR | W | | | TURNING LEFT |
| | | | | OTHER TURNING MOVEMENT |
| CARRY-ALL | E | 34 | 1 | GOING STRAIGHT |
| SEDAN, 4 DOOR | W | 18 | | GOING STRAIGHT |
| PICKUP | N | | | UNKNOWN |
| PICKUP | W | 18 | | GOING STRAIGHT |
| PICKUP | W | 16 | | GOING STRAIGHT |
| SEDAN, 4 DOOR | S | | | CHANGING LANES |
| SEDAN, 4 DOOR | E | 47 | | GOING STRAIGHT |
| PICKUP | N | 17 | 2 | CHANGING LANES |
| UTILITY | S | 77 | 1 | GOING STRAIGHT |
| CARRY-ALL | S | 52 | | GOING STRAIGHT |
| CARRY-ALL | S | 74 | | GOING STRAIGHT |
| HARDTOP, 2 DOOR | S | 18 | | GOING STRAIGHT |
| CARRY-ALL | N | 25 | 1 | GOING STRAIGHT |
| PICKUP | S | 22 | 2 | MAKING U-TURN |
| CARRY-ALL | N | 72 | 3 | GOING STRAIGHT |
| UTILITY | S | 20 | 2 | GOING STRAIGHT |
| UTILITY | S | 17 | | GOING STRAIGHT |
| VAN | S | | | GOING STRAIGHT |
| CARRY-ALL | N | 18 | | TURNING RIGHT |
| SEDAN, 4 DOOR | S | 44 | | GOING STRAIGHT |
| SEDAN, 4 DOOR | N | | | OTHER TURNING MOVEMENT |
| UTILITY | N | 33 | | GOING STRAIGHT |
| SEDAN, 4 DOOR | S | 20 | | TURNING LEFT |
| CARRY-ALL | | 32 | 1 | GOING STRAIGHT |
| SEDAN, 4 DOOR | S | 17 | | TURNING LEFT |
| SEDAN, 4 DOOR | E | 22 | | GOING STRAIGHT |
| SEDAN, 2 DOOR | N | 56 | | CHANGING LANES |
| HARDTOP, 4 DOOR | S | 37 | | GOING STRAIGHT |
| SEDAN, 4 DOOR | S | 20 | | TURNING LEFT |
| SEDAN, 4 DOOR | N | 25 | | GOING STRAIGHT |
| CARRY-ALL | S | 24 | | GOING STRAIGHT |
| VAN | N | 71 | | GOING STRAIGHT |
| SEDAN, 4 DOOR | E | 19 | | TURNING RIGHT |
| CARRY-ALL | N | 70 | | TURNING LEFT |
| PICKUP | N | 41 | 1 | GOING STRAIGHT |
| SEDAN, 4 DOOR | N | 37 | 1 | GOING STRAIGHT |
| SEDAN, 4 DOOR | N | 19 | | GOING STRAIGHT |
| HARDTOP, 4 DOOR | N | 36 | 2 | GOING STRAIGHT |
| HARDTOP, 4 DOOR | N | | | GOING STRAIGHT |

| V1 Driver Factors | V1 Driver Distracted |
| --- | --- |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
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| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
| | |
| APPARENTLY NORMAL | |
| OTHER IMPROPER DRIVING | |
| | |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
| | |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
| DRUG INVOLVEMENT | |
| INATTENTION/DISTRACTED | ANIMALS |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
| ILLNESS | |
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| APPARENTLY NORMAL | |

| V1 Vehicle Factors |
| --- |
| FAILED TO YIELD RIGHT OF WAY |
| OTHER IMPROPER DRIVING |
| FOLLOWED TOO CLOSELY |
| HIT AND RUN |
| FOLLOWED TOO CLOSELY |
| DRIVING TOO FAST FOR CONDITIONS |
| HIT AND RUN |
| MECHANICAL DEFECTS: ROAD DEFECT |
| FOLLOWED TOO CLOSELY |
| HIT AND RUN |
| FOLLOWED TOO CLOSELY |
| |
| FAILURE TO KEEP IN PROPER LANE OR RUNNING OFF ROAD: UNSAFE LANE CHANGE |
| FOLLOWED TOO CLOSELY |
| UNSAFE LANE CHANGE |
| OTHER IMPROPER DRIVING |
| RAN OFF ROAD |
| |
| HIT AND RUN: OTHER IMPROPER DRIVING |
| |
| DISREGARDED TRAFFIC SIGNS, SIGNALS, ROAD MARKINGS |
| FAILURE TO KEEP IN PROPER LANE OR RUNNING OFF ROAD: RAN OFF ROAD: UNSAFE LANE CHANGE |
| FOLLOWED TOO CLOSELY |
| OTHER IMPROPER DRIVING |
| OTHER IMPROPER DRIVING |
| MECHANICAL DEFECTS: ROAD DEFECT |
| |
| FAILED TO YIELD RIGHT OF WAY |
| DISREGARDED TRAFFIC SIGNS, SIGNALS, ROAD MARKINGS |
| FAILED TO YIELD RIGHT OF WAY |
| FOLLOWED TOO CLOSELY |
| FAILED TO YIELD RIGHT OF WAY |
| UNKNOWN |
| DRIVING TOO FAST FOR CONDITIONS |
| FOLLOWED TOO CLOSELY |
| FAILED TO YIELD RIGHT OF WAY |
| |
| DISREGARDED TRAFFIC SIGNS, SIGNALS, ROAD MARKINGS |
| OTHER IMPROPER DRIVING |
| |
| DRIVING TOO FAST FOR CONDITIONS |
| OTHER IMPROPER DRIVING |
| |
| |
| |
| DRIVING TOO FAST FOR CONDITIONS |

| V1 Most Harmful Event | V1 All Events |
|---|---|
| | |
| | SLOW/STOPPED VEHICLE |
| | SLOW/STOPPED VEHICLE |
| | SLOW/STOPPED VEHICLE |
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| | SLOW/STOPPED VEHICLE |
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| | SLOW/STOPPED VEHICLE |
| | SLOW/STOPPED VEHICLE |
| | SLOW/STOPPED VEHICLE |
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| | SLOW/STOPPED VEHICLE: RAN OFF ROAD RIGHT: OVERTURN/ROLLOVER |
| | SLOW/STOPPED VEHICLE |
| | SLOW/STOPPED VEHICLE |
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| | EQUIPMENT FAILURE (BLOWN TIRE, BRAKE FAILURE, ETC.) |
| | SLOW/STOPPED VEHICLE |
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| | UTILITY POLE |
| | SLOW/STOPPED VEHICLE |
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| | SLOW/STOPPED VEHICLE |
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| | SLOW/STOPPED VEHICLE |
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| V2 Type | V2 Dir | V2 Driver Age | V2 Lane Num | V2 Action |
|---|---|---|---|---|
| SEDAN, 4 DOOR | E | | | GOING STRAIGHT |
| CARRY-ALL | W | 44 | | STOPPED |
| PICKUP | W | | | STOPPED |
| SEDAN, 4 DOOR | E | 21 | 1 | STOPPED |
| VAN | W | 61 | 1 | STOPPED |
| | | | | |
| SEDAN, 4 DOOR | | 21 | | STOPPED |
| SEDAN, 4 DOOR | E | 62 | 1 | STOPPED |
| UTILITY | W | 51 | | STOPPED |
| CARRY-ALL | N | | | STOPPED |
| WAGON | W | 38 | | STOPPED |
| PICKUP | W | 61 | | STOPPED |
| SEDAN, 4 DOOR | S | 30 | | GOING STRAIGHT |
| CARRY-ALL | E | 46 | | STOPPED |
| VAN | N | 46 | 2 | GOING STRAIGHT |
| HATCHBACK, 4 DOOR | S | 52 | 1 | STOPPED |
| | | | | |
| PICKUP | S | 66 | | STOPPED |
| UTILITY | S | 31 | | STOPPED |
| CARRY-ALL | N | 38 | 1 | STOPPED |
| HARDTOP, 4 DOOR | S | 35 | 2 | GOING STRAIGHT |
| UTILITY | W | 41 | 3 | STOPPED |
| GARBAGE OR REFUSE | S | 48 | 2 | STOPPED |
| SEDAN, 4 DOOR | S | 59 | | STOPPED |
| HARDTOP, 2 DOOR | S | | | GOING STRAIGHT |
| UTILITY | W | 27 | | STOPPED |
| SEDAN, 4 DOOR | S | 30 | | STOPPED |
| SEDAN, 4 DOOR | W | | | TURNING LEFT |
| HATCHBACK, 2 DOOR | E | 61 | | GOING STRAIGHT |
| PICKUP | W | 26 | | GOING STRAIGHT |
| CARRY-ALL | | 74 | 1 | TURNING RIGHT |
| CONVERTIBLE | N | 59 | | GOING STRAIGHT |
| PICKUP | S | 38 | | GOING STRAIGHT |
| | | | | |
| HARDTOP, 4 DOOR | S | 33 | | STOPPED |
| SEDAN, 2 DOOR | N | 66 | | GOING STRAIGHT |
| SEDAN, 4 DOOR | N | 38 | | GOING STRAIGHT |
| CARRY-ALL | E | 58 | | GOING STRAIGHT |
| UTILITY | N | 65 | | STOPPED |
| PICKUP | S | 70 | | TURNING RIGHT |
| SEDAN, 4 DOOR | N | 21 | | TURNING LEFT |
| PICKUP | N | 55 | 1 | STOPPED |
| PICKUP | N | 52 | 1 | STOPPED |
| UTILITY | N | 45 | | STOPPED |
| CARRY-ALL | N | 53 | 2 | STOPPED |
| CARRY-ALL | N | | | STOPPED |

| V2 Driver Factors | V2 Driver Distracted |
|---|---|
| APPARENTLY NORMAL | |
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| V2 Vehicle Factors | V2 Most Harmful Event |
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| **HIT AND RUN** | |
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| V2 All Events | First Harmful Event | Nonmotorist Factors | Factors Roadway |
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| | | | DRY |
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| | | | DRY |
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| | | | |
| SLOW/STOPPED VEHICLE | | | DRY |
| SLOW/STOPPED VEHICLE | | | DRY |
| SLOW/STOPPED VEHICLE | | | DRY |
| | | | |
| SLOW/STOPPED VEHICLE | | | DRY |
| SLOW/STOPPED VEHICLE | | | DRY |
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| SLOW/STOPPED VEHICLE | | | DRY |
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| OTHER MOVABLE OBJECT | | | DRY |
| SLOW/STOPPED VEHICLE | | | DRY |
| | | | |
| | | | DRY |
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| SLOW/STOPPED VEHICLE | | | DRY |
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| SLOW/STOPPED VEHICLE | | | DRY |
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| SLOW/STOPPED VEHICLE | | | DRY |
| SLOW/STOPPED VEHICLE | | | DRY |
| | | | |

| Lighting | HWY Factors | Agency | Accident Rec Num |
|---|---|---|---|
| | NONE | SPPD | 2307120 |
| DAYLIGHT | NONE | NHP | 2198125 |
| | | SPPD | 2360425 |
| DAYLIGHT | NONE | NHP | 2323760 |
| DUSK | NONE | SPPD | 2187702 |
| | NONE | SPPD | 2187016 |
| DAYLIGHT | NONE | SPPD | 2307015 |
| DAYLIGHT | NONE | SPPD | 2306777 |
| DAYLIGHT | NONE | SPPD | 2306643 |
| | NONE | SPPD | 2307195 |
| DAYLIGHT | NONE | SPPD | 2310316 |
| DAYLIGHT | NONE | NHP | 2381017 |
| DAYLIGHT | NONE | NHP | 2396543 |
| DAYLIGHT | NONE | SPPD | 2401110 |
| DARK - NO LIGHTING | NONE | NHP | 2328681 |
| DAYLIGHT | NONE | NHP | 2329631 |
| DAYLIGHT | | SPPD | 2386556 |
| DAYLIGHT | NONE | NHP | 2226195 |
| DAYLIGHT | | NHP | 2235960 |
| DAYLIGHT | NONE | NHP | 2198488 |
| DARK - SPOT LIGHTING | NONE | NHP | 2214390 |
| DAYLIGHT | NONE | NHP | 2236251 |
| DAYLIGHT | NONE | NHP | 2214930 |
| DAYLIGHT | NONE | NHP | 2214889 |
| | NONE | NHP | 2174623 |
| DAYLIGHT | NONE | NHP | 2237008 |
| DAYLIGHT | NONE | NHP | 2234308 |
| | NONE | NHP | 2175605 |
| DAYLIGHT | NONE | NHP | 2175553 |
| DAYLIGHT | NONE | NHP | 2213853 |
| DAYLIGHT | NONE | SPPD | 2307268 |
| DAYLIGHT | NONE | NHP | 2226746 |
| DARK - SPOT LIGHTING | WET, ICY, SNOW, SLUSH | NHP | 2226839 |
| DARK - SPOT LIGHTING | | SPPD | 2310428 |
| DAYLIGHT | NONE | WASO | 2308403 |
| DARK - SPOT LIGHTING | NONE | NHP | 2327326 |
| UNKNOWN | UNKNOWN | NHP | 2342543 |
| DAYLIGHT | NONE | NHP | 2341213 |
| DAYLIGHT | | NHP | 2358191 |
| DAYLIGHT | | SPPD | 2386245 |
| DAYLIGHT | | NHP | 2395214 |
| DAYLIGHT | NONE | NHP | 2338235 |
| DAYLIGHT | NONE | NHP | 2227032 |
| DAYLIGHT | NONE | NHP | 2382885 |
| DARK - SPOT LIGHTING | NONE | NHP | 2342102 |
| | | NHP | 2176318 |

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|---|---|---|---|---|
| PROPERTY DAMAGE ONLY | 22-Jul-2016 | 2016 | 05:53 PM | SR445 |
| PROPERTY DAMAGE ONLY | 14-Nov-2014 | 2014 | 08:47 AM | SR445 |
| PROPERTY DAMAGE ONLY | 12-Nov-2015 | 2015 | 01:29 PM | SR445 |
| PROPERTY DAMAGE ONLY | 2-Jun-2017 | 2017 | 06:30 PM | SR445 |
| PROPERTY DAMAGE ONLY | 20-Sep-2014 | 2014 | 10:21 AM | SR445 |
| INJURY CRASH | 24-Sep-2014 | 2014 | 07:35 AM | SR445 |
| PROPERTY DAMAGE ONLY | 29-Nov-2014 | 2014 | 05:03 PM | SR445 |
| INJURY CRASH | 14-Dec-2014 | 2014 | 05:16 PM | SR445 |
| PROPERTY DAMAGE ONLY | 4-Feb-2015 | 2015 | 06:07 PM | SR445 |
| PROPERTY DAMAGE ONLY | 1-Jul-2016 | 2016 | 02:25 AM | SR445 |
| INJURY CRASH | 10-Dec-2016 | 2016 | 11:42 AM | SR445 |
| PROPERTY DAMAGE ONLY | 11-Dec-2014 | 2014 | 08:50 AM | SR445 |
| PROPERTY DAMAGE ONLY | 14-Sep-2016 | 2016 | 02:25 PM | SR445 |
| PROPERTY DAMAGE ONLY | 23-Jul-2016 | 2016 | 07:48 PM | SR445 |

| | | | | |
|---|---|---|---|---|
| 24 | S | N LOS ALTOS PKWY | CLEAR | |
| 30 | S | N LOS ALTOS PKWY | CLEAR | |
| 30 | S | N LOS ALTOS PKWY | CLEAR | |
| 30 | S | N LOS ALTOS PKWY | CLEAR | |
| 40 | S | N LOS ALTOS PKWY | CLEAR | |
| 40 | S | N LOS ALTOS PKWY | CLOUDY | |
| 45 | S | N LOS ALTOS PKWY | CLEAR | |
| 50 | S | N LOS ALTOS PKWY | RAIN | |
| 50 | S | N LOS ALTOS PKWY | CLEAR | |
| 55 | S | N LOS ALTOS PKWY | CLEAR | |
| 75 | S | N LOS ALTOS PKWY | RAIN | |
| 100 | S | N LOS ALTOS PKWY | CLOUDY: SEVERE CROSSWINDS | |
| 100 | S | N LOS ALTOS PKWY | CLEAR | |
| 200 | S | N LOS ALTOS PKWY | CLEAR | |
| | | | | **Sum: 0** |
| | | | | **Count: 0** |
| | | | | **Total:** |

| | | | | |
|---|---|---|---|---|
| | PDO | | REAR-END | 2 |
| | PDO | | ANGLE | 2 |
| | PDO | | NON-COLLISION | 1 |
| | PDO | | ANGLE | 2 |
| | PDO | | NON-COLLISION | 1 |
| 1 | | C | REAR-END | 2 |
| | PDO | | REAR-END | 3 |
| 1 | | C | SIDESWIPE, OVERTAKING | 2 |
| | PDO | | REAR-END | 2 |
| | PDO | | NON-COLLISION | 1 |
| 3 | | C | REAR-END | 3 |
| | PDO | | NON-COLLISION | 1 |
| | PDO | | SIDESWIPE, OVERTAKING | 2 |
| | PDO | | NON-COLLISION | 2 |
| Sum: 25 | Count: 40 | | | |
| Count: 20 | | | | |
| 60 | | | | |

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|---|---|---|---|---|
| SEDAN, 4 DOOR | | | 1 | UNKNOWN |
| PICKUP | E | | | TURNING RIGHT |
| STATION WAGON | S | 31 | 1 | GOING STRAIGHT |
| PICKUP | E | 86 | 2 | TURNING RIGHT |
| SEDAN, 4 DOOR | S | | | GOING STRAIGHT |
| VAN | S | 54 | 1 | GOING STRAIGHT |
| CARRY-ALL | N | | | GOING STRAIGHT |
| HARDTOP, 4 DOOR | S | 54 | 1 | NOT REPORTED |
| UTILITY | N | 45 | 1 | GOING STRAIGHT |
| SEDAN, 4 DOOR | S | 16 | 1 | TURNING RIGHT |
| SEDAN, 4 DOOR | N | 21 | | GOING STRAIGHT |
| SEDAN, 2 DOOR | S | | | GOING STRAIGHT |
| PICKUP | S | 36 | | GOING STRAIGHT |
| MOTORCYCLE | N | 31 | | NOT REPORTED |

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| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
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| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
| HAD BEEN DRINKING | |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
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| APPARENTLY NORMAL | |

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| FAILED TO YIELD RIGHT OF WAY |
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| FAILED TO YIELD RIGHT OF WAY |
| MECHANICAL DEFECTS: ROAD DEFECT |
| DRIVING TOO FAST FOR CONDITIONS |
| DRIVING TOO FAST FOR CONDITIONS |
| UNSAFE LANE CHANGE |
| HIT AND RUN |
| FAILURE TO KEEP IN PROPER LANE OR RUNNING OFF ROAD: UNSAFE LANE CHANGE |
| DRIVING TOO FAST FOR CONDITIONS |
| |
| UNKNOWN |
| RAN OFF ROAD |

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|---|---|
| | SLOW/STOPPED VEHICLE |
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| | RAN OFF ROAD LEFT: HIGHWAY TRAFFIC SIGN POST |
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| | SLOW/STOPPED VEHICLE |
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| | |
| | SLOW/STOPPED VEHICLE |
| | NOT REPORTED |
| | SLOW/STOPPED VEHICLE |
| | |
| | |
| | OTHER NON-COLLISION: RAN OFF ROAD RIGHT |

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|---|---|---|---|---|
| CARRY-ALL | N | 56 | 1 | STOPPED |
| CONVERTIBLE | S | | | GOING STRAIGHT |
| | | | | |
| SEDAN, 4 DOOR | S | 18 | 2 | GOING STRAIGHT |
| | | | | |
| HARDTOP, 4 DOOR | S | 38 | 1 | STOPPED |
| SEDAN, 4 DOOR | N | | | STOPPED |
| PICKUP | S | 25 | 1 | GOING STRAIGHT |
| PICKUP | N | 53 | 1 | GOING STRAIGHT |
| | | | | |
| SEDAN, 2 DOOR | N | 30 | | STOPPED |
| | | | | |
| HARDTOP, 4 DOOR | S | 33 | | GOING STRAIGHT |
| | N | | | GOING STRAIGHT |

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| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
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| APPARENTLY NORMAL | |
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| APPARENTLY NORMAL | |
| FELL ASLEEP, FAINTED, FATIGUED, ETC. | |
| APPARENTLY NORMAL | |
| APPARENTLY NORMAL | |
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| APPARENTLY NORMAL | |
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| | |
| UNKNOWN | |
| DISREGARDED TRAFFIC SIGNS, SIGNALS, ROAD MARKINGS: HIT AND RUN | |

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|---|---|---|---|
| SLOW/STOPPED VEHICLE | | | DRY |
| | | | |
| | | | DRY |
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| | | | |
| | | | DRY |
| OTHER NON-COLLISION | | | DRY |

| | | | |
|---|---|---|---|
| DAYLIGHT | NONE | NHP | 2326761 |
| | NONE | NHP | 2170293 |
| DAYLIGHT | NONE | NHP | 2212164 |
| DAYLIGHT | NONE | NHP | 2382558 |
| | NONE | NHP | 2167458 |
| DAYLIGHT | NONE | NHP | 2167602 |
| | NONE | NHP | 2170869 |
| DARK - SPOT LIGHTING | NONE | NHP | 2171626 |
| DARK - SPOT LIGHTING | NONE | NHP | 2174092 |
| DARK - CONTINUOUS LIGHTING | NONE | NHP | 2325599 |
| DAYLIGHT | NONE | NHP | 2341931 |
| | | NHP | 2171463 |
| DAYLIGHT | NONE | NHP | 2329711 |
| DUSK | NONE | NHP | 2326813 |

INTERSECTION DETAIL
SR445 @ SPARKS BLVD / HIGHLAND RANCH PKWY
01 SEP 14 - 01 SEP 17

COUNTY: WASHOE

| Crash Severity | Crash Date | Crash Year | Crash Time | Primary Street |
|---|---|---|---|---|
| PROPERTY DAMAGE ONLY | 26-Jun-2016 | 2016 | 02:05 PM | SPARKS BLVD |
| PROPERTY DAMAGE ONLY | 23-Jul-2015 | 2015 | 06:26 PM | SPARKS BLVD |
| PROPERTY DAMAGE ONLY | 23-Jul-2017 | 2017 | 05:46 PM | SPARKS BLVD |
| INJURY CRASH | 26-Dec-2016 | 2016 | 01:30 PM | HIGHLAND RANCH PKWY |
| INJURY CRASH | 26-May-2016 | 2016 | 05:46 AM | HIGHLAND RANCH PKWY |
| PROPERTY DAMAGE ONLY | 11-Apr-2015 | 2015 | 11:06 AM | HIGHLAND RANCH PKWY |
| PROPERTY DAMAGE ONLY | 30-Nov-2014 | 2014 | 08:56 AM | HIGHLAND RANCH PKWY |
| INJURY CRASH | 14-Apr-2017 | 2017 | 09:27 AM | HIGHLAND RANCH PKWY |
| PROPERTY DAMAGE ONLY | 16-Nov-2015 | 2015 | 03:20 PM | HIGHLAND RANCH PKWY |
| PROPERTY DAMAGE ONLY | 26-Dec-2014 | 2014 | 07:00 PM | SR445 |
| PROPERTY DAMAGE ONLY | 31-Oct-2016 | 2016 | 08:06 AM | SR445 |
| PROPERTY DAMAGE ONLY | 9-Jun-2015 | 2015 | 12:28 PM | SR445 |
| INJURY CRASH | 27-Feb-2016 | 2016 | 11:08 AM | SR445 |
| INJURY CRASH | 28-Mar-2016 | 2016 | 10:45 AM | SR445 |
| PROPERTY DAMAGE ONLY | 7-Jun-2016 | 2016 | 03:34 PM | SR445 |
| PROPERTY DAMAGE ONLY | 14-Jul-2015 | 2015 | 03:17 PM | SR445 |
| PROPERTY DAMAGE ONLY | 3-Oct-2014 | 2014 | 02:30 PM | SR445 |
| PROPERTY DAMAGE ONLY | 6-Nov-2014 | 2014 | 12:20 PM | SR445 |
| INJURY CRASH | 29-Apr-2017 | 2017 | 02:55 PM | SR445 |
| PROPERTY DAMAGE ONLY | 18-Sep-2015 | 2015 | 09:15 PM | SR445 |
| PROPERTY DAMAGE ONLY | 30-Sep-2015 | 2015 | 06:05 PM | SR445 |
| INJURY CRASH | 1-Dec-2015 | 2015 | 07:20 AM | SR445 |
| INJURY CRASH | 6-Dec-2016 | 2016 | 09:05 AM | SR445 |
| PROPERTY DAMAGE ONLY | 18-Jul-2015 | 2015 | 10:42 AM | SR445 |
| PROPERTY DAMAGE ONLY | 6-Sep-2014 | 2014 | 09:31 PM | SR445 |
| PROPERTY DAMAGE ONLY | 28-Nov-2014 | 2014 | 12:52 PM | SR445 |
| PROPERTY DAMAGE ONLY | 20-Sep-2015 | 2015 | 05:47 PM | SR445 |
| INJURY CRASH | 24-Apr-2016 | 2016 | 10:30 PM | SR445 |
| PROPERTY DAMAGE ONLY | 17-Feb-2015 | 2015 | 12:03 PM | SR445 |
| INJURY CRASH | 5-May-2016 | 2016 | 08:46 PM | SR445 |
| PROPERTY DAMAGE ONLY | 28-Jun-2016 | 2016 | 07:45 AM | SR445 |
| PROPERTY DAMAGE ONLY | 23-Dec-2016 | 2016 | 08:17 PM | SR445 |
| INJURY CRASH | 19-May-2017 | 2017 | 06:13 PM | SR445 |
| PROPERTY DAMAGE ONLY | 24-May-2017 | 2017 | 06:30 AM | SR445 |
| INJURY CRASH | 18-Jun-2017 | 2017 | 06:52 PM | SR445 |
| PROPERTY DAMAGE ONLY | 14-Nov-2014 | 2014 | 07:22 PM | SR445 |
| INJURY CRASH | 4-Apr-2015 | 2015 | 10:46 AM | SR445 |
| INJURY CRASH | 8-Jul-2015 | 2015 | 12:21 PM | SR445 |
| INJURY CRASH | 18-Sep-2014 | 2014 | 07:50 PM | SR445 |

| Distance | Dir | Secondary Street | Weather | Fatalities | Injured |
|---|---|---|---|---|---|
| 30 | E | SR445 | CLEAR | | |
| | AT INT | SR445 | CLEAR | | |
| | AT INT | SR445 | CLEAR | | |
| | AT INT | SR445 | CLEAR | | 1 |
| 1 | W | SR445 | CLEAR | | 2 |
| 15 | W | SR445 | CLOUDY | | |
| 20 | W | SR445 | CLOUDY | | |
| 60 | W | SR445 | CLEAR | | 1 |
| 90 | W | SR445 | CLOUDY | | |
| 200 | N | SPARKS BLVD | UNKNOWN | | |
| 150 | N | HIGHLAND RANCH PKWY | CLEAR | | |
| 120 | N | HIGHLAND RANCH PKWY | CLOUDY | | |
| 100 | N | HIGHLAND RANCH PKWY | CLEAR | | 2 |
| 100 | N | SPARKS BLVD | SNOW | | 2 |
| 80 | N | SPARKS BLVD | CLEAR | | |
| 75 | N | HIGHLAND RANCH PKWY | CLOUDY | | |
| 50 | N | HIGHLAND RANCH PKWY | CLEAR | | |
| 40 | N | HIGHLAND RANCH PKWY | CLEAR | | |
| 40 | N | HIGHLAND RANCH PKWY | CLEAR | | 2 |
| 20 | N | HIGHLAND RANCH PKWY | CLEAR | | |
| 20 | N | SPARKS BLVD | RAIN | | |
| 20 | N | SPARKS BLVD | CLEAR | | 1 |
| 10 | N | HIGHLAND RANCH PKWY | CLEAR | | 2 |
| | AT INT | HIGHLAND RANCH PKWY | CLEAR | | |
| | AT INT | HIGHLAND RANCH PKWY | CLEAR | | |
| | AT INT | HIGHLAND RANCH PKWY | CLEAR | | |
| | AT INT | HIGHLAND RANCH PKWY | CLEAR | | |
| | AT INT | HIGHLAND RANCH PKWY | CLOUDY | | 1 |
| | AT INT | SPARKS BLVD | CLEAR | | |
| | AT INT | SPARKS BLVD | RAIN | | 2 |
| | AT INT | SPARKS BLVD | CLEAR | | |
| | AT INT | SPARKS BLVD | RAIN | | |
| | AT INT | SPARKS BLVD | CLEAR | | 1 |
| | AT INT | SPARKS BLVD | CLEAR | | |
| | AT INT | SPARKS BLVD | CLOUDY | | 1 |
| 20 | S | HIGHLAND RANCH PKWY | CLOUDY | | |
| 70 | S | SPARKS BLVD | CLEAR | | 1 |
| 100 | S | SPARKS BLVD | CLOUDY | | 2 |
| 150 | S | SPARKS BLVD | CLOUDY | | 2 |
| | | | | Sum: 0 | Sum: 23 |
| | | | | Count: 0 | Count: 15 |
| | | | | Total: | 39 |

| Property Damage Only | Injury Type | Crash Type | Total Vehicles | V1 Type |
|---|---|---|---|---|
| PDO | | SIDESWIPE, OVERTAKING | 2 | PICKUP |
| PDO | | ANGLE | 2 | PICKUP |
| PDO | | ANGLE | 1 | PICKUP |
| | B | REAR-END | 2 | HATCHBACK, 2 DOOR |
| | | HEAD-ON | 2 | HATCHBACK, 4 DOOR |
| PDO | | REAR-END | 2 | HARDTOP, 2 DOOR |
| PDO | | REAR-END | 2 | CARRY-ALL |
| | C | REAR-END | 2 | HARDTOP, 4 DOOR |
| PDO | | ANGLE | 2 | SEDAN, 4 DOOR |
| PDO | | REAR-END | 2 | UTILITY |
| PDO | | REAR-END | 2 | UTILITY |
| PDO | | REAR-END | 2 | HATCHBACK, 4 DOOR |
| | C | REAR-END | 3 | UTILITY |
| | C | ANGLE | 2 | CARRY-ALL |
| PDO | | REAR-END | 2 | STATION WAGON |
| PDO | | ANGLE | 2 | PICKUP |
| PDO | | REAR-END | 2 | SEDAN, 4 DOOR |
| PDO | | REAR-END | 2 | HATCHBACK, 2 DOOR |
| | A | REAR-END | 3 | SEDAN, 2 DOOR |
| PDO | | REAR-END | 2 | HARDTOP, 4 DOOR |
| PDO | | ANGLE | 2 | PICKUP |
| | C | REAR-END | 2 | HARDTOP, 4 DOOR |
| | C | REAR-END | 3 | UTILITY |
| PDO | | REAR-END | 2 | PICKUP |
| PDO | | ANGLE | 2 | VAN |
| PDO | | ANGLE | 2 | PICKUP |
| PDO | | REAR-END | 2 | SEDAN, 4 DOOR |
| | C | NON-COLLISION | 1 | SEDAN, 4 DOOR |
| PDO | | REAR-END | 2 | CARRY-ALL |
| | C | ANGLE | 2 | VAN |
| PDO | | REAR-END | 2 | SEDAN, 4 DOOR |
| PDO | | ANGLE | 2 | SEDAN, 4 DOOR |
| | C | ANGLE | 3 | PICKUP |
| PDO | | REAR-END | 2 | PICKUP |
| | C | SIDESWIPE, OVERTAKING | 2 | SEDAN, 4 DOOR |
| PDO | | REAR-END | 2 | PICKUP |
| | C | REAR-END | 2 | SEDAN, 4 DOOR |
| | C | REAR-END | 2 | UTILITY |
| | C | REAR-END | 3 | PICKUP |
| Count: 24 | | | | |

| V1 Dir | V1 Driver Age | V1 Lane Num | V1 Action | V1 Driver Factors |
|---|---|---|---|---|
| | | | TURNING RIGHT | |
| S | 63 | | TURNING LEFT | HAD BEEN DRINKING |
| | | | UNKNOWN | |
| E | 22 | | GOING STRAIGHT | INATTENTION/DISTRACTED |
| | | 1 | NOT REPORTED | |
| E | | | GOING STRAIGHT | APPARENTLY NORMAL |
| E | | | GOING STRAIGHT | FELL ASLEEP, FAINTED, FATIGUED, ETC. |
| E | 27 | | GOING STRAIGHT | APPARENTLY NORMAL |
| W | | | NOT REPORTED | OTHER IMPROPER DRIVING |
| S | | | UNKNOWN | |
| S | 59 | 1 | GOING STRAIGHT | APPARENTLY NORMAL |
| E | | | GOING STRAIGHT | APPARENTLY NORMAL |
| S | 49 | 1 | GOING STRAIGHT | APPARENTLY NORMAL |
| N | 17 | | GOING STRAIGHT | APPARENTLY NORMAL |
| S | 75 | 1 | GOING STRAIGHT | APPARENTLY NORMAL |
| N | | | GOING STRAIGHT | APPARENTLY NORMAL |
| S | | | GOING STRAIGHT | APPARENTLY NORMAL |
| S | | | GOING STRAIGHT | APPARENTLY NORMAL |
| S | 18 | | GOING STRAIGHT | ILLNESS |
| S | 22 | | GOING STRAIGHT | INATTENTION/DISTRACTED |
| W | 42 | 2 | TURNING RIGHT | APPARENTLY NORMAL |
| N | 58 | 1 | GOING STRAIGHT | APPARENTLY NORMAL |
| S | 63 | 1 | GOING STRAIGHT | APPARENTLY NORMAL |
| S | | | GOING STRAIGHT | APPARENTLY NORMAL |
| S | 52 | | GOING STRAIGHT | APPARENTLY NORMAL |
| S | | | TURNING LEFT | INATTENTION/DISTRACTED |
| S | | | STOPPED | |
| S | 27 | | GOING STRAIGHT | INATTENTION/DISTRACTED |
| N | | | GOING STRAIGHT | APPARENTLY NORMAL |
| E | 17 | | TURNING LEFT | APPARENTLY NORMAL |
| S | | | TURNING LEFT | INATTENTION/DISTRACTED |
| S | 26 | | GOING STRAIGHT | APPARENTLY NORMAL |
| N | 19 | | GOING STRAIGHT | APPARENTLY NORMAL |
| | 62 | | GOING STRAIGHT | INATTENTION/DISTRACTED |
| S | | | TURNING LEFT | |
| S | | | GOING STRAIGHT | APPARENTLY NORMAL |
| N | 45 | | GOING STRAIGHT | APPARENTLY NORMAL |
| S | 29 | 2 | GOING STRAIGHT | APPARENTLY NORMAL |
| N | 44 | | GOING STRAIGHT | HAD BEEN DRINKING |

| V1 Driver Distracted |
| --- |
| |
| |
| |
| UNKNOWN |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| UNKNOWN |
| |
| |
| |
| |
| |
| ELECTRONIC EQUIPMENT (COMPUTERS, ON BOARD NAVIGATION SYSTEM, ETC.) |
| |
| UNKNOWN |
| |
| |
| ELECTRONIC EQUIPMENT (COMPUTERS, ON BOARD NAVIGATION SYSTEM, ETC.) |
| |
| |
| UNKNOWN |
| |
| |
| |
| |
| |

| V1 Vehicle Factors |
| --- |
| |
| OTHER IMPROPER DRIVING |
| |
| FOLLOWED TOO CLOSELY |
| |
| DRIVING TOO FAST FOR CONDITIONS |
| |
| |
| FAILED TO YIELD RIGHT OF WAY |
| UNKNOWN |
| |
| FOLLOWED TOO CLOSELY |
| |
| UNSAFE LANE CHANGE |
| OTHER IMPROPER DRIVING |
| OTHER IMPROPER DRIVING |
| |
| OTHER IMPROPER DRIVING |
| DRIVING TOO FAST FOR CONDITIONS |
| OTHER IMPROPER DRIVING |
| FAILURE TO KEEP IN PROPER LANE OR RUNNING OFF ROAD: UNSAFE LANE CHANGE |
| FOLLOWED TOO CLOSELY |
| OTHER IMPROPER DRIVING |
| FOLLOWED TOO CLOSELY |
| DISREGARDED TRAFFIC SIGNS, SIGNALS, ROAD MARKINGS |
| OTHER IMPROPER DRIVING |
| UNKNOWN |
| FAILURE TO KEEP IN PROPER LANE OR RUNNING OFF ROAD: UNSAFE LANE CHANGE |
| DRIVING TOO FAST FOR CONDITIONS |
| FAILED TO YIELD RIGHT OF WAY: DISREGARDED TRAFFIC SIGNS, SIGNALS, ROAD MARKINGS |
| |
| UNKNOWN |
| DISREGARDED TRAFFIC SIGNS, SIGNALS, ROAD MARKINGS |
| FOLLOWED TOO CLOSELY |
| FAILURE TO KEEP IN PROPER LANE OR RUNNING OFF ROAD: HIT AND RUN: UNSAFE LANE CHANGE |
| |
| DRIVING TOO FAST FOR CONDITIONS |
| |
| OTHER IMPROPER DRIVING |

| V1 Most Harmful Event | V1 All Events |
|---|---|
| | SLOW/STOPPED VEHICLE |
| | |
| | RAN OFF ROAD LEFT: LIGHT/LUMINARY SUPPORT |
| | SLOW/STOPPED VEHICLE |
| | |
| | |
| | |
| | SLOW/STOPPED VEHICLE |
| | |
| | |
| | SLOW/STOPPED VEHICLE |
| | |
| | SLOW/STOPPED VEHICLE |
| | RAN OFF ROAD RIGHT: SLOW/STOPPED VEHICLE |
| | SLOW/STOPPED VEHICLE |
| | |
| | |
| | |
| | SLOW/STOPPED VEHICLE: SLOW/STOPPED VEHICLE |
| | |
| | |
| | SLOW/STOPPED VEHICLE |
| | SLOW/STOPPED VEHICLE |
| | |
| | |
| | |
| | |
| | HIGHWAY TRAFFIC SIGN POST: RAN OFF ROAD RIGHT: FENCE/WALL |
| | |
| | |
| | SLOW/STOPPED VEHICLE |
| | |
| | |
| | SLOW/STOPPED VEHICLE |
| | |
| | |
| | SLOW/STOPPED VEHICLE |
| | SLOW/STOPPED VEHICLE |
| | |

| V2 Type | V2 Dir | V2 Driver Age | V2 Lane Num | V2 Action |
|---|---|---|---|---|
| VANETTE | N | 53 | | TURNING RIGHT |
| PICKUP | S | 45 | | TURNING LEFT |
| | | | | |
| CARRY-ALL | E | 69 | | STOPPED |
| HATCHBACK, 4 DOOR | | | 1 | GOING STRAIGHT |
| UTILITY | E | | | STOPPED |
| PICKUP | E | | | STOPPED |
| PICKUP | E | 55 | | STOPPED |
| CARRY-ALL | W | | | GOING STRAIGHT |
| UTILITY | S | | | UNKNOWN |
| UTILITY | S | 57 | 1 | STOPPED |
| PICKUP | E | | | GOING STRAIGHT |
| CARRY-ALL | S | 43 | 1 | STOPPED |
| HATCHBACK, 4 DOOR | N | 45 | | STOPPED |
| SEDAN, 4 DOOR | S | 27 | 1 | STOPPED |
| PICKUP | N | | | STOPPED |
| PICKUP | S | | | GOING STRAIGHT |
| HARDTOP, 4 DOOR | S | | | STOPPED |
| MOTORCYCLE | S | 32 | | STOPPED |
| CARRY-ALL | S | 18 | | STOPPED |
| CARRY-ALL | N | 28 | 2 | GOING STRAIGHT |
| PICKUP | N | 44 | 1 | GOING STRAIGHT |
| SEDAN, 4 DOOR | S | 39 | 1 | STOPPED |
| PICKUP | S | | | GOING STRAIGHT |
| CARRY-ALL | N | 29 | | TURNING LEFT |
| SEDAN, 4 DOOR | E | | | STOPPED |
| SEDAN, 4 DOOR | S | | | GOING STRAIGHT |
| | | | | |
| HARDTOP, 4 DOOR | N | | | STOPPED |
| SEDAN, 4 DOOR | W | 58 | | GOING STRAIGHT |
| SEDAN, 4 DOOR | S | | | STOPPED |
| STATION WAGON | N | 77 | | TURNING LEFT |
| SEDAN, 4 DOOR | E | 46 | | GOING STRAIGHT |
| SEDAN, 4 DOOR | | 28 | | STOPPED |
| PICKUP | S | 58 | | TURNING LEFT |
| SEDAN, 4 DOOR | S | | | STOPPED |
| CARRY-ALL | N | 34 | | STOPPED |
| SEDAN, 4 DOOR | S | 63 | 2 | STOPPED |
| SEDAN, 4 DOOR | N | 35 | | STOPPED |

| V2 Driver Factors | V2 Driver Distracted | V2 Vehicle Factors | V2 Most Harmful Event |
|---|---|---|---|
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| | | | |
| APPARENTLY NORMAL | | | |
| | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| | | UNKNOWN | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | OTHER IMPROPER DRIVING | |
| APPARENTLY NORMAL | | OTHER IMPROPER DRIVING | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | FOLLOWED TOO CLOSELY | |
| | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | UNKNOWN | |
| APPARENTLY NORMAL | | UNKNOWN | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | HIT AND RUN | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |
| APPARENTLY NORMAL | | | |

| V2 All Events | First Harmful Event | Nonmotorist Factors | Factors Roadway | Lighting |
|---|---|---|---|---|
| SLOW/STOPPED VEHICLE | | | DRY | DAYLIGHT |
| | | | DRY | DAYLIGHT |
| | | | DRY | DAYLIGHT |
| SLOW/STOPPED VEHICLE | | | DRY | DAYLIGHT |
| | | | DRY | DAYLIGHT |
| | | | | |
| | | | | |
| | | | DRY | DAYLIGHT |
| | | | | |
| | | | | |
| | | | DRY | DAYLIGHT |
| | | | | |
| SLOW/STOPPED VEHICLE | | | DRY | DAYLIGHT |
| | | | DRY | DAYLIGHT |
| | | | DRY | DAYLIGHT |
| | | | | |
| | | | | |
| | | | | |
| SLOW/STOPPED VEHICLE | | | DRY | DAYLIGHT |
| SLOW/STOPPED VEHICLE | | | DRY | DARK - SPOT LIGHTING |
| | | | DRY | DUSK |
| | | | DRY | DAYLIGHT |
| SLOW/STOPPED VEHICLE | | | DRY | DAYLIGHT |
| | | | | |
| | | | DRY | DARK - SPOT LIGHTING |
| | | | | |
| | | | | |
| | | | DRY | DARK - SPOT LIGHTING |
| | | | | |
| | | | DRY | DARK - SPOT LIGHTING |
| SLOW/STOPPED VEHICLE | | | | |
| | | | DRY | DARK - SPOT LIGHTING |
| | | | DRY | DAYLIGHT |
| SLOW/STOPPED VEHICLE | | | DRY | DAYLIGHT |
| | | | DRY | DAYLIGHT |
| | | | | |
| | | | | DAYLIGHT |
| | | | DRY | DAYLIGHT |
| SLOW/STOPPED VEHICLE | | | DRY | DARK - SPOT LIGHTING |

| HWY Factors | Agency | Accident Rec Num |
|---|---|---|
| NONE | SPPD | 2331492 |
| NONE | SPPD | 2307049 |
| NONE | SPPD | 2401106 |
| NONE | SPPD | 2344320 |
| NONE | WASO | 2331826 |
| NONE | NHP | 2288817 |
| NONE | NHP | 2282512 |
| NONE | NHP | 2379787 |
| | WASO | 2310844 |
| | NHP | 2283911 |
| NONE | NHP | 2339494 |
| | SPPD | 2306941 |
| NONE | NHP | 2227258 |
| WET, ICY, SNOW, SLUSH | NHP | 2235595 |
| NONE | NHP | 2324223 |
| NONE | NHP | 2293546 |
| NONE | NHP | 2279690 |
| NONE | NHP | 2281284 |
| NONE | NHP | 2380655 |
| NONE | NHP | 2296743 |
| NONE | NHP | 2297290 |
| NONE | NHP | 2213232 |
| NONE | NHP | 2341605 |
| NONE | NHP | 2293723 |
| NONE | NHP | 2278407 |
| | WASO | 2188599 |
| | WASO | 2308386 |
| NONE | NHP | 2237126 |
| | NHP | 2174674 |
| WEATHER | NHP | 2237693 |
| | SPPD | 2331499 |
| WET, ICY, SNOW, SLUSH | NHP | 2342839 |
| NONE | NHP | 2381812 |
| NONE | SPPD | 2386429 |
| NONE | NHP | 2393668 |
| NONE | NHP | 2170120 |
| NONE | NHP | 2288447 |
| NONE | NHP | 2293226 |
| NONE | NHP | 2167380 |

**INTERSECTION DETAIL**
**SR445 @ GOLDEN VIEW DR**
**01 SEP 14 - 01 SEP 17**

| COUNTY: WASHOE | | | | |
|---|---|---|---|---|
| Crash Severity | Crash Date | Crash Year | Crash Time | Primary Street |
| PROPERTY DAMAGE ONLY | 10-Apr-2015 | 2015 | 02:04 AM | GOLDEN VIEW DR |
| PROPERTY DAMAGE ONLY | 22-May-2015 | 2015 | 07:00 PM | SR445 |
| INJURY CRASH | 21-Apr-2016 | 2016 | 12:27 PM | SR445 |
| PROPERTY DAMAGE ONLY | 8-Aug-2016 | 2016 | 07:30 AM | SR445 |
| INJURY CRASH | 24-Aug-2015 | 2015 | 07:30 AM | SR445 |
| INJURY CRASH | 21-Oct-2014 | 2014 | 01:05 PM | SR445 |
| INJURY CRASH | 11-Feb-2017 | 2017 | 10:57 AM | SR445 |
| PROPERTY DAMAGE ONLY | 2-Mar-2015 | 2015 | 09:17 AM | SR445 |
| PROPERTY DAMAGE ONLY | 11-Dec-2016 | 2016 | 01:57 PM | SR445 |
| PROPERTY DAMAGE ONLY | 21-Jan-2015 | 2015 | 04:45 PM | SR445 |
| INJURY CRASH | 21-Apr-2016 | 2016 | 08:17 PM | SR445 |

| Distance | Dir | Secondary Street | Weather | Fatalities | Injured |
|---|---|---|---|---|---|
| | AT INT | SR445 | CLEAR | | |
| 150 | N | GOLDEN VIEW DR | CLOUDY | | |
| 50 | N | GOLDEN VIEW DR | CLOUDY | | 1 |
| 30 | N | GOLDEN VIEW DR | CLEAR | | |
| 20 | N | GOLDEN VIEW DR | CLEAR | | 2 |
| | AT INT | GOLDEN VIEW DR | CLEAR | | 1 |
| 20 | S | GOLDEN VIEW DR | CLOUDY | | 1 |
| 25 | S | GOLDEN VIEW DR | CLOUDY | | |
| 90 | S | GOLDEN VIEW DR | CLOUDY | | |
| 100 | S | GOLDEN VIEW DR | CLEAR | | |
| 150 | S | GOLDEN VIEW DR | CLEAR | | 1 |
| | | | | Sum: 0 | Sum: 6 |
| | | | | Count: 0 | Count: 5 |
| | | | | Total: | 11 |

| Property Damage Only | Injury Type | Crash Type | Total Vehicles | V1 Type | V1 Dir |
|---|---|---|---|---|---|
| PDO | | NON-COLLISION | 1 | PICKUP | W |
| PDO | | ANGLE | 1 | STATION WAGON | N |
| | C | REAR-END | 2 | SEDAN, 4 DOOR | S |
| PDO | | REAR-END | 2 | PICKUP | S |
| | | REAR-END | 2 | | N |
| | A | HEAD-ON | 2 | MOTORCYCLE | W |
| | B | REAR-END | 2 | PICKUP | N |
| PDO | | REAR-END | 2 | HARDTOP, 4 DOOR | N |
| PDO | | REAR-END | 2 | SEDAN, 4 DOOR | N |
| PDO | | NON-COLLISION | 1 | SEDAN, 4 DOOR | N |
| | C | REAR-END | 3 | CARRY-ALL | N |
| Count: 6 | | | | | |

| V1 Driver Age | V1 Lane Num | V1 Action | V1 Driver Factors | V1 Driver Distracted |
|---|---|---|---|---|
| | | TURNING RIGHT | HAD BEEN DRINKING | |
| | | GOING STRAIGHT | DRUG INVOLVEMENT | |
| 21 | 2 | GOING STRAIGHT | APPARENTLY NORMAL | |
| 18 | 2 | GOING STRAIGHT | APPARENTLY NORMAL | |
| | | GOING STRAIGHT | | |
| 62 | | GOING STRAIGHT | APPARENTLY NORMAL | |
| 19 | 2 | GOING STRAIGHT | INATTENTION/DISTRACTED | OTHER |
| 22 | 2 | CHANGING LANES | APPARENTLY NORMAL | |
| 75 | 2 | GOING STRAIGHT | APPARENTLY NORMAL | |
| | | NOT REPORTED | APPARENTLY NORMAL | |
| 69 | 1 | GOING STRAIGHT | APPARENTLY NORMAL | |

| V1 Vehicle Factors |
| --- |
| MADE AN IMPROPER TURN: FAILURE TO KEEP IN PROPER LANE OR RUNNING OFF ROAD: RAN OFF ROAD: U |
| FAILURE TO KEEP IN PROPER LANE OR RUNNING OFF ROAD: UNSAFE LANE CHANGE |
| |
| |
| HIT AND RUN |
| DRIVING TOO FAST FOR CONDITIONS |
| |
| OPERATING VEHICLE IN ERRATIC, RECKLESS, CARELESS, NEGLIGENT OR AGGRESSIVE MANNER |
| FOLLOWED TOO CLOSELY |
| FAILURE TO KEEP IN PROPER LANE OR RUNNING OFF ROAD: UNSAFE LANE CHANGE |
| DRIVING TOO FAST FOR CONDITIONS |

| V1 Most Harmful Event | V1 All Events | V2 Type |
|---|---|---|
| JNSAFE LANE CHANGE | | |
| | | |
| | SLOW/STOPPED VEHICLE | PICKUP |
| | SLOW/STOPPED VEHICLE | HATCHBACK, 4 DOOR |
| | SLOW/STOPPED VEHICLE | HARDTOP, 4 DOOR |
| | OVERTURN/ROLLOVER: SLOW/STOPPED VEHICLE | UTILITY |
| | SLOW/STOPPED VEHICLE | SEDAN, 4 DOOR |
| | | HATCHBACK, 4 DOOR |
| | SLOW/STOPPED VEHICLE | CARRY-ALL |
| | | |
| | SLOW/STOPPED VEHICLE | CARRY-ALL |

| V2 Dir | V2 Driver Age | V2 Lane Num | V2 Action | V2 Driver Factors | V2 Driver Distracted |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| S | 67 | 2 | STOPPED | APPARENTLY NORMAL | |
| S | 63 | 2 | STOPPED | APPARENTLY NORMAL | |
| N | 63 | | STOPPED | APPARENTLY NORMAL | |
| E | 31 | | STOPPED | APPARENTLY NORMAL | |
| S | 63 | 2 | STOPPED | APPARENTLY NORMAL | |
| N | 24 | 2 | GOING STRAIGHT | APPARENTLY NORMAL | |
| N | 56 | 2 | GOING STRAIGHT | APPARENTLY NORMAL | |
| | | | | | |
| N | 46 | 1 | STOPPED | APPARENTLY NORMAL | |

| V2 Vehicle Factors | V2 Most Harmful Event | V2 All Events | First Harmful Event | Nonmotorist Factors | Factors Roadway |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | DRY |
| | | | | | DRY |
| HIT AND RUN | | | | | DRY |
| | | | | | DRY |
| | | SLOW/STOPPED VEHICLE | | | DRY |
| | | SLOW/STOPPED VEHICLE | | | DRY |
| | | | | | DRY |
| | | | | | |
| | | SLOW/STOPPED VEHICLE | | | DRY |

| Lighting | HWY Factors | Agency | Accident Rec Num |
|---|---|---|---|
| | | WASO | 2308233 |
| | | NHP | 2179199 |
| DAYLIGHT | NONE | NHP | 2236941 |
| DAYLIGHT | NONE | NHP | 2327628 |
| DAYLIGHT | NONE | NHP | 2196982 |
| DAYLIGHT | NONE | NHP | 2280465 |
| DAYLIGHT | NONE | NHP | 2365285 |
| DAYLIGHT | NONE | NHP | 2175350 |
| DAYLIGHT | NONE | NHP | 2341984 |
| | NONE | NHP | 2285027 |
| DARK - SPOT LIGHTING | NONE | NHP | 2236976 |


SOUTH ELEVATION


WEST ELEVATION

SUMMIT CHRISTIAN CHURCH
PHASE 4.0 WORSHIP CENTER
7075 PYRAMID HIGHWAY
SPARKS, NEVADA 89434

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Newport Beach, California 92660
949/759-8587 FAX 949/759-9381

BUILDING
ELEVATIONS
W/ FUTURE OFFICE

| REV. | DESCRIPTION | DATE |
|---|---|---|

PROJECT NO.: 19-07
DATE: 12-12-19
SCALE: 1/8"=1'-0"
SHEET NO.: 7

HORIZONTAL TREX SIDING
EQUIPMENT SCREEN

EXTERIOR PLASTER
WITH REVEALS

INSULATED WALL PANELS

LEDGER STONE VENEER


TUBE STEEL "TREE" COLUMNS
WITH UPLIGHT

ENTRY COURTYARD

ALUMINUM STOREFRONT WINDOW
SYSTEM WITH LOW E HIGH
PERFORMANCE GLAZING

## SOUTH ELEVATION

HORIZONTAL TREX SIDING
EQUIPMENT SCREEN

LEDGER STONE VENEER

INSULATED WALL PANELS

EXTERIOR PLASTER WITH REVEALS

HEARTH CAFE

OUTDOOR DINING

## EAST ELEVATION

INSULATED WALL PANELS

STANDING SEAM METAL ROOF

NORTH ENTRY

BACKSTAGE DOCK

## NORTH ELEVATION

INSULATED WALL PANELS

HORIZONTAL TREX SIDING
EQUIPMENT SCREEN

EXTERIOR PLASTER
WITH REVEALS

COURTYARD BEYOND

## WEST ELEVATION

TERRY D. JACOBSON
REGISTERED
No. 4430
ARCHITECT
STATE OF NEVADA

NORTH

# SUMMIT CHRISTIAN CHURCH
# PHASE 4.0 WORSHIP CENTER
7075 PYRAMID HIGHWAY
SPARKS, NEVADA 89434

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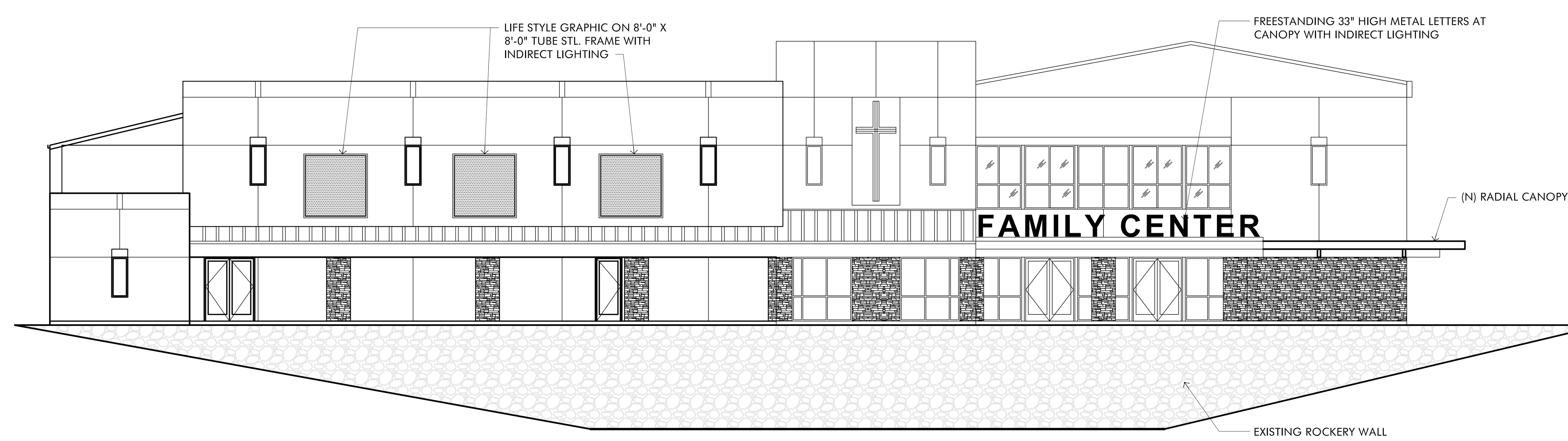
Newport Beach, California 92660
949/759-8587 FAX 949/759-9381

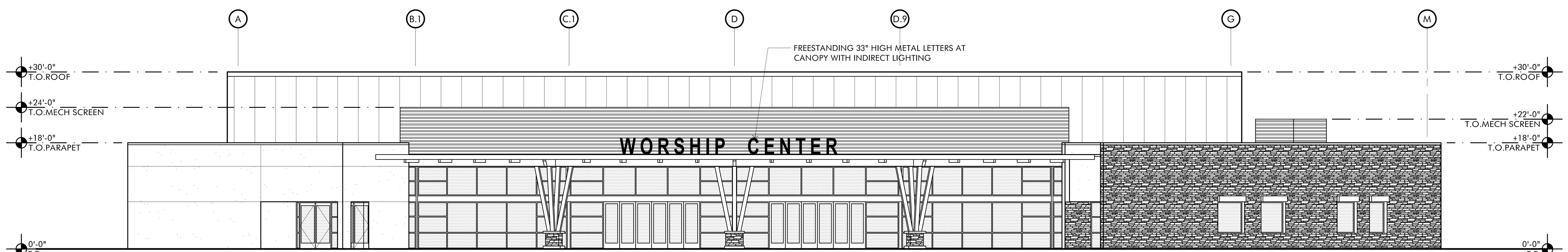
BUILDING
ELEVATIONS

| REV. | DESCRIPTION | DATE |
|---|---|---|
| | | |

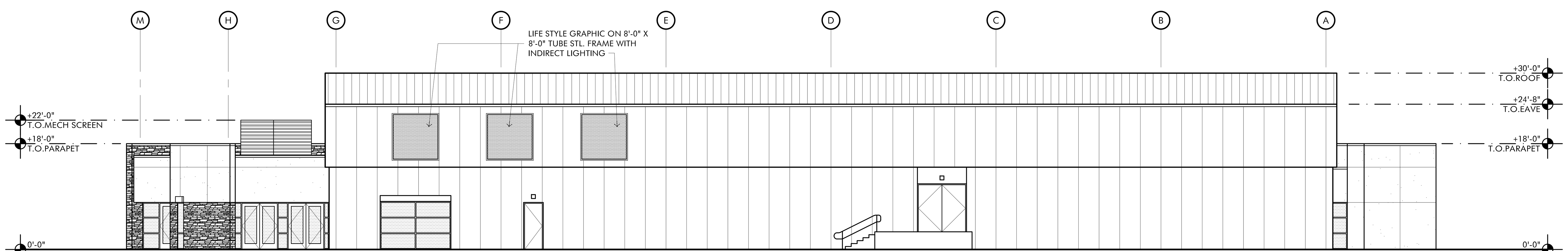
PROJECT NO.: 19-07
DATE: 12-12-19
SCALE: 1/8"=1'-0"
SHEET NO.: 6



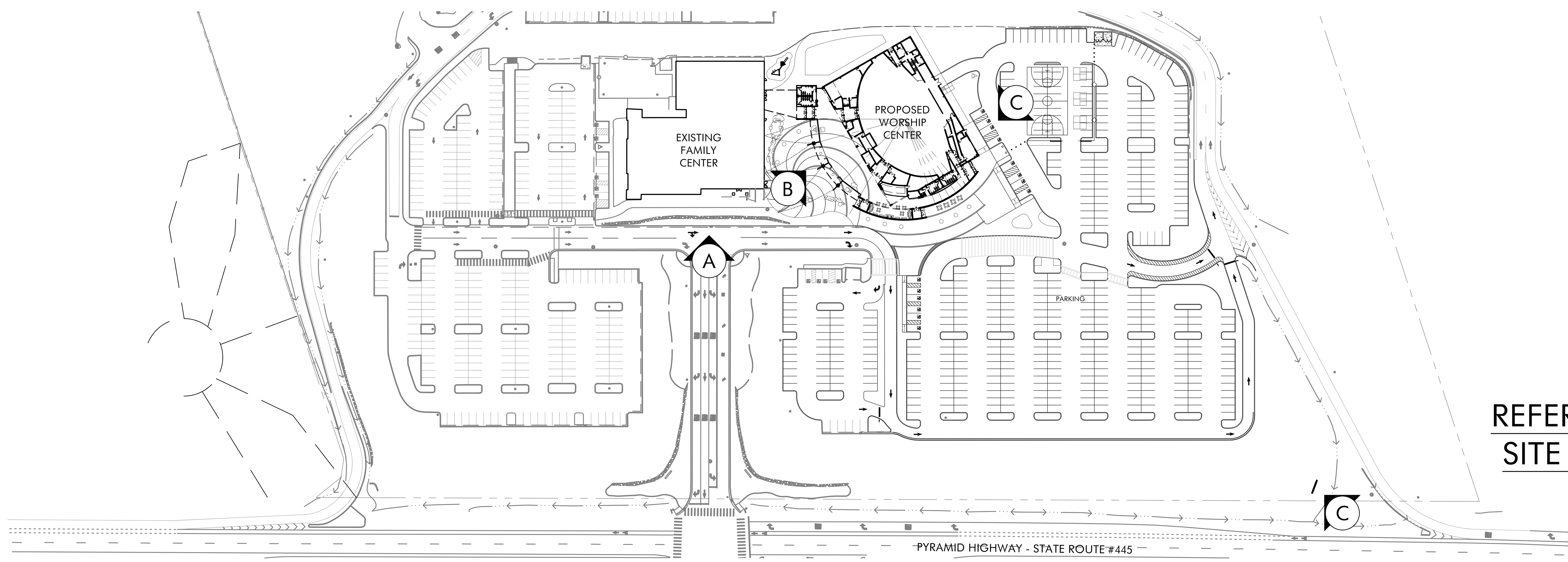

BUILDING SIGNAGE "A"




BUILDING SIGNAGE "B"




BUILDING SIGNAGE "C"




REFERENCE SITE PLAN

# SUMMIT CHRISTIAN CHURCH
# PHASE 4.0 WORSHIP CENTER

7075 PYRAMID HIGHWAY
SPARKS, NEVADA 89434

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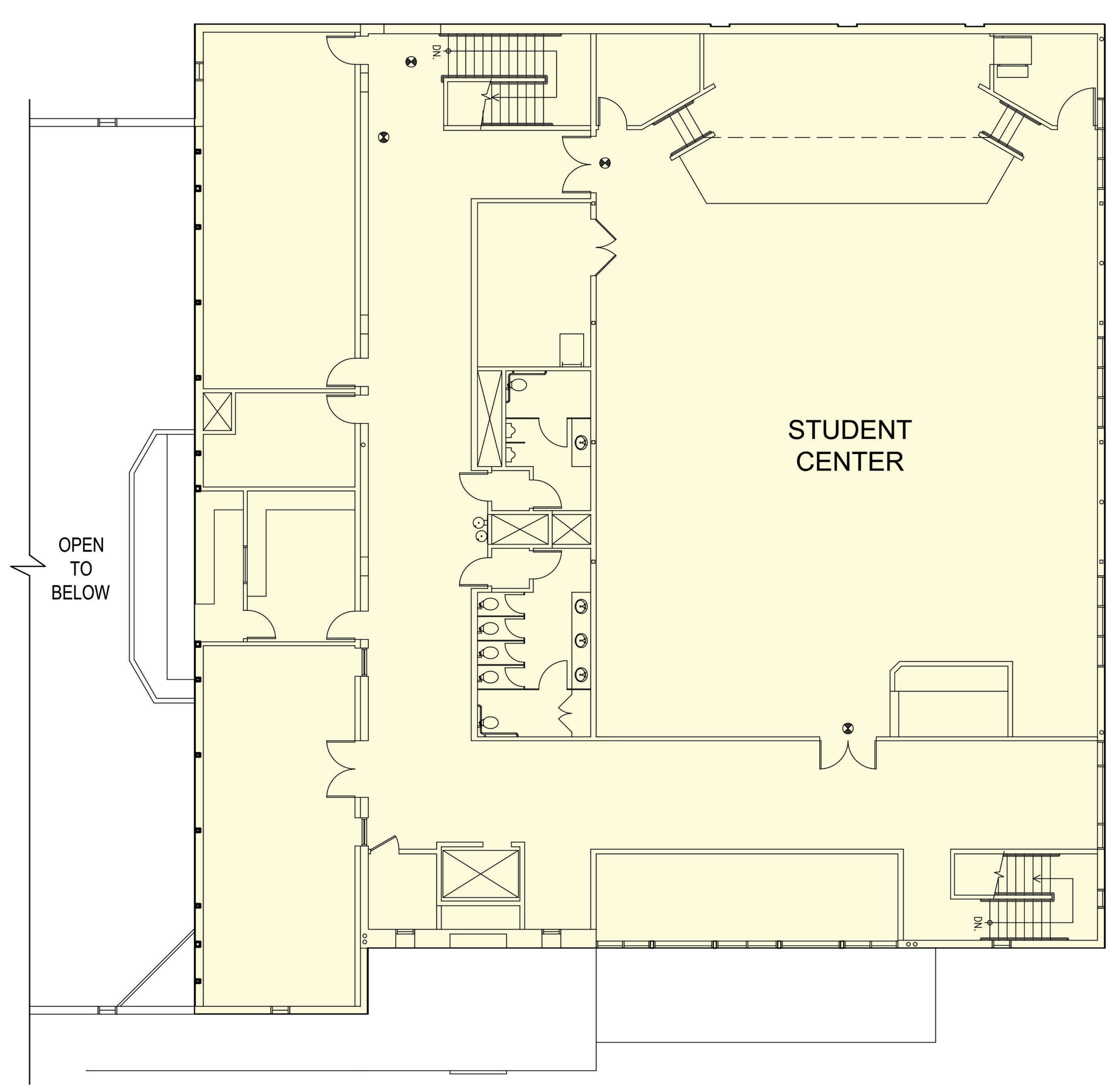
Newport Beach, California 92660
949/759-8587 FAX 949/759-9381

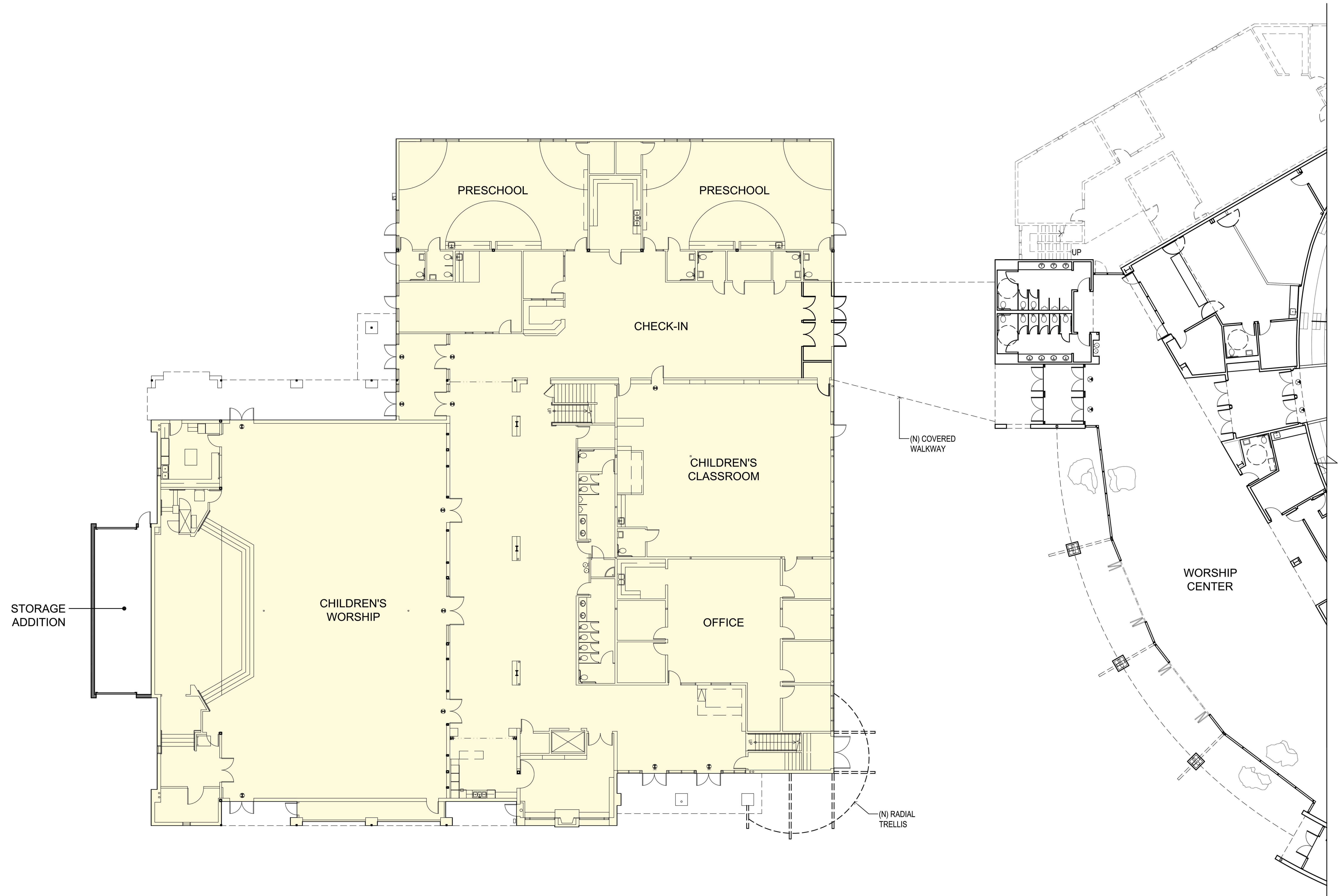
SIGNAGE PROGRAM

| REV. | DESCRIPTION | DATE |
|---|---|---|

| | |
|---|---|
| PROJECT NO.: | 19-07 |
| DATE: | 12-12-19 |
| SCALE: | 1"=40'-0" |
| SHEET NO.: | 1 |




SECOND FLOOR

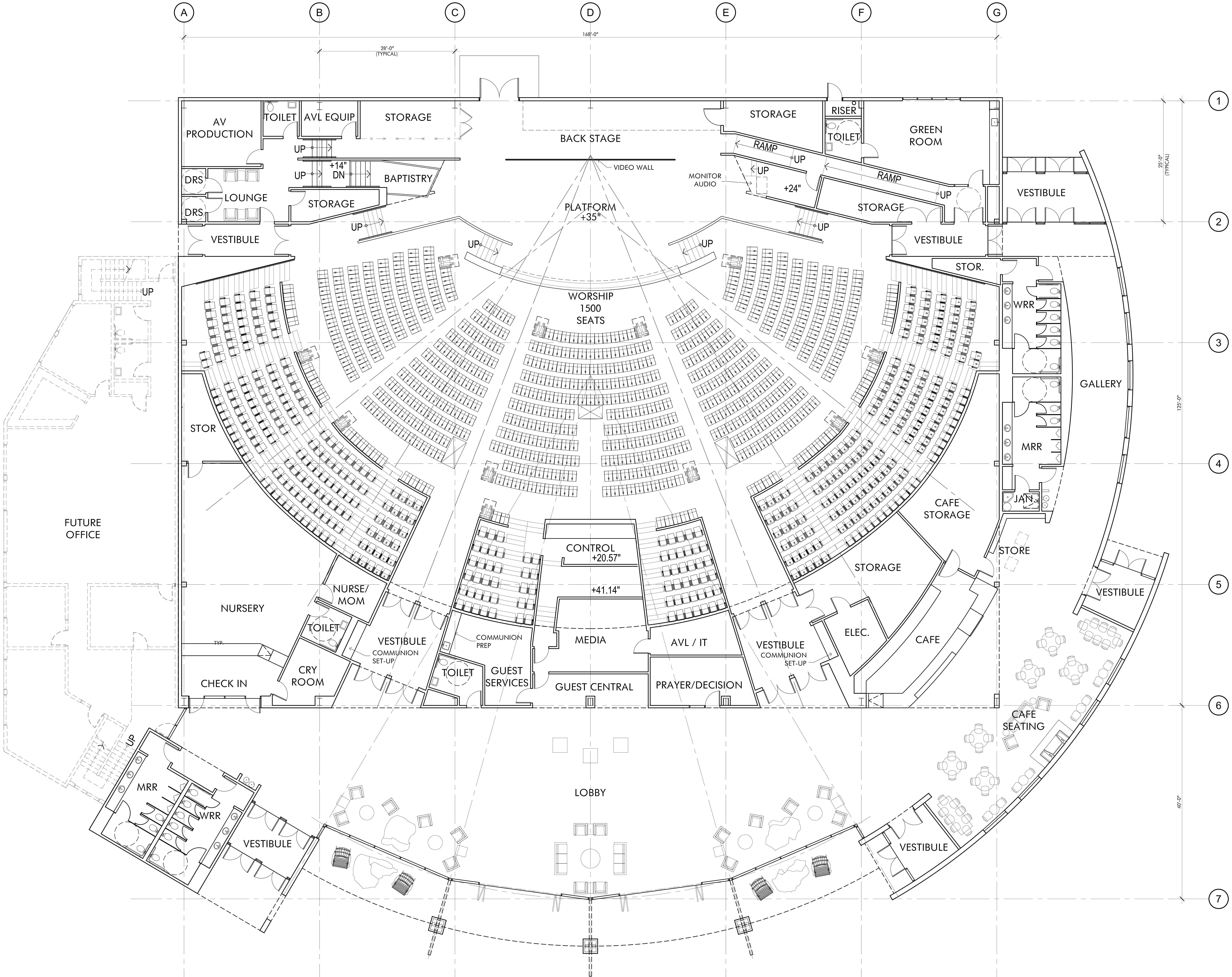



FIRST FLOOR

| | | |
|---|---|---|
| SUMMIT CHRISTIAN CHURCH<br>PHASE 4.0 WORSHIP CENTER<br>7075 PYRAMID HIGHWAY<br>SPARKS, NEVADA 89434 | J7·Architecture<br>Creating space. Inspiring people.<br>20361 Irvine Avenue, Studio B2<br>Newport Beach, California 92660<br>949/759-8587 FAX 949/759-9381 | FAMILY CENTER<br>EXISTING FLOOR PLANS |

| REV. | DESCRIPTION | DATE |
|---|---|---|

| | |
|---|---|
| PROJECT NO.: | 19-07 |
| DATE: | 08-16-19 |
| SCALE: | 1/8"=1'-0" |
| SHEET NO.: | 5 |




TERRY D. JACOBSON
REGISTERED ARCHITECT
No. 4430
STATE OF NEVADA

# SUMMIT CHRISTIAN CHURCH
# PHASE 4.0 WORSHIP CENTER
7075 PYRAMID HIGHWAY
SPARKS, NEVADA 89434

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949/759-8587 FAX 949/759-9381

## FIRST FLOOR PLAN

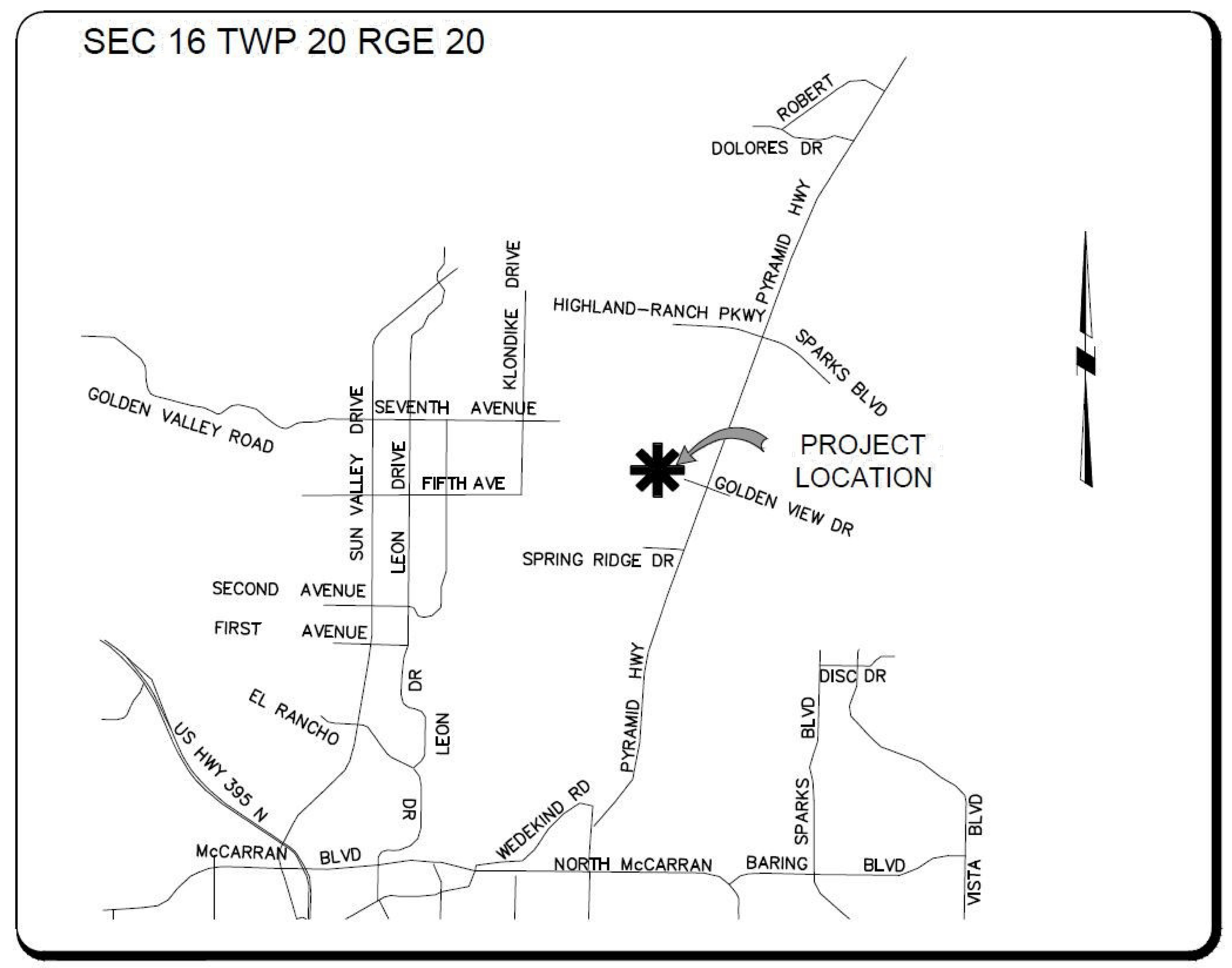
| REV. | DESCRIPTION | DATE |
|---|---|---|
| | | |

| | |
|---|---|
| PROJECT NO.: | 19-07 |
| DATE: | 08-16-19 |
| SCALE: | 1/8"=1'-0" |
| SHEET NO.: | 3 |

# SPECIAL USE PERMIT APPLICATION

# SUMMIT CHRISTIAN CHURCH - PHASE 4.0

## WASHOE COUNTY, NEVADA
## APN: 083-730-13




VICINITY MAP
NOT TO SCALE

| SHEET INDEX | | |
|---|---|---|
| NO. | ID | SHEET TITLE |
| 1 | C-1 | TITLE SHEET |
| 2 | C-2 | PRELIMINARY SITE PLAN |
| 3 | C-3 | PRELIMINARY UTILITY PLAN |
| 4 | C-4 | EXISTING CONDITIONS SLOPE MAP |
| 5 | C-5 | PRELIMINARY GRADING PLAN |
| 6 | C-6 | CROSS SECTIONS |
| 7 | C-7 | EXISTING AND SITEWIDE LANDSCAPE SUMMARY |
| 8 | L1 | PRELIMINARY LANDSCAPE PLAN (COLOR) |
| 9 | L1 | PRELIMINARY LANDSCAPE PLAN |
| 10 | L2 | PRELIMINARY IRRIGATION PLAN |
| 11 | E1.2 | SITE LIGHTING & PHOTOMETRIC PLAN |

### O□NER/PRO□EC□ LOCA□ION
SUMMIT CHRISTIAN CHURCH
7075 PYRAMID WAY
SPARKS, NV 89436
PHONE: (775) 424-5683

### ARCHI□EC□
TERRY JACOBSON
J7 ARCHITECTURE
20361 IRVINE AVE, SUITE B-2
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PHONE: (949) 759-8587

### CI□IL ENGINEER
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DYER ENGINEERING CONSULTANTS, INC.
9160 DOUBLE DIAMOND PARKWAY
RENO, NEVADA 89521
PHONE: (775) 852-1440

### LANDSCAPE ARCHI□EC□
RYAN HANSEN, PLA ASLA
LA STUDIOS NEVADA
1552 C STREET
SPARKS, NV 89431
PHONE: (775) 323-2223

### A□□RE□IA□IONS

| | | | | | |
|---|---|---|---|---|---|
| ABAN | ABANDON | EVC | END OF VERTICAL CURVE | PREFAB | PREFABRICATED |
| ABC | AGGREGATE BASE COURSE | EW | EACH WAY | PROP | PROPERTY |
| AC | ASPHALT CONCRETE | EXP | JT EXPANSION JOINT | PSF | POUNDS PER SQUARE FOOT |
| ADD | ADDITIONAL | FES | FLARED END SECTION | PSI | POUNDS PER SQUARE INCH |
| ADJ | ADJACENT | FFC | FRONT FACE OF CURB | PT | POINT OF TANGENCY |
| APPROX | APPROXIMATE | FG | FINISH GRADE | PUE | PUBLIC UTILITY EASEMENT |
| APPR | APPROVED | FH | FIRE HYDRANT | PVC | POLYVINYL CHLORIDE |
| ARV | AIR RELEASE VALVE | FIG | FIGURE | PVI | POINT OF VERTICAL INTERSECTION |
| AWWA | AMERICAN WATER WORKS ASSOCIATION | FL | FLOWLINE | PVMT | PAVEMENT |
| BC | BEGIN CURVE | FPS | FEET PER SECOND | R | RADIUS |
| BCR | BEGIN CURB RETURN | FT | FOOT OR FEET | RCB | REINFORCED CONCRETE BOX CULVERT |
| BFC | BACK FACE OF CURB | G | GAS | RCP | REINFORCED CONCRETE PIPE |
| BLDG | BUILDING | GAL | GALLON | RD | ROAD |
| BM | BENCH MARK BOT BOTTOM | GALV | GALVANIZED | REF | REFERENCE OR REFER |
| BSW | BACK OF SIDEWALK | GB | GRADE BREAK | REINF | REINFORCED |
| BVC | BEGIN VERTICAL CURVE | GPD | GALLONS PER DAY | REQD | REQUIRED |
| CB | CATCH BASIN | HORIZ | HORIZONTAL | RT | RIGHT |
| CI | CAST IRON | HP | HORSEPOWER | RW OR ROW | RIGHT-OF-WAY |
| CJ | CONSTRUCTION JOINT | ID | INSIDE DIAMETER | SCH | SCHEDULE |
| CL | CENTERLINE | IE | INVERT ELEVATION | SD | STORM DRAIN |
| CLR | CLEAR | IN | INCH | SECT | SECTION |
| CMP | CORRUGATED METAL PIPE | INV | INVERT | SF | SQUARE FOOT |
| CMU | CONCRETE MASONRY UNIT | IRR | IRRIGATION | SI | SQUARE INCH |
| CO | CLEANOUT | KW | KILOWATT | SSE | SANITARY SEWER EASEMENT |
| CONC | CONCRETE | L | LENGTH | STA | STATION |
| CONN | CONNECTION | LAT | LATERAL | SIM | SIMILAR |
| CONT | CONTINUOUS | LB | POUNDS | SPEC | SPECIFICATIONS |
| COORD | COORDINATE | LB/CU FT | POUNDS PER CUBIC FOOT | SQ | SQUARE |
| CTR | CENTER | LONG | LONGITUDINAL | SS | SANITARY SEWER |
| CU | CUBIC | LT | LEFT | SSCO | SANITARY SEWER CLEAN OUT |
| CU IN | CUBIC INCH | MDD | MAX MAXIMUM DRY DENSITY | SSPWC | STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION |
| CU YD | CUBIC YARD | MECH | MECHANICAL | | |
| CULV | CULVERT | MFR | MANUFACTURER | STD | STANDARD |
| DBL | DOUBLE | MH | MANHOLE | SYMM | SYMMETRICAL |
| DEP | DEPRESSED | MIN | MINIMUM | TAN | TANGENT |
| DTL | DETAIL | MISC | MISCELLANEOUS | TB | THRUST BLOCK |
| DI | DROP INLET | MPH | MILES PER HOUR | TC | TOP OF CURB |
| DIA | DIAMETER | N | NORTHING | TC-DEP | TOP OF CURB - DEPRESSED |
| DW | DOMESTIC WATER | NDP | NO DIRECT PAYMENT | TECH | TECHNICAL |
| DWG | DRAWING | NTS | NOT TO SCALE | TEL | TELEPHONE |
| E | EASTING | OC | ON CENTER | TEMP | TEMPERATURE |
| EX OR EXIST | EXISTING | OG | ORIGINAL GROUND | TMWA | TRUCKEE MEADOWS WATER AUTHORITY |
| EA | EACH | OHSA | OCCUPATIONSL SAFETY AND HEALTH ADMINISTRATION | TW | TOP OF WALL |
| EC | END CURVE | OZ | OUNCE | TYP | TYPICAL |
| ECR | END CURB RETURN | PC | POINT OF CURVE | V | VELOCITY |
| ECC | ECCENTRIC | PCC | PORTLAND CEMENT CONCRETE | VC | VERTICAL CURVE |
| EL | ELEVATION | PI | POINT OF INTERSECTION | VERT | VERTICAL |
| ELEC | ELECTRIC | PL | PROPERTY LINE | VG | VALLEY GUTTER |
| ENGR | ENGINEER | PRC | POINT OF REVERSE CURVE | W | WATER |

### □ASIS OF □EARING
□HE □ASIS OF □EARINGS FOR □HIS S□R□E□ IS □HE NE□ADA S□A□E PLANE COORDINA□E S□S□EM□□ ES□ □ONE □□0□ □GRO□ND□NAD □□□□□ □HARN□□MODIFIED □□ A MEAN COM□INA□ION FAC□OR OF 0□□□□0□□000□

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□HE □ASIS OF ELE□A□IONS FOR □HIS S□R□E□ IS NA□D □□□□□□ASED □PON CI□□ OF SPAR□S □ENCHMAR□ □□□□□AS SHO□ N□ELE□A□ION □ □□□0□0□□COMPLE□ED □AN□AR□□□0□□□

PRELIMINARY SUP
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*12-16-2019*

DYER
ENGINEERING
CONSULTANTS
9160 Double Diamond Pkwy, Ste. A
Reno, Nevada 89521 Phone: 1-775-852-1440

PROFESSIONAL SEAL:
ENGINEER
JOHNSON
Exp: 6-30-21
CIVIL
No. 19440
NEVADA
12-16-2019

| NO. | DATE | INITIALS | DESCRIPTION |
|---|---|---|---|
| REVISIONS | | | |

SUMMIT CHRISTIAN CHURCH - PHASE 4.0
SPECIAL USE PERMIT APPLICATION
TITLE SHEET
7075 PYRAMID WAY
SPARKS, NV 89436

WASHOE NEVADA

DESIGNED BY: LJ
DRAWN BY: RC
CHECKED BY: ---
DATE: 12-16-2019
JOB NO.: SCC-PH419

SHEET NO.
C-1
1 OF 11


PARKING REQUIRED

| | |
|---|---|
| 1500 SEATS/3 | 500 |
| 26,572 SF PUBLIC SPACE/300 | 89 |
| TOTAL REQUIRED | 589 |
| ADA REQUIRED 2% OF 738 | 15 |

PARKING PROVIDED

| | |
|---|---|
| EXISTING | |
| STANDARD | 346 |
| ADA | 9 |
| PROPOSED | |
| STANDARD | |
| PHASE 4.0 | 295 |
| FUTURE PHASE | 74 |
| TOTAL | 369 |
| ADA | 14 |
| PHASE 4.0 TOTAL | 664 |
| TOTAL WITH FUTURE PHASE | 738 |
| TOTAL ADA | 23 |

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12-16-2019

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|---|---|---|---|

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# SUMMIT CHRISTIAN CHURCH - PHASE 4.0
SPECIAL USE PERMIT APPLICATION
# PRELIMINARY SITE PLAN
7075 PYRAMID WAY
SPARKS, NV 89436

WASHOE

DESIGNED BY: LJ
DRAWN BY: RC
CHECKED BY: ---
DATE: 12-16-2019
JOB NO. SCC-PH419

SHEET NO.
C-2
2 OF 11



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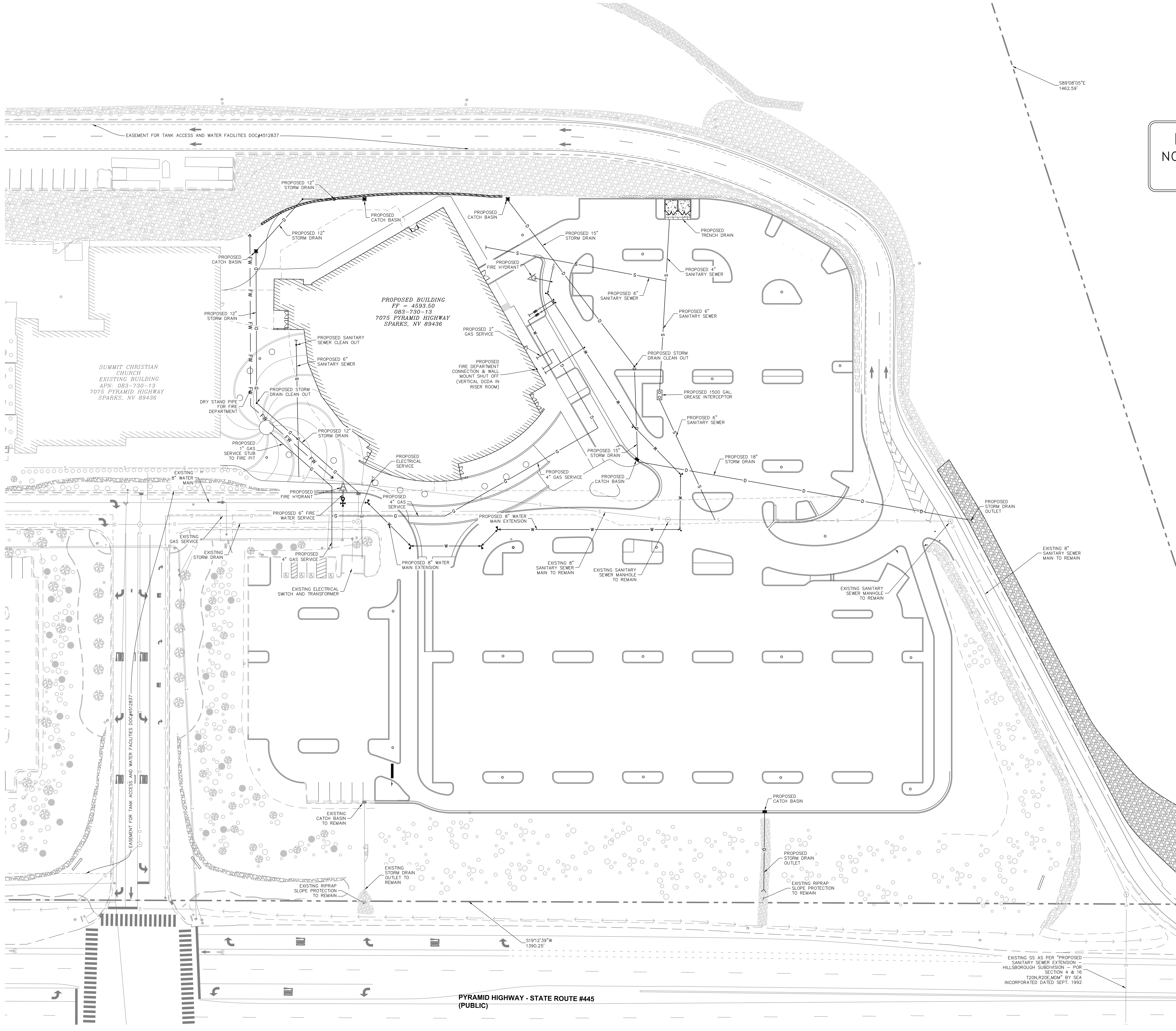


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CIVIL
No. 19440
12-16-2019

REVISIONS

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|---|---|---|---|
| | | | |

SUMMIT CHRISTIAN CHURCH - PHASE 4.0
SPECIAL USE PERMIT APPLICATION
**PRELIMINARY UTILITY PLAN**
7075 PYRAMID WAY
SPARKS, NV 89436

WASHOE NEVADA

DESIGNED BY: LJ
DRAWN BY: RC
CHECKED BY: ----
DATE: 12-16-2019
JOB NO. SCC-PH419

SHEET NO.
C-3
3 OF 11



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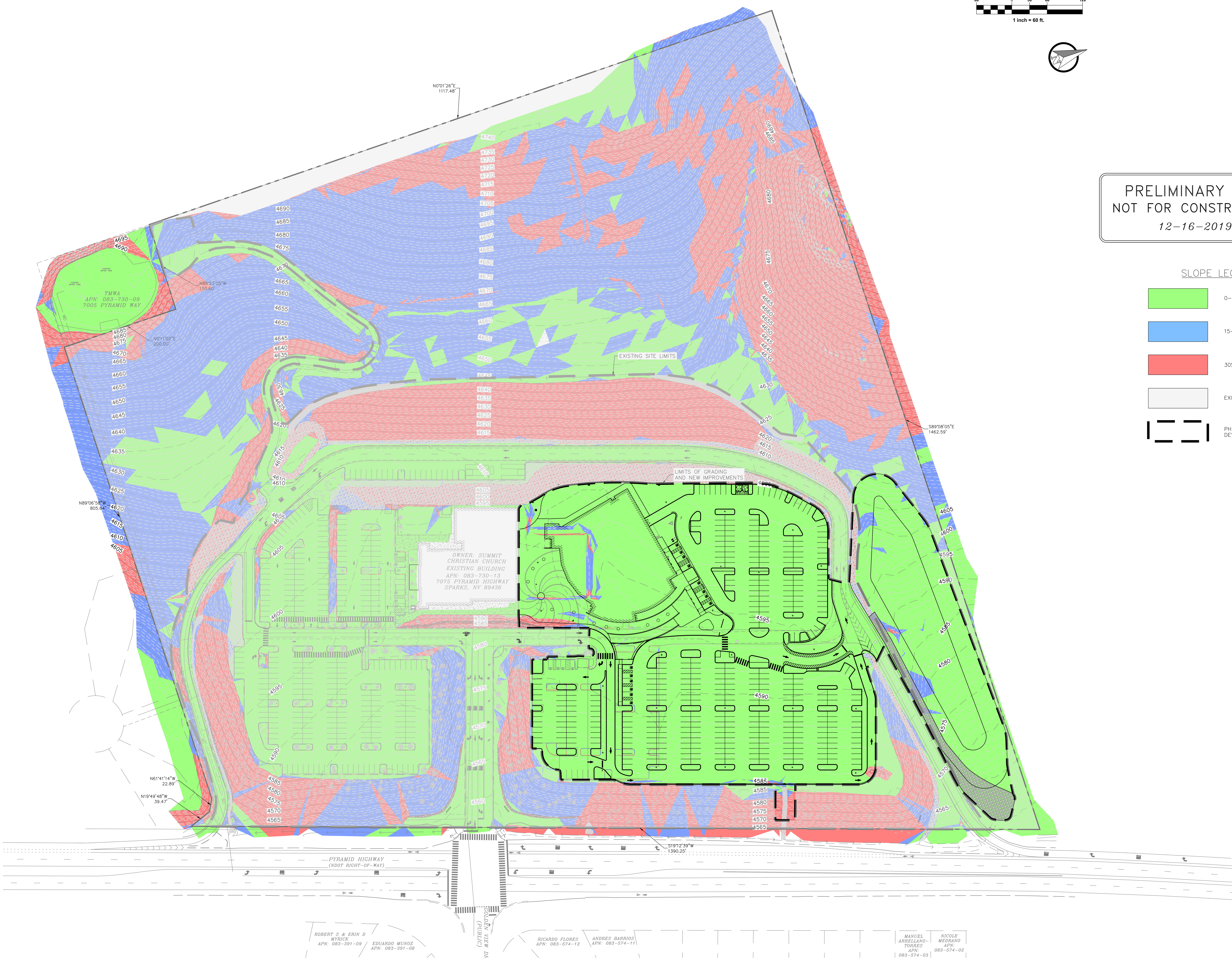
GRAPHIC SCALE

60 0 30 60 120

1 inch = 60 ft.

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12-16-2019

SLOPE LEGEND

| | |
|---|---|
| (green) | 0-14% |
| (blue) | 15-29% |
| (red) | 30% OR GREATER |
| (grey) | EXISTING SITE |
| (dashed line) | PHASE 4.0 DEVELOPMENT LIMITS |

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|---|---|---|---|

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SUMMIT CHRISTIAN CHURCH - PHASE 4.0
SPECIAL USE PERMIT APPLICATION

# EXISTING CONDITIONS SLOPE MAP

7075 PYRAMID WAY
SPARKS, NV 89436

WASHOE

DESIGNED BY: LJ
DRAWN BY: RC
CHECKED BY: ----
DATE: 12-16-2019
JOB NO. SCC-PH419

SHEET NO.
C-4
4 OF 11



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GRAPHIC SCALE

30 0 15 30 60

1 inch = 30 ft.

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Reno, Nevada 89521 Phone: 1-775-852-1440

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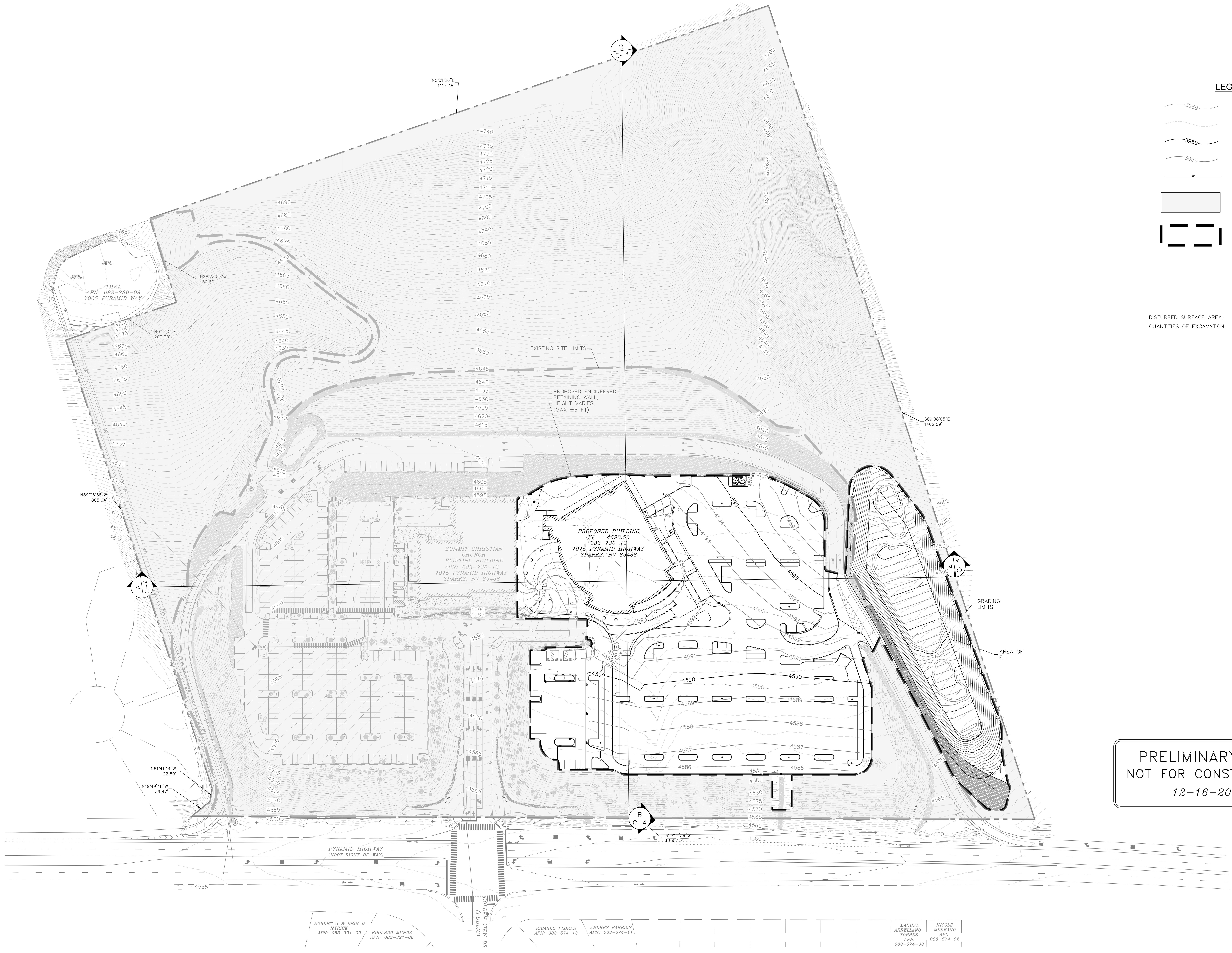
JOHNSON
Exp: 6-30-21
CIVIL
No. 19440
12-16-2019

## LEGEND

- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- SAWCUT LIMITS
- EXISTING SITE
- PHASE 4.0 DEVELOPMENT LIMITS

DISTURBED SURFACE AREA: ±8.1 ACRES
QUANTITIES OF EXCAVATION: ±30,000 CY FILL

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| NO. | DATE | INITIALS | DESCRIPTION |
| --- | --- | --- | --- |
| | | | |

REVISIONS

SUMMIT CHRISTIAN CHURCH - PHASE 4.0
SPECIAL USE PERMIT APPLICATION
# PRELIMINARY GRADING PLAN
7075 PYRAMID WAY
SPARKS, NV 89436

WASHOE NEVADA

DESIGNED BY: LJ
DRAWN BY: RC
CHECKED BY: ----
DATE: 12-16-2019
JOB NO. SCC-PH419

SHEET NO.
C-5
5 OF 11



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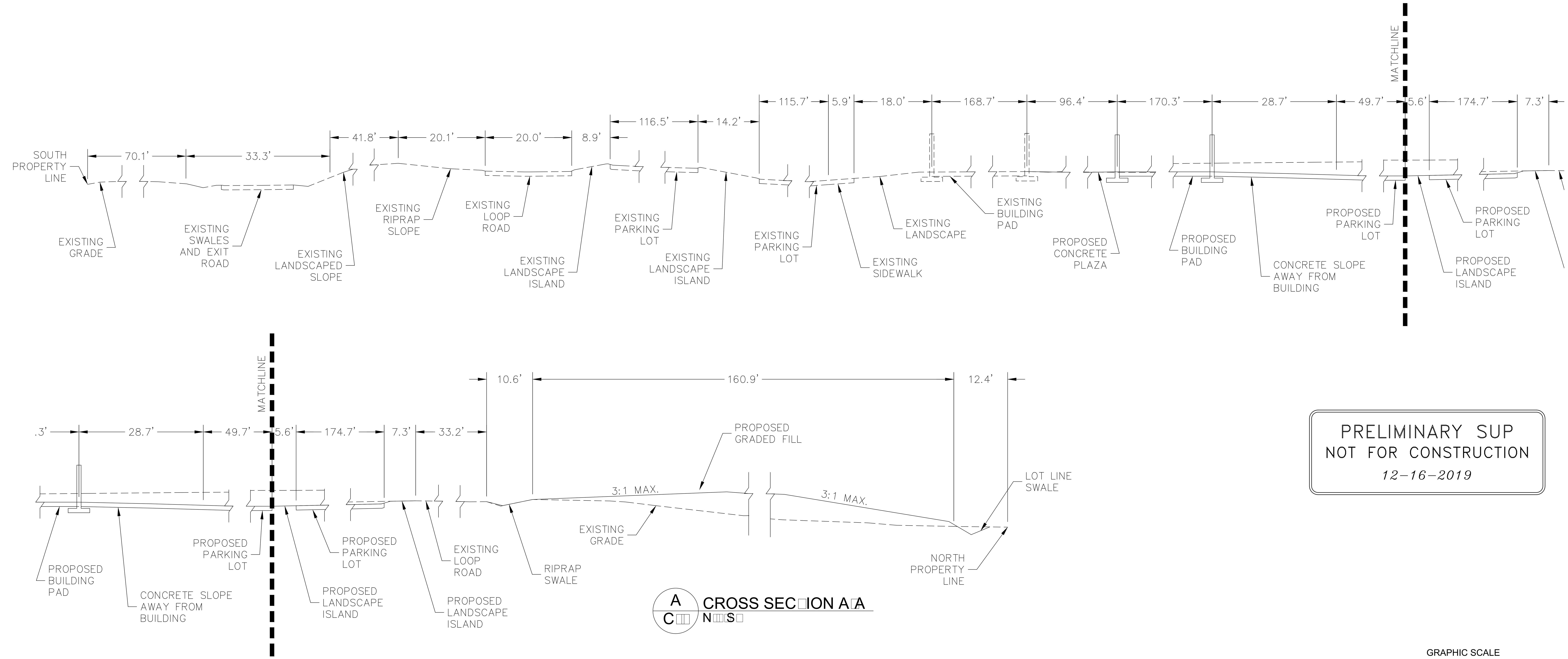
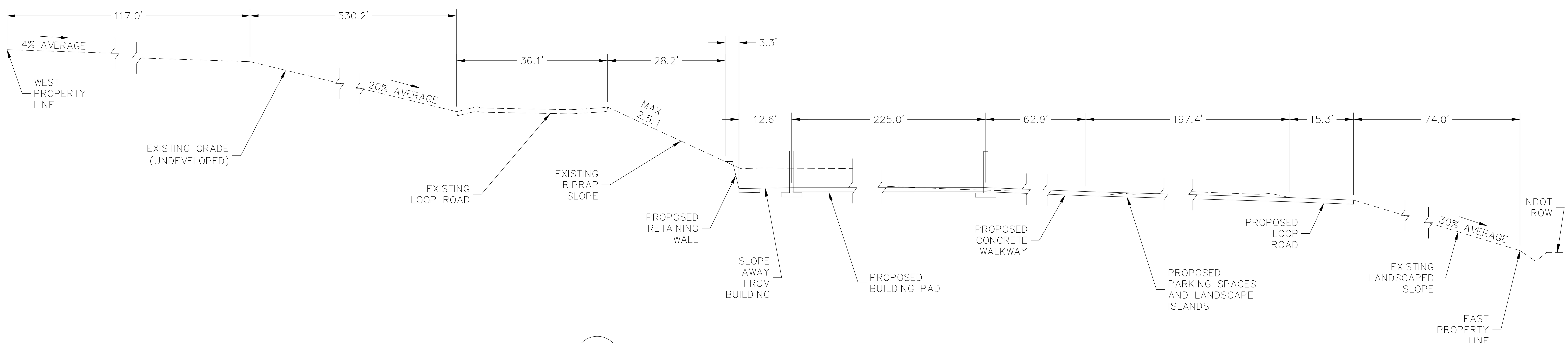



A
C-6
CROSS SECTION A-A
N.T.S.






C-6
CROSS SECTION B-B
N.T.S.

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JOHNSON
Exp: 6-30-21
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No. 19440
12-16-2019

REVISIONS

| NO. | DATE | INITIALS | DESCRIPTION |
|---|---|---|---|
| | | | |

SUMMIT CHRISTIAN CHURCH - PHASE 4.0
SPECIAL USE PERMIT APPLICATION
CROSS SECTIONS
7075 PYRAMID WAY
SPARKS, NV 89436

WASHOE NEVADA

DESIGNED BY: LJ
DRAWN BY: RC
CHECKED BY: ---
DATE: 12-16-2019
JOB NO. SCC-PH419

SHEET NO.
C-6
6 OF 11



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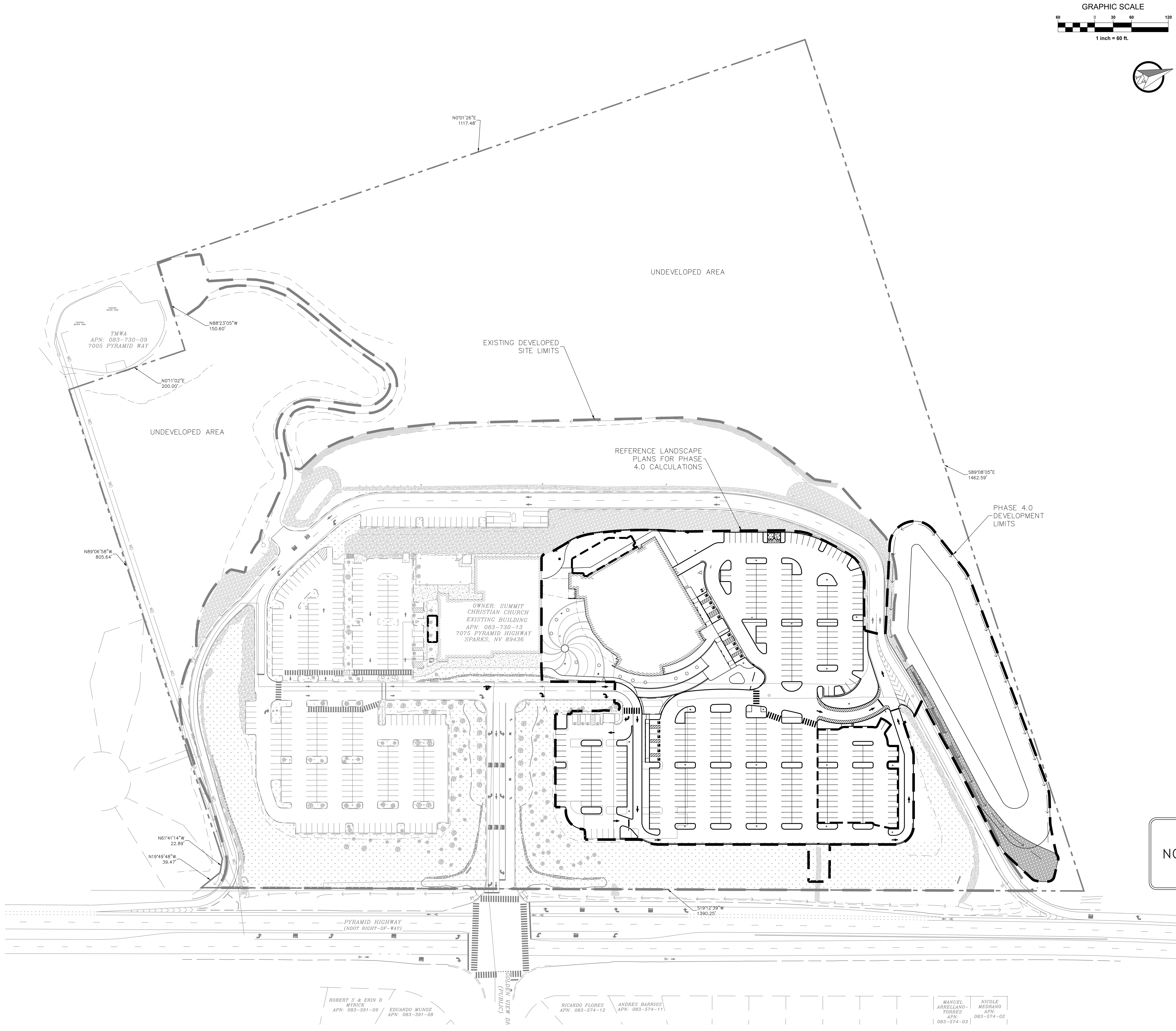


## LEGEND

EXISTING LANDSCAPE

PHASE 4.0 DEVELOPMENT LIMITS REFERENCE LANDSCAPE PLANS

### EXISTING DEVELOPED LANDSCAPE CALCULATIONS:

EXISTING (DEVELOPED)

| | | |
|---|---|---|
| ORNAMENTAL LANDSCAPE: | 1.9 ACRES | |
| NATIVE LANDSCAPE: | 2.7 ACRES | |
| TOTAL EXISTING LANDSCAPE: | 4.6 ACRES | (21.4%) |
| BUILDINGS/PARKING: | 16.9 ACRES | (78.6%) |
| TOTAL: | 21.5 ACRES | |

LANDSCAPE REQUIRED = 20%

TREES REQUIRED = 36
36 = 1 TREE PER 10 PARKING SPACES
(355 SPACES PROVIDED)

TREES PROVIDED = 85

### PHASE 4.0 LANDSCAPE CALCULATIONS:

REFERENCE LANDSCAPE PLANS, SHEET L1

| | |
|---|---|
| AREA SUBJECT TO CONSTRUCTION: | 8.1 ACRES |
| LANDSCAPE AREA: | |
| WORSHIP CENTER & PARKING EXPANSION | |
| ORNAMENTAL LANDSCAPE AREA: | 1.3 ACRES |
| REVEGETATION AREA: | 1.4 ACRES |
| TOTAL: | 2.7 ACRES (33%) |

LANDSCAPE REQUIRED = 20%

TREES REQUIRED = 38
38 = 1 TREE PER 10 PARKING SPACES
(383 SPACES PROVIDED)

TREES PROVIDED = 38 MIN

### SITEWIDE EXISTING + PHASE 4.0 LANDSCAPE CALCULATIONS:

| | |
|---|---|
| PARCEL (APN: 083-730-13): | 36.7 ACRES |
| OPEN SPACE (UNDEVELOPED): | 15.3 ACRES |
| EXISTING DEVELOPED + PHASE 4.0 AREA | 21.4 ACRES |
| LANDSCAPE AREA: | |
| EXISTING DEVELOPED | 4.6 ACRES |
| REVEGETATION AREA: | 2.7 ACRES |
| TOTAL: | 7.3 ACRES (34%) |

LANDSCAPE REQUIRED = 20%

TREES REQUIRED = 74
74 = 1 TREE PER 10 PARKING SPACES
(738 SPACES PROVIDED)

TREES PROVIDED
EXISTING DEVELOPED = 85
PHASE 4.0 = 38 MIN
TOTAL = 123 MIN

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12-16-2019

| NO. | DATE | INITIALS | REVISIONS DESCRIPTION |
|---|---|---|---|

SUMMIT CHRISTIAN CHURCH - PHASE 4.0
SPECIAL USE PERMIT APPLICATION
EXISTING AND SITEWIDE LANDSCAPE SUMMARY
7075 PYRAMID WAY
SPARKS, NV 89436

NEVADA
WASHOE

DESIGNED BY: LJ
DRAWN BY: RC
CHECKED BY: ---
DATE: 12-16-2019
JOB NO. SCC-PH419

SHEET NO.
C-7
7 OF 11



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## PHASE 4 LANDSCAPE DATA

PROPERTY SITE AREA = 36.7 ACRES (1,599,044 SQ FT)
ZONING: GENERAL COMMERCIAL

AREA SUBJECT TO CONSTRUCTION APPROX. 435,835 SQ FT (8.07 ACRES)
REQUIRED LANDSCAPE AREA = 87,169 SQ FT (20%)

**PROVIDED LANDSCAPE AREAS AS AS SHOWN:**
- WORSHIP CENTER & PARKING EXPANSION ORNAMENTAL LANDSCAPE AREA = 56,209 SQ FT
- EXISTING ORNAMENTAL LANDSCAPING = 84,260 SQ FT
- REVEGETATION AREA = 60,924 SQ FT

TREES REQUIRED = 38

- 38 = 1 TREE PER 10 PARKING SPACES (383 SPACES PROVIDED)

TREES PROVIDED = 38 MIN

SHRUBS REQUIRED = SHRUBS SUFFICIENT TO REACH COVERAGE REQUIREMENT PER WASHOE COUNTY CODE

NEW ORNAMENTAL LANDSCAPE

EXISTING ORNAMENTAL LANDSCAPE TO REMAIN

REVEGETATION

FUTURE PROJECT SITE


## PLANT LEGEND

| SYM. | QNT. | BOTANICAL NAME/COMMON NAME | MIN. SIZE |
|---|---|---|---|
| | | DECIDUOUS TREES | |
| | -- | ACER PLATANOIDES/NORWAY MAPLE | 2-½" CAL. |
| | -- | MALUS 'IOENSIS'/PRAIRIE ROSE CRAB | 2-½" CAL. |
| | -- | PLATANUS ACERIFOLIA 'BLOODGOOD'/BLOODGOOD LONDON PLANE | 2-½" CAL. |
| | -- | PRUNUS VIRGINIANA 'CANADA RED'/CANADA RED CHOKECHERRY | 2-½" CAL. |
| | -- | PYRUS CALLERYANA 'REDSPIRE'/REDSPIRE PEAR | 2-½" CAL. |
| | | EVERGREEN TREES | MIN. SIZE |
| | -- | CALOCEDRUS DECURRENS/INCENSE CEDAR | 6' HT. |
| | -- | PICEA PUNGENS 'HOOPSII'/HOOPSII BLUE SPRUCE | 6' HT. |
| | -- | PINUS NIGRA/AUSTRIAN PINE | 6' HT. |
| | | COLUMNAR JUNIPERS (INCLUDED IN SHRUB COUNT) | |
| | -- | JUNIPERUS CHINENSIS 'BLUE POINT'/BLUE POINT JUNIPER | 6' HT. |
| | -- | JUNIPERUS CHINENSIS 'SPARTAN'/SPARTAN JUNIPER | 6' HT. |
| | -- | JUNIPERUS SCOPULORUM 'MOONGLOW'/MOONGLOW JUNIPER | 6' HT. |
| | -- | JUNIPERUS SCOPULORUM 'WICHITA BLUE'/WICHITA BLUE JUNIPER | 6' HT. |
| | | SHRUBS & ORNAMENTAL GRASSES | MIN. SIZE |
| | -- | BERBERIS THUNBERGII 'ATROPURPUREA'/RED-LEAF BARBERRY | 5 GAL. |
| | -- | CALAMAGROSTIS X ACUTIFLORA 'KARL FOERSTER'/FEATHER REED GRASS | 1 GAL. |
| | -- | CORNUS SERICEA 'ISANTI'/ISANTI RED-OSIER DOGWOOD | 5 GAL. |
| | -- | CORNUS STOLONIFERA/REDTWIG DOGWOOD | 5 GAL. |
| | -- | COTONEASTER MICROPHYLLUS/EVERGREEN COTONEASTER | 5 GAL. |
| | -- | EUONYMUS ALATUS 'COMPACTA'/DWARF BURNING BUSH | 5 GAL. |
| | -- | EUONYMUS FORTUNEI/EVERGREEN EUONYMUS | 5 GAL. |
| | -- | EUONYMUS FORTUNEI 'EMERALD AND GOLD'/E&G EUONYMUS | 5 GAL. |
| | -- | EUONYMUS KIAUTSCHOVICUS 'MANHATTAN'/MANHATTAN EUONYMUS | 5 GAL. |
| | -- | FORSYTHIA X INTERMEDIA/FORSYTHIA | 5 GAL. |
| | -- | JUNIPERUS CHINENSIS 'SEA GREEN'/S.G. JUNIPER | 5 GAL. |
| | -- | JUNIPERUS SABINA 'TAMARISCIFOLIA'/TAMARIX JUNIPER | 5 GAL. |
| | -- | PANICUM VIRGATUM/SWITCH GRASS | 1 GAL. |
| | -- | PEROVSKIA ATRIPLICIFOLIA/RUSSIAN SAGE | 1 GAL. |
| | -- | PHOTINIA X INTERMEDIA/PHOTINIA | 5 GAL. |
| | -- | PINUS MUGO MUGO/MUGHO PINE | 5 GAL. |
| | -- | PRUNUS CISTENA/DWARF PURPLE-LEAF PLUM | 5 GAL. |
| | -- | RHUS AROMATICA 'GRO-LOW'/GRO-LOW FRAGRANT SUMAC | 5 GAL. |
| | -- | ROSA X 'NOARE'/RED GROUNDCOVER ROSE | 3 GAL. |
| | -- | ROSA X 'RADRAZZ'/KNOCK OUT ROSE | 3 GAL. |
| | -- | SPIRAEA X BUMALDA 'GOLDFLAME'/GOLDFLAME SPIRAEA | 5 GAL. |
| | -- | SPIRAEA X BUMALDA 'MONHUB'/LIMEMOUND SPIRAEA | 5 GAL. |
| | | PERENNIALS/FLOWERS | |
| | -- | HEMEROCALLIS X 'SUMMER WINE'/SUMMER WINE DAYLILLY | 1 GAL. |
| | -- | LAVENDULA ANGUSTIFOLIA/LAVENDER | 1 GAL. |
| | -- | SALVIA X SUPERBA 'MAY NIGHT'/MAY NIGHT SALVIA | 1 GAL. |

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12-16-2019


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DYER ENGINEERING CONSULTANTS
9160 Double Diamond Pkwy, Ste. A
Reno, Nevada 89521 Phone: 1-775-852-1440

REGISTERED LANDSCAPE ARCHITECT RYAN HANSEN 440 12/16/19 Expires: 6/30/20 STATE OF NEVADA


| NO. | DATE | INITIALS | DESCRIPTION |
|---|---|---|---|
| | | | REVISIONS |

SUMMIT CHRISTIAN CHURCH
Worship Center & Parking Expansion
Preliminary Landscape Plan
7075 Pyramid Way
Sparks, NV 89436
Nevada

DESIGNED BY: KRD
DRAWN BY: KRD
CHECKED BY: RWH
DATE: 12/16/19
JOB NO. 679-504-06-19

L1

SHEET NO.
Landscape
1 OF 4




Z:\HLA-Projects\LA STUDIO PROJECTS\2019\679 (Dyer Engineering)\679-504-06-19 (Summit Christian Church Expansion - CD DD Sparks)\L1-679-504 Landscape Plan.dwg KELLI 12/12/2019 12:34 PM

## PHASE 4 LANDSCAPE DATA

PROPERTY SITE AREA = 36.7 ACRES (1,599,044 SQ FT)
ZONING: GENERAL COMMERCIAL

AREA SUBJECT TO CONSTRUCTION APPROX. 435,835 SQ FT (8.07 ACRES)
REQUIRED LANDSCAPE AREA = 87,169 SQ FT (20%)

**PROVIDED LANDSCAPE AREAS AS AS SHOWN:**
- WORSHIP CENTER & PARKING EXPANSION ORNAMENTAL LANDSCAPE AREA = 56,209 SQ FT
- EXISTING ORNAMENTAL LANDSCAPING = 84,260 SQ FT
- REVEGETATION AREA = 60,924 SQ FT

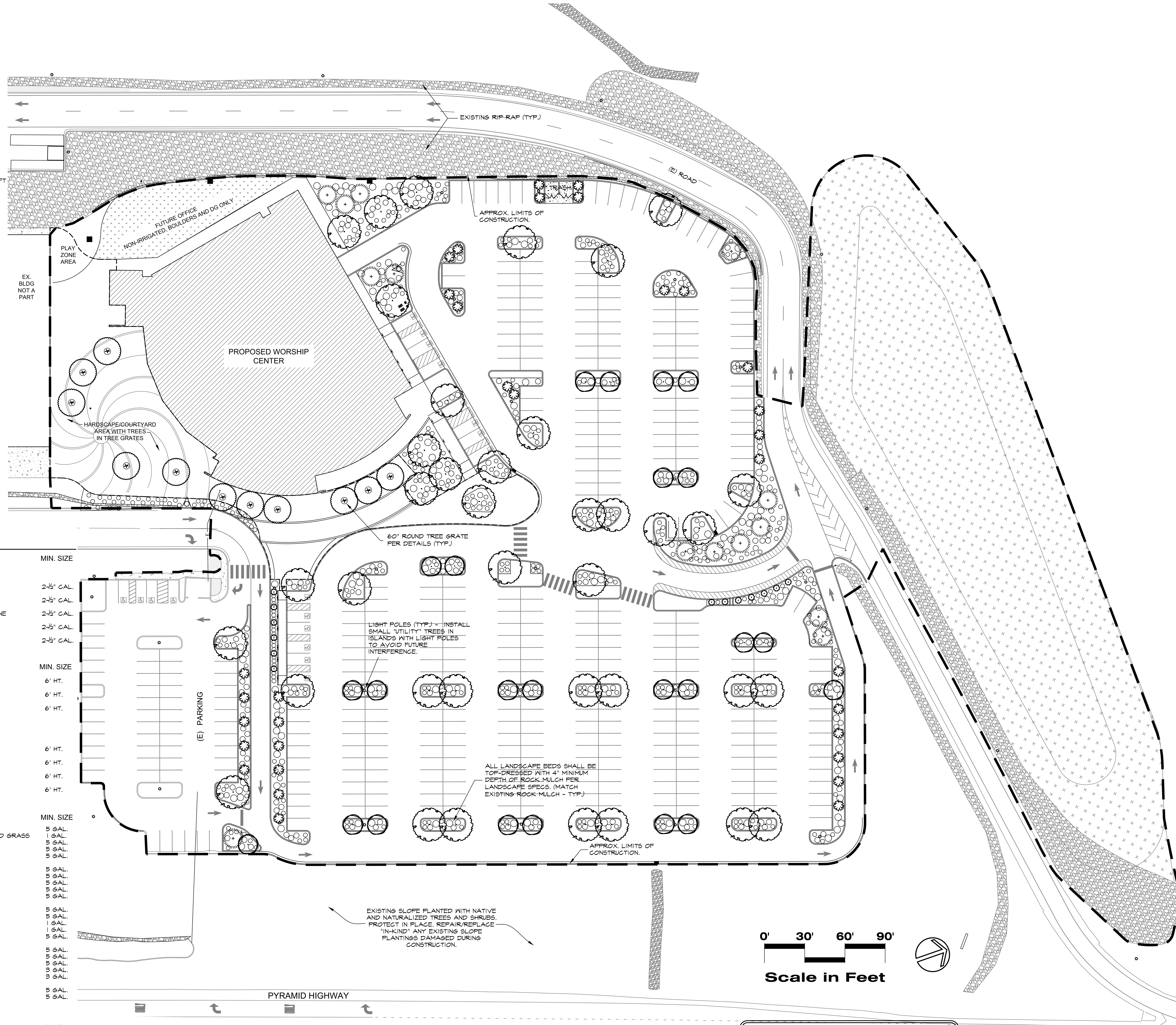
TREES REQUIRED = 38

- 38 = 1 TREE PER 10 PARKING SPACES (383 SPACES PROVIDED)

TREES PROVIDED = 38 MIN

SHRUBS REQUIRED = SHRUBS SUFFICIENT TO REACH COVERAGE REQUIREMENT PER WASHOE COUNTY CODE

NEW ORNAMENTAL LANDSCAPE
EXISTING ORNAMENTAL LANDSCAPE TO REMAIN
REVEGETATION
FUTURE PROJECT SITE




## PLANT LEGEND

| SYM. | QNT. | BOTANICAL NAME/COMMON NAME | MIN. SIZE |
|---|---|---|---|
| | | DECIDUOUS TREES | |
| | -- | ACER PLATANOIDES/NORWAY MAPLE | 2-½" CAL. |
| | -- | MALUS 'IOENSIS'/PRAIRIE ROSE CRAB | 2-½" CAL. |
| | -- | PLATANUS ACERIFOLIA 'BLOODGOOD'/BLOODGOOD LONDON PLANE | 2-½" CAL. |
| | -- | PRUNUS VIRGINIANA 'CANADA RED'/CANADA RED CHOKECHERRY | 2-½" CAL. |
| | -- | PYRUS CALLERYANA 'REDSPIRE'/REDSPIRE PEAR | 2-½" CAL. |
| | | EVERGREEN TREES | MIN. SIZE |
| | -- | CALOCEDRUS DECURRENS/INCENSE CEDAR | 6' HT. |
| | -- | PICEA PUNGENS 'HOOPSII'/HOOPSII BLUE SPRUCE | 6' HT. |
| | -- | PINUS NIGRA/AUSTRIAN PINE | 6' HT. |
| | | COLUMNAR JUNIPERS (INCLUDED IN SHRUB COUNT) | |
| | -- | JUNIPERUS CHINENSIS 'BLUE POINT'/BLUE POINT JUNIPER | 6' HT. |
| | -- | JUNIPERUS CHINENSIS 'SPARTAN'/SPARTAN JUNIPER | 6' HT. |
| | -- | JUNIPERUS SCOPULORUM 'MOONGLOW'/MOONGLOW JUNIPER | 6' HT. |
| | -- | JUNIPERUS SCOPULORUM 'WICHITA BLUE'/WICHITA BLUE JUNIPER | 6' HT. |
| | | SHRUBS & ORNAMENTAL GRASSES | MIN. SIZE |
| | -- | BERBERIS THUNBERGII 'ATROPURPUREA'/RED-LEAF BARBERRY | 5 GAL. |
| | -- | CALAMAGROSTIS X ACUTIFLORA 'KARL FOERSTER'/FEATHER REED GRASS | 1 GAL. |
| | -- | CORNUS SERICEA 'ISANTI'/ISANTI RED-OSIER DOGWOOD | 5 GAL. |
| | -- | CORNUS STOLONIFERA/REDTWIG DOGWOOD | 5 GAL. |
| | -- | COTONEASTER MICROPHYLLUS/EVERGREEN COTONEASTER | 5 GAL. |
| | -- | EUONYMUS ALATUS 'COMPACTA'/DWARF BURNING BUSH | 5 GAL. |
| | -- | EUONYMUS FORTUNEI/EVERGREEN EUONYMUS | 5 GAL. |
| | -- | EUONYMUS FORTUNEI 'EMERALD AND GOLD'/E&G EUONYMUS | 5 GAL. |
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Reno, Nevada 89521 Phone: 1-775-852-1440

REGISTERED LANDSCAPE ARCHITECT RYAN HANSEN 440 12/16/19 Expires: 6/30/20 STATE OF NEVADA

| REVISIONS | | | |
|---|---|---|---|
| NO. | DATE | INITIALS | DESCRIPTION |

SUMMIT CHRISTIAN CHURCH
Worship Center & Parking Expansion
Preliminary Landscape Plan
7075 Pyramid Way
Sparks, NV 89436
Nevada

L1

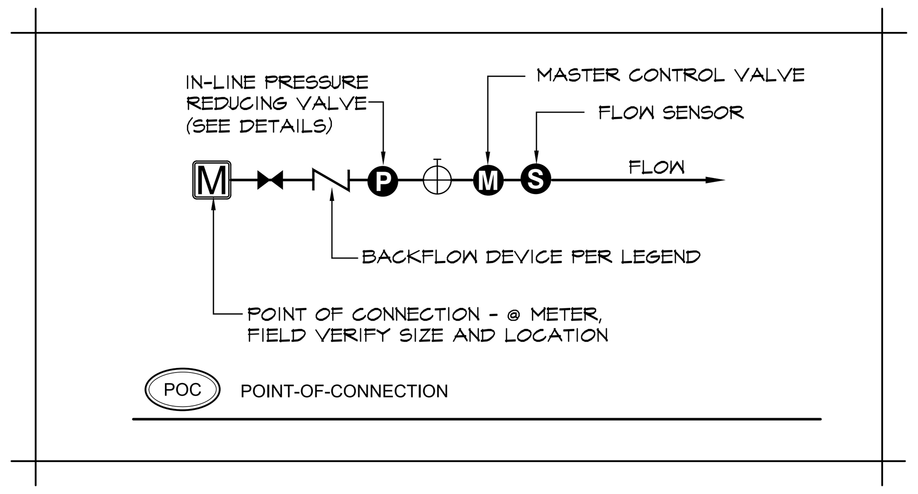
DESIGNED BY: KRD
DRAWN BY: KRD
CHECKED BY: RWH
DATE: 12/16/19
JOB NO. 679-504-06-19

SHEET NO.
Landscape
1 OF 4

Z:\HLA-Projects\LA STUDIO PROJECTS\2019\679 (Dyer Engineering)\679-504-06-19 (Summit Christian Church Expansion - CD DD Sparks)\L1-679-504 Landscape Plan.dwg KELLI 12/12/2019 10:35 AM

## PRELIMINARY WATER DEMAND

ALL CALCULATIONS DONE USING TMWA CALCULATIONS
BASED ON PRELIMINARY LANDSCAPE PLAN BY LA STUDIO NEVADA DATED 11/18/19
- 14560 GALLONS PER WEEK
- TOTAL 1.43 ACRE FEET PER YEAR




## DRIP IRRIGATION LEGEND

| | |
|---|---|
| C | IRRIGATION CONTROL CLOCK: RAINBIRD ESP-LXME/F CONTROLLER. INSTALL CLOCK AND SENSOR PER MFG'S SPECIFICATIONS. |
| M | 1" WATER METER - VERIFY SIZE AND LOCATION PER CIVIL DWGS. |
| | 1" REDUCED PRESSURE TYPE BACKFLOW PREVENTER: WILKENS 975XL (OAE). INSTALL PER DETAIL(S). |
| M | 1" MASTER VALVE - SUPERIOR MASTER VALVE - NORMALLY OPEN |
| F | RAINBIRD FLOW SENSOR AND TRANSMITTERS - SIZE AND INSTALLATION PER MFG"S SPECIFICATIONS. |
| | MANUAL DRAIN VALVE: 3/4" BRASS GATE VALVE. (GRINNELL OR OAE) INSTALL AT ALL LOW POINTS ALONG MAINLINE |
| | BRASS GATE VALVE: GRINNELL (OAE) FOR MAINLINE ISOLATION. SAME SIZE AS MAINLINE. |
| | DRIP VALVE ASSEMBLY: RAINBIRD XCZ-100-PRB-COM COMMERCIAL WIDE FLOW DRIP KIT (0.3-20 GPM). |
| | QUICK COUPLER: RAINBIRD 44-LRC. PROVIDE OWNER WITH TWO VALVE KEYS (RAINBIRD 44-K). |
| # 02 / 1 -- / SIZE GPM | VALVE I.D. - STATION #, VALVE SIZE, AND APPROX. G.P.M. |
| | 1/1/2" MAINLINE: ALL MAINLINES SHALL BE SCH. 40 PVC. INSTALL ALL MAINLINES AT 24" MINIMUM DEPTH. SIZE PER PLAN. |
| | 1" LATERAL PIPES: SCH. 40 PVC LATERAL - INSTALL AT 18" MINIMUM DEPTH. |
| | DRIP DISTRIBUTION TUBING: 3/4" RAINBIRD XBS-BLACK STRIPE TUBING IRRIGATION TUBING WITH RAINBIRD MDCFCAP REMOVABLE FLUSH CAP. |
| | SLEEVES: ALL IRRIGATION SLEEVES UNDER STREETS AND DRIVEWAYS SHALL BE 4" MINIMUM SCH. 40 PVC. SLEEVES FOR DRIP TUBING UNDER SIDEWALKS MAY BE 2" MINIMUM SCH. 40. PROVIDE ONE SLEEVE PER PIPE AND ONE SLEEVE FOR WIRING. |
| | VALVE BOXES (NOT SHOWN): ALL VALVES SHALL BE LOCATED IN RAINBIRD PVB PROFESSIONAL SERIES VALVE BOXES PER DETAILS. |

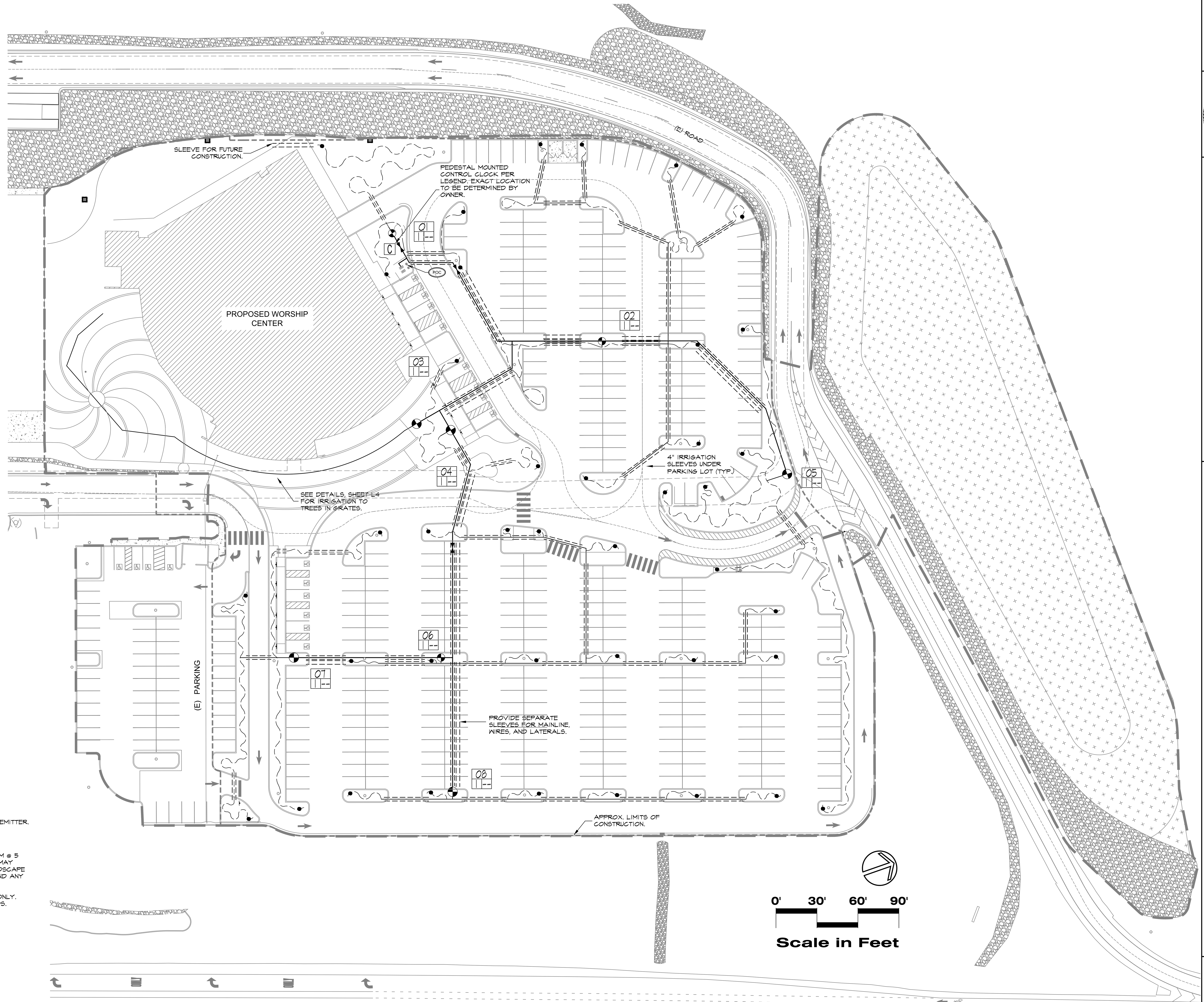
### EMITTER SCHEDULE

TREES: (4) RAINBIRD XERI-BUG 2 GPH PRESSURE COMPENSATING EMITTERS
#5 AND #1 SHRUBS: (2) RAINBIRD XERI-BUG 1 GPH PRESSURE COMPENSATING EMITTERS
GROUND COVER/PERENNIALS: (1) RAINBIRD XERI-BUG 1 GPH PRESSURE COMPENSATING EMITTER.

### DESIGN PRESSURE NOTE:

ASSUMED AVAILABLE WATER PRESSURE AT P.O.C. IS 65 PSI. ASSUMED FLOW IS 12 GPM @ 5 FPS. CONTRACTOR TO VERIFY PRIOR TO SYSTEM INSTALLATION. FUTURE PRESSURES MAY VARY DUE TO NEW DEVELOPMENT AND/OR OTHER UNFORESEEN CIRCUMSTANCES. LANDSCAPE ARCHITECT SHALL BEAR NO RESPONSIBILITY FOR FUTURE DEVIATIONS IN PRESSURE AND ANY RESULTING EFFECTS ON THE PERFORMANCE OF THE IRRIGATION SYSTEM.

IRRIGATION MAINLINES ARE SHOWN IN STREET/PAVED AREAS FOR GRAPHIC CLARITY ONLY. WHERE POSSIBLE, ALL IRRIGATION COMPONENTS SHALL BE LOCATED IN PLANTING BEDS.

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Z:\HLA-Projects\LA STUDIO PROJECTS\2019\679 (Dyer Engineering)\679-504-06-19 (Summit Christian Church Expansion - CD DD Sparks)\L2-679-504 Irrigation Plan.dwg KELLI 12/12/2019 10:12 AM

DYER ENGINEERING CONSULTANTS
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Reno, Nevada 89521 Phone: 1-775-852-1440

REGISTERED LANDSCAPE ARCHITECT
RYAN HANSEN
440
12/16/19
Expires: 6/30/20
STATE OF NEVADA

| REVISIONS | | | |
|---|---|---|---|
| NO. | DATE | INITIALS | DESCRIPTION |

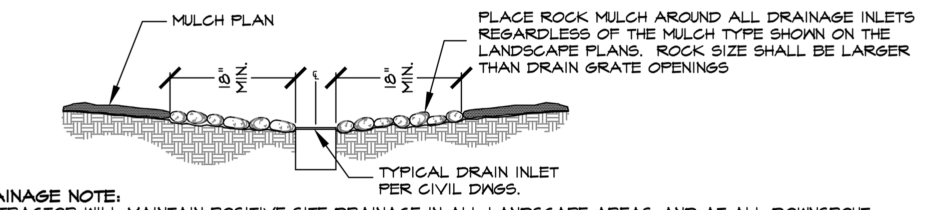
Nevada

SUMMIT CHRISTIAN CHURCH
Worship Center & Parking Expansion
# Preliminary Irrigation Plan
7075 Pyramid Way
Sparks, NV 89436

L1

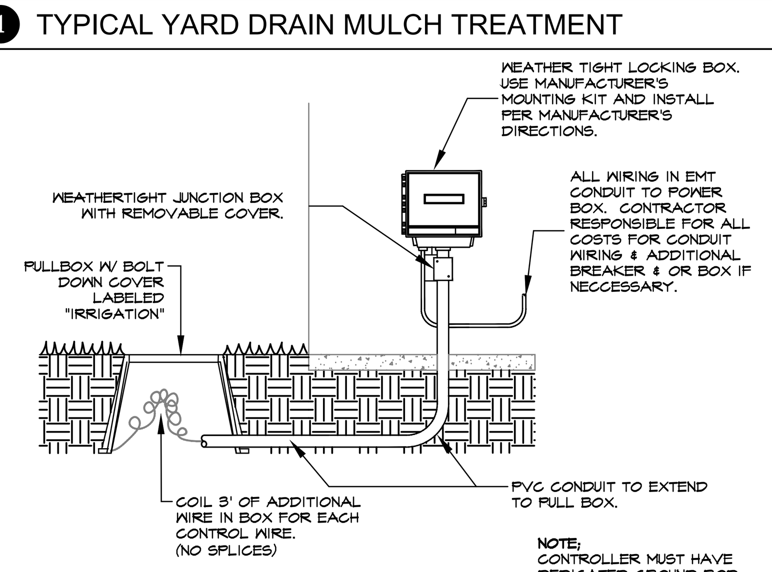
| | |
|---|---|
| DESIGNED BY: | KRD |
| DRAWN BY: | KRD |
| CHECKED BY: | RWH |
| DATE: | 12/16/19 |
| JOB NO. | 679-504-06-19 |

SHEET NO.
Landscape
2 OF 4




**DRAINAGE NOTE:**
CONTRACTOR WILL MAINTAIN POSITIVE SITE DRAINAGE IN ALL LANDSCAPE AREAS, AND AT ALL DOWNSPOUT LOCATIONS AWAY FROM STRUCTURES. PROVIDE NOTCH OR BREAK IN LAWN EDGING (IF APPLICABLE) AS NEEDED. PROVIDE ROCK-LINED "DRY CREEK" DRAINAGE SWALES IN ALL NON-TURF LANDSCAPE AREAS. DO NOT INSTALL DG OR BARK MULCH IN ANY AREAS SUBJECT TO CONCENTRATED DRAINAGE FLOWS (I.E., ROOF DRAIN LOCATIONS, SWALE LINES, YARD DRAIN INLETS, ETC.) WHERE EROSION MAY OCCUR.

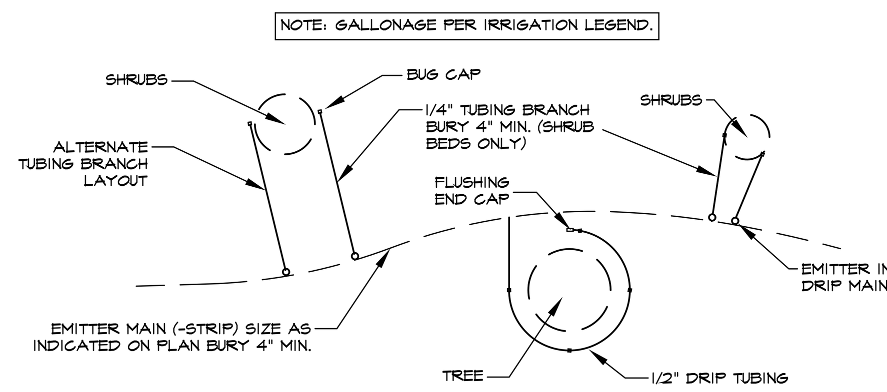
## 1 TYPICAL YARD DRAIN MULCH TREATMENT
NOT TO SCALE



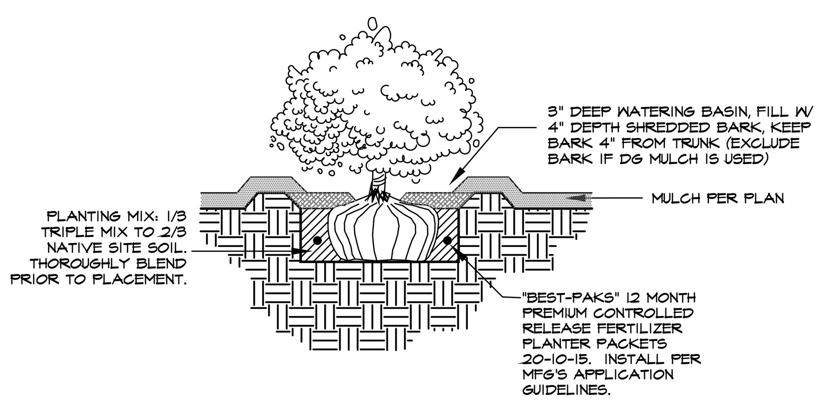

**NOTE;**
CONTROLLER MUST HAVE DEDICATED GROUND ROD

## 1 WALL MOUNTED CONTROL CLOCK
NOT TO SCALE

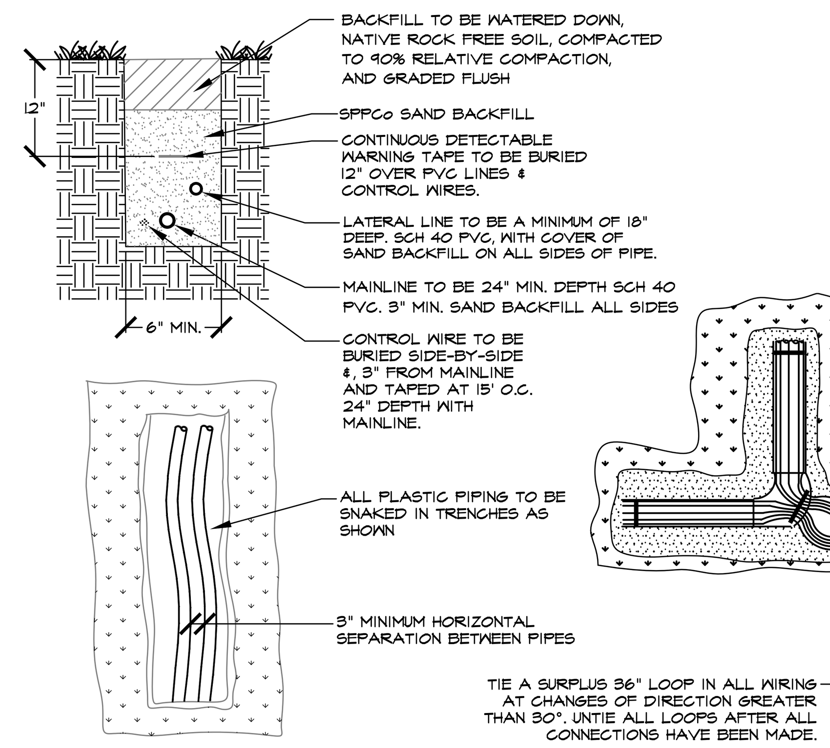
NOTE: GALLONAGE PER IRRIGATION LEGEND.




## 2 DRIP EMITTER LAYOUT
NOT TO SCALE

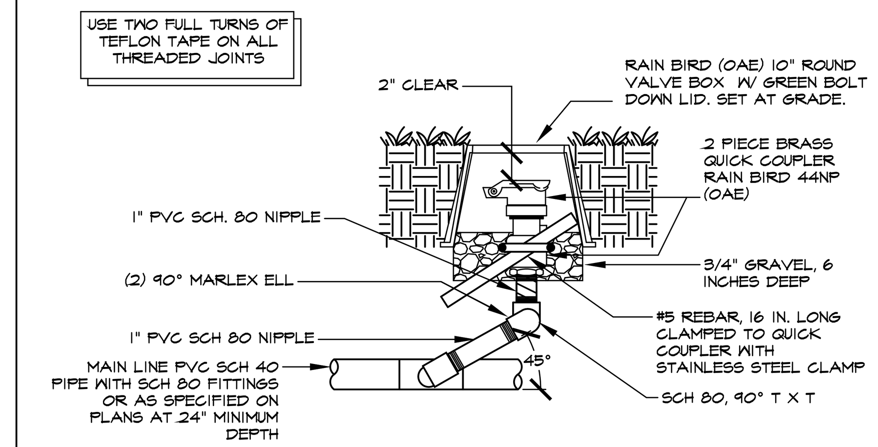



## 3 SHRUB PLANTING DETAIL
NOT TO SCALE

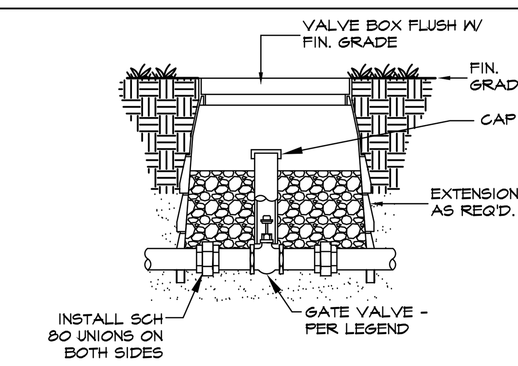



## 4 TRENCH DETAIL/CONTROLLER WIRING
NOT TO SCALE

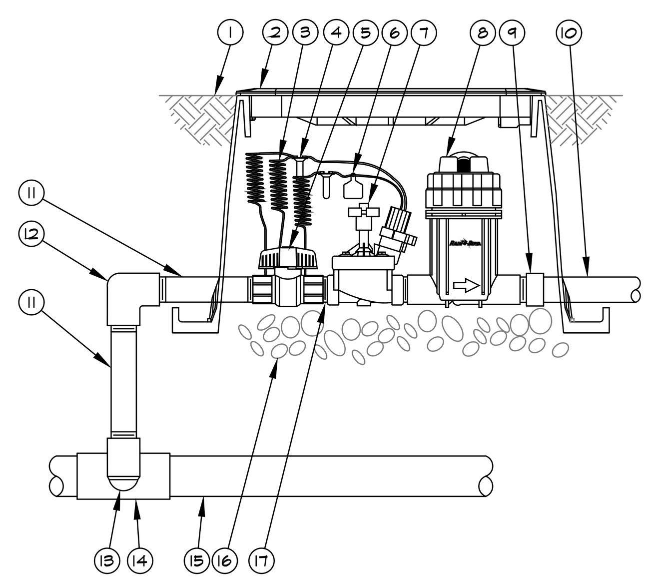
USE TWO FULL TURNS OF TEFLON TAPE ON ALL THREADED JOINTS




## 5 QUICK COUPLING VALVE
NOT TO SCALE

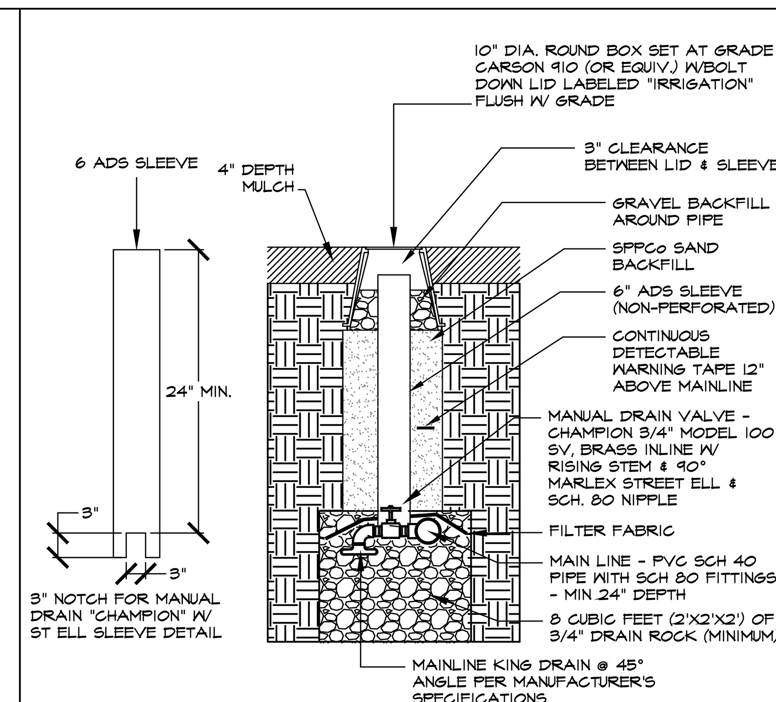



## 6 GATE VALVE
NOT TO SCALE



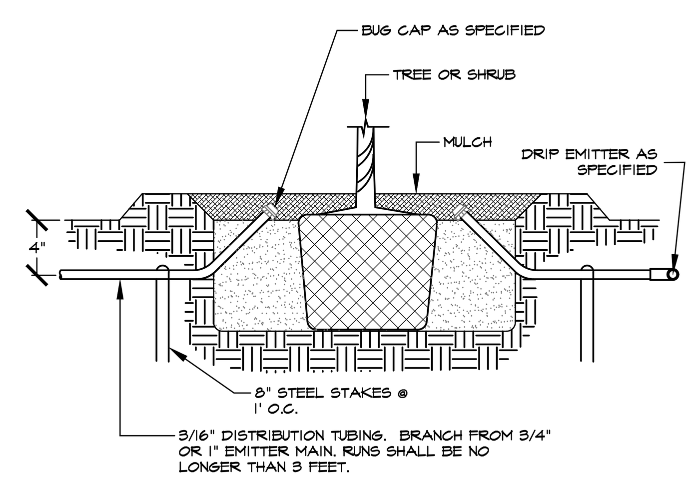

1. FINISH GRADE/TOP OF MULCH
2. VALVE BOX WITH COVER: RAIN BIRD VB-STD
3. 30-INCH LINEAR LENGTH OF WIRE, COILED
4. WATERPROOF CONNECTION: RAIN BIRD DB SERIES
5. 1-INCH BALL VALVE (INCLUDED IN XCZ-PRB-100-COM KIT)
6. ID TAG
7. REMOTE CONTROL VALVE: RAIN BIRD PESB (INCLUCED IN XCZ-PRB-100-COM KIT)
8. PRESSURE REGULATING QUICK CHECK BASKET FILTER: RAIN BIRD PRB-QKCHK-100 (INCLUDED IN XCZ-PRB-100-COM KIT)
9. PVC SCH 40 FEMALE ADAPTOR
10. LATERAL PIPE
11. PVC SCH 80 NIPPLE (LENGTH AS REQUIRED)
12. PVC SCH 80 ELL
13. PVC SCH 80 NIPPLE (2-INCH LENGTH, HIDDEN) AND PVC SCH 40 ELL
14. PVC SCH 80 TEE OR ELL
15. SCH 40 MAINLINE PIPE WITH SCH 80 FITTINGS
16. 3-INCH MINIMUM DEPTH OF 3/4-INCH WASHED GRAVEL
17. PVC SCH 80 NIPPLE, CLOSE (INCLUDED IN XCZ-PRB-100-COM KIT)

## 7 DRIP VALVE ASSEMBLY
NOT TO SCALE




**NOTE:**
INSTALL AT ALL LOW POINTS IN MAINLINE

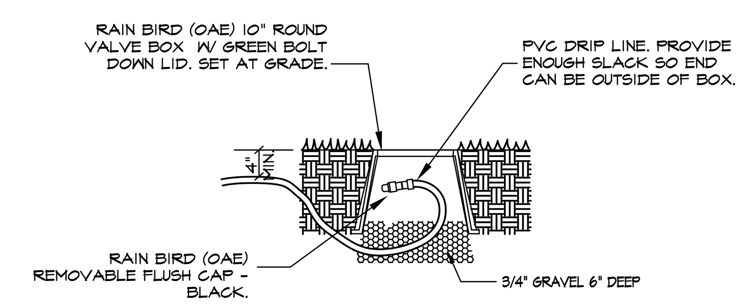
## 8 MANUAL DRAIN VALVE
NOT TO SCALE



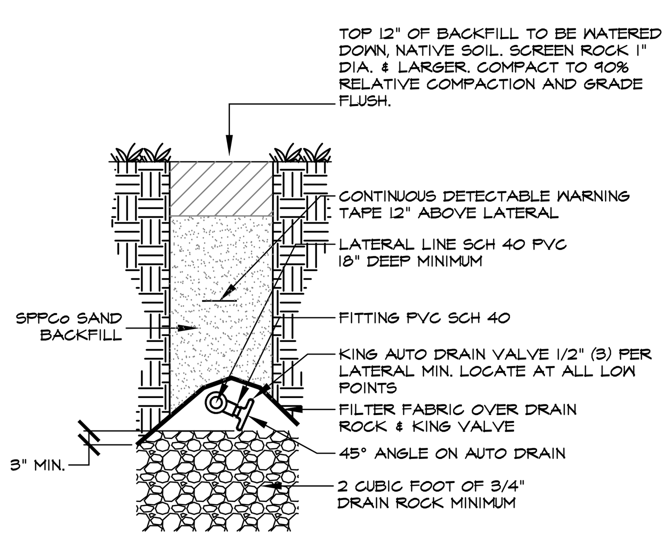

**NOTES:**
1. LOCATE EMITTERS AT SOIL SURFACE MIDWAY BETWEEN ROOTBALL AND EDGE OF WATERING BASIN.

2. GALLONAGE PER IRRIGATION LEGEND.

## 9 DRIP EMITTER INSTALLATION
NOT TO SCALE

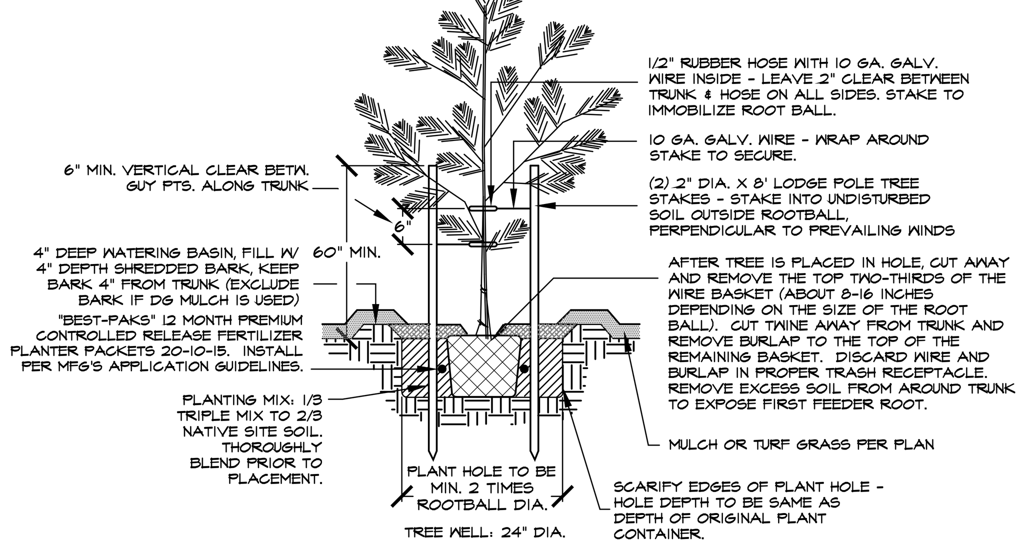



## 10 REMOVABLE FLUSH CAP
NOT TO SCALE




**NOTE:**
ALL AUTO DRAINS SHALL BE LOCATED DOWNSTREAM OF THE BACKFLOW PREVENTER - NAC 445A.67255.

## 11 AUTO DRAIN



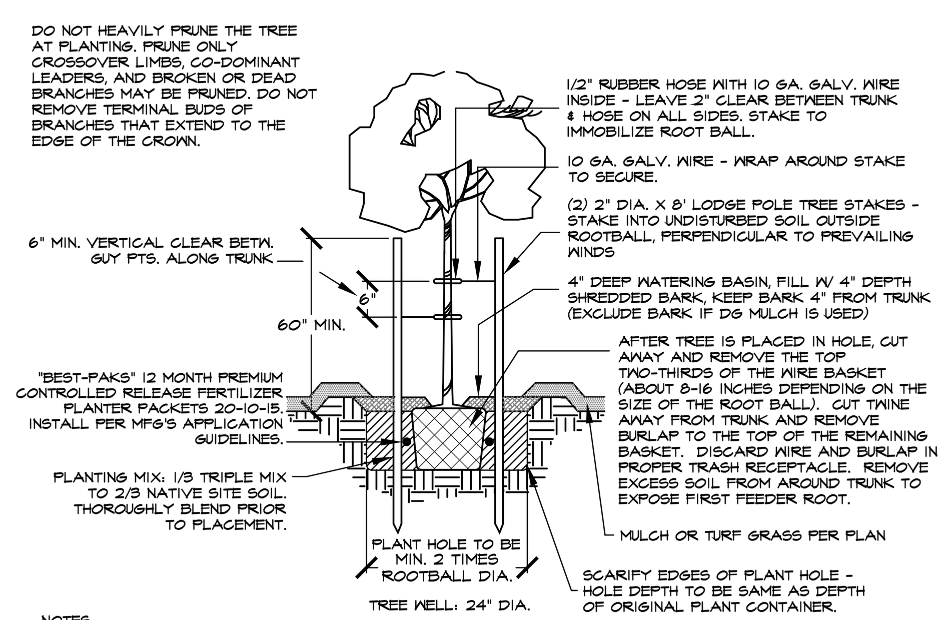

NOTES:

1. REMOVE ALL NURSERY STAKES, TIES & TAGS - TREES MUST STAND UPRIGHT TO BE ACCEPTABLE. SEE NURSERY STOCK QUALITY STANDARDS. ALL TREES SHALL BE STAKED SO AS TO REMAIN UPRIGHT AND PLUMB FOLLOWING INSTALLATION.
2. REMOVE DAMAGED BRANCHES - DO NOT REMOVE CENTRAL LEADER OR ANY LOWER BRANCHES.
3. TOP OF ROOT BALL* TO BE 1" ABOVE EXISTING GRADE - NO NATIVE SOIL TO BE PLACED ON TOP OF ROOT BALL.
4. GRADE WATERING BASIN SUCH THAT WATER COLLECTS AT EDGE OF ROOT BALL, NOT AT TRUNK.
5. THOROUGHLY WATER IMMEDIATELY AFTER PLANTING.
6. ORIENT GRAFT UNION TO FACE NORTH.

* TOP OF ROOT BALL IS DEFINED AS THE LOCATION OF THE UPPERMOST LATERAL ROOT NOT THE SOIL LEVEL IN THE PLANT CONTAINER.

## 12 EVERGREEN TREE PLANTING
NOT TO SCALE

DO NOT HEAVILY PRUNE THE TREE AT PLANTING. PRUNE ONLY CROSSOVER LIMBS, CO-DOMINANT LEADERS, AND BROKEN OR DEAD BRANCHES MAY BE PRUNED. DO NOT REMOVE TERMINAL BUDS OF BRANCHES THAT EXTEND TO THE EDGE OF THE CROWN.

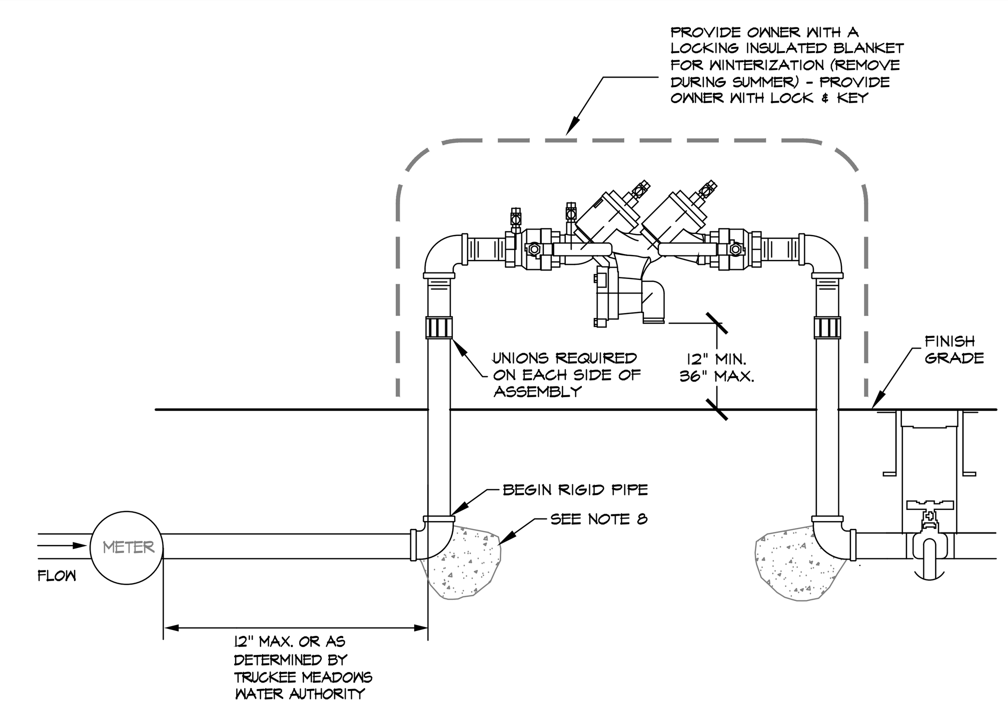



NOTES:

1. REMOVE ALL NURSERY STAKES, TIES & TAGS - TREES MUST STAND UPRIGHT TO BE ACCEPTABLE. SEE NURSERY STOCK QUALITY STANDARDS. ALL TREES SHALL BE STAKED SO AS TO REMAIN UPRIGHT AND PLUMB FOLLOWING INSTALLATION.
2. REMOVE DAMAGED BRANCHES - DO NOT REMOVE CENTRAL LEADER OR ANY LOWER BRANCHES.
3. TOP OF ROOT BALL* TO BE 1" ABOVE EXISTING GRADE - NO NATIVE SOIL TO BE PLACED ON TOP OF ROOT BALL.
4. GRADE WATERING BASIN SUCH THAT WATER COLLECTS AT EDGE OF ROOT BALL, NOT AT TRUNK.
5. THOROUGHLY WATER IMMEDIATELY AFTER PLANTING.
6. ORIENT GRAFT UNION TO FACE NORTH.

* TOP OF ROOT BALL IS DEFINED AS THE LOCATION OF THE UPPERMOST LATERAL ROOT NOT THE SOIL LEVEL IN THE PLANT CONTAINER.

## 13 DECIDUOUS TREE PLANTING
NOT TO SCALE




NOTES:
1. ASSEMBLY SHALL BE A USC APPROVED LEAD FREE DEVICE.
2. THE RP SHALL BE INSTALLED ABOVE GRADE.
3. EITHER VALVE BOXES OR PIPE RISERS MAY BE USED FOR THE 2 BELOW GRADE SHUT OFF VALVES.
4. MANUAL SHUT OFF VALVE: INLINE BRASS GLOBE OR CURB VALVE SIZED SAME AS MAINLINE.
~~5. NO STOP AND WASTE VALVES.~~
6. INSPECTION BY TMWA BACKFLOW PREVENTION GROUP PERSONNEL REQUIRED BEFORE METER IS SET OR SERVICE IS ACTIVATED.
7. IF INITIAL TEST DONE BY TMWA FIELD PERSONNEL FAILS, RETESTING OF BACKFLOW ASSEMBLY IS REQUIRED WITHIN 7 DAYS AFTER METER IS SET OR SERVICE ACTIVATION. COPY OF TEST RESULTS TO BE FORWARDED TO TMWA BACKFLOW PREVENTION GROUP BY A CERTIFIED ASSEMBLY TESTER WITHIN THAT SAME TIMEFRAME.
8. MINIMUM DIMENSIONS FOR THE THRUST BLOCK BEARING AREA FOR PIPE 2" AND SMALLER SHALL BE 8" X 8" AND 12" IN DEPTH. ALL OTHER SIZES TO BE DETERMINED BY ENGINEER.
9. FOR YEAR-ROUND USE REFER TO 10A-2.

| TRUCKEE MEADOWS WATER AUTHORITY | DATE | APPENDIX 10A BACKFLOW PREVENTION ASSEMBLIES | DRAWING NUMBER |
|---|---|---|---|
| | 7/2001 | REDUCED PRESSURE PRINCIPLE ASSEMBLY FOR IRRIGATION AND CONSTRUCTION WATER USE - HORIZONTAL | 10A-3 |
| | REV | | |
| | 6/2016 | | |

## 14 BACKFLOW PREVENTER DETAIL
NOT TO SCALE

PRELIMINARY SUP
NOT FOR CONSTRUCTION
*12-16-2019*

L.A. StudioNevada
the landscape architecture studio
1552 C Street Sparks, NV 89431 (775) 323-2223 NV RLA #440
www.lastudionevada.com



DYER ENGINEERING CONSULTANTS
9160 Double Diamond Pkwy, Ste. A
Reno, Nevada 89521 Phone: 1-775-852-1440

REGISTERED LANDSCAPE ARCHITECT
RYAN HANSEN
440
12/16/19
Expires: 6/30/20
STATE OF NEVADA

| REVISIONS | | | |
|---|---|---|---|
| NO. | DATE | INITIALS | DESCRIPTION |

SUMMIT CHRISTIAN CHURCH
Worship Center & Parking Expansion
# Preliminary Landscape & Irrigation Details
7075 Pyramid Way
Sparks, NV 89436
Nevada

L1

| | |
|---|---|
| DESIGNED BY: | KRD |
| DRAWN BY: | KRD |
| CHECKED BY: | RWH |
| DATE: | 12/16/19 |
| JOB NO. | 679-504-06-19 |

SHEET NO.
Landscape
3 OF 4



Z:\HLA-Projects\LA STUDIO PROJECTS\2019\679 (Dyer Engineering)\679-504-06-19 (Summit Christian Church Expansion - CD DD Sparks)\L3-679-504 Details and Specs (2 Sheets).dwg KELLI 12/12/2019 9:53 AM

# LANDSCAPE SPECIFICATIONS

**GENERAL**

1. PLAN IS DIAGRAMMATIC ONLY. ALL LOCAL GOVERNING CODES SHALL BE MET. EXACT LOCATION OF TREES AND SHRUBS SHALL BE DETERMINED IN THE FIELD (INSTALL AS PER DETAILS) AND APPROVED BY THE OWNER'S REPRESENTATIVE.

2. A MINIMUM OF TWO WORKING DAYS BEFORE PERFORMING ANY DIGGING, CALL UNDERGROUND SERVICE ALERT FOR INFORMATION ON THE LOCATION OF NATURAL GAS LINES, ELECTRIC CABLES, TELEPHONE CABLES, ETC. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATION AND PROTECTION OF ALL UTILITIES, AND REPAIR OF ANY DAMAGE RESULTING FROM HIS WORK AT NO ADDITIONAL COST TO THE OWNER.

3. DAMAGES: CONTRACTOR SHALL PROMPTLY REPAIR ALL DAMAGES TO EXISTING SITE AT NO COST TO OWNER.

4. CONTRACTOR SHALL COORDINATE ALL WORK WITH OTHER TRADES (I.E., PAVING, PLUMBING, ELECTRICAL, ETC.)

5. THE CONTRACTOR SHALL BE RESPONSIBLE TO FIELD VERIFY SITE CONDITIONS PRIOR TO CONSTRUCTION AND TO NOTIFY THE OWNER'S REPRESENTATIVE SHOULD CONDITIONS EXIST WHICH PREVENT CONSTRUCTION AS PER THESE PLANS. COMMENCEMENT OF WORK SHALL CONSTITUTE ACCEPTANCE OF CONDITIONS AND RESPONSIBILITY FOR CORRECTIONS.

6. CONTRACTOR AGREES THAT, IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, CONTRACTOR ASSUMES SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY, THAT THIS REQUIREMENT SHALL BE MADE TO APPLY CONTINUOUSLY AND SHALL NOT BE LIMITED TO NORMAL WORKING HOURS AND CONTRACTOR FURTHER AGREES TO DEFEND, INDEMNIFY AND HOLD HARMLESS THE OWNER FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THE PROJECT.

**PLANTING**

7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FINISH GRADING THROUGHOUT ALL LANDSCAPE AREAS SUCH THAT THERE ARE NO HUMPS OR DEPRESSIONS AND POSITIVE DRAINAGE OCCURS THROUGHOUT. THE TOP 18" OF ALL PLANTING BEDS SHALL BE CLEAN NATIVE SOIL, FREE OF ALL CONSTRUCTION DEBRIS AND NATIVE ROCKS OVER 1" IN DIAMETER. THE CONTRACTOR SHALL AMEND THE PLANTING BED OR PLANTING HOLES PER PLANS AND SPECIFICATIONS. FINAL GRADE OF ALL PLANTERS (I.E. MULCH SURFACE) SHALL BE FLUSH WITH ADJACENT HARDSCAPE SURFACES.

8. SOIL TEST: CONTRACTOR SHALL PROVIDE SOIL TEST RESULTS FOR EXISTING SITE SOIL AS FOLLOWS:
- ANALYSIS PACKAGE LTP.4 BY SUNLAND ANALYTICAL (916)852-8557 (OAE).
- TEST RESULTS SHALL INCLUDE SOIL SATURATION PERCENT, SOIL TEXTURE, INFILTRATION RATE, pH, CONDUCTIVITY, TOTAL DISSOLVED SALTS, CATION EXCHANGE CAPACITY, POTASSIUM, SODIUM, CALCIUM, MAGNESIUM, NITRATE & PHOSPHORUS, SULFUR, CHLORIDE, BORON, COPPER, IRON, MANGANESE, ZINK & LIME REQUIREMENT OR GYPSUM REQUIREMENT, SODIUM ABSORPTION RATIO, EXCHANGEABLE SODIUM PERCENT & ORGANIC MATTER, ALONG WITH RECOMMENDATIONS FOR SOIL AMENDMENT BASED ON ANALYSIS RESULTS.
- CONTRACTOR SHALL FOLLOW RECOMMENDATIONS OF SOIL TEST.

9. IT IS THE CONTRACTOR'S RESPONSIBILITY TO TOTAL AND CONFIRM ALL MATERIAL QUANTITIES. ITEMS QUANTITFIED BY AN AREA (I.E., SQUARE FEET - SF, SQUARE YARD - SY) OR VOLUME (CUBIC FEET - CU FT, CUBIC YARD - CU YD) SHALL BE CALCULATED AND CONFIRMED BY THE CONTRACTOR. THE QUANTITIES LISTED ON THE PLANT LIST ARE ESTIMATED. IN THE EVENT OF A DISCREPANCY BETWEEN THE TOTALS LISTED ON THE PLANT LIST AND THE QUANTITY OF GRAPHIC PLANT SYMBOLS DEPICTED ON THE DRAWINGS, THE GRAPHIC SYMBOLS ON THE PLANS SHALL GOVERN. THE ACTUAL TOTAL QUANTITIES SHALL BE DETERMINED BY THE CONTRACTOR.

10. SOIL AMENDMENT: UNLESS OTHERWISE INDICATED BY THE SOIL TEST, SOIL AMENDMENT SHALL BE HUMUS COMPOSED OF TOPSOIL, BARK HUMUS, AND COMPOST. SUBMIT TO OWNER'S REPRESENTATIVE FOR APPROVAL.

11. CONTRACTOR IS RESPONSIBLE FOR PROVIDING PLANT MATERIAL PER SYMBOLS AND SPACING INDICATED ON PLAN. SYMBOLS PREVAIL OVER NUMBERS ON PLANT LIST. NO SUBSTITUTIONS WILL BE ACCEPTED WITHOUT EXPRESSED WRITTEN CONSENT OF THE OWNER'S REPRESENTATIVE. SEE SUBMITTALS.

12. ALL PLANTS NOT MEETING OR EXCEEDING REQUIREMENTS AND RECOMMENDATIONS OF THE LATEST EDITION OF THE ANSI Z60.1 "AMERICAN STANDARD FOR NURSERY STOCK" BY THE AMERICAN ASSOCIATION OF NURSERYMEN SHALL BE REJECTED. CONTRACTOR SHALL RECEIVE ON-SITE APPROVAL OF PLANT MATERIAL BY OWNER'S REPRESENTATIVE PRIOR TO PLANTING. FAILURE TO RECEIVE PRIOR APPROVAL MAY RESULT IN REJECTION OF PLANT MATERIAL FOLLOWING INSTALLATION. THE OWNER'S REPRESENTATIVE RESERVES THE RIGHT TO INSPECT AND EVALUATE PLANT MATERIAL THROUGHOUT THE CONSTRUCTION AND MAINTENANCE PERIOD.

13. ALL PLANTING BEDS SHALL RECEIVE TOP-DRESSING OF MULCH AS FOLLOWS:

- FROCK, 2"X3" FRACTURED ROCK (OAE) - INSTALL 4" MIN. DEPTH OF ROCK MULCH OVER LANDSCAPE FABRIC IN A LANDSCAPE BEDS.
- BARK MULCH - INSTALL 'WALK-ON' BARK MULCH (OAE) IN TREE AND SHRUB WATERING WELLS LOCATED WITHIN ROCK MULCH AREAS. - DO NOT INSTALL LANDSCAPE FABRIC UNDER BARK.
- LANDSCAPE FABRIC - 'DEWITT' PRO-5 WEED BARRIER (OAE), INSTALL IN ACCORDANCE WITH MFG'S SPECIFICATIONS.
- GRANULAR PRE-EMERGENT HERBICIDE - APPLY RONSTAR TURF & ORNAMENTAL HERBICIDE (OAE) TO ALL PLANTING BEDS PER MFG'S SPECIFICATIONS.

NOTE: DIGITAL PHOTOS OF ALL MULCH SAMPLES SHALL BE SUBMITTED TO OWNER'S REPRESENTATIVE FOR REVIEW AND APPROVAL MIN. 48 HOURS PRIOR TO START OF ANY LANDSCAPE OR IRRIGATION WORK. IF UNACCEPTABLE MULCH IS INSTALLED WITHOUT APPROVAL IT WILL BE THE RESPONSIBILITY OF THE CONTRACTOR TO CORRECT THE ISSUES AT HIS EXPENSE.

**OBSERVATIONS/APPROVALS/SUBMITTALS**

14. CONTRACTOR IS RESPONSIBLE FOR NOTIFYING OWNER'S REPRESENTATIVE, A MINIMUM OF 48 HOURS IN ADVANCE, FOR THE FOLLOWING SITE OBSERVATIONS AND/OR MEETINGS:

A. PRECONSTRUCTION MEETING WITH ALL PARTIES
B. PLANT MATERIAL ON SITE, PRIOR TO INSTALLATION
C. FINAL PROJECT WALK-THROUGH
D. ADDITIONAL SITE OBSERVATIONS AS DEEMED NECESSARY BY THE OWNER'S REPRESENTATIVE AND/OR CONTRACTOR.

15. SUBMIT AMENDMENT AND MULCH SAMPLES TO OWNER'S REPRESENTATIVE FOR APPROVAL PRIOR TO INSTALLATION. FAILURE TO COMPLY MAY RESULT IN REJECTION OF MULCH OR AMENDMENT PRIOR TO OR FOLLOWING INSTALLATION.

16. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO LOCATE AND PROVIDE PLANT MATERIAL AS SPECIFIED ON THIS PLAN. THE CONTRACTOR MAY SUBMIT A REQUEST TO PROVIDE SUBSTITUTIONS FOR THE SPECIFIED PLANT MATERIAL UNDER THE FOLLOWING CONDITIONS:

A. ANY SUBSTITUTIONS PROPOSED SHALL BE SUBMITTED TO THE PROJECT OWNER'S REPRESENTATIVE WITHIN TWO WEEKS OF THE AWARD OF CONTRACT. SUBSTITUTIONS MUST MEET EQUIVALENT DESIGN AND FUNCTIONAL GOALS OF THE ORIGINAL MATERIALS AS DETERMINED BY THE OWNER'S REPRESENTATIVE. ANY CHANGES MUST HAVE THE APPROVAL OF THE OWNER'S REPRESENTATIVE.
B. THE REQUEST WILL BE ACCOMPANIED BY AT LEAST THREE NOTICES FROM PLANT MATERIAL SUPPLIERS THAT THE PLANT MATERIAL SPECIFIED IS NOT AVAILABLE AND WILL NOT BE AVAILABLE PRIOR TO CONSTRUCTION.

17. SUBMIT REQUIRED SOIL REPORT, AND SAMPLE OF PROPOSED SOIL AMENDMENTS TO OWNER'S REPRESENTATIVE PRIOR TO INSTALLATION.

18. RECORD (AS-BUILT) DRAWINGS: FOLLOWING COMPLETION OF PROJECT INSTALLATION, AND PRIOR TO FINAL APPROVAL, CONTRACTOR SHALL PREPARE AND SUBMIT RECORD DRAWINGS DEPICTING A COMPLETE LANDSCAPE AND IRRIGATION INSTALLATION. PROCURE FROM OWNER DIGITAL COPIES OF CONTRACT DRAWINGS. CONSTRUCTION DRAWINGS SHALL BE ON THE PROJECT SITE AT ALL TIMES DURING INSTALLATION. CONTRACTOR SHALL MAKE A DAILY RECORD OF ALL WORK INSTALLED DURING EACH DAY. ACTUAL LOCATION OF TREES AND SHRUB BEDS, IRRIGATION VALVES, AND ALL IRRIGATION AND DRAINAGE PIPING SHALL BE SHOWN ON THE PRINTS BY DIMENSIONS FROM EASILY IDENTIFIED PERMANENT FEATURES, SUCH AS BUILDING, CURBS, FENCES, WALKS, OR PROPERTY LINES. DRAWINGS SHALL SHOW MANUFACTURER'S NAME AND CATALOG NUMBER. THE DRAWINGS SHALL BE TO SCALE. ALL INFORMATION NOTED ON THE PRINT SHALL BE TRANSFERRED TO THE COPIES BY CONTRACTOR AND ALL INDICATIONS SHALL BE RECORDED IN A NEAT, ORDERLY WAY. THE RECORD COPIES SHALL BE TURNED OVER TO THE OWNER'S REPRESENTATIVE.

**GUARANTEES/WARRANTY**

20. ALL PLANTED AREAS SHALL BE MAINTAINED FOR A PERIOD OF SIXTY DAYS FOLLOWING WRITTEN ACCEPTANCE BY OWNER'S REPRESENTATIVE. LANDSCAPE CONTRACTOR WILL GUARANTEE ALL PLANT MATERIAL (INCLUDING BUT NOT LIMITED TO TREES, SHRUBS, GROUNDCOVER, AND GRASSES) FOR A PERIOD OF ONE FULL YEAR FOLLOWING FINAL ACCEPTANCE OF THE LANDSCAPE INSTALLATION BY THE OWNER'S AUTHORIZED REPRESENTATIVE. IN BIDDING AND INSTALLING THE PLANT MATERIAL SPECIFIED ON THESE PLANS, THE LANDSCAPE CONTRACTOR AGREES THAT THE PLANT MATERIAL SPECIFIED IS SUITABLE TO THE PROJECT SITE. FURTHERMORE, THE LANDSCAPE CONTRACTOR AGREES TO HONOR THE WARRANTY AND, IF NECESSARY, REPLACE SPECIES WITH A MORE HARDY PLANT TYPE IF DEEMED NECESSARY DUE TO EXCESSIVE DIE OUT. IF THE LANDSCAPE CONTRACTOR DOES NOT BELIEVE CERTAIN PLANT MATERIAL IS SUITABLE FOR THE SITE AND/OR ITS MICRO-CLIMATES, THE LANDSCAPE CONTRACTOR SHALL REQUEST TO MAKE PLANT MATERIAL SUBSTITUTIONS IN WRITING TO THE LANDSCAPE ARCHITECT PRIOR TO THE START OF INSTALLATION. PROPOSED SUBSTITUTIONS WILL RESULT IN NO ADDED COST.

# IRRIGATION SPECIFICATIONS

**GENERAL**

1. PLAN IS DIAGRAMMATIC ONLY. FINAL LOCATION OF LINES AND HEADS SHALL BE DETERMINED IN THE FIELD AND APPROVED BY THE OWNER'S REPRESENTATIVE. LINES SHALL BE IN A COMMON TRENCH WHEREVER POSSIBLE. THE POINT-OF-CONNECTION SHALL BE AS INDICATED ON THE PLAN.

2. THE CONTRACTOR SHALL VERIFY EXISTING SITE CONDITIONS AND ENSURE THAT ALL LOCAL CODES ARE MET.

3. THE CONTRACTOR SHALL APPLY AND PAY FOR ALL PERMITS REQUIRED FOR INSTALLATION OF THE IRRIGATION SYSTEM AS DEPICTED ON THESE PLANS.

4. CONTRACTOR SHALL VERIFY AVAILABLE FLOW AND PRESSURE DOWNSTREAM FROM THE POINT-OF-CONNECTION PRIOR TO SYSTEM INSTALLATION. CONTRACTOR SHALL NOTIFY OWNER'S REPRESENTATIVE IMMEDIATELY IF AVAILABLE FLOW IS LESS THAN REQUIRED TO RUN THE LARGEST ZONE. CONTRACTOR SHALL NOT PROCEED ANY FURTHER WITH INSTALLATION OF THE SYSTEM UNTIL NECESSARY DESIGN REVISIONS HAVE BEEN DETERMINED BY OWNER'S REPRESENTATIVE.

5. THE CONTRACTOR SHALL NOT WILLFULLY INSTALL THE IRRIGATION SYSTEM AS SHOWN ON THE DRAWINGS WHEN IT IS OBVIOUS IN THE FIELD THAT UNKNOWN OBSTRUCTIONS OR DIFFERENCES IN DIMENSIONS EXIST THAT MIGHT HAVE BEEN UNKNOWN DURING ENGINEERING. SUCH OBSTRUCTIONS SHALL BE BROUGHT TO THE ATTENTION OF THE OWNER'S AUTHORIZED REPRESENTATIVE. IN THE EVENT THIS NOTIFICATION IS NOT PERFORMED, THE CONTRACTOR SHALL ASSUME FULL RESPONSIBILITY FOR ANY REVISIONS NECESSARY AT NO ADDITIONAL COST TO OWNER.

6. ALL SPRINKLER EQUIPMENT NOT OTHERWISE DETAILED OR SPECIFIED SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS AND SPECIFICATIONS.

7. CONTRACTOR SHALL COORDINATE THE INSTALLATION OF ALL IRRIGATION MATERIAL, INCLUDING PIPE, WITH THE LANDSCAPE DRAWINGS TO AVOID INTERFERING WITH THE PLANTING OF TREES, SHRUBS, OR OTHER PLANTINGS.

8. ALL VALVES ARE TO BE LOCATED IN PLANTING AREAS WHEREVER POSSIBLE.

9. ALL ELECTRICAL WIRE FROM CONTROLLER TO VALVES SHALL BE 12 GAUGE UL DIRECT BURIAL OR LARGER AS REQUIRED BY LENGTH PER MANUFACTURER'S SPECIFICATIONS.

10. BACKFILL FOR TRENCHING SHALL BE COMPACTED TO A DRY DENSITY EQUAL TO THE UNDISTURBED ADJACENT SOIL AND SHALL CONFORM TO ADJACENT GRADES WITHOUT DIPS, HUMPS, OR OTHER IRREGULARITIES.

11. A MINIMUM OF TWO WORKING DAYS PRIOR TO PERFORMING ANY DIGGING, CALL UNDERGROUND SERVICE ALERT AT 1-800-227-2600 FOR INFORMATION ON THE LOCATION OF NATURAL GAS LINES, ELECTRICAL CABLES, TELEPHONE CABLES, ETC.

12. CONTRACTOR AGREES THAT, IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, CONTRACTOR WILL BE REQUIRED TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND SHALL NOT BE LIMITED TO NORMAL WORKING HOURS.

13. INSTALL ALL PIPE AND CONTROL WIRES IN LANDSCAPE BEDS AND IN COMMON TRENCHES WHEREVER POSSIBLE.

14. INSTALL ALL PIPE AND CONTROL WIRE, WHICH RUNS UNDER PAVING, WITHIN SCH. 40 PVC SLEEVES 4" DIA. MINIMUM SIZE AS REQUIRED TO ALLOW INSTALLATION WITHOUT BINDING. PROVIDE (1) SLEEVE PER PIPE. PROVIDE SEPARATE SLEEVES FOR CONTROL WIRE.

15. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE FOR COMPLETE DRAINAGE OF THE MAINLINES BY INSTALLING MANUAL DRAINS AS INDICATED ON PLAN AND AT ALL SYSTEM LOW POINTS.

**FLUSHING AND TESTING**

16. PIPING SHALL BE COMPLETELY FLUSHED OF FOREIGN PARTICLES BEFORE ATTACHING IRRIGATION COMPONENTS AND DRAIN VALVES.

17. AFTER FLUSHING, AND WHEN ALL VALVES AND QUICK COUPLERS ARE IN PLACE, ALL MAIN SUPPLY LINES SHALL BE TESTED AT 100 POUNDS PER SQUARE INCH (100 PSI) WITH VALVES CLOSED. MAINTAIN PRESSURE FOR A PERIOD OF NOT LESS THAN (4) CONSECUTIVE HOURS. ALL JOINTS SHOWING LEAKS SHALL BE CLEANED, REMADE, AND TESTED.

18. OPERATIONAL TESTING: PERFORM OPERATIONAL TESTING AFTER HYDROSTATIC TESTING IS COMPLETED. DEMONSTRATE TO THE OWNER'S REPRESENTATIVE THAT THE SYSTEM MEETS COVERAGE REQUIREMENTS (100%) AND THAT AUTOMATIC CONTROLS FUNCTION PROPERLY.

**SUBMITTALS**

19. MATERIALS LIST: WITHIN (15) DAYS AFTER AWARD OF CONTRACT, SUBMIT TO OWNER'S REPRESENTATIVE (3) COPIES OF A COMPLETE MATERIAL LIST (PARTIAL LIST NOT ACCEPTABLE) OF ALL MATERIALS TO BE USED ON THE PROJECT, SPECIFYING MANUFACTURER, GRADE, TRADE NAME, CATALOG NUMBER, SIZE, ETC. THIS SHALL IN NO WAY BE CONSTRUED AS ALLOWING A SUBSTITUTION FOR ANY ITEM SPECIFIED ON THE PLANS. EQUIPMENT OR MATERIALS INSTALLED OR FURNISHED WITHOUT THE PRIOR WRITTEN APPROVAL OF THE OWNER'S REPRESENTATIVE MAY BE REJECTED AND THE CONTRACTOR REQUIRED TO REMOVE THE MATERIALS AT HIS OWN EXPENSE.

INSTALLATION AND PERFORMANCE OF APPROVED SUBSTITUTIONS ARE THE CONTRACTORS RESPONSIBILITY. ANY CHANGES REQUIRED FOR INSTALLATION OF ANY APPROVED SUBSTITUTION MUST BE MADE TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITHOUT ADDITIONAL COST TO OWNER.

20. PRIOR TO SYSTEM INSTALLATION CONTRACTOR SHALL VERIFY AND SUBMIT TO OWNER'S REPRESENTATIVE IN WRITING, AVAILABLE FLOW AND PRESSURE AT POINT-OF-CONNECTION AS DESCRIBED IN SPECIFICATION #4 ABOVE.

21. COMPLETE WARRANTY CARDS FOR AUTOMATIC CONTROLLER AND OTHER IRRIGATION MATERIAL (CONTROLLER KEYS, ETC.) SHALL BE DELIVERED TO OWNER.

22. CONTRACTOR SHALL PREPARE AND ISSUE TO THE OWNER (AT COMPLETION OF THE INSTALLATION) AN ANNUAL CHART INDICATING LOCATION, OPERATING DATES, CYCLES, AND TIME FOR EACH ZONE.

23. ASBUILT IRRIGATION DRAWINGS: CONTRACTOR SHALL FURNISH ASBUILTS OF THE COMPLETE IRRIGATION SYSTEM. PROCURE FROM OWNER'S REPRESENTATIVE DIGITAL COPIES OF CONTRACT DRAWINGS. CONSTRUCTION DRAWINGS SHALL BE ON THE CONSTRUCTION SITE AT ALL TIMES WHILE THE IRRIGATION SYSTEM IS BEING INSTALLED. CONTRACTOR SHALL MAKE A DAILY RECORD OF ALL WORK INSTALLED DURING EACH DAY. ACTUAL LOCATION OF VALVES AND ALL IRRIGATION AND DRAINAGE PIPING SHALL BE SHOWN ON THE PRINTS BY DIMENSIONS FROM EASILY IDENTIFIED PERMANENT FEATURES, SUCH AS BUILDINGS, CURBS, FENCES, WALKS OR PROPERTY LINES. DRAWINGS SHALL SHOW APPROVED MANUFACTURER'S NAME AND CATALOG NUMBER. THE DRAWINGS SHALL BE TO SCALE AND ALL INDICATIONS SHALL BE NEAT. ALL INFORMATION NOTED ON THE PRINT SHALL BE TRANSFERRED TO THE COPIES BY CONTRACTOR AND ALL INDICATIONS SHALL BE RECORDED IN A NEAT, ORDERLY WAY. THE RECORD COPIES SHALL BE TURNED OVER TO THE OWNER'S REPRESENTATIVE AT OR BEFORE FINAL ACCEPTANCE/APPROVAL OF THE PROJECT.

**GUARANTEE/FINAL ACCEPTANCE**

24. CONTRACTOR SHALL UNCONDITIONALLY GUARANTEE THE IRRIGATION SYSTEM FOR A PERIOD OF ONE YEAR FROM THE DATE OF FINAL ACCEPTANCE. MANUFACTURER WARRANTIES SHALL ONLY EXCEED THIS GUARANTEE AND CONTRACTOR SHALL BE LIABLE FOR REPAIRS/REPLACEMENT OF FAILED MATERIAL/WORKMANSHIP.

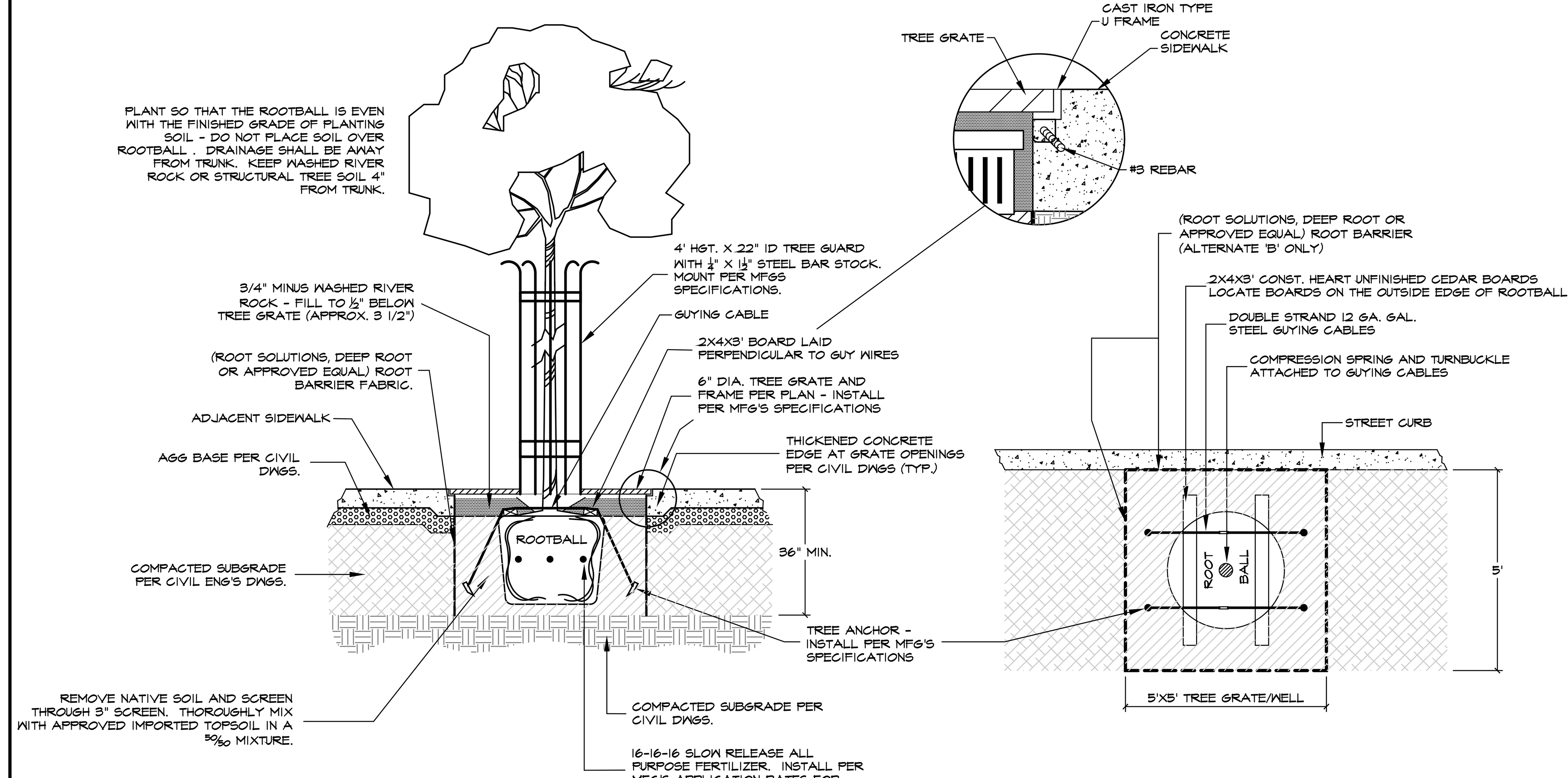
**MAINTENANCE**

25. AFTER SYSTEM IS INSTALLED AND APPROVED, INSTRUCT OWNER'S DESIGNATED PERSONNEL IN COMPLETE OPERATION AND MAINTENANCE PROCEDURES. DRAIN ENTIRE SYSTEM AT END OF FIRST WATERING SEASON FOLLOWING INSTALLATION. TRAIN OWNER'S DESIGNATED PERSONNEL BY HAVING THEM ASSIST IN WINTERIZING PROCEDURE.

NEENAH FOUNDARY "MAJESTIC COLLECTION"
- SERIES NO. R-8871, GRATE SIZE: 60" ROUND
- TREE OPENING SIZE: 16"
- SLOT SIZE: 0.25 INCHES
- WITH LIGHT OPENING: R-8871

## 1 TREE GRATE DETAIL

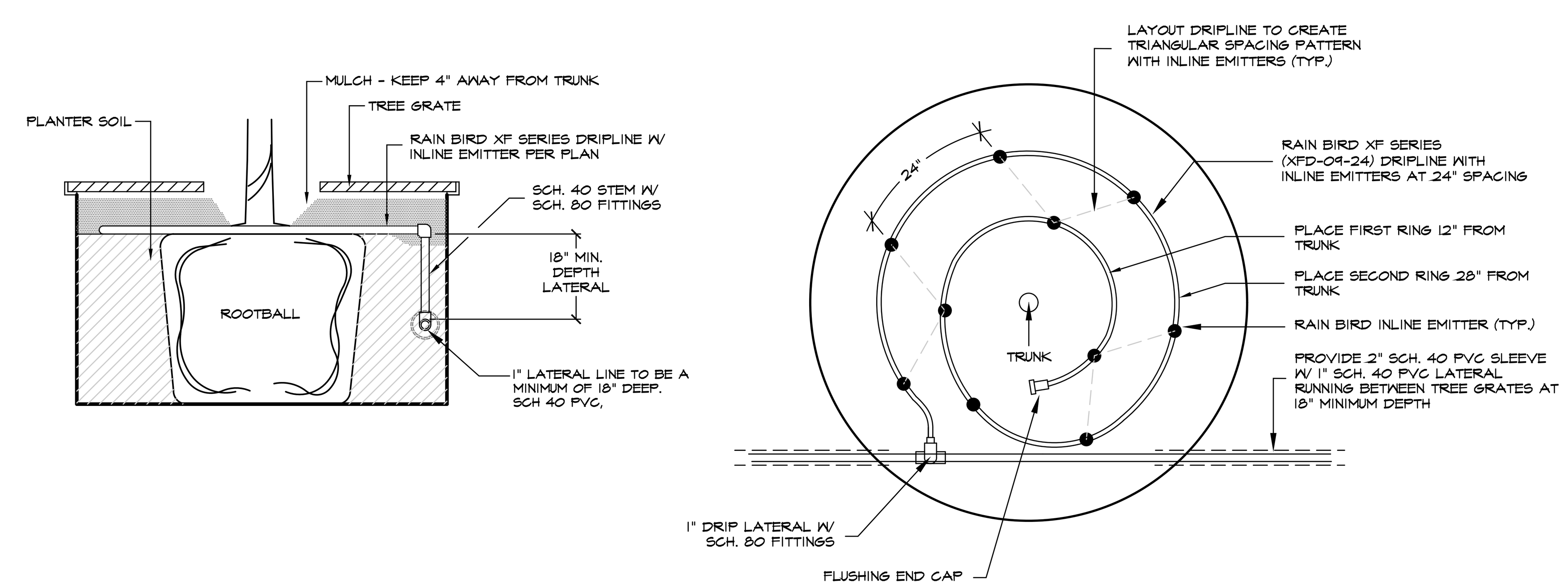
NOT TO SCALE




PLAN VIEW

## 2 TREE GRATE PLANTING DETAIL

NOT TO SCALE




## 3 TREE WELL IRRIGATION

NOT TO SCALE

PRELIMINARY SUP
NOT FOR CONSTRUCTION
12-16-2019


DYER ENGINEERING CONSULTANTS
9160 Double Diamond Pkwy, Ste. A
Reno, Nevada 89521 Phone: 1-775-852-1440

REGISTERED LANDSCAPE ARCHITECT
RYAN HANSEN
440
12/16/19
Expires: 6/30/20
STATE OF NEVADA

L.A. StudioNevada
the landscape architecture studio
1552 C Street Sparks, NV 89431 (775) 323-2223 NV RLA #440
www.lastudionevada.com




| NO. | DATE | INITIALS | DESCRIPTION |
|---|---|---|---|

REVISIONS

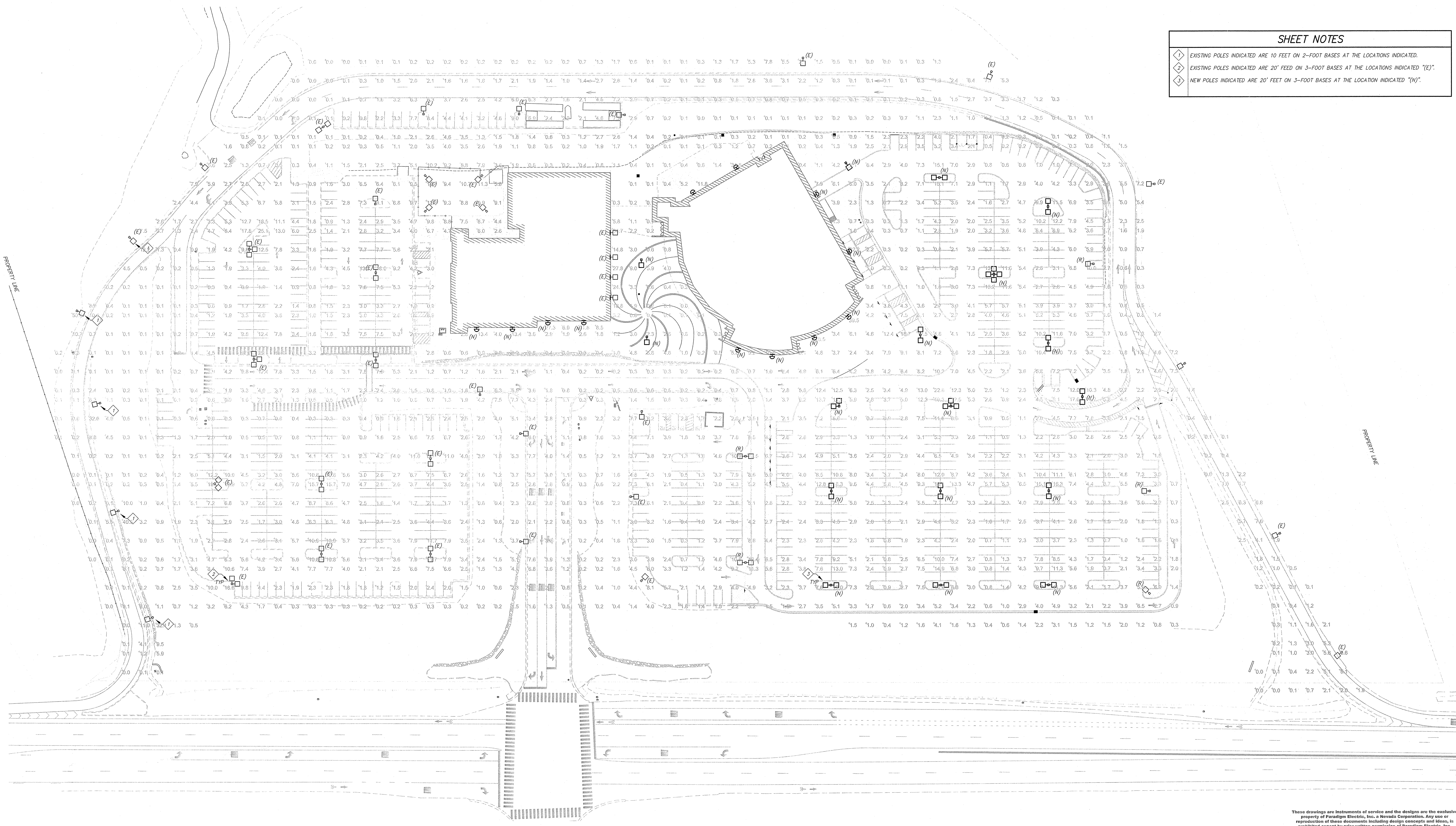
Nevada

SUMMIT CHRISTIAN CHURCH
Worship Center & Parking Expansion
Preliminary Landscape & Irrigation Details
7075 Pyramid Way
Sparks, NV 89436

| | |
|---|---|
| DESIGNED BY: | KRD |
| DRAWN BY: | KRD |
| CHECKED BY: | RWH |
| DATE: | 12/16/19 |
| JOB NO. | 679-504-06-19 |

L1

SHEET NO.
Landscape



## SHEET NOTES

1. EXISTING POLES INDICATED ARE 10 FEET ON 2–FOOT BASES AT THE LOCATIONS INDICATED.
2. EXISTING POLES INDICATED ARE 20' FEED ON 3–FOOT BASES AT THE LOCATIONS INDICATED "(E)".
3. NEW POLES INDICATED ARE 20' FEET ON 3–FOOT BASES AT THE LOCATION INDICATED "(N)".

A
E1.2
SITE LIGHTING & PHOTOMETRY PLAN
SCALE: 1" = 40'-0"

PRELIMINARY SUP
NOT FOR CONSTRUCTION
12-16-2019



**CONTRACTOR**

These plans are prepared and submitted by the contractor as an exemption to NRS 623.330 for work under the contract's license category authorized under NRS 624

Paradigm Electric, Inc.
Company Name
50247
Contractor License Number
Paradigm Electric, Inc
Plans Prepared By:

Mike Hall
(Please Print) Contractor Representative OR Master or Q.I. if Plumbing or Electrical and Number
Signature

# SUMMIT CHRISTIAN CHURCH
# PHASE 4.0 WORSHIP CENTER
7075 PYRAMID HIGHWAY
SPARKS, NEVADA 89434

J7·Architecture
Creating space. Inspiring people.
20361 Irvine Avenue, Studio B2
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PARADIGM ELECTRIC INC
521 vista blvd
sparks, nv 89431
Phone: 775.626.2828
Fax: 775.356.7575
NCL #50247
CCL #963493

PARADIGM ELECTRIC INC. ELECTRICAL CONTRACTOR NEV. LIC. #50247
12.16.19

| REV. | DESCRIPTION | DATE | REV. | DESCRIPTION | DATE |
|---|---|---|---|---|---|

SHEET TITLE:
SITE LIGHTING & PHOTOMETRIC PLAN

| | |
|---|---|
| JOB NAME: | SUMMIT 4.0 CHRISTIAN CHURCH WORSHIP CENTER |
| JOB NO.: | PEI-20-001 |
| DATE: | 12-16-19 |
| DRAWN BY: | PEI |
| CHECKED BY: | MH |
| FILE NAME: | |
| SHEET NO.: | E1.2 |