MASTER DRAINAGE STUDY
UPDATE #3
(RESPONSE TO CCRFCD COMMENTS)

Skye Canyon
City of Las Vegas, Nevada

Job No.: OLY1603.000
Date: November 2016

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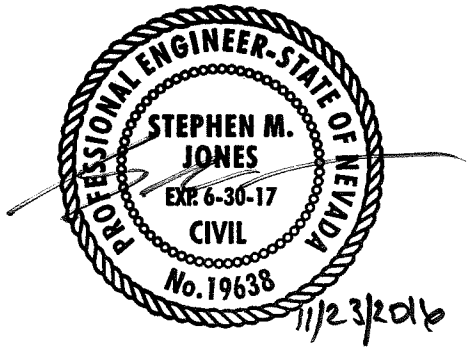


Steve Jones, P.E.
NV Professional Engineer No. 19638

Assisted by: Cameron Bencini, EI

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Skye Canyon Master Drainage Study (CCRFCD RTC) Date: November 2016

Location of Development: a) Descriptive (Cross Streets): North/South: Puli Road; East/West: Grand Teton Drive

b) Section: 12 Township: 19 South Range: 59 East

Section: 6, 7 Township: 19 South Range: 60 East

c) APN: 125-06-101-001; 125-06-401-001; 125-06-501-001; 125-06-701-001; 125-07-101-005; 125-07-201-001, 002, 003; 125-07-301-001, 002; 125-07-401-001, 002; 125-07-501-005; 125-07-602-001, 003, 004, 005; 126-12-000-001; 125-07-310-001, 002; 125-07-410-001

Name of Owner/Developer: KAG Development South, LLC; Section 12, LLC; MF Land, LLC; G Land, LLC; Northland, LLC; Eastland, LLC; East of 95, LLC

Telephone No.: 702-220-6565 Fax No.: 702-220-6566 E-mail Address: mbolduc@olympiacompanies.com

Address: 11411 Southern Highlands Parkway, Suite 300; Las Vegas, NV 89141

Contact Person – Name: Steve Jones, P.E. Telephone No.: 702-284-5300

*E-mail Address: sjones@shg-inc.com Fax No.: 702-284-5399

Firm: Slater Hanifan Group

Address: 5740 S. Arville Street, Suite 216; Las Vegas, NV 89118

Type of Land Development/Land Disturbance Process:

☐	Rezoning	☐	Subdivison Map	☐	Clearing and grading Only
☐	Parcel Map	☐	Planned Unit Development	☒	Other (Please specify below)
☐	Large Parcel Map	☐	Building Permit	☐	Master Drainage Study

1. Total Owned Land Area: At Site: 1,662 +/- Acres Being Developed/Disturbed: All

2. Is a portion or all of the subject property located in a FEMA Flood Hazard Area? ☐ Yes** ☒ No

3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☒ Yes** ☐ No

4. Proposed type of development (Residential, Commercial, Etc.): Residential, Commercial, Schools, Parks, Roadways, Gaming, etc.

5. Approximate upstream land area which drains to the subject site: 6.1 sq. miles +/-

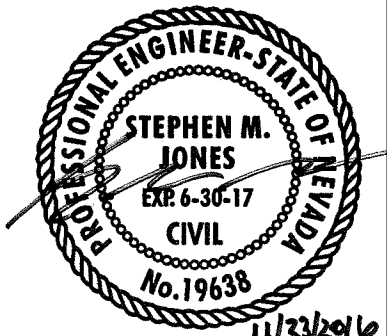
6. Has the site drainage been evaluated in the past? ☒ Yes** ☐ No If yes, please identify documentation:

Master Drainage Study, Update #1 & Update #2 for Kyle Canyon (SHG, DS4420)

Master Drainage Study for Kyle Canyon (GCW, DS4091)

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site:
Intersections of Log Cabin, O'Hare, Iron Mountain, Brent and Horse along Fort Apache Road
Log Cabin (New MPU Alignment) toward Floyd Lamb State Park
U.S. Highway 95 right-of-way

8. Briefly describe your proposed schedule for the subject project: N/A



Engineer's Seal 11/23/2016

Submit this form as part of the required drainage study to the local entity which has jurisdiction over The subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

*Newly Required Field

**Review and concurrence of the Clark County Regional Flood Control District is required

Revision	Date

Local Entity File No.

REFERENCE: ***SHG Job No. OLY1603.000***

STANDARD FORM 1

Updated 05/01/2008

SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS

OLY1603.000

November 23, 2016

Ching C. Wang, P.E.
Senior Civil Engineer
Clark County Regional Flood Control District
600 S. Grand Central Parkway, Suite 300
Las Vegas, Nevada 89106-4511

Subject: Response to CCRFCD Comments on Master Drainage Study Update #3 for Skye Canyon (DS4420) (RFCD#16-9733)

Dear Mr. Wang:

This letter is submitted in response to comments contained in the November 4, 2016 comment letter received from Clark County Regional Flood Control District (CCRFCD) regarding the above referenced project. A meeting was held on November 15, 2016 between SHG, CCRFCD, City of Las Vegas (CLV) and Olympia to discuss the comments and the project's future MPU impacts, and summary notes have been included in Appendix A. A copy of the CCRFCD comment letter is included in Appendix A for reference. The following comments have been individually addressed:

1. **Comment:** *The proposed facilities identified in this Master Drainage Study impacts the North and South Environmental Enhancement Area (Detention Basins). The Engineer slates that the peak outflow from the North Environmental Enhancement Area increases from 30 cfs to 80 cfs and the drain time increases from 2 days to 7 days. Provide a comparison between the existing and proposed condition design parameters of the detention basins. Provide pertinent design reference materials of the existing detention basins and provide calculations justifying that the proposed modifications meet District criteria and State Dam Safety requirements. Address permitting process for any modification to the detention basins. Address any impacts and mitigation measures.*

   Response: Record Sheet 9 – North Environmental Enhancement Area has been annotated with the new parameters resulting from this Master Drainage Study, and included in Appendix A. All design parameters have been reviewed and found to meet CCRFCD criteria. The additional pipe and increased orifice allows for the functionality of the outfall pipe to be in accordance with the design parameters of a non-pressurized outfall. Note that although the outflow increases to 80 cfs, the downstream improvements, including the erosion protection and receiving facilities at the discharge onto Silverstone Ranch were designed for a much larger peak flow rate of 676 cfs; therefore, minimal mitigation measures are necessary on the downstream property.

   The modification of proposing an additional outlet pipe and adjusting the orifice plate on the existing outlet pipe will require adjustment to the outlet structure for a dual barrel penetration. The specifications set forth in constructing the existing basin will be followed as necessary for trenching, backfill, seepage protection, etc. around the new outlet pipe. Additional requirements are also likely for performing these improvements without affecting

the functionality of the existing detention basin. Requirements for this future improvement will be outlined in the processing of the associated technical design plans.

It is anticipated that the work to complete the proposed modification will be performed within an existing public drainage easement dedicated to the City of Las Vegas; therefore, allowing acceptance of the proposed improvements. City of Las Vegas and CCRFCD will be the reviewing agencies of the proposed improvements. State Dam Safety may be contacted for the modification since the affected detention basin is larger than 20 acre-ft; however, it is assumed that Dam Safety will not be part of the permitting process because the basin is essentially below ground with no major embankment that would result in the State Engineer not having jurisdictional review for a change to the outlet pipe.

2. **Comment:** *Provide a detailed impact analysis to the Silverstone Ranch Golf Course in the interim and ultimate conditions based on the modifications proposed with the North Environment Enhancement Area. The analysis must be provided in this Master Drainage Study instead of deferring to the Master Plan Amendment.*

Response: The new MPU alignment and modification to the North Environmental Enhancement Area detention basin's outfall results in an increase in outflow through the Silverstone Golf Course from 30 cfs to 80 cfs, and an extended duration of discharge from 2 days to 7 days. The modification meets CCRFCD criteria, and downstream facilities are considered existing regional facilities that can withstand the extended discharge duration as shown through reference material in the previous submittals.

It is acknowledged that the additional drainage area routed through Silverstone due to this Master Study changes the storm for the watershed to a SDN4 distribution; therefore, a new HEC-1 model included on CD in Appendix E has been constructed to evaluate the impacts of the new storm distribution. Note this HEC-1 model (Ultimate4-Silverstone.OUT) has been constructed in a similar manner to the previous submittals, incorporating the onsite local subbasins merged with the regional subbasins for the offsite areas. Due to inspection of the flow rate within the MSNV alignment, the new SDN4 distribution results in a lower flow rate than currently shown in the MPU as summarized in the below table.

Impact Evaluation of Storm Distribution through Silverstone		
CCRFCD Regional Facility	**Current MPU Q_{100} (cfs) [Drainage Area (square miles)]**	**New SDN4 Watershed Q_{100} (cfs) [Drainage Area (square miles)]**
MSNV-0000 & 0005 *(Concentration Point CNW163-C)*	679 [1.67]	587 [11.25]
1 – Storm centered watershed is downstream of DB1, DB2 and 157DB.		

In order to show a conservative evaluation of the 50 cfs peak flow rate increase from the North Environmental Enhancement Area outfall due to this Master Study, the 50 cfs increase has been arithmetically added through the MSNV regional alignment for an impact analysis requested in the above comment. A normal depth Flowmaster section through the Silverstone existing regional channel shows a peak rate increase of 50 cfs results in insignificant impacts, including reference material that shows the existing culvert crossing at Grand Teton is not negatively impacted by the change. The above material is included in Appendix B.

At the location where flow through Silverstone is perpetuated downstream, the increase of 50 cfs at Grand Teton, is approximately 5% of the total peak flow rate in the system; therefore, the change in outflow becomes insignificant and not an adverse impact on the system. Per a November 15, 2016 meeting with CCRFCD and CLV, the impacts to the Silverstone property and other downstream properties and facilities are considered acceptable.

3. **Comment:** *Log Cabin Outfall/Exhibit K:*
   a. *Facility 52 (72" RCP) is identified as an "onsite CCRFCD Regional facility". The adjacent downstream facility, Facility 43, is identified as a "future CCRFCD Regional facility (By Others)". Facility 52 will be constructed with the Skye Canyon development and the flow will be discharged at a concentrated point and may impact the existing Floyd Lamb Park at Tule Springs. To ensure connectivity of the outfall pipe from the Log Cabin Detention Basin, Facility 43 must be constructed concurrently with Facility 52. Revise exhibits accordingly.*
   b. *Facility X22 is labeled as an "Existing CCRFCD Regional Facility". This is not identified as an existing Regional facility on the Master Plain Update (MPU). Clarify and revise description accordingly.*
   c. *Discuss the purpose of Facility D6. It appears that D6 will be diverting flow to the South Environmental Enhancement Area. Address impacts accordingly.*

Response:

a. Facility 52 is required to not adversely impact the State of Nevada Division of Lands property in Floyd Lamb Park from a long-term discharge out of DB3, and has been designated for a 100-year peak flow rate of 409 cfs totaled at Concentration Point 'CNW128'. Previous coordination with City of Las Vegas it was agreed that the long-term discharge to flow across City property, but improvements are necessary to not adversely impact the State land. Facility 52 has changed to a proposed local facility, per a November 15, 2016 meeting with CCRFCD and CLV, that outlet into existing ground that conveys the flow downstream to the North Environmental Enhancement Area. The regional facility alignment is now shown as the connection to Facility TSDB-0059. Therefore, Facility 43 is no longer necessary, as the current regional facility alignment is shown as the connection into the North Environmental Enhancement Area. a future improvement by others if necessary, since it traverses the City property and Skye Canyon is not adversely impacting it due to the previous agreement. A blow-up exhibit demonstrating flows and facility routing across Floyd Lamb Park from Durango to the North Environmental Enhancement Area has been included in Appendix C. Exhibit K has also been updated accordingly in Appendix H.
b. Facility X22 is an existing storm drain and due to the new regional alignment presented in this study, it will need to be amended in the future MPU Amendment to be designated a regional facility. No change to Exhibit K is necessary.
c. The peak flow rate diverted to the South Environmental Detention Basin by Facility D6 is in accordance with the current MPU hydrology. Note that the routing south of D6 in the MPU currently occurs at the intersection of Log Cabin and El Capitan, and this Master Drainage Study re-locates it to the intersection of Log Cabin and Durango. Per a November 15, 2016 meeting with CLV and CCRFCD, the facility has changed from an open channel to an underground storm drain, conceptual sizing included in Appendix C, maintained in the right-of-way of Durango. The diversion will connect into the existing RCB storm drain to be constructed by CLV Brent Lane storm drain improvements. Reference material has been included in Appendix C showing that this diversion is

feasible and no adverse impacts to the MPU hydrology impacting the South Environmental Enhancement Area. An updated Exhibit K showing the change to Facility D6 has been included in Appendix H.

4. **Comment:** *It is noted in the Engineer's response to comments that the construction of the Log Cabin Detention Basin (DB3) is proposed with the Skye Canyon development. However, DB3 is shown as a "future CCRFCD regional facilities (by others)". Verify and revise accordingly*

   Response: Facility 'DB3', as shown in this Master Drainage Study's ultimate condition or Exhibit K, has been changed to the orange color denoting that the regional facility will be constructed by the master developer in a cost sharing participation with the City of Las Vegas per the Skye Canyon Development Agreement.

5. **Comment:** *Based on District's discussion with City of Las Vegas, the limits of Log Cabin Detention Basin may increase in the ultimate condition. The Engineer must coordinate with City of Las Vegas for limits of Regional facilities in the ultimate condition.*

   Response: Per a November 15, 2016 meeting with CCRFCD and CLV it was agreed that the ultimate condition for Skye Canyon should remain as previously presented, which includes a 475 acre-ft detention basin along Log Cabin. It is acknowledged that the current regional alignment of Moccasin (MOSM facilities) may not occur in the future due to restrictions placed by the National Park Service. Therefore, the grading for the new Log Cabin regional detention basin will be constructed in manner that there will be an opportunity for expansion in case additional runoff is required to be directed to this facility. A concept of the preliminary grading for the detention basin and allowance for future expansion has been included in Appendix D for reference.

   Note that technical design of DB3 will address appropriate measures for future use, and this Master Study only presents a preliminary concept that was agreed to in the November 15, 2016 meeting with CCRFCD and CLV.

6. **Comment:** *There are three detention basins identified on the MPU along the west boundary of the Skye Canyon development (MOHUO186, MOST0060 and MOIR0098). This update eliminates the middle detention basin (MOSR0060) and the offsite flow is routed from the west to the north along a proposed trapezoidal channel to Detention Basin 2 (DB2 on Exhibit J). Address debris mitigation and sediment impacts to DB2. Provide a discussion regarding the capacity of the DB2 to accommodate the additional tributary area.*

   Response: This study being Update #3, the 3 detention basins along the west boundary were combined into the 2 detention basins as shown in this study by Update #1 that received CLV approval and CCRFCD concurrence in March 2015. Debris volume is provided in the total storage volume provided by DB2 as shown on this study's summary tables on Exhibits H and J, with a collector open channel provided to transfer the debris and sediment to the basin. The HEC-1 models and drainage maps previously provided show the accommodation of the tributary area to DB2. No change to the conceptual design of DB2 as it affects master plan hydrology is necessary.

   The future MPU Amendment for the project will address the reduction from 3 detention basins to 2, as described in Response to Comment No. 12.

7. **Comment:** *The project proposes multiple detention basins in series. Typically, detention basins designed in series have been found to be less efficient based on the District's experience. Address hydrologic models for multiple storm centering impacting the detention basins to ensure the downstream properties are properly flood protected. Discuss interim conditions during construction of Regional facilities.*

   Response: It is acknowledged that the multiple detention basins in series is inefficient; however, the master drainage plan of the multiple detention basins are necessary to accommodate the estimated additional 6 square miles of drainage area to a regional alignment that had not been planned to accept. It is believed that the basins in series minimizes the increase in flow downstream of the changed alignment. It is acknowledged that the result to the North Environmental Enhancement Area (outflow 80 cfs) is double detainment of runoff that has been detained upstream by DB3 (outflow 134 cfs); however, the HEC-1 models in this study show that CCRFCD criteria is met in all affected CCRFCD regional detention basins.

   The said inefficiency in the system results in only a net increase of 50 cfs (30 to 80 cfs) in peak flow rate conveyed in the existing facilities downstream of the North Environmental Detention Basin. The system that results in the 50 cfs outflow increase is considered the best alternative rather than expanding the DB3 facility that already may require significant additional expansion in the future to accommodate the Moccasin diversion, or increasing the outflow from the North Environmental Enhancement Area to be greater than DB3 outflow to an existing system that had planned for only 30 cfs.

   Note that it is assumed the double detainment is a primary reason for the long-term discharge increasing the outflow drain time from the North Environmental Enhancement Area to 7 days as indicated in Comments No. 1 and 2.

   It is acknowledged that a storm centered downstream of DB3 matches the current MPU hydrology to the North Environmental Enhancement Area. Therefore, review of storm centering for the watershed results in determining that the new DB3 along Log Cabin is the pertinent point of evaluating impacts on the hydrologic analysis previous presented. Since the watershed is entirely within the SDN3 storm distribution to the North Environmental Enhancement Area, the storm centering that results in the slightest DARF or highest flow rate is a storm centered over a drainage area downstream of Facilities DB1, DB2 and DB157. This storm centering reduces the drainage area to DB3 from 6.15 square miles to 2.51 square miles. An adjusted ultimate condition HEC-1 model for this storm centering has been included in Appendix E. A summary table replicating the results of the HEC-1, comparing the model addressing the entire watershed (all detention basins working in series) versus the model addressing the storm centering over the Skye Canyon development area and downstream has been provided below. The points in the table below are locations that one can make a conclusion that the storm centering model has no significant impact on the results previously presented.

Comparison of Ultimate Condition Flow Rates (Storm Centering Evaluation)		
Location	**Full Watershed Q_{100} (cfs) [Drainage Area (square miles)]**	**Storm Centered Watershed[1] Q_{100} (cfs) [Drainage Area (square miles)]**
WC43	1291 [2.18]	1303 [0.73]
WC44B	2079 [4.95]	1897 [1.31]
EC1	2355 [5.16]	2199 [1.52]
LOGDB	3269 [6.15]	3078 [2.50]
DB-OFF	134 [6.15]	101 [2.50]
CTULEDB	769 [7.50]	804 [3.86]
TULEDB	80 [7.50]	70 [3.86]
1 – Storm centered watershed is downstream of DB1, DB2 and 157DB.		

The above peak 100-year flow rates generated by a centered storm at all pertinent locations that would affect either facility sizing or detention basin sizing are either similar or less than the full watershed hydrologic model. Inspection of the outflow hydrographs from the detention basins meets CCRFCD criteria. It is acknowledged that the peak inflow rate to the North Environmental Enhancement Area (CTULEDB) is slightly larger; however, the increase is slight and the resulting performance parameters (lower peak water surface elevation, shorter discharge duration, etc.) are better than what occurs during the full watershed storm scenario. In conclusion, storm centering has no impact on the master drainage plan as presented in this study.

8. **Comment:** *For clarification, on Exhibits J & K, indicate on the legend description which facilities must be constructed by the Skye Canyon development and which facilities will be constructed by the Skye Canyon development with District funding contribution. Clarify the "future CCRFCD regional facilities (by others)" as it relates to funding responsibility*

Response: Exhibits J and K have been adjusted to show the proposed CCRFCD regional facilities east of Skye Village Road as color orange or constructed utilizing cost sharing between the developer and public funds, in accordance with the Skye Canyon Development Agreement with the City. The yellow color on the exhibits remains designated proposed regional facilities to be constructed by developer funding only. The magenta color remains designation for future regional facilities constructed by others through use of separate funding measures.

9. **Comment:** *The Skye Canyon Master Drainage Study Exhibits K and J do not match. Facilities at EC7 and EC8 are shown as "proposed local facilities" in Exhibit K and "onsite CCRFCD regional facilities" on Exhibit J. Additionally, facility linework is missing from one exhibit to the other along US95 at Eagle Canyon, along with CCP4.*

Response: Exhibits J and K have been updated to have facilities and their color identifier match between the two exhibits. Note that the facilities near EC7 and EC8, referred to in the comment, are identified as cost shared facilities.

10. **Comment:** *Exhibit J:*
    a. *It appears that Facility 9 traverses several parcels. Provide discussion on the chosen alignment and construction impacts to US-95.*
    b. *Exhibit J refers to Exhibit M for Future MPU Facility "MOKC", however exhibit M shows proposed conditions at the Bilbray Elementary School. Additionally, provide discussion on alignment of facility MOKC. Clarify and revise accordingly*
    c. *It does not appear that certain facilities have adequate capacity to convey the design flow or do not match table descriptions. For example, Facility 11, 12, 13a, and 13b are shown as 72" RCP conveying flows in excess of 2,500 cfs. Verify all facility capacity, summary tables and table descriptions and revise accordingly*

    Response:
    a. The alignment of Facility 9 is acknowledged. Coordination with the City and NDOT was performed by SHG to establish the ultimate regional alignment as it egresses from US-95. SHG provided that the alignment shown on Exhibit J is preferred by the developer presently with a 13-ft wide by 6-ft high RCB conceptual design, which would require the dedication of a future public drainage easement across the private property. However, to ensure no adverse impacts to US-95 in the event a drainage easement across private property is not available, SHG provided an alternative alignment that resulted in a 13-ft wide by 8-ft high RCB conceptual design that was contained to the existing NDOT right-of-way. The NDOT acceptance letter for this Master Drainage Study included in Appendix D, alludes to the 13-ft by 8-ft conceptual size requirement. Therefore, the Kyle Canyon Interchange project has identified that it will construct the 13-ft by 8-ft size under US-95 highway to optimize its flexibility in the future depending on the egress alignment. For conceptual purposes, this study's Exhibit J has maintained Facility 9 in its alignment and 13-ft by 6-ft size through the private owned property.
    b. The annotation referring to the exhibit that shows detail of the upstream regional alignment in SR-157 Kyle Canyon Road was mislabeled. Exhibit J has been updated to refer to Exhibit L which is re-included in this study for posterity.
    c. Exhibit J has been revised to show appropriate RCB sizes for the regional facility alignment in Log Cabin east of US-95.

11. **Comment:** *For clarification, provide exhibit(s) identifying which facilities will be constructed with each phase of the Skye Canyon development*

    Response: Exhibit O, included in Appendix H, has been prepared that shows which facilities are required to provide a shadow of protection for the current phases of the property. Note the facilities shown on this exhibit are taken from the ultimate condition as the facilities proposed by this development, regional and local, by way of developer only funding or cost sharing.

12. **Comment:** *This update to the Master Study will require an Amendment to the Master Plan. The District requests an annotated F-Map for all proposed facilities with the Skye Canyon development. Provide discussion on preliminary sizing calculation of proposed District facilities*

    Response: Exhibits J and K, included in Appendix H, have been labeled with the appropriate new and/or affected MPU branch for planning purposes as agreed to in the

November 15, 2016 meeting with CCRFCD. Any MPU reach label shown on the exhibit are those that are anticipated to be addressed in the future MPU Amendment.

The regional facilities within the influence of Skye Canyon no longer drain into the Moccasin alignment and the Las Vegas Wash; therefore, it is anticipated that significant re-naming of the regional alignments are anticipated in the future MPU Amendment. The primary conveyance corridor is now to Log Cabin and then to Tule Springs, as such the naming of regional facilities are proposed to be re-named with prefix 'LC' and 'TS'. Future coordination with CCRFCD is anticipated to allow for the current re-naming shown in this study.

13. **Comment:** *It is noted that several proposed pipes and concrete boxes have velocities in excess of 25 fps and over 44 fps. Per Section 802.2 of the District's Hydrologic Criteria and Drainage Design Manual (HCDDM), the maximum velocities in all storm drains shall be limited to 25 fps. Address impacts to joints, manholes, and junctions in the proposed storm drain facilities. It is noted the excessive velocities and specific site conditions for the Skye Canyon development relating to the proposed pipes and concrete boxes may require locking manhole covers or grated covers based on the HGL and the final grade of the project site. Note the Technical Drainage Studies for these developments should address the hydraulic in detail and provide any changes in design to meet the HCDDM*

Response: The potential for high velocities in storm drains are acknowledged due to the steep terrain in which exists across the property. Several techniques to control and protect against adverse erosive impacts to the conduits include sacrificial concrete, and each facility will be evaluated on a case-by-case basis during the technical design process. For the Master Drainage Study level, the facilities shown on the exhibits are effective in outlining the routing required to match hydrologic patterns.

14. **Comment:** *Address erosive potential at all outlets and earthen channels to ensure public safety and clarify rip rap calculations. For example, the summary report table for Open Channel 3 shows 8.83 fps but the rip rap sizing calculations shows 8.2 fps.*

Response: Individual technical studies that propose storm drain outlets and/or open channels for conveyance will address erosion potential as necessary to meet CCRFCD criteria. Note that Facility 'D3' was erroneously analyzed with the wrong flow rate, its location being in Sheep Mountain downstream of the cut-off from Detention Basin 1. An adjusted calculation for Facility 'D3' has been included in Appendix G.

The other earthen channel previously shown with an erosive velocity was Facility 'EC19'; however, that facility is no longer part of the Master Drainage Study and can be stricken.

15. **Comment:** *Clarify the flow direction of the existing concrete u-channel along the Bonita Vista alignment (above facility 42) on Exhibit K. Address impacts to the project site and downstream properties*

Response: Several high points and flow directions exist along the existing local concrete u-channel, and Exhibits I and K have been better detailed to represent the drainage patterns. A portion of the u-channel drains flows that combine into Facility 'X22'; therefore, this portion has been annotated as Facility 'XC6' with a design flow rate of 238 cfs. Note that due to the new hydrology, the total proposed and ultimate condition flow rate in the

downstream Facility 'X22' is less than the design flow rate of 'XC6' (at Concentration Point CNW129); therefore, no adverse impacts occur to downstream property. However, for completion, this Master Study shows a flow rate of 126 cfs for the 'XC6' or the entire flow generated by Subbasin NW129-C, which it is acknowledged portion of the 126 cfs does not reach XC6 and drains in a different local facility north of Log Cabin.

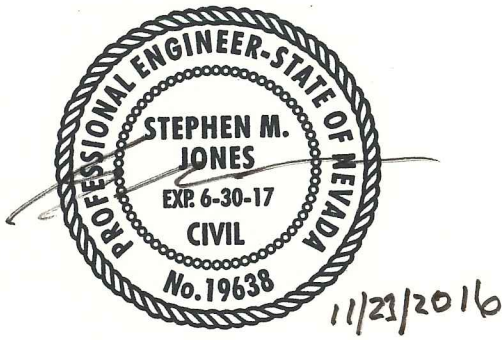
If you have any questions or require additional information, please do not hesitate to contact us at 284-5300.

Respectfully Submitted,

SLATER HANIFAN GROUP

Steve Jones, P.E.
Project Manager - Flood Control Division

cc: Jerry Slater, P.E. – SHG



11/21/2016

APPENDIX

Appendix A – Correspondence
- a) CCRFCD Comment Letter
- b) November 15, 2016 Meeting Notes

Appendix B – Response to Comments No. 1 & 2
(North Environmental DB & Downstream Property Impacts)
- a) Annotated North Environmental Enhancement Area Performance Parameters
- b) Impact Evaluation through Silverstone
- c) Pertinent MPU Maps

Appendix C – Response to Comment No. 3
(Floyd Lamb Park Facilities)
- a) Blow-Up Exhibit with Proposed Culvert Crossing
- b) Pertinent MPU Maps
- c) Reference Material – Brent Lane
- d) Facility D6 Storm Drain Sizing

Appendix D – Response to Comment No. 5
(Conceptual Grading for Detention Basin 3)

Appendix E – Response to Comments No. 2 & 7
(Storm Centering Ultimate Condition HEC-1 Model on CD)
- a) Full Watershed HEC-1 (Re-included from September 2016 Submittal)
- b) Storm Centering HEC-1
- c) Silverstone Impact Evaluation HEC-1

Appendix F – Response to Comment No. 10
(US-95 Coordination)
- a) Reference Material – Kyle Canyon Interchange Hydraulic Supplement
- b) NDOT Approval Letter
- c) Exhibit L (re-included with no change)

Appendix G – Response to Comment No. 14
(Facility D3 Channel Sizing)

Appendix H – Updated Drainage Exhibits
- a) Exhibit H – Proposed Condition Onsite Drainage Facilities Map
- b) Exhibit I – Proposed Condition Offsite East Drainage Facilities Map
- c) Exhibit J – Ultimate Condition Onsite Drainage Facilities Map
- d) Exhibit K – Ultimate Condition Offsite East Drainage Facilities Map
- e) Exhibit O – Shadow of Protection and Phasing Exhibit

APPENDIX A

Correspondence

CCRFCD Comment Letter

REGIONAL FLOOD CONTROL DISTRICT

Steven C. Parrish, P.E.
General Manager/Chief Engineer

BOARD OF DIRECTORS

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Chairman
Clark County

Debra March
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Mayor Allan Litman
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Dr. Lois Tarkanian
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Mayor Rodney Woodbury
City of Boulder City

November 4, 2016

Mr. Oh Sang Kwon, P.E.
City of Las Vegas Department of Public Works
333 North Rancho Drive
Las Vegas, NV 89106

DISTRICT COMMENT(S): **UPDATE # 3 - SKYE CANYON MASTER DRAINAGE STUDY (DS4420N) (RFCD No. 16-9733)**

Dear Mr. Kwon:

Clark County Regional Flood Control District (District) reviewed Technical Drainage Study dated April 14, 2016, and Supplement No. 1 dated August 15, 2016 for above-mentioned project as submitted by SLATER HANIFAN GROUP. In addition, District is in receipt of the Conditional Letter of Acceptance from City of Las Vegas Department of Public Works dated August 15, 2016.

District has the following comment(s):

1. The proposed facilities identified in this Master Drainage Study impacts the North and South Environmental Enhancement Area (Detention Basins). The Engineer states that the peak outflow from the North Environmental Enhancement Area increases from 30 cfs to 80 cfs and the drain time increases from 2 days to 7 days. Provide a comparison between the existing and proposed condition design parameters of the detention basins. Provide pertinent design reference materials of the existing detention basins and provide calculations justifying that the proposed modifications meet District criteria and State Dam Safety requirements. Address permitting process for any modification to the detention basins. Address any impacts and mitigation measures.

2. Provide a detailed impact analysis to the Silverstone Ranch Golf Course in the interim and ultimate conditions based on the modifications proposed with the North Environment Enhancement Area. The analysis must be provided in this Master Drainage Study instead of deferring to the Master Plan Amendment.

3. Log Cabin Outfall/Exhibit K:

    a. Facility 52 (72" RCP) is identified as an "onsite CCRFCD Regional facility". The adjacent downstream facility, Facility 43, is identified as a "future CCRFCD Regional facility (By Others)". Facility 52 will be constructed with the Skye Canyon development and the flow will be discharged at a concentrated point and may impact the existing Floyd Lamb Park at Tule Springs. To ensure connectivity of the outfall pipe from the Log Cabin

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Website: *http://www.regionalflood.org*

Detention Basin, Facility 43 must be constructed concurrently with Facility 52. Revise exhibits accordingly.

b. Facility X22 is labeled as an "Existing CCRFCD Regional Facility". This is not identified as an existing Regional facility on the Master Plain Update (MPU). Clarify and revise description accordingly.

c. Discuss the purpose of Facility D6. It appears that D6 will be diverting flow to the South Environmental Enhancement Area. Address impacts accordingly.

4. It is noted in the Engineer's response to comments that the construction of the Log Cabin Detention Basin (DB3) is proposed with the Skye Canyon development. However, DB3 is shown as a "future CCRFCD regional facilities (by others)". Verify and revise accordingly.

5. Based on District's discussion with City of Las Vegas, the limits of Log Cabin Detention Basin may increase in the ultimate condition. The Engineer must coordinate with City of Las Vegas for limits of Regional facilities in the ultimate condition.

6. There are three detention basins identified on the MPU along the west boundary of the Skye Canyon development (MOHU0186, MOST0060 and MOIR0098). This update eliminates the middle detention basin (MOSR0060) and the offsite flow is routed from the west to the north along a proposed trapezoidal channel to Detention Basin 2 (DB2 on Exhibit J). Address debris mitigation and sediment impacts to DB2. Provide a discussion regarding the capacity of the DB2 to accommodate the additional tributary area.

7. The project proposes multiple detention basins in series. Typically, detention basins designed in series have been found to be less efficient based on the District's experience. Address hydrologic models for multiple storm centering impacting the detention basins to ensure the downstream properties are properly flood protected. Discuss interim conditions during construction of Regional facilities.

8. For clarification, on Exhibits J & K, indicate on the legend description which facilities must be constructed by the Skye Canyon development and which facilities will be constructed by the Skye Canyon development with District funding contribution. Clarify the "future CCRFCD regional facilities (by others)" as it relates to funding responsibility.

9. The Skye Canyon Master Drainage Study Exhibits K and J do not match. Facilities at EC7 and EC8 are shown as "proposed local facilities" in Exhibit K and "onsite CCRFCD regional facilities" on Exhibit J. Additionally, facility linework is missing from one exhibit to the other along US95 at Eagle Canyon, along with CCP4.

REGIONAL FLOOD CONTROL DISTRICT

10. Exhibit J:

    a. It appears that Facility 9 traverses several parcels. Provide discussion on the chosen alignment and construction impacts to US-95.

    b. Exhibit J refers to Exhibit M for Future MPU Facility "MOKC", however exhibit M shows proposed conditions at the Bilbray Elementary School. Additionally, provide discussion on alignment of facility MOKC. Clarify and revise accordingly.

    c. It does not appear that certain facilities have adequate capacity to convey the design flow or do not match table descriptions. For example, Facility 11, 12, 13a, and 13b are shown as 72" RCP conveying flows in excess of 2,500 cfs. Verify all facility capacity, summary tables and table descriptions and revise accordingly.

11. For clarification, provide exhibit(s) identifying which facilities will be constructed with each phase of the Skye Canyon development.

12. This update to the Master Study will require an Amendment to the Master Plan. The District requests an annotated F-Map for all proposed facilities with the Skye Canyon development. Provide discussion on preliminary sizing calculation of proposed District facilities.

13. It is noted that several proposed pipes and concrete boxes have velocities in excess of 25 fps and over 44 fps. Per Section 802.2 of the District's Hydrologic Criteria and Drainage Design Manual (HCDDM), the maximum velocities in all storm drains shall be limited to 25 fps. Address impacts to joints, manholes, and junctions in the proposed storm drain facilities. It is noted the excessive velocities and specific site conditions for the Skye Canyon development relating to the proposed pipes and concrete boxes may require locking manhole covers or grated covers based on the HGL and the final grade of the project site. Note the Technical Drainage Studies for these developments should address the hydraulic in detail and provide any changes in design to meet the HCDDM.

14. Address erosive potential at all outlets and earthen channels to ensure public safety and clarify rip rap calculations. For example, the summary report table for Open Channel 3 shows 8.83 fps but the rip rap sizing calculations shows 8.2 fps.

15. Clarify the flow direction of the existing concrete u-channel along the Bonita Vista alignment (above facility 42) on Exhibit K. Address impacts to the project site and downstream properties.

REGIONAL FLOOD CONTROL DISTRICT

District's review of this project was limited to issues of Regional Flood Control Significance as defined in *Uniform Regulations for the Control of Drainage*.

The consultant must be advised to submit any revisions to the Technical Drainage Study and Improvement Plans to City of Las Vegas Department of Public Works for review/re-approval. District review of any such revisions will commence upon City of Las Vegas Department of Public Works' acceptance.

Please be aware that as additional information becomes available and/or restudies of Flood Insurance Studies are performed, information submitted by SLATER HANIFAN GROUP may be superseded. Compliance with regulatory elements and design standards specified in *Uniform Regulations for the Control of Drainage* does not imply a guarantee that properties will be free from flooding or flood damage.

The District, its officials, or employees assume no liability for information, data, or conclusions presented by consulting engineers. We, therefore, make no warranties, either expressed or implied, in conducting this review.

STEVEN C. PARRISH, P.E.
General Manager/Chief Engineer

BY:

Ching C. Wang, P.E.
Senior Civil Engineer

Abigail Mayrena, P.E., CFM
Principal Civil Engineer

AM:dd

c: Stephen M. Jones, P.E., Slater Hanifan Group

P:\Letters and Memos\Local Drainage\Land Development & Drainage\2016\L-16-9733comment doc

November 15, 2016 Meeting Notes

SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS

MEETING NOTES

Project Number: OLY1603.000
Project Name: Skye Canyon Master Drainage Study
Meeting Date: 11/15/2016
Meeting Location: CCRFCD – Large Conference Room
Meeting Topic: Skye Canyon Master Drainage Study Comments & MPU Impacts

Attendees:	*Organization:*
Abigail Mayrena	CCRFCD
Ching Wang	CCRFCD
Andrew Trelease	CCRFCD
Todd Myers	CCRFCD
Steve Parrish	CCRFCD
Oh Sang Kwon	CLV
Peter Jackson	CLV
Steve Jones	SHG
Jerry Slater	SHG
Bobby Williamson	Olympia
Marc Bolduc	Olympia

Meeting Notes:

Item:	*Discussion:*
1	***History & New MPU Concept*** – SHG discussed that in January 2016, it was agreed to a new MPU alignment by SHG, CLV and CCRFCD in Log Cabin due to the restrictions the National Park Service has placed on the former Moccasin alignment. SHG showed that in order to route the water into the new alignment, it requires 2 new detention basins, 1. Along Kyle Canyon Road (west of Skye Canyon) and 2. Along Log Cabin (east of Skye Canyon).
2	***Future Use of New Log Cabin Detention Basin*** – SHG continued that the developer would construct the Log Cabin detention basin for ultimate build-out of the MPU watershed presented in the Master Drainage Study assuming that the north US-95 diversion to Moccasin would continue in its current alignment and that CCRFCD and CLV would continue to pursue National Park Service approval for the use of Moccasin. CCRFCD noted concerns that the negotiations may not succeed with National Park Service, and SHG discussed that it is currently planning to construct the detention basin for its ultimate condition (minus north US-95 diversion and Moccasin flows) with a large height berm as far as east as feasible to impound the water, which will allow for future expansion in case the City and CCRFCD need additional volume for the Moccasin alignment's storm flows. CCRFCD and CLV agreed to the concept and request that SHG respond to CCRFCD Comment #5 regarding the future use of the basin in this manner by adjusting the facilities exhibit accordingly. CCRFCD added it would like further evidence from SHG that the Log Cabin detention basin functions during the Skye Canyon ultimate condition, meeting all CCRFCD criteria including evaluating if storm centering and efficiency of detention basins in series affects its function.
3	***Impacts to North Environmental Enhancement Area*** – SHG noted that the effects of the new MPU alignment has on this detention basin is a net increase in outflow from 30 to 80 cfs, with the additional volume sent to the basin mitigated by the addition of a new parallel 36-inch barrel to the current single 36-inch barrel outfall. It is noted that the discharge now lasts for 7 days out of the basin instead of the current 2 days, which CCRFCD notes as an impact. Although all parties do not prefer this result, it meets CCRFCD criteria, and it is noted that the facilities downstream are existing improved facilities and if the peak flow rate from the basin is only a net 50 cfs increase than the system can likely accommodate this change. SHG noted that CCRFCD and CLV should be aware that the system as presented by this Master Drainage Study's ultimate condition is now maximized and a reason to continue with assuming that the Moccasin regional alignment remains for the north US-95 diversion. As a result, CCRFCD will allow the above discussed in SHG's response to CCRFCD Comment #2.

Prepared By: Steve Jones, SHG

Please notify the preparer if you have any questions, concerns or additions to these minutes within 2 days. After 2 days the content of this document will be considered accurate and accepted as the final recordation.

Item:	Discussion:
4	***Storm Centering*** – CCRFCD noted that this study needs to prepare an evaluation of storm centering that SHG can justify shows worst case scenario to the new Log Cabin detention basin to show that it will function meeting CCRFCD criteria during the ultimate condition. SHG discussed that the ultimate condition HEC-1 model currently in the Master Drainage Study is inclusive of all detention basins in the watershed to the North Environmental Detention Basin to demonstrate the most conservative discharge timing impacts. SHG discussed that storm centering is minor for all onsite analyses due to its placement in the same storm distribution with or without storm centering, and that storm centering would only affect the results by 1 or 2 DARFs which is considered insignificant. CCRFCD discussed that in the response to CCRFCD Comment #7, it needs to review evidence of storm centering effects on demonstrating CCRFCD criteria in the regional detention basins.
5	***MPU Facilities Required in Floyd Lamb Park*** – It was discussed and agreed that the MPU ultimate alignment from Log Cabin to the North Environmental Enhancement Area should connect into the current planned alignment along its northeast corner. Therefore, use of the existing ditch through the park and required culvert (Master Study Facility 52 constructed by developer) to not adversely impact State Lands property are to be demonstrated as local facilities. Since the culvert is a local facility that discharges into the existing flow line and does not increase peak flow rate over through the park, it is not required to be extended into the North Environmental Enhancement Area. CCRFCD requests revision of the facility maps and evidence of flows through the park based on the above discussion in response to CCRFCD Comment #3a. SHG also discussed that the diversion ditch in Durango (Facility D6 constructed by the developer) is in accordance with the MPU and the contributing watershed to the South Environmental Enhancement Area. However, due to the amount of flow, CCRFCD noted that it should be labeled as a local facility. CLV also added that SHG is required to demonstrate how it will connect into the recently approved Brent Lane improvements and that the facility needs to be maintained in the right-of-way instead of encumbering the park property. SHG discussed it will respond to Comment #3c in the above manner.
6	***Facility Phasing*** – Although all parties are in agreement that demonstrating phasing at this point of time may be futile due to changing developer strategy, SHG discussed that it can provide a phasing and shadow of protection exhibit similar to previous Master Drainage Study in response to CCRFCD Comment #11.
7	***Future MPU Amendment Scope*** – SHG discussed that the scope of the future MPU Amendment for the Skye Canyon area will include the following and all parties were in agreement: • Reduce number onsite detention basins at its western property edge from 3 to 2. • Add detention basin along Kyle Canyon Road west of Skye Canyon. • Add detention basin along Log Cabin east of Skye Canyon. • Realign the regional alignment exiting the Skye Canyon property from Moccasin to Log Cabin. CCRFCD requested that response to CCRFCD Comment #12 includes outlining this scope and delivering preliminary labeling of new and/or modified regional alignments to be addressed with the future MPU Amendment.

Prepared By: Steve Jones, SHG

Please notify the preparer if you have any questions, concerns or additions to these minutes within 2 days. After 2 days the content of this document will be considered accurate and accepted as the final recordation.

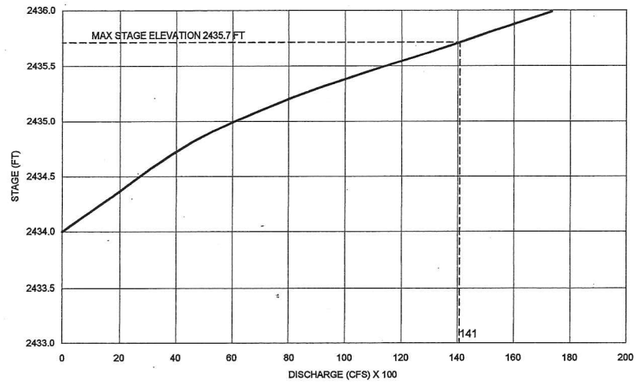
APPENDIX B

Response to Comments No. 1 & 2

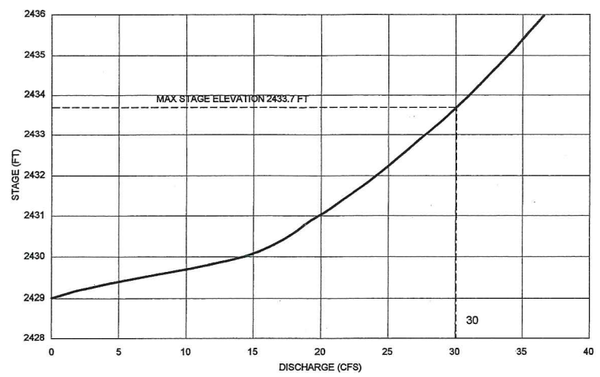
(North Environmental DB & Downstream Property Impacts)

Annotated North Environmental Enhancement Area Performance Parameters

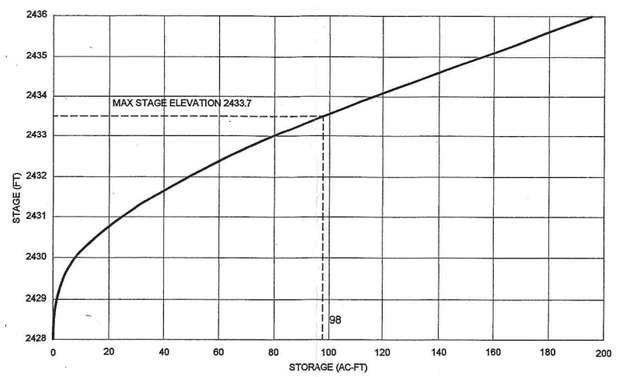
PMF STORM
EMERGENCY SPILLWAY RATING CURVE



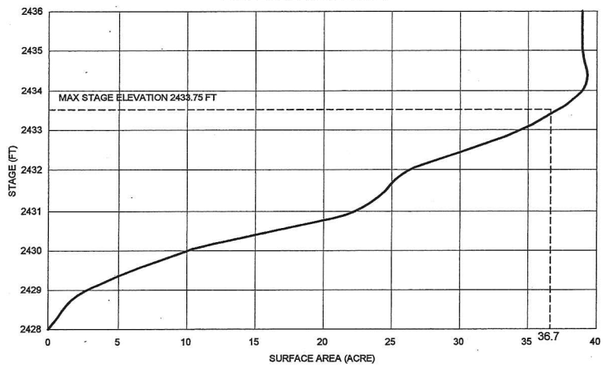
100-YR STORM
OUTLET PIPE RATING CURVE



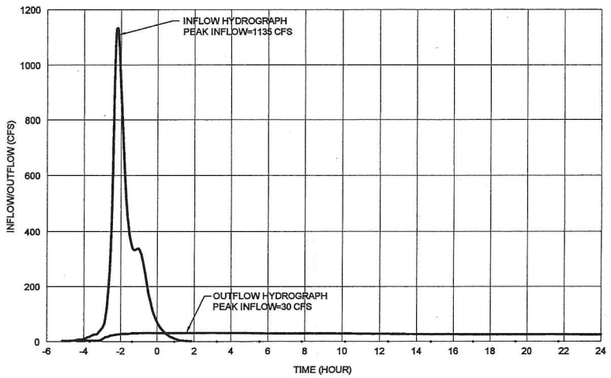
100-YR STORM
STAGE-STORAGE RELATIONSHIP



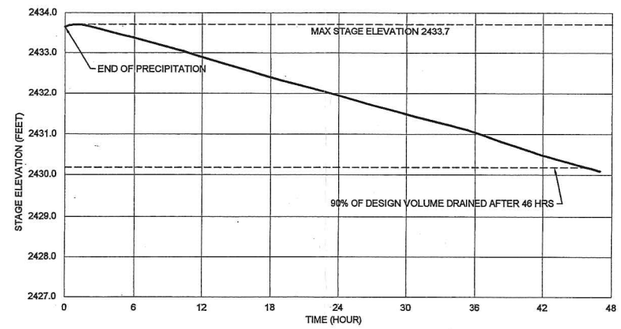
100-YR STORM
STAGE VS SURFACE AREA



100-YR STORM
INFLOW AND OUTFLOW HYDROGRAPHS



100-YEAR STORM
DRAIN TIME CURVE



NOTE: DRAIN TIME IS DEFINED AS THE TIME FROM THE END OF THE PRECIPITATION UNTIL THE BASIN IS DRAINED OF 90% OF DESIGN CAPACITY.

DETENTION BASIN DATA

100-YEAR SUMMARY

DESIGN CHARACTERISTIC	DESIGN PARAMETER
TRIBUTARY AREA	1.9 sq mi
PEAK INFLOW	1,135 cfs
PEAK OUTFLOW	30 cfs
ORIFICE DIAMETER	22 inches
OUTLET PIPE DIAMETER	36 inches
BASIN INVERT ELEVATION AT OUTLET	2,428.0 ft
PEAK STAGE ELEVATION	2,433.75 ft
OVERFLOW SPILLWAY ELEVATION	2,434.0 ft
MAXIMUM WATER DEPTH AT PEAK STAGE	5.75 ft
CLEAR WATER PEAK STORAGE	97.5 ac-ft
PEAK STORAGE WITH SEDIMENT	97.7 ac-ft
TIME TO DRAIN	46 hours
MAXIMUM SEDIMENT STORAGE	18.1 ac-ft

PMF SUMMARY

DESIGN CHARACTERISTIC	DESIGN PARAMETER
TRIBUTARY AREA	1.9 sq mi
PEAK INFLOW	14,518 cfs
PEAK OUTFLOW	14,138 cfs
SPILLWAY LENGTH	2,050 ft
SPILLWAY CREST ELEVATION	2,434.0 ft
PEAK STAGE ELEVATION	2,435.71 ft
PEAK CLEAR WATER STORAGE AT SPILLING CREST	115.4 ac-ft
DISCHARGE COEFFICIENT	3.0
PMF PEAK STORAGE	164 ac-ft

100-YEAR SUMMARY

Design Characteristic	Modified Design Parameter
Tributary Area	7.5 sq. mi.
Peak Inflow	769 cfs
Peak Outflow	80 cfs
Orifice Diameter	(2) 27-inch Round
Outlet Pipe Diameter	(2) 36-inch
Basin Invert Elevation at Outlet	2428.0-ft
Peak Stage Elevation	2433.78-ft
Overflow Spillway Elevation	2434.0-ft
Maximum Water Depth at Peak Stage	5.78-ft
Clear Water Peak Storage	109 acre-ft
Peak Storage with Sediment	109.2 acre-ft
Time to Drain	184 hours (7d-16h)
Maximum Sediment Storage	18.1 acre-ft

NO CHANGE TO PMF PARAMETERS DUE TO THIS MASTER STUDY; THIS MASTER STUDY ALTERS THE WATERSHED BY WAY OF DIVERSION; THEREFORE, NO INCREASE TO PMF BECAUSE IT WILL NOT REACH THIS BASIN NATURALLY.

NO	DATE	DESCRIPTION	BY

SCALE (H): AS SHOWN
SCALE (V): AS SHOWN
FIELD BOOK #:
DATE: 12/02/2009
WA #
DESIGN BY: FKR

THE Louis Berger Group, INC.
500 E. Amigo Court, Suite 100
Las Vegas, Nevada 89119
Voice: 702-736-6832
Fax: 702-736-0704

NORTH AND SOUTH ENVIRONMENTAL ENHANCEMENT AREAS AT FLOYD LAMB PARK

CITY OF LAS VEGAS NEVADA

DEPARTMENT OF PUBLIC WORKS

PROJECT TITLE:
NORTH AND SOUTH ENVIRONMENTAL ENHANCEMENT AREAS AT FLOYD LAMB PARK

SHEET:
NORTH ENVIRONMENTAL ENHANCEMENT AREA
HYDROLOGIC INFORMATION

PROFESSIONAL ENGINEER STATE OF NEVADA
SYDNEY E. STEELE
EXP. 12/31/11
CIVIL
No. 11070
12/1/09

SHEET: 9
9 OF 314

CLV DRAWING NO: 327V282

HTE#09-14377 H#12828

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Impact Evaluation thru Silverstone

MSNV Silverstone CCRFCD Ex. Channel (Current MPU Flow)
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Silverstone Golf CCRFCD Channel - Current MPU Flow
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.40	%
Left Side Slope	10.00	H : V
Right Side Slope	10.00	H : V
Bottom Width	100.00	ft
Discharge	679.00	cfs

SECTION PARAMETERS REFERENCED FROM MPU DESCRIPTION

Results		
Depth	1.54	ft
Flow Area	177.2	ft²
Wetted Perimeter	130.87	ft
Top Width	130.72	ft
Critical Depth	1.09	ft
Critical Slope	1.32	%
Velocity	3.83	ft/s
Velocity Head	0.23	ft
Specific Energy	1.76	ft
Froude Number	0.58	
Flow Type	Subcritical	

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Slater Hanifan Group
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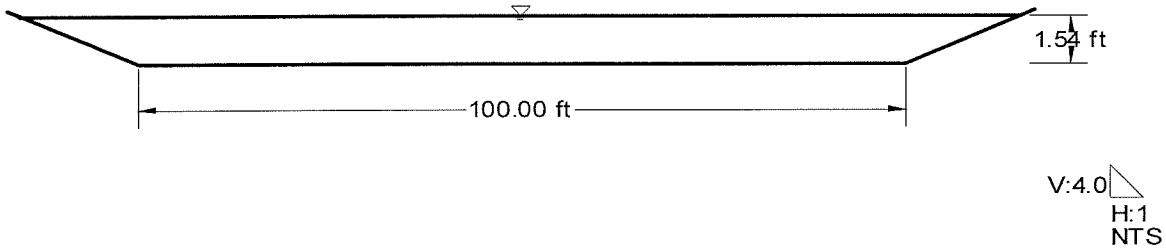
MSNV Silverstone CCRFCD Ex. Channel (Current MPU Flow)
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Silverstone Golf CCRFCD Channel - Current MPU Flow
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Channel Slope	0.40	%
Depth	1.54	ft
Left Side Slope	10.00	H : V
Right Side Slope	10.00	H : V
Bottom Width	100.00	ft
Discharge	679.00	cfs



MSNV Silverstone CCRFCD Ex. Channel (New Flow)
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Silverstone Golf CCRFCD Channel - New Flow
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.40	%
Left Side Slope	10.00	H : V
Right Side Slope	10.00	H : V
Bottom Width	100.00	ft
Discharge	729.00	cfs

GRASS

ASSUMES DIRECT ADDITION OF +50 cfs FROM NORTH ENVIRONMENTAL ENHANCEMENT AREA
(MPW FLOW 679 cfs + 50 cfs) = 729 cfs

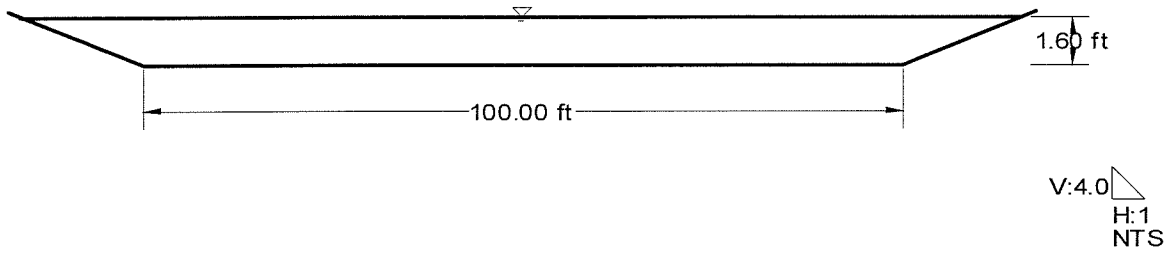
Results		
Depth	1.60	ft
Flow Area	185.6	ft²
Wetted Perimeter	132.16	ft
Top Width	132.00	ft
Critical Depth	1.14	ft
Critical Slope	1.30	%
Velocity	3.93	ft/s
Velocity Head	0.24	ft
Specific Energy	1.84	ft
Froude Number	0.58	
Flow Type	Subcritical	

INCREASE
DEPTH = +0.06'
VELOCITY = +0.1 FPS
⇒ INSIGNIFICANT, NO ADVERSE IMPACT.

MSNV Silverstone CCRFCD Ex. Channel (New Flow)
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Silverstone Golf CCRFCD Channel - New Flow
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

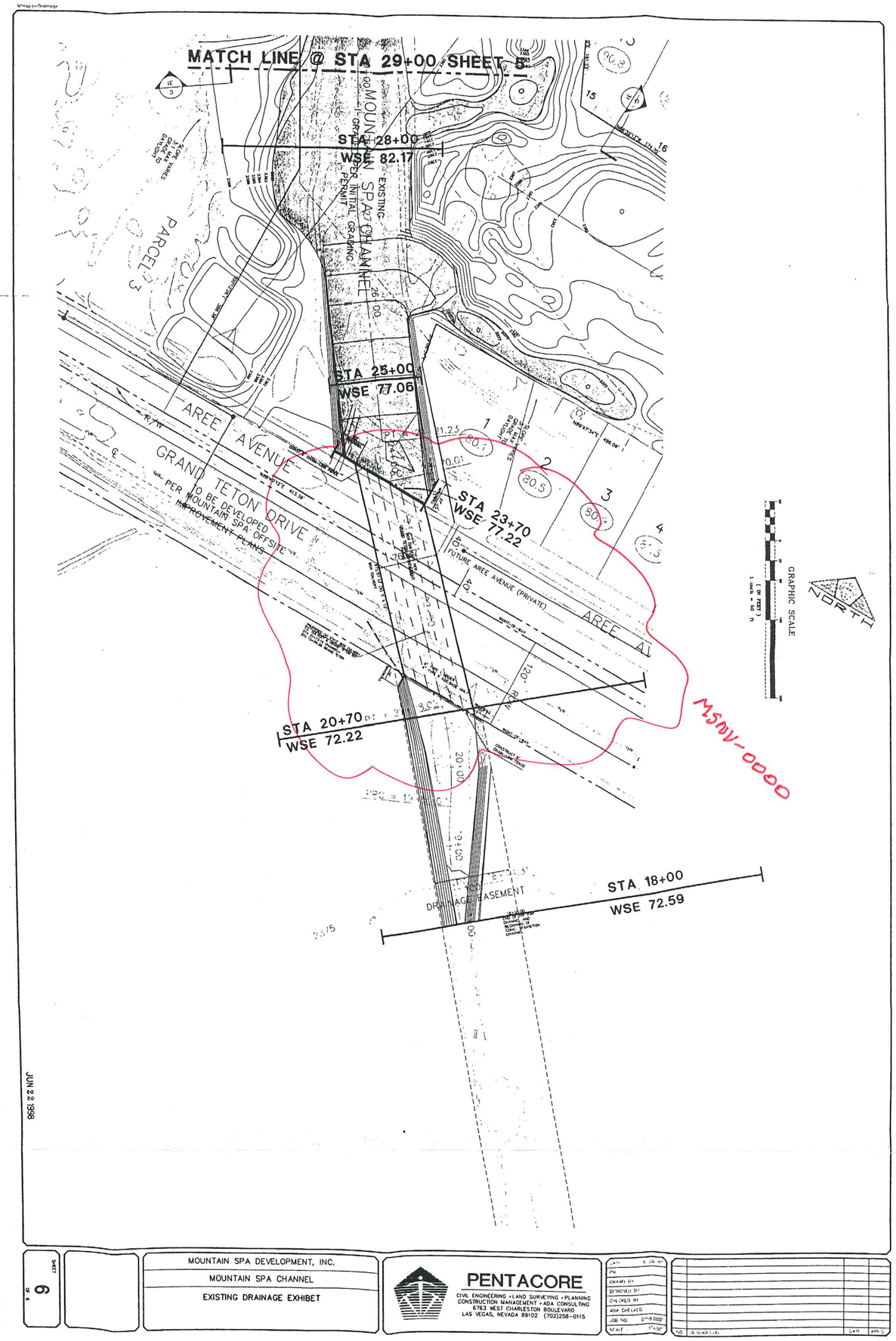
Section Data		
Mannings Coefficient	0.030	
Channel Slope	0.40	%
Depth	1.60	ft
Left Side Slope	10.00	H : V
Right Side Slope	10.00	H : V
Bottom Width	100.00	ft
Discharge	729.00	cfs



HEC-RAS Plan: Plan 31 River: channel Reach: channel

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
channel	9700	793.00	120.00	122.07	121.50	122.24	0.004360	3.31	239.77	187.61	0.51
channel	9500	793.00	119.00	121.06		121.35	0.005683	4.38	186.09	128.50	0.61
channel	9200	793.00	117.00	119.62		119.82	0.002913	3.60	223.08	117.75	0.45
channel	9000	793.00	116.00	119.37		119.43	0.000538	2.02	393.50	133.68	0.21
channel	8900	2195.00	116.00	119.26		119.36	0.000954	2.52	874.98	336.05	0.27
channel	8775	2195.00	115.00	118.15		118.92	0.007717	7.09	316.86	128.93	0.77
channel	8650	2195.00	114.00	117.41		118.02	0.005104	6.39	363.62	140.40	0.64
channel	8575	2741.00	114.00	117.60		117.73	0.001067	3.02	935.18	309.35	0.30
channel	8500	2741.00	113.00	116.96		117.52	0.003839	6.03	458.36	136.31	0.57
channel	8200	2741.00	112.00	115.76		116.31	0.003999	6.01	470.85	161.01	0.58
channel	8000	2741.00	110.00	115.50		115.78	0.001237	4.55	688.63	176.79	0.35
channel	7750	2741.00	109.00	113.91		114.93	0.007092	8.13	337.02	97.36	0.77
channel	7550	2751.00	107.00	113.84	110.60	114.20	0.001124	5.13	591.49	107.02	0.35
channel	7258	Culvert									
channel	7250	2751.00	105.50	109.81		110.88	0.005838	8.59	343.09	93.22	0.73
channel	7100	2751.00	105.00	109.29		110.03	0.004527	7.06	406.55	117.31	0.63
channel	7000	2751.00	105.00	109.49		109.65	0.001033	3.29	836.75	222.97	0.30
channel	6800	2751.00	104.00	107.86		109.06	0.011238	8.77	313.72	114.70	0.93
channel	6600	2751.00	102.00	106.66		107.29	0.003990	6.37	431.79	115.67	0.58
channel	6400	2751.00	101.00	105.95		106.47	0.003480	5.81	473.52	133.35	0.54
channel	6100	2751.00	100.00	104.05		105.01	0.007412	7.86	350.15	110.16	0.78
channel	5800	2751.00	98.00	101.54		102.23	0.005520	6.69	411.32	132.44	0.67
channel	4800	2751.00	92.00	96.26		96.79	0.008060	5.82	472.93	250.28	0.75
channel	4500	2760.00	91.00	93.56	93.56	94.77	0.013705	8.81	313.13	131.40	1.01
channel	4400	2760.00	90.00	93.26		93.46	0.001636	3.54	779.20	262.59	0.36
channel	4300	2760.00	89.00	92.62		93.17	0.004475	5.98	461.30	150.19	0.60
channel	4200	2766.00	88.00	92.11		92.59	0.004285	5.60	494.28	172.61	0.58
channel	4000	2766.00	87.00	90.53		91.42	0.007454	7.59	364.35	121.47	0.77
channel	3700	2766.00	85.00	88.79		89.36	0.004711	6.09	454.32	149.96	0.62
channel	3500	2766.00	84.00	87.39		88.22	0.007281	7.34	376.60	129.85	0.76
channel	3200	2766.00	82.00	85.47		86.14	0.005636	6.57	421.26	141.78	0.67
channel	3000	2979.00	80.00	84.01		84.92	0.007330	7.64	389.81	127.28	0.77
channel	2800	2979.00	79.00	82.17	82.17	83.31	0.013767	8.57	347.49	153.63	1.00
channel	2500	2979.00	73.00	77.06	75.94	77.76	0.004410	5.74	442.07	117.86	0.61
channel	2370	2979.00	70.91	77.22	73.71	77.48	0.000121	4.14	736.41	123.27	0.29
channel	2240	Culvert									
channel	2070	2979.00	69.90	72.22	72.99	75.00	0.004752	13.38	222.67	96.00	0.29
channel	1800	2979.00	68.66	72.59	72.59	74.32	0.001690	10.55	282.33	82.50	1.01

AS PREVIOUSLY INDICATED IN THIS STUDY, CULVERTS (MSNV-0000) DESIGNED PRE-NORTH ENVIRONMENTAL ENHANCEMENT AREA. +50 CFS FROM OUTFALL OF NORTH ENVIRONMENTAL BASIN INCREASES TO CURRENT FLOW OF 729 CFS THRU CULVERTS, FREE FLOWING & NO NEGATIVE IMPACT.



MOUNTAIN SPA DEVELOPMENT, INC.

MOUNTAIN SPA CHANNEL

EXISTING DRAINAGE EXHIBET

SHEET 9

PENTACORE

CIVIL ENGINEERING • LAND SURVEYING • PLANNING
CONSTRUCTION MANAGEMENT • ADA CONSULTING
6763 WEST CHARLESTON BOULEVARD
LAS VEGAS, NEVADA 89102 (702)258-0115

JUN 22 1998

L64000

Pertinent MPU Maps

REGIONAL FLOOD CONTROL DISTRICT

2013
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FIGURE F- 13
FLOOD CONTROL FACILITIES

LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin

- Stormdrain
- Lined Channel
- Unlined Channel
- Levee/Dike
- Natural Wash/Floodway
- ID-Mile Separator

Remove & Replace/Parallel Facilities

Category A	Category B
Channel	Channel
Stormdrain	Stormdrain

N

0 500 1,000 2,000 3,000
Feet

Scale: 1 inch = 2,000 feet

Refer to Figure G-2 for Aerial Source(s)

US95 I-15 I-215

	1	2	3						A1	A2		
	4	5	6						A3	A4		
		7	8	9	10				A5	A6		
11	12	13	14	15	16	17						
	18	19	20	21	22	23						
	24	25	26	27	28							
	29	30	31	32	33	34						
	35	36	37	38	39	40						
	41	42	43	44	45	46						
	47	48	49	50	51	52						
	53	54	55	56								
	57	58	59									

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
BCHU		BELTWAY CHANNEL - HUALAPAI						
0000	E	12' X 5' RCAP	853	501	CBA3-C	WEST3	0.84	1.11
0017	E	8' X 5' RCAP	1216	501	CBA3-C	WEST3	0.84	1.33
0040	E	66" RCP	60	222	DNW26-C	WEST3	0.51	1.04
0042	E	60" RCP	615	222	DNW26-C	WEST3	0.51	1.42
0054	E	54" RCP	770	222	DNW26-C	WEST3	0.51	1.23
BRDB		BRENT DRAINAGE SYSTEM						
0000	E	36" RCP with 18" Orifice Plate	2170	37	BRDB	WEST3	2.48	0.40
0031	E	45,080 cfs PMF Spillway		45080	CBRDB	WEST3	2.48	
0032	E	450 ac-ft South Environmental Enhancement Area		1902	CBRDB	WEST3	2.48	
0033	E	Energy Dissipator	100	957	CNW113-C	WEST3	1.58	
0043	P1	8' X 6' RCB	2920	957	CNW113-C	WEST3	1.58	2.10
0107	P1	8' X 6' RCB	2660	957	CNW113-C	WEST3	1.58	2.40
0157	P1	12' X 6' RCB	1260	741	CNW96-C	WEST3	0.95	0.25
CN95		CENTENNIAL PKWY CHANNEL WEST / U.S 95 BRANCH						
0000	P1	Conc Chnl 22'W 10'D 0:1 SS	2690	3340	CNWBB3-C	WEST3	3.36	2.17
0068	P1	3: 8' X 7' RCB	3380	3216	CNW103-C	WEST3	3.05	2.12
0102	P1	3: 8' X 6' RCB	1710	2888	2CNW89-C	WEST3	2.66	2.09
0167	P1	2: 10' X 6' RCB	1580	2160	2CNW71-E	WEST3	1.64	1.50
0199	E	2: 10' X 6' RCB	320	1423	2CNW72-C	WEST3	1.14	0.82
0218	E	15' X 9' RCB	1127	1423	2CNW72-C	WEST3	1.14	0.82
0257	E	Transition Structure	59	1423	2CNW72-C	WEST3	1.14	0.77
0259	E	15' X 9' RCB	290	653	CNW74-C	WEST3	0.44	0.77
0313	E	10' X 6' RCB	2680	653	CNW74-C	WEST3	0.44	2.50
0318	E	Transition Structure	60	653	CNW74-C	WEST3	0.44	1.50
0333	E	5' X 5' RCB	670	339	NW62-S	WEST3	0.22	1.50
CNGT		CENTENNIAL PKWY CHANNEL WEST / GRAND TETON BRANCH						
0000	E	10' X 5' RCB	2376	600	CNW71-E	WEST3	0.47	2.58
0043	P0	6' X 6' RCB	3980	600	CNW71-E	WEST3	0.47	3.00
0118	E	6' X 5' RCAP	5472	363	KYLEDET*	KYLEDB	57.73	3.72
CNKC		CENTENNIAL PKWY CHANNEL WEST / KYLE CANYON BRANCH						
0000	E	12' X 4' RCB	377	999	CNW72-C	WEST3	0.71	4.58
0007	E	10' X 5' RCB	874	999	CNW72-C	WEST3	0.71	3.28
0024	E	8' X 5' RCB	1385	999	CNW72-C	WEST3	0.71	2.40
0050	P0	84" RCP	2610	854	CNW72-C	WEST3	0.71	3.60
CNWE		CENTENNIAL PKWY CHANNEL WEST						
0150	E	Conc Chnl 40'W 9.5'D 0:1 SS	2279	4233	CNW3B3-C	WEST3	5.64	0.42
0173	E	3: 18' X 8' RCBC @ Torrey Pines	200	4233	CNW3B3-C	WEST3	5.64	0.42
0176	E	Conc Chnl 40'W 9'D 0:1 SS	150	4233	CNW3B3-C	WEST3	5.64	0.41
0189	E	Conc Chnl 36'W 10'D 0:1 SS	1200	4067	CNW2D4-C	WEST3	5.15	0.42
0200	E	Conc Chnl 36'W 9'D 0:1 SS	2470	4067	CNW2D4-C	WEST3	5.15	1.00
0226	E	2: 18' X 8.5' RCBC @ Rio Vista	100	4067	CNW2D4-C	WEST3	5.15	0.51
0241	E	Conc Chnl 36'W 9.5'D 0:1 SS	405	3951	CNW2D3-C	WEST3	4.65	0.51
0251	E	Conc Chnl 36'W 9'D 0:1 SS	575	3951	CNW2D3-C	WEST3	4.65	0.51
0271	E	Conc Chnl 32'W 10'D 0:1 SS	229	3951	CNW2D3-C	WEST3	4.65	0.51
0274	E	32' X 10' RCBC @ Tenaya	142	3951	CNW2D3-C	WEST3	4.65	0.51
0277	E	Conc Chnl 32'W 9'D 0:1 SS	579	3951	CNW2D3-C	WEST3	4.65	0.64
0287	E	Conc Chnl 13'W 10'D 2:1 SS	605	3593	CNW2B2-C	WEST3	3.84	1.19
0301	P2	Conc Chnl 32'W 10'D 0:1 SS	235	3593	CNW2B2-C	WEST3	3.84	1.19
0304	P2	32' X 10' RCB	3259	3593	CNW2B2-C	WEST3	3.84	1.79
0314	E	22' X 7' RCB	785	3593	CNW2B2-C	WEST3	3.84	1.79
0325	P1	32' X 10' RCB	2200	3593	CNW2B2-C	WEST3	3.84	1.75
EKBU		ELKHORN SPRINGS AND BUFFALO						
0000	E	60" RCP	1046	375	NW134-C	WEST3	0.46	1.00
EKDB		ELKHORN SPRINGS DETENTION BASIN						
0000	E	Grass Chnl 15'W 5.8'D 3.5:1 SS	2575	238	CNW150-C	WEST3	1.41	0.39
0025	E	4' X 3' RCB	160	120	ELKBASIN	WEST3	0.84	0.50
0026	E	48" RCP	1270	120	ELKBASIN	WEST3	0.84	1.23
0049	E	60" RCP	1095	120	ELKBASIN	WEST3	0.84	0.13
0070	E	48 ac-ft Elkhorn Springs Detention Basin		629	CNW133-C	WEST3	0.84	

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
EKHU		ELKHORN AND HUALAPAI						
0000	E	6' X 5' RCB Overflow Structure	48	638	CNW26-C	WEST3	0.51	0.91
0001	E	6' X 5' RCAP	72	638	CNW26-C	WEST3	0.51	0.91
0003	E	6' X 4' RCAP	980	638	CNW26-C	WEST3	0.51	3.61
0020	E	6' X 5' RCAP	150	638	CNW26-C	WEST3	0.51	3.61
0023	E	8' X 5' RCAP	1200	638	CNW26-C	WEST3	0.51	0.90
GOEC		GOWAN NORTH - EL CAPITAN BRANCH						
0176	P1	78" RCP	1320	363	CCPFR-C	ALLGOW3	0.46	1.15
GONO		GOWAN NORTH SYSTEM						
0511	P1	7' X 6' RCB	1320	546	CCPHW-C	ALLGOW3	0.60	1.14
LVMD		LAS VEGAS WASH - MIDDLE						
2490	E	2: 13' X 7' RCB	2555	2278	CNW168-C	CWEST3	4.69	0.40
2507	E	2: 13' X 9' RCB	2831	2278	CNW168-C	CWEST3	4.69	0.36
2525	E	24' X 8' RCB	1140	1913	CNW159-C	CWEST3	3.91	0.40
2550	E	24' X 8' RCB	1445	1664	CD161-C	CWEST3	3.41	0.40
2574	E	24' X 8' RCB	1430	1664	CD161-C	CWEST3	3.41	0.40
2599	E	Conc Chnl 24'W 7'D 2:1 SS	1577	1585	CNW162-C	CWEST3	3.08	0.50
2632	E	18' X 5' RCB	1580	968	CNW138-C	WEST3	1.16	0.46
2661	E	18' X 5' RCB	2640	968	CNW138-C	WEST3	1.16	0.46
2711	E	10' X 5' RCB	1320	968	CNW138-C	WEST3	1.16	1.54
2737	E	10' X 5' RCB	1320	818	CNW139-C	WEST3	0.93	2.22
2763	E	6' X 5' RCB	1320	818	CNW139-C	WEST3	0.93	1.79
2789	E	6' X 5' RCB	1470	818	CNW139-C	WEST3	0.93	2.17
MOHU		MOCCASIN - HUALAPAI BRANCH						
0000	P0	14' X 8' RCB	1920	761	2CNW45-N	LOWER3	2.10	0.50
0036	P0	10' X 8' RCB	2590	368	CNW45-N	LOWER3	1.15	0.50
0085	P0	72" RCP	790	368	CNW45-N	LOWER3	1.15	3.00
0100	P0	Natural Wash	850	65	DMODB1	LOWER3	0.81	3.00
0116	P0	60" RCPC	12	65	DMODB1	LOWER3	0.81	3.00
0118	P0	Natural Wash	3485	65	DMODB1	LOWER3	0.81	3.00
MOIR		MOCCASIN - IRON MOUNTAIN BRANCH						
0000	P0	66" RCP	2770	446	2CNW33-C	LOWER3	1.76	3.60
MOKC		MOCCASIN AND KYLE CANYON						
0000	P1	11' X 8' RCB	5450	2662	CNW35-C	LOWER3	2.69	3.40
MOSM		MOCCASIN AND SHEEP MOUNTAIN PARKWAY						
0000	P0	14' X 9' RCB	3370	3778	CNW64-C	LOWER3	5.32	2.40
0064	P0	14' X 8' RCB	880	3505	CNW50-C	LOWER3	4.99	3.00
0080	P0	14' X 8' RCB	710	3325	2CNW35-C	LOWER3	4.80	3.00
MSNV		MOUNTAIN SPA/VISTA RANCH						
0000	E	6: 12' X 5' RCBC @ Grand Teton	273	679	CNW163-C	CWEST3	1.67	0.40
0005	E	Grass Chnl 100'W 4.5'D 10:1 SS	6325	679	CNW163-C	CWEST3	1.67	0.40
0125	E	Grass Chnl 100'W 4.5'D 10:1 SS	1300	116	CNW147E	WEST3	1.54	0.40
RACO		RACEL STREET COLLECTOR						
0000	E	96" RCP Baffled Energy Dissipator	54	497	CNW111S	WEST3	0.55	4.20
0001	E	78" RCP	3245	497	CNW111S	WEST3	0.55	2.46
0064	E	78" RCP	2650	423	DNW111S	WEST3	0.44	2.09
RCBC		RANCHO ROAD SYSTEM - BELTWAY CHANNEL						
0000	E	6' X 5' RCB	1062	222	FADB	WEST3	1.60	1.04
0002	E	54" RCP Outlet with 41" Orifice	503	222	FADB	WEST3	1.60	2.38
0003	E	2,341 cfs PMF Spillway		2341	FADBIN	WEST3	1.60	
0004	E	76 ac-ft Fort Apache Detention Basin		1255	FADBIN	WEST3	1.60	
0007	E	Energy Dissipator	100	1255	FADBIN	WEST3	1.60	
0009	E	12' X 6' RCBC @ Fort Apache Detention Basin	133	1255	FADBIN	WEST3	1.60	1.79
0012	E	Conc Chnl 12'W 6'-7'D 0:1 SS	1937	1255	FADBIN	WEST3	1.60	3.15
0048	E	12' X 6' RCBC @ Grand Canyon	140	1040	CMNA1	WEST3	1.32	3.15
0051	E	Conc Chnl 12'W 6'-8'D 0:1 SS	2660	1040	CMNA1	WEST3	1.32	3.44
0096	E	1: 10' X 6' and 1: 6' X 6' RCBC @ Hualapai Way	190	1040	CMNA1	WEST3	1.32	1.93
0100	E	Conc Chnl 12'W 5.5'D 0:1 SS	2085	598	CDMNA1	WEST3	0.48	2.88
0140	E	Conc Chnl 10'W 5'D 0:1 SS	2155	598	CDMNA1	WEST3	0.48	1.65

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
RCHB		RANCHO ROAD SYSTEM - BELTWAY						
0034	E	Conc Chnl 21'W 8'D 0:1 SS	1000	2631	CNW1C-W	WEST3	4.68	1.19
0053	E	2: 12' X 8' RCBC @ South Ramp Connector	85	2304	CDW1C1	WEST3	4.31	1.40
0054	E	Conc Chnl 21'W 8'D 0:1 SS	432	2304	CDW1C1	WEST3	4.31	1.51
0062	E	Transition Structure	130	2304	CDW1C1	WEST3	4.31	1.51
0065	E	24' X 7' RCB	480	2304	CDW1C1	WEST3	4.31	0.30
0074	E	24' X 6' RCB	50	2226	CNWBC6-C	WEST3	4.17	0.30
0075	E	20' X 6' RCBC @ Beltway	428	2226	CNWBC6-C	WEST3	4.17	2.81
0083	P1	20' X 6' RCB	950	2226	CNWBC6-C	WEST3	4.17	2.49
0101	P1	Conc Chnl 20'W 7'D 0:1 SS	980	2226	CNWBC6-C	WEST3	4.17	2.38
0120	E	20' X 6' RCBC @ Grand Montecito	120	2226	CNWBC6-C	WEST3	4.17	1.00
0122	P1	Conc Chnl 16'-20'W 6'D 0:1 SS	350	2226	CNWBC6-C	WEST3	4.17	1.84
0130	P1	Conc Chnl 16'W 6'D 0:1 SS	1012	2226	CNWBC6-C	WEST3	4.17	2.67
0149	P1	Conc Chnl 16'W 6'-7'D 0:1 SS	87	1888	CNWBC3	WEST3	3.75	2.27
0151	P1	Conc Chnl 16'W 7'D 0:1 SS	1255	1888	CNWBC3	WEST3	3.75	2.65
0171	E	16' X 6' RCBC @ El Capitan Way	234	1888	CNWBC3	WEST3	3.75	1.75
0175	E	Conc Chnl 14'W 7'D 0:1 SS	1220	1888	CNWBC3	WEST3	3.75	2.93
0198	E	Conc Chnl 14'W 7'D 0:1 SS	225	1402	CNWBA6-C	WEST3	3.61	2.93
0227	E	12' X 6' RCB	1885	1402	CNWBA6-C	WEST3	3.61	1.02
0250	E	12' X 6' RCB	3200	1402	CNWBA6-C	WEST3	3.61	1.00
0275	P1	7' X 6' RCB	2650	973	CNW66-C	WEST3	1.75	3.30
0295	P1	7' X 6' RCB	2875	973	CNW66-C	WEST3	1.75	3.30
TSDB		TULE SPRINGS DRAINAGE SYSTEM						
0000	E	2: 10' X 4' RCBC @ Echo Grande	100	26	TULEDB	WEST3	1.35	1.04
0002	E	36" RCP with 22" Orifice Plate	320	26	TULEDB	WEST3	1.35	0.33
0010	E	14,013 cfs PMF Spillway		14013	CTULEDB	WEST3	1.35	
0011	E	117 ac-ft North Environmental Enhancement Area		804	CTULEDB	WEST3	1.35	
0012	E	Energy Dissipator	260	376	CNW148-C	WEST3	0.52	
0023	P1	84" RCP	1320	376	CNW148-C	WEST3	0.52	0.80
0059	P1	78" RCP	2640	376	CNW148-C	WEST3	0.52	1.03

SEE ANNOTATED SHEET 9 IN THIS APPENDIX FOR ADJUSTED PARAMETERS FOR TSDB-0002 & 0011.

⇒ MSNV FACILITIES EVALUATED FOR ADDITIONAL DRAINAGE AREA (HEC-1 'ULTIMATE4-SILVERSTONE') & YIELDED LESS FLOW THAN CURRENT MPU.

THEREFORE, +50 cfs arithmetically added to FLOWMASTER SECTIONS IN THIS APPENDIX.

@ LVMD-02599 ⇒ +50 cfs CONSIDERED INSIGNIFICANT (≈3% INCREASE PEAK TO PEAK); FUTURE MPU AMENDMENT MAY ADDRESS FURTHER, IF REQUIRED.

The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.

***As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.*

^*For parallel facilities, the existing facility flow equals its normal depth capacity, and the proposed parallel facility flow equals the remaining flow (i.e., HEC-1 Node flow = existing facility normal depth capacity + proposed parallel facility flow).*

REGIONAL FLOOD CONTROL DISTRICT

2013 LAS VEGAS VALLEY FLOOD CONTROL MASTER PLAN UPDATE

FACILITY INVENTORY FIGURE F - 13

LEGEND

ID (Facility Identifier) AABB
Parent Stream Name
Stream Name
River Mile 0000
Distance Above Confluence with Parent Stream (Miles)
Miles in Hundredths

Existing Facility.....E
Proposed or Modified Facility.....P
Contingency Level
Category B.....P0
Master Plan.....P1
Preliminary Design.....P2
Design.....P3

Bottom Width.....W
Depth.....D
Side Slope, H:V.....SS

Construction Features

Cast in Place Concrete Pipe.....CIPCP
Corrugated Metal Arch Pipe Culvert.....CMAP
Corrugated Metal Pipe Culvert.....CMPC
High Density Polyethylene.....HDPE
Horizontal Elliptical Reinforced Concrete Pipe.....HERCP
Reinforced Concrete Arch Pipe.....RCAP
Reinforced Concrete Arch Culvert.....RCAC
Reinforced Concrete Box.....RCB
Reinforced Concrete Box Culvert.....RCBC
Reinforced Concrete Pipe.....RCP
Reinforced Concrete Pipe Culvert.....RCPC
Storm Sewer Pipe.....SSP

APPENDIX C

Response to Comment No. 3

(Floyd Lamb Park Facilities)

Blowup Exhibit

EXISTING RCP STORM DRAIN
(REGIONAL CONNECTIVITY
OF DB3 OUTFALL)

G CABIN

DURANGO

ULT Q_{100} = 163 CFS
DESIGN Q_{100} = 413 CFS

ULT Q_{100} = 43 CFS
MPU Q_{100} = 187 CFS

ULTIMATE CONDITION
DIVERSION TO SOUTH ENVIRONMENTAL
ENHANCEMENT AREA
(IN ACCORDANCE WITH MPU HYDROLOGY)

APN 125-04-301-005
CITY OF LAS VEGAS

DAYLIGHT GRADING

PROP. CULVERT FOR
LONG-TERM DISCHARGE
CONVEYANCE MITIGATION FOR
STATE LAND IMPACTS

ULT Q_{100} = 409 CFS
(INCLUDES FLOW ROUTED
FROM LOG CABIN)

APN 125-04-701-002
STATE OF NEVADA DIV LANDS

DAYLIGHT GRADING

MPU Q_{100} = 376 CFS
(INCLUDES FLOW ROUTED
FROM LOG CABIN)

EXISTING NORTH
ENVIRONMENTAL
ENHANCEMENT AREA

APN 125-04-301-005
CITY OF LAS VEGAS

N

S-16

0 180 360
SCALE – 1"=180' FEET

NOTES:

BOTH POINTS OF DISCHARGE INTO NORTH ENVIRONMENTAL ENHANCEMENT AREA (LOCAL & MPU FACILITY) INCLUDE FLOW FROM LOG CABIN MPU ALIGNMENT. SINCE PEAK 100-YR FLOW INTO FLOYD LAMB PARK IS LESS THAN DESIGN, BOTH LOCAL & MPU FACILITIES ARE ADEQUATE WITHOUT MITIGATION BY SKYE CANYON. NO CHANGES TO THE INFLOW TO THE NORTH ENVIRONMENTAL ENHANCEMENT AREA IS REQUIRED

LEGEND

- PROPOSED LOCAL FACILITIES
- EXISTING LOCAL FACILITIES
- CCRFCD REGIONAL FACILITIES (BY OTHERS)
- EXISTING CCRFCD REGIONAL FACILITIES

EXHIBIT - FLOYD LAMB PARK FACILITIES

Pertinent MPU Maps

Flow Split from NW100-W had been anticipated to be routed through NW115-C south toward the South Environmental Enhancement Area Detention Basin. Proposed Facility D6 peak flow rate of 43 cfs is less than MPU designated peak flow rate of 187 cfs. Additionally, the additional runoff volume toward the South Detention Basin has been modeled and analyzed for impacts in the Ultimate Condition 'BRDB' model previously submitted showing no adverse impacts.

REGIONAL FLOOD CONTROL DISTRICT

2008
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FIGURE H- 8
HYDROLOGIC SUMMARY

LEGEND

- Ultimate Development Boundary
- Watershed Boundary
- Subbasin Boundary
- Drought Ordinance Boundary
- Flow Arrows

Flood Control Facilities

- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Category A Remove & Replace/ Parallel Facilities
- Category B Remove & Replace/ Parallel Facilities

Type Hydrologic Soil Groups

- A Low Runoff Potential
- B Moderately Low Runoff Potential
- C Moderately High Runoff Potential
- D High Runoff Potential/Rock Outcrops

Typical Land Use

- 1 Undeveloped Land, Open Desert
- 2 Parks, Golf Courses
- 3 Rural
- 4 / 14* Low Density Residential
- 5 / 15* Medium Density Residential
- 6 / 16* High Density Residential
- 7 / 17* Public Facility, Residential
- 8 / 18* Very High Density Residential
- 9 / 19* Commerical, Retail, Casino, High Rise Condominiums
- 10 / 20* Light Industrial
- 11 / 21* Heavy Industrial
- 12 / 22* Schools
- 13 Lakes

* Drought Ordinance Applied

N

0 500 1,000 2,000 3,000
Feet

Scale: 1 inch = 2,000 feet

Refer to Figure G-2 for Aerial Source(s)

US95 I-15 I-215

PBS&J PB

REGIONAL FLOOD CONTROL DISTRICT

2008
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FIGURE H- 13

HYDROLOGIC SUMMARY

LEGEND

- Ultimate Development Boundary
- Watershed Boundary
- Subbasin Boundary
- Drought Ordinance Boundary
- Flow Arrows

Flood Control Facilities

- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Category A Remove & Replace/ Parallel Facilities
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Type Hydrologic Soil Groups

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- 8 / 18* Very High Density Residential
- 9 / 19* Commerical, Retail, Casino, High Rise Condominiums
- 10 / 20* Light Industrial
- 11 / 21* Heavy Industrial
- 12 / 22* Schools
- 13 Lakes

* Drought Ordinance Applied

N

0 500 1,000 2,000 3,000
Feet

Scale: 1 inch = 2,000 feet

Refer to Figure G-2 for Aerial Source(s)

US95 I-15 I-215

1	2	3					
4	5	6					
	7	8	9	10			
11	12	13	14	15	16	17	
	18	19	20	21	22	23	
	24	25	26	27	28		
	29	30	31	32	33	34	
	35	36	37	38	39	40	
	41	42	43	44	45	46	
	47	48	49	50	51	52	
	53	54	55	56			
	57	58	59				

PBS&J PB

Reference Material – Brent Lane

50% DRAINAGE REPORT
Brent Lane Drainage System & Trail
(Durango Dr. to Floyd Lamb Detention Basin)

City of Las Vegas, Nevada

Job No.: CLV1401.000
Date: September 2014

Prepared By:
Slater Hanifan Group, Inc.
5740 S. Arville Street, Suite 216
Las Vegas, Nevada 89118
Phone: 702-284-5300 ▪ Fax: 702-284-5399

Prepared For:
City of Las Vegas
Department of Public Works
333 N. Rancho Drive
Las Vegas, Nevada 89106
Phone: 702-229-6276 ▪ Fax: 702-382-0848

9/8/14

Mark Failla, P.E.
NV Professional Engineer No. 14566

Assisted By: Andrew Howard, P.E.
Pavel Kontchakov, E.I.

ANTICIPATED TO BE ROUTED SOUTH TO SOUTH ENVIRONMENTAL DB. PROPOSED FACILITY DB. ROUTES LESS FLOW SOUTH. BASIN IS SMALL OK

LEGEND

- MPU BASIN BOUNDARY
- PROPOSED BASIN BOUNDARY
- PROJECT ALIGNMENT
- FUTURE ALIGNMENT
- ID — MPU BASIN ID
- ID — PROPOSED BASIN ID
- FLOW DIRECTION
- ID — CONCENTRATION POINT

N

0 500 1000
SCALE – 1"=500' FEET

KYLE CANYON ROAD
LOG CABIN WAY
OHARE ROAD
IRON MOUNTAIN ROAD
BRENT LANE
HORSE DRIVE
RACEL STREET
ACKERMAN AVENUE
GRAND CANYON DRIVE
PORT APACHE ROAD
EL CAPITAN WAY
HOMESTEAD ROAD
DURANGO DRIVE
TULE SPRINGS ROAD
U.S. 95

DLOGC 187CFS
DOHARE 61CFS
DIRONM 118CFS
DBRENT 176CFS

CP-A1
CP-A2
CP-B
CP-C
CP-D
CP-E
CP-F
CP-G

NW62-N
NW100-W
NW115-C
NW96-C
NW75-C
NW114-C
NW113-C
NW147W

BAS10U
BAS9U
BAS8U
BAS7U
BAS6U
BAS5U
BAS4U
BAS3U
BAS2U
BAS1U

EXISTING SOUTH ENVIRONMENTAL ENHANCEMENT AREA DETENTION BASIN BRDB 0032

Flow Rate Summary (Ultimate Condition)

Basin ID	Area (ac)	Q_{100} (cfs)
BAS1U	225.54	489
BAS2U	93.83	263
BAS3U	80.14	124
BAS4U	87.25	154
BAS5U	56.54	134
BAS6U	108.25	126
BAS7U	121.90	187
BAS8U	71.01	106
BAS9U	61.97	136
BAS10U	82.84	178

Concentration Points Summary (Ultimate Condition)

Concentration Point	Area (sq-mi)	Q_{100} (cfs)
CP-A1 *(DLOGC + BAS10U)*	0.58	380
CP-A2 *(DCBAS1D + BAS3U + CP-A1)*	0.70	515
CP-B *(DBAS4U + BAS4U + CP-A2)*	0.84	766
CP-C *(DBAS2U + BAS5U + CPB)*	1.07	1022
CP-D *NOT USED*	N/A	N/A
CP-E *(BAS7U + CP-C)*	1.26	1179
CP-F *(BAS6U + BAS8U)*	0.28	225
CP-G *(CP-E + CP-F)*	1.54	1353

SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS
5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118
PHONE (702) 284-5300 FAX (702) 284-5399

NO.	DESCRIPTION	DATE	BY	APP. DATE	APP.

CITY OF LAS VEGAS

BRENT LANE DRAINAGE SYSTEM & TRAIL
REGIONAL ANALYSIS - ULTIMATE CONDITION DRAINAGE MAP

DATE: SEPT. 2014
DRAFTER: AJH
DESIGNER: AJH
CHECKED: MJF

PROJECT NO.
CLV1401.000

EXHIBIT C
SHEET 1 OF 1

t:\clv\1401 – brent lane\drainage\50% submittal\figures\clv1401–000 exhibit c regional analysis – ultimate condition drainage map.dwg 9/2/2014 4:46 PM Andrew Howard

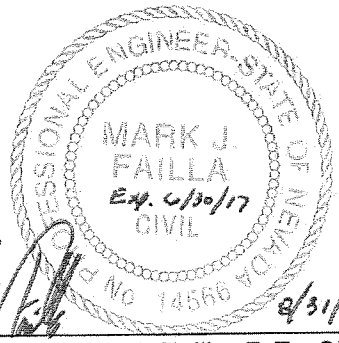
100% DRAINAGE REPORT
Brent Lane Drainage System & Trail
(Durango Dr. to Floyd Lamb Detention Basin)

City of Las Vegas, Nevada

Job No.: CLV1401.000
Date: August 2015

Prepared By:
Slater Hanifan Group, Inc.
5740 S. Arville Street, Suite 216
Las Vegas, Nevada 89118
Phone: 702-284-5300 ▪ Fax: 702-284-5399

Prepared For:
City of Las Vegas
Department of Public Works
333 N. Rancho Drive
Las Vegas, Nevada 89106
Phone: 702-229-6276 ▪ Fax: 702-382-0848



8/31/15

Mark Failla, P.E., CFM
NV Professional Engineer No. 14566

Assisted By: Andrew Howard, P.E.
Eric Mata, E.I

DEPARTMENT OF PUBLIC WORKS

Mayor:
CAROLYN G. GOODMAN

City Council:
STEVEN D. ROSS (Mayor Pro-tem)
STAVROS S. ANTHONY
LOIS TARKANIAN
RICKI Y. BARLOW
BOB COFFIN
BOB BEERS

City Manager:
ELIZABETH N. FRETWELL

Director of Public Works:
DAVID N. BOWERS, P.E., P.T.O.E.

City Engineer:
ALLEN E. PAVELKA, P.E.

BRENT LANE DRAINAGE SYSTEM & TRAIL

Funded By:
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
SOUTHERN NEVADA PUBLIC LAND MANAGEMENT ACT
STATE DIVISION OF PARKS RECREATIONAL TRAIL PROGRAMS GRANT

Reviewed By:

CLV CITY ENGINEER — DATE

CLV PROJECT MANAGER — DATE

CLV CITY TRAFFIC ENGINEER — DATE

CLV CONSTRUCTION MANAGER — DATE

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT — DATE

CLARK COUNTY PUBLIC WORKS — DATE

SOUTHWEST GAS CORPORATION — DATE

CENTRAL TELEPHONE COMPANY d/b/a CENTURYLINK — DATE
THE AFFIXED CENTURYLINK NEVADA APPROVAL DOES NOT ASSUME OR GUARANTEE LIABILITY FOR KNOWN OR UNKNOWN CONFLICTS WITH EXISTING OR PROPOSED IMPROVEMENTS. RESOLUTION OF ANY CONFLICT WILL BE ACCOMPLISHED PURSUANT TO LOCAL ORDINANCES, NEVADA REVISED STATUTES AND/OR PUBLIC UTILITY COMMISSION STANDARD REGULATIONS.

COX COMMUNICATIONS LAS VEGAS, INC. — DATE

NV ENERGY – DISTRIBUTION — DATE
NV ENERGY ACKNOWLEDGES THAT WE HAVE RECEIVED YOUR PLANS AND WILL PROVIDE SERVICE TO ALL ELECTRICAL NEEDS ASSOCIATED WITH THIS PROJECT. NV ENERGY RESERVES THE RIGHT TO ADDRESS ANY EXISTING OR FUTURE CONFLICTS ONCE THE FINAL DESIGN IS COMPLETED. THE NEW SERVICE AND THE RESOLUTION OF ANY CONFLICTS WILL BE ACCOMPLISHED PURSUANT TO THE NEVADA PUBLIC UTILITY COMMISSION'S RULES AND REGULATIONS.

NV ENERGY - TRANSMISSION — DATE

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# 123165
SHEETS: CV, GN-01, GN-02, RD-01, SD-06, SD-08, SD-09, GR-04

THE SIGNATURE ABOVE ACKNOWLEDGES THAT THE UTILITY COMPANY REPRESENTATIVE HAS REVIEWED THE PLANS, AND THAT TO THE BEST OF HIS OR HER KNOWLEDGE THE UTILITY LINES ARE SHOWN IN THE CORRECT LOCATIONS AND ARE THE CORRECT SIZES. WHILE SUCH DATA HAS BEEN COLLECTED WITH REASONABLE CARE, THERE IS NO EXPRESSED OR IMPLIED GUARANTEE THAT THE LOCATIONS ARE EXACT. THE CONTRACTOR SHALL BEAR THE RESPONSIBILITY OF OBTAINING THE ACTUAL FIELD LOCATIONS.

THE SIGNATURE ABOVE FURTHER ACKNOWLEDGES THAT THE UTILITY COMPANY DOES NOT ANTICIPATE CONSTRUCTION OR MAINTENANCE IN THE PROJECT AREA FOR FIVE (5) YEARS IN CONFORMANCE WITH THE CLV NO-CUT POLICY.

REVISIONS | NO. | DATE

PREPARED BY
SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS
9740 S. ARVILLE STREET #216, LAS VEGAS, NV 89119
PHONE (702) 384-4300 FAX (702) 384-4339

PREPARED FOR
CITY OF LAS VEGAS
H# 49876
DATE: AUGUST 2016
SUBMITTAL STAGE:
BID# 16-49876
DESIGNED BY: DAM
DRAWN BY: DAM
CHECKED BY: JSR/MJF

TITLE
BRENT LANE DRAINAGE SYSTEM & TRAIL

SHEET
COVER SHEET

PROFESSIONAL ENGINEER – STATE OF NEVADA
MARK J. FAILLA
Exp. 06/30/2017
CIVIL
No. 14566

SHEET
CV
1 OF 64
DRAWING NO.

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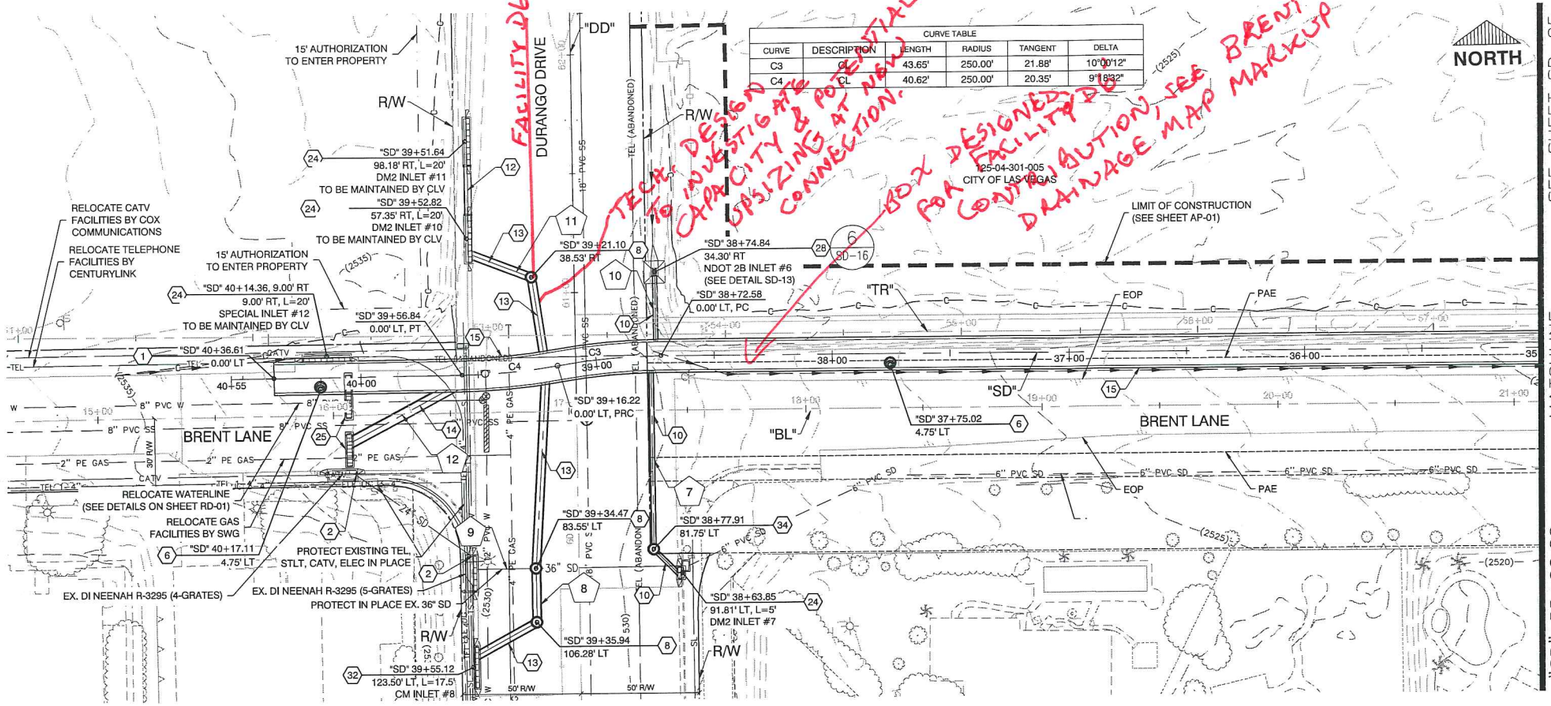
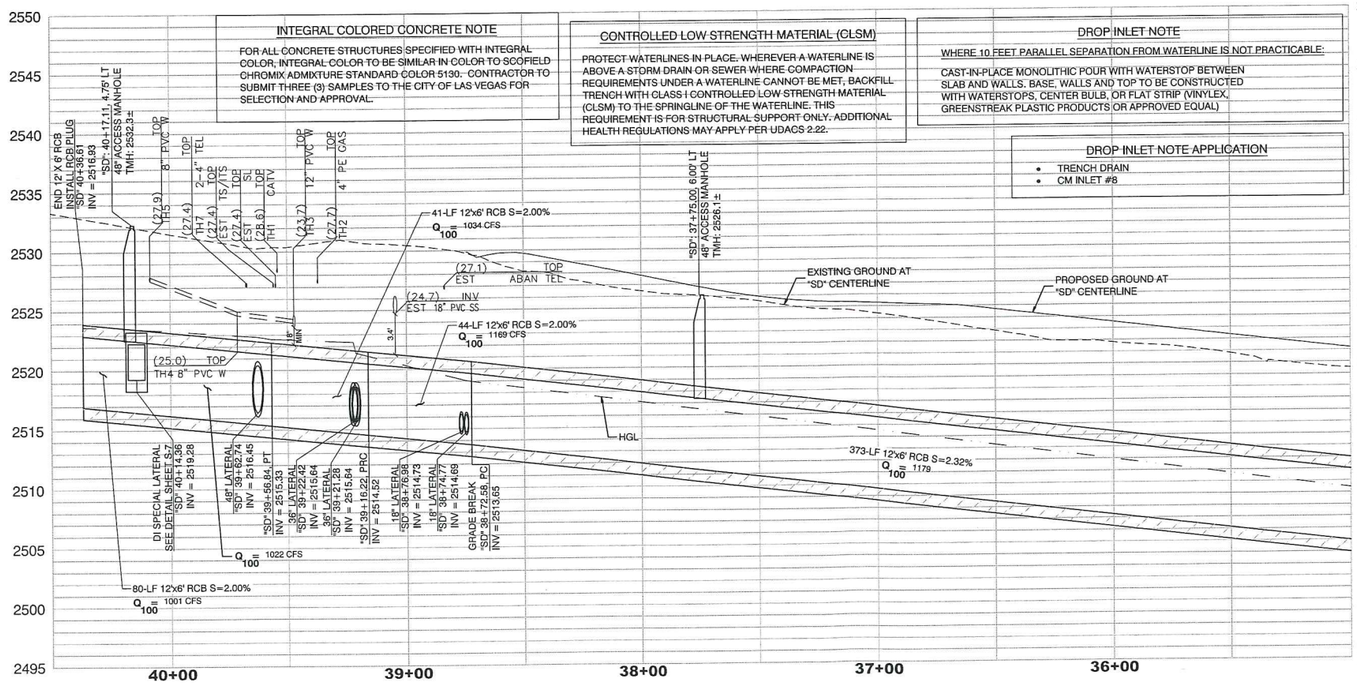


CURVE TABLE					
CURVE	DESCRIPTION	LENGTH	RADIUS	TANGENT	DELTA
C3	CL	43.65'	250.00'	21.88'	10°00'12"
C4	CL	40.62'	250.00'	20.35'	9°18'32"



GRAPHIC SCALE

30 0 15 30 60

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION NOTES

1. CONSTRUCT RCB PLUG (SEE DETAIL 3, SHEET S-1)
2. CONSTRUCT STORM DRAIN PIPE PLUG (SEE DETAIL 4, SHEET S-1)
3. CONSTRUCT INTEGRAL COLORED CONCRETE CHANNEL TRANSITION AND HEADWALL (SEE DETAIL SHEET S-5)
4. CONSTRUCT 12' WIDE INTEGRAL COLORED CONCRETE CHANNEL ACCESS RAMP (SEE DETAIL 2, SHEET SD-14 AND DETAIL 1, SHEET S-8)
5. CONSTRUCT INTEGRAL COLORED CONCRETE FLUME (SEE DETAIL 1, SHEET SD-14)
6. CONSTRUCT 48" RCB ACCESS MANHOLE (SEE DETAIL 6, SHEET S-1)
7. INSTALL 42" RCP
8. CONSTRUCT 60" TYPE III MANHOLE (USDCCA STD. DWG. NO. 406.1)
9. CONSTRUCT 12' WIDE 6" INTEGRAL COLORED CONCRETE OVER 6" TYPE II AGGREGATE BASE CHANNEL ACCESS RAMP (SEE SHEET GR-01) ("SD" 12+11.00, 20.00' LT TO "SD" 12+11.00, 57.90' LT)
10. INSTALL 18" RCP
11. INSTALL 24" RCP
12. INSTALL 30" RCP
13. INSTALL 36" RCP
14. INSTALL 48" RCP
15. CONSTRUCT 12' X 6' RCB (SEE DETAILS SHEET S-3)
16. CONSTRUCT 20' X 7' RCB (SEE DETAILS SHEET S-3)
17. CONSTRUCT 6" INTEGRAL COLORED CONCRETE PAD OVER 4" TYPE II AGGREGATE BASE WITH CUTOFF WALLS (SEE DETAIL SHEET S-6)
18. CONSTRUCT RESET RIPRAP LINED TRAPEZOIDAL CHANNEL W/40' BOTTOM WIDTH, EXISTING TOPS OF BANK TO REMAIN. (SEE SHEET SD-11 FOR LIMITS OF PARTIALLY GROUTED RIPRAP) (SEE SHEET SD-12 FOR PARTIALLY GROUTED RIPRAP DETAIL)
19. CONSTRUCT INTEGRAL COLORED CONCRETE HEADWALL (SEE SHEET S-6)
20. RESET STOCKPILED RIPRAP AS IDENTIFIED ON NOTE 7 OF SHEET DR-02
21. INSTALL ACCESS LADDER (SEE DETAIL 4, SHEET S-2)
22. INSTALL METAL GRATE (SEE DETAIL SHEET S-10)
23. CONSTRUCT SPECIAL DROP INLET W/ CONCRETE APRON (SEE DETAILS ON SHEET SD-13, SHEET S-9)
24. CONSTRUCT TYPE "DM2" DROP INLET (USDCCA STD. DWG. NO. 412.1)
25. CONSTRUCT TRENCH DRAIN (SEE DETAIL SHEET S-7)
26. CONSTRUCT 12' WIDE x 7' DEEP INTEGRAL COLORED CONCRETE LINED TRAPEZOIDAL CHANNEL (SEE DETAIL SHEET S-3)
27. INSTALL 12' WIDE 6" TYPE II MAINTENANCE ROAD
28. CONSTRUCT NDOT TYPE 2B DROP INLET (NDOT STD. DWG. R-4.2.2) W/ CONCRETE APRON (NDOT STD. DWG. R-4.2.7) (SEE DETAIL SHEET SD-13)
29. CONSTRUCT 12' WIDE 6" TYPE II CHANNEL ACCESS RAMP (SEE SHEET GR-1) ("SD" 12+11.00, 57.90' LT TO "SD" 12+58.41, 122.28' LT)
30. CONSTRUCT 4' DEEP BY 1' THICK CONCRETE CUTOFF WALL
31. CONSTRUCT 6" INTEGRAL COLORED CONCRETE PAD OVER 4" TYPE II AGGREGATE BASE
32. CONSTRUCT TYPE "CM" DROP INLET, INSIDE WIDTH = 1'-8" (USDCCA STD. DWG. NO. 422)
33. CONSTRUCT INTEGRAL COLORED CONCRETE CHANNEL TRANSITION AND HEADWALL (SEE DETAIL SHEET S-4)
34. CONSTRUCT 48" TYPE I MANHOLE (USDCCA STD. DWG. NO. 403.1)
35. CONSTRUCT EARTHEN/RIPRAP LINED BERM (SEE SECTION F, SHEET SD-10)

NOTES

1. ALL PIPE LENGTHS MEASURED ALONG PIPE CENTERLINE TO CENTER OF MANHOLE OR GRADE BREAK OR TO INSIDE EDGE OF DI, RCB, OR STRUCTURE.
2. ALL DROP INLETS AND CONCRETE APRONS SHALL INCLUDE STORM WATER MANAGEMENT STAMP AND DETAIL PER USDCCA STD. DWG. NO. 421.
3. ALL STORM DRAIN SHALL BE CLASS III UNLESS OTHERWISE NOTED.
4. NV ENERGY, CENTURYLINK TELEPHONE, AND SOUTHWEST GAS SHOWN FOR INFORMATIONAL ONLY. REFERENCE NV ENERGY, CENTURYLINK TELEPHONE, AND SOUTHWEST GAS DRAWINGS FOR CONSTRUCTION DETAILS. CONTRACTOR TO COORDINATE WITH UTILITIES FOR REMOVAL AND INSTALLATION OF FACILITIES.
5. ALL EXISTING UTILITY LOCATIONS SHOW HEREON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO DETERMINE THE EXACT VERTICAL AND HORIZONTAL LOCATION OF ALL EXISTING UNDERGROUND UTILITIES PRIOR TO COMMENCING CONSTRUCTION. NO REPRESENTATION IS MADE THAT ALL UTILITIES ARE SHOWN HEREON. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR UTILITIES NOT SHOWN IN THEIR PROPER LOCATION. THE DEPTH BELOW GRADE OF THE VARIOUS UTILITIES DEPICTED ON THE PLANS VARIES THROUGHOUT THE PROJECT AREA. THE CONTRACTOR SHALL EXERCISE EXTREME CARE WHERE EXCAVATING AND GRADING THE SUBBASE IN THE VICINITY OF UTILITIES TO AVOID DAMAGE TO THE LATTER.
6. ALL EXISTING UTILITIES SHALL BE PROTECTED IN PLACE UNLESS OTHERWISE NOTED.
7. SEE SC-01 FOR RCB AND CHANNEL GEOMETRY.

LATERAL RUN PROFILE INDEX

LATERAL RUN NO	SEE SHEETS
X	SD-07 THRU SD-09

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER

DATE: PROJECT# 123165

NO.	DATE	REVISIONS

PREPARED BY:
SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS
5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118
PHONE (702) 284-5300 FAX (702) 284-5399

PREPARED FOR: CITY OF LAS VEGAS

BID# 16-49876
H# 49876
DESIGNED BY: DAM
DRAWN BY: SPC/DAM
CHECKED BY: JSR/MJF
DATE: AUGUST 2016
SUBMITTAL STAGE:

TITLE: BRENT LANE DRAINAGE SYSTEM & TRAIL

SHEET: STORM DRAIN PLAN AND PROFILE "SD" 35+00.00 TO "SD" 40+55.00

PROFESSIONAL ENGINEER, STATE OF NEVADA
MARK J. FAILLA
Exp. 06/30/2017
CIVIL
No. 14568

SHEET SD-06
15 OF 64
DRAWING NO.

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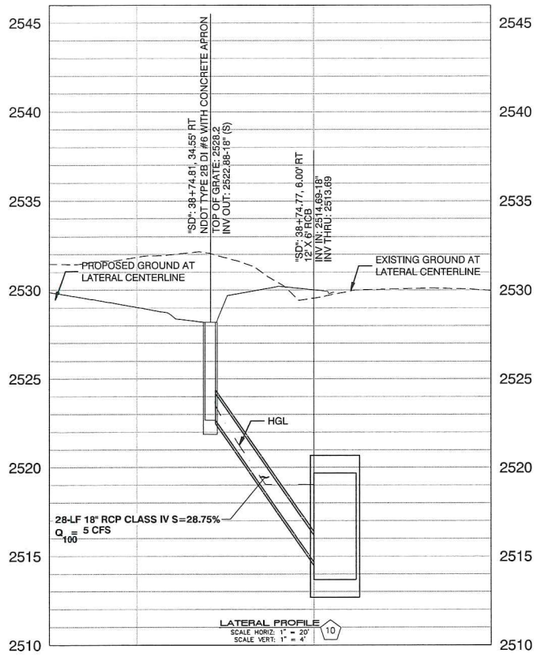

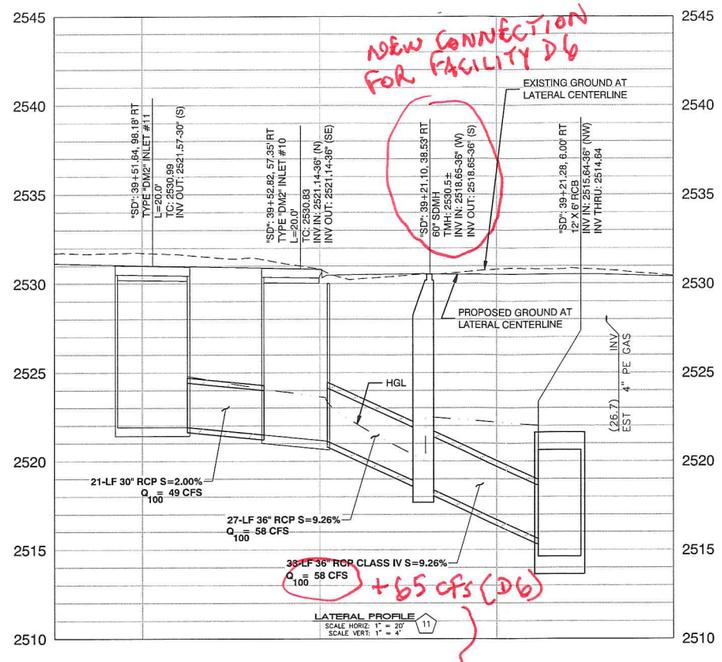

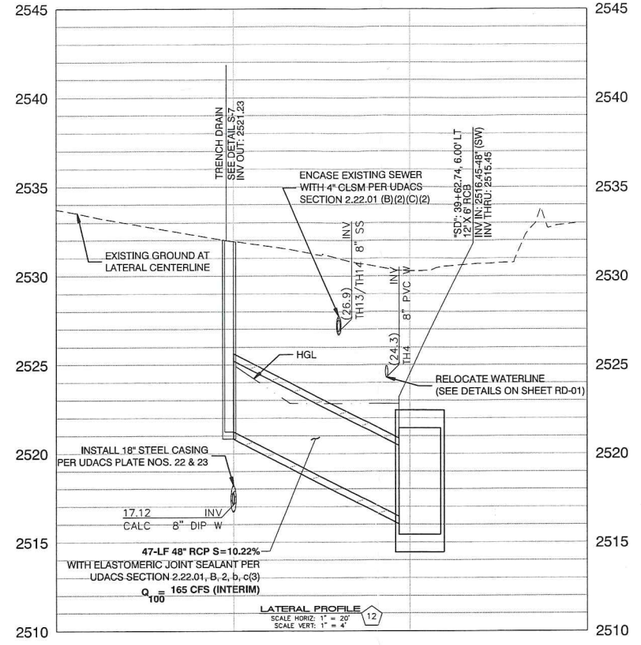

TECH. DESIGN TO INVESTIGATE CAPACITY & HYDROGRAPH TIMING & RETROFIT POSSIBILITY

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

PROTECT WATERLINES IN PLACE. WHEREVER A WATERLINE IS ABOVE A STORM DRAIN OR SEWER WHERE COMPACTION REQUIREMENTS UNDER A WATERLINE CANNOT BE MET, BACKFILL TRENCH WITH CLASS I CONTROLLED LOW STRENGTH MATERIAL (CLSM) TO THE SPRINGLINE OF THE WATERLINE. THIS REQUIREMENT IS FOR STRUCTURAL SUPPORT ONLY. ADDITIONAL HEALTH REGULATIONS MAY APPLY PER UDACS 2.22.

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# 123165

FOR TRENCHES SIX (6) FEET WIDE AND GREATER:

IF THE PIPE MATERIAL IS ACP, THE EXPOSED PIPE MUST BE REPLACED WITH DUCTILE IRON PIPE.

CONTRACTOR MUST SUBMIT PIPE SUPPORT DETAIL PREPARED BY A NEVADA LICENSED ENGINEER TO LVVWD ENGINEERING SERVICES BEFORE CONSTRUCTION TO SHOW HOW WATERLINE(S) WILL BE SUPPORTED DURING EXCAVATION AND BACK FILL.

SUPPORTED PIPE MAY BE EXPOSED FOR NO LONGER THAN 90 DAYS MAXIMUM. IF THE PIPE WILL BE EXPOSED FOR MORE THAN 90 DAYS PLANS MUST BE SUBMITTED AND APPROVED BY THE LVVWD TO RELOCATE PIPE.

NO.	DATE	REVISIONS

PREPARED BY
SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS
5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118
PHONE (702) 284-5300 FAX (702) 284-5399

PREPARED FOR
CITY OF LAS VEGAS

H# 49876 | BID# 16-49876
DATE: AUGUST 2016 | DESIGNED BY: DAM
SUBMITTAL STAGE: | DRAWN BY: SPC/DAM
CHECKED BY: JSR/MJF

TITLE
BRENT LANE DRAINAGE SYSTEM & TRAIL

SHEET
STORM LATERAL DRAIN PROFILES

PROFESSIONAL ENGINEER STATE OF NEVADA
MARK J. FAILLA
Exp. 06/30/2017
CIVIL
No. 14566

SHEET
SD-09
18 OF 64
DRAWING NO.

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Facility D6 Storm Drain Sizing

D6-Ult.
Worksheet for Circular Channel

Project Description	
Worksheet	Facility D6
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.50	%
Discharge	43.00	cfs

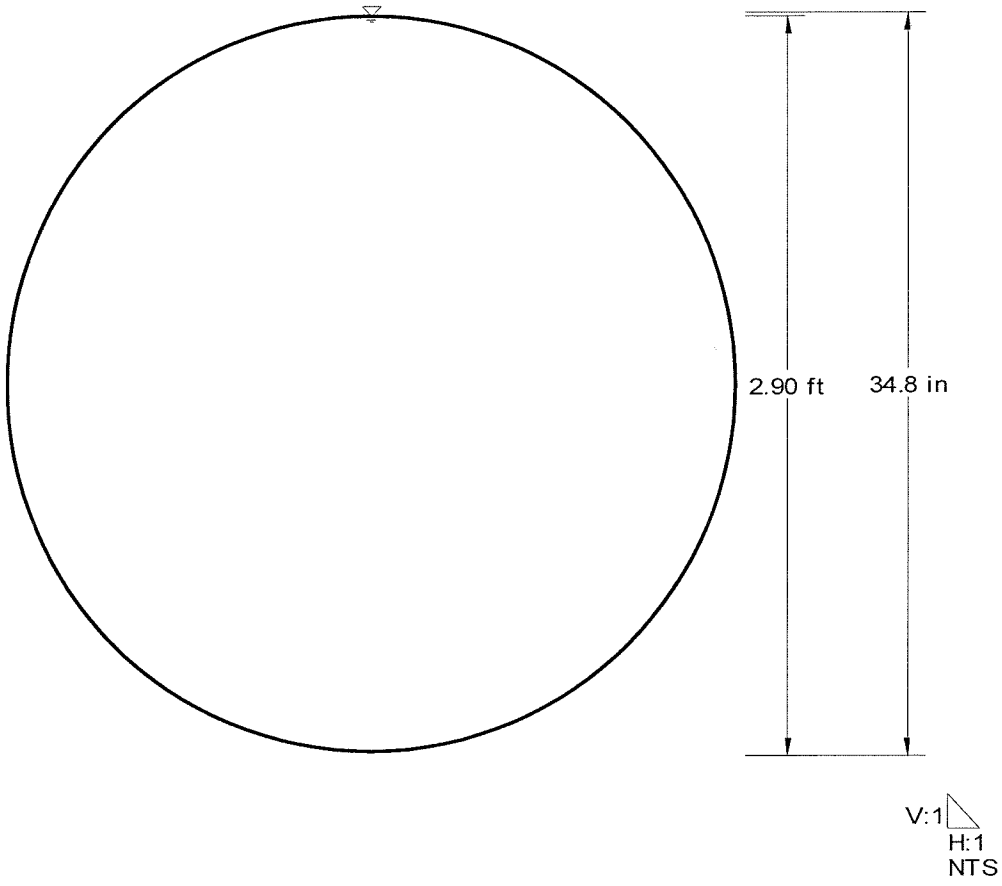
Results		
Depth	2.90	ft
Diameter	34.8	in
Flow Area	6.6	ft²
Wetted Perimeter	0.00	ft
Top Width	0.00	ft
Critical Depth	2.15	ft
Percent Full	100.0	%
Critical Slope	0.61	%
Velocity	6.52	ft/s
Velocity Head	0.66	ft
Specific Energy	3.56	ft
Froude Number	0.00	
Maximum Discharge	46.26	cfs
Discharge Full	43.00	cfs
Slope Full	0.50	%
Flow Type	N/A	

→ 42" RCP

D6-Ult.
Cross Section for Circular Channel

Project Description	
Worksheet	Facility D6
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

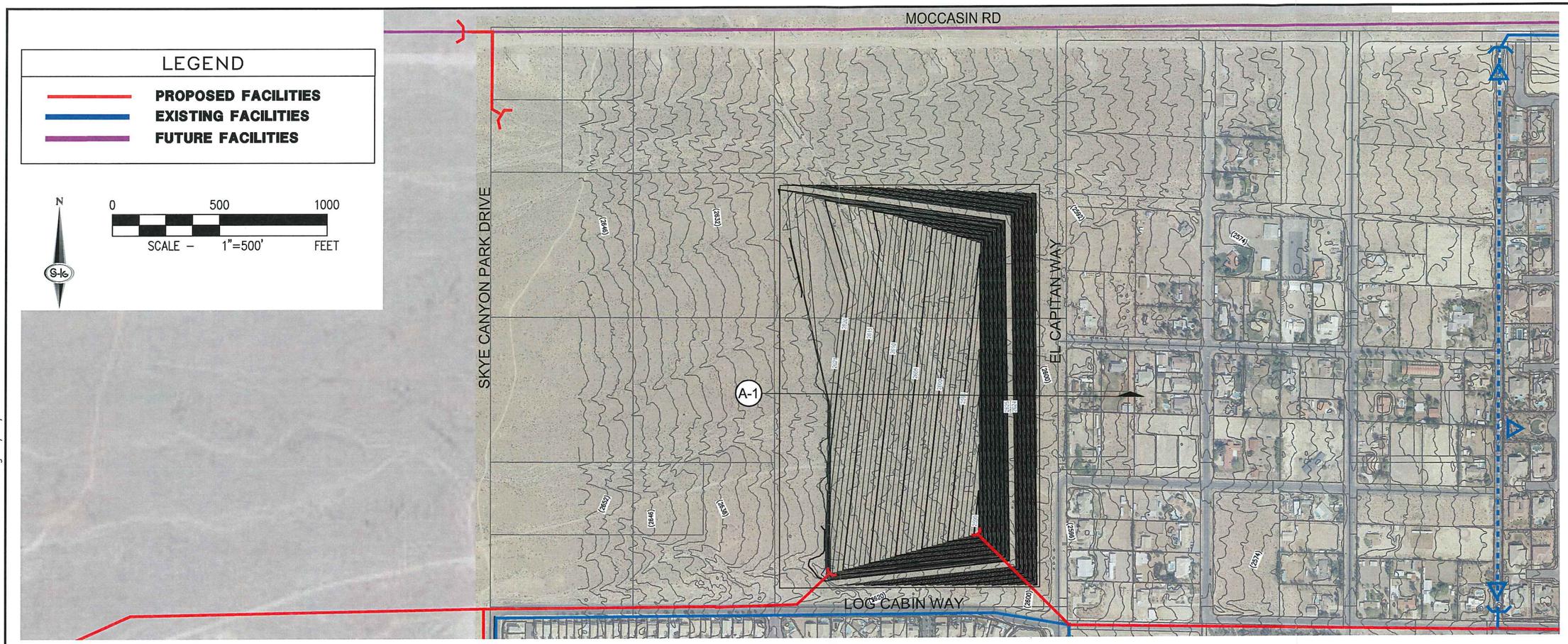
Section Data		
Mannings Coefficient	0.013	
Channel Slope	0.50	%
Depth	2.90	ft
Diameter	34.8	in
Discharge	43.00	cfs

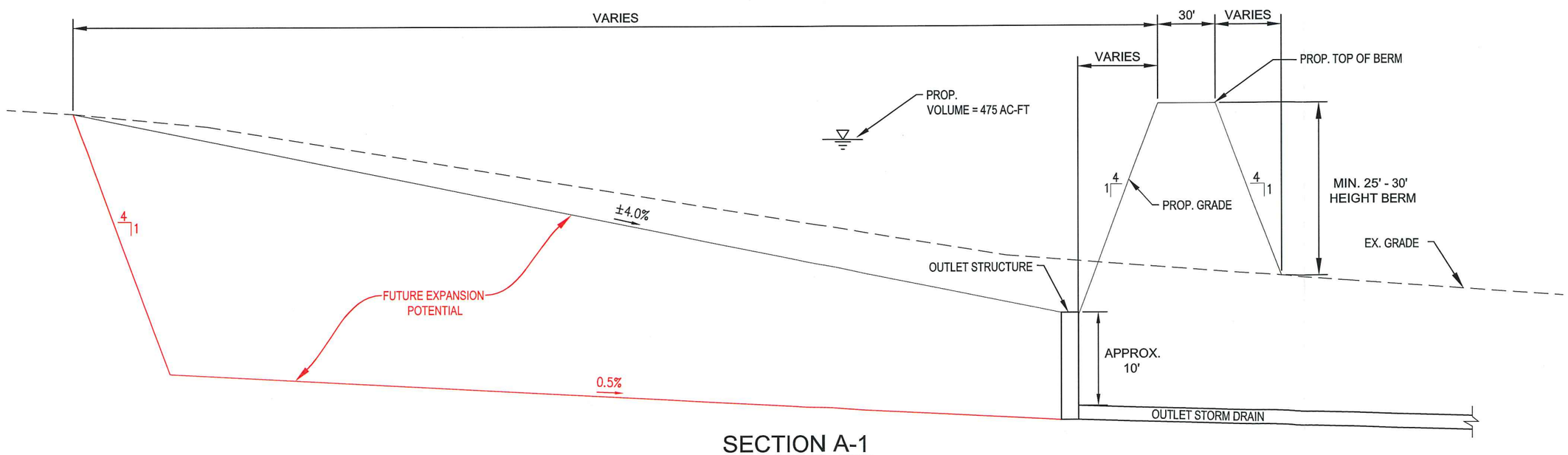


APPENDIX D

Response to Comment No. 5

(Conceptual Grading for Detention Basin 3)





SECTION A-1

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NO.	DESCRIPTION	DATE	BY	APP. DATE	APP.

OLYMPIA COMPANIES

SKYE CANYON - MASTER DRAINAGE STUDY
DETENTION BASIN 3 PRELIMINARY CONCEPT

DATE:	NOV. 2016
DRAFTER:	CWB
DESIGNER:	SMJ
CHECKED:	SMJ
PROJECT NO.	OLY1603.000

EXHIBIT
SHEET 1 OF 1

j:\oly1603-000 skye mds-2016\drainage\conceptual study\ccrfcd\rtc1\figures\oly1603-000 exhibit x db3 detail.dwg 11/22/2016 8:51 AM Cameron Bencini

APPENDIX E

Response to Comments No. 2 & 7

(Storm Centering Ultimate Condition HEC-1 Models on CD)

- Full Watershed HEC-1 (Re-included from September 2016 Submittal)
- Storm Centering HEC-1 (Minus DB1, DB2, 157DB)
- Silverstone Impact HEC-1 (SDN4 Distribution)

APPENDIX F

Response to Comment No. 10

(US-95 Coordination)

Reference Material – Kyle Canyon Interchange
Hydraulic Supplement

Steve Jones

From: Steve Jones
Sent: Thursday, June 30, 2016 5:19 AM
To: Jay Guzman (JGuzman@gcwengineering.com); rbelsick@gcwengineering.com; tmccoy@gcwengineering.com
Cc: Chris Holman (cholman@dot.state.nv.us)
Subject: US95/Kyle RFCD Facility
Attachments: NDOT Concept Exhibit-ULTIMATE CONDITIONS FACILITIES SUMMARY.PDF

Jay and Ryan and Tim,

I spoke to Chris Holman, Sajid Sulahria and 'Z' Alemu yesterday (6/29) afternoon regarding the attached exhibit showing the current alignment of our RFCD facility. In order to have assurances that the regional alignment works in the future, there were essentially 2 options we had to satisfy them:

1. Revise the alignment to the s-curve so that the storm drain is back within a roadway by the time it leaves NDOT right-of-way. This gives NDOT the security that the line can be extended in the future from the NDOT right-of-way in what is planned as Log Cabin street without having to go through private property. As Ryan Belsick and I spoke over the phone today, our hydraulic model we have at this point in time will have to be revised to match a new S-Curve alignment. Chris Holman noted that hydraulic criteria for analyzing this storm drain is defaulted to HCDDM. A follow-up question I had after the phone call was if the S-curve alignment is chosen, is this Interchange project going to construct the regional facility in the proposed approaching roadway to the interchange east of US95?
2. Dedicate a drainage easement across the private property so the reservation of the extension of the current line's alignment is in place prior to construction of the Interchange. We were going to investigate how the schedules coordinate if this option is chosen.

SHG and NDOT are planning a follow-up conference call Tuesday next week when the NDOT PM is available to finalize what option we are moving forward with, in order for SHG to commit to supplying the conceptual design to GCW by Friday 7/8 as agreed with Ryan Belsick.

Steve Jones, P.E.
Project Manager II

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FAX: (602) 483-1007

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Steve Jones

From: Steve Jones
Sent: Tuesday, July 05, 2016 3:12 PM
To: 'Alemu, Zelalem A'; 'Keller, Jenica A'; 'Holman, Christopher M'; 'Randy McConnell (rmcconnell@lasvegasnevada.gov)'; 'Ryan Belsick (RBelsick@gcwengineering.com)'; 'Sulahria, Sajid M'; tmccoy@gcwengineering.com
Cc: mbolduc@olympiacompanies.com; Bobby Williamson - Olympia (bwilliamson@olympiacompanies.com); Jerry Slater
Subject: RE: Kyle Canyon Interchange MPU Facility Discussion

To summarize our conference call today, below are notes I took with regards to action items:

- SHG is seeking to move forward with the red alignment on the attached exhibit. Based on a previous phone call with NDOT Hydraulics, a drainage easement will be reserved across the private property between Sky Pointe and US-95 to give assurances to NDOT of future extension through the interchange. In order to allow NDOT to move forward within the current framework of the scope of the project, the easement will be dedicated to City of Las Vegas from the private parcel owner presently and the City will sign it over to NDOT in the future. SHG will prepare a legal description for the proposed drainage easement based upon public standards from the conceptual profile it will provide the City on 7/8/2016.
- SHG had mentioned that the difference in size of storm drain crossing US-95 was a 13-ft by 6-ft RCB in the red alignment and a 13-ft by 8-ft RCB in the blue alignment. SHG will provide a conceptual profile and working hydraulic model for both the red and blue alignments on 7/8/2016. This will allow NDOT and the City to propose what it feels is appropriate for the project.
- Moving forward, all parties are in agreement that the red straight alignment through the Interchange is most desirable for hydraulic efficiency.

Let me know if there is anything else that needs to be added to these notes.

NDOT Concept Exhibit-Alternati...

Steve Jones, P.E.
Project Manager II

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From: Steve Jones
Sent: Tuesday, July 05, 2016 1:28 PM
To: 'Alemu, Zelalem A'; Keller, Jenica A; Holman, Christopher M; Randy McConnell (rmcconnell@lasvegasnevada.gov); Ryan Belsick (RBelsick@gcwengineering.com); Sulahria, Sajid M
Cc: mbolduc@olympiacompanies.com; Bobby Williamson - Olympia (bwilliamson@olympiacompanies.com); Jerry Slater
Subject: RE: Kyle Canyon Interchange MPU Facility Discussion

All,

Attached is an exhibit for our conference call today that shows the proposal for the CCRFCD facility crossing US-95. Olympia and SHG seek to move forward with the red option on the exhibit. We would dedicate a drainage easement in the private out-parcel in the Interchange for the construction of the project to give NDOT assurances of ultimate connectivity and plan on a future drainage easement across our property downstream of the Interchange.
<< File: NDOT Concept Exhibit-Alternative Alignment - Temp-ULTIMATE CONDITIONS FACILITIES SUMMARY.pdf >>

Steve Jones, P.E.
Project Manager II

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-----Original Appointment-----
From: Alemu, Zelalem A [mailto:ZAlemu@dot.state.nv.us]
Sent: Thursday, June 30, 2016 11:42 AM
To: Alemu, Zelalem A; Keller, Jenica A; Holman, Christopher M; Randy McConnell (rmcconnell@lasvegasnevada.gov);

Ryan Belsick (RBelsick@gcwengineering.com); Sulahria, Sajid M; Steve Jones
Subject: Kyle Canyon Interchange MPU Facility Discussion
When: Tuesday, July 05, 2016 8:00 AM-8:30 AM (UTC-08:00) Pacific Time (US & Canada).
Where: Hydraulics Conference Room/Conference Call

Hello All,

This is a follow up conference call to assist Slater Hanifan Group in finalizing conceptual design for the proposed CCRFCD facility at the US95/Kyle Canyon Interchange. In particular, we will be discussing the two options proposed by SHG in order to ensure the facility works in the future.

Toll Free Call in Number: 888-363-4734
Access Code: 1929337
Host Passcode: 8290

Sincerely,

Zelalem Alemu, PE
Senior Hydraulics Engineer
Nevada Department of Transportation
1263 South Stewart
Carson City, NV 89712
775-888-7287

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SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS

OLY1608.000

July 8, 2016

Oh Sang Kwon, P.E.
City of Las Vegas – Department of Public Works
Flood Control Section
333 N. Rancho Drive – 7th Floor
Las Vegas, Nevada 89106

Subject: Supplement for US95/Kyle Canyon Road Interchange – Conceptual Design for CCRFCD Regional Facility Crossing

Dear Mr. Kwon:

The Interchange project is proposing to construct the regional storm drain under the US-95 and it's on/off ramps. The approach upstream and downstream connections into the culvert will be constructed by private developer as a part of the Skye Canyon master planned community. Upon coordination with City of Las Vegas (CLV) Public Works and GCW Engineers, the developer is required to prepare conceptual analysis for the regional storm drain alignment through the Nevada Dept. of Transportation (NDOT) right-of-way to confirm the proposed culvert crossing by the Interchange project is sufficient to accommodate the proposed regional flow rates in the alignment. An exhibit demonstrating the preliminary regional storm drain alignment, inclusive of the proposed Interchange culvert crossing, within the vicinity of the NDOT right-of-way has been included for reference.

Review of this supplement's regional storm drain alignment compared to the alignment in the current Clark County Regional Flood Control District (CCRFCD) MPU shows a difference. The changed alignment is attributed to a new master land plan for Skye Canyon and downstream regional alignment constraints placed on the Moccasin alignment. Several coordination meetings have occurred between the developer, SHG, CLV and CCRFCD regarding the changed alignment shown in this supplement and all parties are in agreement regarding what is shown in this supplement. A *Master Drainage Study Update #3 for Skye Canyon* (DS4420), prepared by SHG, is currently under review by CLV showing this alignment, and has been utilized to determine the proper design flow rates within the proposed interchange storm drain and its developer upstream and downstream connections. An ultimate condition flow rate of 2,079 cfs has been referenced as the 100-year design flow rate in the portion of the regional storm drain crossing the highway and constructed by the Interchange. The Ultimate Condition Drainage Facilities Map referenced from the Master Study has been included in this supplement.

Two (2) alignments are proposed in the future through the NDOT right-of-way and Interchange project. The Water Surface and Pressure Gradient (WSPG) Hydraulic Analysis System software has been utilized to determine HGLs to verify the CCRFCD criteria are satisfied.

- The regional alignment, entitled "Skye Village-Log Cabin", crossing US-95 to convey the regional flows east. The portion of the storm drain passing under the highway and on/off ramps is to be constructed with the Interchange project, the remainder of the alignment is anticipated to be installed by the private developer.

- The regional alignment, entitled "SR157-Oso Blanca", is the future regional facility planned in Kyle Canyon Road (a.k.a. SR157) that needs to connect into the "Skye Village-Log Cabin" regional alignment to adhere to MPU drainage patterns. It has been profiled because the alignment is different than previously anticipated by the MPU through the Interchange.

Skye Village-Log Cabin Regional Alignment

A conceptual design profile has been prepared that extends from Skye Canyon Park Drive (upstream limits) to Log Cabin Way (downstream limits). The upstream limits of concept have been selected to understand the vertical constraints as the future storm drain crosses the existing 36-inch water line. The downstream limits of concept have been selected because it is considered adequately outside NDOT right-of-way to show no hydraulic effects on the regional alignment. This alignment includes the subject proposed storm drain by the Interchange and represents the conveyance of the total ultimate condition regional flow rates exiting the NDOT right-of-way through the downstream Skye Canyon community. Note that the ultimate condition of regional facility connectivity represents the condition with the largest flow rate conveyed in this alignment, represented by confluence in Oso Blanca of the SR157-Oso Blanca regional facility discussed later in this supplement. However, the contributing watershed to the future regional facility from SR157 impacts the Skye Village-Log Cabin regional alignment currently but represents less total flow in the alignment. Collection of these flows is represented by the several 10-ft wide by 4-ft high RCB laterals shown in the profile south of Oso Blanca Road between Stations 44+50 to 50+00. Since the interim condition in which the 10-ft by 4-ft RCBs are potentially in-use generates less flow than ultimate regional condition, the interim condition has not been analyzed.

Resulting from a July 5, 2016 conference call with NDOT, CLV and GCW, two (2) alternative alignments extending east from US-95 are presented in this supplement. An exhibit has been included to show the potential alignments, colored in red and blue. Conceptual profiles and corresponding hydraulic models have been prepared for both alignments. It is noted that the likely alignment by the developer is the red alignment that extends through the developer's private property, as it presents the most hydraulic efficient option. A drainage easement is to be dedicated by the developer to CLV on the private property between the highway and Sky Pointe to reserve the corridor for future extension through the Interchange. As an alternative, in case the private developer does not connect and extend the regional facility in the future, the blue alignment represents an option entirely contained within the NDOT right-of-way that allows extension of the regional facility without private developer participation. The table below represents a comparative summary of size differences between the two alignments within the Interchange boundary. The respective hydraulic model has also been summarized in the below table.

13'X8' SELECTED SO NO ISSUES ARISE IN FUTURE COORD. OF DRAINAGE EASEMENT BY PRIVATE PROP.

Comparison of CCRFCD Regional Facility Sizes through US95 Interchange	
Straight Alignment (Red)	**S-Curve Alignment (Blue)**
13-ft wide by 6-ft high RCB *KCI-R.WSW*	13-ft wide by 8-ft high RCB *KCI-B.WSW*

Analysis shows that the flow velocities in the storm drain may be considered erosive by CCRFCD Manual standards (greater than 25 ft/s); therefore, an additional 1-inch cover of 6,000 psi compressive strength concrete over the steel reinforcing at the flowline of the RCB

will be required. The starting water surface elevation utilized in analysis is assumed top of RCB because it is anticipated that downstream extension will not result in a tailwater condition on the regional alignment, all the significant head losses that would impact the Interchange crossing have been evaluated with this supplement's conceptual design.

SR157-Oso Blanca Regional Alignment

A conceptual design profile has been prepared that extends from SR157 (upstream limits) to the Oso Blanca confluence with the Skye Village-Log Cabin alignment Log Cabin Way (downstream limits). The upstream limits of concept have been selected because it is adequate to show hydraulic impacts of the re-alignment of the regional facility bending south from SR157. The downstream limits of concept have been selected because it connects into the trunk Skye Village-Log Cabin alignment and the hydraulic losses associated with the confluence structure in Oso Blanca has been modeled with that alignment. Therefore, the starting water surface elevation in the SR157-Oso Blanca alignment model has been referenced from the Skye Village-Log Cabin alignment model. Similarly to the Skye Village-Log Cabin concept, analysis shows that the flow velocities in the storm drain may be considered erosive by CCRFCD Manual standards (greater than 25 ft/s); therefore, an additional 1-inch cover of 6,000 psi compressive strength concrete over the steel reinforcing at the flowline of the RCB will be required.

Note that the design flow rate utilized in this alignment varies from the current CCRFCD MPU. The Master Drainage Study that is referenced for establishing flow rates is proposing to update the MPU in the future to provide for upstream regional detention on a vacant BLM parcel adjacent to SR157. This new detention basin functions to limit the peak 100-year flow rate entering NDOT right-of-way, in order to not exceed what occurs during existing condition. The concept of adding regional detention in the SR157 regional alignment has been discussed with CLV and CCRFCD and agreed to in concept.

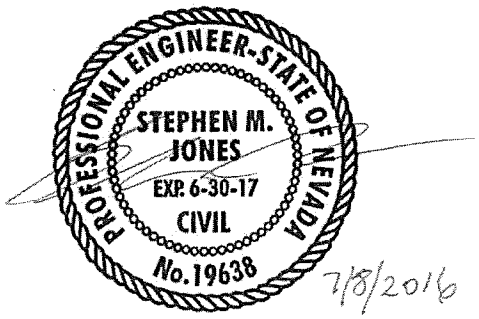
It is acknowledged that the developer for Skye Canyon is not responsible for this storm drain alignment because it is a future CCRFCD facility improvement, only a stub is planned to be constructed by the developer and reserved for future connection into the Skye Village-Log Cabin alignment. The developer has planned for collection of these flows that impact the alignment in the existing condition, via the several storm drain laterals shown in Skye Village and south of Oso Blanca.

Supporting calculations and exhibits are included in this supplement. If you have any questions or require additional information, please do not hesitate to contact us at 284-5300.

Respectfully Submitted,

SLATER HANIFAN GROUP

Steve Jones, P.E.
Project Manager - Flood Control Division



cc: Jerry Slater, P.E. – SHG
Marc Bolduc, P.E. – Olympia
Ryan Belsick, P.E. – GCW Engineers

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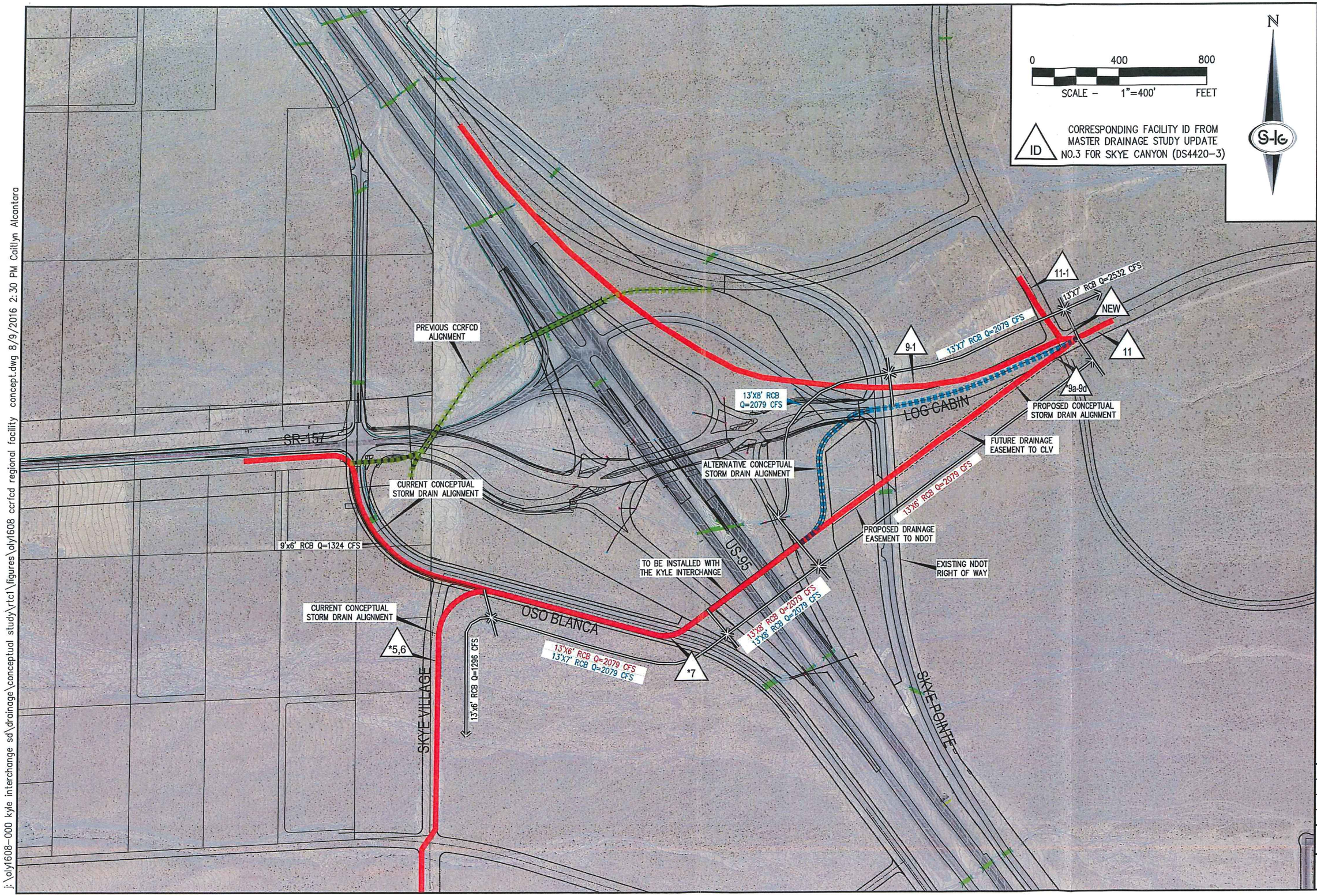

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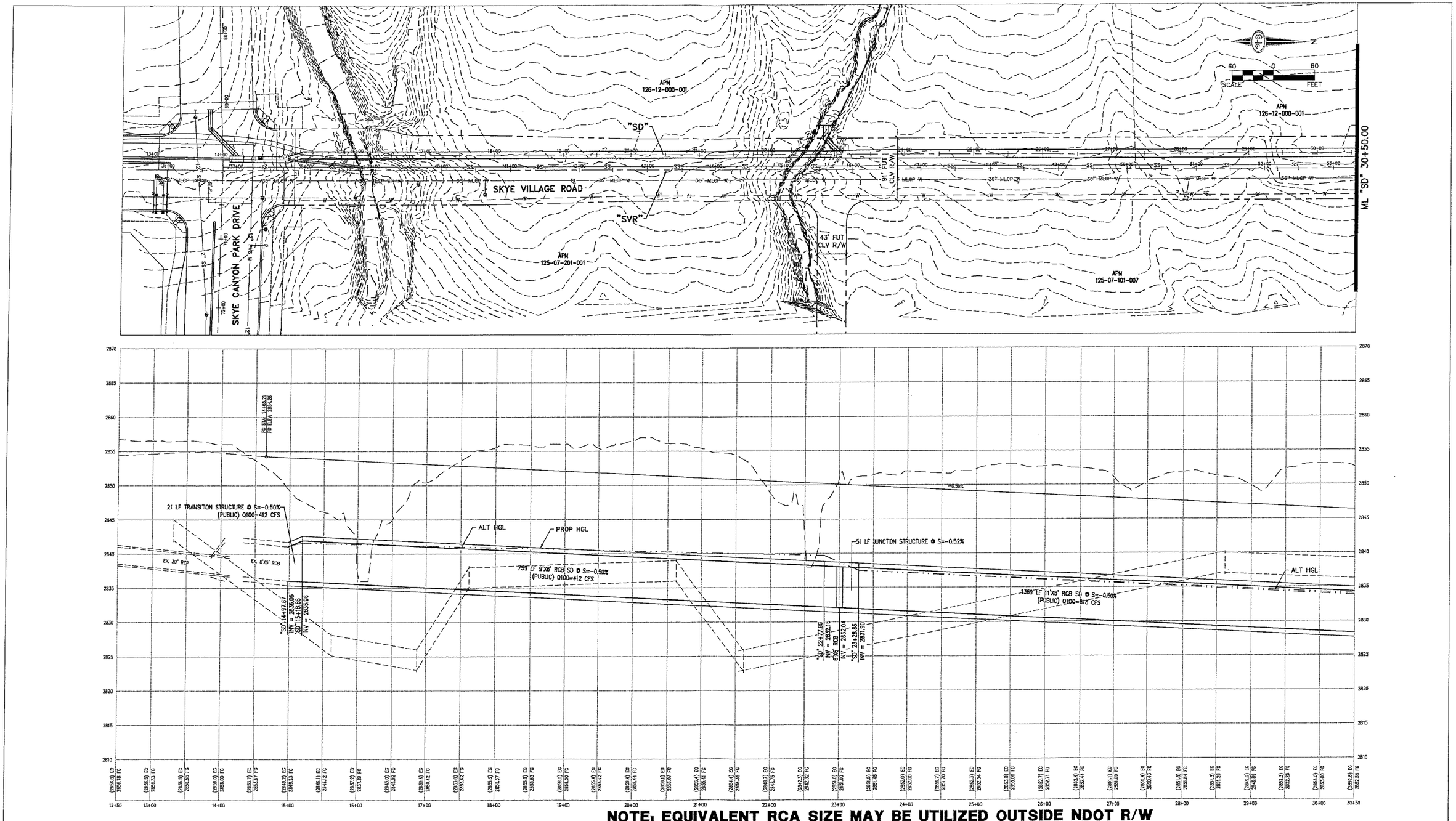
NO.	DESCRIPTION	DATE	BY	APP. DATE	APP

OLYMPIA COMPANIES (COOP. GCW, CLV, NDOT)

US-95 / KYLE CANYON INTERCHANGE
CCRFCD REGIONAL FACILITY CONCEPT

DATE:	AUGUST 2016
DRAFTER:	CAA
DESIGNER:	CAA
CHECKED:	SMJ
PROJECT NO.	OLY1608.000

EXHIBIT
SHEET 1 OF 1



NOTE: EQUIVALENT RCA SIZE MAY BE UTILIZED OUTSIDE NDOT R/W

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KYLE CANYON INTERCHANGE

SKYE VILLAGE-LOG CABIN REGIONAL ALIGNMENT PROPOSED STORM DRAIN-CONCEPTUAL PROFILE (PROFILE SUBJECT TO CHANGE UPON TECHNICAL DESIGN)

EXHIBIT 1

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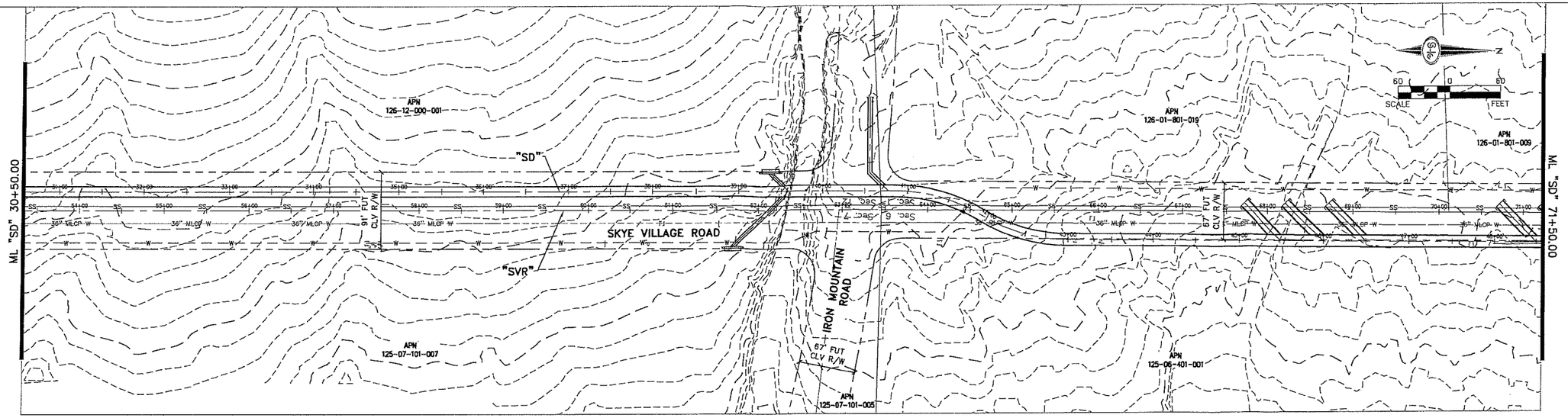

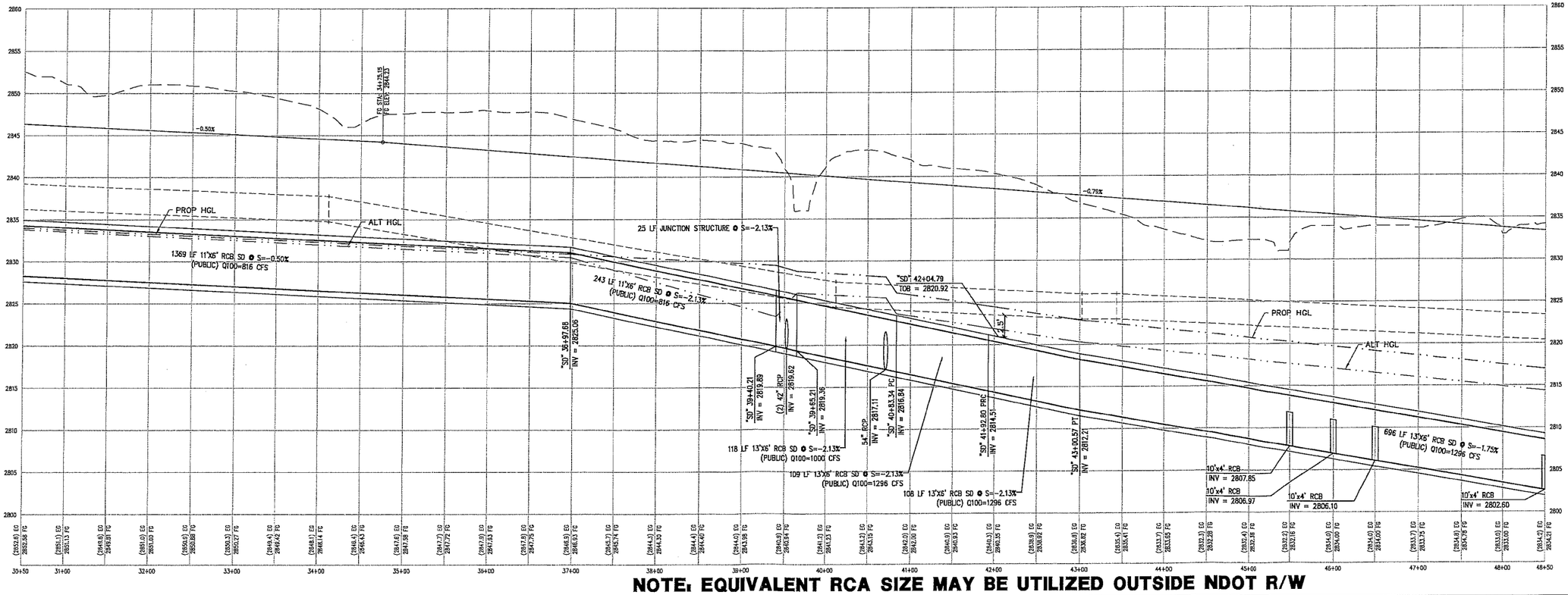

NOTE: EQUIVALENT RCA SIZE MAY BE UTILIZED OUTSIDE NDOT R/W

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SKYE VILLAGE-LOG CABIN REGIONAL ALIGNMENT PROPOSED STORM DRAIN-CONCEPTUAL PROFILE (PROFILE SUBJECT TO CHANGE UPON TECHNICAL DESIGN)

EXHIBIT 2

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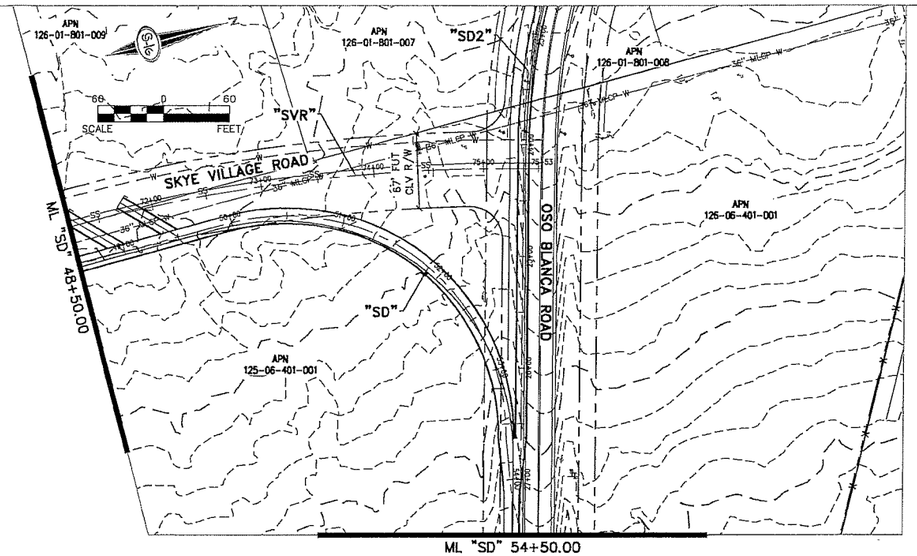

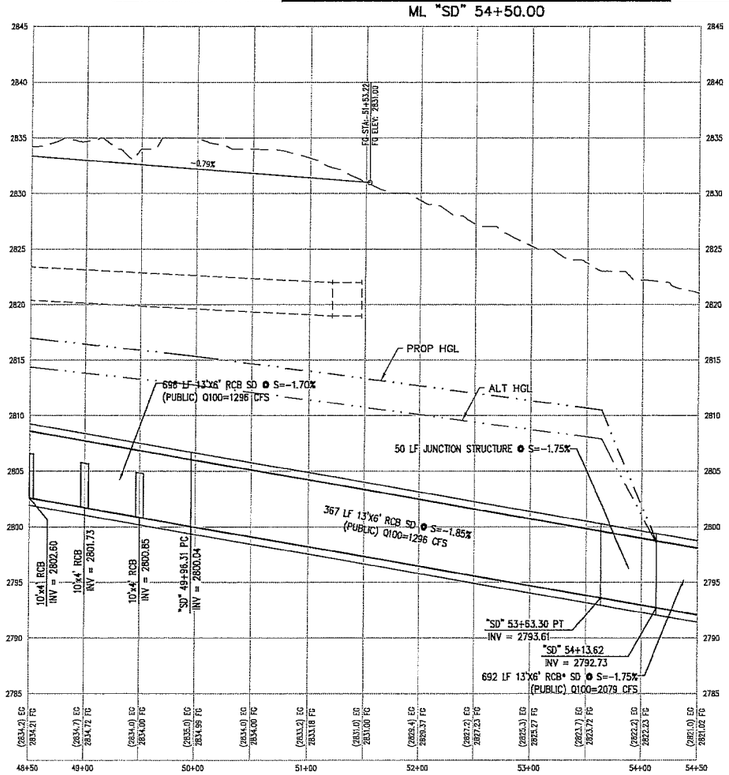

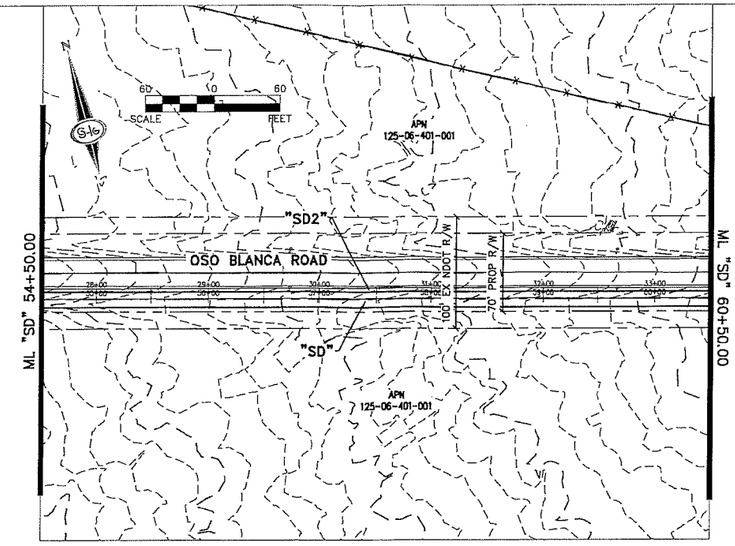

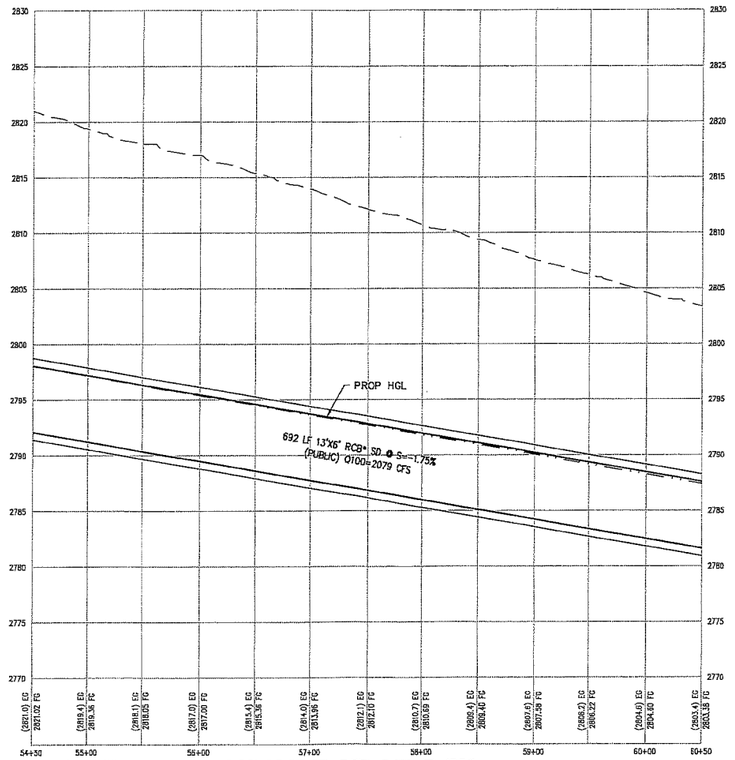

NOTE: EQUIVALENT RCA SIZE MAY BE UTILIZED OUTSIDE NDOT R/W

*-SEE RCB SHOP DRAWING

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EXHIBIT 3

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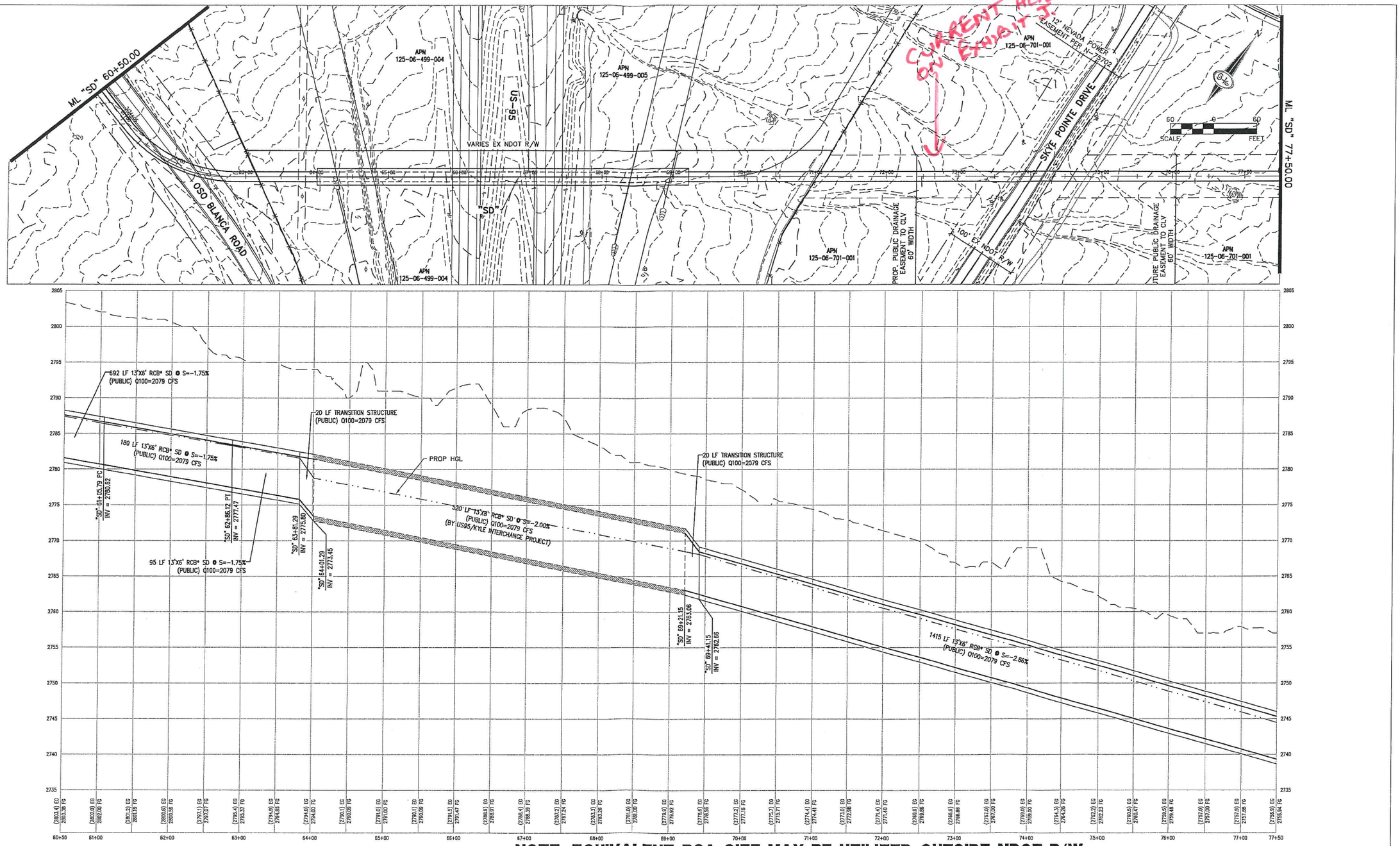
CURRENT ALIGNMENT ON EXHIBIT J.



NOTE: EQUIVALENT RCA SIZE MAY BE UTILIZED OUTSIDE NDOT R/W

*—SEE RCB SHOP DRAWING

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KYLE CANYON INTERCHANGE

SKYE VILLAGE-LOG CABIN REGIONAL ALIGNMENT PROPOSED STORM DRAIN-CONCEPTUAL PROFILE (PROFILE SUBJECT TO CHANGE UPON TECHNICAL DESIGN)

EXHIBIT 4

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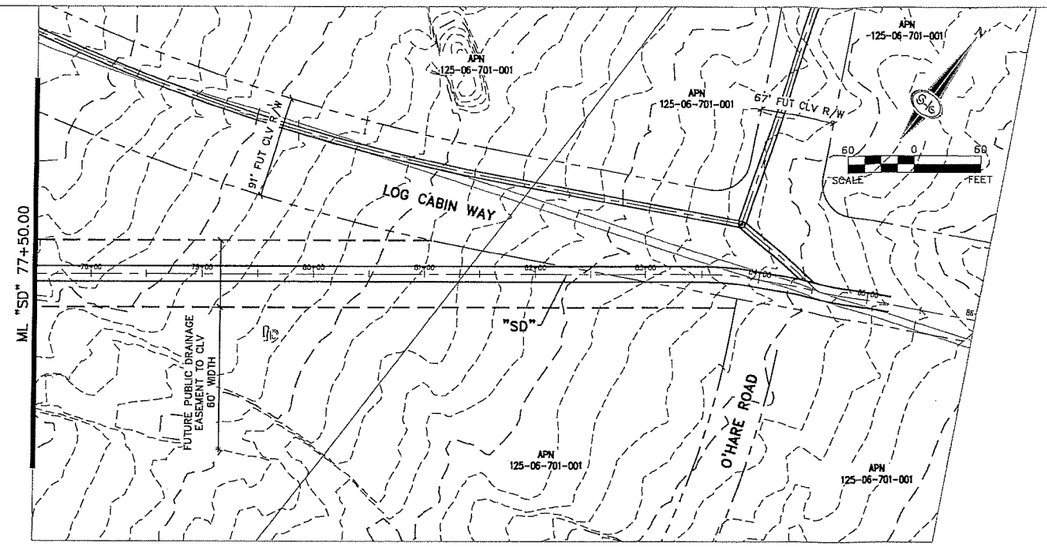
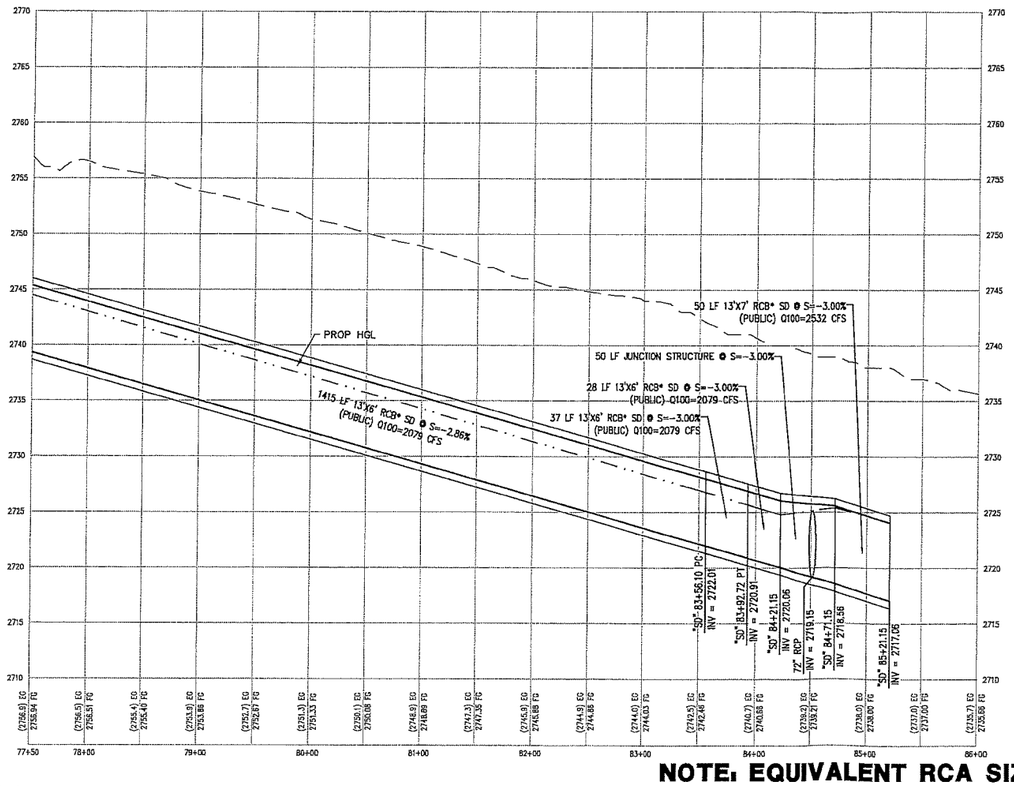
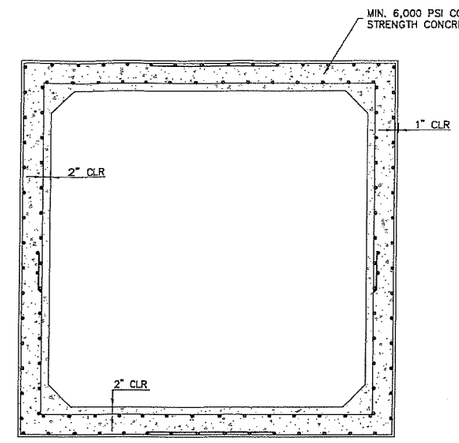




RCB SHOP DRAWING

(FOR HIGH VELOCITIES)



SECTION CUT OF BOX CULVERT

NOTE: EQUIVALENT RCA SIZE MAY BE UTILIZED OUTSIDE NDOT R/W

*-SEE RCB SHOP DRAWING

SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS
5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118
PHONE (702) 284-5300 FAX (702) 284-5399

KYLE CANYON INTERCHANGE

SKYE VILLAGE-LOG CABIN REGIONAL ALIGNMENT PROPOSED STORM DRAIN-CONCEPTUAL PROFILE (PROFILE SUBJECT TO CHANGE UPON TECHNICAL DESIGN)

EXHIBIT 5

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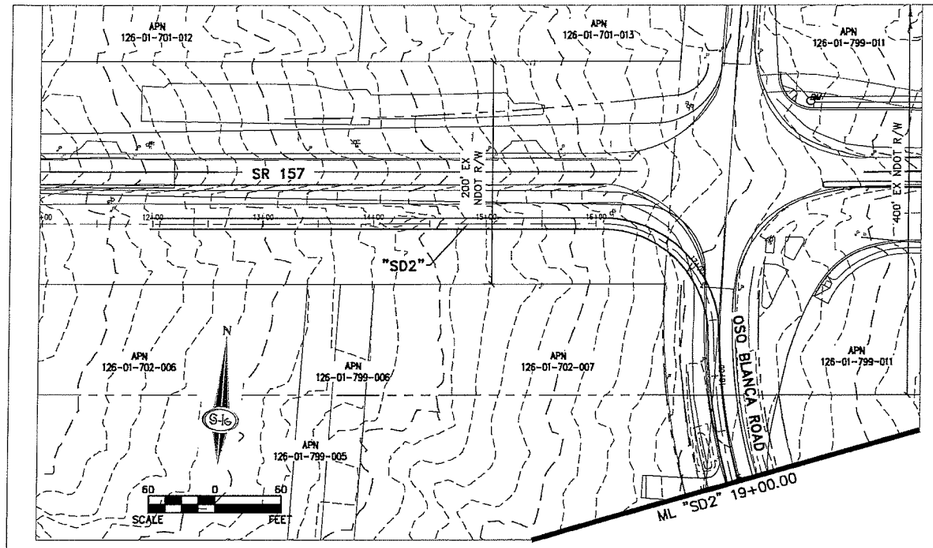

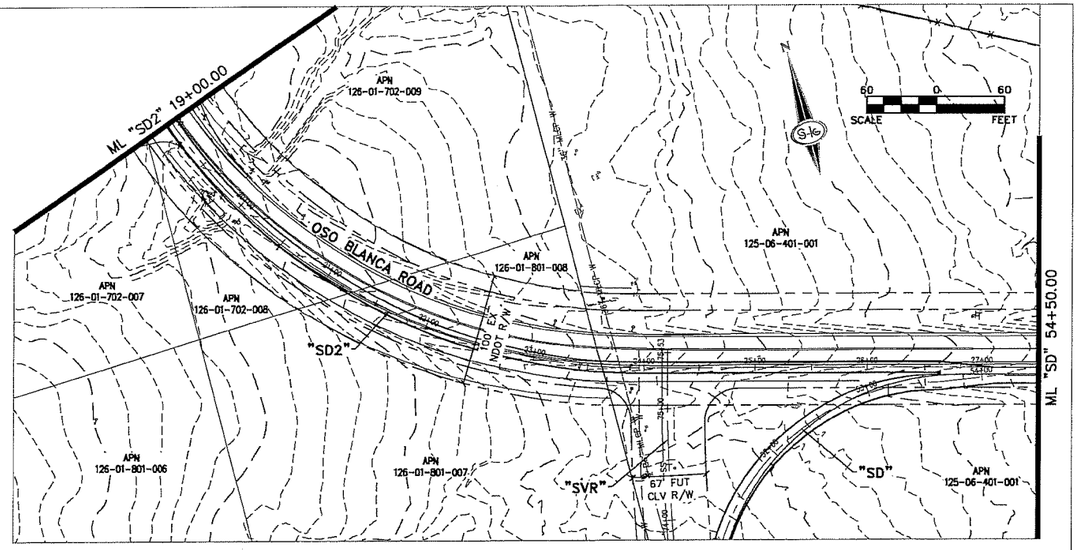

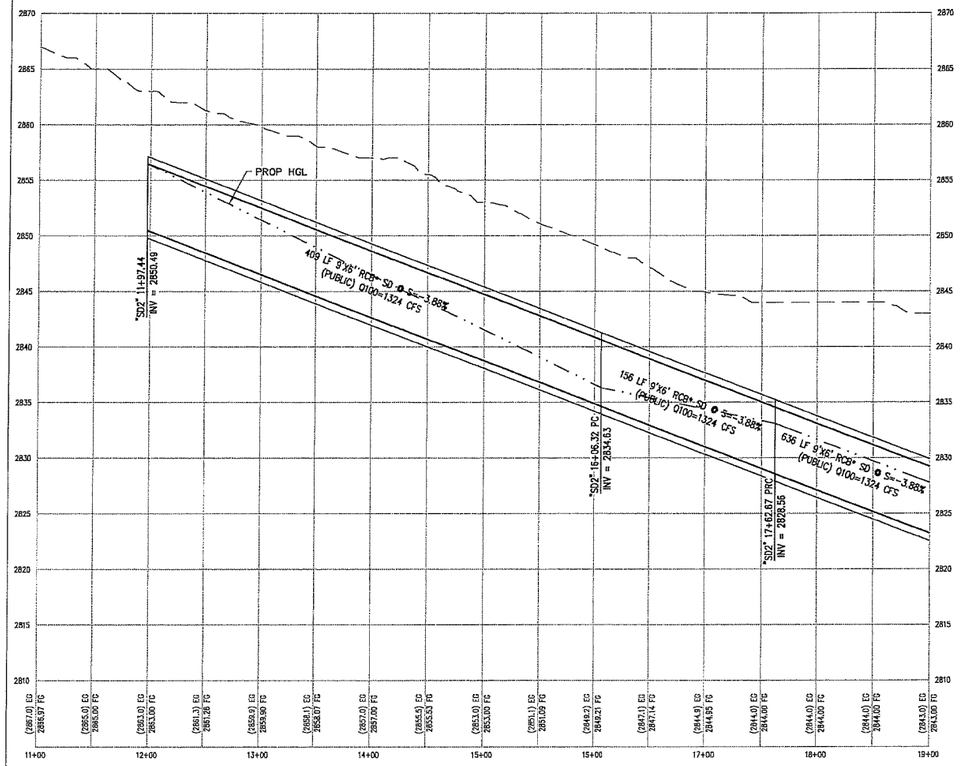

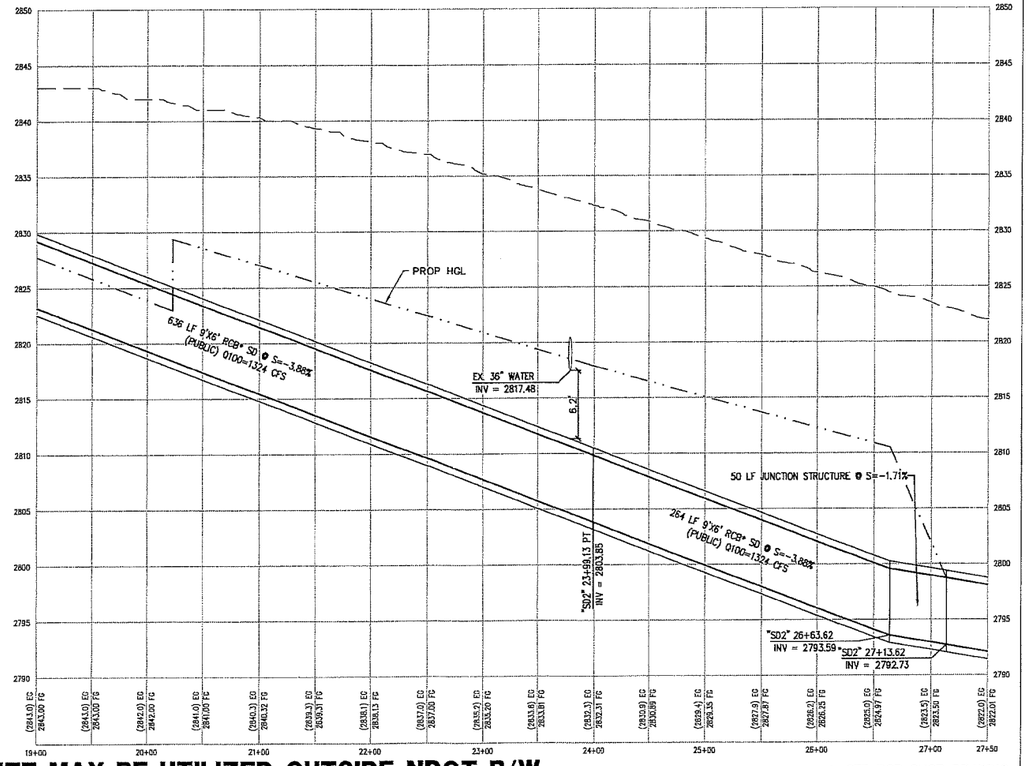

NOTE: EQUIVALENT RCA SIZE MAY BE UTILIZED OUTSIDE NDOT R/W

*–SEE RCB SHOP DRAWING

SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS
5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118
PHONE (702) 284-5300 FAX (702) 284-5399

KYLE CANYON INTERCHANGE
SR157-OSO BLANCA REGIONAL ALIGNMENT
PROPOSED STORM DRAIN-CONCEPTUAL PROFILE
(PROFILE SUBJECT TO CHANGE UPON TECHNICAL DESIGN)

EXHIBIT 6

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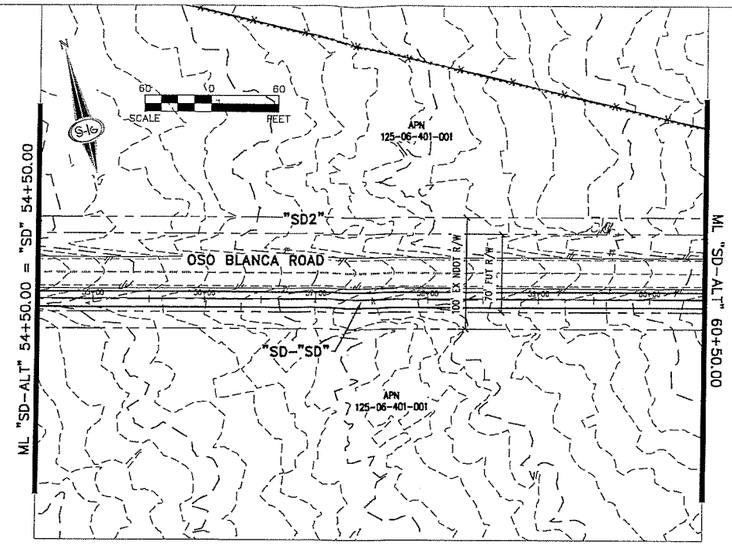

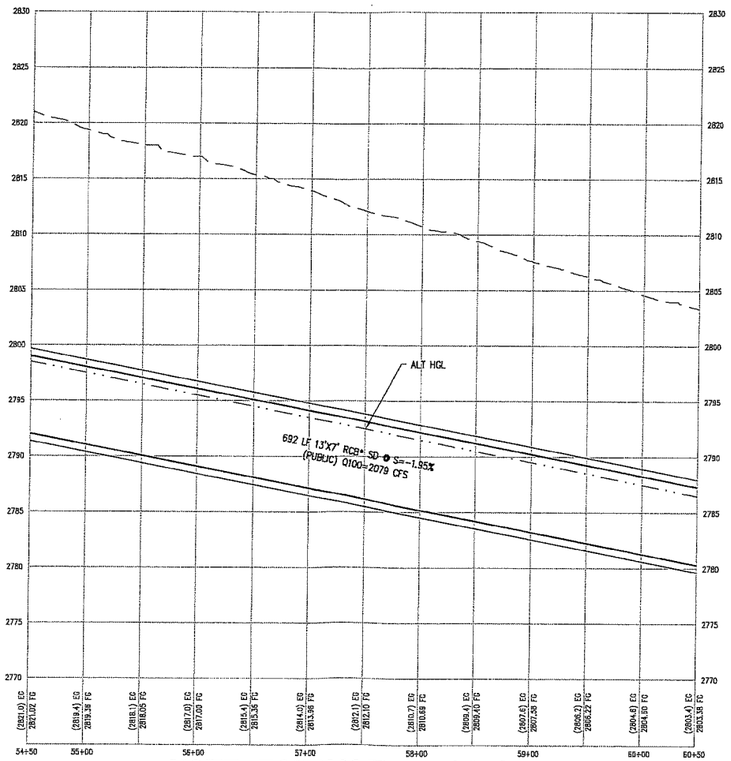

NOTE: EQUIVALENT RCA SIZE MAY BE UTILIZED OUTSIDE NDOT R/W

*-SEE RCB SHOP DRAWING

SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS
5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118
PHONE (702) 284-5300 FAX (702) 284-5399

KYLE CANYON INTERCHANGE

SKYE VILLAGE-LOG CABIN REGIONAL ALIGNMENT STORM DRAIN-ALTERNATIVE CONCEPTUAL PROFILE (PROFILE SUBJECT TO CHANGE UPON TECHNICAL DESIGN)

EXHIBIT 3A

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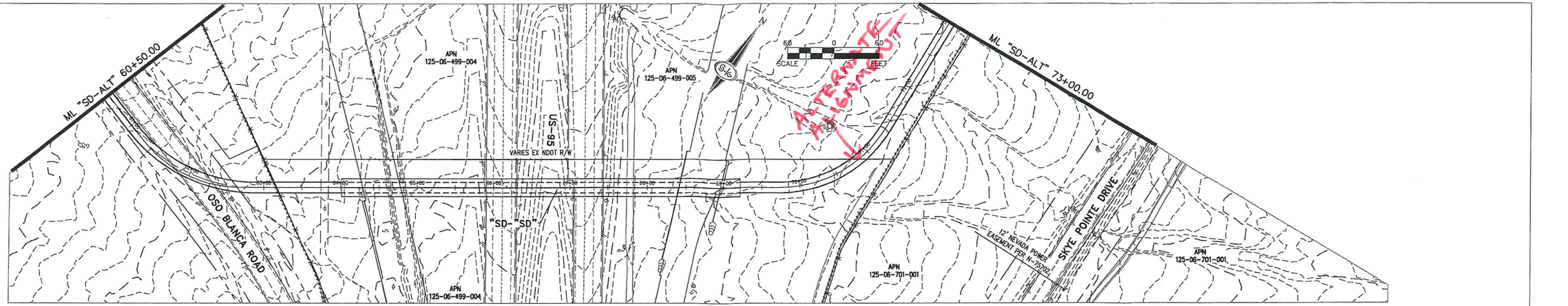

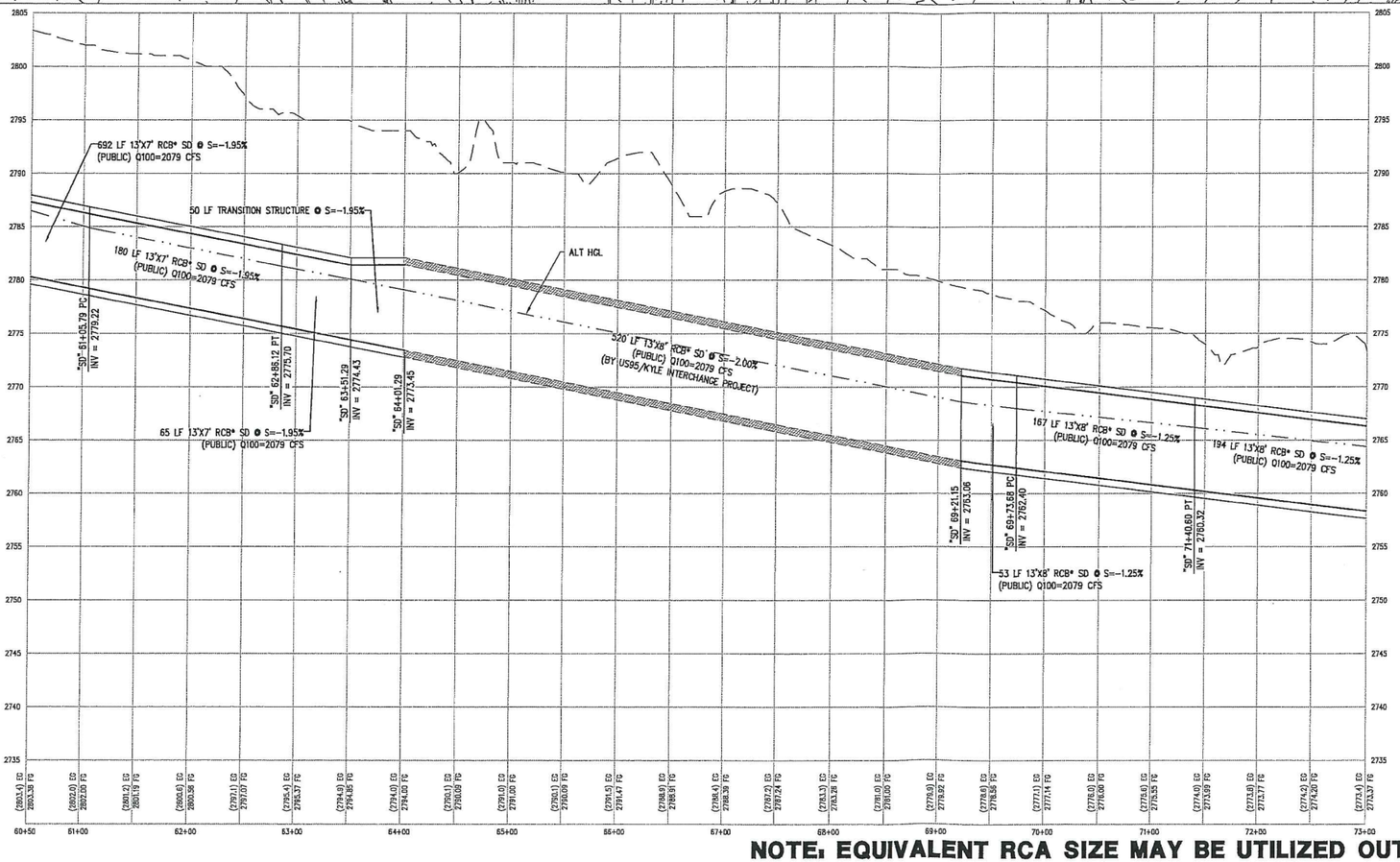

NOTE: EQUIVALENT RCA SIZE MAY BE UTILIZED OUTSIDE NDOT R/W

*-SEE RCB SHOP DRAWING

SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS
5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118
PHONE (702) 284-5300 FAX (702) 284-5399

KYLE CANYON INTERCHANGE
SKYE VILLAGE-LOG CABIN REGIONAL ALIGNMENT STORM DRAIN-ALTERNATIVE CONCEPTUAL PROFILE (PROFILE SUBJECT TO CHANGE UPON TECHNICAL DESIGN)

EXHIBIT 4A

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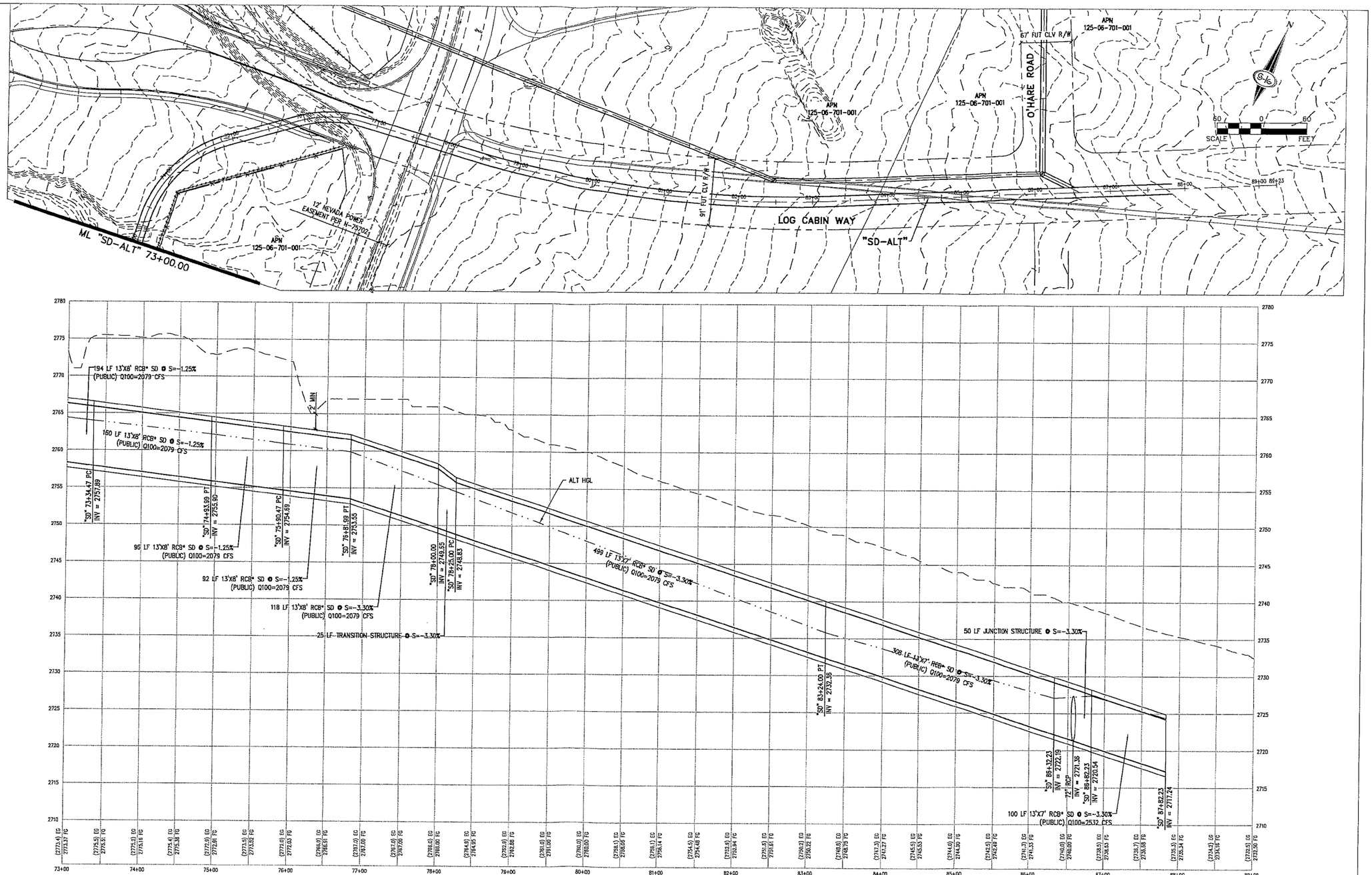


NOTE: EQUIVALENT RCA SIZE MAY BE UTILIZED OUTSIDE NDOT R/W

*-SEE RCB SHOP DRAWING

SLATER HANIFAN GROUP
CONSULTING ENGINEERS & PLANNERS
5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118
PHONE (702) 284-5300 FAX (702) 284-5399

KYLE CANYON INTERCHANGE

SKYE VILLAGE-LOG CABIN REGIONAL ALIGNMENT STORM DRAIN-ALTERNATIVE CONCEPTUAL PROFILE (PROFILE SUBJECT TO CHANGE UPON TECHNICAL DESIGN)

EXHIBIT 5A

J:\DLY1608-000 Kyle Interchange SD\Dwg\Design\DLY1608_000_SD_NTWK_ALTERNATIVE.dwg, 8/9/2016 8:34:34 PM, dmyhre

NDOT Approval Letter

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION
1263 S. Stewart Street
Carson City, Nevada 89712

BRIAN SANDOVAL
Governor

RUDY MALFABON, P.E., *Director*

In Reply Refer to:

October 20, 2016

SLATER HANIFAN GROUP 5740 S.
ARVILLE STREET
SUITE 216
LAS VEGAS, NV 89118

MASTER DRAINAGE STUDY
FOR SKY CANYON
CITY OF LAS VEGAS, NV

Dear Mr. Jones:

The Nevada Department of Transportation (NDOT) Hydraulics Section has received and reviewed the following document(s) for the above-referenced project.

Document:	**Dated:**
Update #3 to the Master Drainage Study for Sky Canyon	September 2016

The drainage design information presented in the reviewed document(s):

	is acceptable in concept. Final Hydraulic Section approval will be based on review of final design documents submitted with the NDOT Right-Of-Way Occupancy Permit application that must be submitted for this project.
x	is acceptable in concept. Final Hydraulic Section approval will be based on review of final design documents submitted with the NDOT Right-Of-Way Occupancy Permit application that must be submitted for this project. The following comments should be addressed with the permit application:
	must be supplemented or modified to satisfy the following comment(s) before preliminary Hydraulic Section approval can be granted:

1. As discussed in our phone conversation on October 19, 2016, Exhibit J properly identifies Facility 8 as a 13' x 8' RCB. However, the downstream pipe, Facility 9 is identified as a 60" RCP. According to the exhibits (Exhibit 4A) we received on July 22, 2016, the Faculty 9 should also be a 13' x 8' RCB. It was agreed that the sizes will be changed accordingly.

All submittals regarding this project must be forwarded through (or copied to) the local NDOT District permitting office. All pertinent drainage design documents (including those previously submitted for preliminary review) must be submitted to the local NDOT District permitting office with the Right-Of-Way Occupancy Permit Application. All plans and reports must be signed and stamped by a Nevada registered civil engineer.

No liability is assumed by the Department in performing this review. Verification and acceptance of all background information, design data and conclusions is the responsibility of the consulting engineer.

Please call me at (775) 888-7287 should you have any questions.

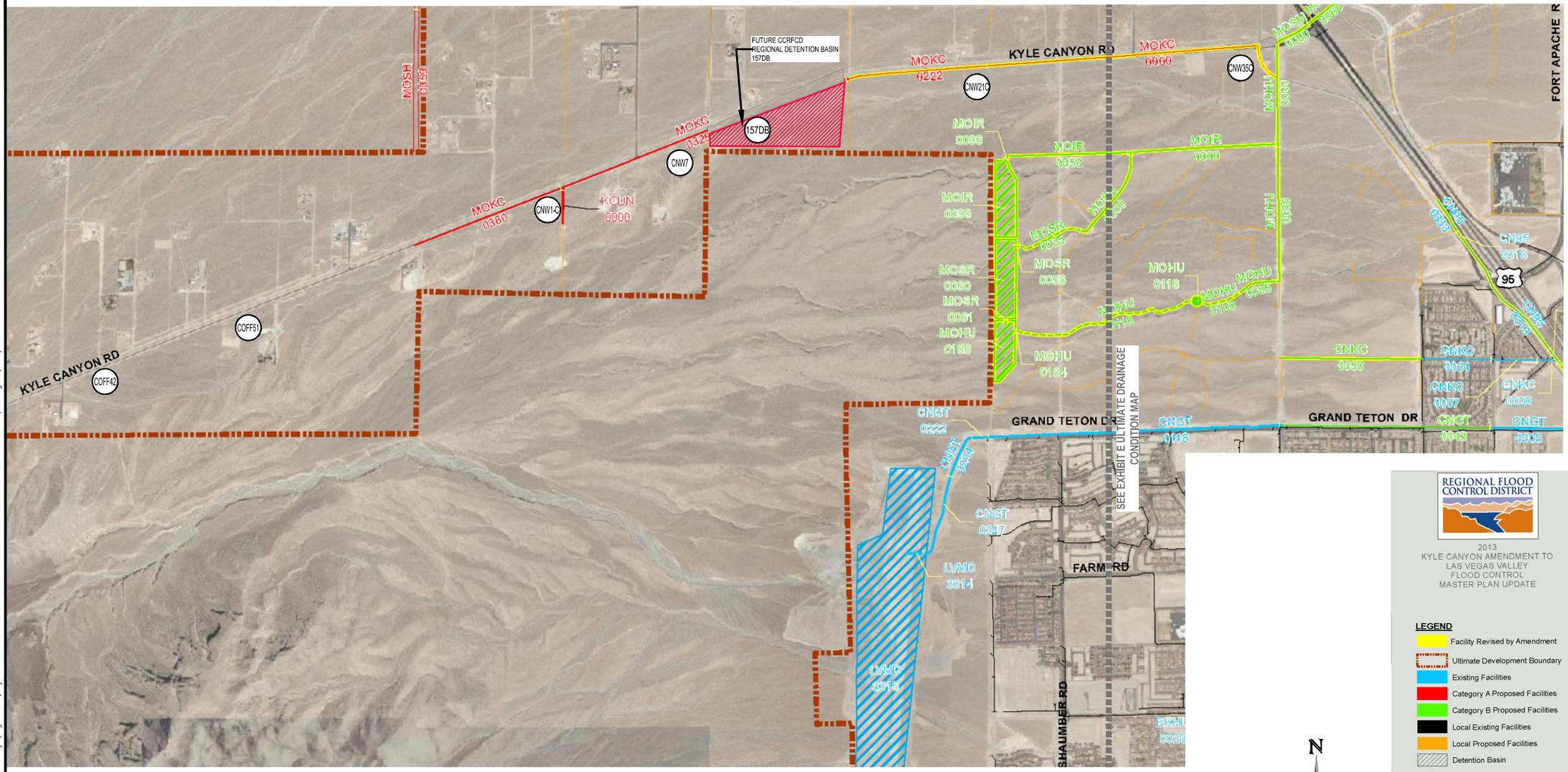
Sincerely,

Zelalem Alemu, P.E.
Senior Hydraulic Engineer

c: Charles Molisee, District 1 Permit Coordinator
Linda Olguin, District 1 Permit Coordinator

Exhibit L

(Re-Included with No Change)



			Current MPU Facilties						Revised MPU Facilites		
ID	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	Hec-1 Model	Tributary Area (sq. mi.)	Channel Slope (%)	Revised Q_{100} (cfs)	Estimated Revised Facility Size	Estimated Revised Length (ft.)
MOKC		MOCASSIN AND KYLE CANYON									
0000	P1	11' X 8' RCB	5450	2662	CNW35-C	LOWER3	2.69	3.40	1324	7' X 6' RCB	5800
0222	P1	10' X 8' RCB	1500	2341	CNW21-C	LOWER3	2.35	3.40	1139	6' X 6' RCB	N/A
0325	P1	9' X 8' RCB	5700	2192	CNW7	LOWER3	2.19	3.65	N/A	N/A	3000
		DETENTION BASIN									
157DB	N/A	71 ac-ft Detention Basin	N/A	N/A	157DB	N/A	N/A	N/A	1093	71 ac-ft	N/A

NOTE:

- FUTURE MPU AMENDMENT REQUIRED TO INCORPORATE CHANGES ON THIS EXHIBIT.

0 2000 4000

SCALE – 1"=2000' FEET

N

REGIONAL FLOOD CONTROL DISTRICT

2013
KYLE CANYON AMENDMENT TO
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

LEGEND

- Facility Revised by Amendment
- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin
- Culvert or Bridge Crossing
- Stormdrain
- Lined Channel
- Unlined Channel
- Levee/Dike
- Natural Wash/Floodway
- ID-Mile Separator

Remove & Replace/Parallel Facilities

Category A	Category B
Channel	Channel
Stormdrain	Stormdrain
Crossing	Crossing

SLATER HANIFAN GROUP
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5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118
PHONE (702) 284-5300 FAX (702) 284-5399

NO.	DESCRIPTION	DATE	BY	APP. DATE	APP.

OLYMPIA COMPANIES

SKYE CANYON - MASTER DRAINAGE STUDY
ULTIMATE CONDITION OFFSITE
WEST DRAINAGE FACILITIES MAP

DATE: APRIL 2016
DRAFTER: JSR
DESIGNER: JSR
CHECKED: SMJ

PROJECT NO.
OLY1603.000

EXHIBIT L
SHEET 1 OF 1

j:\oly1603-000 skye mds-2016\drainage\conceptual study\figures\oly1603-000 exhibit m ult offsite west facilities map.dwg 4/13/2016 4:36 PM Jonathan Rocha

APPENDIX G

Response to Comment No. 14

(Facility D3 Channel Sizing)

D3-Ult.
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Facility D3
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

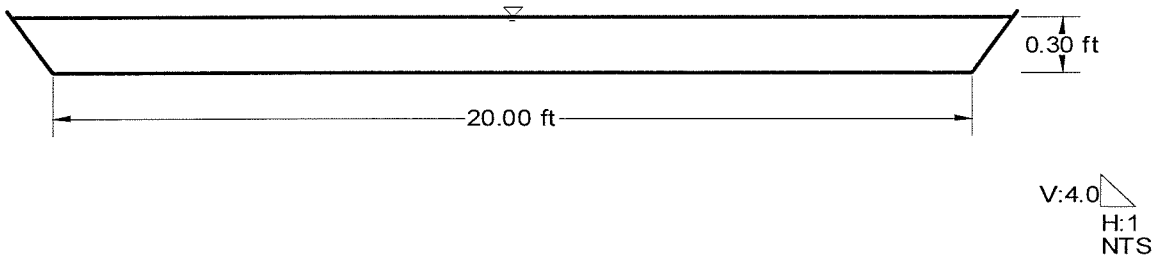
Input Data		
Mannings Coefficient	0.025	
Channel Slope	3.60	%
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	20.00	ft
Discharge	31.00	cfs

Results		
Depth	0.30	ft
Flow Area	6.3	ft²
Wetted Perimeter	21.91	ft
Top Width	21.81	ft
Critical Depth	0.41	ft
Critical Slope	1.26	%
Velocity	4.92	ft/s
Velocity Head	0.38	ft
Specific Energy	0.68	ft
Froude Number	1.61	
Flow Type	Supercritical	

D3-Ult.
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Facility D3
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.025	
Channel Slope	3.60	%
Depth	0.30	ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	20.00	ft
Discharge	31.00	cfs



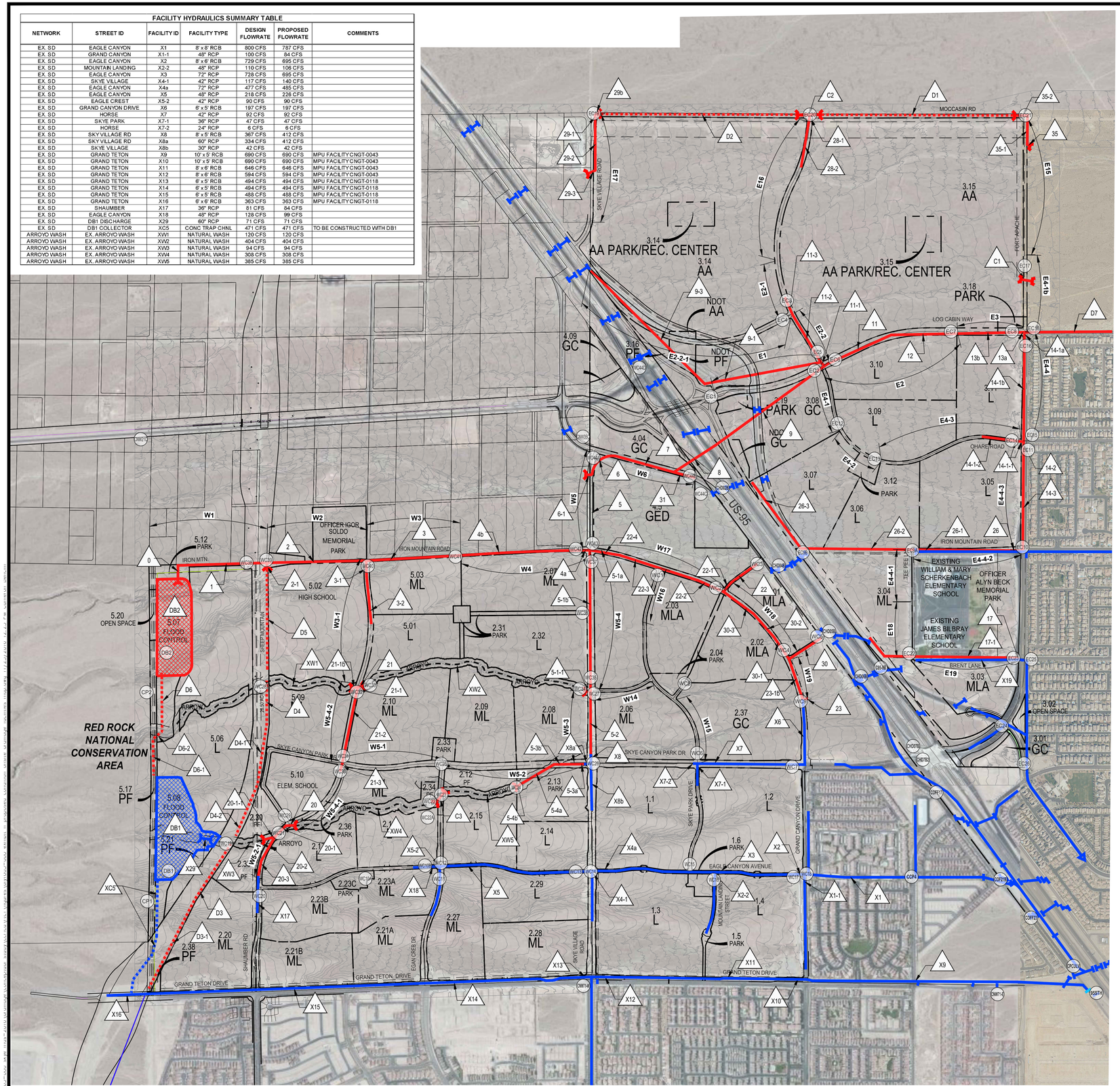
APPENDIX H

Updated Drainage Exhibits

- Exhibit H – Proposed Condition Onsite Drainage Facilities Map
- Exhibit I – Proposed Condition Offsite East Drainage Facilities Map
- Exhibit J – Ultimate Condition Onsite Drainage Facilities Map
- Exhibit K – Ultimate Condition Offsite East Drainage Facilities Map
- Exhibit O – Shadow of Protection & Phasing Exhibit

FACILITY HYDRAULICS SUMMARY TABLE

NETWORK	STREET ID	FACILITY ID	FACILITY TYPE	DESIGN FLOWRATE	PROPOSED FLOWRATE	COMMENTS
EX. SD	EAGLE CANYON	X1	8' x 8' RCB	800 CFS	787 CFS	
EX. SD	GRAND CANYON	X1-1	48" RCP	100 CFS	84 CFS	
EX. SD	EAGLE CANYON	X2	8' x 6' RCB	729 CFS	695 CFS	
EX. SD	MOUNTAIN LANDING	X2-2	48" RCP	110 CFS	106 CFS	
EX. SD	EAGLE CANYON	X3	72" RCP	728 CFS	695 CFS	
EX. SD	SKYE VILLAGE	X4-1	42" RCP	117 CFS	140 CFS	
EX. SD	EAGLE CANYON	X4a	72" RCP	477 CFS	485 CFS	
EX. SD	EAGLE CANYON	X5	48" RCP	218 CFS	226 CFS	
EX. SD	EAGLE CREST	X5-2	42" RCP	90 CFS	90 CFS	
EX. SD	GRAND CANYON DRIVE	X6	6' x 5' RCB	197 CFS	197 CFS	
EX. SD	HORSE	X7	42" RCP	92 CFS	92 CFS	
EX. SD	SKYE PARK	X7-1	36" RCP	47 CFS	47 CFS	
EX. SD	HORSE	X7-2	24" RCP	6 CFS	6 CFS	
EX. SD	SKY VILLAGE RD	X8	8' x 5' RCB	367 CFS	412 CFS	
EX. SD	SKY VILLAGE RD	X8a	60" RCP	334 CFS	412 CFS	
EX. SD	SKYE VILLAGE	X8b	30" RCP	42 CFS	42 CFS	
EX. SD	GRAND TETON	X9	10' x 5' RCB	690 CFS	690 CFS	MPU FACILITY CNGT-0043
EX. SD	GRAND TETON	X10	10' x 5' RCB	690 CFS	690 CFS	MPU FACILITY CNGT-0043
EX. SD	GRAND TETON	X11	8' x 6' RCB	646 CFS	646 CFS	MPU FACILITY CNGT-0043
EX. SD	GRAND TETON	X12	8' x 6' RCB	594 CFS	594 CFS	MPU FACILITY CNGT-0043
EX. SD	GRAND TETON	X13	6' x 5' RCB	494 CFS	494 CFS	MPU FACILITY CNGT-0118
EX. SD	GRAND TETON	X14	6' x 5' RCB	494 CFS	494 CFS	MPU FACILITY CNGT-0118
EX. SD	GRAND TETON	X15	6' x 5' RCB	488 CFS	488 CFS	MPU FACILITY CNGT-0118
EX. SD	GRAND TETON	X16	6' x 6' RCB	363 CFS	363 CFS	MPU FACILITY CNGT-0118
EX. SD	SHAUMBER	X17	36" RCP	81 CFS	84 CFS	
EX. SD	EAGLE CANYON	X18	48" RCP	128 CFS	99 CFS	
EX. SD	DB1 DISCHARGE	X29	60" RCP	71 CFS	71 CFS	
EX. SD	DB1 COLLECTOR	XC5	CONC TRAP CHNL	471 CFS	471 CFS	TO BE CONSTRUCTED WITH DB1
ARROYO WASH	EX. ARROYO WASH	XW1	NATURAL WASH	120 CFS	120 CFS	
ARROYO WASH	EX. ARROYO WASH	XW2	NATURAL WASH	404 CFS	404 CFS	
ARROYO WASH	EX. ARROYO WASH	XW3	NATURAL WASH	94 CFS	94 CFS	
ARROYO WASH	EX. ARROYO WASH	XW4	NATURAL WASH	308 CFS	308 CFS	
ARROYO WASH	EX. ARROYO WASH	XW5	NATURAL WASH	385 CFS	385 CFS	


RED ROCK NATIONAL CONSERVATION AREA
IRON MTN.
IRON MOUNTAIN ROAD
SKYE VILLAGE ROAD
SKYE CANYON PARK DR
SKYE PARK DRIVE
GRAND CANYON DRIVE
EAGLE CANYON AVENUE
GRAND TETON DRIVE
SHAUMBER RD
EGAN CREEK DR
MOUNTAIN LANDING DRIVE
MOCCASIN RD
FORT APACHE
LOG CABIN WAY
OHARE ROAD
BRENT LANE
IRON MOUNTAIN ROAD
TEE PEE
US-95
I-215
I-23
AA PARK/REC. CENTER
OFFICER IGOR SOLDO MEMORIAL PARK
HIGH SCHOOL
ELEM. SCHOOL
EXISTING WILLIAM & MARY SCHERKENBACH ELEMENTARY SCHOOL
OFFICER ALYN BECK MEMORIAL PARK
EXISTING JAMES BILBRAY ELEMENTARY SCHOOL
ARROYO
5.12 PARK
5.20 OPEN SPACE
5.07 FLOOD CONTROL
5.08 FLOOD CONTROL
5.17 PF
5.02
5.03 ML
5.01 L
2.31 PARK
2.32 L
2.67 ML
2.03 MLA
2.02 MLA
2.04 PARK
2.10 ML
2.09 ML
2.08 ML
2.06 ML
2.37 GC
2.33 PARK
2.12 PF
2.13 PARK
2.14 L
2.15 L
2.36 PARK
2.30 PF
2.23C PARK
2.23A ML
2.23B ML
2.21A ML
2.21B ML
2.27 ML
2.28 ML
2.29 L
2.20 ML
2.38 PF
1.1 L
1.2 L
1.3 L
1.4 L
1.5 PARK
1.6 PARK
3.14 AA
3.15 AA
3.16 PF
3.18 PARK
3.19 PARK
3.10 L
3.09 L
3.08 GC
3.07 L
3.12 PARK
3.06 L
3.05 L
3.04 ML
3.03 MLA
3.02 OPEN SPACE
3.01 GC
4.09 GC
4.04 GC
5.06 L
5.10 ELEM. SCHOOL
5.09
5.21 PF
5.05 GED
5.11 MLA
5.14 PARK
5.15 PARK
5.16 PARK
5.18 PARK
5.19 PARK
W1
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W4
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W5-1
W5-2
W5-3
W5-4
W5-4-1
W5-4-2
W6
W9
W14
W16
W17
W18
E1
E2
E2-1
E2-2
E2-2-1
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E4-1
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E4-1b
E4-2
E4-3
E4-4
E4-4-1
E4-4-2
E4-4-3
E15
E16
E17
E18
E19
D1
D2
D4
D4-1
D4-2
D5
D6
D6-1
D6-2
D7
C1
C2
C3
DB1
DB2
CP1
CP2
X1
X1-1
X2
X2-2
X3
X4a
X4-1
X5
X5-2
X6
X7
X7-1
X7-2
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X8a
X8b
X9
X10
X11
X12
X13
X14
X15
X16
X17
X18
X29
XW1
XW2
XW3
XW4
XW5
XC5
DRAINAGE BASIN 1
DRAINAGE BASIN 2
DRAINAGE BASIN 3
DRAINAGE BASIN 4
DRAINAGE BASIN 5
DRAINAGE BASIN 6
DRAINAGE BASIN 7
DRAINAGE BASIN 8
DRAINAGE BASIN 9
DRAINAGE BASIN 10
DRAINAGE BASIN 11
DRAINAGE BASIN 12
DRAINAGE BASIN 13
DRAINAGE BASIN

NETWORK	STREET ID	FACILITY ID	FACILITY TYPE	LENGTH	SLOPE	FLOW RATE	COMMENTS
OFFSITE SD	OUTFLOW FROM DB3	41	60" RCP	621	1.30%	187 CFS	
OFFSITE SD	RCP	42	60" RCP	1957	2.10%	187 CFS	
OFFSITE SD	DB OUTLET	44	(2) 36" RCP	329	0.50%	78 CFS	1-BARREL 36" RCP WITH 22" ORIFICE REPLACED BY 2-BARREL 36" RCP WITH 27" ORIFICE
OFFSITE SD	STATE LAND CULVERT CROSSING TO XDB1	52	72" RCP	567	1.80%	188 CFS	SIZED FOR LONG TERM DISCHARGE FROM DB3
OFFSITE SD	10-IN RIPRAP CHNL	D7	TRAP CHNL	1671	1.00%	1013 CFS	25' BOTTOM WIDTH 3:1 SIDE SLOPES; 5' DEEP

FACILITY HYDRAULICS SUMMARY TABLE

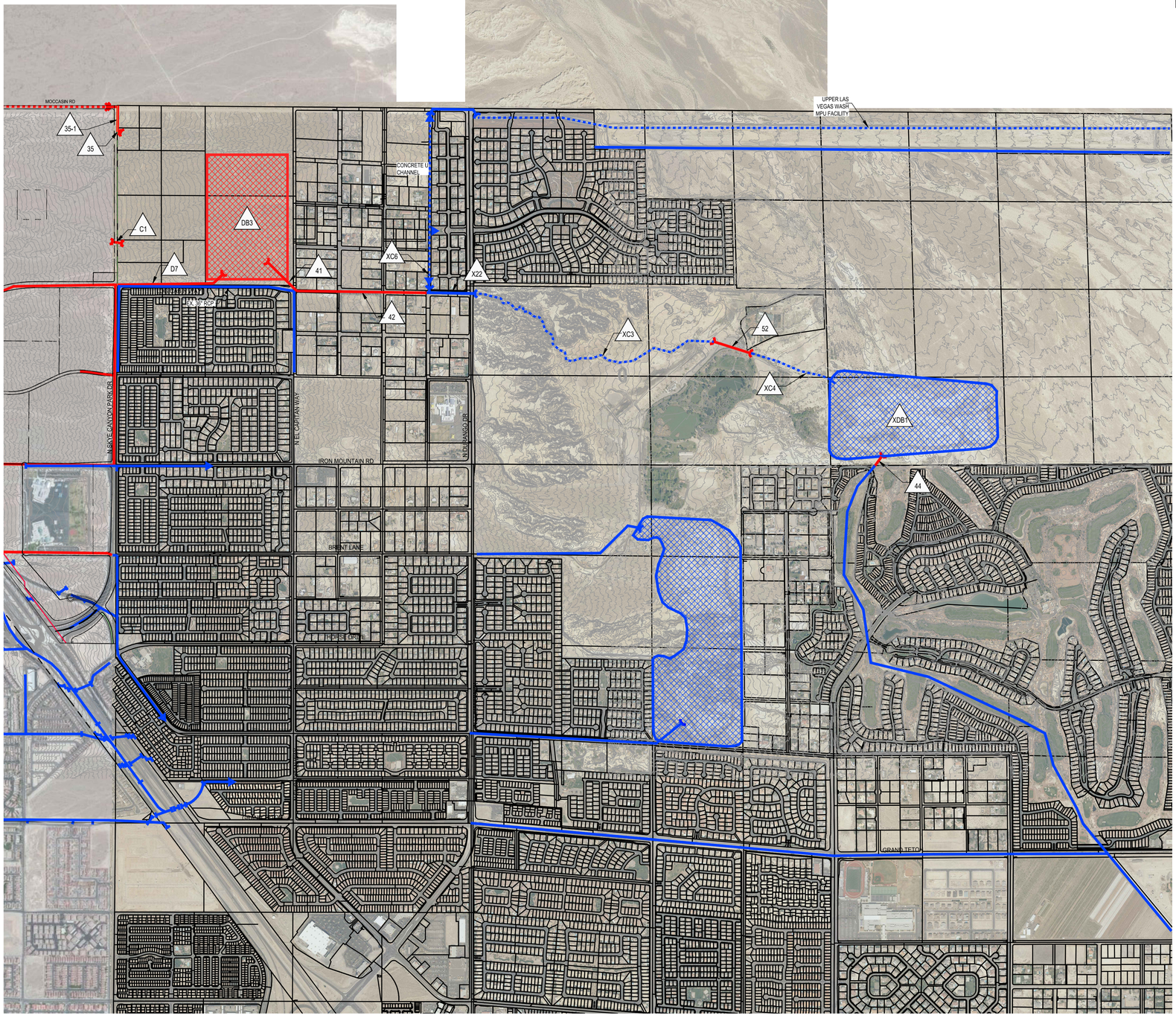
NETWORK	STREET ID	FACILITY ID	FACILITY TYPE	DESIGN FLOW RATE	PROPOSED FLOW RATE	COMMENTS
EX. SD	LOG CABIN WAY	X22	72" RCP	400 CFS	188 CFS	
EX. SD	EX. WASH	XC3	EX. WASH	413 CFS	188 CFS	
EX. SD	EX. WASH	XC4	EX. WASH	413 CFS	399 CFS	
EX. SD	EX. U-CHANNEL	XC6	EX. U-CHANNEL	238 CFS	126 CFS	

FACILITY HYDRAULICS SUMMARY TABLE

FACILITY ID	INFLOW	OUTFLOW	100-YR STORAGE	DEBRIS STORAGE	TOTAL STORAGE	PMF FLOW	COMMENTS
DB3	1385 CFS	187 CFS	156 AC-FT	8 AC-FT	164 AC-FT	2770 CFS	PROPOSED LOG CABIN DETENTION BASIN 3
XDB1	654 CFS	78 CFS	103 AC-FT	N/A	117 AC-FT	14138 CFS	TULE SPRINGS NORTH ENVIRONMENTAL DETENTION BASIN

NOTES:

- PMF NOT APPLICABLE FOR DB3; THEREFORE SPILLWAY ANTICIPATED FOR 2x 100-YR INFLOW = 2,770 CFS
- 2-FT TOPOGRAPHIC CONTOURS SHOWN ON EXHIBIT



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SCALE – 1"=800' FEET

LEGEND

- PROPOSED FACILITIES
- EXISTING FACILITIES

SLATER HANIFAN GROUP
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NO.	DESCRIPTION	DATE	BY	APP. DATE	APP.

OLYMPIA COMPANIES

SKYE CANYON - MASTER DRAINAGE STUDY

PROPOSED CONDITION OFFSITE EAST DRAINAGE FACILITIES MAP

DATE: NOV. 2016
DRAFTER: CWB
DESIGNER: SMJ
CHECKED: SMJ
PROJECT NO.
OLY1603.000

EXHIBIT I
SHEET 1 OF 1

FACILITY HYDRAULICS SUMMARY TABLE

NETWORK	STREET ID	FACILITY ID	FACILITY TYPE	DESIGN FLOW/RATE	PROPOSED FLOW/RATE	COMMENTS
EX. SD	EAGLE CANYON	X1	8' x 8' RCB	800 CFS	787 CFS	
EX. SD	GRAND CANYON	X1-1	48" RCP	100 CFS	84 CFS	
EX. SD	EAGLE CANYON	X2	8' x 6' RCB	729 CFS	695 CFS	
EX. SD	MOUNTAIN LANDING	X2-2	48" RCP	110 CFS	106 CFS	
EX. SD	EAGLE CANYON	X3	72" RCP	728 CFS	695 CFS	
EX. SD	SKYE VILLAGE	X4-1	42" RCP	117 CFS	140 CFS	
EX. SD	EAGLE CANYON	X4a	72" RCP	477 CFS	485 CFS	
EX. SD	EAGLE CANYON	X5	48" RCP	218 CFS	226 CFS	
EX. SD	EAGLE CREST	X5-2	42" RCP	90 CFS	90 CFS	
EX. SD	GRAND CANYON DRIVE	X6	6' x 5' RCB	197 CFS	197 CFS	
EX. SD	HORSE	X7	42" RCP	92 CFS	92 CFS	
EX. SD	SKYE PARK	X7-1	36" RCP	47 CFS	47 CFS	
EX. SD	HORSE	X7-2	24" RCP	6 CFS	6 CFS	
EX. SD	SKY VILLAGE RD	X8	8' x 5' RCB	367 CFS	412 CFS	
EX. SD	SKY VILLAGE RD	X8a	60" RCP	334 CFS	412 CFS	
EX. SD	SKYE VILLAGE	X8b	30" RCP	42 CFS	42 CFS	
EX. SD	GRAND TETON	X9	10' x 5' RCB	690 CFS	690 CFS	MPU FACILITY CNGT-0043
EX. SD	GRAND TETON	X10	10' x 5' RCB	690 CFS	690 CFS	MPU FACILITY CNGT-0043
EX. SD	GRAND TETON	X11	8' x 6' RCB	646 CFS	646 CFS	MPU FACILITY CNGT-0043
EX. SD	GRAND TETON	X12	8' x 6' RCB	594 CFS	594 CFS	MPU FACILITY CNGT-0043
EX. SD	GRAND TETON	X13	6' x 5' RCB	494 CFS	494 CFS	MPU FACILITY CNGT-0118
EX. SD	GRAND TETON	X14	6' x 5' RCB	494 CFS	494 CFS	MPU FACILITY CNGT-0118
EX. SD	GRAND TETON	X15	6' x 5' RCB	488 CFS	488 CFS	MPU FACILITY CNGT-0118
EX. SD	GRAND TETON	X16	6' x 6' RCB	363 CFS	363 CFS	MPU FACILITY CNGT-0118
EX. SD	SHAUMBER	X17	36" RCP	81 CFS	84 CFS	
EX. SD	EAGLE CANYON	X18	48" RCP	128 CFS	99 CFS	
EX. SD	DB1 DISCHARGE	X29	60" RCP	71 CFS	71 CFS	
EX. SD	DB1 COLLECTOR	XC5	CONC TRAP CHNL	471 CFS	471 CFS	TO BE CONSTRUCTED WITH DB1
ARROYO WASH	EX. ARROYO WASH	XW1	NATURAL WASH	120 CFS	120 CFS	
ARROYO WASH	EX. ARROYO WASH	XW2	NATURAL WASH	404 CFS	404 CFS	
ARROYO WASH	EX. ARROYO WASH	XW3	NATURAL WASH	94 CFS	94 CFS	
ARROYO WASH	EX. ARROYO WASH	XW4	NATURAL WASH	308 CFS	308 CFS	
ARROYO WASH	EX. ARROYO WASH	XW5	NATURAL WASH	385 CFS	385 CFS	

DETENTION BASIN HYDRAULIC SUMMARY TABLE

FACILITY ID	INFLOW	OUTFLOW	100-YR STORAGE	DEBRIS STORAGE	TOTAL STORAGE	PMF FLOW	COMMENTS
DB1	794 CFS	71 CFS	57 AC-FT	6 AC-FT	63 AC-FT	6744 CFS	EXISTING DETENTION BASIN 1
DB2	708 CFS	57 CFS	72 AC-FT	6 AC-FT	78 AC-FT	5899 CFS	PROPOSED DETENTION BASIN 2

FACILITY HYDRAULICS SUMMARY TABLE

NETWORK	STREET ID	FACILITY ID	FACILITY TYPE	LENGTH	SLOPE	FLOW	COMMENTS
WEST SD	DB2 OUTLET	0	30" RCP	214'	2.00%	57 CFS	
WEST SD	W1	1	42" RCP	1099'	2.90%	65 CFS	
WEST SD	W2	2	42" RCP	1236'	5.00%	90 CFS	
WEST SD	INFLOW FROM SHEEP MOUNTAIN CHNL	2-1	24" RCP	66'	4.40%	19 CFS	
WEST SD	W3	3	54" RCP	1161'	3.20%	227 CFS	
WEST SD	W3-1	3-1	42" RCP	191'	3.00%	112 CFS	
WEST SD	W3-1	3-2	30" RCP	595'	1.70%	40 CFS	
WEST SD	W4	4a	54" RCP	100'	4.50%	370 CFS	
WEST SD	W4	4b	54" RCP	1500'	4.50%	249 CFS	
WEST SD	W5	5	13' x 6' RCB	931'	1.80%	1296 CFS	PER KYLE INTERCHANGE HYDRAULIC SUPPLEMENT
WEST SD	ARROYO WASH INFLOW	5-1-1	6'x 6' RCB	51'	14.60%	404 CFS	
WEST SD	W5-4	5-1a	13' x 6' RCB	100'	2.10%	1000 CFS	PER KYLE INTERCHANGE HYDRAULIC SUPPLEMENT
WEST SD	W5-4	5-1b	11' x 6' RCB	165'	0.50%	816 CFS	PER KYLE INTERCHANGE HYDRAULIC SUPPLEMENT
WEST SD	W5-3	5-2	9' x 6' RCB	779'	0.50%	412 CFS	PER KYLE INTERCHANGE HYDRAULIC SUPPLEMENT
WEST SD	W5-2	5-3a	60" RCP	79'	3.00%	412 CFS	
WEST SD	W5-2	5-3b	60" RCP	301'	0.03	359 CFS	
WEST SD	CONVEYS FLOW TO SD 5-3a	5-4a	60" RCP	491'	3.00%	359 CFS	
WEST SD	INFLOW FROM ARROYO WASH	5-4b	6' x 6' RCB	50'	2.80%	359 CFS	
WEST SD	W6	6	13' x 6' RCB	445'	1.80%	1296 CFS	PER KYLE INTERCHANGE HYDRAULIC SUPPLEMENT
WEST SD	N/A	6-1	(6) 10' X 4' RCB	62'	N/A	N/A	INTERIM COLLECTOR PRIOR TO COMPLETION OF FACILITY 7-1; CAPPED/PLUGGED IN ULTIMATE CONDITION
WEST SD	W6	7	13'X6' RCB	723'	1.80%	2079 CFS	PER KYLE INTERCHANGE HYDRAULIC SUPPLEMENT
WEST SD	MPU FACILITY	7-1	9' X 6' RCB	309'	5.00%	1324 CFS	MCKC-0000 MPU FACILITY PER KYLE INTERCHANGE HYDRAULIC SUPPLEMENT
WEST SD	DISCHARGE TO ARROYO WASH	20	60" RCP	109'	2.00%	201 CFS	
WEST SD	W5-2-1	20-1	48" RCP	194'	2.00%	180 CFS	
WEST SD	INFLOW FROM DB1	20-1-1	48" RCP	135'	2.20%	94 CFS	
WEST SD	W5-2-1	20-2	36" RCP	340'	3.00%	84 CFS	
WEST SD	W5-2-1	20-3	36" RCP	193'	3.50%	84 CFS	
WEST SD	DISCHARGE TO ARROYO WASH	21	54" RCP	42'	4.00%	244 CFS	
WEST SD	W5-4-2	21-1	42" RCP	100'	2.50%	124 CFS	
WEST SD	INFLOW FROM ARROYO WASH	21-1b	54" RCP	68'	3.40%	120 CFS	
WEST SD	W5-4-2	21-2	36" RCP	863'	3.40%	62 CFS	
WEST SD	W5-4-1	21-3	36" RCP	105'	0.013	62 CFS	
WEST SD	N/A	22	7' X 6' RCB	426'	2.20%	73 CFS	
WEST SD	N/A	22-1	7' X 6' RCB	146'	2.20%	73 CFS	
WEST SD	W17	22-2	8' x 6' RCB	339'	2.00%	73 CFS	COMPLETION OF CCRFCD REGIONAL FACILITIES MAY ELIMINATE NEED FOR STORM DRAIN
WEST SD	W17	22-3	8' X 6' RCB	1017'	2.00%	0 CFS	COMPLETION OF CCRFCD REGIONAL FACILITIES MAY ELIMINATE NEED FOR STORM DRAIN
WEST SD	W17	22-4	8' X 6' RCB	382'	2.60%	0 CFS	COMPLETION OF CCRFCD REGIONAL FACILITIES MAY ELIMINATE NEED FOR STORM DRAIN
WEST SD	W19 OUTLET TO WASH	23	36" RCP	59'	3.40%	288 CFS	
WEST SD	W19	23-1b	54" RCP	529'	1.70%	0 CFS	COMPLETION OF CCRFCD REGIONAL FACILITIES MAY ELIMINATE NEED FOR STORM DRAIN
WEST SD	N/A	30	42" RCP	476'	2.50%	170 CFS	
WEST SD	W18	30-1	72" RCP	297'	1.20%	135 CFS	COMPLETION OF CCRFCD REGIONAL FACILITIES MAY ELIMINATE NEED FOR STORM DRAIN
WEST SD	W18	30-2	54" RCP	364'	1.80%	0 CFS	COMPLETION OF CCRFCD REGIONAL FACILITIES MAY ELIMINATE NEED FOR STORM DRAIN
WEST SD	W18	30-3	54" RCP	527'	1.40%	0 CFS	COMPLETION OF CCRFCD REGIONAL FACILITIES MAY ELIMINATE NEED FOR STORM DRAIN
WEST SD	W6	31	8' X 6' RCB	272'	2.00%	0 CFS	PLUGGED/ABANDONED UPON COMPLETION OF CCRFCD FACILITIES
WEST SD	DISCHARGE FROM SB	50	CONC TRAP CHNL	1017'	1.50%	471 CFS	12' BOTTOM WIDTH, 5' DEEP (TO BE CONSTRUCTED BY GRAND TETON/SHEEP MTN INTERCHANGE, REPLACES FACILITY XC5)
WEST SD	ARROYO WASH CULVERT	C3	6' X 5' RCB	164'	6.10%	308 CFS	
WEST SD	SHEEP MOUNTAIN CHNL	D3	EARTHEN TRAP CHNL	815'	3.60%	31 CFS	20' BOTTOM WIDTH, 3:1 SIDE SLOPES, 3' DEEP
WEST SD	SHEEP MOUNTAIN CHNL	D3-1	EARTHEN TRAP CHNL	1239'	1.70%	31 CFS	8' BOTTOM WIDTH, 3:1 SIDE SLOPES, 3' DEEP
WEST SD	SHEEP MOUNTAIN CHNL	D4	EARTHEN TRAP CHNL	534'	4.50%	11 CFS	5' BOTTOM WIDTH, 3:1 SIDE SLOPES, 3' DEEP
WEST SD	SHEEP MOUNTAIN CHNL	D4-1	EARTHEN TRAP CHNL	757'	1.50%	11 CFS	5' BOTTOM WIDTH, 3:1 SIDE SLOPES, 3' DEEP
WEST SD	SHEEP MOUNTAIN CHNL	D4-2	EARTHEN TRAP CHNL	691'	1.00%	11 CFS	5' BOTTOM WIDTH, 3:1 SIDE SLOPES, 3' DEEP
WEST SD	SHEEP MOUNTAIN CHNL	D5	EARTHEN TRAP CHNL	1252'	0.012	6 CFS	5' BOTTOM WIDTH, 3:1 SIDE SLOPES, 3' DEEP
WEST SD	CHANNEL TO DB2	D6	CONCRETE TRAP CHNL	723'	3.00%	235 CFS	12' BOTTOM WIDTH, 3:1 SIDE SLOPES, 3' DEEP TO BE CONSTRUCTED WITH DB2
WEST SD	CHANNEL TO DB2	D6-1	EARTHEN TRAP CHNL	451'	0.90%	10 CFS	5' BOTTOM WIDTH, 3:1 SIDE SLOPES, 3' DEEP TO BE CONSTRUCTED WITH DB2
WEST SD	CHANNEL TO DB2	D6-2	EARTHEN TRAP CHNL	145'	1.40%	10 CFS	5' BOTTOM WIDTH, 3:1 SIDE SLOPES, 3' DEEP TO BE CONSTRUCTED WITH DB2

FACILITY HYDRAULICS SUMMARY TABLE

NETWORK	STREET ID	FACILITY ID	FACILITY TYPE	LENGTH	SLOPE	FLOW	COMMENTS
EAST SD	US-95 SD CROSSING	8	13' x 6' RCB	605'	2.90%	2079 CFS	TO BE CONSTRUCTED BY SEPARATE CLV KYLE INTERCHANGE PROJECT
EAST SD	RCB	9	13' x 6' RCB	1724'	2.50%	2079 CFS	PER KYLE INTERCHANGE HYDRAULIC SUPPLEMENT
EAST SD	US-95	9-1	72" RCP	1462'	1.40%	250 CFS	
EAST SD	US-95	9-3	72" RCP	1987'	1.50%	250 CFS	
EAST SD	E2	11	13' X 7' RCB	913'	2.90%	2532 CFS	PER KYLE INTERCHANGE HYDRAULIC SUPPLEMENT
EAST SD	E2-2	11-1	72" RCP	53'	3.00%	432 CFS	PER KYLE INTERCHANGE HYDRAULIC SUPPLEMENT
EAST SD	E2-2	11-2	42" RCP	680'	1.20%	73 CFS	
EAST SD	E2-1	11-3	30" RCP	238'	1.70%	39 CFS	
EAST SD	E2	12	13' X 7' RCB	794'	2.90%	2532 CFS	
EAST SD	E3	13a	13' X 7' RCB	50'	1.60%	2606 CFS	
EAST SD	E3	13b	13' X 7' RCB	809'	2.90%	2532 CFS	
OFFSITE SD	LOG CABIN WAY	14	14' x 7' RCB	1591'	2.20%	3137 CFS	SEE EXHIBIT K FOR CONTINUATION
EAST SD	E4-3	14-1-1	42" RCP	50'	5.00%	181 CFS	
EAST SD	E4-3	14-1-2	24" RCP	481'	5.00%	36 CFS	
EAST SD	E4-4	14-1a	72" RCP	51'	0.70%	276 CFS	
EAST SD	E4-4	14-1b	72" RCP	1303'	0.007	254 CFS	
EAST SD	E4-4-3	14-2	60" RCP	50'	0.40%	73 CFS	
EAST SD	E-4-4-3	14-3	54" RCP	1299'	0.40%	0 CFS	
EAST SD	E19	17	36" RCP	56'	3.00%	70 CFS	
EAST SD	E19	17-1	6' x 6' RCB	1632'	3.50%	83 CFS	
EAST SD	PARCEL 3.04	17-2	48" RCP	298'	2.30%	220 CFS	
EAST SD	E4-4-2	26	60" RCP	209'	2.60%	57 CFS	
EAST SD	E4-4-2	26-1	60" RCP	1180'	2.60%	57 CFS	
EAST SD	PARCEL 3.06	26-2	60" RCP	1355'	2.60%	23 CFS	
EAST SD	PARCEL 3.07	26-3	60" RCP	1018'	2.50%	23 CFS	
EAST SD	MPU FACILITY	28	N/A	N/A	N/A	N/A	LVMO-0144 MPU FACILITY, REPLACES PROP. CONDITION FACILITY D1
EAST SD	E16	28-1	60" RCP	50'	0.80%	199 CFS	
EAST SD	E16	28-2	42" RCP	660'	0.80%	81 CFS	
EAST SD	MPU FACILITY	29	N/A	N/A	N/A	N/A	LVMO-0184 MPU FACILITY, REPLACES PROP. CONDITION FACILITY D2
EAST SD	E17	29-1	66" RCP	50'	4.00%	72 CFS	
EAST SD	E17	29-2	66" RCP	647'	0.60%	25 CFS	
PROPOSED SD	CROSSING FORT APACHE	35	66" RCP	46'	0.005	0 CFS	NOT UTILIZED WITHIN THE ULTIMATE CONDITIONS
PROPOSED SD	E15	35-1	66" RCP	359'	0.80%	0 CFS	NOT UTILIZED WITHIN THE ULTIMATE CONDITIONS
PROPOSED SD	MOCASSIN CHNL INFLOW	35-2	66" RCP	120'	3.30%	0 CFS	NOT UTILIZED WITHIN THE ULTIMATE CONDITIONS
PROPOSED SD	C1	C1	72" RCP	147'	2.00%	0 CFS	NOT UTILIZED WITHIN THE ULTIMATE CONDITIONS
PROPOSED SD	CULVERT CROSSING	C2	6' x 6' RCB	155'	1.00%	0 CFS	NOT UTILIZED WITHIN THE ULTIMATE CONDITIONS

NOTES:

- REFER TO EXHIBIT M - ULTIMATE CONDITION US-95 HYDRAULICS SUMMARY MAP FOR DETAILED FLOW THRU EXISTING US-95 CULVERTS & RCB FACILITIES
- REFER TO EXHIBIT K - ULTIMATE CONDITION OFFSITE EAST FACILITIES MAP FOR EXTENSION OF FACILITIES REQUIRED IN MPU ALIGNMENT EAST OF SKYE CANYON.
- 5-FT TOPOGRAPHIC CONTOURS SHOWN ON EXHIBIT

LEGEND

- PROPOSED LOCAL FACILITIES
- EXISTING LOCAL FACILITIES
- FUTURE LOCAL FACILITIES
- PROP CCRFCD REGIONAL FACILITIES (BY DEVELOPER)
- PROP CCRFCD REGIONAL FACILITIES (BY DEVELOPER W/ CLV COST SHARING)
- FUTURE CCRFCD REGIONAL FACILITIES (BY OTHERS)
- EXISTING CCRFCD REGIONAL FACILITIES
- LCHU — MPU AMENDMENT FACILITY ALIGNMENT
- ID — STREET SEGMENT ID

N

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SCALE – 1"=600' FEET

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NO. | DESCRIPTION | DATE | BY | APP. DATE | APP.

OLYMPIA COMPANIES

SKYE CANYON - MASTER DRAINAGE STUDY

ULTIMATE CONDITIONS ONSITE DRAINAGE FACILITIES MAP

DATE: NOV. 2016
DRAFTER: CWB
DESIGNER: SMJ
CHECKED: SMJ

PROJECT NO.
OLY1603.000

EXHIBIT J
SHEET 1 OF 1

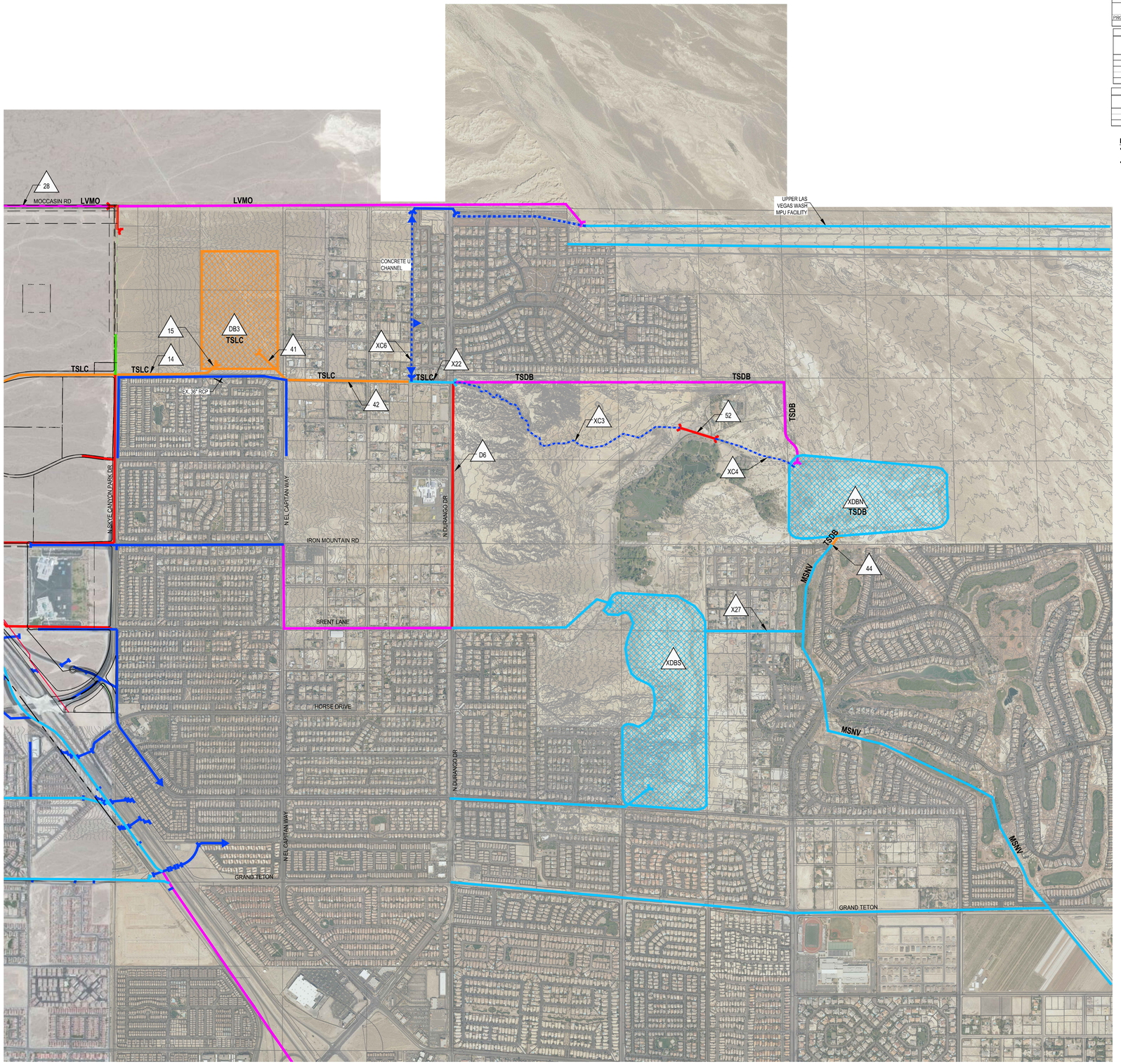
FACILITY HYDRAULICS SUMMARY TABLE							
NETWORK	STREET ID	FACILITY ID	FACILITY TYPE	LENGTH	SLOPE	FLOW RATE	COMMENTS
OFFSITE SD	LOG CABIN WAY	14	14' x 7' RCB	1457	2.20%	3137 CFS	
OFFSITE SD	DISCHARGE TO DB3	15	14' x 7' RCB	192	2.20%	3137 CFS	
OFFSITE SD	OUTFLOW FROM DB3	41	60" RCP	604	1.30%	134 CFS	44" ORFICE PLATE DB3 OUTFALL
OFFSITE SD	RCP	42	60" RCP	1957	2.10%	134 CFS	
OFFSITE SD	DISCHARGE TO XDBN	43	72" RCP	1360	0.80%	409 CFS	
OFFSITE SD	DB OUTLET	44	(2) 36" RCP	329	0.50%	80 CFS	1-BARREL 36" RCP WITH 22" ORFICE REPLACED BY 2-BARREL 36" RCP WITH 27" ORFICE
PROPOSED OFFSITE SD	STATELAND CULVERT CROSSING TO XDB1	52	72" RCP	567	1.80%	409 CFS	
OFFSITE SD	EARTHERN TRAP CHNL	D6	DURANGO DR	3907	0.50%	65 CFS	9' BOTTOM WIDTH, 3:1 SIDE SLOPES, 3' DEEP

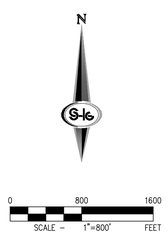
FACILITY HYDRAULICS SUMMARY TABLE					
NETWORK	STREET ID	FACILITY ID	FACILITY TYPE	DESIGN FLOW RATE	ULTIMATE FLOW RATE	COMMENTS
EX. SD	LOG CABIN WAY	X22	72" RCP	400 CFS	206 CFS	
EX. SD	XDBS OUTFLOW	X27	30" RCP	37 CFS	36 CFS	
EX. SD	EX. WASH	XC3	EX. WASH	400 CFS	163 CFS	
EX. SD	EX. WASH	XC4	EX. WASH	400 CFS	409 CFS	
EX. SD	EX. U-CHANNEL	XC6	EX. U-CHANNEL	238 CFS	126 CFS	

FACILITY HYDRAULICS SUMMARY TABLE							
FACILITY ID	INFLOW	OUTFLOW	100-YR STORAGE	DEBRIS STORAGE	TOTAL STORAGE	PMF FLOW	COMMENTS
DB3	3269 CFS	134 CFS	467 AC-FT	8 AC-FT	475 AC-FT	6538 CFS	ULTIMATE LOG CABIN DETENTION BASIN 3
XDBN	789 CFS	80 CFS	109 AC-FT	N/A	117 AC-FT	14138 CFS	TULE SPRINGS NORTH ENVIRONMENTAL DETENTION BASIN
XDBS	1482 CFS	36 CFS	141 AC-FT	N/A	450 AC-FT	45080 CFS	TULE SPRINGS SOUTH ENVIRONMENTAL DETENTION BASIN

NOTES:

- PMF NOT APPLICABLE FOR DB3; THEREFORE SPILLWAY ANTICIPATED FOR 2x 100-YR INFLOW = 6,538 CFS
- 2-FT TOPOGRAPHIC CONTOURS SHOWN ON THIS EXHIBIT





LEGEND

- PROPOSED LOCAL FACILITIES
- EXISTING LOCAL FACILITIES
- FUTURE LOCAL FACILITIES
- PROP CCRFCD REGIONAL FACILITIES (BY DEVELOPER)
- PROP CCRFCD REGIONAL FACILITIES (BY DEVELOPER W/ CLV COST SHARING)
- FUTURE CCRFCD REGIONAL FACILITIES (BY OTHERS)
- EXISTING CCRFCD REGIONAL FACILITIES
- LCHU MPU AMENDMENT FACILITY ALIGNMENT

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NO.	DESCRIPTION	DATE	BY	APP. DATE	APP.

OLYMPIA COMPANIES

SKYE CANYON - MASTER DRAINAGE STUDY

ULTIMATE CONDITION OFFSITE EAST DRAINAGE FACILITIES MAP

DATE: NOV. 2016
DRAFTER: CWB
DESIGNER: SMJ
CHECKED: SMJ
PROJECT NO. OLY1603.000

EXHIBIT K
SHEET 1 OF 1

MOCCASIN ROAD

SKY POINTE DRIVE

OSO BLANCA RD

US-95

HUALAPAI WAY

SKYE CANYON PARK DR.

N

NOT TO SCALE

PHASE 3

SEE EXHIBIT K FOR CONTINUATION OF FACILITIES REQUIRED FOR PHASE 3 (ALL PROP. FACILITIES ON EXHIBIT K)

LOG CABIN WAY

SR-157

SR-157

PHASE 7

PHASE 5

US-95

IRON MOUNTAIN ROAD

IRON MOUNTAIN ROAD

DETENTION BASIN #2

SHEEP MOUNTAIN PARKWAY

PHASE 6

PHASE 4

BRENT LANE

RED ROCK NATIONAL CONSERVATION AREA

SKYE CANYON PARK DR.

DETENTION BASIN #1

SKYE CANYON PARK

PHASE 1

EAGLE CANYON AVENUE

SHAUMBER ROAD

EGAN CREST DRIVE

SKYE VILLAGE DRIVE

GRAND CANYON DRIVE

PHASE 2

GRAND TETON DRIVE

LEGEND

- PROJECT BOUNDARY
- PHASE BOUNDARY
- SHADOW OF PROTECTION FROM DETENTION BASIN 1
- SHADOW OF PROTECTION FROM DETENTION BASIN 2
- MASTER DRAINAGE INFRASTRUCTURE REQUIRED PRIOR TO BUILDING PERMITS FOR PHASE 1
- MASTER DRAINAGE INFRASTRUCTURE REQUIRED PRIOR TO BUILDING PERMITS FOR PHASE 2
- MASTER DRAINAGE INFRASTRUCTURE REQUIRED PRIOR TO BUILDING PERMITS FOR PHASE 3
- MASTER DRAINAGE INFRASTRUCTURE REQUIRED PRIOR TO BUILDING PERMITS FOR PHASE 4
- MASTER DRAINAGE INFRASTRUCTURE REQUIRED PRIOR TO BUILDING PERMITS FOR PHASE 5
- MASTER DRAINAGE INFRASTRUCTURE REQUIRED PRIOR TO BUILDING PERMITS FOR PHASE 6

NOTES:

1. DETENTION BASIN(S) MAY BE REQUIRED TO BE IN PLACE AND FUNCTIONING TO PROTECT THE APPLICABLE SHADOW OF PROTECTION AREAS, UNLESS OTHERWISE ABLE TO DEMONSTRATE THAT DEVELOPMENT OF AN AFFECTED AREA DOES NOT ADVERSELY IMPACT DOWNSTREAM PROPERTY.
2. ALL AREAS NOT LOCATED WITHIN A SHADOW OF PROTECTION AREA WILL BE REQUIRED TO SHOW DEVELOPMENT DOES NOT ADVERSELY IMPACT DOWNSTREAM PROPERTY.
3. PHASING SHOWN ON THIS EXHIBIT IS CONSIDERED PRELIMINARY. AS FUTURE PHASES PROGRESS AND DO NOT MATCH AS PRESENTED, THIS EXHIBIT WILL NEED TO BE UPDATED.
4. THE DESIGNATED MASTER DRAINAGE INFRASTRUCTURE FOR EACH PHASE IS CONCEPTUAL IN NATURE ONLY. A TECHNICAL DRAINAGE STUDY FOR EACH PHASE OF MASTER DRAINAGE INFRASTRUCTURE IS REQUIRED TO FORMALLY ESTABLISH THE LIMITS OF FACILITIES AND ADEQUATE FLOOD PROTECTION.

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NO.	DESCRIPTION	DATE	BY	APP. DATE	APP.

OLYMPIA COMPANIES

SKYE CANYON - MASTER DRAINAGE STUDY

SHADOW OF PROTECTION & PRELIMINARY PHASING EXHIBIT

DATE: NOV. 2016
DRAFTER:CWB
DESIGNERSMJ
CHECKED:SMJ
PROJECT NO.
OLY1603.000

EXHIBIT O
SHEET 1 OF 1