Constraints Analysis

for

Three Bridges in Nogales, AZ:
Gold Hill Road, Produce Row, and Calle Sonora

Project Number: 15-12913

Prepared for:

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Submitted to:
City of Nogales

October 2015

EXPIRES 3/31/18

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1.0 Introduction

City of Nogales Project No: 15-12913
Project Title: Constraints Analysis for Three Bridges in Nogales, AZ:
Gold Hill Road, Produce Row, and Calle Sonora

The constraints analysis document has been prepared to determine if improvements can be made to three (3) side streets east of Grand Avenue (B-19): Gold Hill Road, Produce Row and Calle Sonora. This study evaluated the feasibility to realigning the roadway to meet horizontal curvature standards, adding capacity to accommodate future traffic, improving turning movements, and replacing the bridges over the Nogales Wash with a structure designed to accommodate the overweight truck traffic design load all while not adversely impacting floodplain elevations, accommodating utilities, and meeting Union Pacific Railroad and ADOT standards for design and signalization. The State Map and Project Vicinity Map are located in **Figure 1** and **Figure 2**.

The project consists of three side street segments along Grand Avenue (B-19). Project exhibits are located in **Appendix A**.

Calle Sonora

The Calle Sonora segment begins at the Grand Avenue east curb line and continues east to Smokey Lane. The segment then continues southward along Hohokam Drive approximately 600 feet. The reconstruction along Calle Sonora includes eastbound and westbound travel lanes with curb, gutter and sidewalk, a concrete median to provide driveway access control, a one-way center left turn lane, a right turn bay to northbound Grand Avenue and replacement of the bridge over Nogales Wash. Hohokam Drive will be realigned approximately 300 feet to the east to incorporate a one-way loop connection to Smokey Lane which will divert the turning vehicles causing queues on Calle Sonora.

Produce Row

The Produce Row segment begins at the Grand Avenue east curb line and continues east to Donna Avenue. The reconstruction along Produce Row includes eastbound and westbound travel lanes with 6 foot shoulders, a one-way center left turn lane, and replacement of the bridge over Nogales Wash.

Gold Hill Road

The Gold Hill Road segment begins 300 feet west of Grand Avenue on Mesa Verde Road and continues east along Gold Hill Road, terminating 400 feet east of Palenque Avenue. The reconstruction along Mesa Verde Road includes eastbound and westbound travel lanes with curb, gutter and sidewalk, a one-way center left turn lane, and driveway relocations. The reconstruction along Gold Hill Road includes eastbound and westbound travel lanes with curb and gutter, a one-way center left turn lane, replacement of the bridge over Nogales Wash and geometric

realignment east of the railroad tracks. The purpose of the realignment is to remove the 90 degree turn (horizontal curve) and improve safety at the Silver Hill Drive intersection.

The roadway and structure needs will require additional right-of-way and easements. Right-of-way shown in exhibits is based on GIS data. Survey will be required during final design to determine needs and acquisition.

The total estimated cost for this project is $11,200,000. This cost reflects project construction, design and right-of-way costs. Environmental clearance is not included. A breakdown of the costs is as follows:

Calle Sonora

Construction Cost	$3,070,000
Design Cost	$405,000
Right-of-Way	$700,000
Total Project Cost	$4,800,000

Produce Row

Construction Cost	$1,720,000
Design Cost	$230,000
Right-of-Way	$158,000
Total Project Cost	$2,500,000

Gold Hill Road

Construction Cost	$2,800,000
Design Cost	$369,000
Right-of-Way	$179,000
Total Project Cost	$3,900,000

These conceptual designs are preliminary and have not addressed all design issues such as minimizing impacts to neighboring properties and incorporating feedback from stakeholders. Final design will follow a process whereby many of these design details will be addressed and presented to City Staff at multiple design stages to demonstrate how concerns are being incorporated. No funds have currently been allocated for the project; however, the City has overweight permit fees that can be applied toward both final design and construction. An itemized cost estimate is provided in **Figure 7**.

Figure 1. State Map

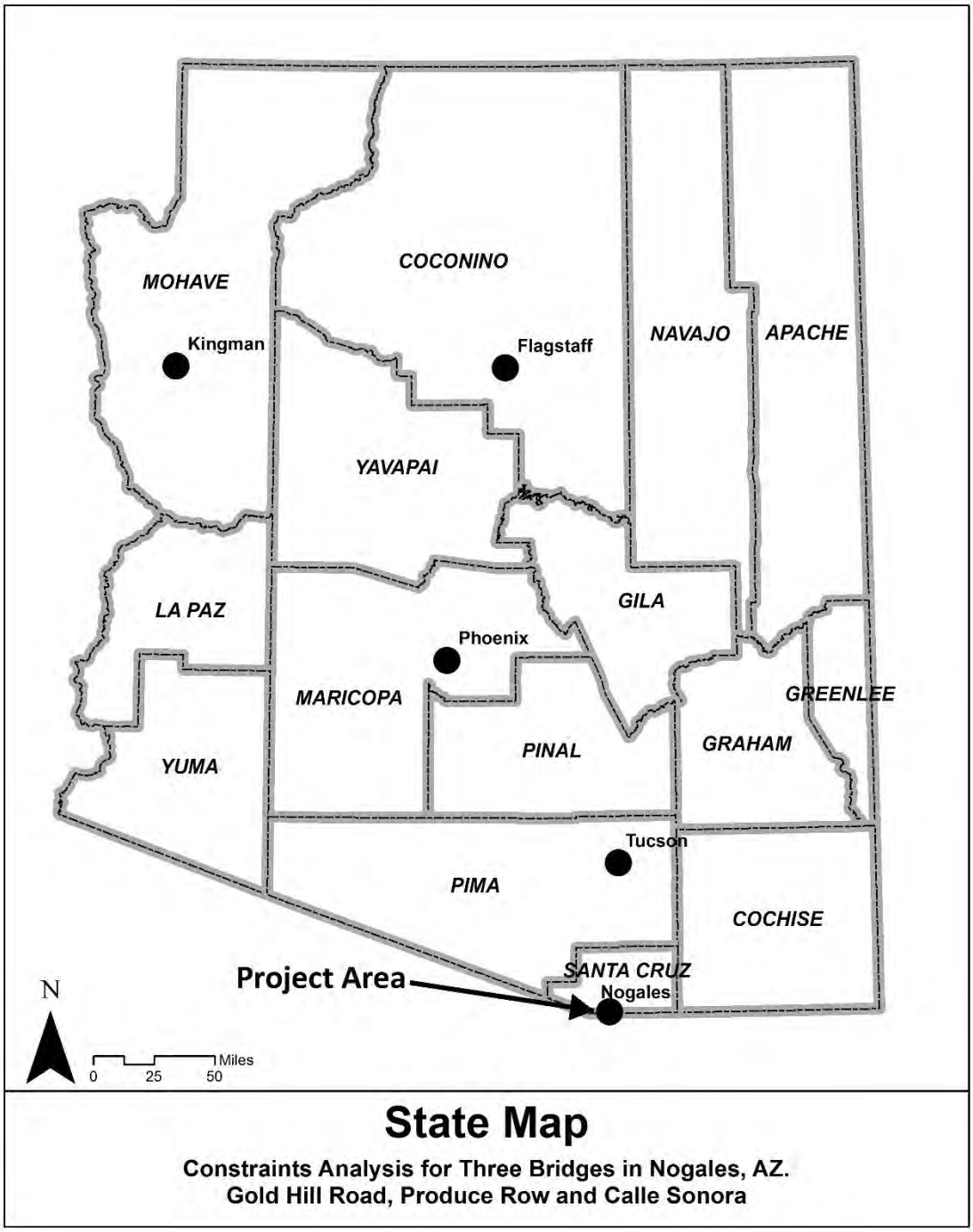


Figure 2. Project Vicinity Map

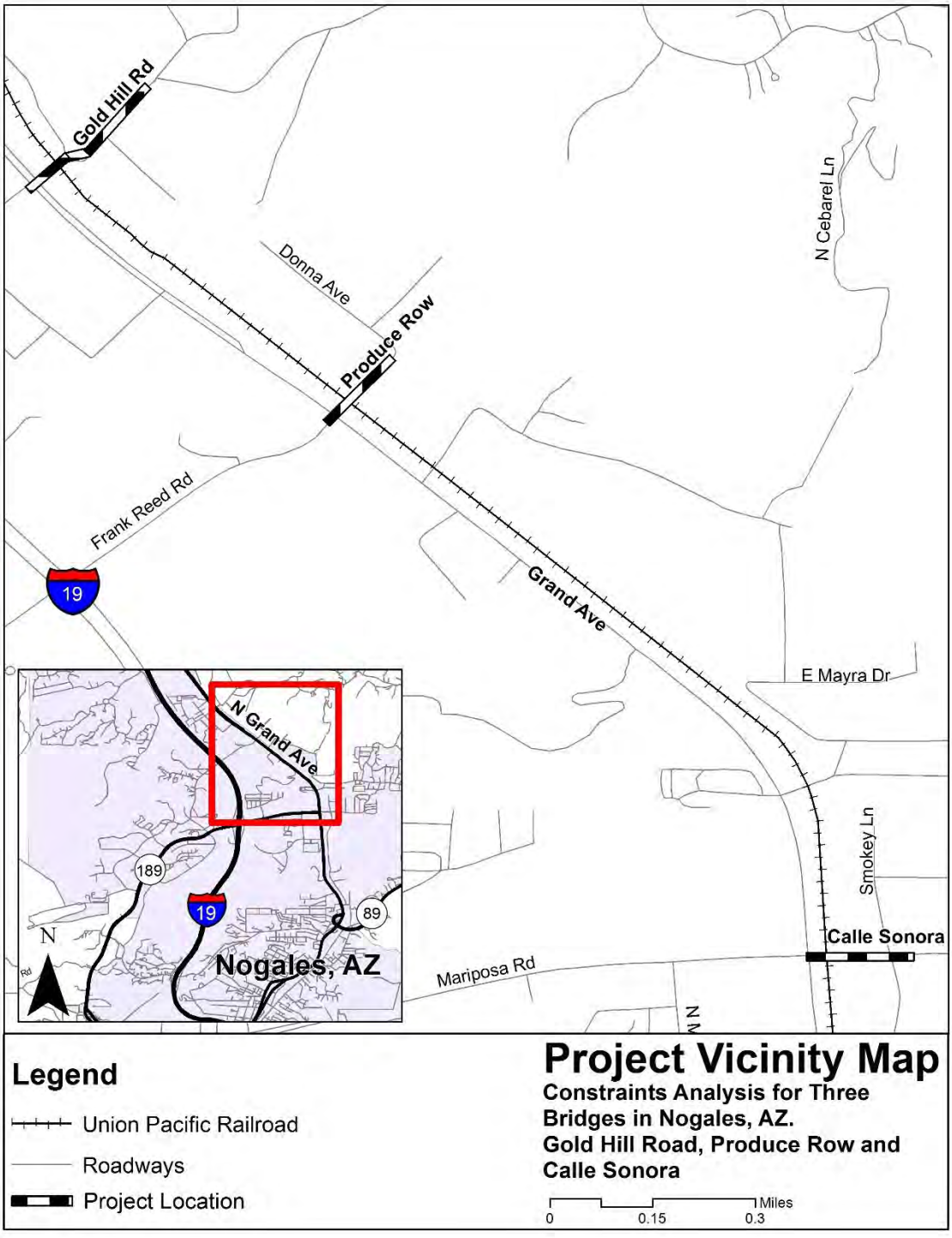
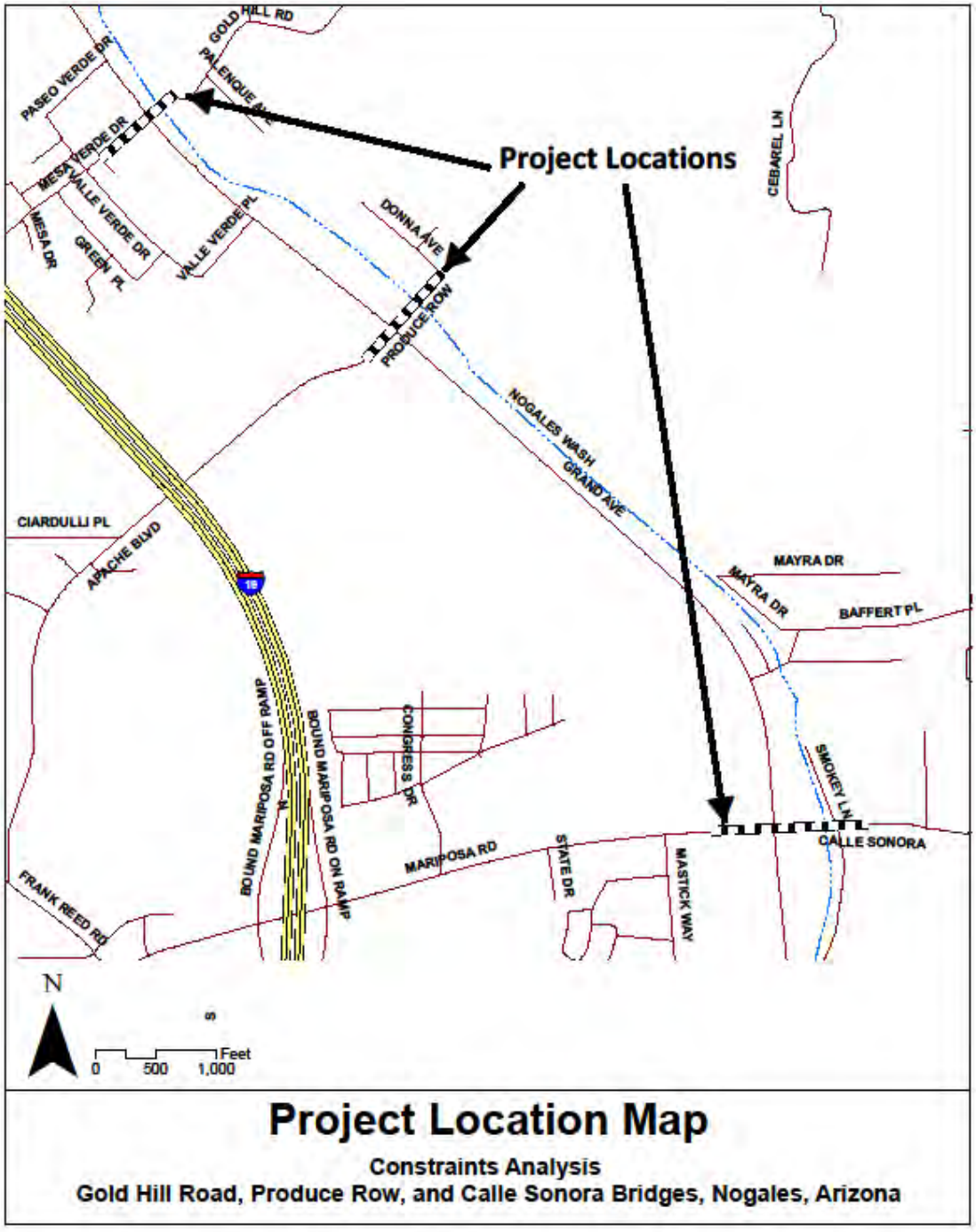


Figure **3.** *Project Location Map*



2.0 Background Data

The purpose of this project is to provide a conceptual design for replacing the Nogales Wash bridges that accommodates the heavier truck loads presently being permitted by ADOT. Due the age of the existing bridges, no as-builts have been

located and their design loads are unknown. Replacement of the bridges is the only realistic option to ensure that the structural integrity is provided to service the heavier truck loads. The secondary purpose of the project is to identify roadway configurations that improve mobility and safety within the short distances constrained by Grand Avenue, the railroad and the existing bridges. Preliminary traffic analysis has recommended geometric improvements consisting of a center turn lane to reduce vehicle queuing and increase efficiency of the intersections.

One of the major issues on this project is the existing bridge width. With the amount of large truck traffic in this area, the width restriction creates a "bottle neck" which is further complicated with the close proximity to the railroad tracks. Width of bridge also has implications on the turning templates of large trucks as is evidenced in the field, trucks have hit bridge barriers while trying to navigate the smaller radii and avoid oncoming traffic.

This study will document that improvements proposed at the three bridges are unable to solve the regional and international flooding issue with the Nogales Wash. The solutions proposed are limited to no rise in water surface elevation and may not exacerbate flooding conditions on neighboring properties.

3.0 Project Description and Scope

The project includes evaluation of the reconstruction of the bridges over the Nogales Wash and the associated roadway approaches at Calle Sonora, Produce Row and Gold Hill Road. Site specific improvements area are outlined below.

Calle Sonora

The existing 30-foot wide bridge and roadway will be removed and a new bridge consisting of a 12-foot wide westbound travel lane, a 14-foot wide eastbound travel lane, a 12-foot wide left turn lane, a 4-foot center median and 6-foot shoulders in each direction will be constructed. The roadway connection to Grand Avenue will be reconstructed to include a westbound right turn, through and left turn lanes, an eastbound through lane and a concrete median for railroad gate equipment and driveway access control. The railroad crossing will require upgrades to accommodate this wider configuration. Hohokam Drive will be relocated 270-feet to the east and a one-way loop will be incorporated immediately to the east of the bridge to re-direct traffic accessing Smokey Lane. The purpose of this loop or "jug handle" is to remove the queuing encountered with turning vehicles between the railroad and Smokey Lane. The roadway profile between the railroad tracks and the bridge will be adjusted to reduce the abrupt elevation change as vehicles approach the track pad. Final design analysis may indicate the need to reconfigure or relocate the parking area at the northeast corner of Smokey Lane and Calle Sonora.

Calle Sonora Alternate Route

An alternative to the proposed improvements to the east of the bridge is described in the Road Safety Assessment of Mariposa Road (SR 189)/Target Range Road and Calle Sonora/Hohokam Drive prepared by ADOT in June 2009. This alternative recommends converting Smokey Lane to one-way southbound and acquiring property on the north side of the Villa's Food Market to use to access Smokey Lane from North Ocean Garden Drive.

Calle Sonora Roundabout

An alternative to the "jug handle" is a more traditional roundabout, which serves the same purpose of circulation as the jug handle but without the stop conditions. A single-lane roundabout was laid out with a 130' inside diameter which accommodates a WB-67 (interstate semi-trailer) design vehicle. The roundabout geometry represents the paved footprint without curb and sidewalk. The roundabout, as laid out, may have some slight encroachment into private property on the north but was done as an exercise to show the feasibility. Refinements to the geometry of the roundabout could be evaluated in advanced planning or final design to try to limit acquisition of property north of Calle Sonora and also to accommodate driveway access.

Produce Row

The existing 30-foot wide bridge and roadway will be removed and a new bridge consisting of a 12-foot wide westbound travel lane, a 12-foot wide eastbound travel lane, a 12-foot wide left turn lane, and 6-foot shoulders in each direction will be constructed. The roadway connection to Grand Avenue will be reconstructed to include a westbound through lane, a westbound left turn lane and an eastbound through lane to match the lane configuration to the west of Grand Avenue (Frank Reed Road). The roadway profile between the railroad tracks and the bridge will be adjusted to reduce the abrupt elevation change as vehicles approach the track pad.

Gold Hill Road

The existing 30-foot wide bridge and roadway will be removed and a new bridge consisting of a 12-foot wide westbound travel lane, a 12-foot wide eastbound travel lane, a 12-foot wide left turn lane, and 6-foot shoulders in each direction will be constructed. The roadway connection to Grand Avenue will be reconstructed to include a westbound through lane, a westbound left turn lane and an eastbound through lane. Mesa Verde Road (west connection of Grand Avenue) will also be reconstructed with a similar roadway configuration. The Mesa Verde Road profile will not be adjusted to improve sight distance or to provide a more desirable approach grade to the intersection due to stormwater recommendations. Gold Hill Road will be realigned from N. Silver Hill Drive approximately 600-feet east. The purpose of the realignment is to reduce the conflict points at the N. Silver Hill Drive and Gold Hill Road intersection and to remove the 90-degree horizontal curve on Gold Hill Road immediately south of this intersection. In addition, this will provide

a more defined access to Palenque Avenue, as current traffic encroaches onto the adjacent private property to travel southbound. These roadway geometric improvements will require new right-of-way and easements.

In scoping meetings the City had requested to investigate whether northbound right turn lanes on Grand Ave would provide vehicle storage during train crossing for those vehicle desiring to turn right onto the subject project side streets, thus freeing up the eastern northbound through lane. Evaluation of this request reveals that utilities and city bus pads are constraining the geometry from being able to fit another lane in along Grand Ave.

No funds have currently been allocated for the project. An itemized cost estimate is shown in **Figures 6, 7 and 8**.

The project will require relocations of overhead power poles, valve adjustments, sanitary sewer manhole adjustments, and the relocation or adjustment of gas facilities due to bridge reconstruction. Utility relocations are anticipated to the west of the intersection of Gold Hill Road and Palenque Avenue due to the realignment of Gold Hill Road.

Section 8 shows a recommended action item checklist for the project.

4.0 Project Development Considerations

4.1.1 Environmental Overview

The intent of this project is to improve mobility, safety and intersection efficiency at Gold Hill Road, Produce Row and Calle Sonora east of Grand Avenue (B-19). The project improvements will require acquisition of new right-of-way.

The following sections summarize the environmental issues and the additional analysis and documentation that would be undertaken if federal construction funding is used.

4.1.2 Biology

It is anticipated that a Biological Evaluation (BE) will be required as a condition of using a USACE Nationwide Permit. A qualified biologist would conduct a site visit to evaluate the potential for the project to affect federally listed threatened and endangered species, as well as AGFD special status species. Preparation of the BE would include another review and evaluation of USFWS species lists for Santa Cruz County, as well as the AGFD review tool, if required.

4.1.3 Cultural Resources

It is anticipated that a Class 3 archeological inventory survey will be required as a condition of using a USACE Nationwide Permit.

4.1.4 Clean Water Act

The Nogales Wash is a Water of the U.S. (WOUS) that is regulated by the Corps of Engineers Regulatory Branch. Any fill of dredged or discharged material will require a Section 404 Permit. Based on anticipated disturbance quantity we assume that the project(s) will qualify for a Nationwide Permit (NWP). Steps for compliance with Section 404 of the Clean Water Act are as follows:

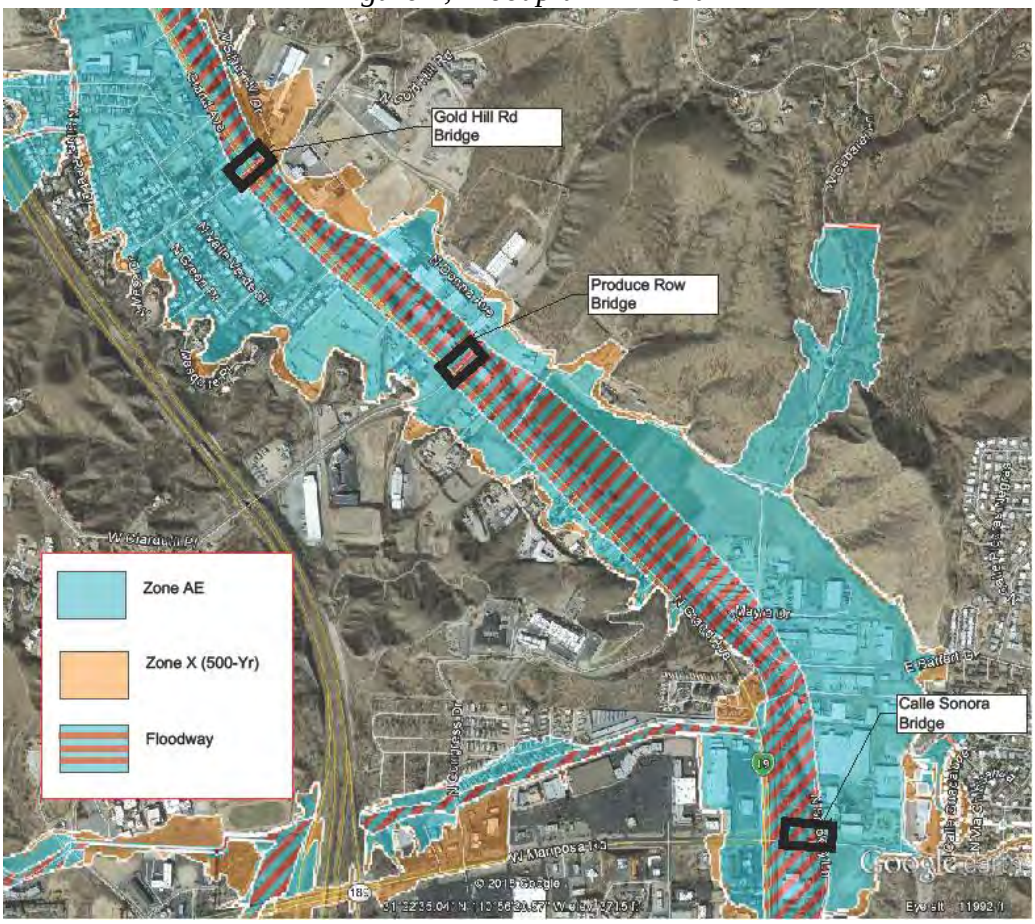
- Confirm whether a Jurisdictional Delineation (JD) exists for the Nogales Wash or prepare a Preliminary Jurisdictional Delineation (PJD)
- Conduct impact calculations of WOUS in total acreage
- Determine if amount of impacts meets NWP threshold or whether Individual Permit process must be followed.
- Prepare BE and scoping letter with US Fish and Wildlife Service
- Prepare Type III Cultural Resources Survey
- Prepare Pre-construction Notification

Since the Nogales Wash is an impaired WOUS it will have additional conditions during the Section 401 Certification. The Nogales Wash is impaired with Ammonia (2004), chlorine (1996), Copper (dissolved) (2004), and E. coli (1998). It is noted that Nogales Wash is a mostly perennial water source and if wetland features are observed, the act of de-watering during construction may be regulated to a certain season and time-frame.

4.1.5 100-Year Floodplains

The project limits are within Federal Emergency Management Agency Flood Insurance Rate Maps (FIRM) 04023C0464C, and 04023C0631C, which are both dated December 2, 2011 (See Figure 4, Floodplain Exhibit) . According to the FIRM the project area is within Zone AE of the 100-year floodplain. Proposed structures are not expected to adversely impact base flood elevations. A hydraulic analysis was conducted using the Effective Flood Insurance Study HEC-RAS model with modifications including showing the new bridges. Results of the hydraulic analysis were compared to the existing base flood elevations (BFEs) and it was determined that the proposed improvements will not increase BFEs as a result of the new structures. Models and results are presented in the Appendix _

Figure 4, Floodplain Exhibit



4.1.6 National Pollutant Discharge Elimination System

It is expected that project construction would disturb 1 or more acres of land; therefore, a Storm Water Pollution Prevention Plan would be prepared and a Notice of Intent would be filed with Arizona Department of Environmental Quality (ADEQ) in accordance with Arizona Pollution Discharge Elimination System (AZPDES) regulations. ADEQ has identified the project reach as an "impaired" water way.

4.1.7 Scenic or Historic Routes

No scenic or historic routes are within the project limits.

4.1.8 Temporary Construction Impacts

Temporary construction easements on adjacent lands will be required. Detours would be provided for pedestrians and mitigation measures would be developed to minimize impacts on traffic and pedestrians during construction. Site specific construction phasing and detours outlined below.

Calle Sonora

During the demolition of the existing bridge and construction of the new bridge and approaches, traffic would be detoured to the Doe Street bridge which is approximately one mile south.

Produce Row

Reconstruction of the bridge structure will require two phases. The first phase consists of detouring traffic to the south half with alternating movements with flaggers and reconstructing the north half. During the second phase of work, traffic would utilize the completed portion while reconstruction shifted to the south half.

Gold Hill Road

During the demolition of the existing bridge and construction of the new bridge and approaches, traffic would be detoured 0.9 miles east on Gold Gill Road, 3.5 miles south on Camino Vista del Cielo/Old Patagonia Road and 1.6 miles west on SR 82 to the Patagonia Highway bridge at Grand Avenue. The total detour route is approximately 6 miles. Phasing the bridge reconstruction would not allow for vehicle storage west of the bridge due to the close proximity to Grand Avenue but is noted to be a second option.

4.1.9 Public and Agency Involvement

During preparation of the CE, scoping letters would be distributed to pertinent agencies, stakeholders, and adjacent landowners. The letters would describe the project and solicit comments. Due to the impacts on traffic during construction, a public meeting is anticipated for the project.

4.2 Construction Contract Method

This project is anticipated to be a Design-Bid-Build contract.

4.3 Drainage and Geotechnical Requirements

4.3.1 Existing Drainage Characteristics

The project consists of evaluating three proposed bridges for possible replacement along the Nogales Wash, which were modeled as part of a detailed study for the Flood Insurance Study effective December 2, 2011. The Nogales Wash channel lacks capacity and overbank flow is common. The existing bridges at Gold Hill Rd, Produce Row, and Calle Sonora would all be overtopped during the 100-year design storm. Additionally, evidence of lateral erosion is present on the eastern channel bank, upstream of Produce Row.

4.3.2 Drainage Structure Requirements

Proposed project improvements include three bridge replacements and improved bridge approaches. The bridge at Produce Row is proposed to be extended 20 feet on the east side to account for channel widening and to increase hydraulic efficiency. The effective HEC-RAS model was provided by Santa Cruz County to model the impacts of the proposed improvements. The effective model was revised to more accurately model existing roadway geometry.

Recommended bridge types were selected to prevent rise in water surface elevation and maximize conveyance and were evaluated relative to the revised, Effective Nogales Wash HEC-RAS model. Infrastructure improvements were designed to prevent adverse impacts, defined as no increase in water surface elevation. Proposed water way cross-sectional area is increasing from existing conditions and abutments will be vertical wall abutments which will transition back to existing channel width by the use of concrete lined bank transitions. See Table 1 for bridge recommendations and a comparison of water surface elevations. Location of project improvements and hydraulic cross sections (for reference to HEC-RAS model) are shown on Figure 5, Hydraulic Exhibit.

New bridge structures will not be able to solve the regional flooding problem. Presently there is not enough capacity in the channel which is sandwiched between the railroad and Grand Ave. As the Floodplain Exhibit on page 9 shows, Grand Avenue and significant extents of commercial and residential property along the corridor will continue to be in a FEMA special flood hazard area after these projects are implemented.

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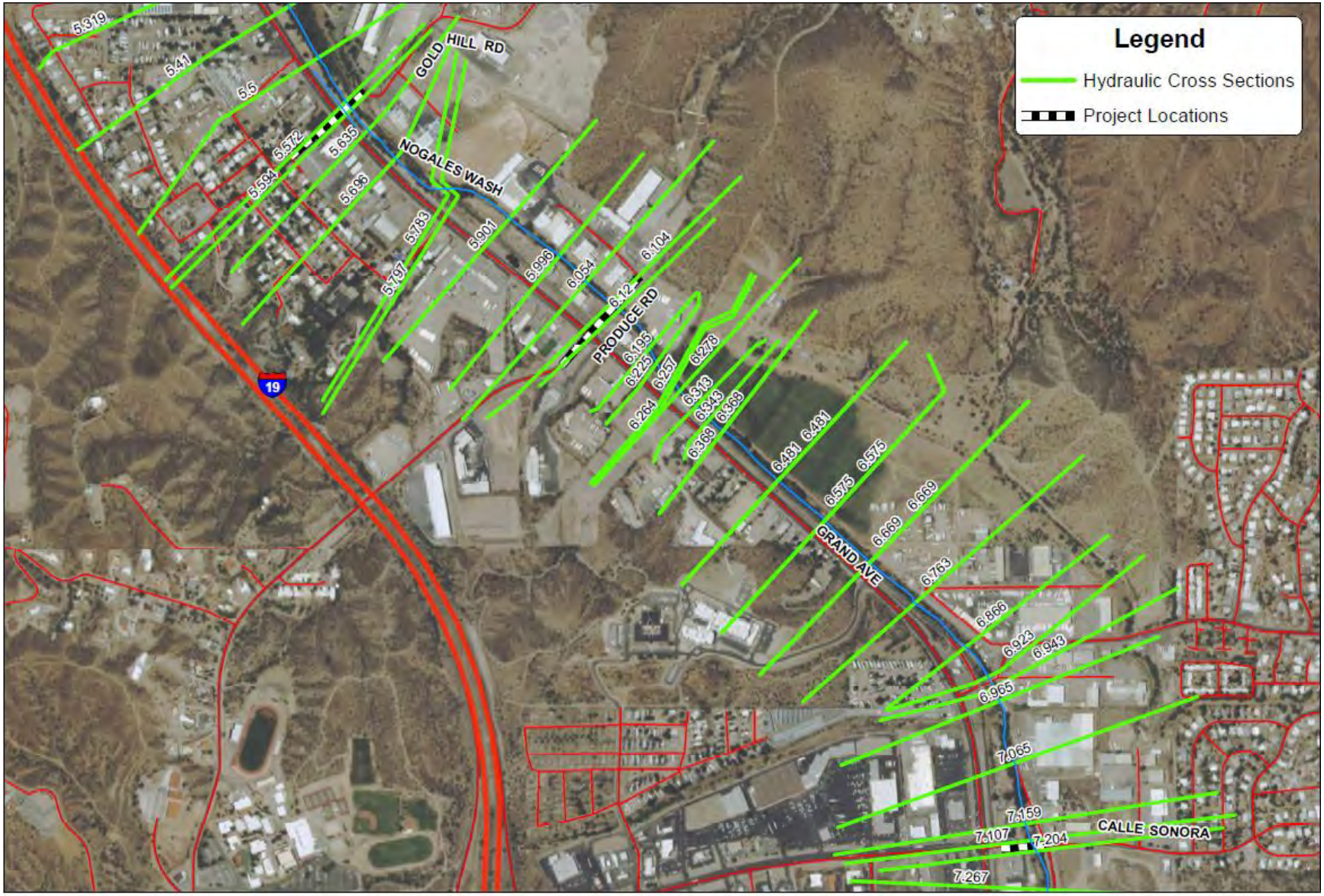

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Figure 5, Hydraulic Exhibit

Gold Hill Road, Produce Row and Calle Sonora

Table 1. Bridge Hydraulics

Location	Bridge Type	Superstructure Depth [ft]	# of piers	Upstream WSEL [ft]	Delta WSEL [ft]
Calle Sonora	Existing Conditions	1.50	1	3750.25	--
Calle Sonora	Proposed Box Beam	2.67	1	3750.15	-0.10
Produce Row	Existing Conditions	3.70	0	3709.45	--
Produce Row	Proposed AASHTO Type II	4.00	0	3708.83	-0.62
Gold Hill	Existing Conditions	3.50	2	3687.57	--
Gold Hill	Proposed Box Beam	3.17	0	3687.36	-0.21

Scour Calculations

Scour calculations were performed according to the methodology outlined in the City of Tucson's *Standards Manual for Drainage Design and Floodplain Management*. Scour calculations were completed based on hydraulic conditions in Nogales Wash improvements. Scour components include Long Term, Local, General, Anti-Dune, Low-Flow Thalweg. The local scour component includes only pier scour. The Nogales Wash channel has a slope that appears to be stable at 0.8%. Based on this profile, the long term scour baseline is approximately 3 feet below grade at Produce Row suggesting that some degradation could occur within that reach. Gold Hill Rd and Calle Sonora are already below the long term scour profile. Refer to Table 2 for scour depth recommendations. Table 2, Scour Design Recommendations gives design scour depths which are based on the worst case of the 10-year or 100-year. Since the general scour component is based on the relationship between channel depth and velocity, the 10-year event, in some cases, is more severe. Scour calculations are provided in Appendix C, Drainage Support.

Table 2. Scour Design Recommendations

Proposed Improvement	Design Scour Depth for Pier (ft)	Design Scour Depth for Abutment/Channel Protection [ft]
Gold Hill Rd Box Beam Bridge	N/A	7
Produce Row AASHTO II Bridge	N/A	9
Calle Sonora Box Beam Bridge	23	10

4.3.3 Geotechnical Requirements

A geotechnical report was not completed for this project assessment. The preliminary design roadway pavement section will assume 6" Asphalt Concrete over 6" Aggregate Base Course. This pavement section was used on the recently designed Intersection project in Santa Cruz County. A geotechnical report will be required for final design to address pavement recommendations, structure foundation data, channel bank slope recommendations and earthwork.

4.4 Critical Outside Agency Involvement

The City of Nogales is responsible for public and agency scoping activities which include providing a description of the project's scope of work and a schedule to local residents and businesses as well as adjacent local, county, and state agencies. Agencies and the public will be given an opportunity to comment on the project and the City of Nogales will respond to any comments.

A meeting was held March 13, 2015 with the ADOT Tucson District traffic team to discuss ADOT requirements and coordination. To obtain ADOT approval to modify a connection to their highway system, the design team will be required to submit a set of plans and a drainage report. To perform construction work within ADOT right-of-way, an encroachment permit will be needed. This permit also requires an environmental certification.

Initial contact with Union Pacific Railroad was initiated in March 2015. E-mail correspondence is summarized below:

-Designers need to consider standards regarding crossings (AREMA) and the limiting conditions to the west of the railroad.

-Grand Avenue (Old Nogales Hwy) is close to the railroad and the approaches to these crossings and intersections require a creative, well documented approach to both traffic and train warning signal installation and interconnection.

4.5 Right-of-Way Requirements

The right-of-way corridor within the project limits varies as follows:

Grand Avenue	ADOT R/W Width (FT)	UPRR R/W Width (FT)
Calle Sonora	120	46
Produce Row	102	88
Gold Hill Road	160	200

Note: Dimensions based on as-builts and need to be confirmed with agency right-of-way departments. The contractor will be required to obtain a Right-of-Entry Agreement from UPRR.

City Street	City of Nogales R/W Width (FT)	New R/W Acquisition and Easements (APN # and description)
Calle Sonora	50 to 70	New R/W: 10201008A (full take), 10201013 (partial), 10201009 (partial), 10201014 (partial), 10201075 (partial)
Hohokam Drive	55 to 75	New R/W: 1020121086 (partial)
Produce Row	60	New R/W: 10528016 (partial), 10528005A (partial), 10528012A (partial), 10528005B (partial) TCE: 10528016 (at north driveay), 10528005A (at south driveway)
Gold Hill Road (at bridge)	85	Extend public easement though UPRR right-of-way
Gold Hill Road (at realignment)	60	New R/W: 10502004A (partial) Slope Easement: 10502004A (north fill slope) TCE: 1052018 (Palenque Ave), 1052014B (Palenque Ave)
Mesa Verde Road	60	New R/W: 10524003 (partial), 10523025 (partial) TCE: 10524003 (north driveway), 10523025 (south driveway)

Note: Dimensions based on GIS data and need to be confirmed with agency right-of-way departments.

Due to the changing conditions of land use and development, it is recommended to proceed with the right-of-way process to reserve areas needed for these improvements.

4.6 Utility Relocation Requirements

A Blue Stake Design Ticket was submitted on February 16, 2015 to identify utility companies which have facilities within the proposed construction limits.

The following are the companies that have facilities within the area, their contact representative and references to requirements or responses.

ADOT-Tucson District Drainage	Jim Lewis (520) 604-0372

ADOT has drainage facilities along Grand Avenue at Gold Hill Road. Widening may require drainage ditch reconstruction and culvert extensions.

ADOT-Tucson District	Anthony Barcelo
Rdwy Lighting and Traffic Signals	(520) 838-2842

ADOT owns and maintains roadway lighting and traffic signals at all three traffic intersections. Existing traffic signals will need to be removed and replaced to accommodate cross street widening.

City of Nogales	Lee Jacobs, PE
Sewer and Water	(520) 287-8352

The City of Nogales owns and operates a 16 inch water main and a 30 inch sanitary sewer pipe along the east bank of the Nogales Wash. Utility modifications should be limited to water valve and manhole adjustments at Calle Sonora. Produce Row modifications will include backflow assembly, water meter and fire hydrant relocation along with meter valve adjustments. A private PVC water line is attached to the south side of the Produce Row bridge which will require relocation during reconstruction. A significant above ground water facility located 200 feet east of the railroad at Gold Hill Road will need to be relocated due to the new roadway realignment. Water valve and meter work may also be required.

CenturyLink	Robert Porter
Coaxial and Fiber	(520) 281-0153

CenturyLink has underground and overhead facilities along Calle Sonora that will require relocation. There are underground lines located at the south end of the Produce Row bridge that require further locating methods to determine conflicts. Underground lines are also located along the existing north curb line of Gold Hill Road that will do not appear to be in conflict at this time.

Conterra Ultra Broadband	Hector Soberon
Communication and Fiber	(800) 634-1374

Facilities are located along the west side of Grand Avenue at Gold Hill Road and Produce Row. No conflicts are anticipated at this time.

MediaCom	Kevin Young
Coaxial and Fiber	(602) 295-5213

MediaCom has overhead facilities on the power poles along Calle Sonora and Produce Row that will require relocation to accommodate roadway widening. Overhead facilities are also on the power poles along the west side of Grand Avenue at Gold Hill Road that are not anticipated to be in conflict.

UniSource Energy Services	Carlos Parra
Electrical and Gas	(520) 755-7950

UniSource owns overhead power facilities that run along the west side of Grand Avenue at all three intersections. Conflicts are not anticipated for this facility. Overhead power is also located along the north side of Calle Sonora, west side of Hohokam Drive, south side of Produce Row and the south side of Gold Hill Road. Relocation is anticipated at Calle Sonora and Produce Row to accommodate roadway widening.

UniSource owns and operates natural gas pipelines that are attached to all three bridges that will require further coordination and relocation. Cost for relocation was not considered assuming license agreements exists for use of City Right of Way.

Valley Telephone Cooperative	Danny Chastain
Coaxial and Fiber	(520) 384-2231

Arriba fiber is buried inside UPRR right-of-way north of Gold Hill Road to Doe Street (one mile south of Calle Sonora). Conflicts are not anticipated at this time.

Costs for utility relocation work within the project estimates is limited to City owned utilities. Costs for private utility relocation is assumed to be paid for by the owner of the utility.

4.7 Traffic Requirements

A traffic evaluation was performed to determine and evaluate existing conditions. A future traffic forecast was conducted based on growth trends and feedback from members of the Fresh Produce of the Americas (FPAA). The interviews provided a local perspective of the existing conditions and also assisted with determining what the future needs in terms of traffic growth require. The complete traffic evaluation can be found in **Appendix B**.

Traffic data was collected on *February 4th, 2015*. The traffic data was collected during what would be considered the peak season for produce shipments from Mexico. The collected traffic data includes 24-hour tube counts located on the 3 bridges and AM/PM peak period intersection turning movement counts. Turning movement counts were collected at the intersections of Grand Avenue / Gold Hill Road, Grand Avenue / Produce Row, Grand Avenue / Calle Sonora, Calle Sonora / Smokey Lane. Also, a vehicle classification study was performed concurrently with the 24-hour tube counts to provide truck percentage that would typically occur.

Roadway-Bridge Cross-section

Both safety and traffic operational concerns due to the continuous heavy truck traffic require the need for a wider cross-section at the three locations. According to field observations and feedback from FPAA members, trucks turning from cross-

streets must overtake opposing lanes. Thus, interrupting opposing traffic which causes vehicles to queue up or increase unsafe situations that may lead to collisions.

To accommodate the heavy trucks turning from access drives or intersecting roadways, it is recommended to increase the roadway cross-section. The increased cross-section shall allow heavy trucks to execute turning maneuvers without utilizing the opposing lane. It is recommended that each of the three roadways consist of wider through lanes. Also, include a left-turn lane on the westbound approaches such that the storage length is extended east of the bridges as engineering constraints permit.

Turn Lane Warrant

Turn Lane Warrants from the *ADOT Traffic Engineering Policies, Guidelines, and Procedures (December 2014), Section 200,* were utilized to determine the need for right-turn lanes on the northbound approaches of each of the three intersections along Grand Avenue. Existing and future traffic volumes justify the need for right-turn lanes at the 3 northbound approaches. However, due to the observed engineering constraints, such as right-of-way, utilities and bridge constraints, constructing right-turn lanes along Grand Avenue lanes would be infeasible.

Intersection Operations

To improve intersection operations to accommodate the estimated future traffic volumes, it is recommended to implement the following concurrently with the construction of the new bridges:

<u>Calle Sonora</u>

- Construct an exclusive right-turn lane on the westbound approach of Calle Sonora, designed such that it meets ADOT minimum standards.
- With the exclusive westbound left-turn lane, reconfigure the traffic control signal for optimized standard phasing. Thus, removing the existing split-phasing as it would not be necessary with the enhanced intersection configuration would allow for efficient shorter cycle lengths.

<u>Produce Row</u>

- Reconfigure the traffic control signal's cycle length to allow for turning trucks completely clear the intersection during approaches green phase. Comments from the stakeholder interviews and observations shows that existing timing of the signal phases, yellow change and red clearance intervals, especially right/left turning trucks, doesn't allow trucks to safely clear out of the intersection. Note that there is no standard practice or methods recommended for intersections with significant heavy truck percentages.

Gold Hill Road

- It is recommended to construct an exclusive left-turn lane at the eastbound approach of Mesa Verde Road, designed such that it meets ADOT minimum standards. With the left-turn lane on the westbound approach as part of the Gold Hill Road enhancement, construction of the eastbound dedicated left-turn lane would not require split-phasing. Thus, reduce delays of the left/right turning vehicles during the peak periods.

Access Management

The potential reconstruction of the 3 bridges and roadways, would allow for an opportunity to implement access management practices on each roadway. Access management allows for maintaining roadway safety and mobility by controlling access location, design, spacing and operation. The following is recommended to be implemented during the construction of the new bridges:

- At Calle Sonora, close 1 of the northbound driveways (Alex's Tires, Inc.) and relocate the southbound and northbound driveways, located west of the bridge. Relocate the access drives from the intersection of Grand Avenue / Calle Sonora to allow 150' minimum spacing between the access drives and the Grand Avenue curb line. A 150' minimum is typically a standard policy in many jurisdictions.
- Also, access drive turning restriction should be considered at the relocated driveways along Calle Sonora for both the north and south access drives due to the proximity to the signalized intersection. Allowing all movements may increase accident potential. Thus, consider a roadway cross-section that would restrict left-in and left-out movements on both driveways.
- At Produce Row, construct an access drive for the two businesses on the north and south of Produce Row, west of the bridge. Locate the dedicated access drives such that at a minimum 150' spacing or more exists between the access drive and the Grand Avenue curb line.
- With the construction of the eastbound exclusive left-turn lane on Mesa Verde Road, construct new access drives for both the north and south properties. Construct such that a minimum 150' spacing or more exists between the access drive and the Grand Avenue curb line.

4.8 Seasonal Considerations

Due to anticipated conflicts with UniSource electrical and gas facilities, the schedule for utility relocations will need to account for the "peak use" timeframes for electric and gas. The general peak seasons are the following:

- Electric Power: April – October
- Gas: October – March

The relocation of large steel power poles and gas pipelines require significant lead time. This timeframe must also be accounted for in the project schedule. Fiber optic lines are often relocated along with the electric lines. Water modifications are performed in the off peak season between October 1 and March 30. Sewer facilities general have no seasonal constraints.

Nesting season for migratory birds may preclude removal of vegetation as a condition of utilizing a Nationwide Permit from the Corps. The Biological Evaluation would set target dates for when these periods occur and the requirements for working around trees with nesting sites.

4.9 Design Criteria

The project will be implemented in accordance with *A Policy on Geometric Design of Highways and Streets* (2011), *Pima County/City of Tucson Pavement Marking Design Manual* (2008), and the latest edition of the Arizona Department of Transportation standard drawings, specifications and design guidelines.

No AASHTO design exceptions apply to this project.

Side street and driveway turning movements have been checked for lane encroachment using a WB-50 design vehicle per ADOT RDG Table 407.2. Intersection sight distance at these locations have also been checked per AASHTO sight triangle methods. Preliminary analysis indicates a sight obstruction from the bridge barrier for the north driveway on Calle Sonora between the railroad and the bridge. Further design will be required to address this driveway and adjacent parcel configuration.

Access control will be implemented in the form of a concrete median on Calle Sonora between Grand Avenue and Smokey lane. This is recommended to remove the queuing caused by stopped vehicles waiting to turn across traffic lanes to the adjacent driveways. Access control to Palenque Avenue will also be improved by using curb and gutter to provide defined southbound direction.

Geometric layouts presented in the appendix are preliminary and further traffic analysis is warranted at the final design stage to confirm the proposed layouts will work with updated movements and traffic counts.

4.10 Structural Design

As noted in the previous sections, the proposed roadway improvements to Gold Hill Road, Produce Row and Calle Sonora require improvements to the existing bridges over the Nogales Wash on these side streets. For the purpose of this report it is assumed that the bridge improvements will consist of full bridge replacements. The bridge improvements include both vertical and horizontal geometric and structural improvements. The increased roadway widths at the bridge locations require wider structures in addition to the roadway profile modifications requiring adjustments to the existing bridge profiles. These side streets see significant overweight truck traffic and therefore in addition to the AASHTO HL-93 live loading requirements, the bridges will be designed for to accommodate an overweight truck loading of 90,000 pounds. Utilities supported on the existing bridges will need to be considered during final design. ADOT has a policy of not allowing utilities on new bridges, but since the funding source for construction will likely be local funds the City can decide. Cost for utility relocation was not considered assuming that the City has active license agreements with the utilities for use of City Right of Way.

4.10.1 Calle Sonora

Existing Bridge

The existing bridge is a two-span precast prestressed concrete box beam bridge with an overall bridge length of approximately 70-ft and overall bridge width of approximately 36-ft. As-builts for the bridge were not available, but based on information gathered and recent ADOT Bridge Inspection Reports it is assumed that the existing bridge is supported on drilled shaft foundations at the abutments and pier. This bridge has not been identified as scour critical.

There is an existing gas line and underground telephone line supported on the north side of the bridge that will be relocated to the new bridge structure.

Proposed Improvements

The proposed bridge improvements will replace the existing bridge in kind with improved geometrics to match the roadway widening and adjusted roadway profile.

The proposed bridge geometry will consist of a 12-foot wide westbound travel lane, a 14-foot wide eastbound travel lane, a 12-foot wide left turn lane, a 4-foot center median, 6-foot shoulders in each direction and 5'-10" sidewalk with ADOT Combination Pedestrian Traffic Barrier Railing in each direction for an overall bridge width of 70-ft. The overall bridge length will 70.5-ft. The bridge profile will be raised slightly from the existing bridge profile to match the proposed roadway improvements.

As discussed in the Drainage section, the existing creek bottom will be excavated out below the bridge to mitigate effects of the proposed roadway and bridge

improvements on the current floodplain elevation. The bridge will abutments will be full height abutments supported on drilled shafts. The bridge pier will also be supported on drilled shafts. The existing wash banks on the inlet and outlet of the bridge will be protected with slope protection as discussed in the Drainage section.

4.10.2 Produce Row

Existing Bridge

The existing bridge is a single span steel I-beam bridge with an overall bridge length of approximately 41-ft and overall bridge width of approximately 29.5-ft. As-builts for the bridge were not available, but based on information gathered and recent ADOT Bridge Inspection Reports it is assumed that the existing bridge is supported by full height abutments on spread footings. The 2013 ADOT Structure Inventory and Appraisal report classifies the bridge as scour critical.

There is an existing gas line supported on the north side of the bridge that will be relocated to the new bridge structure. There is also an existing private 2" PVC water line on the south side of the bridge that will be relocated to the new bridge structure.

Proposed Improvements

As discussed in the Drainage section, an increased bridge span is required at this location due to existing bank erosion issues and to improve flow in the wash and mitigate effects of the proposed roadway improvements on the current floodplain elevation. Based on the increased span length and desire to minimize the overall depth of the bridge structure, the proposed bridge will consist of a single span precast prestressed AASHTO box beam bridge with full height abutments.

The proposed bridge geometry will consist of a 12-foot wide westbound travel lane, a 12-foot wide eastbound travel lane, a 12-foot wide left turn lane, 6-foot shoulders in each direction and 5'-10" sidewalk with ADOT Combination Pedestrian Traffic Barrier Railing in each direction for an overall bridge width of 62-ft. The overall bridge length will 60-ft. The bridge profile will be raised slightly from the existing bridge profile to match the proposed roadway improvements.

The bridge abutments will be full height abutments supported on drilled shafts. The existing wash banks on the inlet and outlet of the bridge will be protected with slope protection as discussed in the Drainage section.

4.10.3 Gold Hill Road

Existing Bridge

The existing bridge is a three-span cast-in-place concrete closed frame slab bridge with an overall bridge length of approximately 70-ft and overall bridge width of 33.3-ft. As-builts for the bridge were not available, but based on information gathered and recent ADOT Bridge Inspection Reports it is assumed that the existing

bridge is supported on spread footings protected by a concrete slab scour floor. This bridge has not been identified as scour critical.

There is an existing gas line and underground telephone line supported on the south side of the bridge that will be relocated to the new bridge structure.

Proposed Improvements

Two bridge types, a three-span cast-in-place concrete closed frame slab bridge and a single span precast prestressed AASHTO box beam bridge with full height abutments, were considered for the bridge replacement at this location. The selected bridge type for the purposes of this report is a single span precast prestressed AASHTO box beam bridge with full height abutments. As discussed in the Drainage section, the single span bridge was required to improve flow in the wash and mitigate effects of the proposed roadway improvements on the current floodplain elevation. The new bridge width and profile will be set to match the proposed roadway widening and adjusted roadway profile.

The proposed bridge geometry will consist of a 12-foot wide westbound travel lane, a 16-foot wide eastbound travel lane, a 12-foot wide left turn lane, 6-foot shoulders in each direction and 5'-10" sidewalk with ADOT Combination Pedestrian Traffic Barrier Railing in each direction for an overall bridge width of 66-ft. The overall bridge length will be 70.5-ft. The bridge profile will be raised slightly from the existing bridge profile to match the proposed roadway improvements.

The bridge abutments will be full height abutments supported on drilled shafts. The existing wash banks on the inlet and outlet of the bridge will be protected with slope protection

5.0 Grade Separated Railroad Crossing

A detailed analysis for grade separated railroad crossings is not included in this report due to the economic infeasibility and construction impacts associated with this option. The minimum vertical clearance for a bridge over the UPRR is 23.5 feet per the BNSF-UPRR Guidelines for Railroad Grade Separated Projects. Adding the depth of structure would increase the roadway elevation approximately 30 feet above existing ground. Implementing the maximum allowable grade from the AASHTO Green Book and the ADOT Roadway Design Guidelines (RDG) would require ramps approximately 400 feet in length. Business and residential access fronting the face of the ramp retaining walls would be closed and require access from other locations along the site. Similar projects of this scope encountered construction costs in the $10 million to $15 million range not including design, right-of-way and utility costs.

6.0 Estimated Cost

6.1 Construction

An itemized construction cost estimate for each location is shown in Figures 6, 7, & 8. Calle Sonora alternatives were not estimated separately because for planning purposes the "jug handle" alternative is comparable in cost to the roundabout. No funds have currently been allocated for the project.

6.2 Design

Design costs are broken out by project as follows: Gold Hill Road $369,000; Produce Row $217,000; Calle Sonora $405,000.

Figure 6, Gold Hill Rd Conceptual Cost Estimate

Federal No : N/A
TRACS No : N/A
Project No : N/A
Date: July, 2015

Project Description : Gold Hill Road Cost Estimate
Project Location : Nogales, Arizona
Stage : Preliminary
Project Manager : Scott Altherr, PE

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
2010001	Clearing and Grubbing	L.S.	1	$ 10,000.00	$ 10,000
2020001	Removal of Structures & Obstructions	L.S.	1	$ 60,000.00	$ 60,000
2030300	Roadway Excavation	C.Y.	3,815	$ 15.00	$ 57,225
2030904	Borrow	C.Y.	7,230	$ 12.00	$ 86,760
3030003	Aggregate Base	C.Y.	1,166	$ 60.00	$ 69,960
4090003	Asphaltic Concrete (Miscellaneous Structural)	Ton	2,330	$ 90.00	$ 209,700
5150002	Utility Relocation Work	L.S.	1	$ 40,000.00	$ 40,000
6080107	Miscellaneous Work (Signs)	L.S.	1	$ 12,000.00	$ 12,000
7040015	Pavement Markings	L.S.	1	$ 8,000.00	$ 8,000
7330029	Traffic Signal	L.S.	1	$ 200,000.00	$ 200,000
8080012	Seeding and Miscellaneous Landscape Work	L.S.	1	$ 15,000.00	$ 15,000
9130100	Concrete Channel Lining	S.Y.	230	$ 120.00	$ 27,600
9050001	Guard Rail, W-Beam, Single Face	L.F.	350	$ 15.00	$ 5,250
9050041	Guard Rail End Terminal Assembly	EACH	4	$ 2,500.00	$ 10,000
9080050	Concrete Curb and Gutter	L.F.	2,344	$ 26.00	$ 60,944
9080201	Concrete Sidewalk	S.F.	2,444	$ 6.00	$ 14,664
9080288	Curb Access Ramp	EACH	4	$ 1,600.00	$ 6,400
9080302	Concrete Driveway	EACH	2	$ 2,200.00	$ 4,400
9300128	Miscellaneous Work 18 (Drainage Improvements)	L.S.	1	$ 20,000.00	$ 20,000
9300201	Railroad Personnel, Protective Crossings and Private Crossings	L.S.	1	$ 150,000.00	$ 150,000
	Bridge	L.S.	1	$ 890,000.00	$ 890,000
				ROADWAY AND BRIDGE SUBTOTAL	**$ 1,957,903**
	Construction Work Contingency	Percent	20%		$ 391,581
				SUBTOTAL	**$ 2,349,484**
	Construction Surveying and Layout	Percent	3%		$ 70,485
	Erosion Control	Percent	2%		$ 46,990
	Contractor Quality Control	Percent	2%		$ 46,990
	Furnish Water Supply	Percent	2%		$ 46,990
	Maintenance and Protection of Traffic	Percent	10%		$ 234,948
				SUBTOTAL	**$ 2,795,887**
	Mobilization	Percent	10%		$ 279,589
				CONSTRUCTION SUBTOTAL	**$ 3,075,476**
	Construction Administration	Percent	10%		$ 279,589
				CONSTRUCTION TOTAL COST	**$ 3,355,065**
	Design Costs	Percent	12%	Cst Subtotal	$ 369,057
	Right-of-Way				$ 179,400
				TOTAL PROJECT COST	**$ 3,903,522**

Figure 7, Produce Row Conceptual Cost Estimate

Federal No : N/A
TRACS No : N/A
Project No : N/A
Date: July, 2015

Project Description : Produce Row Cost Estimate
Project Location : Nogales, Arizona
Stage : Preliminary
Project Manager : Scott Altherr, PE

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
2010001	Clearing and Grubbing	L.S.	1	$ 10,000.00	$ 10,000
2020001	Removal of Structures & Obstructions	L.S.	1	$ 30,000.00	$ 30,000
2050001	Grading Roadway for Pavement	S.Y.	1,890	$ 5.00	$ 9,450
3030003	Aggregate Base	C.Y.	315	$ 60.00	$ 18,900
4090003	Asphaltic Concrete (Miscellaneous Structural)	Ton	629	$ 90.00	$ 56,610
5150002	Utility Relocation Work	L.S.	1	$ 20,000.00	$ 20,000
6080107	Miscellaneous Work (Signs)	L.S.	1	$ 3,000.00	$ 3,000
7040015	Pavement Markings	L.S.	1	$ 2,000.00	$ 2,000
7330029	Traffic Signal	L.S.	1	$ 50,000.00	$ 50,000
8080012	Seeding and Miscellaneous Landscape Work	L.S.	1	$ 5,000.00	$ 5,000
9080050	Concrete Curb and Gutter	L.F.	182	$ 26.00	$ 4,732
9080288	Curb Access Ramp	EACH	2	$ 1,600.00	$ 3,200
9130100	Concrete Channel Lining	S.Y.	700	$ 120.00	$ 84,000
9300128	Miscellaneous Work 18 (Drainage Improvements)	L.S.	1	$ 8,000.00	$ 8,000
9300201	Railroad Personnel, Protective Crossings and Private Crossings	L.S.	1	$ 150,000.00	$ 150,000
	Bridge	L.S.	1	$ 750,000.00	$ 750,000
				ROADWAY AND BRIDGE SUBTOTAL	**$ 1,204,892**
	Construction Work Contingency	Percent	20%		$ 240,978
				SUBTOTAL	**$ 1,445,870**
	Construction Surveying and Layout	Percent	3%		$ 43,376
	Erosion Control	Percent	2%		$ 28,917
	Contractor Quality Control	Percent	2%		$ 28,917
	Furnish Water Supply	Percent	2%		$ 28,917
	Maintenance and Protection of Traffic	Percent	10%		$ 144,587
				SUBTOTAL	**$ 1,720,584**
	Mobilization	Percent	10%		$ 172,058
				CONSTRUCTION SUBTOTAL	**$ 1,892,642**
	Construction Administration	Percent	15%		$ 258,088
				CONSTRUCTION TOTAL COST	**$ 2,150,730**
	Design Costs	Percent	12%	Cst Subtotal	$ 227,117
	Right-of-Way				$ 158,196
				TOTAL PROJECT COST	**$ 2,536,043**

Figure 8, Calle Sonora Conceptual Cost Estimate

Federal No : N/A
TRACS No : N/A
Project No : N/A
Date: July, 2015

Project Description : Calle Sonora Cost Estimate
Project Location : Nogales, Arizona
Stage : Preliminary
Project Manager : Scott Altherr, PE

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
2010001	Clearing and Grubbing	L.S.	1	$ 25,000.00	$ 25,000
2020001	Removal of Structures & Obstructions	L.S.	1	$ 50,000.00	$ 50,000
2050001	Grading Roadway for Pavement	S.Y.	6,914	$ 5.00	$ 34,570
3030003	Aggregate Base	C.Y.	1,155	$ 60.00	$ 69,300
4090003	Asphaltic Concrete (Miscellaneous Structural)	Ton	2,305	$ 90.00	$ 207,450
5150002	Utility Relocation Work	L.S.	1	$ 30,000.00	$ 30,000
6080107	Miscellaneous Work (Signs)	L.S.	1	$ 9,000.00	$ 9,000
7040015	Pavement Markings	L.S.	1	$ 6,000.00	$ 6,000
7330029	Traffic Signal	L.S.	1	$ 100,000.00	$ 100,000
8080012	Seeding and Miscellaneous Landscape Work	L.S.	1	$ 10,000.00	$ 10,000
9080002	Concrete Curb	L.F.	603	$ 20.00	$ 12,060
9080050	Concrete Curb and Gutter	L.F.	2,255	$ 26.00	$ 58,630
9080150	Concrete Median Pavement	S.F.	2,036	$ 7.00	$ 14,252
9080201	Concrete Sidewalk	S.F.	7,408	$ 6.00	$ 44,448
9080288	Curb Access Ramp	EACH	8	$ 1,600.00	$ 12,800
9080302	Concrete Driveway	EACH	2	$ 2,200.00	$ 4,400
9130100	Concrete Channel Lining	S.Y.	400	$ 120.00	$ 48,000
9300128	Miscellaneous Work 18 (Drainage Improvements)	L.S.	1	$ 15,000.00	$ 15,000
9300201	Railroad Personnel, Protective Crossings and Private Crossings	L.S.	1	$ 200,000.00	$ 200,000
	Bridge	L.S.	1	$ 1,200,000.00	$ 1,200,000
				ROADWAY AND BRIDGE SUBTOTAL	**$ 2,150,910**
	Construction Work Contingency	Percent	20%		$ 430,182
				SUBTOTAL	**$ 2,581,092**
	Construction Surveying and Layout	Percent	3%		$ 77,433
	Erosion Control	Percent	2%		$ 51,622
	Contractor Quality Control	Percent	2%		$ 51,622
	Furnish Water Supply	Percent	2%		$ 51,622
	Maintenance and Protection of Traffic	Percent	10%		$ 258,109
				SUBTOTAL	**$ 3,071,500**
	Mobilization	Percent	10%		$ 307,150
				CONSTRUCTION SUBTOTAL	**$ 3,378,650**
	Construction Administration	Percent	10%		$ 307,150
				CONSTRUCTION TOTAL COST	**$ 3,685,800**
	Design Costs	Percent	12%	Cst Subtotal	$ 405,438
	Right-of-Way				$ 696,582
				TOTAL PROJECT COST	**$ 4,787,820**

7.0 Project Action Item Checklist

- Submit constraints analysis to Public Works Department
- Submit constraints analysis for courtesy review to Flood Control District and ADOT
- Present findings at City Council meeting
- Begin right-of-way acquisition process
- Set aside and budget funding for design and construction
- Scope the final design and construction documents.
- Obtain Section 404 Clean Water Act Permit
- Prepare Plans, Specifications, and Estimate for first project.
- Begin utility relocation
- Advertise for Construction Bids
- Construct

8.0 Study Limitations

The intent of this analysis is to provide a scoping document that analyzes the constraints and possible solutions and provides a significant step forward in the planning process to budget and deliver projects for these crossings. Detailed design issues such as restoring access, construction phasing, and traffic control need further analysis. It is anticipated that with the congested nature of these project areas that any project development will have the interest of the general public, emergency services, business community, and utility industry as well as agencies such as ADOT, Santa Cruz County Flood Control District, and Union Pacific. Some assumptions that were made that could have an effect on cost of these projects are:

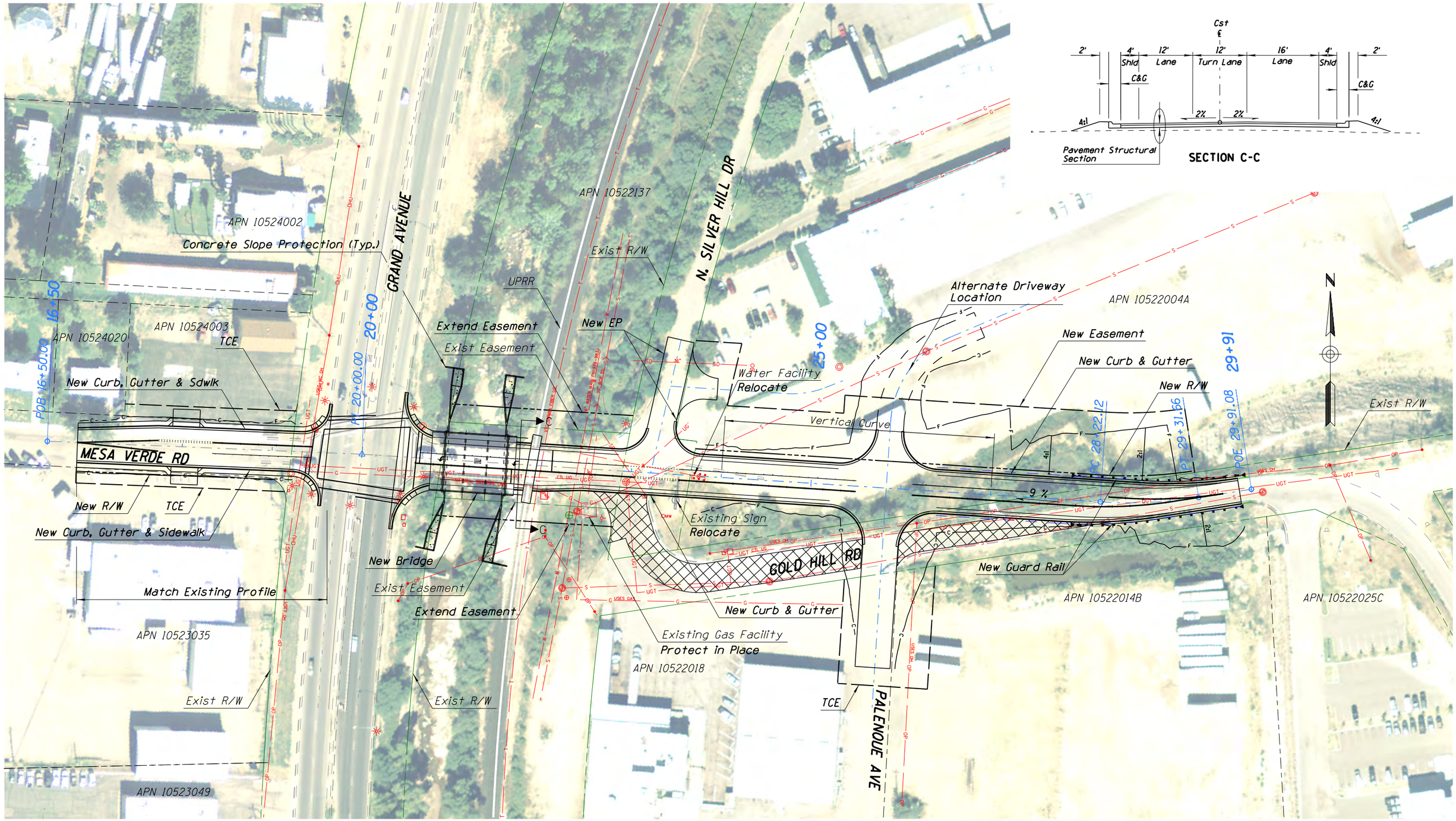
- No improvements outside of signalization, signing and striping will be required for connections to Grand Ave (B-19).
- Lighting of intersections will not impact overhead utilities and approaches to intersections do not require additional lighting.
- 20% Contingency is sufficient to cover unknown costs at this conceptual stage
- Geotechnical investigation will not discover any constraints that will increase the cost of construction
- De-watering of channel during construction is a given and is buried into bridge costs.

9.0 Preliminary Plans

The Preliminary Plans show the conceptual horizontal alignments, roadway improvements and proposed bridge structures for Gold Hill Road, Produce Row and Calle Sonora. These plans were prepared without design level survey, survey control, photometric analysis and geotechnical design recommendations. When these projects are advanced to final design each of these components will be added and the resulting information may require some modification of the conceptual plans and cost. The Preliminary Plans are shown in **Appendix A**.

Appendix A

Preliminary Plans



Notes:

1. Add left turn lanes to east and west connections to Grand Avenue.
2. Realign Gold Hill Road and reconstruct driveways.
3. Remove and replace bridge.
4. Northbound right turn bay design on Grand Avenue omitted due to bridge constraints.

EXHIBIT
Grand Ave/Gold Hill Rd
Preliminary Configuration

07/09/2015

Kimley»Horn

SCALE:
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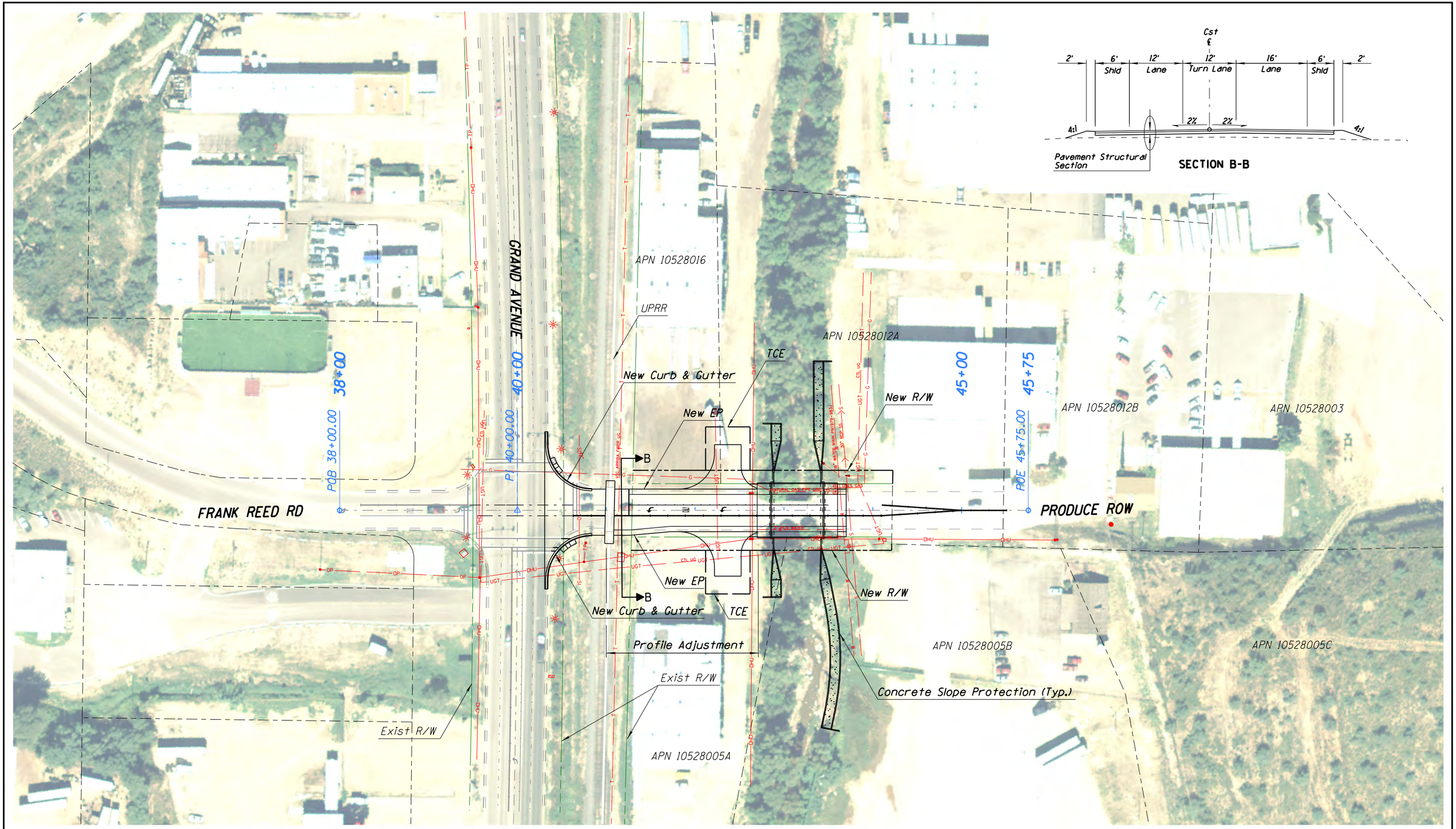
(11"x17")



NOTES:

1. Add left turn lane to east connection at Grand Avenue.
2. Reconstruct driveways.
3. Remove and replace bridge.
4. Northbound right turn bay design on Grand Avenue omitted due to right-of-way constraints.

EXHIBIT

Grand Ave/Produce Row
Preliminary Configuration

07/09/2015

Kimley»Horn

SCALE:
1"=100'
(11"x17")

GRAND AVENUE

MARIPOSA RD

CALLE SONORA

SMOKEY LN

HOHOKAM DR

UPRR

APN 10201008E

APN 10201016
(City of Nogales)

APN 10201013

APN 10201016
(City of Nogales)

APN 10201085

APN 10201075

New R/W

APN 10201008D

APN 10201008A

New Curb, Gutter & Sdwlk

See Note 6

New EP

See Note 7

POB 60+00.00

60+00

65+00

69+00

POE 69+00.00

A

A

Profile Adjustment

New R/W

New Curb, Gutter & Sdwlk

New Bridge

APN 10201009

Concrete Slope Protection (Typ.)

APN 10201076C

One-Way Loop

New EP

New Curb & Gutter

New Curb, Gutter & Sdwlk

APN 10201210A

Exist R/W

Exist R/W

APN 10201014

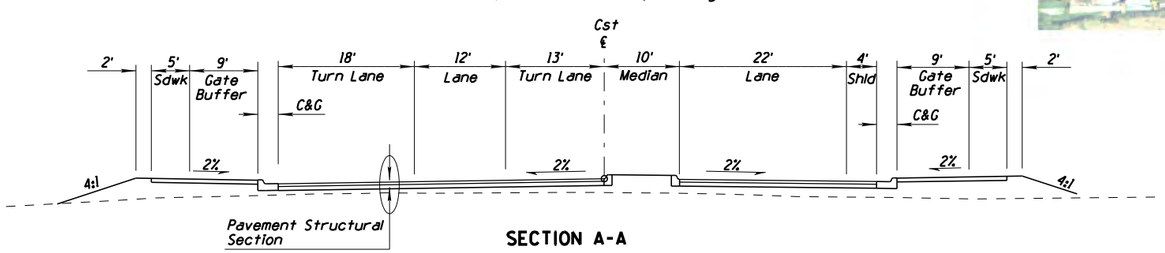
Realign Hohokam Dr.

New R/W

APN 10201210C

NOTES:

1. Add left and right turn lanes to east connection at Grand Avenue.
2. Add concrete median to provide access control to driveways.
3. Restrict left turns to Smokey Lane. Provide loop access to Hohokam Drive.
4. Remove and replace bridge.
5. Northbound right turn bay design on Grand Avenue omitted due to right-of-way constraints.
6. Driveway sight triangle conflict with bridge barrier.
7. Further design may indicate need to reconfigure/relocate parking.



SECTION A-A

EXHIBIT

Grand Ave/Calle Sonora
Preliminary Configuration

07/09/2015

Kimley»Horn

SCALE:
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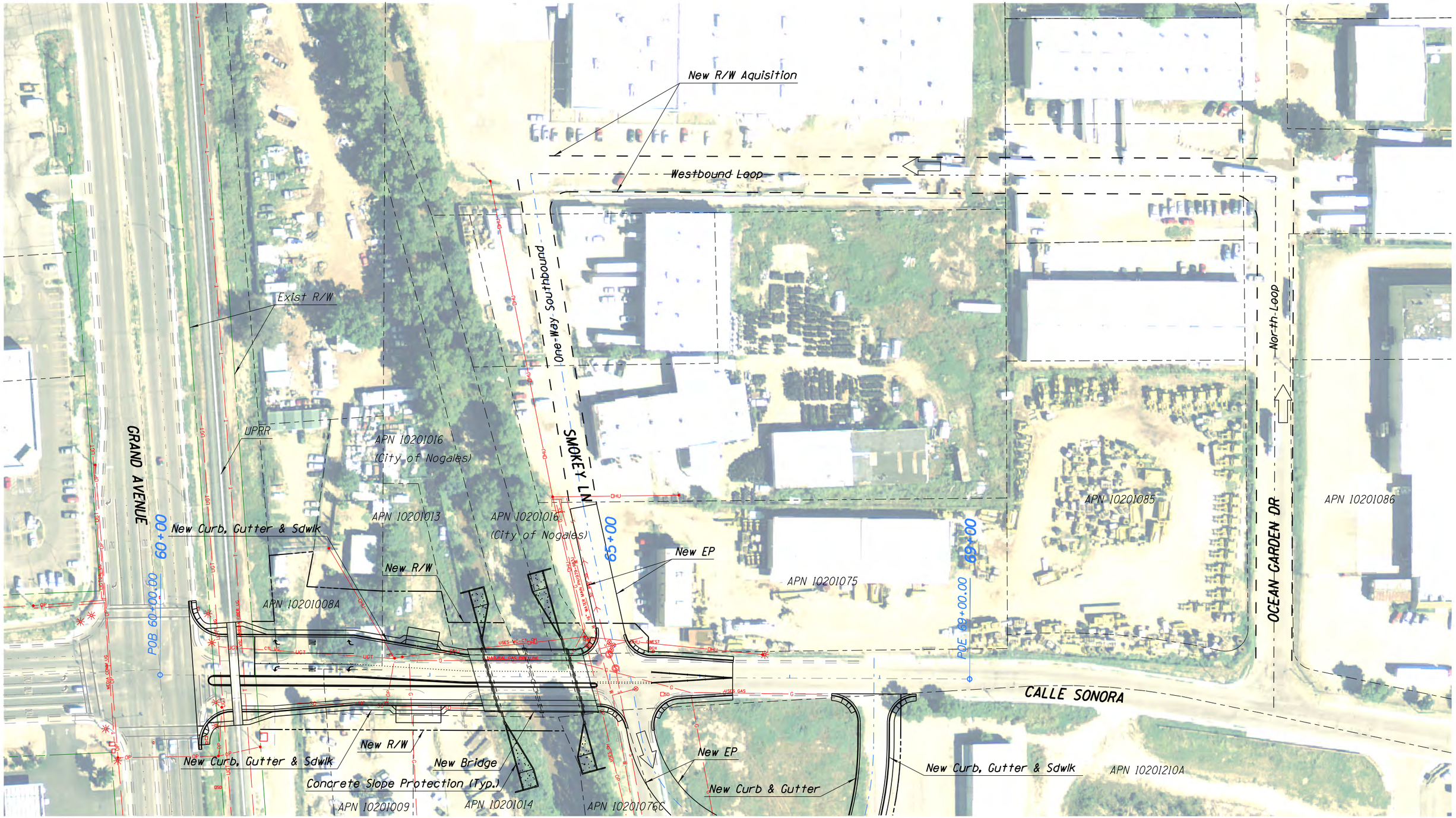
(11"x17")



NOTES:

Alternate from Road Safety Assessment Calle Sonora/Hohokam Drive, June 2-4, 2009

Alternative: Consider converting Smokey Lane one-way southbound and acquire the private property on the north side of the Villa's Food Market to use to access Smokey Lane From N. Ocean Garden Drive.

EXHIBIT	07/09/2015
Grand Ave/Calle Sonora Alternate Route	Kimley»Horn

SCALE:
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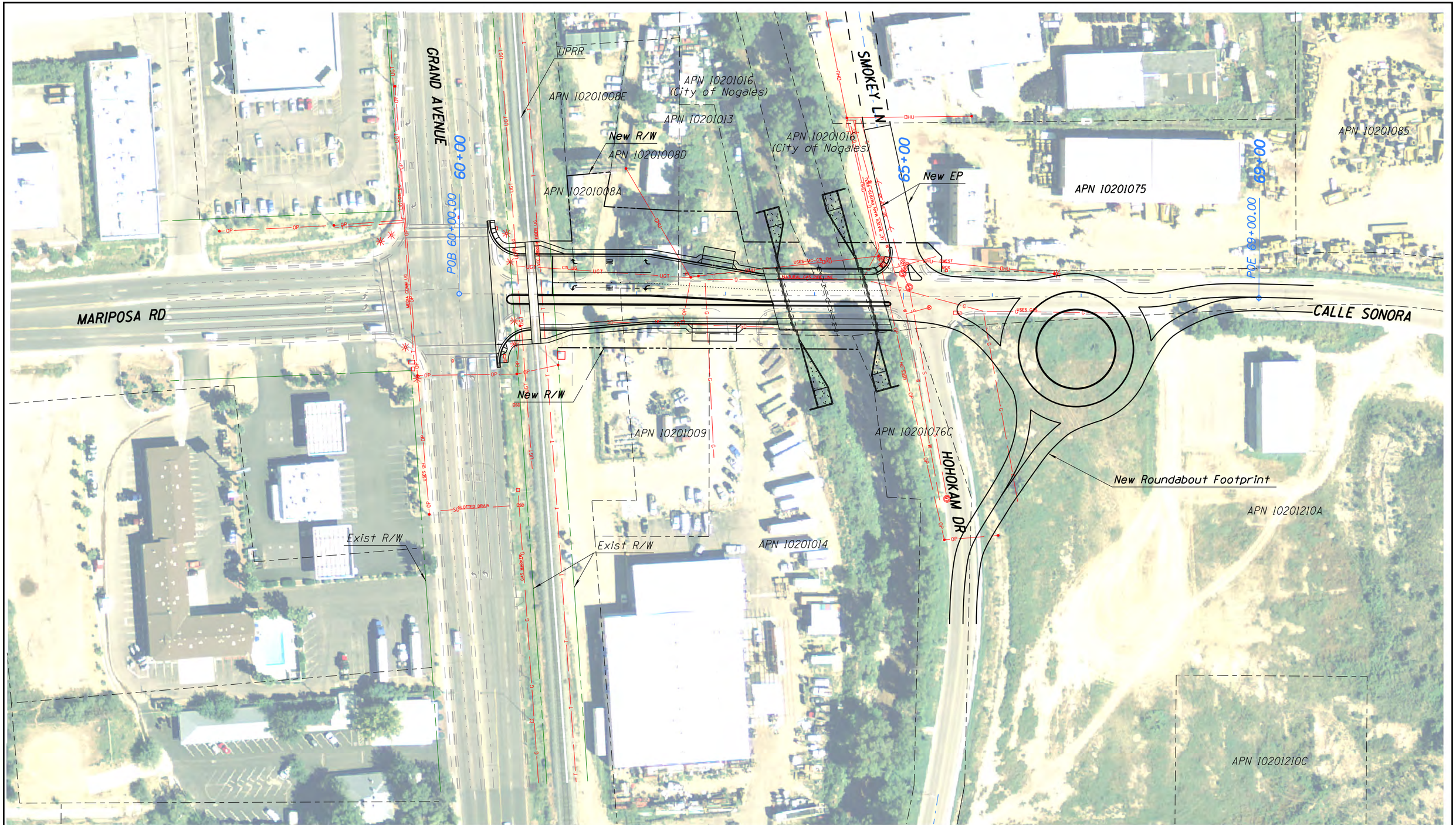

EXHIBIT

Calle Sonora Preliminary Roundabout Configuration

09/25/2015

Kimley»Horn

SCALE:
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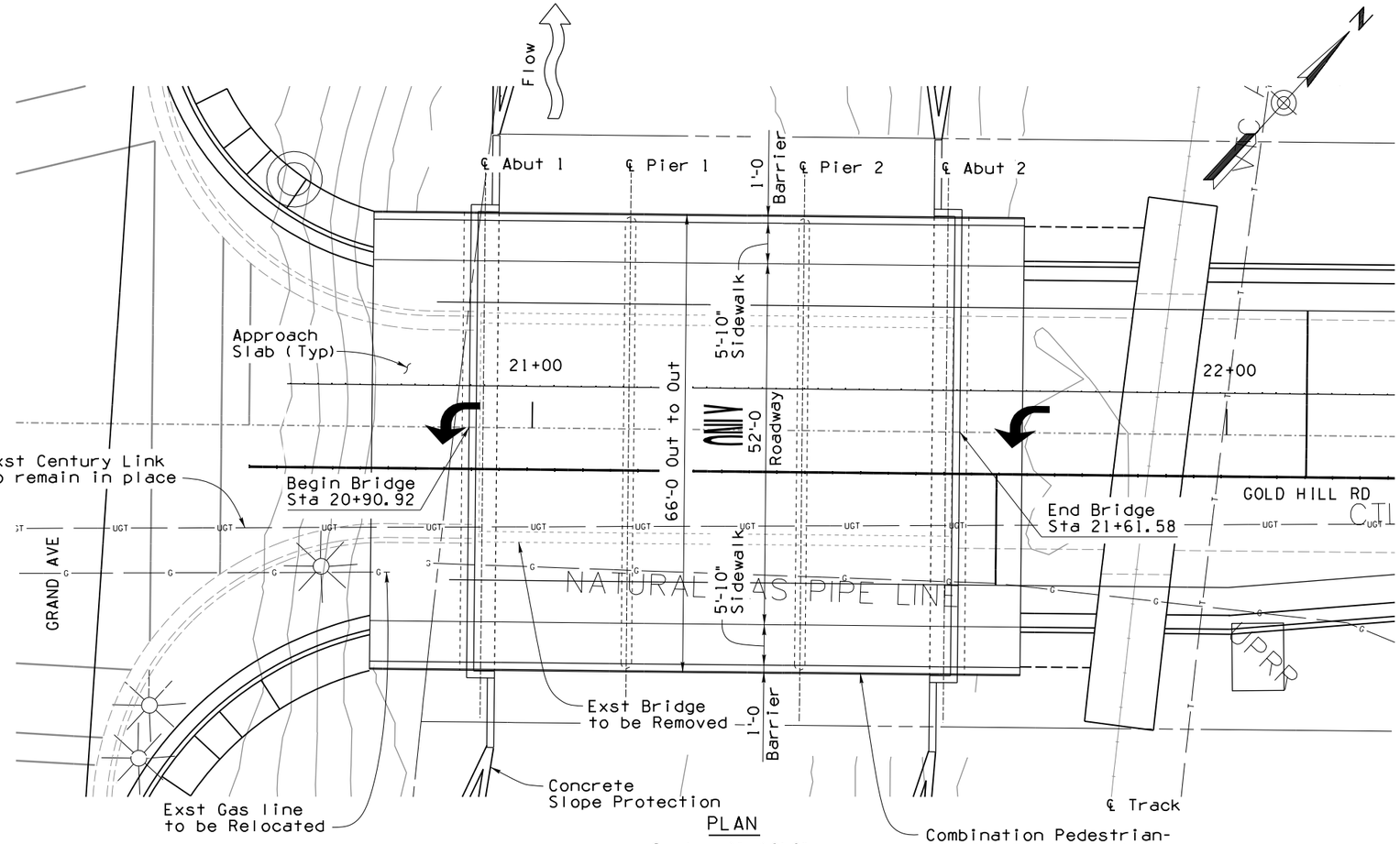
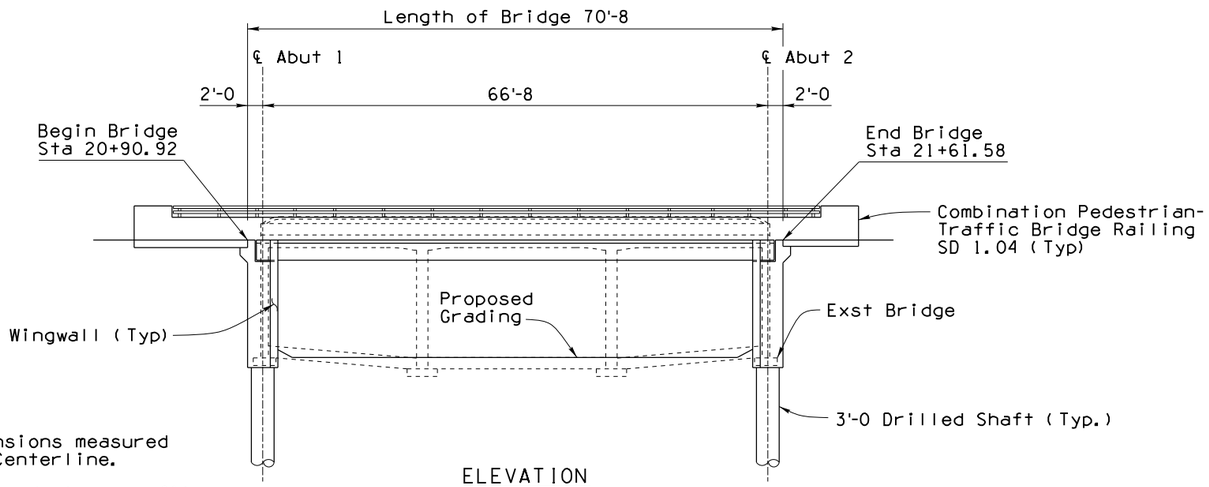
(11"x17")



PLAN

Scale: 1" = 10'-0"
00° 00' 00" Skew Lt



ELEVATION

Scale: 1" = 10'-0"

NOTES:

1. Stationing and dimensions measured along Gold Hill Rd Centerline.
2. Elevations are measured along profile grade line.

GENERAL NOTES:

Construction Specification -
Arizona Department of Transportation Standard Specifications for Road and Bridge Construction, Edition of 2008.

Design Specifications -
AASHTO LRFD Bridge Design Specifications 6th Edition 2012

Dead Load -
Dead Load includes allowance of 25 pounds per square foot for future wearing surface.

Loading Class - HS20-44 and/or Interstate Alternate Loading.

Composite Design -
Dead load carried by box beams only. Box beams are designed using transformed section properties.

All concrete shall be Class "S" unless noted otherwise.

Reinforcing steel shall conform to ASTM Specification A615. All reinforcing shall be furnished as Grade 60.

All bends and hooks shall meet the requirements of AASHTO Article 5.10.2 All bend dimensions for reinforcing steel shall be out-to-out of bars. All placement dimensions for reinforcing steel shall be to center of bars unless noted otherwise.

All reinforcing steel shall have 2 inch clear cover unless noted otherwise.

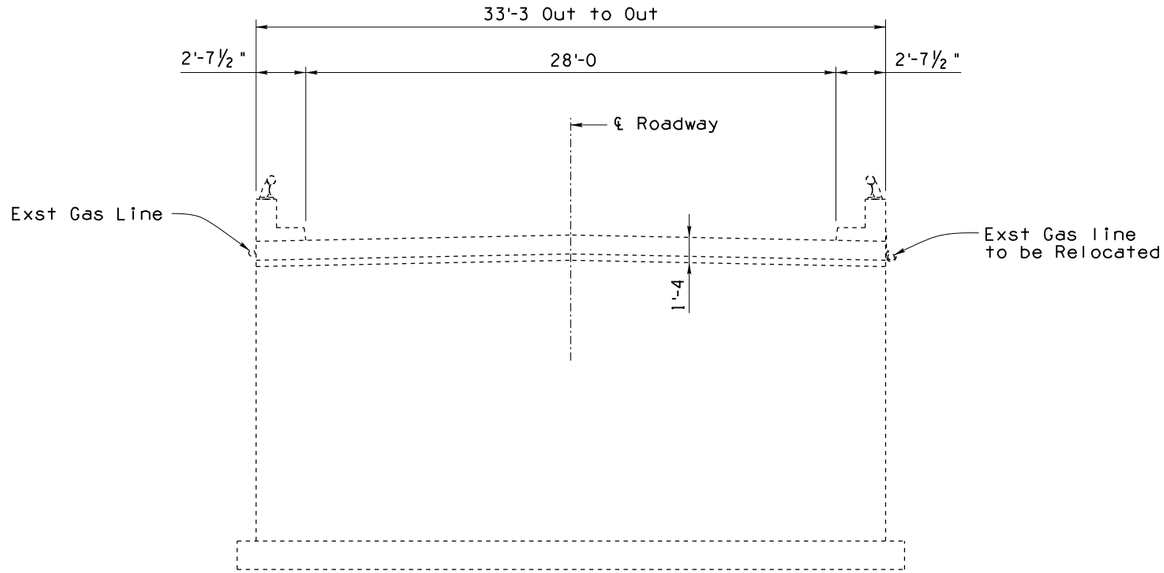
Barrier shall be constructed after spans have taken dead load deflection. Barrier shall not be slip formed.

Dimensions shall not be scaled from the drawings.

Chamfer all exposed corners ¾" per Chamfer Detail unless noted otherwise.

GOLD HILL ROAD
LOCATION PLAN

Kimley»Horn



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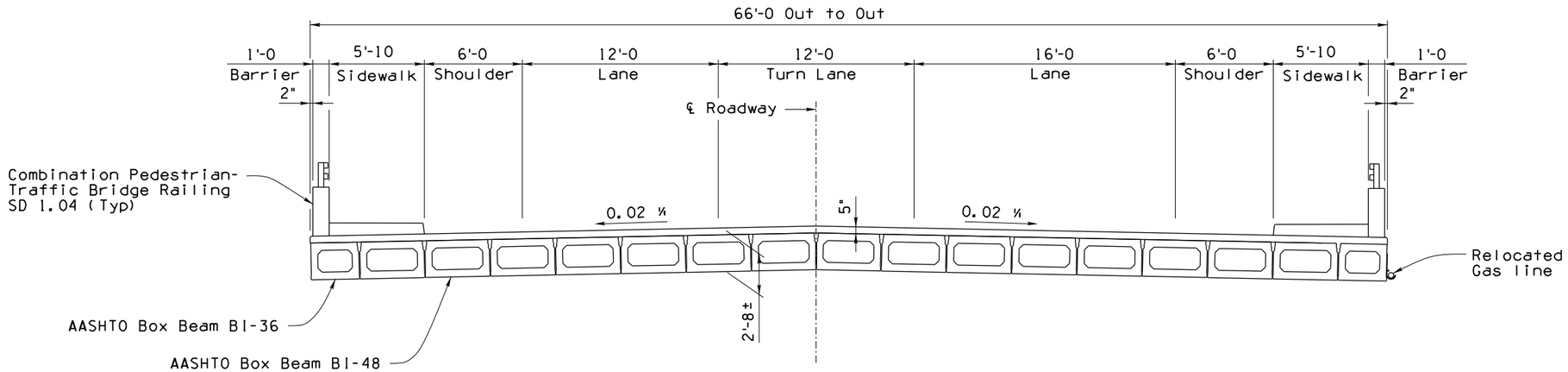
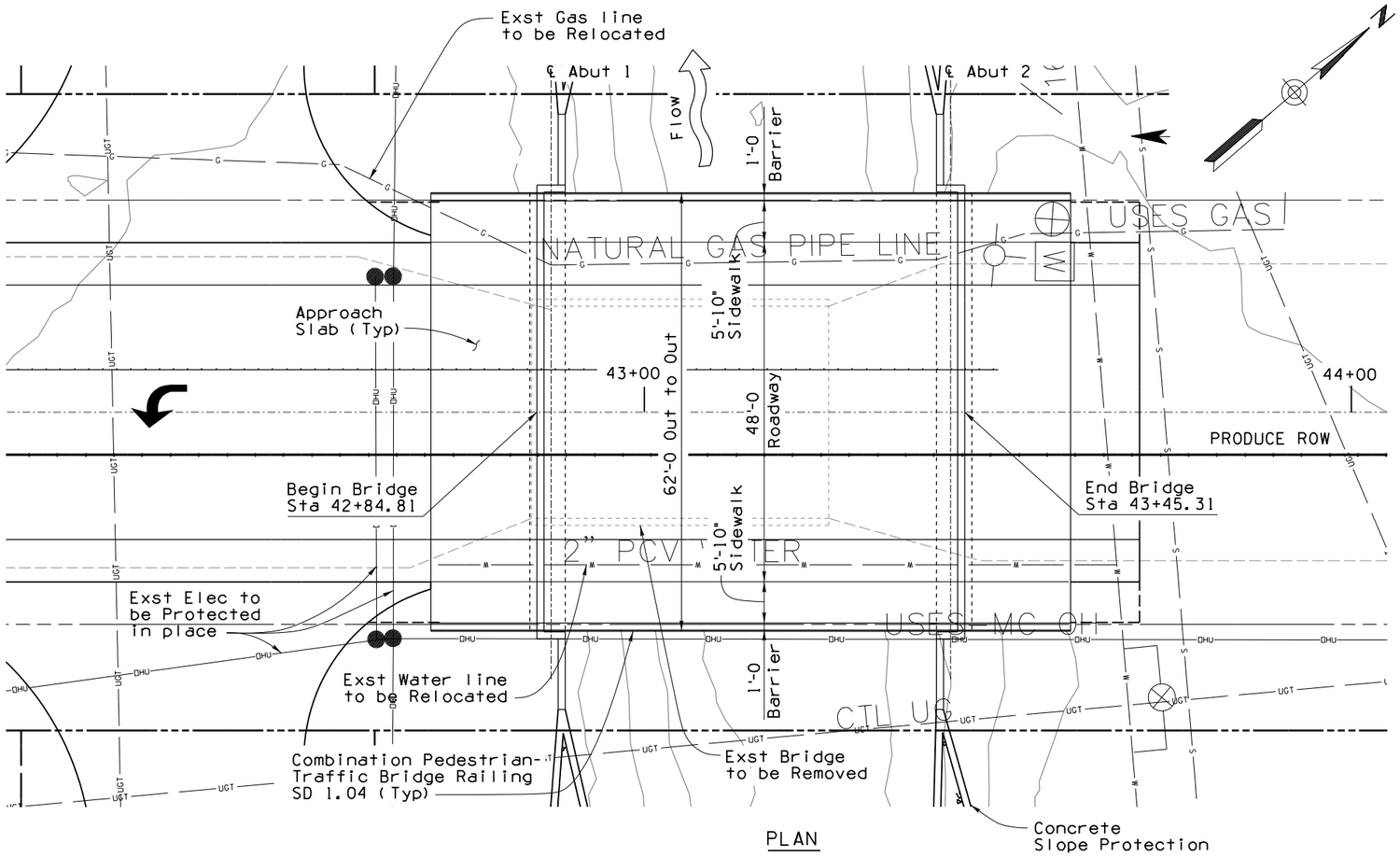


PROPOSED SECTION

Scale: ¼" = 1'-0"

GOLD HILL ROAD
TYPICAL SECTIONS

Kimley»Horn



PLAN

Scale: 1" = 10'-0"
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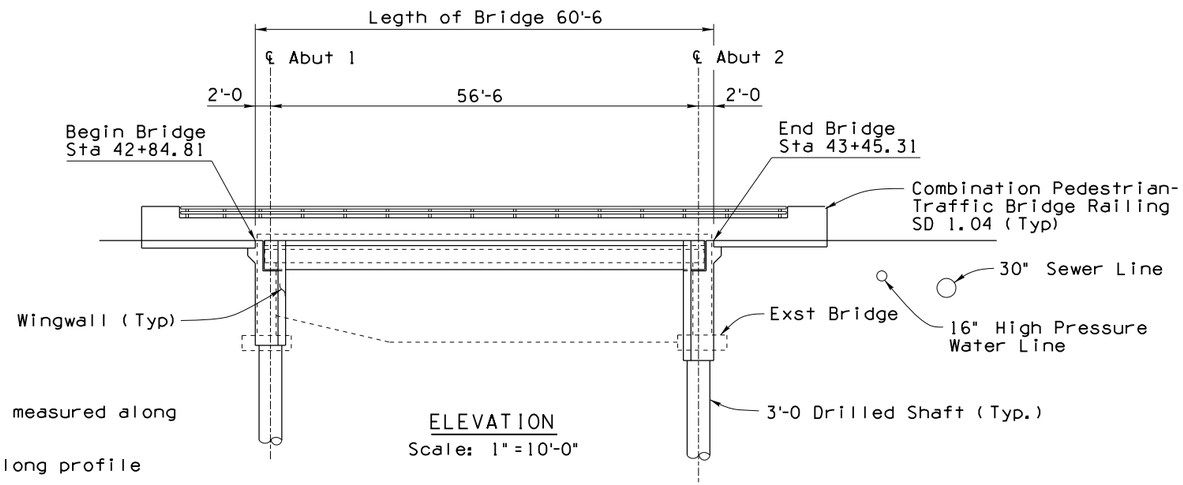


ELEVATION

Scale: 1" = 10'-0"

NOTES:

1. Stationing and dimensions measured along Produce Row Centerline.
2. Elevations are measured along profile grade line.

GENERAL NOTES:

Construction Specification -
Arizona Department of Transportation Standard Specifications for Road and Bridge Construction, Edition of 2008.

Design Specifications -
AASHTO LRFD Bridge Design Specifications, 6th Edition, 2012.

Dead Load - Dead Load includes an allowance of 25 pounds per square foot for future wearing surface.

Loading Class HL-93.

All concrete shall be Class 'S' unless noted otherwise.

Reinforcing steel shall conform to ASTM Specification A615. All reinforcing shall be furnished as Grade 60.

All bends and hooks shall meet the requirements of AASHTO Article 5.10.2 All bend dimensions for reinforcing steel shall be out-to-out of bars. All placement dimensions for reinforcing steel shall be to center of bars unless noted otherwise.

All reinforcing steel shall have 2 inch clear cover unless noted otherwise.

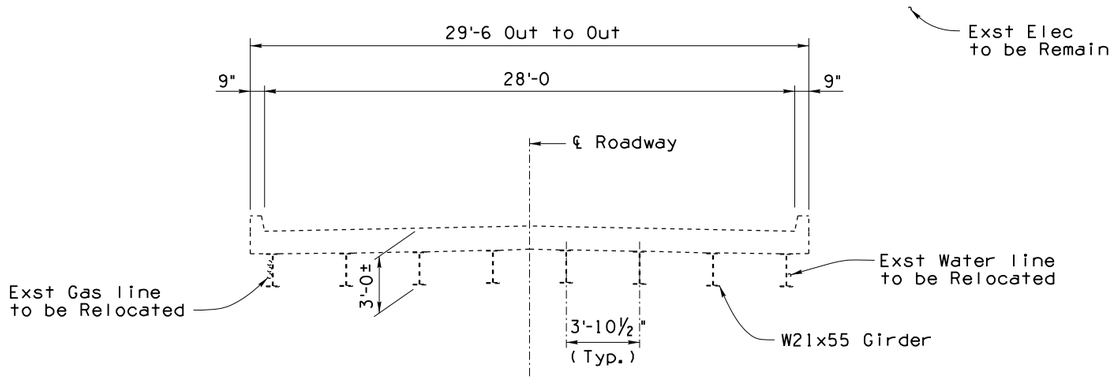
Barriers shall be constructed after spans have taken dead load deflection. Barriers shall not be slip formed.

Dimensions shall not be scaled from drawings.

Chamfer all exposed corners ¾" per Chamfer Detail unless noted otherwise.

PRODUCE ROW
LOCATION PLAN

Kimley»Horn



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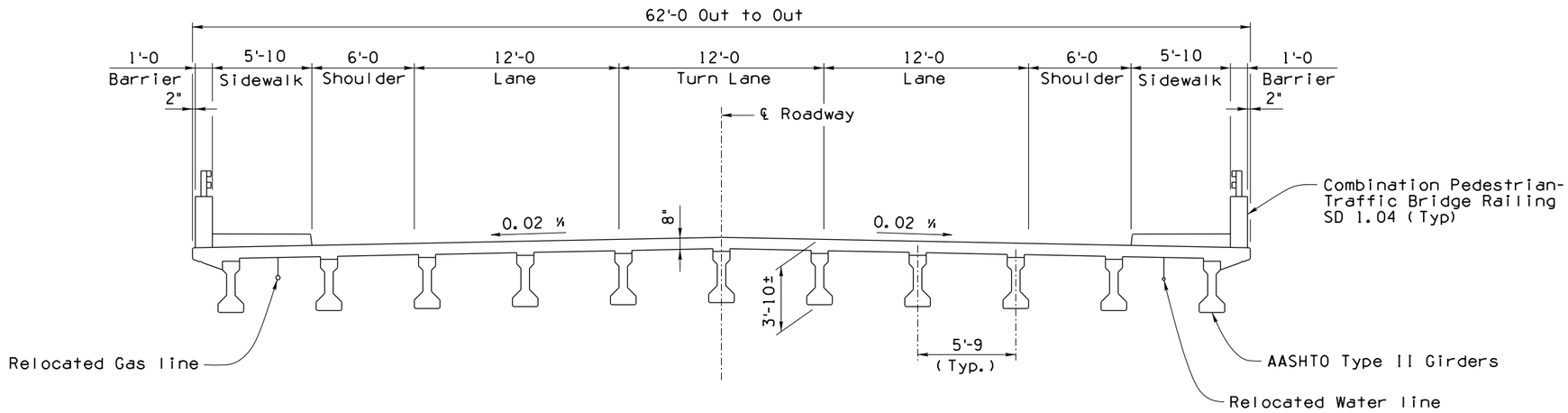
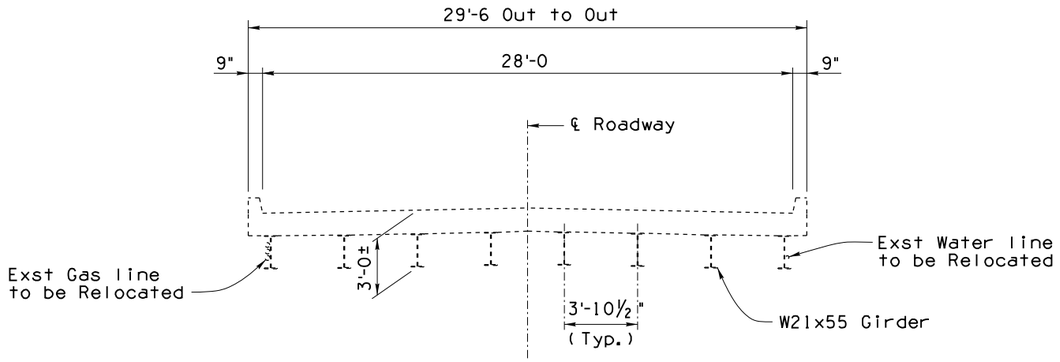


OPTION 1 - PROPOSED SECTION

Scale: ¼" = 1'-0"

PRODUCE ROW
TYPICAL SECTIONS

Kimley»Horn



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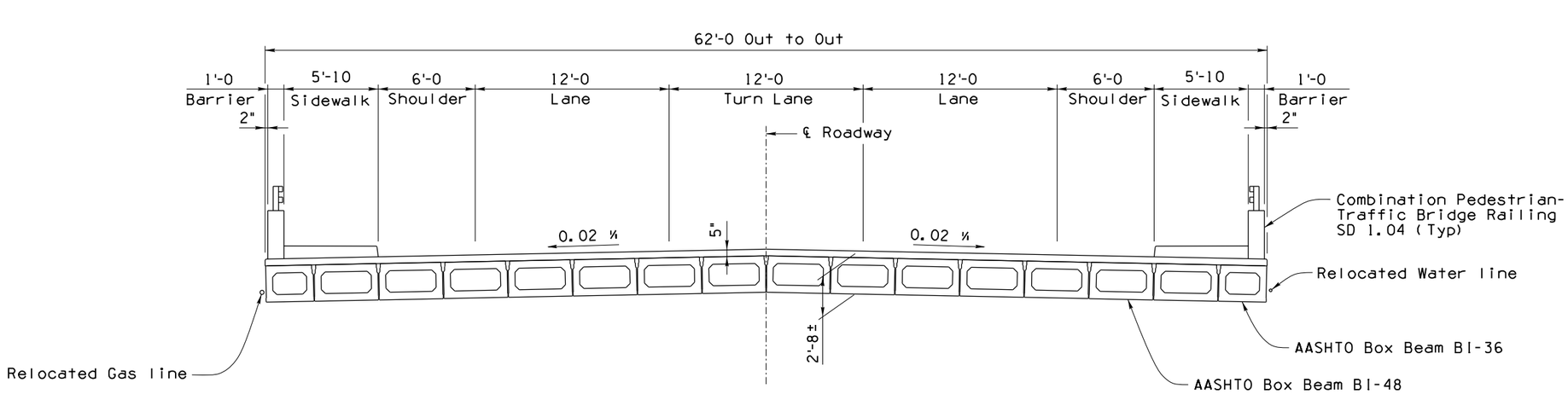

OPTION 2 - PROPOSED SECTION

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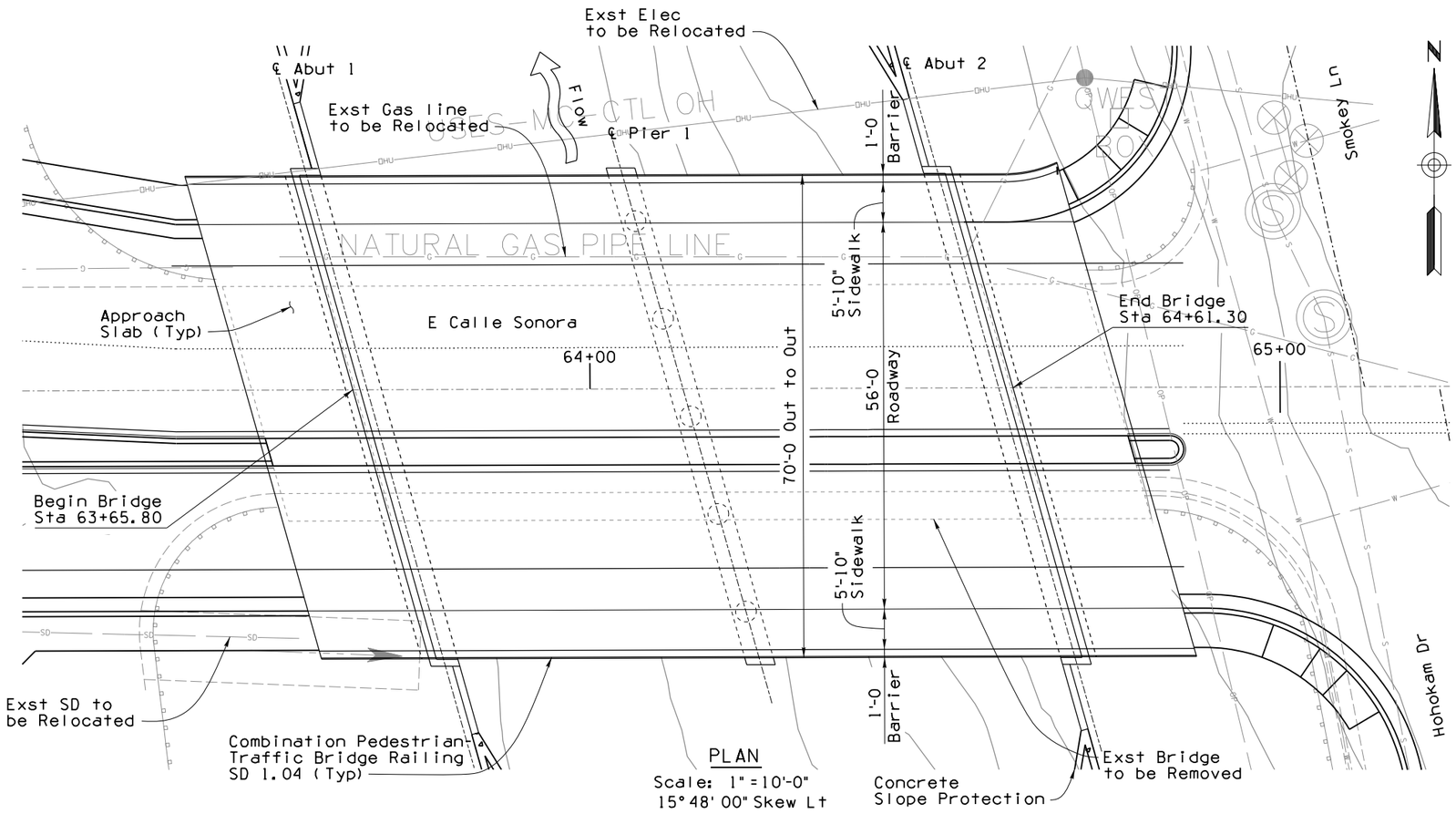
PRODUCE ROW
TYPICAL SECTIONS

Kimley»Horn



PLAN

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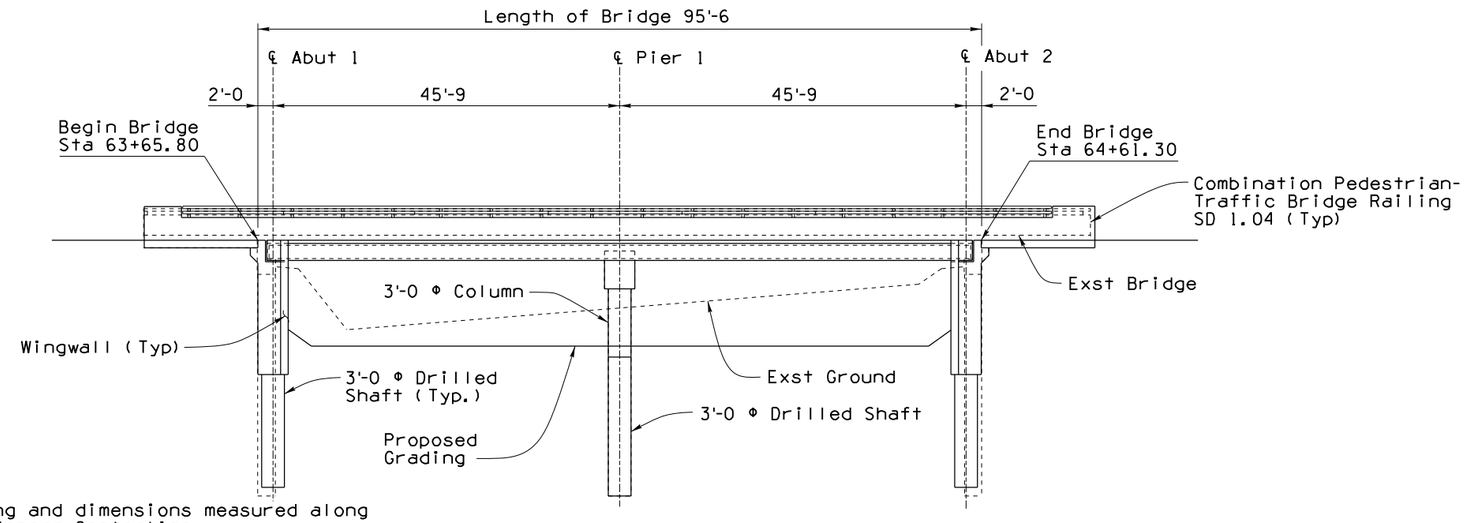
15° 48' 00" Skew Lt



ELEVATION

Scale: 1" = 10'-0"

NOTES:

1. Stationing and dimensions measured along E Calle Sonora Centerline.
2. Elevations are measured along profile grade line.

GENERAL NOTES:

Construction Specification -
Arizona Department of Transportation Standard Specifications for Road and Bridge Construction, Edition of 2008.

Design Specifications -
AASHTO LRFD Bridge Design Specifications 6th Edition 2012

Dead Load -
Dead Load includes allowance of 25 pounds per square foot for future wearing surface.

Loading Class - HS20-44 and/or Interstate Alternate Loading.

Composite Design -
Dead load carried by box beams only. Box beams are designed using transformed section properties.

All concrete shall be Class "S" unless noted otherwise.

Reinforcing steel shall conform to ASTM Specification A615. All reinforcing shall be furnished as Grade 60.

All bends and hooks shall meet the requirements of AASHTO Article 5.10.2 All bend dimensions for reinforcing steel shall be out-to-out of bars. All placement dimensions for reinforcing steel shall be to center of bars unless noted otherwise.

All reinforcing steel shall have 2 inch clear cover unless noted otherwise.

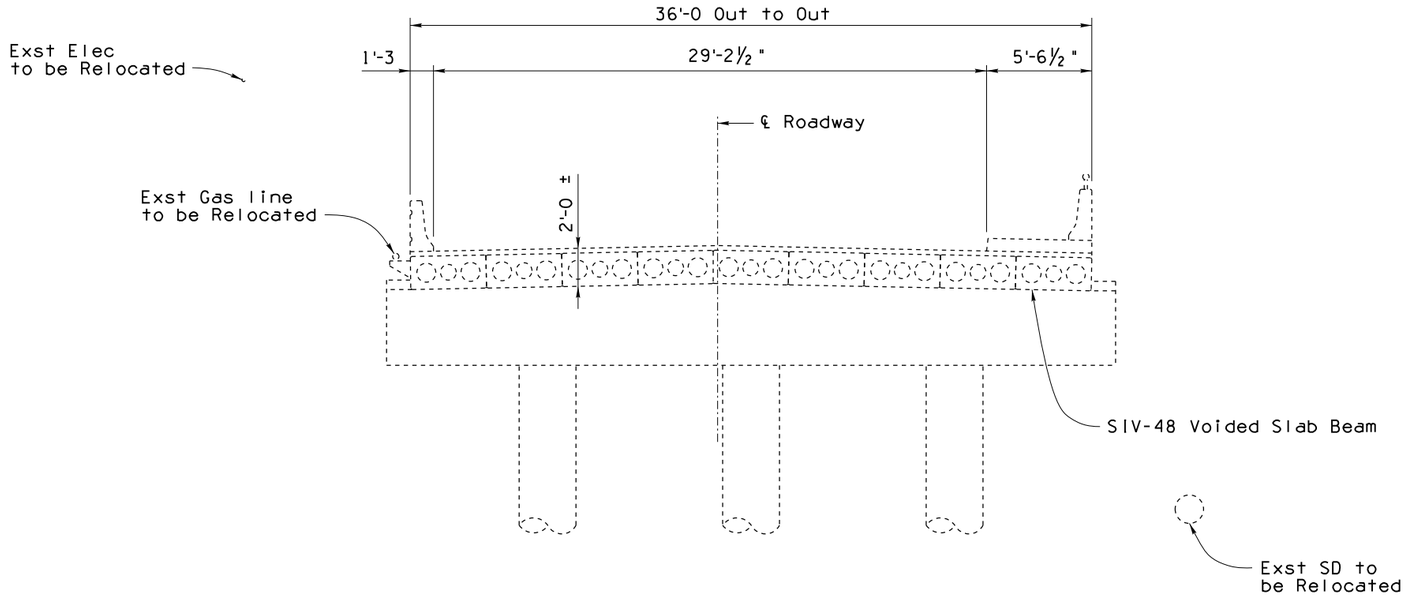
Barrier shall be constructed after spans have taken dead load deflection. Barrier shall not be slip formed.

Dimensions shall not be scaled from the drawings.

Chamfer all exposed corners ¾" per Chamfer Detail unless noted otherwise.

E CALLE SONORA
LOCATION PLAN

Kimley»Horn



EXISTING SECTION

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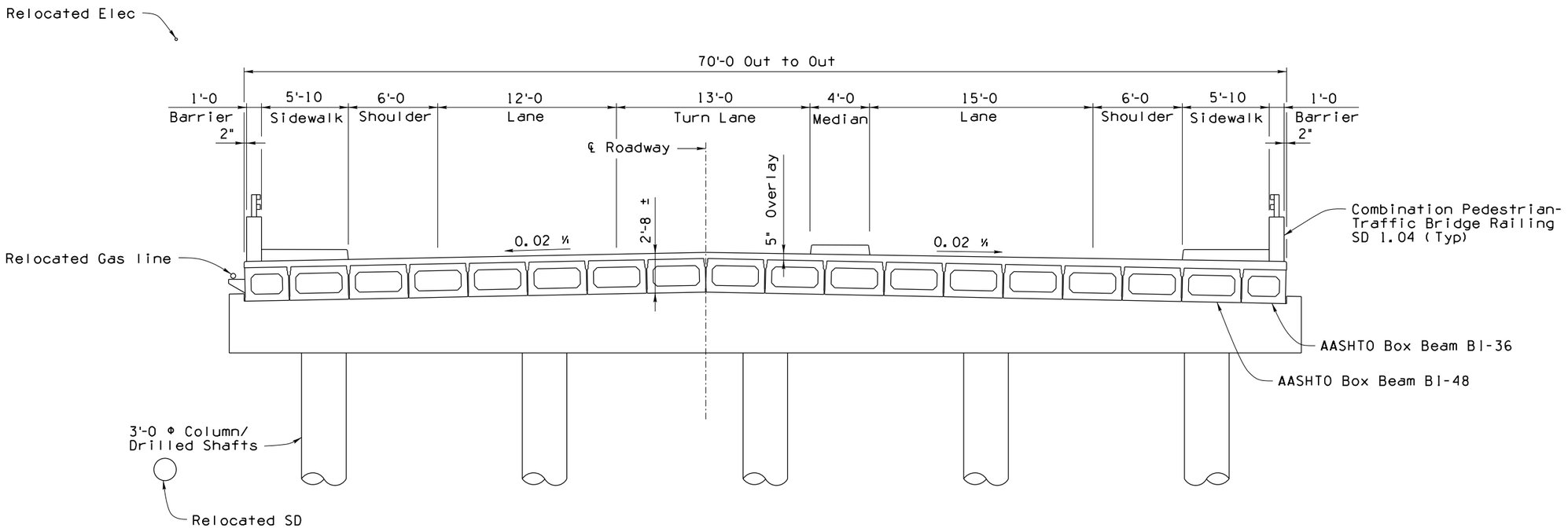


PROPOSED SECTION

Scale: ¼" = 1'-0"

E CALLE SONORA
TYPICAL SECTIONS

Kimley»Horn

Appendix B

Traffic Evaluation

NOGALES CONSTRAINTS ANALYSIS TRAFFIC EVALUATION

June 19, 2015

Prepared for:

City of Nogales

Prepared by:

333 E. Wetmore Road, Suite 280
Tucson, Arizona 85705

Table of Contents

Figures

Tables

1. INTRODUCTION

Background Information

The City of Nogales is conducting a study that will determine potential improvements for three side streets east of Grand Avenue with potential replacement of three bridges that span across the Nogales Wash. The side streets include: Gold Hill Road, Produce Row, and Calle Sonora. The overall study will encompass a set of analysis to determine feasibility and conceptual cost of improving access, capacity, alignment geometry, and accommodating overweight vehicles and projected traffic volumes. This document provides the results of the traffic analysis portion of the study.

Objectives of the Study

This section of the evaluation will document the analysis of current and future traffic conditions. The objectives of the traffic study include the following:

- Determine existing traffic conditions based on collected peak-hour turning movement counts, 24-hour tube counts with truck classification data, 3-year crash history within the study limits. Also, a set of interviews with warehouse operators/stakeholders to understand their perspectives on existing conditions and transport needs were conducted.
- Forecast future traffic conditions at each of the 3 locations based on anticipated growth and development plans based on the stakeholder interview process.
- Perform a traffic analysis on current and future traffic.

2. EXISTING CONDITIONS

The study area encompasses 3 streets along Grand Avenue that provide access to a number of warehouses in the area. The streets include Gold Hill Road, Produce Row, and Calle Sonora. Each street has a bridge that crosses over the Nogales Wash. **Figure 2** illustrates current lane configuration.

Grand Avenue

Grand Avenue, also known as the Tucson-Nogales Highway is a major North/South arterial that connects to the Mexico border south of the city and connects to I-19 north of the city. Grand Avenue consists of segments with a 4-lane cross-section. Segments consist of having a center Two-Way-Left-Turn (TWLT) lane and other segments have a 4-lane median separated cross-sections. The posted speed limit on Grand Avenue is 40 MPH. According to data provided by the South Eastern Arizona Governments Organization (SEAGO), Grand Avenue has an Annual Average Daily Traffic (AADT) of 17,600 vehicles (2013).

Gold Hill Road

Gold Hill Road is a 2-lane collector street located north within the project limits. The street intersects with Grand Avenue which then becomes Mesa Verde Road, west of Grand Avenue. The intersection is signalized. Based on the 24-hour traffic data collected, Gold Hill Road has approximately 3,000 vehicle per day (VPD). The road gives access to multiple warehouses and residential areas further east. The road is estimated to have a 25 MPH speed limit. The intersection of Grand Avenue and Gold Hill Road is signalized. According to a site visit, the cycle length of the signal was estimated to be 80 seconds with Permissive left turns for each approach.

Produce Row

Produce Row is a 2-lane collector street centrally located within the project limits with a speed limit of 25 MPH. The street intersects with Grand Avenue which then becomes Frank Reed Road, west of Grand Avenue. The intersection is signalized. Based on the 24-hour traffic data collected, Produce Row has approximately 2,000 VPD. The road provides access primarily to Warehouses with no residential access. According to a site visit, the cycle length of the signal was estimated to be 80 seconds in length with permissive/protected lefts for the northbound and southbound direction.

Calle Sonora

Calle Sonora is a 2-lane collector street located south within of the project limits with a speed limit of 25 MPH. The street intersects with Grand Avenue which then becomes Mariposa Road, west of Grand Avenue The intersection is signalized. Based on the 24-hour traffic data

collected, Calle Sonora has approximately 4,500 VPD. The road provides access to some warehouses and residential areas within Santa Cruz County. According to a site visit the cycle length was estimated to be 130 seconds long with split phasing for the east/west bound direction.

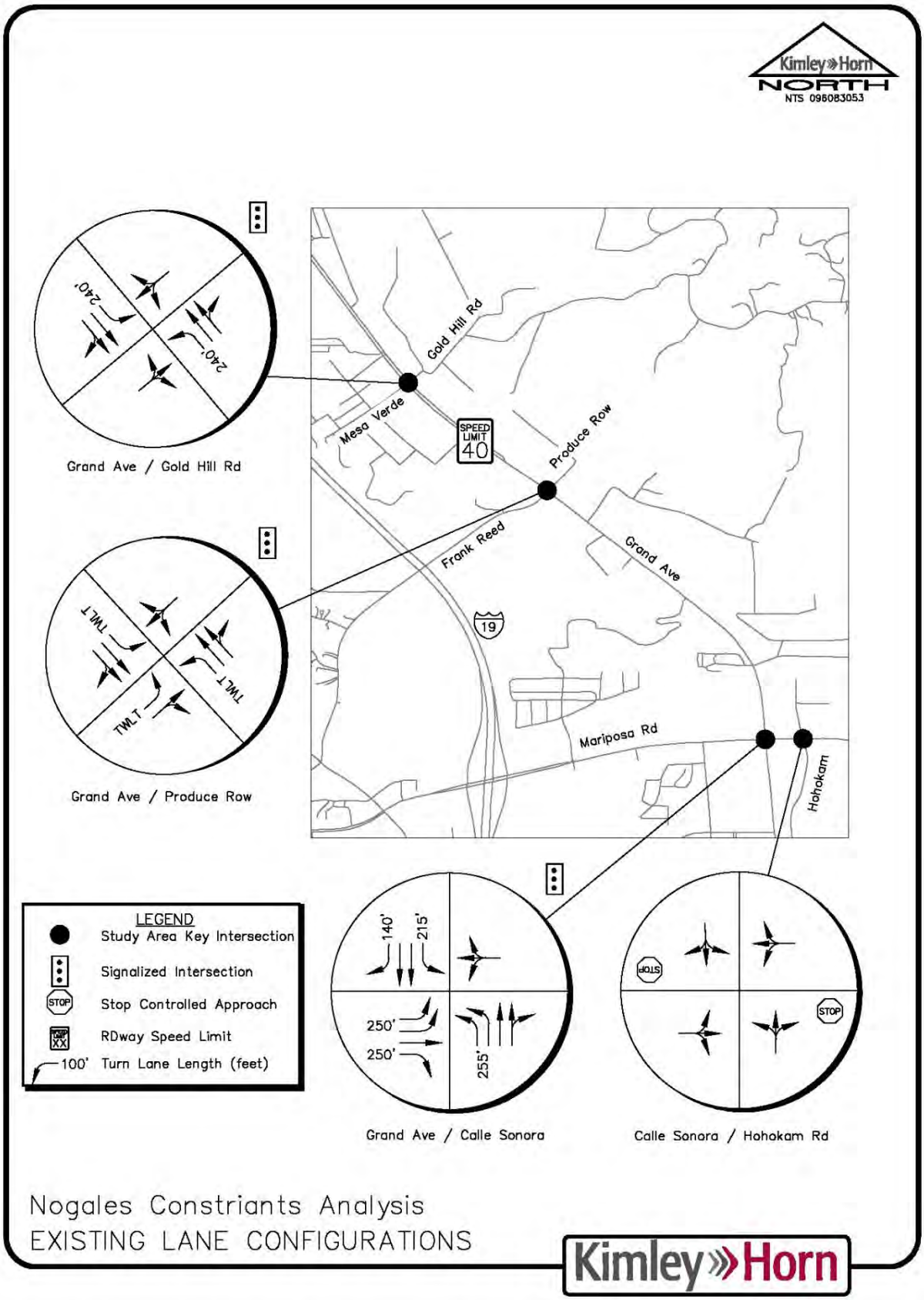
Union Pacific Railroad

The Union Pacific Railroad (UPRR) runs at-grade through each of the 3 cross-streets, parallel to Grand Avenue just to the east. According to comments from Fresh Produce Association of America (FPAA) members, approximately 5-7 trains pass through on a daily basis at low speeds resulting in approximately 10-20 minute periods where the side-streets are inaccessible.

Stakeholder Interviews

Stakeholder interviews with members of the Fresh Produce Association of the Americas (FPAA) were conducted on March 6th, 2015. The FPAA is an influential group that works to ensure uninterrupted access to Mexican grown fruits and vegetables. The objective of the interviews were to gain a local perspective of existing conditions but also determine what the future needs in terms of traffic growth are anticipated. Discussion points from the interviews are presented in various sections of the traffic report when appropriate. A summary of the stakeholder comments can be found in **Appendix B**.

Figure 1 - Existing Lane Configuration



Traffic Data Collection

Traffic data was collected on *February 4th, 2015*. The traffic data was collected during what would be considered the peak season for produce shipments from Mexico. The collected traffic data includes 24-hour tube counts located on the 3 bridges and AM/PM peak period intersection turning movement counts. **Figure 2** illustrates the 24-hour traffic volumes pattern.

Figure 2 – 24-hour Traffic Volume Profile

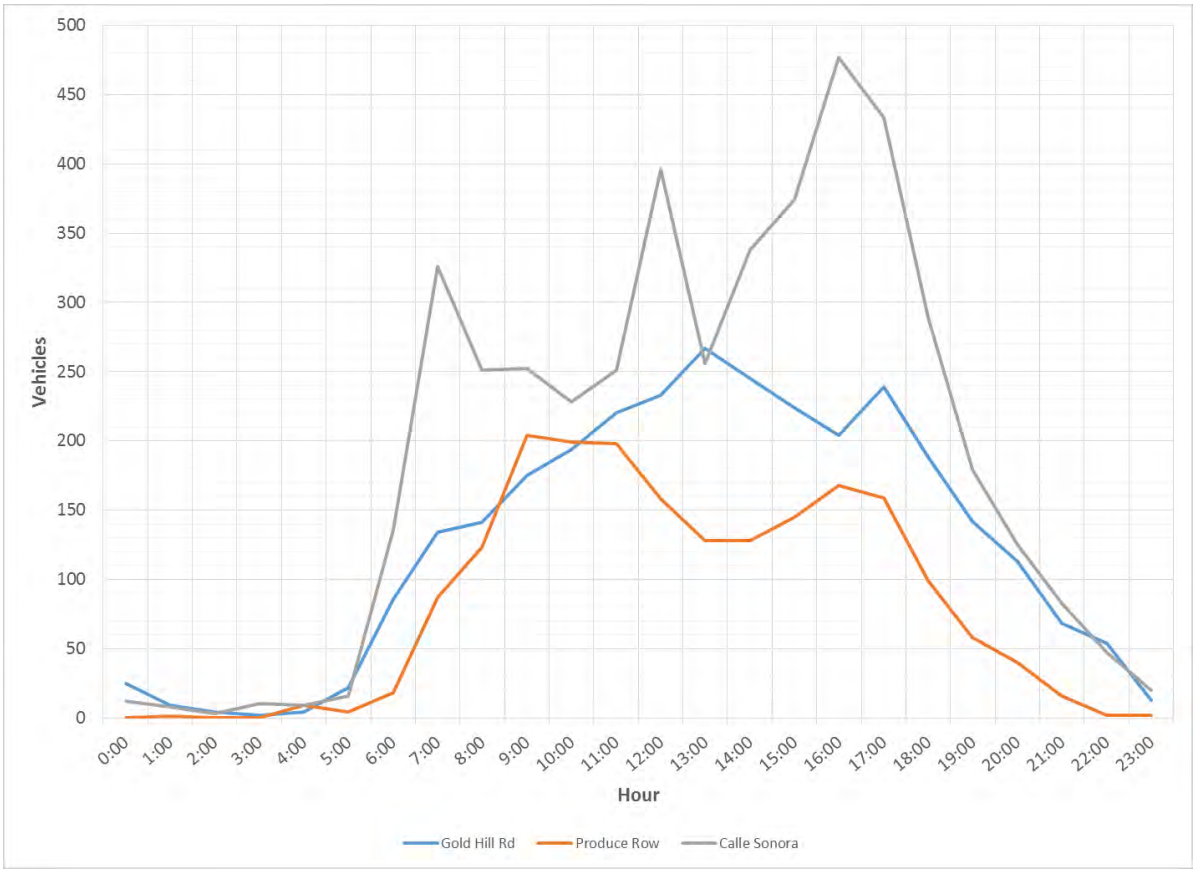
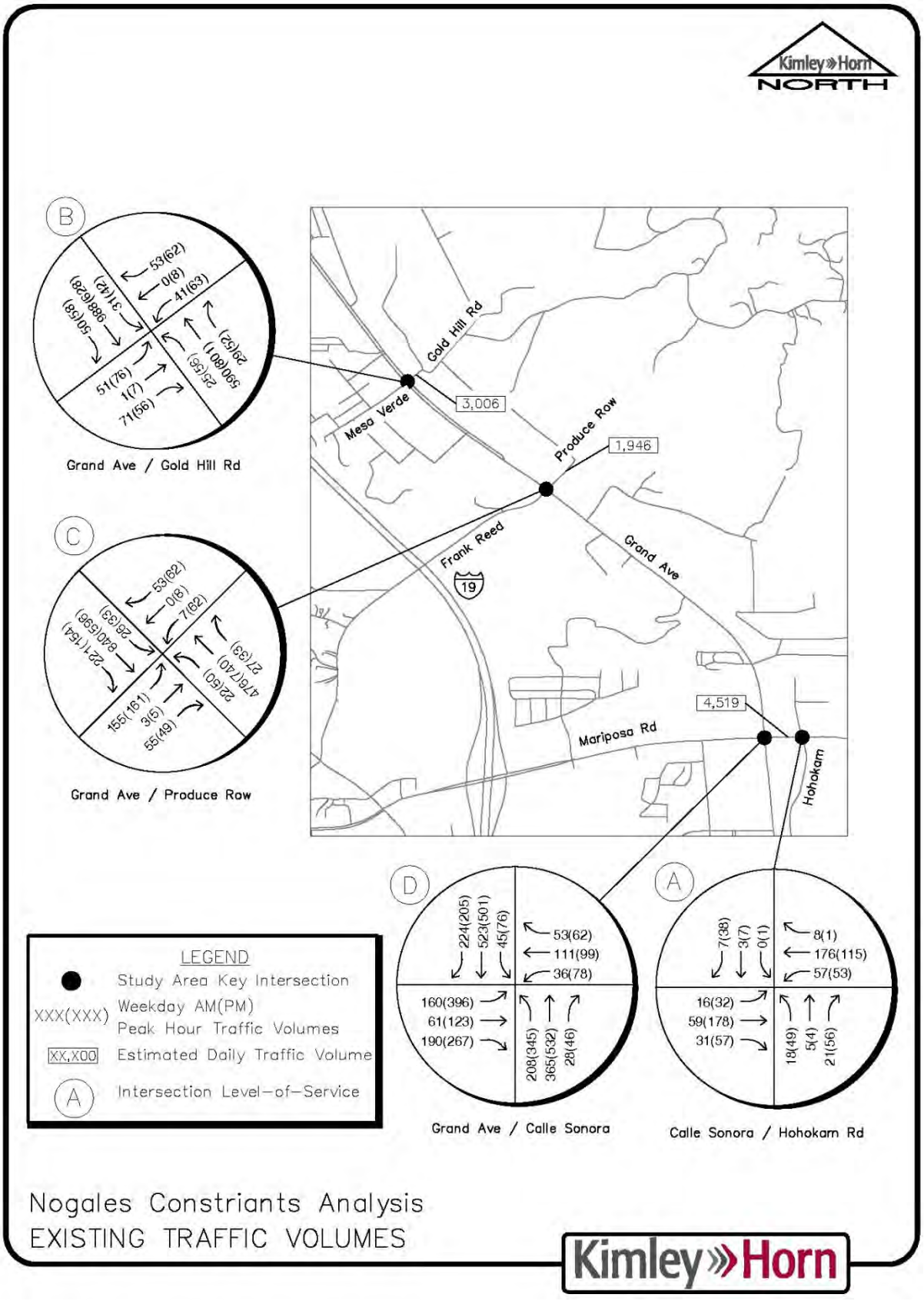


Figure 3 illustrates AM/PM peak-hour turning movement volumes at each of the study intersections.

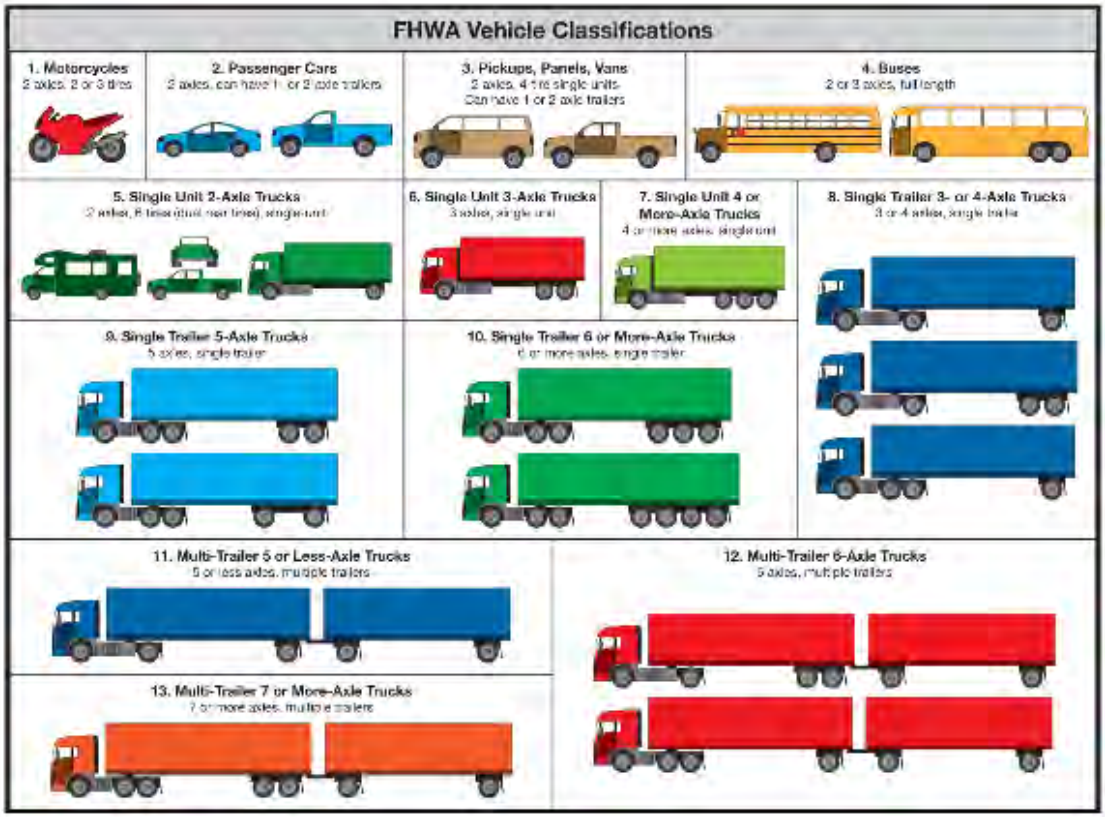
Figure 3 – Existing Traffic Volumes



Truck Volumes

A vehicle classification study was performed during the time when the 24-hour tube counts were collected. Vehicles were classified using the Federal Highway Association's (FHWA) 13-Category vehicle classification scheme. The categories depend on whether the vehicle carries passengers or commodities. Non-passenger vehicles are further subdivided by number of axles and number of units, including both power and trailer units. **Figure 4** illustrates the FHWA 13-Category vehicle classification scheme.

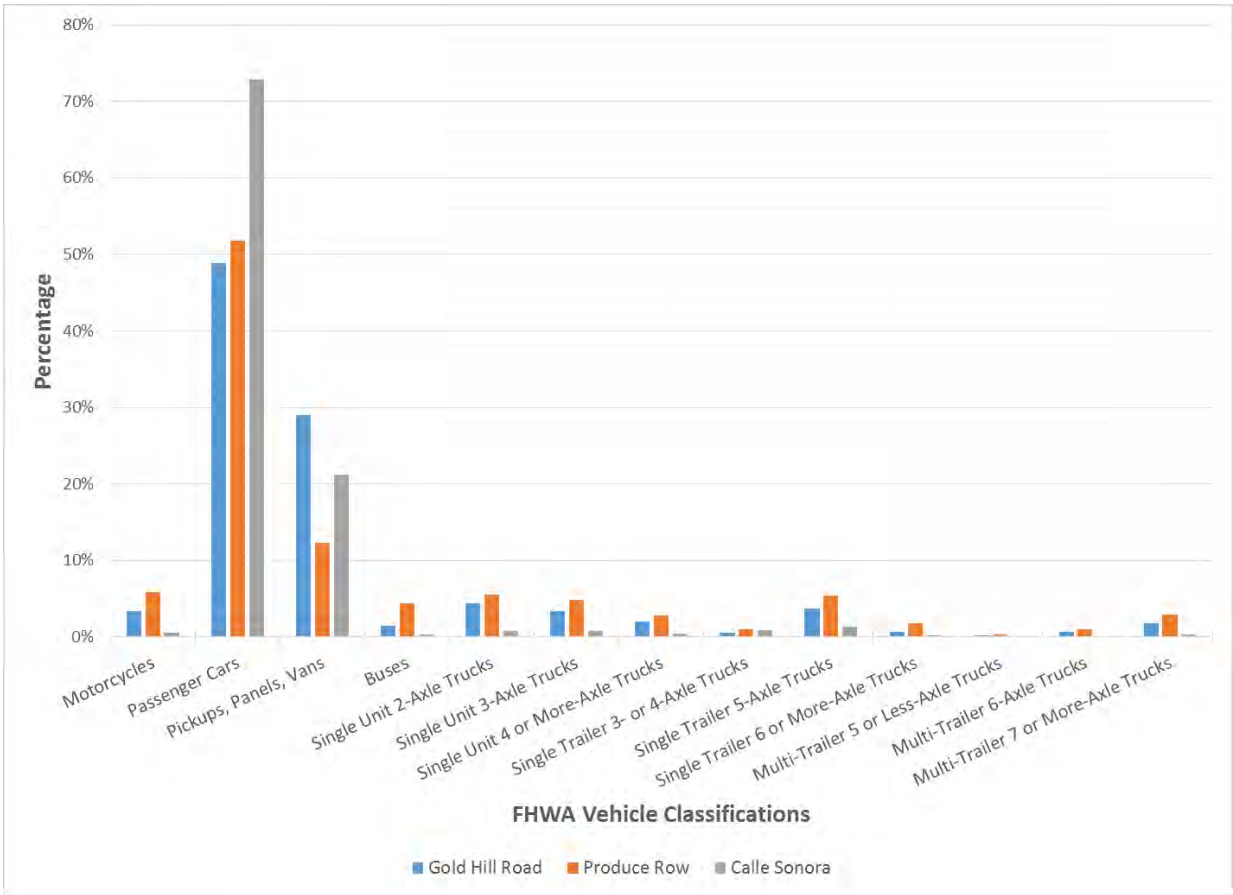
Figure 4 – FHWA Vehicle Classifications



As shown in **Figure 5**, each of the three side streets shows a unique distribution of vehicle types throughout the day. A majority of the truck traffic include Single Unit 2-Axle trucks, Single Unit 3-Axle trucks and Single Trailer 5-Axle trucks. Also, Multi-Trailer 7 or More-Axle trucks may be encountered on Gold-Hill Road and Produce Row. According to the traffic data collected, each side street consists of the following truck percentages:

- Gold-Hill Road: 19% Trucks
- Produce Row: 30% Trucks
- Calle Sonora: 5% Trucks

Figure 5 – Existing Vehicle Class Frequency



Crash Analysis

Historic crash data was only available within the vicinity of the Grand Avenue and Gold Hill Road intersection. The crash data ranged from 2006 – 2015 with a total of 10 crashes reported by the Nogales Police Department. The crash statistics available included:

- Severity: 6 of the crashes resulted in injuries, 1 fatality, 1 damaged property, 2 other crashes reported as Hit/Run.
- None of the crashes were reported as alcohol related
- 6 of the reported crashes involved trucks with 1 of the truck involved crashes resulting in a fatality.
- 4 of the reported crashes were results of a vehicle's failure to yield, though one crash was argued that a truck in the southbound turning lane obstructed the view of conflicting traffic.
- 2 of the reported crashes were results of vehicles running a red light.

Other crash statistics for Calle Sonora & Hohokam Drive (data from the *Road Safety Assessment Mariposa Road /Target Range Road Calle Sonora/Hohokam Drive* performed in 2009) include:

- Severity: 3 non-incapacitating/possible injury, 14 property damage only
- 7 rear-end (includes 2 backing crashes)
- 6 right angle
- 2 sideswipe same direction
- Traffic queues on westbound Calle Sonora due to Grand Avenue signal and train cited in 4 crashes
- Tractor trailers involved in 6 crashes

Existing Traffic Analysis

A capacity analysis of existing transportation facilities and traffic volumes was conducted for this study.

Analysis Methodology

Capacity analysis is an iterative process that demonstrates the relationship between traffic operations and roadway/intersection geometry, assesses deficiencies, and identifies alternatives. Capacity analysis is performed based on methodologies outlined in the Highway Capacity Manual (Transportation Research Board, 2000). The Highway Capacity Manual (HCM) employs methodologies to calculate intersection LOS. LOS is a qualitative assessment of the quantitative effect of factors such as intersection geometry, lane configuration, and traffic volumes. Operating conditions are categorized as "A" through "F," with "A" representing the most favorable conditions and "F" representing the least favorable. LOS "D" for signalized intersections is equal to being delayed at the intersection for less than 35-55 seconds per vehicle. **Table 1** shows the delay (wait time thresholds) for each LOS grade.

Table 1 - Level of Service Delay Thresholds

LOS	Signalized Intersection	Unsignalized Intersection
A	≤10 sec	≤10 sec
B	10-20 sec	10-15 sec
C	20-35 sec	15-25 sec
D	35-55 sec	25-35 sec
E	55-80 sec	35-50 sec
F	≥80 sec	≥50 sec

Intersection LOS is computed as a weighted average of vehicle delay. An intersection may have an acceptable overall LOS but may also have individual movements with unacceptable LOS. As a result, all movements are analyzed individually, and recommendations are made to reduce delay and increase capacity on critical movements.

Synchro was used to determine the LOS for each movement at each intersection. This enabled the identification of improvements that would needed at each intersection to maintain a LOS of "D" or better, consistent with most urban areas' engineering policy.

As shown in **Table 2**, the capacity analysis shows the traffic operational performance for each intersection and individual movements. Grand Avenue & Calle Sonora has the worst performance of the three intersections which is due to the higher volumes that currently exist at the intersection. However, LOS D is typically considered acceptable within urban areas.

It is important to note that the capacity analysis may not capture actual traffic conditions. Such an analysis would require a micro-simulation analysis with an extensive calibration procedure. Thus, the capacity analysis may show that the intersection is performing better than what is actually experienced. However, field observations and feedback from FPAA members described that roadway geometry constraints, especially for trucks maneuvering through the intersections are the governing factors for the traffic conditions.

Table 2 – Existing Intersection Level-of-Service

Local Intersections	EB			WB			NB			SB			Intersection LOS	Traffic Control
	L	T	R	L	T	R	L	T	R	L	T	R		
Grand Avenue & Gold Hill Road														
AM Peak Hour	B			B			A	B		B	A		B	Signalized
PM Peak Hour	B			A			B	B		B	B		B	
Grand Avenue & Produce Row														
AM Peak Hour	D	A		A			A	B		A	C		C	Signalized
PM Peak Hour	C	A		B			B	C		B	C		B	
Grand Avenue & Calle Sonora														
AM Peak Hour	D	D	B	D			D	C		E	D	B	D	Signalized
PM Peak Hour	E	D	A	E			E	D		E	D	B	D	
Calle Sonora & Hohokam Road														
AM Peak Hour	A			A			B			B			A	Unsignalized
PM Peak Hour	A			A			C			B			A	

3. FUTURE TRAFFIC CONDITIONS

As documented from the stake-holder interviews prior to this study, truck traffic is inevitably going to increase within the study areas as the operations of the warehouses and distribution facilities expand or as new ones get constructed. From the stakeholder interviews, it was mentioned that the Nogales Port of Entry (POE) currently has approximately 1800 trucks pass through the POE per day from Mexico during the peak season and this is expected to double in approximately 10 years. With recent improvements to the Mariposa Port of Entry, the facility may have the capacity to process up to 4,000 trucks daily. FPAA members mentioned that various warehouses are unique and each facility anticipates different Mexican to American truck ratios. Though, the standard rule-of-thumb seems to be that for every truck that comes into Nogales from Mexico, 2 American trucks come into Nogales. Also, peak seasons vary among the facilities though, typically the peak season is considered to be from February – May. According to an FPAA presentation, fresh produce crossing from Mexico showed an increase of 17% in 2012-2013 in Nogales. However, it was discussed that an average growth of 6 - 8 percent per year is typical, on average.

Traffic Forecast

A traffic forecast was performed at each study intersection and roadway segment. The forecast was based on multiple sources of references including the information gathered from the stakeholder interviews, mainly FPAA members, and the 2010 Unified Nogales Santa Cruz County Transportation Plan. The objective of the forecast is to observe the future needs of the intersection and future cross-section requirements of the three bridges.

Listed are assumptions that were considered for the traffic forecast:

- For consistency with the 2010 transportation plan, traffic volumes were forecasted for 2030. Inbound daily truck traffic from Mexico coming into the POE is expected to double by this time.
- According to the *Unified Nogales Santa Cruz County Transportation Plan 2010*, Grand Avenue is expected to see 30% traffic growth in 2030. The major factors influencing the forecast include future housing and employment, Port of Entry to and from Mexico, and magnitude of traffic to and from Pima County and points beyond.
- The growth rates that were used from the *Unified Nogales Santa Cruz County Transportation Plan 2010* traffic estimation assumed that both car and truck traffic were included in the rate. In this case, existing truck percentages were maintained.
- Produce Row, east of Grand Avenue shows no opportunity for residential growth but has potential for Warehouse expansion and increased truck traffic. A growth rate for trucks was applied.

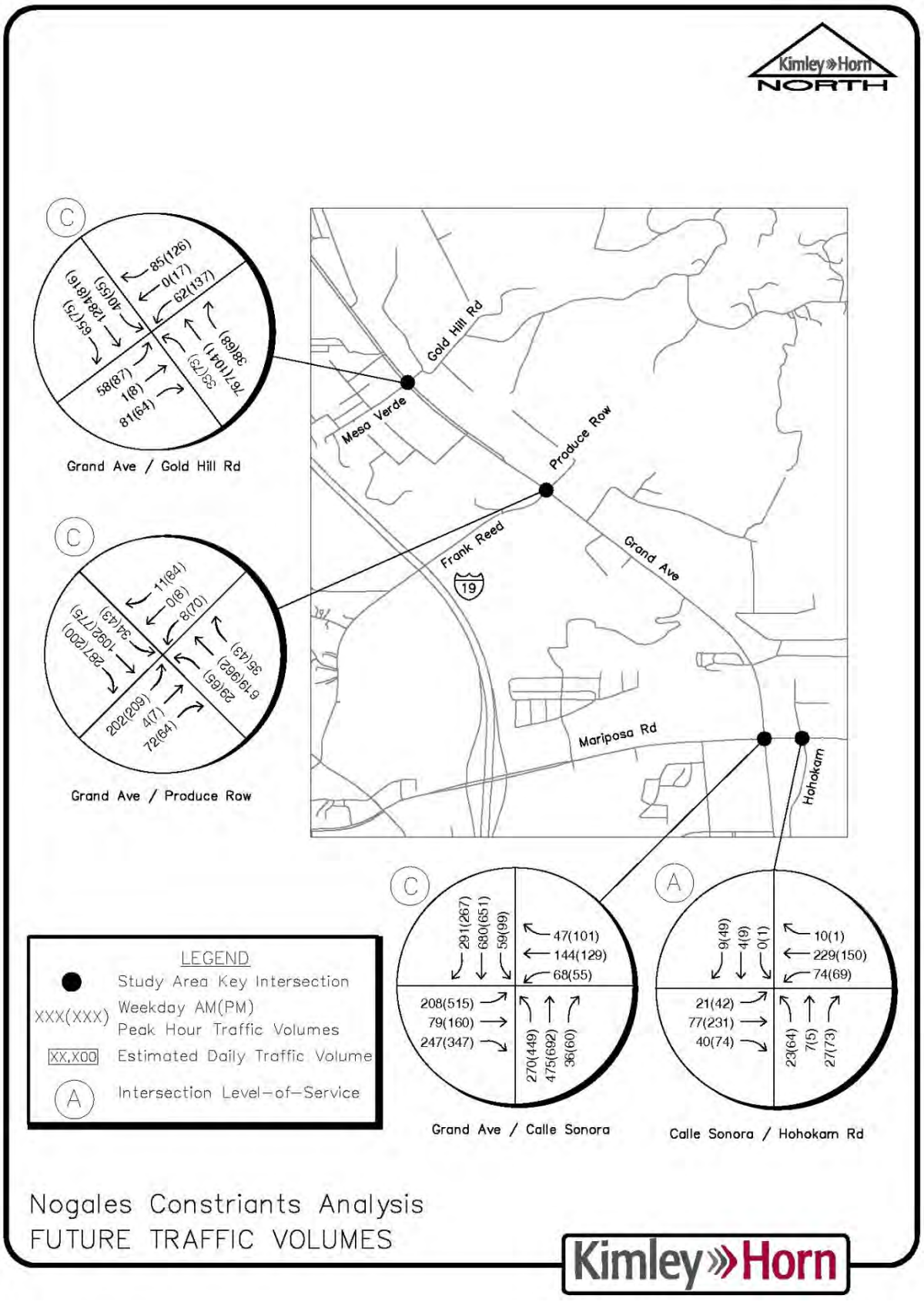
A summary of the 2030 traffic forecast is shown in **Table 3.**

Table 3 – 2030 Traffic Forecast

Road	Growth Rate	Description
Grand Avenue	30%	Corridor wide growth rate on Grand Avenue, as forecasted in the Unified Nogales Santa Cruz County Transportation Plan 2010
WB Gold Hill Road (*East of Grand Avenue*)	14%	Interpolated using the 2010 Unified Nogales Santa Cruz County Transportation Plan estimated & forecasted housing Units from 2015 to 2030.
Gold Hill Road, Produce Row, Calle Sonora (**Trucks Only**)	6%	Based on the average estimated truck loads from Mexico, Southwest Border Crossing Trends (FPAA).
EB Frank Reed Road (*West of Grand Avenue at Produce Row*)	30%	Growth rate based on the 2010 Unified Nogales Santa Cruz County Transportation Plan for Frank Reed Road, east of Grand Avenue.
Calle Sonora/Mariposa Road	30%	Growth rate based on the 2010 Unified Nogales Santa Cruz County Transportation Plan.
Hohokam Drive/Smokey Lane (**Trucks Only**)	6%	Based on the average estimated truck loads from Mexico, Southwest Border Crossing Trends (FPAA).

Figure 6 illustrates the future traffic volumes for both AM/PM peak periods.

Figure 6 – Estimated Future Peak-Hour Traffic Volumes



Future Year Traffic Analysis

An analysis was performed using the estimated future peak-hour volumes, as illustrated in **Figure 6**. The potential geometric enhancements for the intersections and bridges, to accommodate heavy-truck volumes, were incorporated into the analysis and additional enhancements were identified based on a future-year capacity analysis. In addition to the capacity analysis, access management, sight distance, and turn-lane warrants along Grand Avenue were used to identify the needs for safe and efficient circulation within the study intersections.

Table 4 illustrates the results of the capacity analysis based on the estimated future year traffic conditions. With the enhancements incorporated, intersection operations are expected to be maintained with increased future traffic volumes.

Table 4 – Estimated Future LOS

Local Intersections	EB			WB			NB			SB			Intersection LOS	Traffic Control
	L	T	R	L	T	R	L	T	R	L	T	R		
Grand Avenue & Gold Hill Road														
AM Peak Hour	C	A		C	A		D	B		D	D		C	Signalized
PM Peak Hour	C	A		C	B		D	C		D	C		C	
Grand Avenue & Produce Row														
AM Peak Hour	E	A		A	C		A	B		A	D		C	Signalized
PM Peak Hour	C	A		C	A		A	C		A	B		B	
Grand Avenue & Calle Sonora														
AM Peak Hour	C	C	A	C	D	A	E	C		D	C	A	C	Signalized
PM Peak Hour	C	C	A	A	D	B	D	C		E	D	A	C	
Calle Sonora & Hohokam Road														
AM Peak Hour	A			A			B			B			A	Unsignalized
PM Peak Hour	A			A			C			B			A	

4. SUMMARY OF RECOMMENDATIONS

Roadway-Bridge Cross-section

Both safety and traffic operational concerns due to the continuous heave truck traffic require the need for a wider cross-section at the three locations. According to field observations and feedback from FPAA members, trucks turning from cross-streets must overtake opposing lanes. Thus, interrupting opposing traffic which causes vehicles to queue up will increase unsafe situations that may lead to collisions.

To accommodate the heavy trucks turning from access drives or intersecting roadways, it is recommended to increase the roadway cross-section. The increased cross-section shall allow heavy trucks to execute turning maneuvers without utilizing the opposing lane. It is recommended that each of the three roadways consist of wider through lanes. Also, include a left-turn lane on the westbound approaches such that the storage length is extended east of the bridges as engineering constraints permit.

Turn Lane Warrant

Turn Lane Warrants from the *ADOT Traffic Engineering Policies, Guidelines, and Procedures (December 2014), Section 200,* were utilized to determine the need for right-turn lanes on the northbound approaches of each of the three intersections along Grand Avenue. Existing and future traffic volumes justify the need for right-turn lanes at the 3 northbound approaches. However, due to the observed engineering constraints, such as right-of-way, utilities and bridge constraints, constructing right-turn lanes along Grand Avenue lanes would not be feasible.

Intersection Operations

To improve intersection operations and accommodate the estimated future traffic volumes, it is recommended to implement the following concurrently with the construction of the new bridges

<u>Calle Sonora</u>

- Construct an exclusive right-turn lane on the westbound approach of Calle Sonora, designed such that it meets ADOT minimum standards.
- With the exclusive westbound left-turn lane, reconfigure the traffic control signal for optimized standard phasing. Thus, removing the existing split-phasing as it would not be necessary with the enhanced intersection configuration would allow for efficient shorter cycle lengths.

<u>Produce Row</u>

- Reconfigure the traffic control signal's cycle length to allow for turning trucks to completely clear the intersection during approaches green phase. Comments from the stakeholder interviews and observations shows that existing timing of the signal phases,

yellow change and red clearance intervals, especially right/left turning trucks, doesn't allow trucks to safely clear out of the intersection. Note that there is no standard practice or methods recommended for intersections with significant heavy truck percentages.

Gold Hill Road

- It is recommended to construct an exclusive left-turn lane at the eastbound approach of Mesa Verde Road, designed such that it meets ADOT minimum standards. With the left-turn lane on the westbound approach as part of the Gold Hill Road enhancement, construction of the eastbound dedicated left-turn lane would not require split-phasing. Thus, reduce delays of the left/right turning vehicles during the peak periods.

Access Management

The potential reconstruction of the 3 bridges and roadways, would allow for an opportunity to implement access management practices on each roadway. Access management allows for maintaining roadway safety and mobility by controlling access location, design, spacing and operation. The following is recommended to be implemented during the construction of the new bridges:

- At Calle Sonora, it is recommended to close 1 of the northbound access drive (Alex's Tires, Inc.) and relocate the southbound and northbound driveways, located west of the bridge. Relocate the access drives from the intersection of Grand Avenue / Calle Sonora to allow 150' minimum spacing between the access drives and the Grand Avenue curb line. A 150' minimum is typically a standard policy in many jurisdictions.
- Also, access drive turning restriction should be considered at the relocated driveways along Calle Sonora for both the north and south access drives due to the proximity to the signalized intersection. Allowing all movements may increase accident potential. Thus, consider a roadway cross-section that would restrict left-in and left-out movements on both driveways.
- At Produce Row, construct an access drive for the two businesses on the north and south of Produce Row, west of the bridge. Locate the dedicated access drives such that at a minimum 150' spacing or more exists between the access drive and the Grand Avenue curb line.
- With the construction of the eastbound exclusive left-turn lane on Mesa Verde Road, construct new access drives for both the north and south properties. Construct such that a minimum 150' spacing or more exists between the access drive and the Grand Avenue curb line.

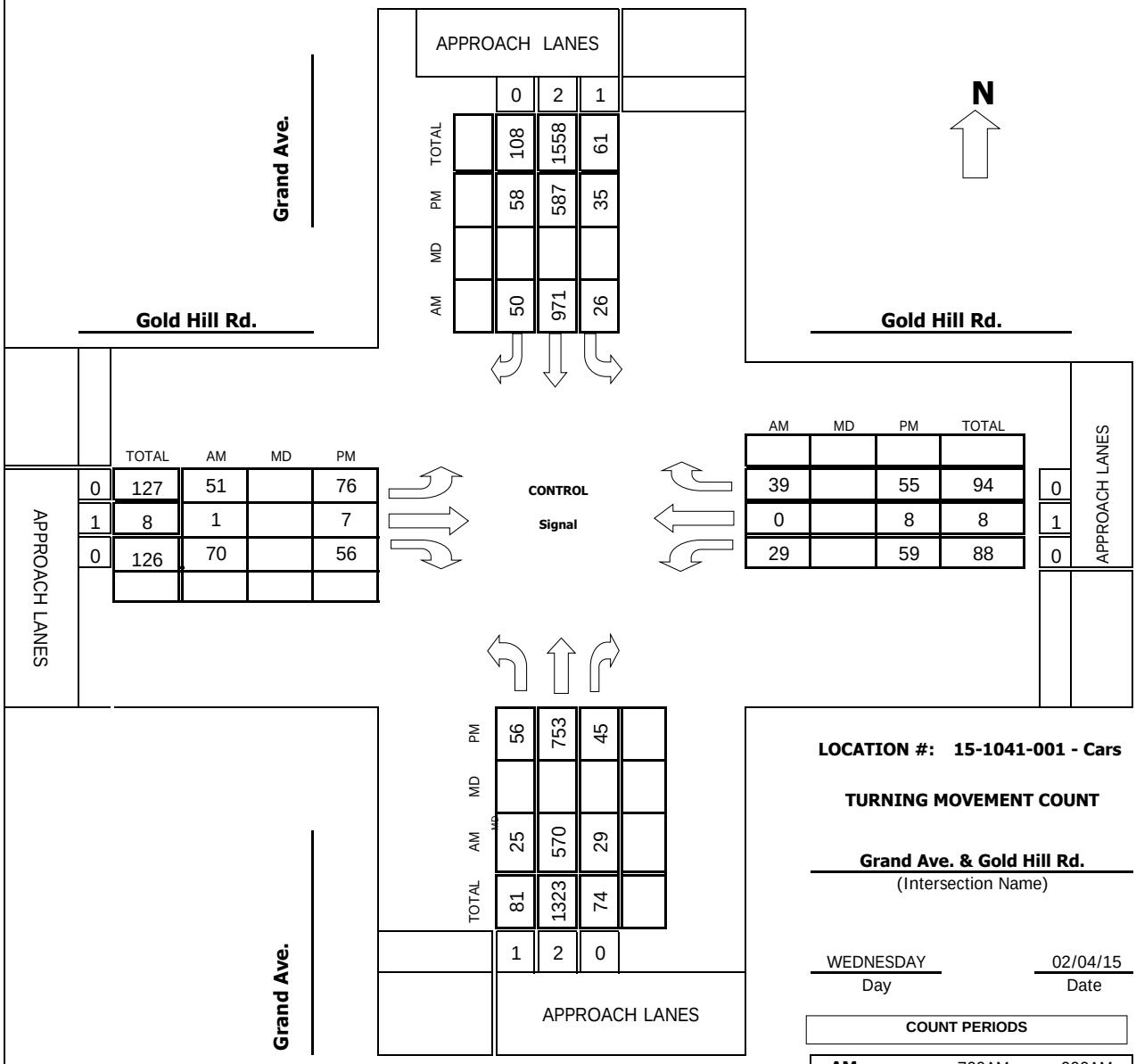
Appendix A – Traffic Count Data

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 15-1041-001 - Cars

TMC SUMMARY OF Grand Ave. & Gold Hill Rd.



LOCATION #: 15-1041-001 - Cars

TURNING MOVEMENT COUNT

Grand Ave. & Gold Hill Rd.
(Intersection Name)

WEDNESDAY — Day
02/04/15 — Date

COUNT PERIODS			
AM	700AM	-	900AM
NOON		-	
PM	400PM	-	600PM

AM PEAK HOUR	700 AM
NOON PEAK HOUR	
PM PEAK HOUR	500 PM

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Gold Hill Rd.	DAY:	WEDNESDAY	PROJECT#	15-1041-001 - Cars

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	1	2	0	0	1	0	0	1	0	
6:00 AM						**CARS ONLY**							
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	7	176	5	5	197	9	12	1	9	6	0	15	442
7:15 AM	6	173	2	4	217	10	23	0	15	9	0	16	475
7:30 AM	8	106	7	10	329	21	8	0	25	7	0	5	526
7:45 AM	4	115	15	7	228	10	8	0	21	7	0	3	418
8:00 AM	6	87	12	11	173	12	11	0	11	8	2	2	335
8:15 AM	8	75	9	9	124	13	11	1	10	3	0	6	269
8:30 AM	9	77	11	12	138	6	10	2	16	9	0	7	297
8:45 AM	10	88	9	10	170	13	15	2	11	16	0	7	351
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	58	897	70	68	1576	94	98	6	118	65	2	61	3113
Approach %	5.66	87.51	6.83	3.91	90.68	5.41	44.14	2.70	53.15	50.78	1.56	47.66	
App/Depart	1025	/	1056	1738	/	1759	222	/	144	128	/	154	

AM Peak Hr Begins at: 700 AM

PEAK													
Volumes	25	570	29	26	971	50	51	1	70	29	0	39	1861
Approach %	4.01	91.35	4.65	2.48	92.74	4.78	41.80	0.82	57.38	42.65	0.00	57.35	
PEAK HR. FACTOR:		0.830			0.727			0.803			0.680		0.885

CONTROL: Signal
COMMENT 1:
GPS: 31.383543, -110.947529

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Gold Hill Rd.	DAY:	WEDNESDAY	PROJECT#	15-1041-001 - Cars

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	1	2	0	0	1	0	0	1	0	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	20	177	7	10	183	14	17	1	15	13	1	7	465
4:15 PM	26	157	6	9	130	8	21	2	13	13	1	14	400
4:30 PM	19	167	14	7	150	5	18	2	19	12	4	8	425
4:45 PM	21	172	15	14	158	11	11	0	9	10	0	8	429
5:00 PM	11	196	11	6	147	16	22	2	15	15	2	15	458
5:15 PM	16	189	10	7	144	14	13	3	15	15	1	12	439
5:30 PM	15	193	13	11	151	10	18	1	12	16	2	13	455
5:45 PM	14	175	11	11	145	18	23	1	14	13	3	15	443
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

CARS ONLY

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	142	1426	87	75	1208	96	143	12	112	107	14	92	3514
Approach %	8.58	86.16	5.26	5.44	87.60	6.96	53.56	4.49	41.95	50.23	6.57	43.19	
App/Depart	1655	/	1661	1379	/	1427	267	/	174	213	/	252	

PM Peak Hr Begins at: 500 PM

PEAK													
Volumes	56	753	45	35	587	58	76	7	56	59	8	55	1795
Approach %	6.56	88.17	5.27	5.15	86.32	8.53	54.68	5.04	40.29	48.36	6.56	45.08	
PEAK HR. FACTOR:		0.966			0.977			0.891			0.953		0.980

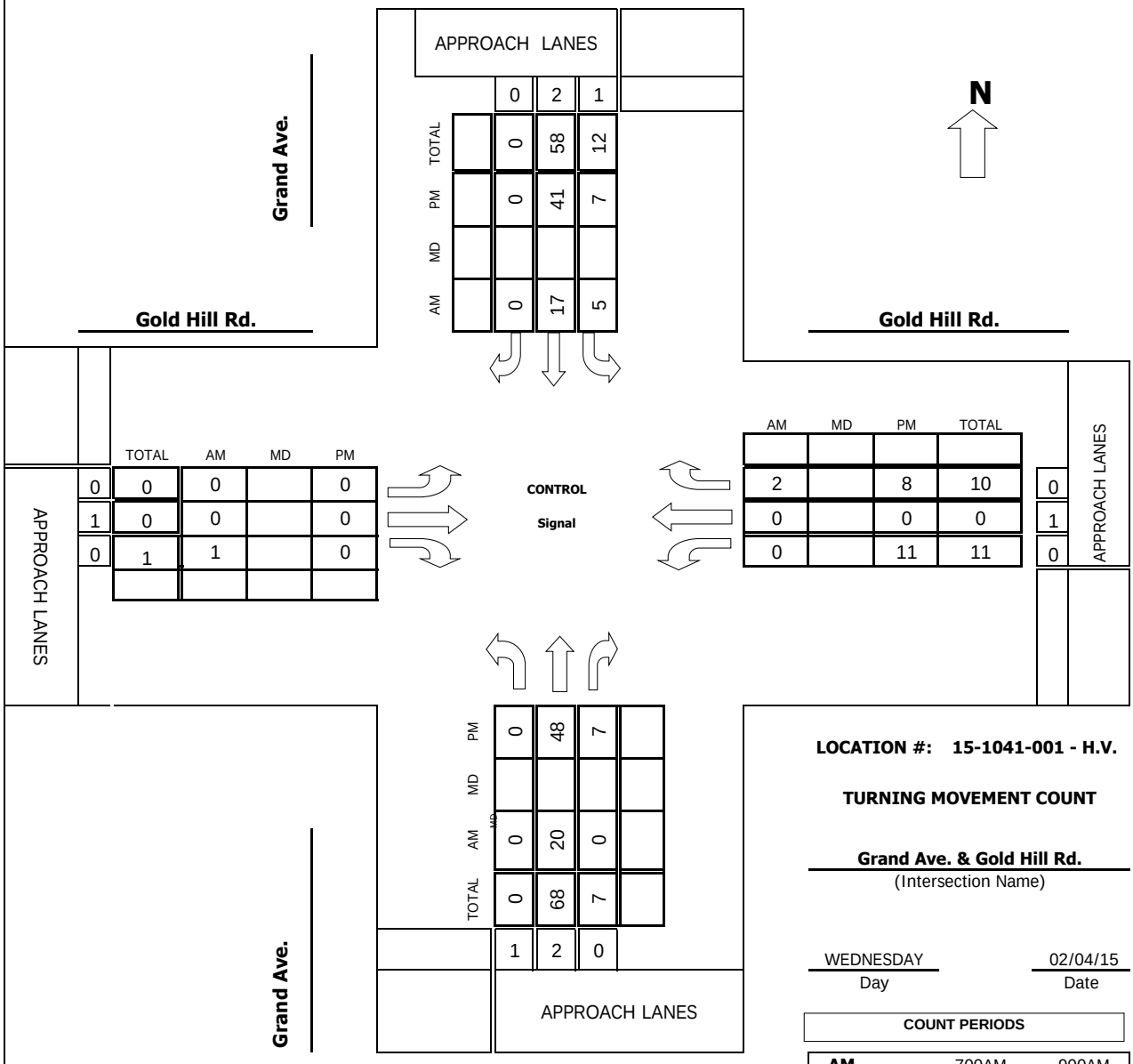
CONTROL:	Signal
COMMENT 1:	0
GPS:	31.383543, -110.947529

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 15-1041-001 - H.V.

TMC SUMMARY OF Grand Ave. & Gold Hill Rd.



LOCATION #: 15-1041-001 - H.V.

TURNING MOVEMENT COUNT

Grand Ave. & Gold Hill Rd.
(Intersection Name)

WEDNESDAY (Day) 02/04/15 (Date)

COUNT PERIODS			
AM	700AM	-	900AM
NOON		-	
PM	400PM	-	600PM

AM PEAK HOUR 745 AM

NOON PEAK HOUR

PM PEAK HOUR 500 PM

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup
Traffic Studies Done Right

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Gold Hill Rd.	DAY:	WEDNESDAY	PROJECT#	15-1041-001 - H.V.

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	1	2	0	0	1	0	0	1	0	
6:00 AM					**HEAVY VEHICLES ONLY**								
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	0	4	0	0	2	0	0	0	0	0	0	1	7
7:15 AM	0	3	0	1	1	2	0	0	0	0	0	2	9
7:30 AM	0	1	0	0	3	0	0	0	0	1	0	1	6
7:45 AM	0	3	0	3	7	0	0	0	1	0	0	0	14
8:00 AM	0	5	0	1	4	0	0	0	0	0	0	0	10
8:15 AM	0	4	0	1	5	0	0	0	0	0	0	0	10
8:30 AM	0	8	0	0	1	0	0	0	0	0	0	2	11
8:45 AM	0	5	1	0	4	0	0	0	0	1	0	1	12
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	0	33	1	6	27	2	0	0	1	2	0	7	79
Approach %	0.00	97.06	2.94	17.14	77.14	5.71	0.00	0.00	100.00	22.22	0.00	77.78	
App/Depart	34	/	40	35	/	30	1	/	7	9	/	2	

AM Peak Hr Begins at: 745 AM

PEAK													
Volumes	0	20	0	5	17	0	0	0	1	0	0	2	45
Approach %	0.00	100.00	0.00	22.73	77.27	0.00	0.00	0.00	100.00	0.00	0.00	100.00	
PEAK HR. FACTOR:		0.625			0.550			0.250			0.250		0.804

CONTROL: Signal
COMMENT 1:
GPS: 31.383543, -110.947529

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Gold Hill Rd.	DAY:	WEDNESDAY	PROJECT#	15-1041-001 - H.V.

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	1	2	0	0	1	0	0	1	0	
1:00 PM					**HEAVY VEHICLES ONLY**								
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	0	12	5	3	13	0	0	0	0	1	0	1	35
4:15 PM	0	6	5	2	10	0	0	0	0	2	0	1	26
4:30 PM	0	10	2	3	10	0	0	0	0	3	0	1	29
4:45 PM	0	8	0	0	6	0	0	0	0	3	0	0	17
5:00 PM	0	7	2	2	12	0	0	0	0	3	0	3	29
5:15 PM	0	14	0	2	14	0	0	0	0	3	0	2	35
5:30 PM	0	10	3	2	6	0	0	0	0	4	0	1	26
5:45 PM	0	17	2	1	9	0	0	0	0	1	0	2	32
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	0	84	19	15	80	0	0	0	0	20	0	11	229
Approach %	0.00	81.55	18.45	15.79	84.21	0.00	####	####	####	64.52	0.00	35.48	
App/Depart	103	/	95	95	/	100	0	/	34	31	/	0	

PM Peak Hr Begins at: 500 PM

PEAK													
Volumes	0	48	7	7	41	0	0	0	0	11	0	8	122
Approach %	0.00	87.27	12.73	14.58	85.42	0.00	####	####	####	57.89	0.00	42.11	
PEAK HR. FACTOR:		0.724			0.750			0.000			0.792		0.871

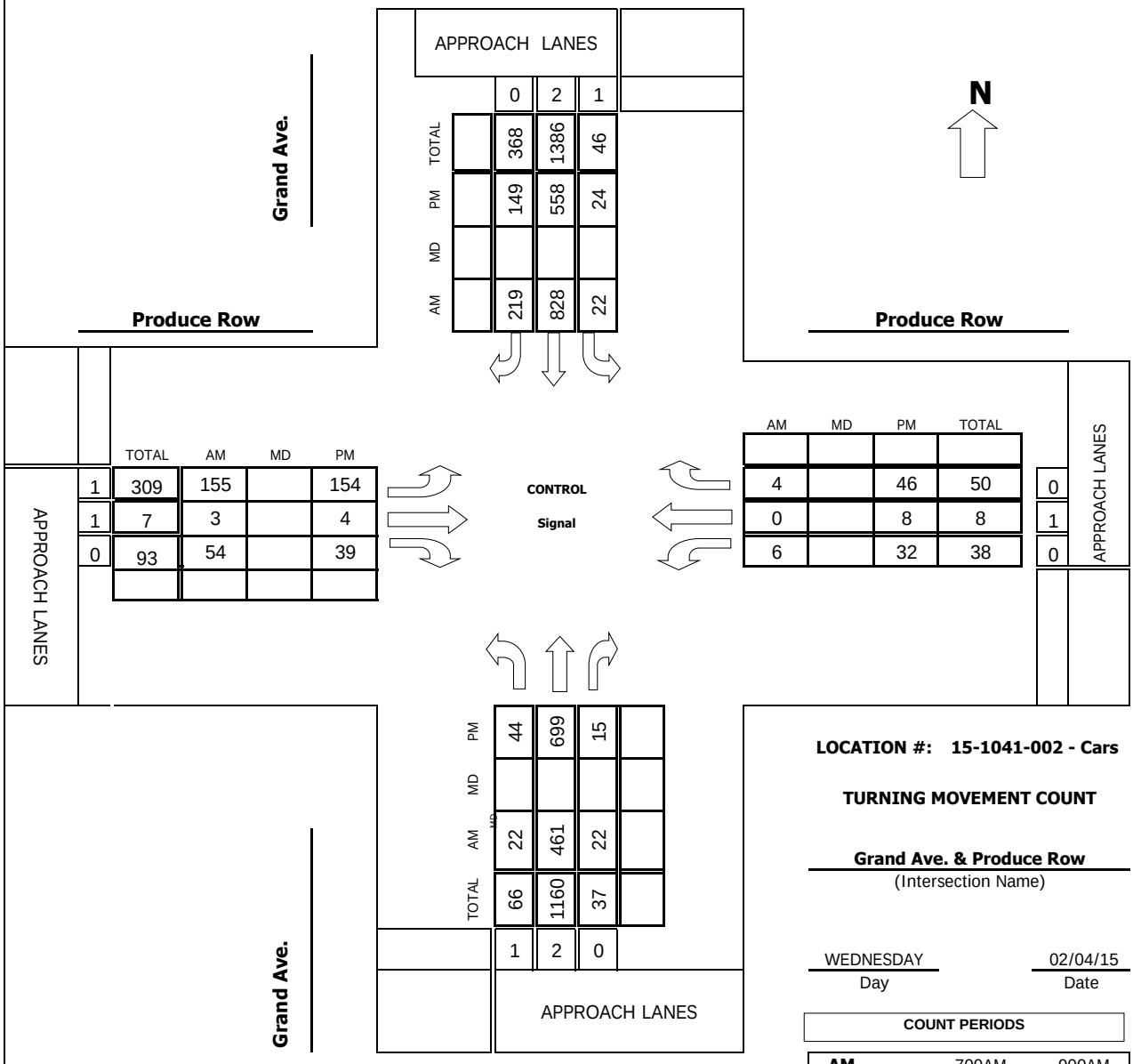
CONTROL:	Signal
COMMENT 1:	0
GPS:	31.383543, -110.947529

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 15-1041-002 - Cars

TMC SUMMARY OF Grand Ave. & Produce Row



LOCATION #: 15-1041-002 - Cars

TURNING MOVEMENT COUNT

Grand Ave. & Produce Row
(Intersection Name)

WEDNESDAY (Day) 02/04/15 (Date)

COUNT PERIODS			
AM	700AM	-	900AM
NOON		-	
PM	400PM	-	600PM

AM PEAK HOUR 700 AM

NOON PEAK HOUR

PM PEAK HOUR 500 PM

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Produce Row	DAY:	WEDNESDAY	PROJECT#	15-1041-002 - Cars

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	1	2	0	1	1	0	0	1	0	
6:00 AM						CARS ONLY							
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	7	105	2	1	148	70	58	1	29	1	0	1	423
7:15 AM	0	128	3	2	223	26	53	1	19	1	0	1	457
7:30 AM	9	113	4	6	270	70	14	1	2	1	0	1	491
7:45 AM	6	115	13	13	187	53	30	0	4	3	0	1	425
8:00 AM	4	90	9	5	169	27	17	3	8	1	1	0	334
8:15 AM	3	74	11	12	113	18	17	3	3	3	0	1	258
8:30 AM	4	98	16	11	139	21	14	3	3	3	0	2	314
8:45 AM	0	90	20	10	155	21	13	5	0	6	1	5	326
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	33	813	78	60	1404	306	216	17	68	19	2	12	3028
Approach %	3.57	87.99	8.44	3.39	79.32	17.29	71.76	5.65	22.59	57.58	6.06	36.36	
App/Depart	924	/	1041	1770	/	1491	301	/	155	33	/	341	

AM Peak Hr Begins at: 700 AM

PEAK													
Volumes	22	461	22	22	828	219	155	3	54	6	0	4	1796
Approach %	4.36	91.29	4.36	2.06	77.46	20.49	73.11	1.42	25.47	60.00	0.00	40.00	
PEAK HR. FACTOR:		0.942			0.772			0.602			0.625		0.914

CONTROL: Signal
COMMENT 1:
GPS: 31.378618, -110.941097

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Produce Row	DAY:	WEDNESDAY	PROJECT#	15-1041-002 - Cars

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	1	2	0	1	1	0	0	1	0	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	4	161	6	6	156	39	29	2	7	8	6	12	436
4:15 PM	10	148	5	7	133	31	27	2	6	6	2	7	384
4:30 PM	6	173	5	7	148	31	42	3	6	3	2	8	434
4:45 PM	1	129	5	1	118	16	25	2	5	4	2	5	313
5:00 PM	14	200	10	7	143	36	35	1	12	15	2	14	489
5:15 PM	10	156	2	1	135	34	46	0	14	9	3	12	422
5:30 PM	10	187	2	6	146	41	41	1	6	0	1	9	450
5:45 PM	10	156	1	10	134	38	32	2	7	8	2	11	411
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

CARS ONLY

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	65	1310	36	45	1113	266	277	13	63	53	20	78	3339
Approach %	4.61	92.84	2.55	3.16	78.16	18.68	78.47	3.68	17.85	35.10	13.25	51.66	
App/Depart	1411	/	1665	1424	/	1229	353	/	94	151	/	351	

PM Peak Hr Begins at: 500 PM

PEAK													
Volumes	44	699	15	24	558	149	154	4	39	32	8	46	1772
Approach %	5.80	92.22	1.98	3.28	76.33	20.38	78.17	2.03	19.80	37.21	9.30	53.49	
PEAK HR. FACTOR:		0.846			0.947			0.821			0.694		0.906

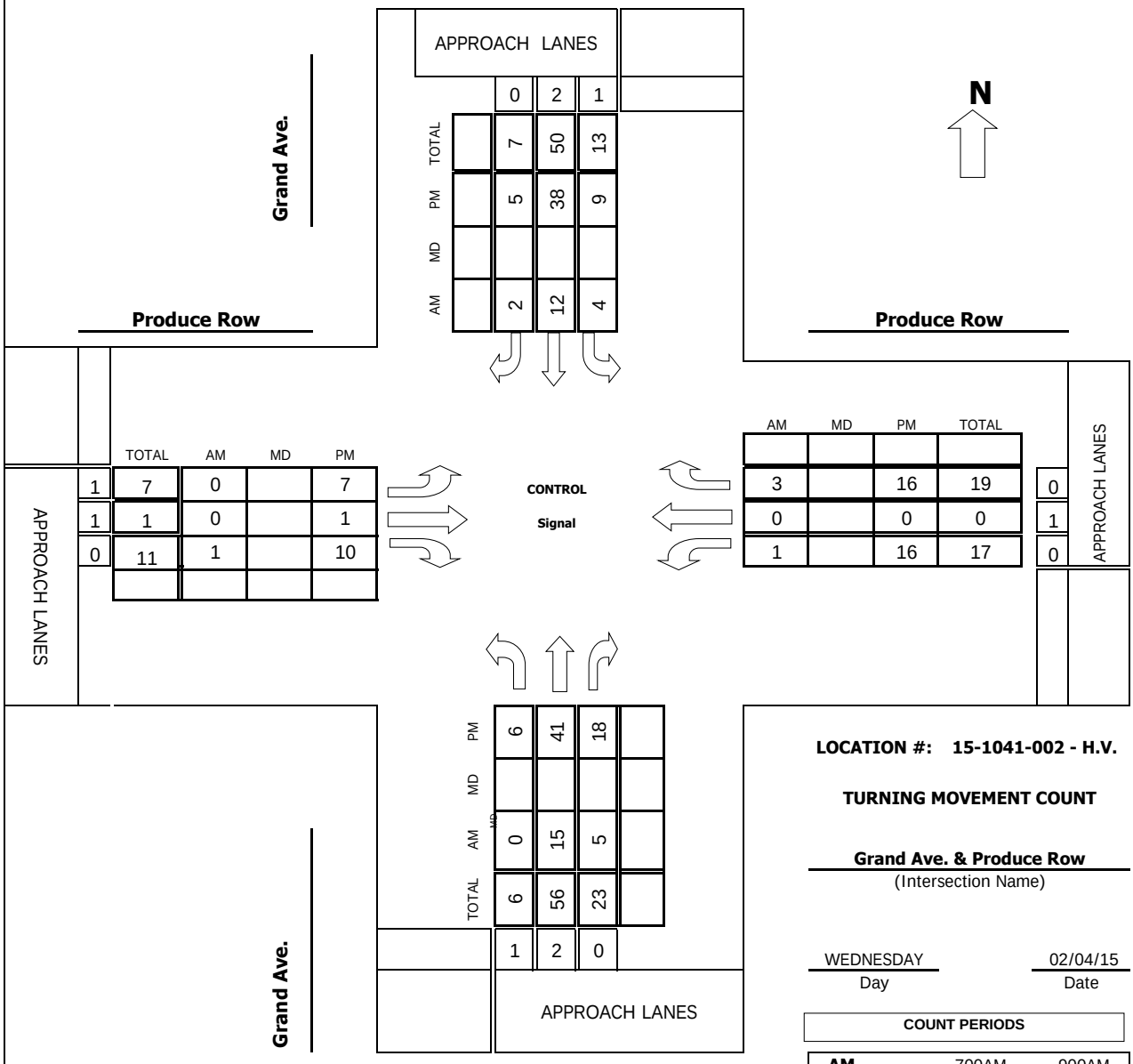
CONTROL:	Signal
COMMENT 1:	0
GPS:	31.378618, -110.941097

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 15-1041-002 - H.V.

TMC SUMMARY OF Grand Ave. & Produce Row



LOCATION #: 15-1041-002 - H.V.

TURNING MOVEMENT COUNT

Grand Ave. & Produce Row
(Intersection Name)

WEDNESDAY (Day) 02/04/15 (Date)

COUNT PERIODS			
AM	700AM	-	900AM
NOON		-	
PM	400PM	-	600PM

AM PEAK HOUR 800 AM

NOON PEAK HOUR

PM PEAK HOUR 500 PM

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Produce Row	DAY:	WEDNESDAY	PROJECT#	15-1041-002 - H.V.

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	1	2	0	1	1	0	0	1	0	
6:00 AM					**HEAVY VEHICLES ONLY**								
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	0	5	0	2	1	0	0	0	0	0	0	0	8
7:15 AM	0	4	1	0	0	0	1	0	0	0	0	0	6
7:30 AM	0	0	0	1	4	0	0	0	0	0	0	0	5
7:45 AM	0	2	1	0	7	0	1	0	1	2	0	1	15
8:00 AM	0	4	1	1	4	0	0	0	0	0	0	1	11
8:15 AM	0	4	0	1	3	1	0	0	0	0	0	0	9
8:30 AM	0	3	2	0	0	0	0	0	0	1	0	1	7
8:45 AM	0	4	2	2	5	1	0	0	1	0	0	1	16
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	0	26	7	7	24	2	2	0	2	3	0	4	77
Approach %	0.00	78.79	21.21	21.21	72.73	6.06	50.00	0.00	50.00	42.86	0.00	57.14	
App/Depart	33	/	32	33	/	29	4	/	14	7	/	2	

AM Peak Hr Begins at: 800 AM

PEAK													
Volumes	0	15	5	4	12	2	0	0	1	1	0	3	43
Approach %	0.00	75.00	25.00	22.22	66.67	11.11	0.00	0.00	100.00	25.00	0.00	75.00	
PEAK HR. FACTOR:		0.833			0.563			0.250			0.500		0.672

CONTROL:	Signal
COMMENT 1:	
GPS:	31.378618, -110.941097

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Produce Row	DAY:	WEDNESDAY	PROJECT#	15-1041-002 - H.V.

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	1	2	0	1	1	0	0	1	0	
1:00 PM					**HEAVY VEHICLES ONLY**								
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	3	8	2	5	8	3	0	0	1	2	0	3	35
4:15 PM	1	9	2	1	6	3	0	0	0	2	1	3	28
4:30 PM	1	6	4	4	7	3	3	1	2	4	0	2	37
4:45 PM	1	3	2	0	8	0	1	0	0	2	0	3	20
5:00 PM	2	12	7	5	9	1	0	0	4	2	0	1	43
5:15 PM	1	6	0	1	12	3	2	1	1	7	0	5	39
5:30 PM	2	12	5	2	10	0	3	0	3	6	0	3	46
5:45 PM	1	11	6	1	7	1	2	0	2	1	0	7	39
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	12	67	28	19	67	14	11	2	13	26	1	27	287
Approach %	11.21	62.62	26.17	19.00	67.00	14.00	42.31	7.69	50.00	48.15	1.85	50.00	
App/Depart	107	/	105	100	/	106	26	/	49	54	/	27	

PM Peak Hr Begins at: 500 PM

PEAK													
Volumes	6	41	18	9	38	5	7	1	10	16	0	16	167
Approach %	9.23	63.08	27.69	17.31	73.08	9.62	38.89	5.56	55.56	50.00	0.00	50.00	
PEAK HR. FACTOR:		0.774			0.813			0.750			0.667		0.908

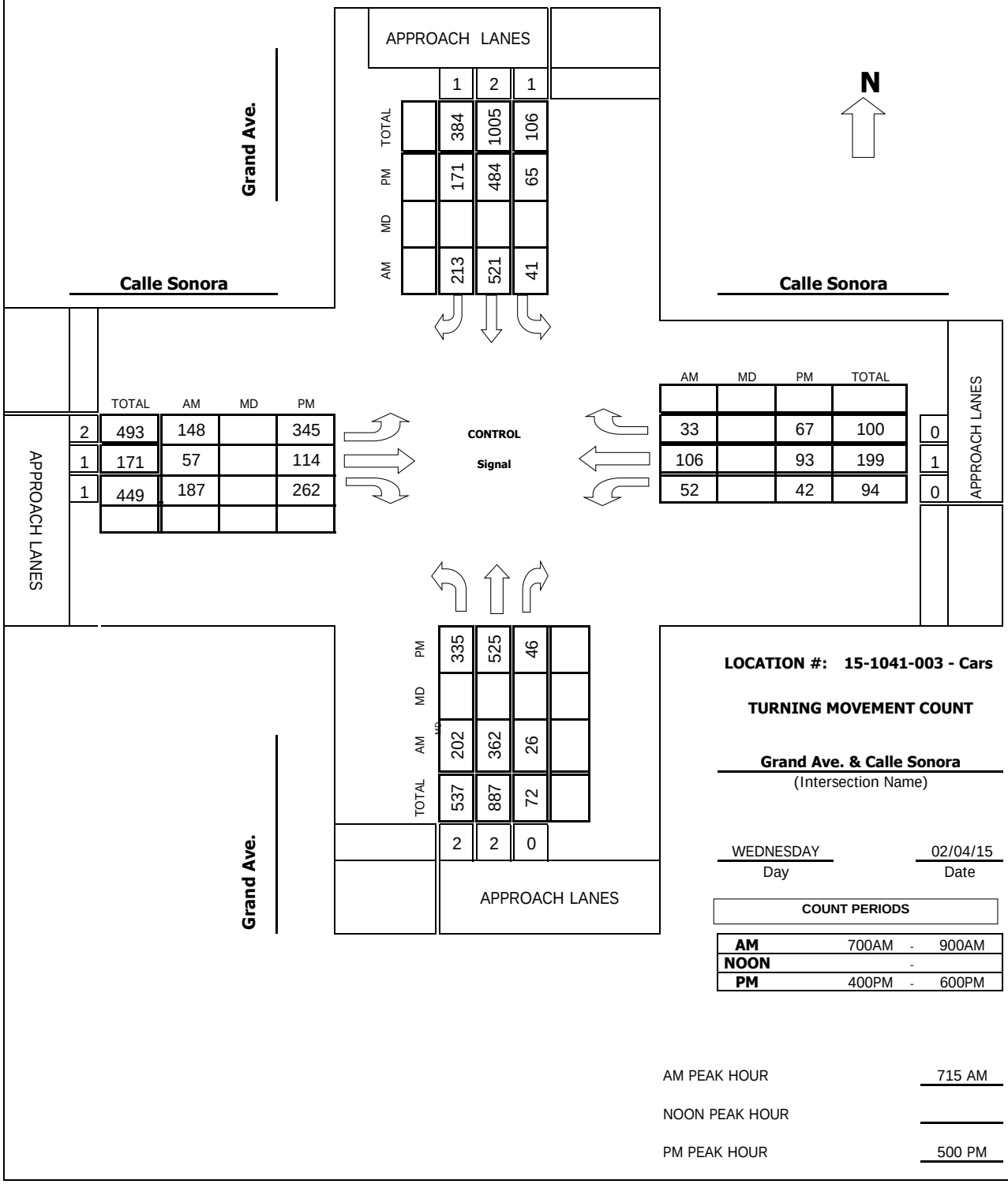
CONTROL:	Signal
COMMENT 1:	0
GPS:	31.378618, -110.941097

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 15-1041-003 - Cars

TMC SUMMARY OF Grand Ave. & Calle Sonora



LOCATION #: 15-1041-003 - Cars

TURNING MOVEMENT COUNT

Grand Ave. & Calle Sonora
(Intersection Name)

WEDNESDAY (Day) 02/04/15 (Date)

COUNT PERIODS			
AM	700AM	-	900AM
NOON		-	
PM	400PM	-	600PM

AM PEAK HOUR 715 AM

NOON PEAK HOUR

PM PEAK HOUR 500 PM

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Calle Sonora	DAY:	WEDNESDAY	PROJECT#	15-1041-003 - Cars

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	2	0	1	2	1	2	1	1	0	1	0	
6:00 AM						CARS ONLY							
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	28	85	1	9	92	61	42	10	32	8	11	8	387
7:15 AM	30	88	6	8	106	62	37	21	69	11	21	5	464
7:30 AM	64	95	4	6	177	53	31	6	36	18	29	7	526
7:45 AM	71	91	9	11	123	63	47	20	48	20	48	12	563
8:00 AM	37	88	7	16	115	35	33	10	34	3	8	9	395
8:15 AM	50	71	9	6	88	40	35	9	41	8	22	4	383
8:30 AM	46	82	4	9	84	48	49	11	30	12	18	7	400
8:45 AM	44	77	12	12	92	56	39	13	38	12	18	6	419
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	370	677	52	77	877	418	313	100	328	92	175	58	3537
Approach %	33.67	61.60	4.73	5.61	63.92	30.47	42.24	13.50	44.26	28.31	53.85	17.85	
App/Depart	1099	/	1048	1372	/	1297	741	/	229	325	/	963	

AM Peak Hr Begins at: 715 AM

PEAK													
Volumes	202	362	26	41	521	213	148	57	187	52	106	33	1948
Approach %	34.24	61.36	4.41	5.29	67.23	27.48	37.76	14.54	47.70	27.23	55.50	17.28	
PEAK HR. FACTOR:		0.863			0.821			0.772			0.597		0.865

CONTROL: Signal
COMMENT 1:
GPS: 31.367221, -110.931068

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Calle Sonora	DAY:	WEDNESDAY	PROJECT#	15-1041-003 - Cars

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	2	0	1	2	1	2	1	1	0	1	0	
1:00 PM						CARS ONLY							
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	77	108	16	11	126	60	75	36	70	16	27	24	646
4:15 PM	75	114	21	14	97	57	51	26	62	13	17	6	553
4:30 PM	74	100	11	9	100	61	79	26	81	9	22	13	585
4:45 PM	92	98	19	19	93	42	69	29	71	6	24	6	568
5:00 PM	91	160	21	21	132	34	72	31	69	7	31	29	698
5:15 PM	87	119	12	23	120	34	102	25	80	16	21	14	653
5:30 PM	77	109	4	8	99	49	80	26	52	11	22	13	550
5:45 PM	80	137	9	13	133	54	91	32	61	8	19	11	648
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	653	945	113	118	900	391	619	231	546	86	183	116	4901
Approach %	38.16	55.23	6.60	8.37	63.88	27.75	44.34	16.55	39.11	22.34	47.53	30.13	
App/Depart	1711	/	1680	1409	/	1532	1396	/	462	385	/	1227	

PM Peak Hr Begins at: 500 PM

PEAK													
Volumes	335	525	46	65	484	171	345	114	262	42	93	67	2549
Approach %	36.98	57.95	5.08	9.03	67.22	23.75	47.85	15.81	36.34	20.79	46.04	33.17	
PEAK HR. FACTOR:		0.833			0.900			0.871			0.754		0.913

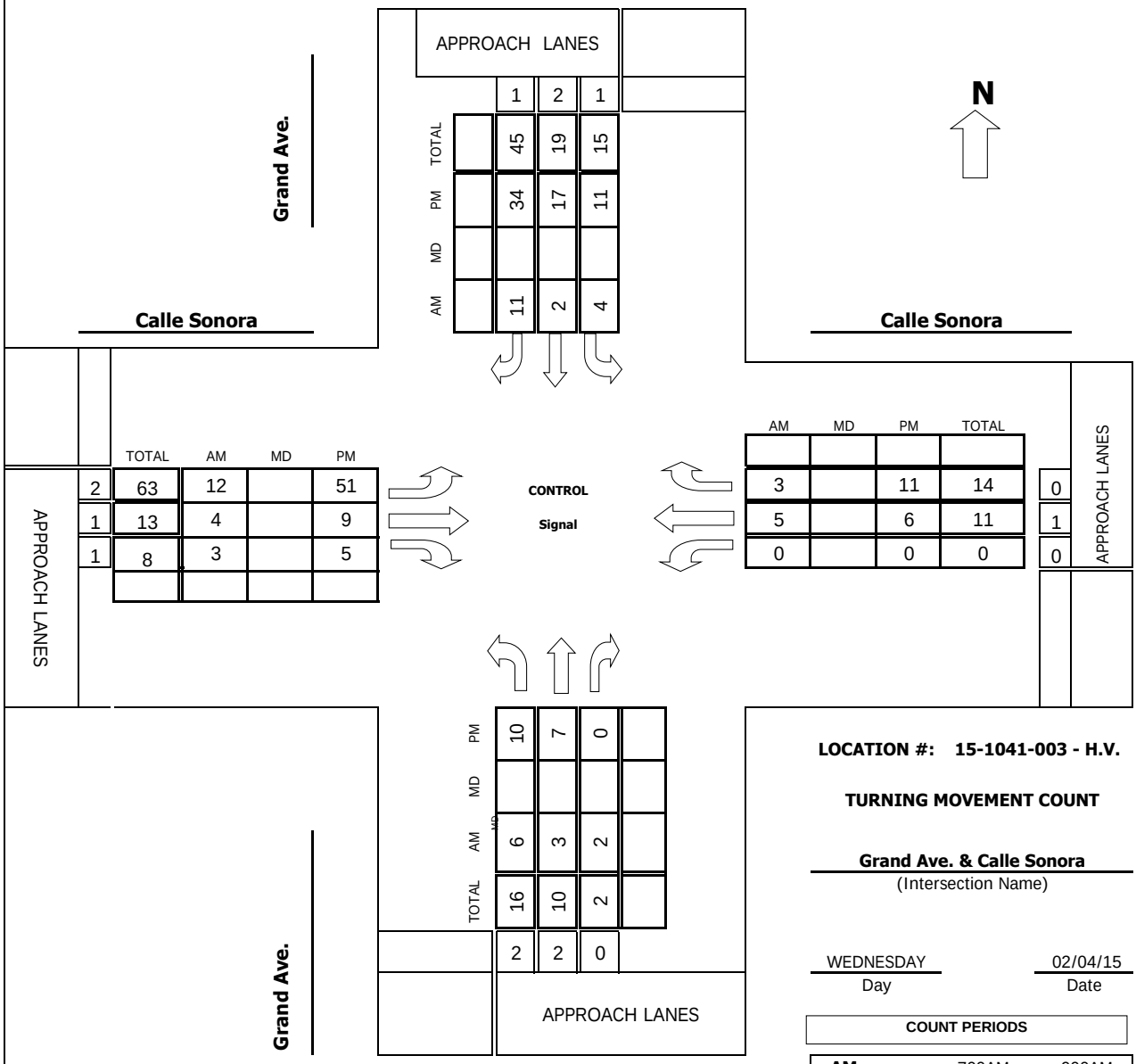
CONTROL:	Signal
COMMENT 1:	0
GPS:	31.367221, -110.931068

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 15-1041-003 - H.V.

TMC SUMMARY OF Grand Ave. & Calle Sonora



LOCATION #: 15-1041-003 - H.V.

TURNING MOVEMENT COUNT

Grand Ave. & Calle Sonora
(Intersection Name)

WEDNESDAY (Day) 02/04/15 (Date)

COUNT PERIODS			
AM	700AM	-	900AM
NOON		-	
PM	400PM	-	600PM

AM PEAK HOUR 800 AM

NOON PEAK HOUR

PM PEAK HOUR 500 PM

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Calle Sonora	DAY:	WEDNESDAY	PROJECT#	15-1041-003 - H.V.

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	2	0	1	2	1	2	1	1	0	1	0	
6:00 AM					HEAVY VEHICLES ONLY								
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	0	0	0	0	0	1	0	2	1	0	0	0	4
7:15 AM	1	1	0	1	0	0	0	0	0	0	0	0	3
7:30 AM	1	0	0	1	0	1	0	2	0	0	0	0	5
7:45 AM	0	1	0	0	3	5	3	0	1	0	2	0	15
8:00 AM	1	0	1	1	2	2	2	0	2	0	1	1	13
8:15 AM	1	0	0	2	0	1	3	2	0	0	0	1	10
8:30 AM	1	2	0	0	0	2	3	1	0	0	2	0	11
8:45 AM	3	1	1	1	0	6	4	1	1	0	2	1	21
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	8	5	2	6	5	18	15	8	5	0	7	3	82
Approach %	53.33	33.33	13.33	20.69	17.24	62.07	53.57	28.57	17.86	0.00	70.00	30.00	
App/Depart	15	/	23	29	/	10	28	/	16	10	/	33	

AM Peak Hr Begins at: 800 AM

PEAK													
Volumes	6	3	2	4	2	11	12	4	3	0	5	3	55
Approach %	54.55	27.27	18.18	23.53	11.76	64.71	63.16	21.05	15.79	0.00	62.50	37.50	
PEAK HR. FACTOR:		0.550			0.607			0.792			0.667		0.655

CONTROL:	Signal
COMMENT 1:	
GPS:	31.367221, -110.931068

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Grand Ave.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Calle Sonora	DAY:	WEDNESDAY	PROJECT#	15-1041-003 - H.V.

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	2	0	1	2	1	2	1	1	0	1	0	
1:00 PM					**HEAVY VEHICLES ONLY**								
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	1	1	0	0	3	7	15	3	0	0	1	3	34
4:15 PM	1	1	0	2	0	7	11	2	1	0	2	2	29
4:30 PM	2	2	0	2	1	9	15	0	2	0	3	0	36
4:45 PM	1	1	0	0	1	11	10	3	1	0	5	1	34
5:00 PM	1	3	0	4	6	5	15	2	1	0	2	3	42
5:15 PM	2	1	0	2	6	8	12	4	1	0	1	1	38
5:30 PM	2	1	0	3	3	13	9	0	1	0	2	6	40
5:45 PM	5	2	0	2	2	8	15	3	2	0	1	1	41
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	15	12	0	15	22	68	102	17	9	0	17	17	294
Approach %	55.56	44.44	0.00	14.29	20.95	64.76	79.69	13.28	7.03	0.00	50.00	50.00	
App/Depart	27	/	131	105	/	31	128	/	32	34	/	100	

PM Peak Hr Begins at: 500 PM

PEAK													
Volumes	10	7	0	11	17	34	51	9	5	0	6	11	161
Approach %	58.82	41.18	0.00	17.74	27.42	54.84	78.46	13.85	7.69	0.00	35.29	64.71	
PEAK HR. FACTOR:		0.607			0.816			0.813			0.531		0.958

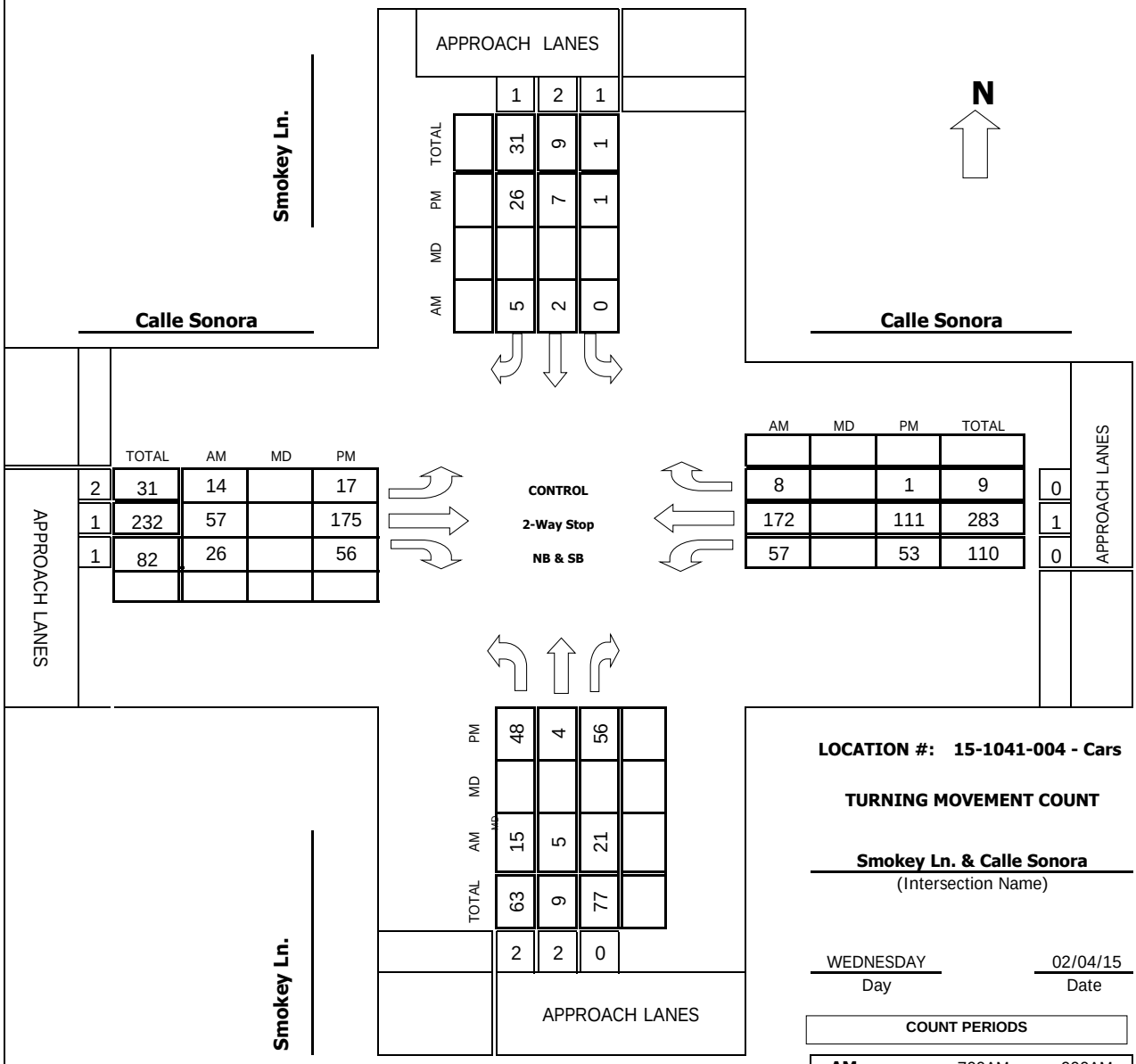
CONTROL:	Signal
COMMENT 1:	0
GPS:	31.367221, -110.931068

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 15-1041-004 - Cars

TMC SUMMARY OF Smokey Ln. & Calle Sonora



LOCATION #: 15-1041-004 - Cars

TURNING MOVEMENT COUNT

Smokey Ln. & Calle Sonora
(Intersection Name)

WEDNESDAY (Day) 02/04/15 (Date)

COUNT PERIODS			
AM	700AM	-	900AM
NOON		-	
PM	400PM	-	600PM

AM PEAK HOUR 700 AM

NOON PEAK HOUR

PM PEAK HOUR 415 PM

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Smokey Ln.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Calle Sonora	DAY:	WEDNESDAY	PROJECT#	15-1041-004 - Cars

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	2	0	1	2	1	2	1	1	0	1	0	
6:00 AM						**CARS ONLY**							
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	1	0	4	0	0	1	1	13	10	7	28	4	69
7:15 AM	4	0	7	0	0	2	1	20	10	8	33	0	85
7:30 AM	6	1	5	0	1	0	3	11	1	15	35	0	78
7:45 AM	4	4	5	0	1	2	9	13	5	27	76	4	150
8:00 AM	3	2	8	1	1	2	5	11	9	5	10	3	60
8:15 AM	7	2	3	1	1	3	5	13	6	12	24	1	78
8:30 AM	3	1	2	1	0	1	7	10	6	5	22	0	58
8:45 AM	6	3	4	0	0	4	5	17	7	7	29	0	82
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	34	13	38	3	4	15	36	108	54	86	257	12	660
Approach %	40.00	15.29	44.71	13.64	18.18	68.18	18.18	54.55	27.27	24.23	72.39	3.38	
App/Depart	85	/	61	22	/	144	198	/	149	355	/	306	

AM Peak Hr Begins at: 700 AM

PEAK													
Volumes	15	5	21	0	2	5	14	57	26	57	172	8	382
Approach %	36.59	12.20	51.22	0.00	28.57	71.43	14.43	58.76	26.80	24.05	72.57	3.38	
PEAK HR. FACTOR:		0.788			0.583			0.782			0.554		0.637

CONTROL: 2-Way Stop (NB & SB)
COMMENT 1:
GPS: 31.367234, -110.929419

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Smokey Ln.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Calle Sonora	DAY:	WEDNESDAY	PROJECT#	15-1041-004 - Cars

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	2	0	1	2	1	2	1	1	0	1	0	
1:00 PM						**CARS ONLY**							
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	19	2	16	0	1	4	4	26	16	14	33	1	136
4:15 PM	12	3	15	0	0	8	5	41	11	5	20	1	121
4:30 PM	17	0	12	0	1	9	3	42	19	11	26	0	140
4:45 PM	2	0	16	0	4	2	4	30	11	15	26	0	110
5:00 PM	17	1	13	1	2	7	5	62	15	22	39	0	184
5:15 PM	6	1	7	0	0	6	4	34	14	12	33	2	119
5:30 PM	10	0	18	0	0	8	5	24	15	21	33	0	134
5:45 PM	2	1	9	0	1	4	2	25	17	14	20	0	95
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	85	8	106	1	9	48	32	284	118	114	230	4	1039
Approach %	42.71	4.02	53.27	1.72	15.52	82.76	7.37	65.44	27.19	32.76	66.09	1.15	
App/Depart	199	/	44	58	/	241	434	/	391	348	/	363	

PM Peak Hr Begins at: 415 PM

PEAK													
Volumes	48	4	56	1	7	26	17	175	56	53	111	1	555
Approach %	44.44	3.70	51.85	2.94	20.59	76.47	6.85	70.56	22.58	32.12	67.27	0.61	
PEAK HR. FACTOR:		0.871			0.850			0.756			0.676		0.754

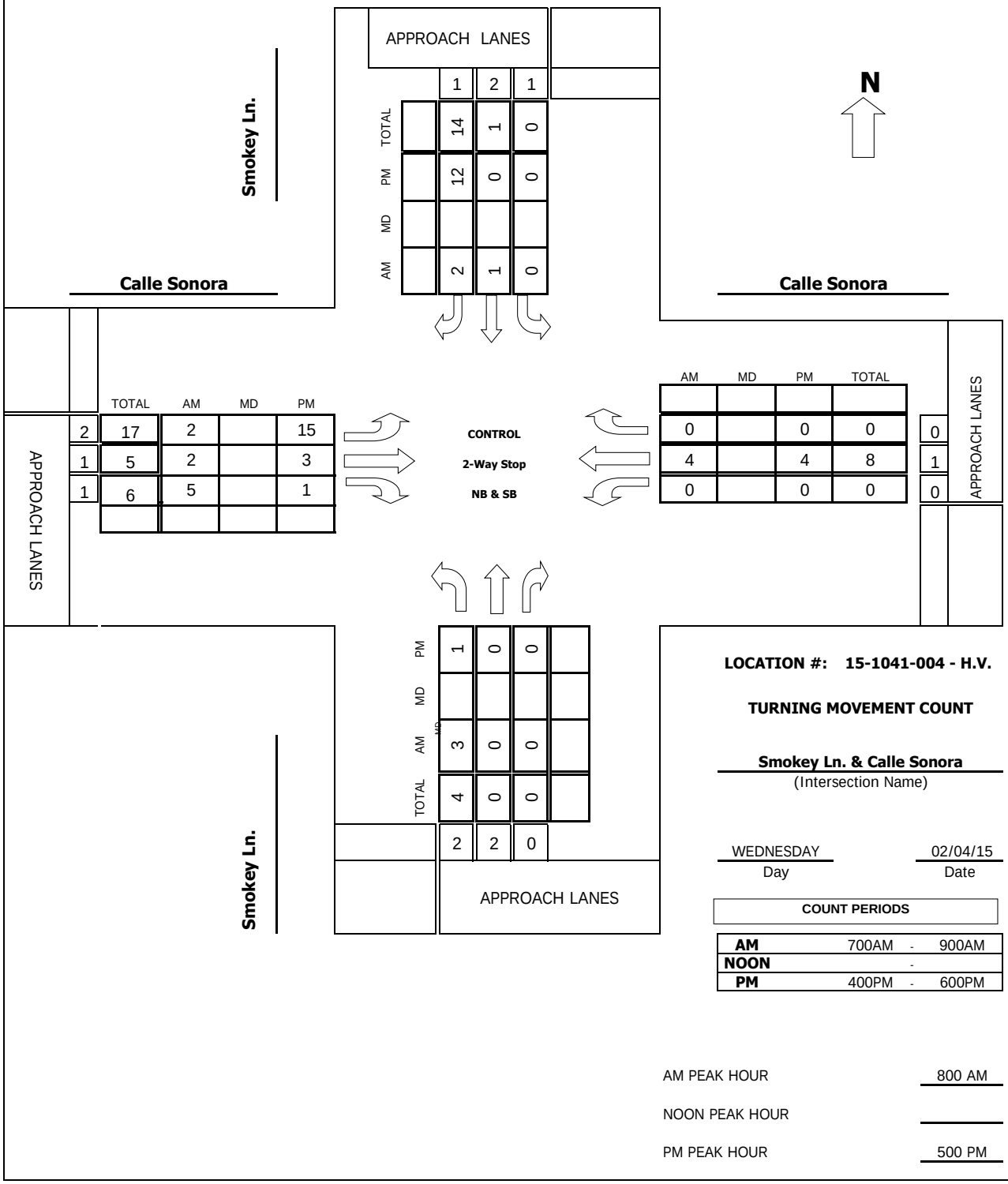
CONTROL: 2-Way Stop (NB & SB)
COMMENT 1: 0
GPS: 31.367234, -110.929419

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 15-1041-004 - H.V.

TMC SUMMARY OF Smokey Ln. & Calle Sonora



LOCATION #: 15-1041-004 - H.V.

TURNING MOVEMENT COUNT

Smokey Ln. & Calle Sonora
(Intersection Name)

WEDNESDAY (Day) 02/04/15 (Date)

COUNT PERIODS			
AM	700AM	-	900AM
NOON		-	
PM	400PM	-	600PM

AM PEAK HOUR 800 AM

NOON PEAK HOUR

PM PEAK HOUR 500 PM

Intersection Turning Movement
Prepared by:

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Smokey Ln.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Calle Sonora	DAY:	WEDNESDAY	PROJECT#	15-1041-004 - H.V.

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	2	0	1	2	1	2	1	1	0	1	0	
6:00 AM					HEAVY VEHICLES ONLY								
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	3	0	0	0	0	0	1	0	0	0	0	0	4
7:15 AM	0	0	0	0	0	0	2	0	0	0	0	0	2
7:30 AM	0	0	0	0	0	0	0	1	1	0	0	0	2
7:45 AM	1	0	0	0	0	1	1	0	0	0	0	0	3
8:00 AM	1	0	0	0	0	0	0	2	0	0	0	0	3
8:15 AM	1	0	0	0	1	1	1	0	1	0	1	0	6
8:30 AM	0	0	0	0	0	1	1	0	2	0	1	0	5
8:45 AM	1	0	0	0	0	0	0	0	2	0	2	0	5
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	7	0	0	0	1	3	6	3	6	0	4	0	30
Approach %	100.00	0.00	0.00	0.00	25.00	75.00	40.00	20.00	40.00	0.00	100.00	0.00	
App/Depart	7	/	6	4	/	7	15	/	3	4	/	14	

AM Peak Hr Begins at: 800 AM

PEAK													
Volumes	3	0	0	0	1	2	2	2	5	0	4	0	19
Approach %	100.00	0.00	0.00	0.00	33.33	66.67	22.22	22.22	55.56	0.00	100.00	0.00	
PEAK HR. FACTOR:		0.750			0.375			0.750			0.500		0.792

CONTROL:	2-Way Stop (NB & SB)
COMMENT 1:	
GPS:	31.367234, -110.929419

Intersection Turning Movement

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

N-S STREET:	Smokey Ln.	DATE:	02/04/15	LOCATION:	Nogales
E-W STREET:	Calle Sonora	DAY:	WEDNESDAY	PROJECT#	15-1041-004 - H.V.

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	2	0	1	2	1	2	1	1	0	1	0	
1:00 PM					HEAVY VEHICLES ONLY								
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	1	1	0	0	0	2	2	3	0	1	1	0	11
4:15 PM	0	0	0	0	1	2	2	2	0	0	0	0	7
4:30 PM	2	0	0	0	0	2	1	1	0	0	4	0	10
4:45 PM	1	1	0	1	0	2	0	0	0	0	1	0	6
5:00 PM	0	0	0	0	0	2	5	2	0	0	2	0	11
5:15 PM	0	0	0	0	0	1	2	1	1	0	0	0	5
5:30 PM	1	0	0	0	0	6	3	0	0	0	2	0	12
5:45 PM	0	0	0	0	0	3	5	0	0	0	0	0	8
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
Volumes	5	2	0	1	1	20	20	9	1	1	10	0	70
Approach %	71.43	28.57	0.00	4.55	4.55	90.91	66.67	30.00	3.33	9.09	90.91	0.00	
App/Depart	7	/	22	22	/	3	30	/	10	11	/	35	

PM Peak Hr Begins at: 500 PM

PEAK													
Volumes	1	0	0	0	0	12	15	3	1	0	4	0	36
Approach %	100.00	0.00	0.00	0.00	0.00	100.00	78.95	15.79	5.26	0.00	100.00	0.00	
PEAK HR. FACTOR:		0.250			0.500			0.679			0.500		0.750

CONTROL:	2-Way Stop (NB & SB)
COMMENT 1:	0
GPS:	31.367234, -110.929419

Field Data Services of Arizona

21636 N. Dietz Dr.
Maricopa, AZ 85138
520.316.6745

Site Code: 15-1041-001
Station ID:
Gold Hill Rd. east of Grand Ave.
(on bridge)
Latitude: 0' 0.000 Undefined

EB

Start Time	Bikes	Cars & Tlrs	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Double	5 Axle Double	>6 Axle Double	<6 Axle Multi	6 Axle Multi	>6 Axle Multi	Total
2/4/15	0	7	1	0	0	0	0	0	0	0	0	0	0	8
01:00	0	0	0	0	0	1	1	0	0	0	0	0	0	2
02:00	0	0	1	0	0	0	0	0	0	0	0	0	0	1
03:00	0	0	0	0	0	0	0	0	1	0	0	0	0	1
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	1	8	3	0	1	0	1	**1**	0	0	0	0	0	15
06:00	0	24	13	0	2	0	0	0	1	0	0	1	0	41
07:00	3	24	31	1	1	2	0	0	0	0	0	0	0	62
08:00	0	36	40	0	1	1	0	0	0	0	0	0	1	79
09:00	2	47	**53**	0	0	**3**	2	0	**5**	**1**	0	0	2	**115**
10:00	**4**	50	41	**3**	**6**	3	1	0	0	0	0	1	1	110
11:00	1	**51**	32	1	5	3	**3**	1	5	1	0	**2**	**4**	109
12 PM	4	43	38	3	**10**	6	2	2	3	2	0	1	**5**	119
13:00	4	**52**	46	2	3	7	6	**3**	2	2	1	1	3	**132**
14:00	4	48	**54**	4	6	5	2	1	1	1	0	**3**	2	131
15:00	**9**	38	36	1	4	**13**	6	0	1	1	**2**	1	0	112
16:00	7	47	32	3	4	1	2	1	1	0	0	0	4	102
17:00	4	45	33	**6**	2	1	1	0	1	0	1	1	5	100
18:00	5	31	26	2	9	6	**7**	2	**7**	**3**	0	2	3	103
19:00	1	31	17	3	6	1	4	0	3	1	0	0	2	69
20:00	2	26	12	0	1	1	0	0	1	1	1	1	2	48
21:00	0	16	12	0	0	0	0	0	0	0	0	0	0	28
22:00	0	5	6	0	0	0	0	0	0	0	0	0	0	11
23:00	0	1	2	0	0	0	0	0	0	0	0	0	0	3
Day Total	51	630	529	29	61	54	38	11	32	13	5	14	34	1501
Percent	3.4%	42.0%	35.2%	1.9%	4.1%	3.6%	2.5%	0.7%	2.1%	0.9%	0.3%	0.9%	2.3%	
AM Peak	10:00	11:00	09:00	10:00	10:00	09:00	11:00	05:00	09:00	09:00		11:00	11:00	09:00
Vol.	4	51	53	3	6	3	3	1	5	1		2	4	115
PM Peak	15:00	13:00	14:00	17:00	12:00	15:00	18:00	13:00	18:00	18:00	15:00	14:00	12:00	13:00
Vol.	9	52	54	6	10	13	7	3	7	3	2	3	5	132
Grand Total	51	630	529	29	61	54	38	11	32	13	5	14	34	1501
Percent	3.4%	42.0%	35.2%	1.9%	4.1%	3.6%	2.5%	0.7%	2.1%	0.9%	0.3%	0.9%	2.3%	

Field Data Services of Arizona
21636 N. Dietz Dr.
Maricopa, AZ 85138
520.316.6745

Site Code: 15-1041-001
Station ID:
Gold Hill Rd. east of Grand Ave.
(on bridge)
Latitude: 0' 0.000 Undefined

WB

Start Time	Bikes	Cars & Tlrs	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Double	5 Axle Double	>6 Axle Double	<6 Axle Multi	6 Axle Multi	>6 Axle Multi	Total
2/4/15	0	11	6	0	0	0	0	0	0	0	0	0	0	17
01:00	1	5	0	**1**	0	0	0	0	0	0	0	0	0	7
02:00	0	1	1	0	0	0	0	0	1	0	0	0	0	3
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	0	4	0	0	0	0	0	0	0	0	0	0	4
05:00	0	6	1	0	0	0	0	0	0	0	0	0	0	7
06:00	1	31	8	0	1	2	0	0	2	0	0	0	0	45
07:00	1	42	**24**	0	3	0	1	0	0	0	0	**1**	0	72
08:00	0	43	15	0	0	1	**2**	0	1	0	0	0	0	62
09:00	0	37	12	0	3	**5**	0	0	2	0	0	0	1	60
10:00	1	48	23	1	5	2	0	**1**	1	**1**	0	1	0	84
11:00	**2**	**57**	21	0	**10**	3	1	0	**13**	1	0	0	**3**	**111**
12 PM	2	61	30	2	6	**5**	2	0	5	0	0	0	1	114
13:00	3	68	31	1	8	1	**4**	**1**	**12**	**1**	0	**1**	**4**	135
14:00	3	51	**35**	2	5	5	3	1	8	0	0	0	1	114
15:00	3	58	31	0	5	3	2	1	5	0	0	1	3	112
16:00	4	71	18	0	1	0	0	1	3	1	0	1	2	102
17:00	**7**	**79**	32	**3**	5	5	1	0	4	0	0	1	2	**139**
18:00	6	37	12	3	**9**	5	3	1	4	1	0	1	3	85
19:00	5	38	8	1	4	3	2	0	11	1	0	0	0	73
20:00	4	31	11	1	4	4	0	0	8	1	0	0	1	65
21:00	3	26	8	0	1	0	1	0	1	0	0	0	0	40
22:00	4	30	6	0	1	2	0	0	0	0	0	0	0	43
23:00	0	6	4	0	0	0	0	0	0	0	0	0	0	10
Day Total	50	838	341	15	71	46	22	6	81	7	0	7	21	1505
Percent	3.3%	55.7%	22.7%	1.0%	4.7%	3.1%	1.5%	0.4%	5.4%	0.5%	0.0%	0.5%	1.4%	
AM Peak	11:00	11:00	07:00	01:00	11:00	09:00	08:00	10:00	11:00	10:00		07:00	11:00	11:00
Vol.	2	57	24	1	10	5	2	1	13	1		1	3	111
PM Peak	17:00	17:00	14:00	17:00	18:00	12:00	13:00	13:00	13:00	13:00		13:00	13:00	17:00
Vol.	7	79	35	3	9	5	4	1	12	1		1	4	139
Grand Total	50	838	341	15	71	46	22	6	81	7	0	7	21	1505
Percent	3.3%	55.7%	22.7%	1.0%	4.7%	3.1%	1.5%	0.4%	5.4%	0.5%	0.0%	0.5%	1.4%	

Field Data Services of Arizona
21636 N. Dietz Dr.
Maricopa, AZ 85138
520.316.6745

Site Code: 15-1041-001
Station ID:
Gold Hill Rd. east of Grand Ave.
(on bridge)
Latitude: 0' 0.000 Undefined

EB, WB

Start Time	Bikes	Cars & Tlrs	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Double	5 Axle Double	>6 Axle Double	<6 Axle Multi	6 Axle Multi	>6 Axle Multi	Total
2/4/15	0	18	7	0	0	0	0	0	0	0	0	0	0	25
01:00	1	5	0	1	0	1	1	0	0	0	0	0	0	9
02:00	0	1	2	0	0	0	0	0	1	0	0	0	0	4
03:00	0	1	0	0	0	0	0	0	1	0	0	0	0	2
04:00	0	0	4	0	0	0	0	0	0	0	0	0	0	4
05:00	1	14	4	0	1	0	1	**1**	0	0	0	0	0	22
06:00	1	55	21	0	3	2	0	0	3	0	0	1	0	86
07:00	4	66	55	1	4	2	1	0	0	0	0	1	0	134
08:00	0	79	55	0	1	2	2	0	1	0	0	0	1	141
09:00	2	84	**65**	0	3	**8**	2	0	7	1	0	0	3	175
10:00	**5**	98	64	**4**	11	5	1	1	1	1	0	**2**	1	194
11:00	3	**108**	53	1	**15**	6	**4**	1	**18**	**2**	0	2	**7**	**220**
12 PM	6	104	68	5	16	11	4	2	8	2	0	1	6	233
13:00	7	120	77	3	11	8	**10**	**4**	**14**	3	1	2	**7**	**267**
14:00	7	99	**89**	6	11	10	5	2	9	1	0	**3**	3	245
15:00	**12**	96	67	1	9	**16**	8	1	6	1	**2**	2	3	224
16:00	11	118	50	3	5	1	2	2	4	1	0	1	6	204
17:00	11	**124**	65	**9**	7	6	2	0	5	0	1	2	7	239
18:00	11	68	38	5	**18**	11	10	3	11	**4**	0	3	6	188
19:00	6	69	25	4	10	4	6	0	14	2	0	0	2	142
20:00	6	57	23	1	5	5	0	0	9	2	1	1	3	113
21:00	3	42	20	0	1	0	1	0	1	0	0	0	0	68
22:00	4	35	12	0	1	2	0	0	0	0	0	0	0	54
23:00	0	7	6	0	0	0	0	0	0	0	0	0	0	13
Day Total	101	1468	870	44	132	100	60	17	113	20	5	21	55	3006
Percent	3.4%	48.8%	28.9%	1.5%	4.4%	3.3%	2.0%	0.6%	3.8%	0.7%	0.2%	0.7%	1.8%	
AM Peak	10:00	11:00	09:00	10:00	11:00	09:00	11:00	05:00	11:00	11:00		10:00	11:00	11:00
Vol.	5	108	65	4	15	8	4	1	18	2		2	7	220
PM Peak	15:00	17:00	14:00	17:00	18:00	15:00	13:00	13:00	13:00	18:00	15:00	14:00	13:00	13:00
Vol.	12	124	89	9	18	16	10	4	14	4	2	3	7	267
Grand Total	101	1468	870	44	132	100	60	17	113	20	5	21	55	3006
Percent	3.4%	48.8%	28.9%	1.5%	4.4%	3.3%	2.0%	0.6%	3.8%	0.7%	0.2%	0.7%	1.8%	

Field Data Services of Arizona

21636 N. Dietz Dr.
Maricopa, AZ 85138
520.316.6745

Site Code: 15-1041-002
Station ID:
Produce Row east of Tucson - Nogales Hwy
(on bridge)
Latitude: 0' 0.000 Undefined

EB

Start Time	Bikes	Cars & Tlrs	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Double	5 Axle Double	>6 Axle Double	<6 Axle Multi	6 Axle Multi	>6 Axle Multi	Total
2/4/15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	1	0	0	0	0	1
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	4	3	0	0	0	0	0	1	0	0	0	0	8
05:00	0	2	0	0	0	0	0	0	0	0	0	0	1	3
06:00	0	9	0	0	1	0	0	1	0	1	0	0	0	12
07:00	1	51	15	2	0	0	0	1	3	0	0	0	0	73
08:00	2	72	14	0	2	0	**1**	1	2	3	0	0	0	97
09:00	5	**73**	**17**	0	2	1	1	**2**	2	0	0	0	2	**105**
10:00	3	56	14	**4**	**10**	2	1	2	4	**4**	0	0	**3**	103
11:00	**8**	49	13	1	6	**4**	1	1	**10**	1	0	**1**	2	97
12 PM	3	**39**	7	2	**7**	**5**	0	0	7	0	0	1	3	**74**
13:00	4	17	8	**9**	5	1	3	1	7	0	0	0	**4**	59
14:00	**6**	22	6	5	6	3	2	1	3	1	0	0	0	55
15:00	1	26	**12**	3	4	0	0	0	**11**	2	1	0	2	62
16:00	5	33	3	3	3	3	3	**3**	5	**4**	**3**	**2**	1	71
17:00	3	36	6	2	2	3	**5**	1	3	2	0	0	1	64
18:00	4	13	3	1	3	1	1	1	5	2	0	0	2	36
19:00	0	1	1	2	0	2	0	0	3	1	0	0	0	10
20:00	2	2	0	0	0	1	0	0	2	0	0	0	0	7
21:00	1	2	0	0	1	0	0	0	1	0	0	0	0	5
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Day Total	48	507	122	34	53	26	18	15	70	21	4	4	21	943
Percent	5.1%	53.8%	12.9%	3.6%	5.6%	2.8%	1.9%	1.6%	7.4%	2.2%	0.4%	0.4%	2.2%	
AM Peak	11:00	09:00	09:00	10:00	10:00	11:00	08:00	09:00	11:00	10:00		11:00	10:00	09:00
Vol.	8	73	17	4	10	4	1	2	10	4		1	3	105
PM Peak	14:00	12:00	15:00	13:00	12:00	12:00	17:00	16:00	15:00	16:00	16:00	16:00	13:00	12:00
Vol.	6	39	12	9	7	5	5	3	11	4	3	2	4	74
Grand Total	48	507	122	34	53	26	18	15	70	21	4	4	21	943
Percent	5.1%	53.8%	12.9%	3.6%	5.6%	2.8%	1.9%	1.6%	7.4%	2.2%	0.4%	0.4%	2.2%	

Field Data Services of Arizona
21636 N. Dietz Dr.
Maricopa, AZ 85138
520.316.6745

Site Code: 15-1041-002
Station ID:
Produce Row east of Tucson - Nogales Hwy
(on bridge)
Latitude: 0' 0.000 Undefined

WB

Start Time	Bikes	Cars & Tlrs	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Double	5 Axle Double	>6 Axle Double	<6 Axle Multi	6 Axle Multi	>6 Axle Multi	Total
2/4/15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1
05:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1
06:00	2	2	0	0	2	0	0	0	0	0	0	0	0	6
07:00	1	10	1	0	1	0	0	0	1	0	0	0	0	14
08:00	3	14	4	0	2	1	2	0	0	0	0	0	0	26
09:00	**9**	56	14	**5**	5	2	1	0	3	0	0	**2**	2	99
10:00	5	52	**19**	2	3	3	**4**	0	**5**	0	0	2	1	96
11:00	3	**62**	9	5	**7**	**5**	0	0	1	**4**	0	1	**4**	**101**
12 PM	3	40	**15**	5	4	9	1	**1**	0	1	0	1	4	84
13:00	5	28	6	4	6	7	1	0	5	1	0	0	**6**	69
14:00	2	31	6	**9**	3	6	4	1	2	1	0	**3**	5	73
15:00	**6**	40	5	6	**9**	6	6	0	3	0	1	0	1	83
16:00	4	**64**	7	2	1	3	2	1	4	**2**	**2**	3	2	**97**
17:00	6	49	6	3	6	**11**	2	1	**6**	0	0	1	4	95
18:00	6	19	8	4	3	8	**8**	0	2	1	0	2	2	63
19:00	6	12	5	7	1	4	4	1	2	1	0	1	4	48
20:00	1	15	11	0	0	2	0	0	2	2	0	0	0	33
21:00	1	7	0	0	1	1	1	0	0	0	0	0	0	11
22:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
23:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Day Total	65	502	117	52	55	68	36	5	36	13	3	16	35	1003
Percent	6.5%	50.0%	11.7%	5.2%	5.5%	6.8%	3.6%	0.5%	3.6%	1.3%	0.3%	1.6%	3.5%	
AM Peak	09:00	11:00	10:00	09:00	11:00	11:00	10:00		10:00	11:00		09:00	11:00	11:00
Vol.	9	62	19	5	7	5	4		5	4		2	4	101
PM Peak	15:00	16:00	12:00	14:00	15:00	17:00	18:00	12:00	17:00	16:00	16:00	14:00	13:00	16:00
Vol.	6	64	15	9	9	11	8	1	6	2	2	3	6	97
Grand Total	65	502	117	52	55	68	36	5	36	13	3	16	35	1003
Percent	6.5%	50.0%	11.7%	5.2%	5.5%	6.8%	3.6%	0.5%	3.6%	1.3%	0.3%	1.6%	3.5%	

Field Data Services of Arizona
21636 N. Dietz Dr.
Maricopa, AZ 85138
520.316.6745

Site Code: 15-1041-002
Station ID:
Produce Row east of Tucson - Nogales Hwy
(on bridge)
Latitude: 0' 0.000 Undefined

EB, WB

Start Time	Bikes	Cars & Tlrs	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Double	5 Axle Double	>6 Axle Double	<6 Axle Multi	6 Axle Multi	>6 Axle Multi	Total
2/4/15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	1	0	0	0	0	1
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	1	4	3	0	0	0	0	0	1	0	0	0	0	9
05:00	1	2	0	0	0	0	0	0	0	0	0	0	1	4
06:00	2	11	0	0	3	0	0	1	0	1	0	0	0	18
07:00	2	61	16	2	1	0	0	1	4	0	0	0	0	87
08:00	5	86	18	0	4	1	3	1	2	3	0	0	0	123
09:00	**14**	**129**	31	5	7	3	2	**2**	5	0	0	**2**	4	**204**
10:00	8	108	**33**	**6**	**13**	5	**5**	2	9	4	0	2	4	199
11:00	11	111	22	6	13	**9**	1	1	**11**	**5**	0	2	**6**	198
12 PM	6	79	**22**	7	11	**14**	1	1	7	1	0	2	7	158
13:00	9	45	14	13	11	8	4	1	12	1	0	0	**10**	128
14:00	8	53	12	**14**	9	9	6	2	5	2	0	3	5	128
15:00	7	66	17	9	**13**	6	6	0	**14**	2	2	0	3	145
16:00	9	**97**	10	5	4	6	5	**4**	9	**6**	**5**	**5**	3	**168**
17:00	9	85	12	5	8	14	7	2	9	2	0	1	5	159
18:00	**10**	32	11	5	6	9	**9**	1	7	3	0	2	4	99
19:00	6	13	6	9	1	6	4	1	5	2	0	1	4	58
20:00	3	17	11	0	0	3	0	0	4	2	0	0	0	40
21:00	2	9	0	0	2	1	1	0	1	0	0	0	0	16
22:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
23:00	0	0	0	0	2	0	0	0	0	0	0	0	0	2
Day Total	113	1009	239	86	108	94	54	20	106	34	7	20	56	1946
Percent	5.8%	51.8%	12.3%	4.4%	5.5%	4.8%	2.8%	1.0%	5.4%	1.7%	0.4%	1.0%	2.9%	
AM Peak	09:00	09:00	10:00	10:00	10:00	11:00	10:00	09:00	11:00	11:00		09:00	11:00	09:00
Vol.	14	129	33	6	13	9	5	2	11	5		2	6	204
PM Peak	18:00	16:00	12:00	14:00	15:00	12:00	18:00	16:00	15:00	16:00	16:00	16:00	13:00	16:00
Vol.	10	97	22	14	13	14	9	4	14	6	5	5	10	168
Grand Total	113	1009	239	86	108	94	54	20	106	34	7	20	56	1946
Percent	5.8%	51.8%	12.3%	4.4%	5.5%	4.8%	2.8%	1.0%	5.4%	1.7%	0.4%	1.0%	2.9%	

Field Data Services of Arizona

21636 N. Dietz Dr.
Maricopa, AZ 85138
520.316.6745

Site Code: 15-1041-003
Station ID:
Calle Sonora east of Grand Ave
(on bridge)
Latitude: 0' 0.000 Undefined

EB

Start Time	Bikes	Cars & Tlrs	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Double	5 Axle Double	>6 Axle Double	<6 Axle Multi	6 Axle Multi	>6 Axle Multi	Total
2/4/15	0	5	2	0	0	0	0	0	0	0	0	0	0	7
01:00	0	4	1	0	0	0	0	0	0	0	0	0	0	5
02:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
03:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
04:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
05:00	0	7	1	0	0	0	0	0	0	0	0	0	0	8
06:00	0	35	11	0	1	0	0	0	0	0	0	0	0	47
07:00	0	104	13	**1**	0	**5**	**1**	0	**2**	0	0	0	0	**126**
08:00	0	86	**24**	0	0	2	1	**4**	0	0	0	0	0	117
09:00	0	75	22	0	**2**	2	1	0	1	0	0	**1**	0	104
10:00	0	**106**	1	0	0	0	0	0	0	0	0	0	0	107
11:00	**1**	102	16	1	1	1	0	1	0	0	0	0	0	123
12 PM	0	125	46	0	**5**	0	0	3	2	1	0	0	**2**	184
13:00	0	54	17	**1**	0	2	0	1	1	1	0	0	0	77
14:00	**1**	121	**52**	1	0	2	1	2	3	0	0	0	0	183
15:00	0	139	45	1	1	**3**	0	0	5	0	0	0	1	195
16:00	0	**216**	40	0	1	2	**6**	**4**	**6**	**2**	0	**1**	0	**278**
17:00	0	168	37	0	3	1	0	1	2	1	**1**	0	1	215
18:00	0	120	31	0	1	3	1	3	4	0	0	0	0	163
19:00	0	94	14	0	0	0	0	0	1	0	0	0	0	109
20:00	0	57	12	0	0	0	0	0	2	0	1	0	0	72
21:00	0	37	16	0	0	0	0	0	0	0	0	0	0	53
22:00	0	23	9	0	0	0	0	0	0	0	0	0	0	32
23:00	0	12	2	0	0	0	0	0	0	0	0	0	0	14
Day Total	2	1696	413	5	15	23	11	19	29	5	2	2	4	2226
Percent	0.1%	76.2%	18.6%	0.2%	0.7%	1.0%	0.5%	0.9%	1.3%	0.2%	0.1%	0.1%	0.2%	
AM Peak	11:00	10:00	08:00	07:00	09:00	07:00	07:00	08:00	07:00			09:00		07:00
Vol.	1	106	24	1	2	5	1	4	2			1		126
PM Peak	14:00	16:00	14:00	13:00	12:00	15:00	16:00	16:00	16:00	16:00	17:00	16:00	12:00	16:00
Vol.	1	216	52	1	5	3	6	4	6	2	1	1	2	278
Grand Total	2	1696	413	5	15	23	11	19	29	5	2	2	4	2226
Percent	0.1%	76.2%	18.6%	0.2%	0.7%	1.0%	0.5%	0.9%	1.3%	0.2%	0.1%	0.1%	0.2%	

Field Data Services of Arizona
21636 N. Dietz Dr.
Maricopa, AZ 85138
520.316.6745

Site Code: 15-1041-003
Station ID:
Calle Sonora east of Grand Ave
(on bridge)
Latitude: 0' 0.000 Undefined

WB

Start Time	Bikes	Cars & Tlrs	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Double	5 Axle Double	>6 Axle Double	<6 Axle Multi	6 Axle Multi	>6 Axle Multi	Total
2/4/15	0	4	1	0	0	0	0	0	0	0	0	0	0	5
01:00	0	1	2	0	0	0	0	0	0	0	0	0	0	3
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	7	0	0	0	0	0	0	0	0	0	0	0	7
04:00	0	7	1	0	0	0	0	0	0	0	0	0	0	8
05:00	0	8	0	0	0	0	0	0	0	0	0	0	0	8
06:00	0	71	18	0	0	0	0	0	0	0	0	0	0	89
07:00	0	**149**	**48**	0	1	0	**1**	0	1	0	0	0	0	**200**
08:00	0	90	38	0	1	1	0	0	3	0	0	0	**1**	134
09:00	0	107	34	1	1	**2**	0	**1**	1	0	0	0	1	148
10:00	**4**	102	13	0	1	0	0	1	0	0	0	0	0	121
11:00	3	87	28	**2**	**3**	0	1	0	**4**	0	0	0	0	128
12 PM	5	128	56	**1**	**5**	**3**	2	6	3	1	0	**1**	1	212
13:00	**10**	117	40	1	1	2	1	1	4	0	0	0	2	179
14:00	0	102	47	1	1	0	0	2	2	0	0	0	0	155
15:00	0	111	**58**	1	0	2	0	1	2	0	0	1	**3**	179
16:00	3	127	44	1	3	1	**4**	**8**	3	1	**1**	1	2	199
17:00	0	**159**	50	0	2	1	1	1	1	**2**	0	1	0	**218**
18:00	0	93	26	0	0	0	0	1	**5**	0	0	0	1	126
19:00	0	49	19	0	0	0	0	0	2	0	0	0	0	70
20:00	0	44	9	0	0	0	0	0	0	0	0	0	0	53
21:00	0	20	8	0	0	0	0	0	2	0	0	0	0	30
22:00	0	11	3	0	0	0	0	0	1	0	0	0	0	15
23:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
Day Total	25	1600	543	8	19	12	10	22	34	4	1	4	11	2293
Percent	1.1%	69.8%	23.7%	0.3%	0.8%	0.5%	0.4%	1.0%	1.5%	0.2%	0.0%	0.2%	0.5%	
AM Peak	10:00	07:00	07:00	11:00	11:00	09:00	07:00	09:00	11:00				08:00	07:00
Vol.	4	149	48	2	3	2	1	1	4				1	200
PM Peak	13:00	17:00	15:00	12:00	12:00	12:00	16:00	16:00	18:00	17:00	16:00	12:00	15:00	17:00
Vol.	10	159	58	1	5	3	4	8	5	2	1	1	3	218
Grand Total	25	1600	543	8	19	12	10	22	34	4	1	4	11	2293
Percent	1.1%	69.8%	23.7%	0.3%	0.8%	0.5%	0.4%	1.0%	1.5%	0.2%	0.0%	0.2%	0.5%	

Field Data Services of Arizona
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Maricopa, AZ 85138
520.316.6745

Site Code: 15-1041-003
Station ID:
Calle Sonora east of Grand Ave
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Latitude: 0' 0.000 Undefined

EB, WB

Start Time	Bikes	Cars & Tlrs	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Double	5 Axle Double	>6 Axle Double	<6 Axle Multi	6 Axle Multi	>6 Axle Multi	Total
2/4/15	0	9	3	0	0	0	0	0	0	0	0	0	0	12
01:00	0	5	3	0	0	0	0	0	0	0	0	0	0	8
02:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
03:00	0	10	0	0	0	0	0	0	0	0	0	0	0	10
04:00	0	8	1	0	0	0	0	0	0	0	0	0	0	9
05:00	0	15	1	0	0	0	0	0	0	0	0	0	0	16
06:00	0	106	29	0	1	0	0	0	0	0	0	0	0	136
07:00	0	**253**	61	1	1	**5**	**2**	0	3	0	0	0	0	**326**
08:00	0	176	**62**	0	1	3	1	**4**	3	0	0	0	**1**	251
09:00	0	182	56	1	3	4	1	1	2	0	0	**1**	1	252
10:00	**4**	208	14	0	1	0	0	1	0	0	0	0	0	228
11:00	4	189	44	**3**	**4**	1	1	1	**4**	0	0	0	0	251
12 PM	5	253	102	1	**10**	3	2	9	5	2	0	1	3	396
13:00	**10**	171	57	**2**	1	4	1	2	5	1	0	0	2	256
14:00	1	223	99	2	1	2	1	4	5	0	0	0	0	338
15:00	0	250	**103**	2	1	**5**	0	1	7	0	0	1	**4**	374
16:00	3	**343**	84	1	4	3	**10**	**12**	**9**	**3**	**1**	**2**	2	**477**
17:00	0	327	87	0	5	2	1	2	3	3	1	1	1	433
18:00	0	213	57	0	1	3	1	4	9	0	0	0	1	289
19:00	0	143	33	0	0	0	0	0	3	0	0	0	0	179
20:00	0	101	21	0	0	0	0	0	2	0	1	0	0	125
21:00	0	57	24	0	0	0	0	0	2	0	0	0	0	83
22:00	0	34	12	0	0	0	0	0	1	0	0	0	0	47
23:00	0	18	2	0	0	0	0	0	0	0	0	0	0	20
Day Total	27	3296	956	13	34	35	21	41	63	9	3	6	15	4519
Percent	0.6%	72.9%	21.2%	0.3%	0.8%	0.8%	0.5%	0.9%	1.4%	0.2%	0.1%	0.1%	0.3%	
AM Peak	10:00	07:00	08:00	11:00	11:00	07:00	07:00	08:00	11:00			09:00	08:00	07:00
Vol.	4	253	62	3	4	5	2	4	4			1	1	326
PM Peak	13:00	16:00	15:00	13:00	12:00	15:00	16:00	16:00	16:00	16:00	16:00	16:00	15:00	16:00
Vol.	10	343	103	2	10	5	10	12	9	3	1	2	4	477
Grand Total	27	3296	956	13	34	35	21	41	63	9	3	6	15	4519
Percent	0.6%	72.9%	21.2%	0.3%	0.8%	0.8%	0.5%	0.9%	1.4%	0.2%	0.1%	0.1%	0.3%	

Appendix B – Stakeholder Interview Summary

Nogales – Constraints Analysis at Three (3) Bridges

KHA Job # 098036004

Stakeholder Interviews Summary

3/6/2015

Stakeholder interviews were conducted on March 6th, 2015 with members of the Fresh Produce Association of the Americas (FPAA).

Meetings were conducted at individual offices and at the FPAA building. Representatives from the following were interviewed:

- Pacific Brokerage
- City of Nogales (Land Development Department)
- J-C Distributing, Inc.
- Wholesome Family Farms
- Wilson Produce, LLC
- Harvey Trucking
- Fresh Produce of the Americas

<u>Summary</u>

- General information regarding the port of entry (POE) was discussed. As of now, 1800 trucks per day come into Nogales, AZ from Mexico. With POE expansions, the goal is to double the inflow to approximately 3600 trucks per day. 10 years is the anticipated target for doubling the inflow of trucks.
- The typical rule-of-thumb ratio for American trucks vs. Mexican trucks is 2:1. However, other FPAA members mentioned the ratio may vary by product. Thus, increasing the number of American trucks for each Mexican truck. It was mentioned that 1 Mexican truck can generate 5 – 6 American trucks.
- The typical trend for American trucks is to have mixed loads or loads that involve less than the truckload. “Straight” loads are uncommon due to the demand for the fresh produce. Thus, requiring more American trucks for every Mexican truck to come into Nogales.
- It is common for Mexican trucks to pay the overweight fees ($75) when coming into Nogales.

- It was also mentioned that along Calle Sonora, an increase in larger (18-wheel) trucks is occurring that are creating issues within the existing roadway geometries at Calle Sonora & Smokey Lane. Generated by Delta Fresh Sales, LLC
- Anticipated constraints, according to the City of Nogales Land Development Department includes the railroad right-of-way.
- It was discussed that some of the existing warehouses have plans to expand their facilities in the area. Areas are zoned for industrial use, including land owned by Larry Harvey and J-C Distributing. Some of the immediate plans include:
    - 110,000 SF J-C Distributing Warehouse within the vicinity of Produce Row
    - 70,000 SF Warehouse which would include 4-5 cold rooms. Also, within the vicinity of Produce Row.
    - Potential 130 acres of residential development off of Gold Hill Road towards the east. Unknown number of units or lot size at this time. However, the potential for increased residential traffic at Gold Hill Road & Grand Avenue would increase significantly.
- Approximately, Wilson Produce, LLC can see up to 300 trucks per day. The facility has recently expanded, the trucks per day may be even higher.
- There was definitely a consensus that wider bridges are necessary with existing traffic conditions and essential as truck traffic increases. A multiple lane bridge is desired. Existing turn radii at the 3 intersections do not accommodate the standard size trucks. The majority of the congestion is caused by turning trucks.
- According to the FPAA members, peak seasons vary for different warehouses. Thus, depending on the produce. Typical peak occurs during January – May. For Wholesum Family Produce, peak is typically year round.
- Last year's growth was 17% which is not normal. Typical average growth rate per year is around 6 - 7% per year.
- Signal at Gold Hill Road only allows for 1 truck to go through the intersection which has been some contributing factors for some collisions.
- The railroad crossing was cited as an issue as collisions involving trucks and trains is fairly common.
- An estimate of 5 – 7 trains per day cross through the area. It can take as much as 20 minutes for a train to clear an intersection, creating severe queues east of the railroad tracks.

Appendix C – Synchro Output Files

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (veh/h)	31	988	50	25	590	29	51	1	71	29	0	41
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1509	1717	1750	1750	1701	1750	1750	1740	1750	1750	1700	1750
Adj Flow Rate, veh/h	42	1353	68	30	711	35	64	1	89	43	0	60
Adj No. of Lanes	1	2	0	1	2	0	0	1	0	0	1	0
Peak Hour Factor	0.73	0.73	0.73	0.83	0.83	0.83	0.80	0.80	0.80	0.68	0.68	0.68
Percent Heavy Veh, %	16	2	2	0	3	3	0	0	0	0	0	0
Cap, veh/h	390	1953	98	215	1937	95	205	28	224	206	24	224
Arrive On Green	0.62	0.62	0.62	0.62	0.62	0.62	0.27	0.27	0.27	0.27	0.00	0.27
Sat Flow, veh/h	577	3162	159	353	3136	154	498	101	820	499	89	822
Grp Volume(v), veh/h	42	697	724	30	366	380	154	0	0	103	0	0
Grp Sat Flow(s),veh/h/ln	577	1631	1689	353	1616	1674	1419	0	0	1410	0	0
Q Serve(g_s), s	2.8	20.9	21.0	4.5	8.2	8.2	2.3	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	11.1	20.9	21.0	25.6	8.2	8.2	6.0	0.0	0.0	3.7	0.0	0.0
Prop In Lane	1.00		0.09	1.00		0.09	0.42		0.58	0.42		0.58
Lane Grp Cap(c), veh/h	390	1008	1044	215	998	1034	457	0	0	455	0	0
V/C Ratio(X)	0.11	0.69	0.69	0.14	0.37	0.37	0.34	0.00	0.00	0.23	0.00	0.00
Avail Cap(c_a), veh/h	443	1158	1199	248	1147	1188	457	0	0	455	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	9.7	9.3	9.4	17.9	6.9	6.9	21.5	0.0	0.0	20.7	0.0	0.0
Incr Delay (d2), s/veh	0.1	1.5	1.5	0.3	0.2	0.2	2.0	0.0	0.0	0.3	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	9.7	10.1	0.5	3.6	3.8	2.8	0.0	0.0	1.6	0.0	0.0
LnGrp Delay(d),s/veh	9.8	10.8	10.8	18.2	7.1	7.1	23.5	0.0	0.0	21.0	0.0	0.0
LnGrp LOS	A	B	B	B	A	A	C			C		
Approach Vol, veh/h		1463			776			154			103	
Approach Delay, s/veh		10.8			7.6			23.5			21.0	
Approach LOS		B			A			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		24.0		49.3		24.0		49.3
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		20.0		52.0		20.0		52.0
Max Q Clear Time (g_c+I1), s		8.0		23.0		5.7		27.6
Green Ext Time (p_c), s		1.2		20.0		1.3		17.7

Intersection Summary	
HCM 2010 Ctrl Delay	11.0
HCM 2010 LOS	B

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (veh/h)	26	840	221	22	476	27	155	3	55	7	0	7
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1522	1733	1750	1750	1685	1750	1750	1717	1750	1750	1362	1750
Adj Flow Rate, veh/h	34	1091	287	23	506	29	258	5	92	11	0	11
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	0	1	0
Peak Hour Factor	0.77	0.77	0.77	0.94	0.94	0.94	0.60	0.60	0.60	0.62	0.62	0.62
Percent Heavy Veh, %	15	1	1	0	3	3	0	0	0	0	0	0
Cap, veh/h	456	1260	329	236	1501	86	490	22	408	194	16	142
Arrive On Green	0.06	0.49	0.49	0.06	0.49	0.49	0.29	0.29	0.29	0.29	0.00	0.29
Sat Flow, veh/h	1449	2585	675	1667	3078	176	1313	76	1395	432	53	485
Grp Volume(v), veh/h	34	692	686	23	263	272	258	0	97	22	0	0
Grp Sat Flow(s),veh/h/ln	1449	1646	1614	1667	1601	1654	1313	0	1471	970	0	0
Q Serve(g_s), s	0.9	29.7	30.3	0.5	8.0	8.1	8.6	0.0	4.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	0.9	29.7	30.3	0.5	8.0	8.1	12.7	0.0	4.0	4.0	0.0	0.0
Prop In Lane	1.00		0.42	1.00		0.11	1.00		0.95	0.50		0.50
Lane Grp Cap(c), veh/h	456	802	787	236	780	806	490	0	430	351	0	0
V/C Ratio(X)	0.07	0.86	0.87	0.10	0.34	0.34	0.53	0.00	0.23	0.06	0.00	0.00
Avail Cap(c_a), veh/h	456	802	787	236	780	806	490	0	430	351	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	8.7	18.1	18.3	14.3	12.6	12.6	24.2	0.0	21.4	20.4	0.0	0.0
Incr Delay (d2), s/veh	0.3	11.8	12.8	0.8	1.2	1.1	4.0	0.0	1.2	0.3	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	15.9	16.1	0.3	3.8	3.9	5.5	0.0	1.8	0.4	0.0	0.0
LnGrp Delay(d),s/veh	9.0	29.9	31.1	15.1	13.7	13.7	28.3	0.0	22.6	20.7	0.0	0.0
LnGrp LOS	A	C	C	B	B	B	C		C	C		
Approach Vol, veh/h		1412			558			355			22	
Approach Delay, s/veh		30.0			13.8			26.7			20.7	
Approach LOS		C			B			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		27.4	9.6	43.0		27.4	9.6	43.0
Change Period (Y+Rc), s		4.0	4.5	4.0		4.0	4.5	4.0
Max Green Setting (Gmax), s		23.4	5.1	39.0		23.4	5.1	39.0
Max Q Clear Time (g_c+I1), s		14.7	2.5	32.3		6.0	2.9	10.1
Green Ext Time (p_c), s		1.0	0.0	5.4		1.4	0.0	16.8

Intersection Summary	
HCM 2010 Ctrl Delay	25.5
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	160	61	190	52	111	36	208	365	28	45	523	224
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1620	1636	1716	1750	1725	1750	1699	1725	1750	1606	1750	1667
Adj Flow Rate, veh/h	208	79	247	87	185	60	242	424	33	55	638	273
Adj No. of Lanes	2	1	1	0	1	0	2	2	0	1	2	1
Peak Hour Factor	0.77	0.77	0.77	0.60	0.60	0.60	0.86	0.86	0.86	0.82	0.82	0.82
Percent Heavy Veh, %	8	7	2	0	0	0	3	1	1	9	0	5
Cap, veh/h	561	307	273	99	210	68	306	1132	88	67	1028	438
Arrive On Green	0.19	0.19	0.19	0.23	0.23	0.23	0.10	0.37	0.37	0.04	0.31	0.31
Sat Flow, veh/h	2994	1636	1458	433	920	298	3139	3083	239	1529	3325	1417
Grp Volume(v), veh/h	208	79	247	332	0	0	242	225	232	55	638	273
Grp Sat Flow(s),veh/h/ln	1497	1636	1458	1651	0	0	1570	1639	1683	1529	1663	1417
Q Serve(g_s), s	6.7	4.5	18.2	21.3	0.0	0.0	8.3	11.0	11.1	3.9	18.0	18.1
Cycle Q Clear(g_c), s	6.7	4.5	18.2	21.3	0.0	0.0	8.3	11.0	11.1	3.9	18.0	18.1
Prop In Lane	1.00		1.00	0.26		0.18	1.00		0.14	1.00		1.00
Lane Grp Cap(c), veh/h	561	307	273	377	0	0	306	602	618	67	1028	438
V/C Ratio(X)	0.37	0.26	0.90	0.88	0.00	0.00	0.79	0.37	0.38	0.82	0.62	0.62
Avail Cap(c_a), veh/h	595	325	290	570	0	0	478	602	618	153	1033	440
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	38.9	38.1	43.6	40.9	0.0	0.0	48.4	25.5	25.5	52.0	32.4	32.4
Incr Delay (d2), s/veh	0.4	0.4	28.6	10.3	0.0	0.0	4.8	1.8	1.7	20.5	1.1	2.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.8	2.1	9.5	10.8	0.0	0.0	3.8	5.3	5.5	2.0	8.4	7.4
LnGrp Delay(d),s/veh	39.3	38.5	72.2	51.2	0.0	0.0	53.2	27.2	27.2	72.6	33.5	35.1
LnGrp LOS	D	D	E	D			D	C	C	E	C	D
Approach Vol, veh/h		534			332			699			966	
Approach Delay, s/veh		54.4			51.2			36.2			36.2	
Approach LOS		D			D			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.8	45.3		25.1	16.2	38.9		29.5
Change Period (Y+Rc), s	5.0	5.0		4.5	5.5	5.0		4.5
Max Green Setting (Gmax), s	11.0	40.3		21.8	16.7	34.1		37.9
Max Q Clear Time (g_c+I1), s	5.9	13.1		20.2	10.3	20.1		23.3
Green Ext Time (p_c), s	0.0	9.5		0.4	0.4	6.9		1.7

Intersection Summary	
HCM 2010 Ctrl Delay	42.0
HCM 2010 LOS	D

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (veh/h)	42	628	58	56	801	52	76	7	56	70	8	63
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1496	1645	1750	1750	1644	1750	1750	1743	1750	1750	1538	1750
Adj Flow Rate, veh/h	43	641	59	58	826	54	85	8	63	74	8	66
Adj No. of Lanes	1	2	0	1	2	0	0	1	0	0	1	0
Peak Hour Factor	0.98	0.98	0.98	0.97	0.97	0.97	0.89	0.89	0.89	0.95	0.95	0.95
Percent Heavy Veh, %	17	7	7	0	6	6	0	0	0	0	0	0
Cap, veh/h	251	1403	129	342	1443	94	364	50	225	305	48	220
Arrive On Green	0.48	0.48	0.48	0.48	0.48	0.48	0.40	0.40	0.40	0.40	0.40	0.40
Sat Flow, veh/h	504	2894	266	698	2977	195	709	127	566	568	120	553
Grp Volume(v), veh/h	43	346	354	58	433	447	156	0	0	148	0	0
Grp Sat Flow(s),veh/h/ln	504	1562	1598	698	1562	1610	1403	0	0	1241	0	0
Q Serve(g_s), s	4.5	9.9	10.0	4.1	13.4	13.4	0.0	0.0	0.0	0.5	0.0	0.0
Cycle Q Clear(g_c), s	18.0	9.9	10.0	14.0	13.4	13.4	4.2	0.0	0.0	4.7	0.0	0.0
Prop In Lane	1.00		0.17	1.00		0.12	0.54		0.40	0.50		0.45
Lane Grp Cap(c), veh/h	251	757	774	342	757	780	639	0	0	573	0	0
V/C Ratio(X)	0.17	0.46	0.46	0.17	0.57	0.57	0.24	0.00	0.00	0.26	0.00	0.00
Avail Cap(c_a), veh/h	340	1035	1058	466	1035	1066	639	0	0	573	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	18.9	11.6	11.6	16.2	12.5	12.5	13.6	0.0	0.0	13.7	0.0	0.0
Incr Delay (d2), s/veh	0.3	0.4	0.4	0.2	0.7	0.7	0.9	0.0	0.0	0.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	4.3	4.4	0.8	5.9	6.1	2.1	0.0	0.0	1.9	0.0	0.0
LnGrp Delay(d),s/veh	19.2	12.0	12.0	16.5	13.2	13.1	14.5	0.0	0.0	14.0	0.0	0.0
LnGrp LOS	B	B	B	B	B	B	B			B		
Approach Vol, veh/h		743			938			156			148	
Approach Delay, s/veh		12.4			13.4			14.5			14.0	
Approach LOS		B			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		31.0		36.9		31.0		36.9
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		27.0		45.0		27.0		45.0
Max Q Clear Time (g_c+I1), s		6.2		20.0		6.7		16.0
Green Ext Time (p_c), s		1.8		13.0		1.8		14.0

Intersection Summary	
HCM 2010 Ctrl Delay	13.1
HCM 2010 LOS	B

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (veh/h)	33	596	154	50	740	33	161	5	49	48	8	62
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1378	1661	1750	1562	1619	1750	1683	1458	1750	1750	1378	1750
Adj Flow Rate, veh/h	35	627	162	59	871	39	196	6	60	70	12	90
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	0	1	0
Peak Hour Factor	0.95	0.95	0.95	0.85	0.85	0.85	0.82	0.82	0.82	0.69	0.69	0.69
Percent Heavy Veh, %	27	6	6	12	6	6	4	20	20	0	0	0
Cap, veh/h	216	962	248	275	1201	54	540	45	446	227	51	228
Arrive On Green	0.03	0.39	0.39	0.05	0.40	0.40	0.39	0.39	0.39	0.39	0.39	0.39
Sat Flow, veh/h	1312	2484	641	1488	2999	134	1163	114	1142	400	131	583
Grp Volume(v), veh/h	35	398	391	59	447	463	196	0	66	172	0	0
Grp Sat Flow(s),veh/h/ln	1312	1578	1548	1488	1538	1595	1163	0	1257	1114	0	0
Q Serve(g_s), s	1.1	14.8	14.9	1.7	17.6	17.6	2.3	0.0	2.4	4.7	0.0	0.0
Cycle Q Clear(g_c), s	1.1	14.8	14.9	1.7	17.6	17.6	10.0	0.0	2.4	7.6	0.0	0.0
Prop In Lane	1.00		0.41	1.00		0.08	1.00		0.91	0.41		0.52
Lane Grp Cap(c), veh/h	216	611	599	275	616	639	540	0	491	506	0	0
V/C Ratio(X)	0.16	0.65	0.65	0.21	0.73	0.73	0.36	0.00	0.13	0.34	0.00	0.00
Avail Cap(c_a), veh/h	271	717	703	347	729	756	540	0	491	506	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	14.4	18.0	18.0	13.6	18.2	18.2	16.5	0.0	14.1	15.6	0.0	0.0
Incr Delay (d2), s/veh	0.3	1.6	1.7	0.4	3.0	2.9	1.9	0.0	0.6	0.4	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	6.7	6.6	0.7	8.0	8.2	3.2	0.0	0.9	2.5	0.0	0.0
LnGrp Delay(d),s/veh	14.7	19.7	19.7	14.0	21.1	21.0	18.3	0.0	14.6	16.0	0.0	0.0
LnGrp LOS	B	B	B	B	C	C	B		B	B		
Approach Vol, veh/h		824			969			262			172	
Approach Delay, s/veh		19.5			20.7			17.4			16.0	
Approach LOS		B			C			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		32.0	8.0	31.8		32.0	7.0	32.7
Change Period (Y+Rc), s		4.0	4.5	4.0		4.0	4.5	4.0
Max Green Setting (Gmax), s		28.0	6.9	32.6		28.0	5.5	34.0
Max Q Clear Time (g_c+I1), s		12.0	3.7	16.9		9.6	3.1	19.6
Green Ext Time (p_c), s		2.0	0.0	9.7		2.1	0.0	9.1

Intersection Summary	
HCM 2010 Ctrl Delay	19.5
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	396	123	267	42	99	78	345	532	46	76	501	205
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1549	1636	1716	1750	1625	1750	1699	1734	1750	1535	1699	1496
Adj Flow Rate, veh/h	455	141	307	56	132	104	416	641	55	84	557	228
Adj No. of Lanes	2	1	1	0	1	0	2	2	0	1	2	1
Peak Hour Factor	0.87	0.87	0.87	0.75	0.75	0.75	0.83	0.83	0.83	0.90	0.90	0.90
Percent Heavy Veh, %	13	7	2	6	6	6	3	1	1	14	3	17
Cap, veh/h	581	332	296	70	165	130	542	975	84	135	753	296
Arrive On Green	0.20	0.20	0.20	0.24	0.24	0.24	0.17	0.32	0.32	0.09	0.23	0.23
Sat Flow, veh/h	2861	1636	1458	291	685	540	3139	3072	263	1462	3228	1271
Grp Volume(v), veh/h	455	141	307	292	0	0	416	343	353	84	557	228
Grp Sat Flow(s),veh/h/ln	1431	1636	1458	1515	0	0	1570	1647	1688	1462	1614	1271
Q Serve(g_s), s	19.6	9.8	26.5	23.6	0.0	0.0	16.5	23.4	23.5	7.2	20.9	21.9
Cycle Q Clear(g_c), s	19.6	9.8	26.5	23.6	0.0	0.0	16.5	23.4	23.5	7.2	20.9	21.9
Prop In Lane	1.00		1.00	0.19		0.36	1.00		0.16	1.00		1.00
Lane Grp Cap(c), veh/h	581	332	296	366	0	0	542	523	536	135	753	296
V/C Ratio(X)	0.78	0.42	1.04	0.80	0.00	0.00	0.77	0.66	0.66	0.62	0.74	0.77
Avail Cap(c_a), veh/h	581	332	296	366	0	0	542	523	536	135	753	296
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	49.2	45.3	51.9	46.5	0.0	0.0	51.5	38.4	38.4	57.0	46.3	46.7
Incr Delay (d2), s/veh	10.1	3.9	61.9	16.4	0.0	0.0	10.0	6.3	6.2	19.9	6.5	17.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.6	4.8	15.8	11.6	0.0	0.0	7.9	11.6	11.9	3.7	10.0	9.1
LnGrp Delay(d),s/veh	59.3	49.2	113.8	62.9	0.0	0.0	61.5	44.7	44.6	76.9	52.8	64.1
LnGrp LOS	E	D	F	E			E	D	D	E	D	E
Approach Vol, veh/h		903			292			1112			869	
Approach Delay, s/veh		76.3			62.9			51.0			58.1	
Approach LOS		E			E			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	17.0	46.4		31.0	28.0	35.4		36.0
Change Period (Y+Rc), s	5.0	5.0		4.5	5.5	5.0		4.5
Max Green Setting (Gmax), s	12.0	41.4		26.5	22.5	30.4		31.5
Max Q Clear Time (g_c+I1), s	9.2	25.5		28.5	18.5	23.9		25.6
Green Ext Time (p_c), s	1.3	3.9		0.0	0.6	2.6		0.8

Intersection Summary	
HCM 2010 Ctrl Delay	61.2
HCM 2010 LOS	E

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (veh/h)	40	1284	65	33	767	38	58	1	81	62	0	85
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1552	1766	1800	1800	1750	1800	1800	1765	1800	1800	1698	1800
Adj Flow Rate, veh/h	55	1759	89	40	924	46	72	1	101	91	0	125
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.73	0.73	0.73	0.83	0.83	0.83	0.80	0.80	0.80	0.68	0.68	0.68
Percent Heavy Veh, %	16	2	2	0	3	3	0	0	0	0	0	0
Cap, veh/h	65	1613	81	61	1656	82	316	3	284	345	0	291
Arrive On Green	0.04	0.52	0.52	0.04	0.51	0.51	0.05	0.19	0.19	0.06	0.00	0.20
Sat Flow, veh/h	1478	3086	155	1714	3224	160	1714	15	1488	1714	0	1443
Grp Volume(v), veh/h	55	951	897	40	477	493	72	0	102	91	0	125
Grp Sat Flow(s),veh/h/ln	1478	1678	1562	1714	1662	1722	1714	0	1502	1714	0	1443
Q Serve(g_s), s	3.3	46.0	46.0	2.0	17.2	17.2	2.9	0.0	5.2	3.7	0.0	6.7
Cycle Q Clear(g_c), s	3.3	46.0	46.0	2.0	17.2	17.2	2.9	0.0	5.2	3.7	0.0	6.7
Prop In Lane	1.00		0.10	1.00		0.09	1.00		0.99	1.00		1.00
Lane Grp Cap(c), veh/h	65	877	817	61	854	885	316	0	287	345	0	291
V/C Ratio(X)	0.84	1.08	1.10	0.66	0.56	0.56	0.23	0.00	0.36	0.26	0.00	0.43
Avail Cap(c_a), veh/h	141	877	817	99	854	885	335	0	287	345	0	291
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	41.7	21.0	21.0	41.9	14.6	14.6	26.9	0.0	30.9	26.4	0.0	30.7
Incr Delay (d2), s/veh	23.5	55.7	62.1	11.5	0.8	0.8	0.4	0.0	3.4	0.4	0.0	1.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.8	34.8	33.8	1.1	8.0	8.3	1.4	0.0	2.4	1.8	0.0	2.7
LnGrp Delay(d),s/veh	65.3	76.7	83.1	53.4	15.4	15.4	27.2	0.0	34.3	26.8	0.0	31.7
LnGrp LOS	E	F	F	D	B	B	C		C	C		C
Approach Vol, veh/h		1903			1010			174			216	
Approach Delay, s/veh		79.4			16.9			31.4			29.6	
Approach LOS		E			B			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.6	20.8	7.6	50.0	8.6	21.7	8.4	49.2
Change Period (Y+Rc), s	4.5	4.0	4.5	4.0	4.5	4.0	4.5	4.0
Max Green Setting (Gmax), s	5.1	16.8	5.1	46.0	5.1	16.8	8.4	42.7
Max Q Clear Time (g_c+I1), s	5.7	7.2	4.0	48.0	4.9	8.7	5.3	19.2
Green Ext Time (p_c), s	0.0	0.9	0.0	0.0	0.0	0.8	0.0	19.4

Intersection Summary	
HCM 2010 Ctrl Delay	54.5
HCM 2010 LOS	D

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (veh/h)	34	1092	287	29	619	35	202	4	72	8	0	11
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1522	1733	1750	1750	1685	1750	1750	1718	1750	1357	1067	1750
Adj Flow Rate, veh/h	44	1418	373	31	659	37	337	7	120	13	0	18
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.77	0.77	0.77	0.94	0.94	0.94	0.60	0.60	0.60	0.62	0.62	0.62
Percent Heavy Veh, %	15	1	1	0	3	3	0	0	0	29	0	0
Cap, veh/h	390	1425	363	133	1668	94	427	23	388	275	0	253
Arrive On Green	0.04	0.55	0.55	0.03	0.54	0.54	0.28	0.28	0.28	0.28	0.00	0.28
Sat Flow, veh/h	1449	2599	663	1667	3083	173	1305	81	1391	916	0	907
Grp Volume(v), veh/h	44	882	909	31	342	354	337	0	127	13	0	18
Grp Sat Flow(s),veh/h/ln	1449	1646	1616	1667	1601	1655	1305	0	1472	916	0	907
Q Serve(g_s), s	1.2	45.6	48.0	0.7	10.9	10.9	22.4	0.0	6.0	1.0	0.0	1.3
Cycle Q Clear(g_c), s	1.2	45.6	48.0	0.7	10.9	10.9	23.7	0.0	6.0	7.0	0.0	1.3
Prop In Lane	1.00		0.41	1.00		0.10	1.00		0.94	1.00		1.00
Lane Grp Cap(c), veh/h	390	902	886	133	866	895	427	0	410	275	0	253
V/C Ratio(X)	0.11	0.98	1.03	0.23	0.39	0.40	0.79	0.00	0.31	0.05	0.00	0.07
Avail Cap(c_a), veh/h	420	902	886	179	878	907	427	0	410	275	0	253
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	8.8	19.2	19.8	21.0	11.7	11.7	32.0	0.0	24.9	27.7	0.0	23.2
Incr Delay (d2), s/veh	0.1	24.4	37.1	0.9	0.3	0.3	13.8	0.0	2.0	0.1	0.0	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	26.7	30.3	0.4	4.8	5.0	9.7	0.0	2.7	0.3	0.0	0.3
LnGrp Delay(d),s/veh	8.9	43.7	56.9	21.9	12.0	12.0	45.8	0.0	26.9	27.7	0.0	23.4
LnGrp LOS	A	D	F	C	B	B	D		C	C		C
Approach Vol, veh/h		1835			727			464			31	
Approach Delay, s/veh		49.4			12.4			40.6			25.2	
Approach LOS		D			B			D			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		28.4	7.1	52.0		28.4	7.8	51.4
Change Period (Y+Rc), s		4.0	4.5	4.0		4.0	4.5	4.0
Max Green Setting (Gmax), s		24.4	5.1	48.0		24.4	5.1	48.0
Max Q Clear Time (g_c+I1), s		25.7	2.7	50.0		9.0	3.2	12.9
Green Ext Time (p_c), s		0.0	0.0	0.0		1.9	0.0	26.2

Intersection Summary	
HCM 2010 Ctrl Delay	39.0
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	208	79	247	68	144	47	270	475	36	59	680	291
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1759	1776	1863	1900	1900	1759	1845	1873	1900	1743	1900	1810
Adj Flow Rate, veh/h	270	103	321	113	240	78	314	552	42	72	829	355
Adj No. of Lanes	2	1	1	1	1	1	2	2	0	1	2	1
Peak Hour Factor	0.77	0.77	0.77	0.60	0.60	0.60	0.86	0.86	0.86	0.82	0.82	0.82
Percent Heavy Veh, %	8	7	2	0	0	8	3	1	1	9	0	5
Cap, veh/h	728	409	365	431	396	312	408	1181	90	91	1011	431
Arrive On Green	0.10	0.23	0.23	0.08	0.21	0.21	0.12	0.35	0.35	0.05	0.28	0.28
Sat Flow, veh/h	3250	1776	1583	1810	1900	1495	3408	3353	255	1660	3610	1538
Grp Volume(v), veh/h	270	103	321	113	240	78	314	292	302	72	829	355
Grp Sat Flow(s),veh/h/ln	1625	1776	1583	1810	1900	1495	1704	1780	1828	1660	1805	1538
Q Serve(g_s), s	4.2	3.2	13.2	3.2	7.7	2.9	6.0	8.6	8.6	2.9	14.4	14.5
Cycle Q Clear(g_c), s	4.2	3.2	13.2	3.2	7.7	2.9	6.0	8.6	8.6	2.9	14.4	14.5
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.14	1.00		1.00
Lane Grp Cap(c), veh/h	728	409	365	431	396	312	408	627	644	91	1011	431
V/C Ratio(X)	0.37	0.25	0.88	0.26	0.61	0.25	0.77	0.47	0.47	0.79	0.82	0.82
Avail Cap(c_a), veh/h	1169	422	377	717	452	356	431	627	644	148	1073	457
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	18.0	21.1	25.0	18.2	24.1	22.2	28.7	16.9	16.9	31.4	22.6	22.7
Incr Delay (d2), s/veh	0.3	0.3	20.1	0.3	1.8	0.4	7.9	2.5	2.4	13.9	4.9	11.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.9	1.6	7.7	1.6	4.2	1.2	3.3	4.6	4.8	1.7	7.8	7.5
LnGrp Delay(d),s/veh	18.3	21.5	45.1	18.5	26.0	22.7	36.6	19.4	19.3	45.3	27.5	33.8
LnGrp LOS	B	C	D	B	C	C	D	B	B	D	C	C
Approach Vol, veh/h		694			431			908			1256	
Approach Delay, s/veh		31.2			23.4			25.3			30.3	
Approach LOS		C			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.7	28.7	9.9	20.0	13.5	23.8	11.4	18.5
Change Period (Y+Rc), s	5.0	5.0	4.5	4.5	5.5	5.0	4.5	4.5
Max Green Setting (Gmax), s	6.0	23.0	16.0	16.0	8.5	20.0	16.0	16.0
Max Q Clear Time (g_c+I1), s	4.9	10.6	5.2	15.2	8.0	16.5	6.2	9.7
Green Ext Time (p_c), s	0.0	7.5	0.2	0.4	0.1	2.3	0.7	2.0

Intersection Summary	
HCM 2010 Ctrl Delay	28.2
HCM 2010 LOS	C

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (veh/h)	55	816	75	73	1041	68	87	8	64	137	17	126
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1538	1692	1800	1800	1691	1800	1800	1784	1800	1513	1590	1800
Adj Flow Rate, veh/h	56	833	77	75	1073	70	98	9	72	144	18	133
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.98	0.98	0.98	0.97	0.97	0.97	0.89	0.89	0.89	0.95	0.95	0.95
Percent Heavy Veh, %	17	7	7	0	6	6	0	0	0	19	0	0
Cap, veh/h	151	1221	113	220	1257	82	433	43	346	213	24	179
Arrive On Green	0.41	0.41	0.41	0.41	0.41	0.41	0.25	0.25	0.25	0.15	0.15	0.15
Sat Flow, veh/h	405	2975	275	590	3063	200	1714	171	1371	1441	164	1212
Grp Volume(v), veh/h	56	450	460	75	563	580	98	0	81	144	0	151
Grp Sat Flow(s),veh/h/ln	405	1607	1643	590	1607	1656	1714	0	1542	1441	0	1376
Q Serve(g_s), s	5.8	14.5	14.5	7.6	20.1	20.2	2.9	0.0	2.6	6.0	0.0	6.7
Cycle Q Clear(g_c), s	26.0	14.5	14.5	22.1	20.1	20.2	2.9	0.0	2.6	6.0	0.0	6.7
Prop In Lane	1.00		0.17	1.00		0.12	1.00		0.89	1.00		0.88
Lane Grp Cap(c), veh/h	151	659	674	220	659	679	433	0	389	213	0	203
V/C Ratio(X)	0.37	0.68	0.68	0.34	0.85	0.85	0.23	0.00	0.21	0.68	0.00	0.74
Avail Cap(c_a), veh/h	151	659	674	220	659	679	433	0	389	364	0	347
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	29.7	15.3	15.3	24.4	17.0	17.0	18.8	0.0	18.7	25.6	0.0	25.8
Incr Delay (d2), s/veh	1.5	2.9	2.8	0.9	10.6	10.3	1.2	0.0	1.2	3.7	0.0	5.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.0	6.9	7.0	1.3	10.8	11.1	1.5	0.0	1.2	2.6	0.0	2.8
LnGrp Delay(d),s/veh	31.3	18.2	18.1	25.3	27.5	27.3	20.0	0.0	19.9	29.3	0.0	31.1
LnGrp LOS	C	B	B	C	C	C	B		B	C		C
Approach Vol, veh/h		966			1218			179			295	
Approach Delay, s/veh		18.9			27.3			19.9			30.2	
Approach LOS		B			C			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		20.0		30.0		13.4		30.0
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		16.0		26.0		16.0		26.0
Max Q Clear Time (g_c+I1), s		4.9		28.0		8.7		24.1
Green Ext Time (p_c), s		0.5		0.0		0.8		1.7

Intersection Summary	
HCM 2010 Ctrl Delay	24.1
HCM 2010 LOS	C

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (veh/h)	43	775	200	65	962	43	209	7	64	70	8	84
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1417	1708	1800	1607	1665	1800	1731	1500	1800	1161	1277	1800
Adj Flow Rate, veh/h	45	816	211	76	1132	51	255	9	78	101	12	122
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.85	0.85	0.85	0.82	0.82	0.82	0.69	0.69	0.69
Percent Heavy Veh, %	27	6	6	12	6	6	4	20	20	55	0	0
Cap, veh/h	232	1098	284	297	1378	62	347	39	335	320	28	289
Arrive On Green	0.04	0.43	0.43	0.06	0.45	0.45	0.29	0.29	0.29	0.29	0.29	0.29
Sat Flow, veh/h	1350	2554	660	1531	3083	139	1162	134	1161	814	99	1002
Grp Volume(v), veh/h	45	518	509	76	581	602	255	0	87	101	0	134
Grp Sat Flow(s),veh/h/ln	1350	1623	1592	1531	1582	1640	1162	0	1295	814	0	1100
Q Serve(g_s), s	1.0	15.2	15.2	1.5	18.2	18.3	10.8	0.0	2.9	6.1	0.0	5.6
Cycle Q Clear(g_c), s	1.0	15.2	15.2	1.5	18.2	18.3	16.4	0.0	2.9	9.1	0.0	5.6
Prop In Lane	1.00		0.41	1.00		0.08	1.00		0.90	1.00		0.91
Lane Grp Cap(c), veh/h	232	698	684	297	707	733	347	0	374	320	0	317
V/C Ratio(X)	0.19	0.74	0.74	0.26	0.82	0.82	0.73	0.00	0.23	0.32	0.00	0.42
Avail Cap(c_a), veh/h	293	737	722	346	724	750	347	0	374	320	0	317
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	11.1	13.6	13.6	10.2	13.7	13.7	23.8	0.0	15.4	18.9	0.0	16.4
Incr Delay (d2), s/veh	0.4	3.9	3.9	0.4	7.4	7.2	12.9	0.0	1.5	0.6	0.0	0.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	7.5	7.4	0.6	9.4	9.7	5.1	0.0	1.2	1.4	0.0	1.8
LnGrp Delay(d),s/veh	11.5	17.4	17.5	10.6	21.1	20.9	36.7	0.0	16.9	19.4	0.0	17.3
LnGrp LOS	B	B	B	B	C	C	D		B	B		B
Approach Vol, veh/h		1072			1259			342			235	
Approach Delay, s/veh		17.2			20.4			31.6			18.2	
Approach LOS		B			C			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		20.4	8.0	28.4		20.4	7.0	29.4
Change Period (Y+Rc), s		4.0	4.5	4.0		4.0	4.5	4.0
Max Green Setting (Gmax), s		16.4	5.3	25.8		16.4	5.1	26.0
Max Q Clear Time (g_c+I1), s		18.4	3.5	17.2		11.1	3.0	20.3
Green Ext Time (p_c), s		0.0	0.0	7.2		1.5	0.0	5.0

Intersection Summary	
HCM 2010 Ctrl Delay	20.4
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	515	160	347	55	129	101	449	692	60	99	651	267
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1593	1682	1765	1800	1698	1579	1748	1784	1800	1579	1748	1538
Adj Flow Rate, veh/h	592	184	399	73	172	135	541	834	72	110	723	297
Adj No. of Lanes	2	1	1	1	1	1	2	2	0	1	2	1
Peak Hour Factor	0.87	0.87	0.87	0.75	0.75	0.75	0.83	0.83	0.83	0.90	0.90	0.90
Percent Heavy Veh, %	13	7	2	0	6	14	3	1	1	14	3	17
Cap, veh/h	792	437	390	297	223	176	625	1103	95	142	831	327
Arrive On Green	0.19	0.26	0.26	0.06	0.13	0.13	0.19	0.35	0.35	0.09	0.25	0.25
Sat Flow, veh/h	2943	1682	1500	1714	1698	1342	3229	3157	273	1504	3320	1308
Grp Volume(v), veh/h	592	184	399	73	172	135	541	448	458	110	723	297
Grp Sat Flow(s),veh/h/ln	1472	1682	1500	1714	1698	1342	1614	1694	1735	1504	1660	1308
Q Serve(g_s), s	13.7	7.5	12.4	3.0	8.1	6.1	13.5	19.4	19.4	5.9	17.3	10.9
Cycle Q Clear(g_c), s	13.7	7.5	12.4	3.0	8.1	6.1	13.5	19.4	19.4	5.9	17.3	10.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.16	1.00		1.00
Lane Grp Cap(c), veh/h	792	437	390	297	223	176	625	592	607	142	831	327
V/C Ratio(X)	0.75	0.42	1.02	0.25	0.77	0.77	0.87	0.76	0.76	0.78	0.87	0.91
Avail Cap(c_a), veh/h	800	437	390	522	327	259	642	592	607	181	880	347
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	23.1	25.5	10.2	28.3	34.9	19.7	32.4	23.9	23.9	36.7	29.8	10.6
Incr Delay (d2), s/veh	3.9	0.6	51.6	0.4	6.6	7.9	11.7	8.7	8.5	14.7	9.0	25.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.9	3.6	10.7	1.4	4.2	2.6	7.0	10.5	10.7	3.1	9.0	6.2
LnGrp Delay(d),s/veh	27.0	26.2	61.8	28.7	41.5	27.6	44.1	32.6	32.4	51.4	38.9	36.5
LnGrp LOS	C	C	F	C	D	C	D	C	C	D	D	D
Approach Vol, veh/h		1175			380			1447			1130	
Approach Delay, s/veh		38.7			34.1			36.8			39.4	
Approach LOS		D			C			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	13.3	34.0	9.6	26.1	21.6	25.8	20.3	15.4
Change Period (Y+Rc), s	5.5	* 5	4.5	4.5	5.5	5.0	4.5	4.5
Max Green Setting (Gmax), s	10.0	* 29	16.0	16.0	16.5	22.0	16.0	16.0
Max Q Clear Time (g_c+I1), s	7.9	21.4	5.0	14.4	15.5	19.3	15.7	10.1
Green Ext Time (p_c), s	0.6	3.1	0.1	0.7	0.3	1.4	0.1	0.7

Intersection Summary	
HCM 2010 Ctrl Delay	37.8
HCM 2010 LOS	D

Notes

* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

Appendix C

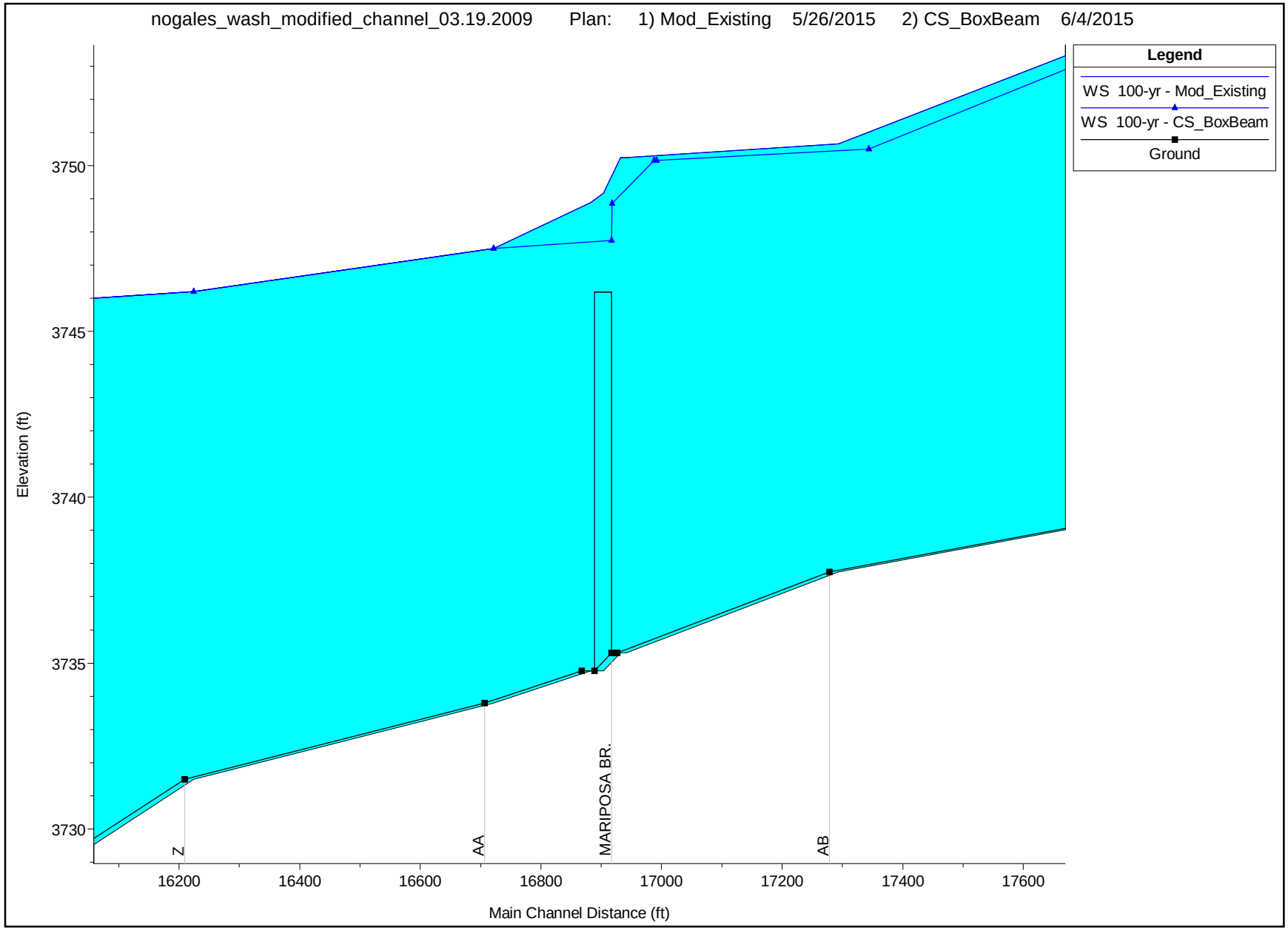
Drainage Support

CALLE SONORA WSEL COMPARISON

HEC-RAS Locations: User Defined Profile: 100-yr

River	Reach	River Sta	Profile	Plan	Vel Total	W.S. Elev
					(ft/s)	(ft)
Nogales Wash	1	7.204	100-yr	CS_BB_BO	5.85	3749.97
Nogales Wash	1	7.198 BR U	100-yr	Mod_Existing	6.31	3750.25
Nogales Wash	1	7.198 BR U	100-yr	CS_BB_BO	6.67	3749.97
Nogales Wash	1	7.198 BR D	100-yr	Mod_Existing	6.34	3749.17
Nogales Wash	1	7.198 BR D	100-yr	CS_BB_BO	6.02	3748.66
Nogales Wash	1	7.187	100-yr	CS_BB_BO	8.65	3747.74

CALLE SONORA WSEL COMPARISON

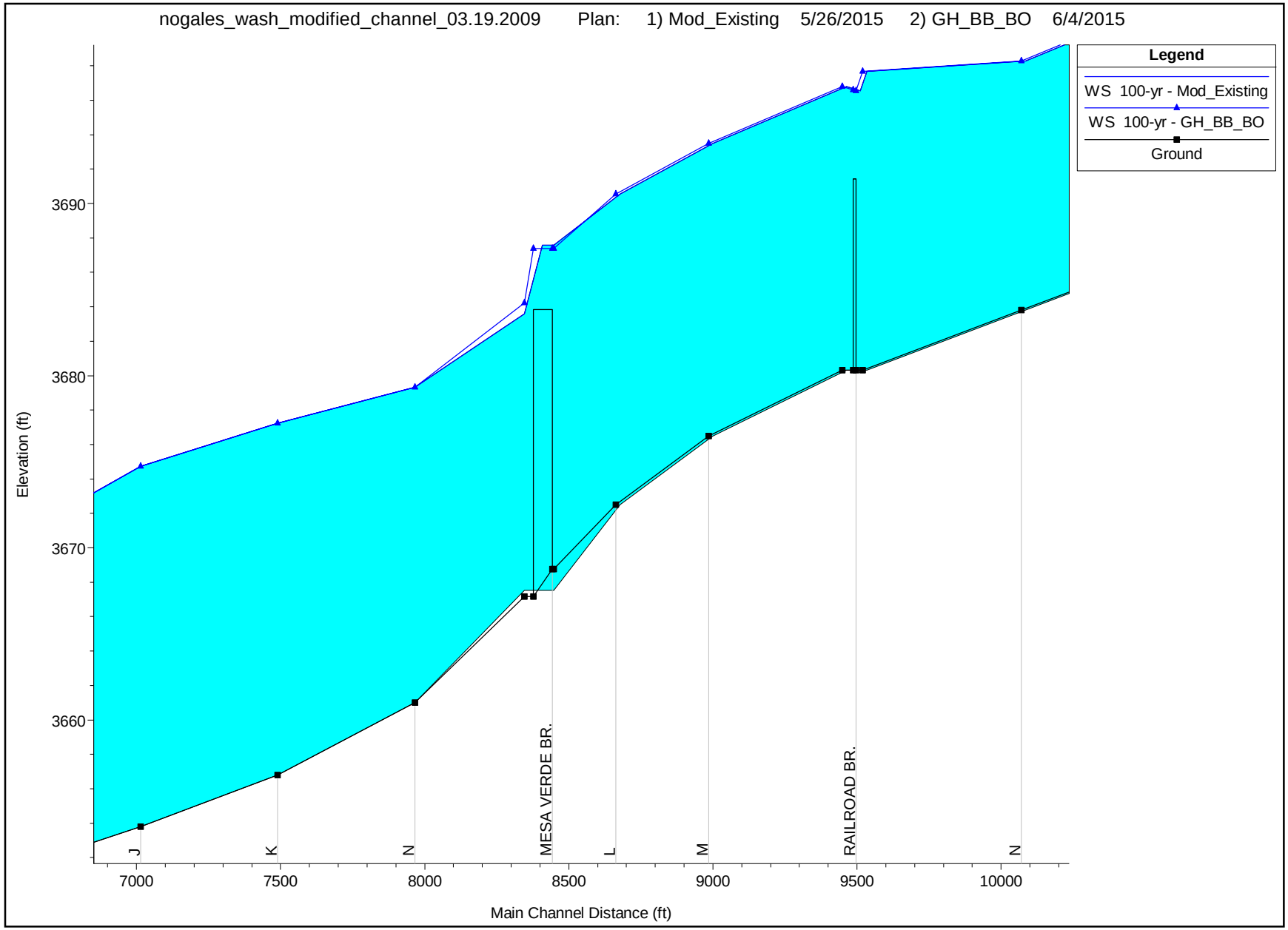


GOLD HILL RD WSEL COMPARISON

HEC-RAS Locations: User Defined Profile: 100-yr

River	Reach	River Sta	Profile	Plan	Vel Total	W.S. Elev
					(ft/s)	(ft)
Nogales Wash	1	5.594	100-yr	GH_BB_BO	9.66	3687.38
Nogales Wash	1	5.58 BR U	100-yr	Mod_Existing	9.34	3687.57
Nogales Wash	1	5.58 BR U	100-yr	GH_BB_BO	9.41	3687.38
Nogales Wash	1	5.58 BR D	100-yr	Mod_Existing	10.29	3687.57
Nogales Wash	1	5.58 BR D	100-yr	GH_BB_BO	9.03	3687.38
Nogales Wash	1	5.572	100-yr	Mod_Existing	14.43	3683.60
Nogales Wash	1	5.572	100-yr	GH_BB_BO	12.58	3684.21

GOLD HILL RD WSEL COMPARISON

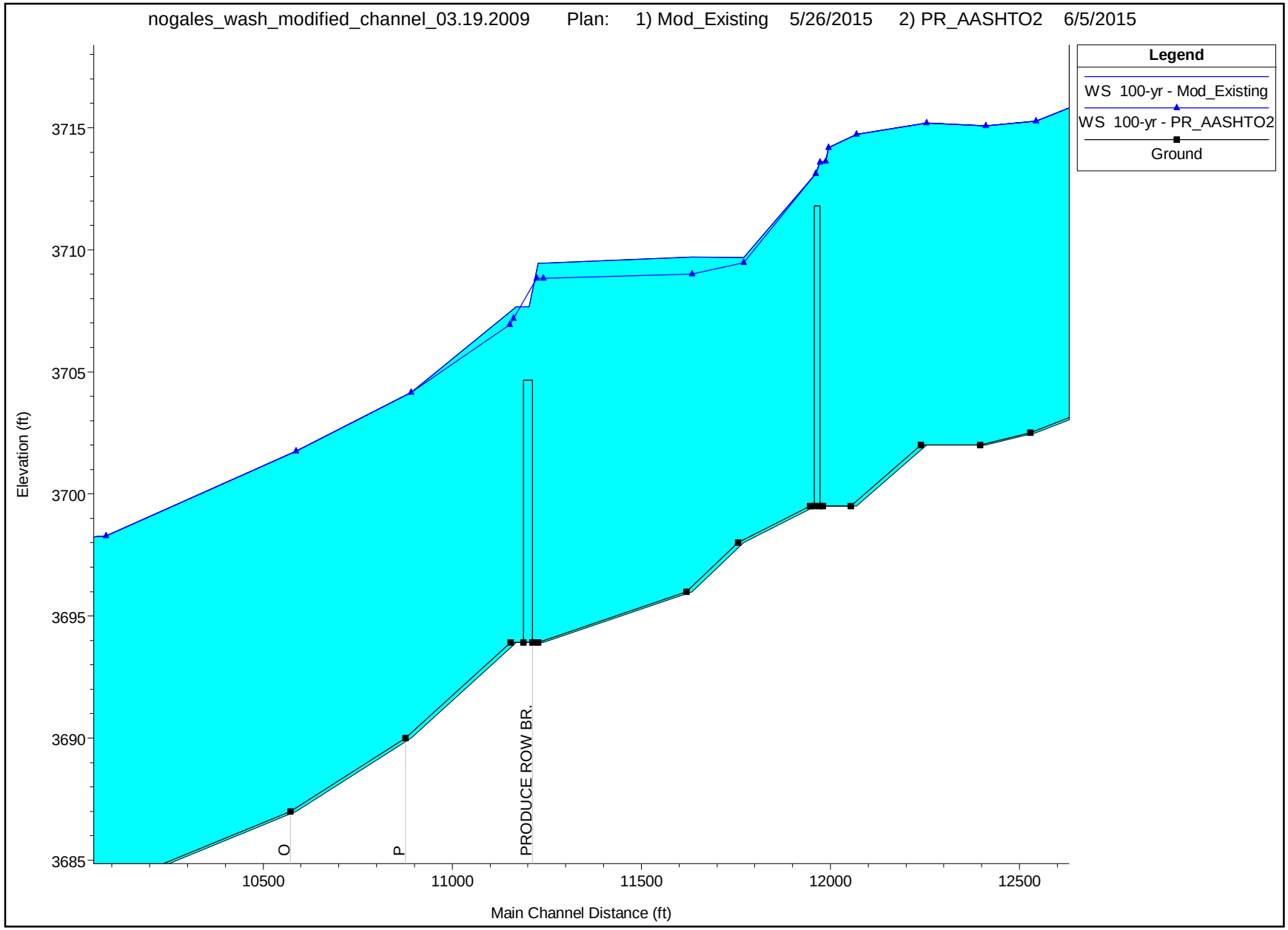


PRODUCE ROW WSEL COMPARISON

HEC-RAS Locations: User Defined Profile: 100-yr

River	Reach	River Sta	Profile	Plan	Vel Total	W.S. Elev
					(ft/s)	(ft)
Nogales Wash	1	6.12	100-yr	Mod_Existing	5.47	3709.45
Nogales Wash	1	6.12	100-yr	PR_AASHTO2_BO	5.58	3708.80
Nogales Wash	1	6.113 BR U	100-yr	Mod_Existing	5.89	3709.45
Nogales Wash	1	6.113 BR U	100-yr	PR_AASHTO2_BO	5.97	3708.80
Nogales Wash	1	6.113 BR D	100-yr	Mod_Existing	5.43	3707.67
Nogales Wash	1	6.113 BR D	100-yr	PR_AASHTO2_BO	5.45	3707.11
Nogales Wash	1	6.104	100-yr	PR_AASHTO2_BO	9.40	3706.93

PRODUCE ROW WSEL COMPARISON



EQUATION 6.3, Standards Manual for Drainage Design and Floodplain Management

Nogales Wash - Calle Sonora Bridge

Z_t = Design scour depth, excluding long-term aggradation/degradation, in feet;
Z_{gs} = General scour depth, in feet;
Z_a = Anti-dune trough depth, in feet;
Z_{ls} = Local scour depth, in feet;
Z_{bs} = Bend scour depth, in feet;
Z_{lft} = Low-flow thalweg depth, in feet;

Z_t = $1.3*(Z_{gs} + 1/2Z_a + Z_{ls} + Z_{bs} + Z_{lft})$

Z_{gs} =	4.7	ft
Z_a =	2.5	ft
Z_{lsp} =	9.9	ft
Z_{lse}	0.0	
Z_{bs} =	0.0	ft
Z_{lft} =	2.0	ft
Z_{lss} =	0.0	

Z_t = 23.2 ft

EQUATION 6.4, Standards Manual for Drainage Design
and Floodplain Management

Z_{gs} = General scour depth, in feet;
V_m = Average velocity of flow, in feet per second;
Y_{max} = Maximum depth of flow, in feet;
Y_h = Hydraulic depth of flow, in feet;
S_e = Energy slope (or bed slope for uniform-flow conditions), in feet per foot

$$Z_{gs} = Y_{max}\left[(0.0685V_m^{0.8}/Y_h^{0.4}S_e^{0.3})-1\right]$$

V_m =	13.52	fps
Y_{max} =	12.59	ft
Y_h =	12.59	ft
S_e =	0.001631	ft/ft

Z_{gs} = 4.658 ft

****Hydraulics from XS 7.204**

EQUATION 6.5, Standards Manual for Drainage Design and Floodplain Management

Z_a = Anti-dune trough depth, in feet;
V_m = Average velocity of flow, in feet per second;
g = Acceleration due to gravity, in feet per second squared;

Z_a = **$0.5(0.14)2¶V_m^2/g = 0.0137V_m^2$**

V_m = 13.52 fps
g = 32.2 ft/sec^2

Z_a = 2.50 ft

****Hydraulics from XS 7.204**

Section 6.6.3, Standards Manual for Drainage Design and Floodplain Management

Z_{lft} = Low flow thalweg depth, in feet;
Y = Flow depth; in feet;
W = Flow width; in feet;
V_m = Average Velocity of flow, in feet per second;

Z_{lft} = **1' when W/Y>1.15V_m**

V_m =	13.52	fps			**Regional or Non-Regi**
W =	1726.49	ft	**Z_{lft} =**	2.00 ft	Regional
Y =	12.6	ft			
W/Y =	137.1				
1.15V_m =	15.5				

****Hydraulics from XS 7.204**

Section 6.6.4, Standards Manual for Drainage Design and Floodplain Management

Z_{lft} = Bend scour component, in feet;
V_m = Average velocity of flow, in feet per second;
Y_{max} = Maximum depth of flow immediately upstream of bend, in feet;
Y_h = Hydraulic depth of flow immediately upstream of bend, in feet;
S_e = Energy slope (or bed slope for uniform-flow conditions), in feet per foot
α = Angle between centerline of channel and outside bend tangent line, in degrees

$Z_{bs} = \left(0.0685 Y_{max} V_m^{0.8} / Y_h^{0.4} S_e^{0.3}\right)\left[2.1(\sin^2(\alpha/2)/\cos\alpha)^{0.2} - 1\right]$

V_m =	13.52	fps
Y_{max} =	12.59	ft
Y_h =	12.59	ft
S_e =	0.001631	ft/ft
α =	0	degrees
α =	0.00	radians

Z_{bs} = 0.00 ft

**Hydraulics from XS 7.204

Section 6.6.5, Standards Manual for Drainage Design and Floodplain Management

Z_{lsp} = Local scour due to piers, in feet
Y = Flow depth, in feet
b_p = Pier width normal to flow direction, in feet
F_u = Upstream Froude number
R_f = Reduction Factor (Table 6.1)

Z_{lsp} = $\mathbf{2.2\ R_f\ Y\ [(b_p/Y)^{0.65}]\ F_u^{0.43}}$

b_{pe} = Effective pier width, in feet
L = Length of pier wall, in feet
$\emptyset_p$ = Angle of approach flow in relationship to pier wall, in degrees

b_{pe} = $\mathbf{L \sin \emptyset_p + b_p \cos \emptyset_p}$

Y =	13.82	ft
b_p =	5	ft
F_u =	0.44	
R_f =	0.9	
b_{pe} =	5.00	
L =	69.75	
$\emptyset_p$ =	0	degrees
$\emptyset_p$ =	0.00	radians

Z_{lsp} = 9.93 ft

****Hydraulics from downstream Internal Bridge Cross-Section**

EQUATION 6.3, Standards Manual for Drainage Design and Floodplain Management

Nogales Wash - Calle Sonora Bridge 10-Year

Z_t = Design scour depth, excluding long-term aggradation/degradation, in feet;
Z_{gs} = General scour depth, in feet;
Z_a = Anti-dune trough depth, in feet;
Z_{ls} = Local scour depth, in feet;
Z_{bs} = Bend scour depth, in feet;
Z_{lft} = Low-flow thalweg depth, in feet;

Z_t = $1.3*(Z_{gs} + 1/2Z_a + Z_{ls} + Z_{bs} + Z_{lft})$

Z_{gs} =	0.0	ft
Z_a =	0.4	ft
Z_{lsp} =	9.9	ft
Z_{lse}	0.0	
Z_{bs} =	0.0	ft
Z_{lft} =	2.0	ft
Z_{lss} =	0.0	

Z_t = 15.8 ft

EQUATION 6.4, Standards Manual for Drainage Design and Floodplain Management

Nogales W General scour depth, in feet;
V_m = Average velocity of flow, in feet per second;
Y_{max} = Maximum depth of flow, in feet;
Y_h = Hydraulic depth of flow, in feet;
S_e = Energy slope (or bed slope for uniform-flow conditions), in feet per foot

$$Z_{gs} = Y_{max}\left[(0.0685V_m^{0.8}/Y_h^{0.4}S_e^{0.3})-1\right]$$

V_m =	5.3	fps
Y_{max} =	9.5	ft
Y_h =	9.5	ft
S_e =	0.000667	ft/ft

Z_{gs} = 0.000 ft

****Hydraulics from XS 7.204**

EQUATION 6.5, Standards Manual for Drainage Design and Floodplain Management

Nogales W Anti-dune trough depth, in feet;
V_m = Average velocity of flow, in feet per second;
g = Acceleration due to gravity, in feet per second squared;

Z_a = **$0.5(0.14)2¶V_m^2/g = 0.0137V_m^2$**

V_m = 5.3 fps
g = 32.2 ft/sec^2

Z_a = 0.38 ft

****Hydraulics from XS 7.204**

Section 6.6.3, Standards Manual for Drainage Design and Floodplain Management

Nogales W Low flow thalweg depth, in feet;
Y = Flow depth; in feet;
W = Flow width; in feet;
V_m = Average Velocity of flow, in feet per second;

Z_{lft} = **1' when W/Y>1.15V_m**

V_m =	5.3	fps			**Regional or Non-Regi**
W =	1726.49	ft	**Z_{lft} =**	2.00 ft	Regional
Y =	9.5	ft			
W/Y =	181.7				
1.15V_m =	6.1				

****Hydraulics from XS 7.204**

Section 6.6.4, Standards Manual for Drainage Design and Floodplain Management

Nogales W Bend scour component, in feet;

V_m = Average velocity of flow, in feet per second;

Y_{max} = Maximum depth of flow immediately upstream of bend, in feet;

Y_h = Hydraulic depth of flow immediately upstream of bend, in feet;

S_e = Energy slope (or bed slope for uniform-flow conditions), in feet per foot

α = Angle between centerline of channel and outside bend tangent line, in degrees

$$Z_{bs} = \left(0.0685 Y_{max} V_m^{0.8} / Y_h^{0.4} S_e^{0.3}\right)\left[2.1(\sin^2(\alpha/2)/\cos\alpha)^{0.2} - 1\right]$$

V_m =	5.3	fps
Y_{max} =	9.5	ft
Y_h =	9.5	ft
S_e =	0.000667	ft/ft
α =	0	degrees
α =	0.00	radians

Z_{bs} = 0.00 ft

**Hydraulics from XS 7.204

Section 6.6.5, Standards Manual for Drainage Design and Floodplain Management

Nogales W Local scour due to piers, in feet

Y = Flow depth, in feet

b_p = Pier width normal to flow direction, in feet

F_u = Upstream Froude number

R_f = Reduction Factor (Table 6.1)

Z_{lsp} = $\mathbf{2.2\ R_f\ Y\ [(b_p/Y)^{0.65}]\ F_u^{0.43}}$

b_{pe} = Effective pier width, in feet

L = Length of pier wall, in feet

$\emptyset_p$ = Angle of approach flow in relationship to pier wall, in degrees

b_{pe} = $\mathbf{L \sin \emptyset_p + b_p \cos \emptyset_p}$

Y =	13.82	ft
b_p =	5	ft
F_u =	0.44	
R_f =	0.9	
b_{pe} =	5.00	
L =	69.75	
$\emptyset_p$ =	0	degrees
$\emptyset_p$ =	0.00	radians

Z_{lsp} = 9.93 ft

****Hydraulics from downstream Internal Bridge Cross-Section**

EQUATION 6.3, Standards Manual for Drainage Design and Floodplain Management

Nogales Wash - Gold Hill Road 10-Year

Z_t = Design scour depth, excluding long-term aggradation/degradation, in feet;
Z_{gs} = General scour depth, in feet;
Z_a = Anti-dune trough depth, in feet;
Z_{ls} = Local scour depth, in feet;
Z_{bs} = Bend scour depth, in feet;
Z_{lft} = Low-flow thalweg depth, in feet;

Z_t = $1.3*(Z_{gs} + 1/2Z_a + Z_{ls} + Z_{bs} + Z_{lft})$

Z_{gs} =	2.5	ft
Z_a =	1.1	ft
Z_{lsp} =	0.0	ft
Z_{lse}	0.0	
Z_{bs} =	0.0	ft
Z_{lft} =	2.0	ft
Z_{lss} =	0.0	

Z_t = 6.6 ft

EQUATION 6.4, Standards Manual for Drainage Design
and Floodplain Management

Z_{gs} = General scour depth, in feet;
V_m = Average velocity of flow, in feet per second;
Y_{max} = Maximum depth of flow, in feet;
Y_h = Hydraulic depth of flow, in feet;
S_e = Energy slope (or bed slope for uniform-flow conditions), in feet per foot

$$Z_{gs} = Y_{max}\left[(0.0685V_m^{0.8}/Y_h^{0.4}S_e^{0.3})-1\right]$$

V_m =	9	fps
Y_{max} =	8.3	ft
Y_h =	8.3	ft
S_e =	0.001143	ft/ft

Z_{gs} = 2.492 ft

****Hydraulics from XS 5.594**

EQUATION 6.5, Standards Manual for Drainage Design and Floodplain Management

Z_a = Anti-dune trough depth, in feet;
V_m = Average velocity of flow, in feet per second;
g = Acceleration due to gravity, in feet per second squared;

Z_a = **$0.5(0.14)2¶V_m^2/g = 0.0137V_m^2$**

V_m = 9 fps
g = 32.2 ft/sec^2

Z_a = 1.11 ft

****Hydraulics from XS 5.594**

Section 6.6.3, Standards Manual for Drainage Design and Floodplain Management

Z_{lft} = Low flow thalweg depth, in feet;
Y = Flow depth; in feet;
W = Flow width; in feet;
V_m = Average Velocity of flow, in feet per second;

Z_{lft} = **1' when W/Y>1.15V_m**

V_m =	9	fps			**Regional or Non-Regi**
W =	1637.05	ft	**Z_{lft} =**	2.00 ft	Regional
Y =	8.3	ft			
W/Y =	197.2				
1.15V_m =	10.4				

****Hydraulics from XS 5.594**

Section 6.6.4, Standards Manual for Drainage Design and Floodplain Management

Z_{lft} = Bend scour component, in feet;
V_m = Average velocity of flow, in feet per second;
Y_{max} = Maximum depth of flow immediately upstream of bend, in feet;
Y_h = Hydraulic depth of flow immediately upstream of bend, in feet;
S_e = Energy slope (or bed slope for uniform-flow conditions), in feet per foot
α = Angle between centerline of channel and outside bend tangent line, in degrees

$Z_{bs} = \mathbf{(0.0685 Y_{max} V_m^{0.8} / Y_h^{0.4} S_e^{0.3})[2.1(\sin^2(\alpha/2)/\cos\alpha)^{0.2} - 1]}$

V_m =	9	fps
Y_{max} =	8.3	ft
Y_h =	8.3	ft
S_e =	0.001143	ft/ft
α =	3	degrees
α =	0.05	radians

Z_{bs} = 0.00 ft

****Hydraulics from XS 5.594**

Section 6.6.5, Standards Manual for Drainage Design and Floodplain Management

Z_{lsp} = Local scour due to piers, in feet
Y = Flow depth, in feet
b_p = Pier width normal to flow direction, in feet
F_u = Upstream Froude number
R_f = Reduction Factor (Table 6.1)

Z_{lsp} = $\mathbf{2.2\ R_f\ Y\ [(b_p/Y)^{0.65}]\ F_u^{0.43}}$

b_{pe} = Effective pier width, in feet
L = Length of pier wall, in feet
$\emptyset_p$ = Angle of approach flow in relationship to pier wall, in degrees

b_{pe} = $\mathbf{L \sin \emptyset_p + b_p \cos \emptyset_p}$

Y =	20.19	ft
b_p =	0	ft
F_u =	0.54	
R_f =	0.9	
b_{pe} =	0.00	
L =	0	
$\emptyset_p$ =	0	degrees
$\emptyset_p$ =	0.00	radians

Z_{lsp} = 0.00 ft

****Hydraulics from downstream Internal Bridge Cross-Section**

EQUATION 6.3, Standards Manual for Drainage Design and Floodplain Management

Nogales Wash - Produce Row Bridge -10Yr

Z_t = Design scour depth, excluding long-term aggradation/degradation, in feet;
Z_{gs} = General scour depth, in feet;
Z_a = Anti-dune trough depth, in feet;
Z_{ls} = Local scour depth, in feet;
Z_{bs} = Bend scour depth, in feet;
Z_{lft} = Low-flow thalweg depth, in feet;

Z_t = $1.3*(Z_{gs} + 1/2Z_a + Z_{ls} + Z_{bs} + Z_{lft})$

Z_{gs} =	4.1	ft
Z_a =	1.3	ft
Z_{lsp} =	0.0	ft
Z_{lse}	0.0	
Z_{bs} =	0.0	ft
Z_{lft} =	2.0	ft
Z_{lss} =	0.0	

Z_t = 8.8 ft

EQUATION 6.4, Standards Manual for Drainage Design and Floodplain Management

Nogales W General scour depth, in feet;
V_m = Average velocity of flow, in feet per second;
Y_{max} = Maximum depth of flow, in feet;
Y_h = Hydraulic depth of flow, in feet;
S_e = Energy slope (or bed slope for uniform-flow conditions), in feet per foot

$$Z_{gs} = Y_{max}\left[(0.0685V_m^{0.8}/Y_h^{0.4}S_e^{0.3})-1\right]$$

V_m =	9.7	fps
Y_{max} =	9.05	ft
Y_h =	9.05	ft
S_e =	0.000852	ft/ft

Z_{gs} = 4.132 ft

****Hydraulics from XS 6.12**

EQUATION 6.5, Standards Manual for Drainage Design and Floodplain Management

Nogales W Anti-dune trough depth, in feet;
V_m = Average velocity of flow, in feet per second;
g = Acceleration due to gravity, in feet per second squared;

Z_a = **$0.5(0.14)2¶V_m^2/g = 0.0137V_m^2$**

V_m = 9.7 fps
g = 32.2 ft/sec^2

Z_a = 1.29 ft

****Hydraulics from XS 6.12**

Section 6.6.3, Standards Manual for Drainage Design and Floodplain Management

Nogales W Low flow thalweg depth, in feet;
Y = Flow depth; in feet;
W = Flow width; in feet;
V_m = Average Velocity of flow, in feet per second;

Z_{lft} = **1' when W/Y>1.15V_m**

V_m =	9.7	fps			**Regional or Non-Regi**
W =	569	ft	**Z_{lft} =**	2.00 ft	Regional
Y =	9.1	ft			
W/Y =	62.9				
1.15V_m =	11.2				

****Hydraulics from XS 6.12**

Section 6.6.4, Standards Manual for Drainage Design and Floodplain Management

Nogales W Bend scour component, in feet;

V_m = Average velocity of flow, in feet per second;

Y_{max} = Maximum depth of flow immediately upstream of bend, in feet;

Y_h = Hydraulic depth of flow immediately upstream of bend, in feet;

S_e = Energy slope (or bed slope for uniform-flow conditions), in feet per foot

α = Angle between centerline of channel and outside bend tangent line, in degrees

$$Z_{bs} = \left(0.0685 Y_{max} V_m^{0.8} / Y_h^{0.4} S_e^{0.3}\right)\left[2.1(\sin^2(\alpha/2)/\cos\alpha)^{0.2} - 1\right]$$

V_m =	9.7	fps
Y_{max} =	9.05	ft
Y_h =	9.05	ft
S_e =	0.000852	ft/ft
α =	0	degrees
α =	0.00	radians

Z_{bs} = 0.00 ft

**Hydraulics from XS 6.12

Section 6.6.5, Standards Manual for Drainage Design and Floodplain Management

Nogales W Local scour due to piers, in feet

Y = Flow depth, in feet

b_p = Pier width normal to flow direction, in feet

F_u = Upstream Froude number

R_f = Reduction Factor (Table 6.1)

Z_{lsp} = $\mathbf{2.2\ R_f\ Y\ [(b_p/Y)^{0.65}]\ F_u^{0.43}}$

b_{pe} = Effective pier width, in feet

L = Length of pier wall, in feet

$\emptyset_p$ = Angle of approach flow in relationship to pier wall, in degrees

b_{pe} = $\mathbf{L \sin \emptyset_p + b_p \cos \emptyset_p}$

Y =	15.01	ft
b_p =	0	ft
F_u =	0.47	
R_f =	0.9	
b_{pe} =	0.00	
L =	0	
$\emptyset_p$ =	0	degrees
$\emptyset_p$ =	0.00	radians

Z_{lsp} = 0.00 ft

****Hydraulics from downstream Internal Bridge Cross-Section**