2010P023

Ocotillo Road Alignment Study Report – Greenfield to Higley #ST054

PRELIMINARY ENGINEERING ASSESSMENT

Prepared for the Town of Gilbert

GILBERT
ARIZONA

May 2010

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PERMIT ROUTING SLIP

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Project Name. Ocotillo Road Alignment Study

Location. Ocotillo Rd @ EMF + Chandler Hts. Basin

Permit No. 2010P023

(Please charge your review time to this PCN and Activity)
PCN No. 001.02.60
Activity. Plan Review

To: CSV/FET (1), BIZ (2), Ann

From: SJB

Please review and return comments and red-lined changes to my attention by:

Date. 6/22/10

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1. INTRODUCTION

1.1 PROJECT OVERVIEW

This report presents the findings and conclusions developed in the course of conducting a Preliminary Engineering Assessment and Alignment Study for Ocotillo Road extending from Greenfield Road to Higley Road (Study). This study was conducted for the Town of Gilbert (Town) and was assigned Town of Gilbert Project Number ST 054. This study was undertaken in order to provide planning information to assist in developing alternatives for improvements to Ocotillo Road between Greenfield and Higley Roads in the Town of Gilbert, Arizona and to assist in identifying significant design elements and associated estimates of improvement costs and schedule.

This report provides the Town of Gilbert with a planning document that presents information to assist the Town in decisions involving stakeholders along this transportation corridor such as the traveling public and local landowners that include the Flood Control District of Maricopa County (FCDMC) and the Roosevelt Water Conservation District (RWCD). Additionally, this report was prepared to provide information to assist in developing well-formed and supportable decisions that may affect and enhance future development and transportation opportunities in the Town of Gilbert.

1.2 PROJECT LIMITS

The project is located along the northern boundary of Section 22 and the southern boundary of Section 15 of Township 2 South, Range 6 East of the Gila and Salt River Base and Meridian. The project corridor is shown on Figure 1.1 and is bounded by Greenfield Road on the west and Higley Road on the east and consists of approximately one mile of roadway improvements.

1.3 PREVIOUS STUDIES

A previous study entitled *Final Report, Access Control and Corridor Improvement* was conducted in March 2005 for Ocotillo Road extending from Alma School Road to Power Road (Aztec, 2005) and was performed from a multi-agency and regional planning perspective. The recommendations for the project corridor presented in the referenced study were considered and incorporated in the alternatives analysis conducted for this study. Additionally, traffic and accident analysis and data for the project corridor that was developed for the referenced study are summarized in this report.

1.4 PURPOSE AND NEED FOR THE PROJECT

The southeast valley, including the Town of Gilbert, has seen sustained growth for over four decades that has been accelerating in pace over the past two decades. Although development in the recent years has slowed considerably in response to the broader economic setting, continued growth is foreseen for the Town of Gilbert and

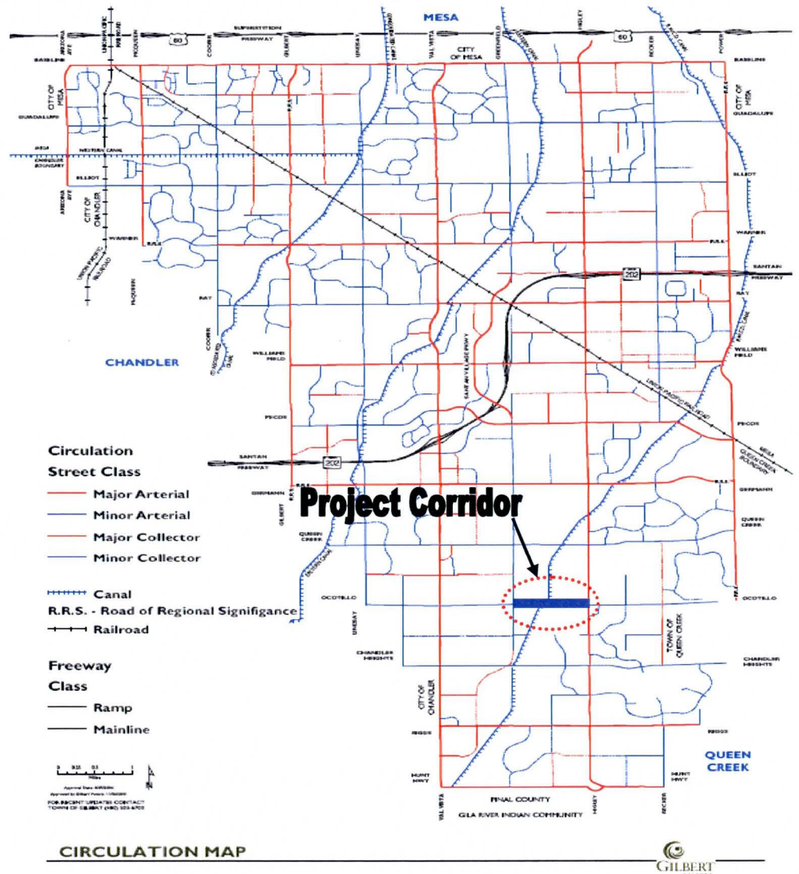


Figure 1.1: Project Location Map showing street classification for the project corridor (Town of Gilbert, 2006b)

surrounding area in the long-term planning horizon. Growth has provided the southeast valley and the Town of Gilbert with continuing transportation challenges in the form of traffic congestion and development of a transportation network that provides a safe and efficient roadway system for residents and other users.

The proposed extension and connection of Ocotillo Road will serve both local and regional transportation needs, providing a connection for local traffic east and west that is currently divided by the East Maricopa Floodway (EMF), Chandler Heights Basin, Queen Creek Wash and the Roosevelt Water Conservation District's (RWCD) Main Canal (see Figure 1.2). On a regional level, the extension and connection will provide an important parallel east-west roadway to assist in alleviating congestion. Local community growth and long-term regional transportation needs within the project area affirm the need for construction of the planned improvements. Additionally, Ocotillo Road was anticipated to be connected through the project corridor with four through lanes in the Maricopa Association of Governments Regional Transportation Plan (MAG, 2003, Figure 9.2).

1.5 PROJECT OBJECTIVES

- Develop conceptual horizontal and vertical alignment alternatives for the project corridor connecting the existing roadway improvements, forming a continuous roadway alignment for Ocotillo Road between Greenfield Road and Higley Road.
- Develop concepts for off-site drainage and irrigation water conveyance that safely and effectively direct stormwater runoff and irrigation water through the project corridor in a manner that allows existing flood control and irrigation facilities to continue functioning consistent with their current use and purpose.
- Develop project corridor geomatics and topography and review existing regional monumentation discrepancy.
- Review property ownership and develop stakeholder list
- Develop an appropriate roadway cross-section.
- Conduct preliminary geotechnical evaluation in order to provide supporting data for use in roadway and bridge alternative analysis
- Develop drainage overview and discuss integration of the proposed improvements with existing flood control facilities
- Develop inventory and preliminary mapping of existing utilities along with an estimate of impact to existing utilities such as overhead electric, water, sewer, reclaimed water lines.
- Develop a consensus preferred alignment for further study and development.
- Develop structural solutions for crossing the East Maricopa Floodway, the Chandler Heights Basin, and Queen Creek Wash.
- Develop conceptual access control plan and identify median break locations and critical access locations.
- Develop estimates of project cost and schedules
- Prepare a report documenting findings and conclusions developed during the study

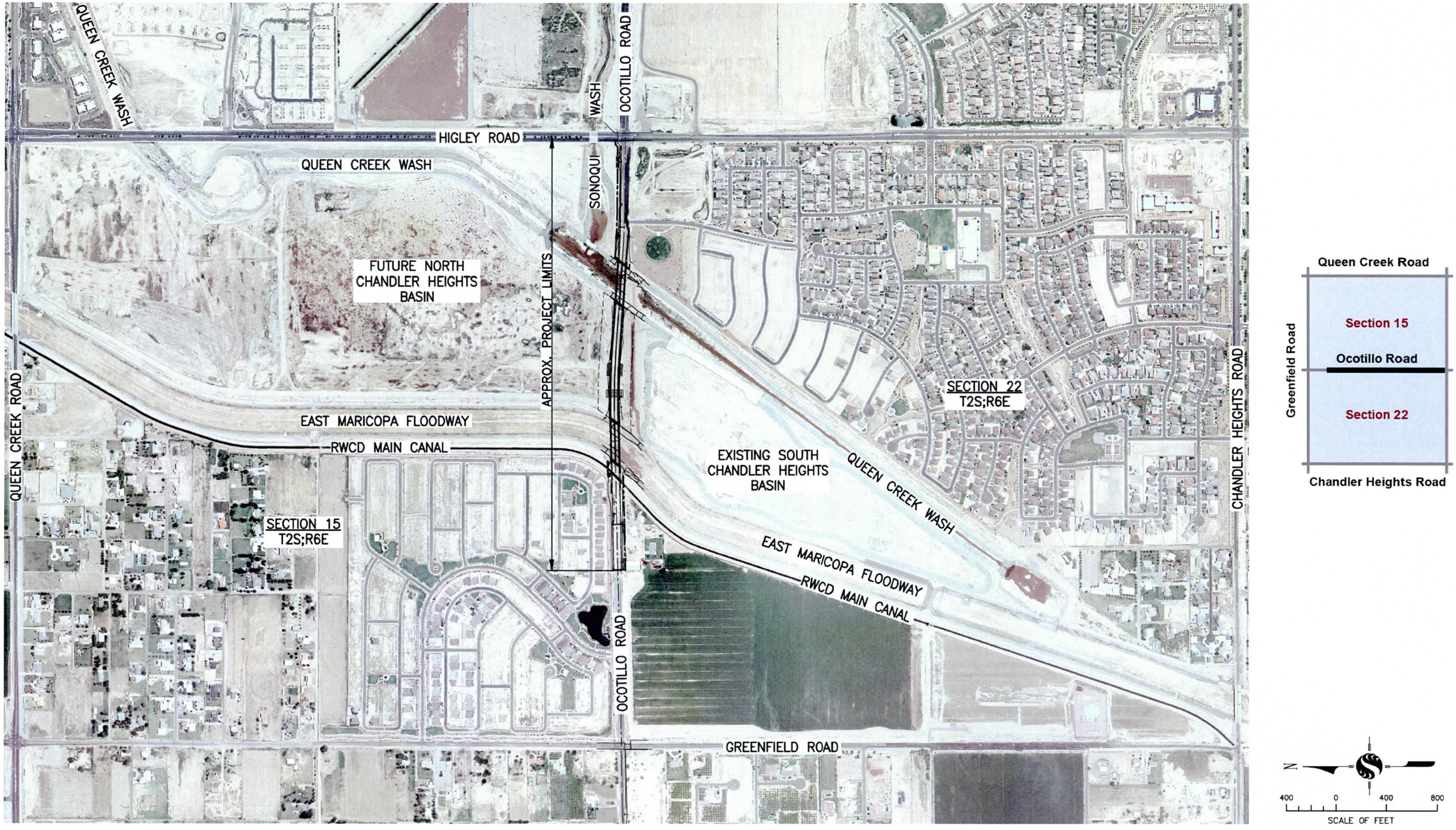


Figure 1.2 *Project Vicinity Map*

2. PROJECT SETTING

2.1 LAND USE

Existing land use surrounding the project corridor has historically consisted of a combination of agricultural, flood control conveyance, and irrigation conveyance interspersed with unused desert land and regionally significant watercourses. The project corridor is situated in an area that has been transitioning from these historical uses to suburban residential use consisting of single-family residential housing with ancillary roadways, open spaces, and other infrastructure typically associated with residential development. Recent residential development has occurred in areas available for development; however, much of the project corridor is used for irrigation or flood control conveyance and as such is not available for private development.

Photograph 2.1 & 2.2: *Top photo taken from the west bank of the EMF looking northeast showing the existing channel improvements with overhead utilities shown in the right-background also. Bottom photo taken from the east bank of Queen Creek Wash looking west showing the existing channel with overhead utilities in the right-background of the photograph.*

The project corridor is situated immediately downstream of the confluence of Queen Creek Wash and Sonoqui Wash, two ephemeral watercourses that are significant regional drainage features and have undergone significant modifications in order to stabilize the watercourses for the purpose of flood control. In addition to these watercourses, the project corridor also traverses significant regional flood control structures consisting of the EMF and Chandler Heights Basin, which serve to capture and convey stormwater runoff. All of the land associated with these improvements in the vicinity of the project corridor is owned and maintained by the FCDMC.

Irrigation for agricultural use in the vicinity of the project corridor is provided by the RWCD. The project corridor transects the RWCD's primary conveyance canal that is situated immediately west of the EMF. A check structure and turnout to distribution canals and piping are situated within the project corridor.

2.2 PHYSICAL CORRIDOR CHARACTERISTICS

The project corridor is oriented east-west and is situated in an area that has undergone extensive alteration from its natural desert condition. A review of regional topographic mapping for the site and surrounding area indicates the project corridor slopes generally to the west with elevations that vary from approximately 1,308 feet near the project intersection with Greenfield Road to 1,322 feet near the intersection with Higley Road for an average slope of 0.27% through the project corridor (Figure 2.1).

Visual reconnaissance was conducted for the site and surrounding area by Maria Brady, PE, Gary Brady, PE, Stephanie Gerlach, PE, Craig S. Bolze, PE , and Rob Shelley, Senior Designer, of Stantec. Site reconnaissance was undertaken to gather information regarding existing conditions, drainage patterns, topography, and physical infrastructure.

Terrain within the project corridor has been heavily modified primarily in association with flood control improvements and to a lesser extent, irrigation infrastructure and agricultural use.

The EMF was observed to consist of an unlined earthen channel trending from northeast to southwest with ancillary access roads on both the east and west banks (Photograph 2.1). An access ramp into the EMF was observed extending southwest into the channel from the east bank beginning at a location in the vicinity of the project corridor.

Similar to the EMF, Queen Creek Wash was observed to consist of an unlined earthen channel trending from northeast to southwest with ancillary access roads on both the east and west banks (Photograph 2.2). An access ramp into Queen Creek Wash was observed extending southwest into the channel from the east bank beginning at a location in the vicinity of the project corridor. Sonoqui Wash parallels the project corridor upstream of its confluence with Queen Creek Wash. An outfall structure for Sonoqui Wash was observed upstream of the project corridor. Additionally, a grade control structure was also observed a short distance upstream of the Sonoqui Wash outfall, providing improved vertical alignment for the confluence of Queen Creek Wash and Sonoqui Wash.

The existing and proposed Chandler Heights Basin facilities were observed and consist of an unlined detention basin with a stabilized weir structure situated between the west bank of Queen Creek Wash and the east bank of the EMF. The weir structure is situated along the west bank of Queen Creek Wash and allows stormwater runoff to enter the basin (Photograph 2.3).

RWCD's main canal was observed to transect the project corridor,

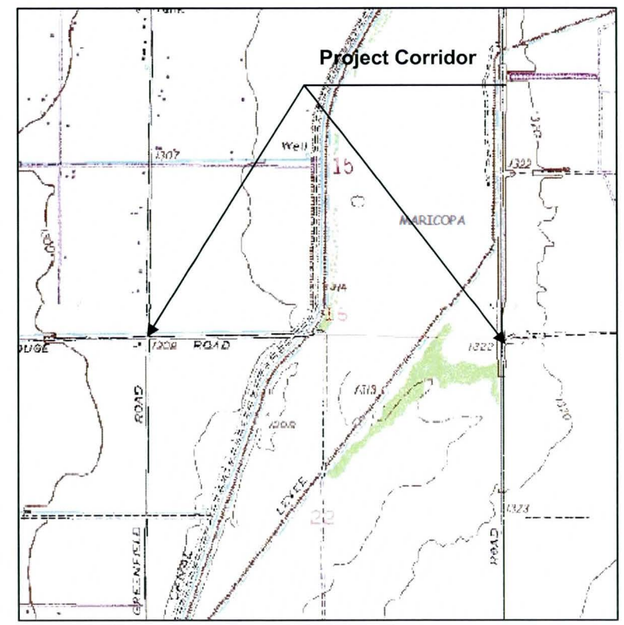


Figure 2.1: *USGS mapping showing the project corridor (USGS, 1973).*

paralleling, and adjacent to, the EMF along its west bank. The main canal consists of a concrete lined irrigation canal with associated check structures, gates, and distribution inlets. Additionally, access roads parallel the canal on both its east and west banks providing access for monitoring and maintenance (Photograph 2.4).

Photograph 2.3: *Taken from the project corridor looking south at the existing Chandler Heights Basin. The weir structure along Queen Creek Wash is shown in the left-background. The foreground shows the location of the project corridor and the proposed Chandler Heights Basin Phase 2.*

Stantec understands that both RWCD and FCDMC plan additional improvements in the future associated with their facilities. FCDMC is planning to construct Phase 2 of the Chandler Heights Basin, which includes a portion of the project corridor. RWCD plans continuing maintenance and improvements on its facilities. Both RWCD and FCDMC facilities will be impacted by the proposed improvements to Ocotillo Road.

In addition to flood control improvements constructed by FCDMC, retention basins associated with improvements constructed by private development were observed situated along the north and south sides of Ocotillo Road east of Queen Creek Wash. These basins serve to capture and hold stormwater runoff from the associated development and the developed portions of Ocotillo Road. An existing well site was observed along the west bank of the RWCD canal along the south side of the project corridor. This well site consists of a concrete well-head and does not appear to be currently in-use. No surficial indication of a pump was observed during the site reconnaissance.

Photograph 2.4: *Taken from the RWCD Check structure looking south showing the existing RWCD main canal and associated access roads on either bank.*

2.3 INTERSECTION IMPROVEMENTS

The project corridor intersects two regionally significant roadways, Greenfield Road on the west and Higley Road on the east. These roadways form the extents of the study area for the project.

The Ocotillo Road and Greenfield Road Intersection forms the beginning of the project corridor and is a 4-way stop intersection. The east quadrant has two through lanes eastbound and one through lane westbound with a dedicated right-turn lane onto northbound Greenfield Road. The north and south quadrants have one through lane southbound and northbound respectively with dedicated left turn lanes onto east and westbound Greenfield Road. The west quadrant has one through lane eastbound and westbound.

Photograph 2.5*: Unfinished Ocotillo Road just west of RWCD Main Canal looking west to Greenfield Road*

Photograph 2.6: *Ocotillo Road and Banning Street looking east.*

The Ocotillo Road and Higley Road Intersection is a signalized intersection having two through lanes in each direction at the east quadrant with dedicated left-turn lane southbound onto Higley Road and dedicated right-turn lane onto northbound Higley Road (Photograph 2.7 & 2.8). In the west quadrant the intersection is fully developed with two through lanes eastbound and dedicated left turn lane and right turn lane onto northbound and southbound Higley Road respectively and then tapers to a half-street section continuing to the west with one through lane westbound. Higley Road at the south and north quadrants has three lanes northbound and southbound with dedicated left turn and right turn lanes onto eastbound and westbound Ocotillo Road respectively.

2.4 EXISTING ROADWAY IMPROVEMENTS

Ocotillo Road was observed to be a discontinuous roadway between Greenfield Road on the west and Higley Road on the east. Existing improvements extend from Greenfield Road on the west to the east bank of the RWCD canal (Photograph 2.5). No road improvements are present from the RWCD Main Canal east across the EMF, Chandler Heights Basin, and Queen Creek Wash until Banning Street (Photograph 2.6). Improvements have been undertaken corresponding to the Town of Gilbert minor arterial roadway section for Ocotillo Road extending from Greenfield Road east to its existing terminus near the RWCD Main Canal. The only portion that remains unimproved in this section is the frontage along the existing privately-owned Freeman properties, which abut the south side of the project corridor adjacent to the west bank of the RWCD Main Canal.

Similarly, half-street improvements have been constructed for the south half of Ocotillo Road beginning at Banning Street east of the east bank of Queen Creek Wash extending to the intersection with Higley Road. The half-street section tapers to match the full intersection improvements at the intersection (Photographs 2.6, 2.7 & 2.8).

2.5 PRELIMINARY GEOTECHNICAL EVALUATION

A preliminary geotechnical evaluation was conducted as part of this study in order to develop information to assist in characterizing subsurface soil conditions for use roadway and bridge alternative evaluation. The scope of services for this evaluation included a review of previously published geologic and engineering data, aerial photographs, and topographic mapping as well as a review of previously prepared geotechnical reports from nearby projects. The information developed in this report was used to formulate preliminary geotechnical recommendations for use as supporting information for this study. A report documenting the findings and conclusions of this evaluation was prepared and is presented in Appendix A. The results of the preliminary evaluation should be used for planning purposes only. Detailed geotechnical investigation including subsurface investigations, laboratory testing, and engineering analysis will need to be performed as part of final design activities for this project.

Photograph 2.7 & 2.8: *Top Photo - Ocotillo Road intersection with Higley Road looking south from Higley Road. Bottom Photo - Ocotillo Road intersection with Higley Road looking east from Ocotillo Road.*

3. PROJECT GEOMATICS & LAND OWNERSHIP OVERVIEW

3.1 GENERAL

The Ocotillo Road Alignment Study is located along the boundary between sections 15 and 22, T2S, R6E, Gila and Salt River Baseline and Meridian (G&SR B&M). The project extends between Greenfield Road on the west and Higley Road on the east, although the majority of the project realignment is focused on the reach between the RWCD Canal on the west and Higley Road on the east.

3.2 ADJACENT PROPERTY OWNERS

A Fulton Homes Subdivision (Freeman Farms) is partially constructed from Greenfield Road to the RWCD on the north and south sides of Ocotillo Road (Photograph 3.1). As part of this subdivision platting, a road dedication was established and road improvements constructed. On the south side of Ocotillo Road, just west of the RWCD Main Canal, are two remaining private properties that abut the proposed Ocotillo Road project (Photograph 3.2).

Photograph 3.1 *Fulton Homes Freeman Farms subdivision north of Ocotillo Road near project start.*

Photograph 3.2 *Looking south on Banning Street at Shamrock Estates south of Ocotillo Road and east of Queen Creek Wash.*

The RWCD Main canal Right-of-way creates the first physical boundary to the project on the west side of the proposed alignment. Adjacent to the RWCD Main Canal Right-of-way are a series of FCDMC properties described in greater detail in the following section. FCDMC also owns the adjacent property on the north side of the proposed alignment from Queen Creek Wash to Higley Road (Parcel 7 on Figure 3.1).

Shamrock Estates Subdivision is partially constructed on the south side of the proposed Ocotillo Road alignment from Queen Creek Wash (Parcel 15 on Figure 3.1) east to Higley Road. As part of this subdivision platting, a half road dedication was established and road improvements were constructed.

3.3 FCDMC PARCELS

The primary land owner of the Ocotillo reach between the RWCD Canal and Higley Road is the Flood Control District of Maricopa County (FCDMC). There are approximately 15 parcels along the north and south sides of Ocotillo Road, which include the following:

1. FCDMC 304-70-018B
2. FCDMC 304-70-019
3. FCDMC 304-70-011A
4. FCDMC 304-77-009A
5. FCDMC 304-70-010
6. FCDMC 304-70-007B
7. FCDMC 304-70-007A
8. FCDMC 304-77-012
9. FCDMC 304-77-011
10. FCDMC 304-77-005B
11. FCDMC 304-77-005E
12. FCDMC 304-77-002B
13. FCDMC 304-77-005G (does not connect to section line)
14. FCDMC 304-77-002D
15. FCDMC 304-77-013

These parcels appear to be suitable for the purpose of determining the additional and ultimate roadway easement for Ocotillo Road. A strip easement across the currently described FCDMC parcels can be prepared as long as the easement is adequately and clearly connected to known monuments and can be retraceable through survey.

3.4 DUAL QUARTER CORNERS WITHIN PROJECT ALIGNMENT

In addition to the number of FCDMC parcels along Ocotillo Road is the existence of two quarter-corners along the section line separating sections 15 and 22 within the roadway corridor. These two quarter corners, located about 75 feet apart (north to south) within the EMF channel, have a significant affect on the Ocotillo Road alignment and the configuration of parcels and other facilities within the corridor. The majority of the improvements west of the RWCD Canal appear to follow the northerly quarter-corner alignment, while improvements east of the RWCD Canal follow the southernmost quarter-corner alignment. Figure 3.1 shows the quarter-corner alignment. It was also noted that legal descriptions contained in deeds for the unplatted parcels along the section line are based upon metes and bounds referenced from the northernmost quarter-corner alignment west of the RWCD canal and the southernmost quarter-corner alignment east of the RWCD canal.

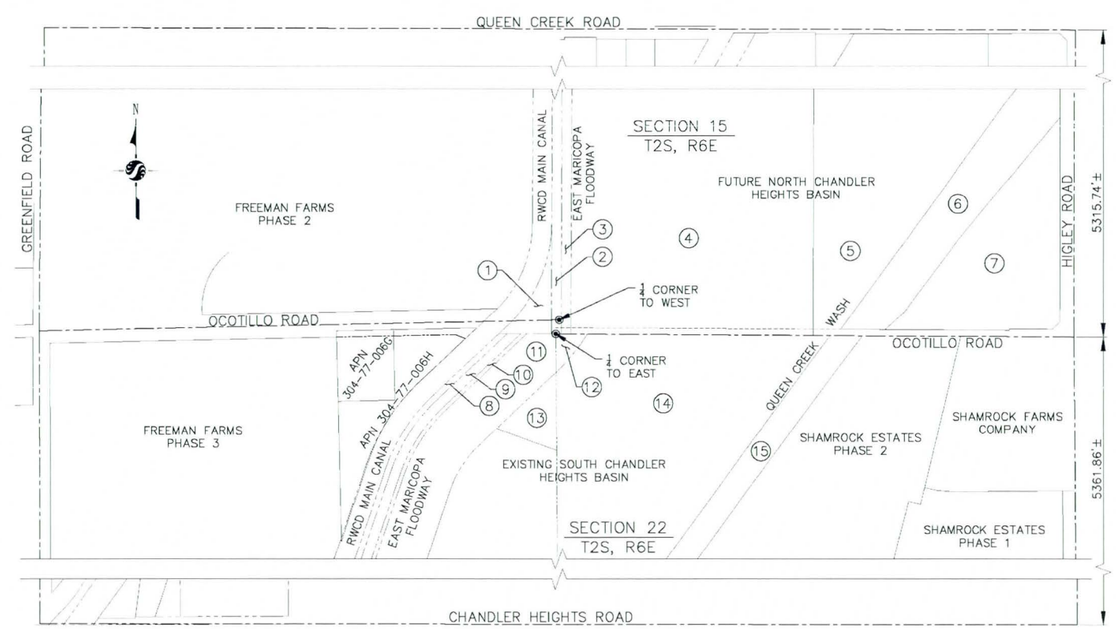


Figure 3.1: *Map of the Dual Quarter-Corners Alignment*

Although the existence of the dual quarter-corners along Ocotillo Road is similarly undesirable to the multiple segmented parcel issue, it does not necessarily present a challenge for defining the additional and ultimate roadway easement for Ocotillo Road. A strip easement across the two quarter-corners can be prepared as long as the easement is adequately and clearly connected to the known monuments and can be retraceable through survey.

The following recorded documents reference historical information found regarding the dual quarter-corner issue. Documents 1-4 indicate the quarter-corner to be located approximately 75 feet north of the location shown by documents 5-7, Document 8 reports both locations.

1. Weir, Mike (1978) *Record of Survey Discrepancies*, Book 201 of Maps, Page 50.
2. Allen Consulting Engineers (2005) *Freeman Farms Phase 2, Parcel 2*, Book 794, Page 46.
3. Allen Consulting Engineers (2005) *Freeman Farms Map of Dedication S. Greenfield and E. Ocotillo Roads*, Book 797, Page 35.
4. Allen Consulting Engineers (2006) *Freeman Farms, Greenfield and Ocotillo Roads ALTA Survey*, Book 816, Page 6.
5. (1870) GLO Plat for Township 2 South, Range 6 East.
6. Weckerly & Associates (1973) *Roosevelt Water District Alignment & Rights of Way of Main Canal*, Book 164, Page 46.
7. AMEC (2002) *PLSS Subdivision Record of Survey, Maricopa County Geodetic Densification and Cadastral Survey*, Book 589, Page 47.
8. CEI (2002) *Results of Survey for Maricopa County Flood Control*, Book 591, Page 39 (8 has been provided as it documents on one sheet the monument problem; all other documents can be provided if required).

3.5 EXISTING AND REQUIRED RIGHT-OF-WAY

A 65-foot right-of-way has already been dedicated for the north half of the Ocotillo Road alignment between Greenfield Road and the RWCD Main Canal. A 65-foot easement was dedicated for the south side of Ocotillo Road from Greenfield to approximately 2500 feet east by the Town of Gilbert as an expansion of the existing 33-foot right-of-way to accommodate waterlines that were installed in 2008. This right-of-way should be adequate to accommodate the future road alignment. However, additional right-of-way may be required for roadway storm water runoff depending on final drainage requirements.

A 130-foot easement will be required across the RWCD Main Canal to accommodate the proposed road and a 130-foot easement will be required across the FCDMC drainage features (the EMF, Chandler Heights Basin and Queen Creek Wash) as well.

A 65-foot right-of-way along the south half of Ocotillo Road enlarged the existing 33' roadway easement and was established as part of the platting of the Shamrock Farms Subdivision from the Queen Creek Wash to Higley Road. The existing 33-foot roadway easement on the north side of Ocotillo Road between Queen Creek Wash and Higley Road will need to be widened to 65 feet. FCDMC is the underlying fee owner for this additional roadway easement.

Temporary construction easement will be required from RWCD and FCDMC between the RWCD Canal and Higley Road. Temporary construction easement from the private Freeman properties on the south side of Ocotillo Road west of RWCD will likely not be required.

3.6 ADDITIONAL PROJECT SURVEY ISSUES

The following issues discuss some of the project issues already addressed or other survey related issues for the project:

1. Per Bk. 2 of Road Maps, Pg. 60, dated in January 1925, there is a 66' (33' each side) Roadway easement along the North Section line of Section 22, South Section line of Section 15. This is the historical roadway easement that was expanded from 33' to 65'on the south side as part of the Shamrock Farms Development and will be expanded by acquisition from FCDMC on the north side to accommodate the required project roadway easement.
2. Deeds for APN's 304-77-005B, -011, -012, -013 (FCDMC) describe the North boundary lines to the North Section line of Section 22.
3. Recorded plats for Freeman Farms Phase 2, Parcels 1 & 2 and Freeman Farms Phase 3, Parcels 3 & 4, as well as APN's 304-77-006G & -006H parallel the Section line to the farthest North 1/4 corner.
4. All the FCDMC parcels parallel the Section line to the farthest South 1/4 corner.

4. TRAFFIC AND TRANSPORTATION

4.1 INTRODUCTION

No traffic, accident, or level of services data or analysis was developed as part of this study. Currently, Ocotillo Road does not exist for much of the project corridor and therefore data acquisition is not viable. However, a previous study that encompassed the project corridor did develop and analyze data for the existing portions of Ocotillo Road. The results of this study were presented in a report *entitled Access Control and Corridor Improvement Study, Ocotillo Road, Power Road to Alma School Road* (Aztec, 2005) and portions of that report are summarized in sections 4.3 through 4.6.

4.2 FUNCTIONAL CLASSIFICATION

The functional classification of Ocotillo Road through the project corridor will be a minor arterial in accordance Town of Gilbert Standard Detail 22 Minor Arterial Street presented later on Figure 6.1 (Town of Gilbert, 2006a). The functional classification of Greenfield Road, at the point of intersection with the proposed Ocotillo Road improvements, is as a minor arterial. Higley Road is currently classified as a Major Arterial at its point of connection at the east terminus of the project corridor as illustrated in Figure 1.1(Town of Gilbert, 2006b).

4.3 ACCIDENT DATA

Accident data was not acquired as part of this study because Ocotillo Road does not exist through much of the project corridor and accident data is not available. Additionally, the Greenfield Intersection and the portion of Ocotillo Road east of Greenfield were improved in 2007. The portion of Ocotillo Road west of the Higley Road intersection as well as the Higley Road intersection were recently constructed in 2008.

Accident data was reviewed during a previous study encompassing the project corridor (Aztec, 2005). In that study data collected from the Arizona Department of Transportation Traffic Records Section was reviewed for a three year period extending from January 1, 2001 to December 31, 2003. The Higley Road intersection did not exist during this period and the Greenfield Road intersection was stop controlled only. The report lists eight accidents occurring at the Greenfield Road intersection, placing it at the lowest number of accidents for all of the intersections studied.

4.4 TRAFFIC ANALYSIS

Traffic analysis was not conducted as part of this study because Ocotillo Road does not exist through much of the project corridor and little traffic data is available. Additionally, both the Greenfield Road Intersection and the portion of Ocotillo Road east of Greenfield were improved in 2007. The portions of Ocotillo Road west of the Higley Road intersection, as well as the Higley Road intersection, were recently constructed. Likewise, the improvements immediately east of the Greenfield Road intersection, similar to the Greenfield Road intersection itself are also recently constructed.

4.5 EXISTING CONDITIONS LEVEL OF SERVICE

The existing conditions analysis presented in the Aztec report was based on the existing intersection geometrics as well as completed roadway segments at the time of the publication of the Aztec report (2005). The existing level of service for the Greenfield Road intersection with Ocotillo Road was Level B for both the weekday morning and evening peak hours. Additionally the report noted that the Higley Road intersection did not exist at the time of the report. The level of service for the project corridor was not defined because Ocotillo Road did not exist within the project corridor at the time of the study. However, the adjoining roadway segment extending from Val Vista Drive to Greenfield Road was classified as operating at level of service B.

4.6 FUTURE PROJECTIONS LEVEL OF SERVICE

Future projections analysis were presented for the year 2025 for two model scenarios, with and without the roadway connection that will be provided by the project corridor, using traffic projection numbers developed by the Maricopa Association of Governments (MAG). Additionally, forecast volumes for the year 2015 were developed by linearly interpolating the results of the analysis for 2025 (Aztec, 2005).

The analysis developed for 2015 and 2025 classifies the level of service for the project corridor and adjoining segments as C for both forecast years. Additionally, the report classifies the Greenfield Road intersection as operating at capacity for both forecast years. However, the Higley Road intersection is classified as operating under capacity for the forecast year 2015 and operating at capacity for the forecast year 2025 (Aztec, 2005).

4.7 ACCESS CONTROL

In accordance with Town of Gilbert Standard Detail 2, Figure 4.1 minimum spacing between access points will be 220 feet from centerline of driveway to centerline of driveway. Minor arterial roadways such as Ocotillo Road intersecting major arterials such as Higley Road require a raised median left turn and an auxiliary right turn. Additionally, Detail 2 restricts access points to no closer than 250 feet of a minor arterial without a raised median as well (Town of Gilbert, 2005).

The proposed road improvements will require maintaining access to two residential lots west of the RWCD Main Canal and maintenance roads on either side of the RWCD Main Canal, the EMF and Queen Creek. The maintenance road access points will require gated access to prevent general traffic from using the maintenance roads.

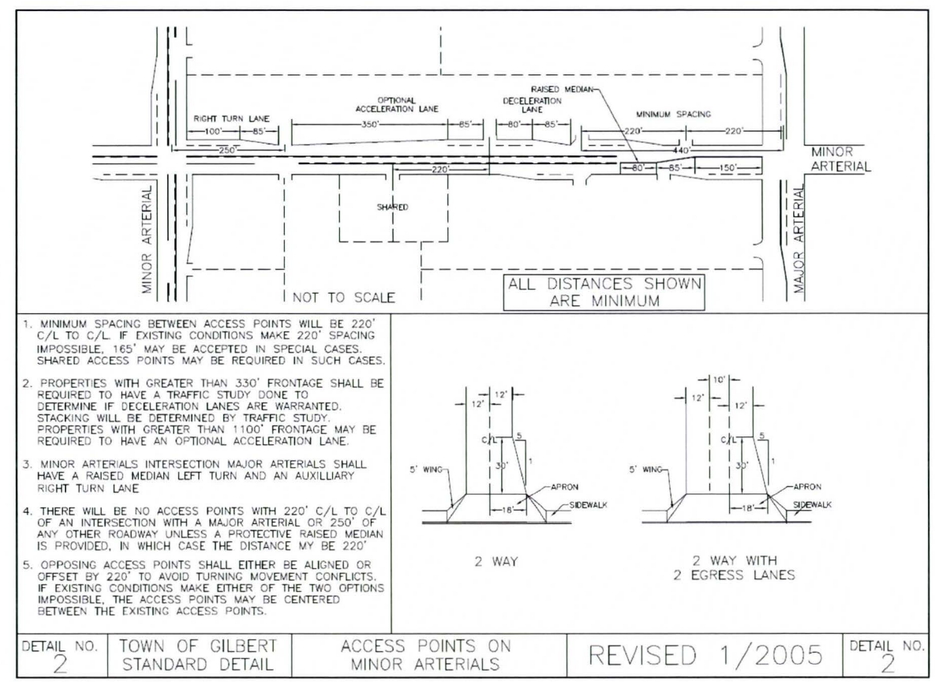


Figure 4.1: *Town Of Gilbert Standard Detail for Access Control on Minor Arterials*

5. ALTERNATIVES DEVELOPMENT

5.1 CONCEPTUAL ALTERNATIVES DEVELOPMENT

A principal focus for this study was to develop and evaluate proposed horizontal alignments for Ocotillo Road that would form a continuous roadway section from Greenfield Road on the west to Higley Road on the east. Two section quarter corners located approximately 75 feet from each other, north to south, cause the existing improvements for the west section of Ocotillo Road, west of the RWCD canal to skew to the north of the existing roadway improvements east of Queen Creek Wash (see Figure 3.1). No roadway section currently exists between the RWCD main canal and Queen Creek Wash. Connecting these two existing roadway alignments was a principal focus of this study.

Several Factors along the proposed alignment affect the desirability of each alignment studied. These factors include:

- Connecting to the existing roadway improvements
- Resolving the existing alignment issues associated with the two section quarter corners
- Reducing or eliminating impacts to private property owners (Kelly/Meghan Freeman, Wayne/Helen Freeman, Freeman Farms Subdivision and Shamrock Farms Subdivision)
- Reducing or eliminating impacts to RWCD existing structures
- Maintaining adequate access to existing RWCD features
- Maintaining adequate access to the existing FCDMC EMF and Queen Creek Wash
- Accommodating the proposed future expansion of the Chandler Heights Basin
- Reducing or accommodating the existing utility features (SRP 69kV line along the north side of proposed alignment, Town of Gilbert waterline, sewer line and reuse line, and City of Chandler waterline)
- Reducing Right-of-way Costs and/or reducing difficulty in acquiring Right-of-way

Seven conceptual alignments were reviewed as part of the study along with a no-build alternative. Two of the conceptual alignments had been developed during previous studies; alignment 7 was developed as part of the *Access Control and Corridor Improvement Study, Ocotillo Road, Power Road to Alma School Road* (Aztec, 2005) and alignment 1 had been developed to provide information for use in the design of proposed waterlines for the Town of Gilbert and City of Chandler in 2007. The remaining alignments 2, 3, 4, 5, and 6 were developed as part of this study. Centerlines of these alternatives are presented on Figure 5.1 on the following page.

Table 5.1 Alternatives Matrix was prepared to evaluate the non-monetary factors associated with each alignment. Scoring from 1 to 3 was attached to each factor for each alignment option. A score of 1 represents the least impact or best option for that factor and a 3 represents the most impact or worst option for that factor.

5.2 CONCEPTUAL ALTERNATIVES EVALUATION

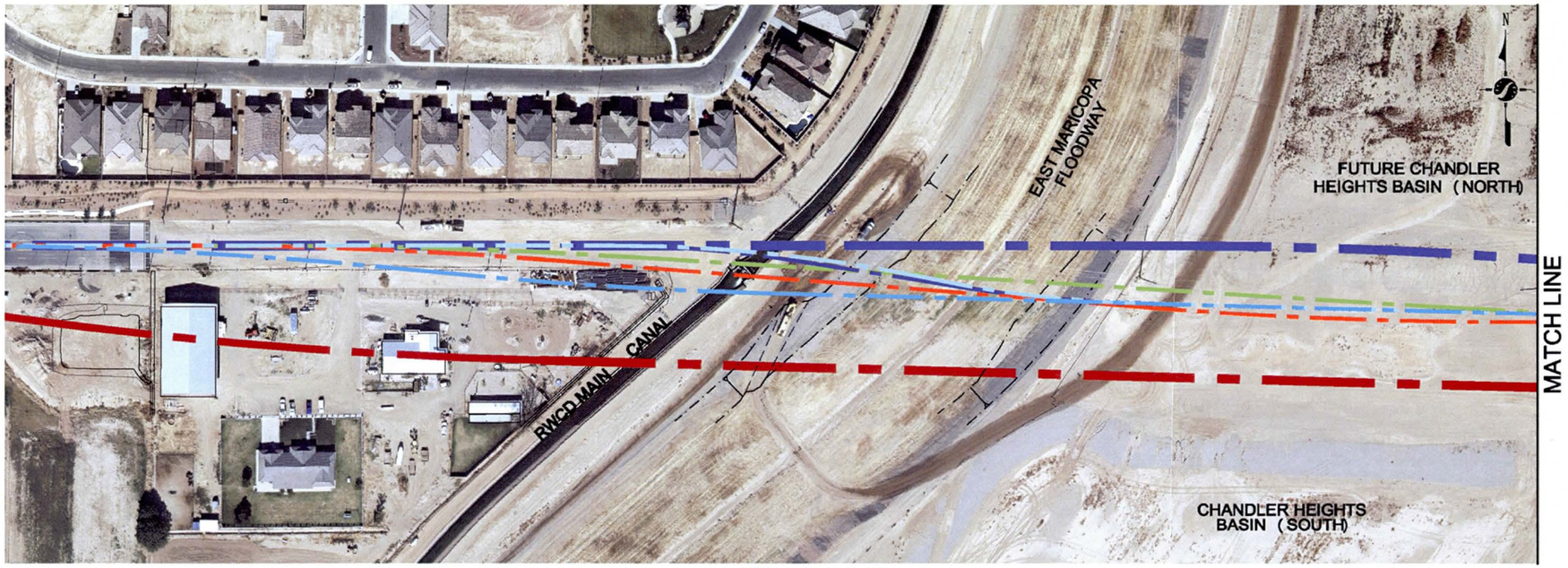
If the no-build alternative was selected, Ocotillo Road would remain discontinuous between Greenfield Road and Higley Road. Future development in the surrounding areas is anticipated to continue and Ocotillo Road will provide an important transportation corridor supporting continued development. This alternative was eliminated from further consideration because it does not satisfy the project objectives or the long-term need to improve the operational and safety characteristics of the local and regional roadway system.

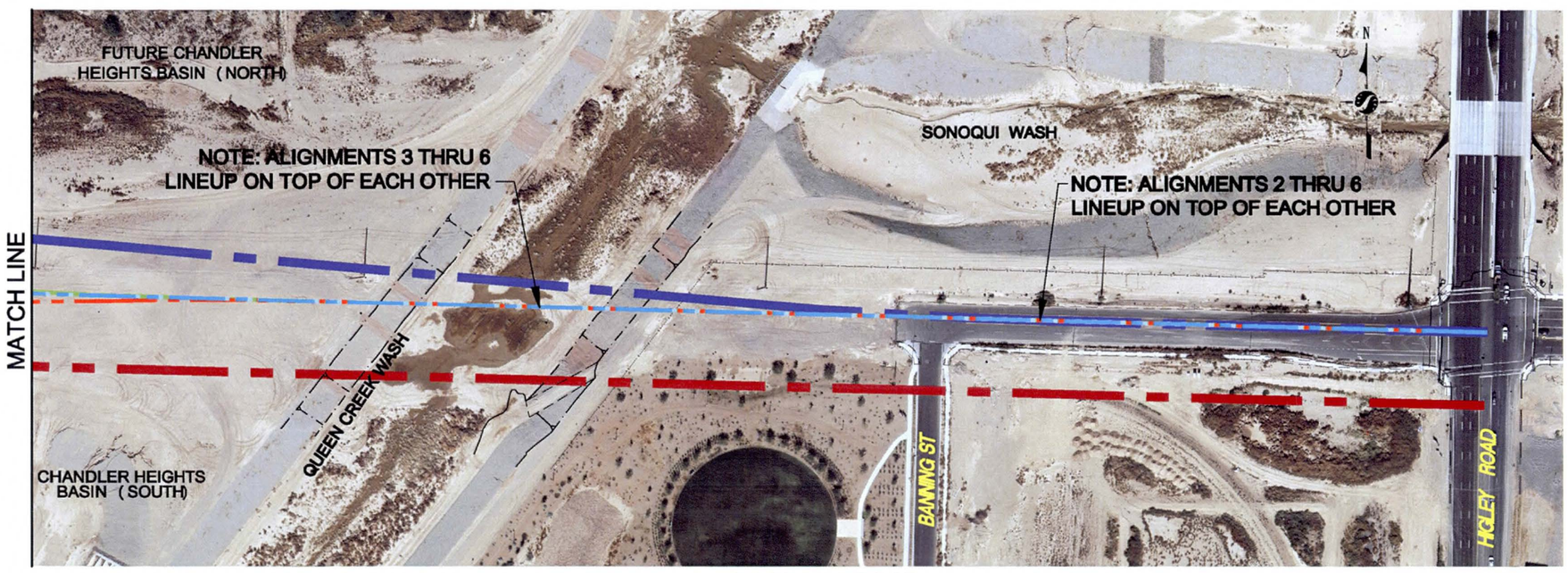
The alignment presented in the Aztec study recommends a bridge extending from the west bank of the RWCD canal and continuously bridging the RWCD canal, EMF, Chandler Heights Basin, Queen Creek Wash and ending at the east bank of Queen Creek Wash. The total length of the proposed bridge was approximately 2,200 feet. This alignment is located significantly further south of the section line than the other alignment developed for this study. This alignment would reduce the impact to the RWCD structures and the SRP 69 kV power poles; however, it significantly impacts the southern private property owners from Greenfield Road to the RWCD and from Queen Creek Wash to Higley Road. In addition, improvements undertaken by Freeman Farms, Shamrock Estates, and at the Higley Road-Ocotillo Road intersection subsequent to the issuance of the corridor study do not conform to this alignment. This alternative subsequently had the highest score and was eliminated from further consideration.

The remaining six alternatives were based on an alignment along the section line, box culverts for the RWCD canal and the Chandler Heights Basin and shorter bridges over the EMF and Queen Creek Wash.

***Table 5.1**: Alternative Matrix (Lowest Total Score Represents Best Non-Monetary Benefit)*

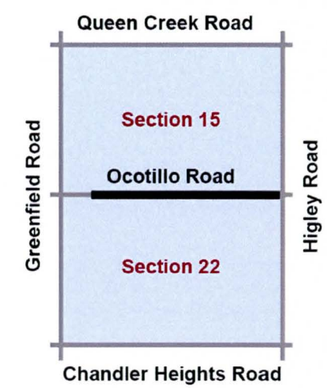
No.	Horizontal Geometrics		Impact to Adjacent Landowners Existing Facilities									Impact to Existing Utilities			Right of Way				Totals
			Private Property				RWCD		FCDMC										
Alignment Alternatives	Connects to Exist Improvements	Resolves Alignments	Freeman, Kelly/Meghan	Freeman, Wayne/Helen	Freeman Farms	Shamrock Farms	Check/Turnout Structures	Existing Access	QC Access	EMF Access	Chandler Heights Basin Access	69kv OHE	Water Lines	Reclaimed Water, Sewer Lines	Freeman, Kelly/Meghan	Freeman, Wayne/Helen	FCDMC	RWCD	Alignment Totals
1	1	2	2	2	1	1	3	3	1	1	1	1	1	2	2	2	2	2	30
2	1	1	1	1	1	1	3	3	1	1	1	3	1	1	1	1	3	2	27
3	1	1	2	2	1	1	3	3	1	2	1	2	1	2	1	2	2	2	30
4	1	2	1	1	1	1	3	3	1	2	1	1	1	2	1	1	1	2	26
5	1	1	1	1	1	1	3	3	1	2	1	1	1	2	1	1	1	2	25
6	2	1	2	3	1	1	3	3	2	3	1	2	2	3	2	2	2	2	37
7	3	1	3	3	3	3	1	2	3	3	3	1	3	1	3	3	3	2	44





LEGEND

- ALIGNMENT 1
- ALIGNMENT 2 (PREFERRED)
- ALIGNMENT 3
- ALIGNMENT 4
- ALIGNMENT 5
- ALIGNMENT 6
- ALIGNMENT 7 (PREVIOUS STUDY)



80 0 80 160
SCALE OF FEET

Figure 5.1: *Roadway Alignment Alternatives*

As previously mentioned, existing improvements for Ocotillo Road immediately west of Higley Road are offset south of the existing improvements immediately east of Greenfield Road. This offset serves to facilitate the outfall of Sonoqui Wash into Queen Creek Wash and also results from an offset in section lines due to a discrepancy in section corners. Each horizontal alignment alternative considered for this study connected these existing improvements and resolves the two existing alignments using a reverse curve separated by a tangent section; however, the affect on key corridor stakeholders and roadway design characteristics varied widely. The results of the initial alternatives review are presented in the Alternatives Matrix (Table 5.1).

All conceptual alignment alternatives were presented to the Town of Gilbert in a meeting on September 15, 2008. After discussion, alternatives 2, 3 and 5 were selected for additional development and evaluation.

Greater detail for these alternatives and preliminary cost estimates were prepared for each of these alternatives and a second review meeting was held with the Town of Gilbert on October 24, 2008. The preliminary cost estimates found that alternatives 2, 3 and 5 were nearly the same cost; however, alternative 2 was slightly more expensive than the other two because of the additional FCDMC ROW that will be required. The offsetting value of this alternative is the reduced impact to the private Freeman properties located just west of the RWCD Main Canal and south of the proposed alignments. The impact to the RWCD features is essentially the same for all three alternatives. Alternative 2 represented the least impact to the FCDMC features due to improved maintenance access with Alternative 2 vertical and horizontal geometry. After review of the matrix, the vertical and horizontal alignment and preliminary costs, Alternative 2 was selected as the preferred alternative.

The preferred alternative was then detailed further and presented to FCDMC in meetings on January 7, 2009 and February 19, 2009. Continued development of this alignment has proceeded through the remainder of the study. The preferred alternative horizontal alignment is presented on the Roadway Plan and Profile Drawings (Appendix G: 1 through 16).

5.3 PREFERRED ALTERNATIVE

Key measures used in evaluating the proposed alignments consisted of the following:

- Geometrics: Use of applicable geometric design criteria, Town of Gilbert Guidelines, connection to existing improvements to Ocotillo Road
- Impacts to adjacent landowners: Impacts to existing improvements such as check structures (RWCD), access roads, driveways, use of property.
- Utilities: Impacts to existing overhead and underground utilities: Relocation of utilities, decreased access.
- Right-of-way: Amount of right-of-way required for the roadway configuration from abutting property owners.

After evaluation by the project team, Alternative 2 was chosen as the preferred alternative. The preferred alternative is shown on the Roadway Plan and Profile Drawings (Appendix G: 1 through 16).

6. ROADWAY DESIGN FEATURES

6.1 INTRODUCTION

The proposed improvements for Ocotillo Road will serve to improve both local and regional surface transportation facilities. Rapid development in the southeast valley, and particularly the Town of Gilbert, has resulted in increasing demands on the Ocotillo Road transportation corridor. Discontinuous development occurring throughout the project corridor has resulted in widely disparate roadway improvements along Ocotillo Road; a condition that this project will serve to remedy by constructing a continuous roadway section to support growth and provide sufficient capacity and infrastructure for a safe and efficient facility.

Analysis and recommendations developed during this study are focused on providing the basis for future improvements for Ocotillo Road. Additionally, the information developed in this study may be used to assist the Town of Gilbert in evaluating planning and design decisions for Flood Control District of Maricopa County improvements to Chandler Heights Basin as well as ancillary development on other adjacent parcels. All of the design elements of the preferred alternative for the proposed Ocotillo Road extension and bridged crossings of the East Maricopa Floodway (EMF) and Queen Creek Wash are anticipated to meet AASHTO and the Town of Gilbert guidelines and standards. No significant design exceptions are anticipated at this time.

6.2 ROADWAY TYPICAL SECTION

As shown on Figure 1.1, the typical roadway section for this segment of Ocotillo Road is defined in the Town of Gilbert Street Circulation Map as a Minor Arterial (Town of Gilbert, 2006b). A minor arterial is composed of two travel lanes and a bike lane in each direction separated by a striped median (Figure 6.1). Additionally, this section includes a detached sidewalk on each side of the roadway.

The proposed roadway typical section was modified following an Alternatives Review Meeting with the Town of Gilbert on October 24, 2008. At this meeting the project team concluded that the roadway section should be narrowed for the portion of roadway extending from the west approach to the bridge over the EMF through Chandler Heights Basin to the east bridge approach over Queen Creek Wash. The modifications consisted of reducing the striped median section to 4 feet and adding a raised concrete median to control access. Additionally, sidewalk at the bridge was placed adjacent to the curb. The reduction in roadway width was undertaken to reduce bridge and roadway costs, reduce right-of-way acquisition and associated costs, and to reduce impacts to the Chandler Heights Basin stormwater storage volume and control access. The modified sections are presented in Figure 6.1 (Top).

6.3 DESIGN CONTROLS

The design controls for this study were developed using the Town of Gilbert Engineering Standards and Standard Details (Town of Gilbert, 2005), the American Association of State Highways and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets (AASHTO, 2004). The roadway design criteria for this study are summarized in Table 6.1.

6.4 HORIZONTAL ALIGNMENT

The final horizontal alignment developed for this study was evaluated with respect to the design criteria presented in Table 6.1 on the following page and was based on the preferred alternative selected during the alternatives evaluation conducted for this study. Horizontal geometrics were prepared using base mapping developed from survey information collected and integrated during this study and from previous design activities conducted by Stantec for the Town of Gilbert.

Because of the dual quarter corners (see Section 3, Project Geomatics and Land Ownership Overview for complete discussion); the horizontal alignment for the west section of Ocotillo Road west of the RWCD canal is situated north of the existing alignment for the portion of Ocotillo Road east of Queen Creek Wash. Two curves separated by a tangent section were used to transition from the north alignment to the southern alignment. Curve and tangent information is shown on the Roadway Plan and Profile Drawings (Appendix G: 1 through 16).

6.5 VERTICAL ALIGNMENT

The vertical alignment developed for this study is controlled by the criteria presented in Table 6.1 for bridge clearances, minimum and maximum roadway grades, roadway superelevation, existing land use and the proposed ultimate configuration of Chandler Heights Basin. The conceptual vertical alignment prepared for this study is presented on the Roadway Plan and Profile Drawings (Appendix G: 1 through 16).

The conceptual vertical alignment is shown with minimum clearances over the EMF and Queen Creek Wash (Table 6.1) In order to assist in minimizing embankment fill through the Chandler

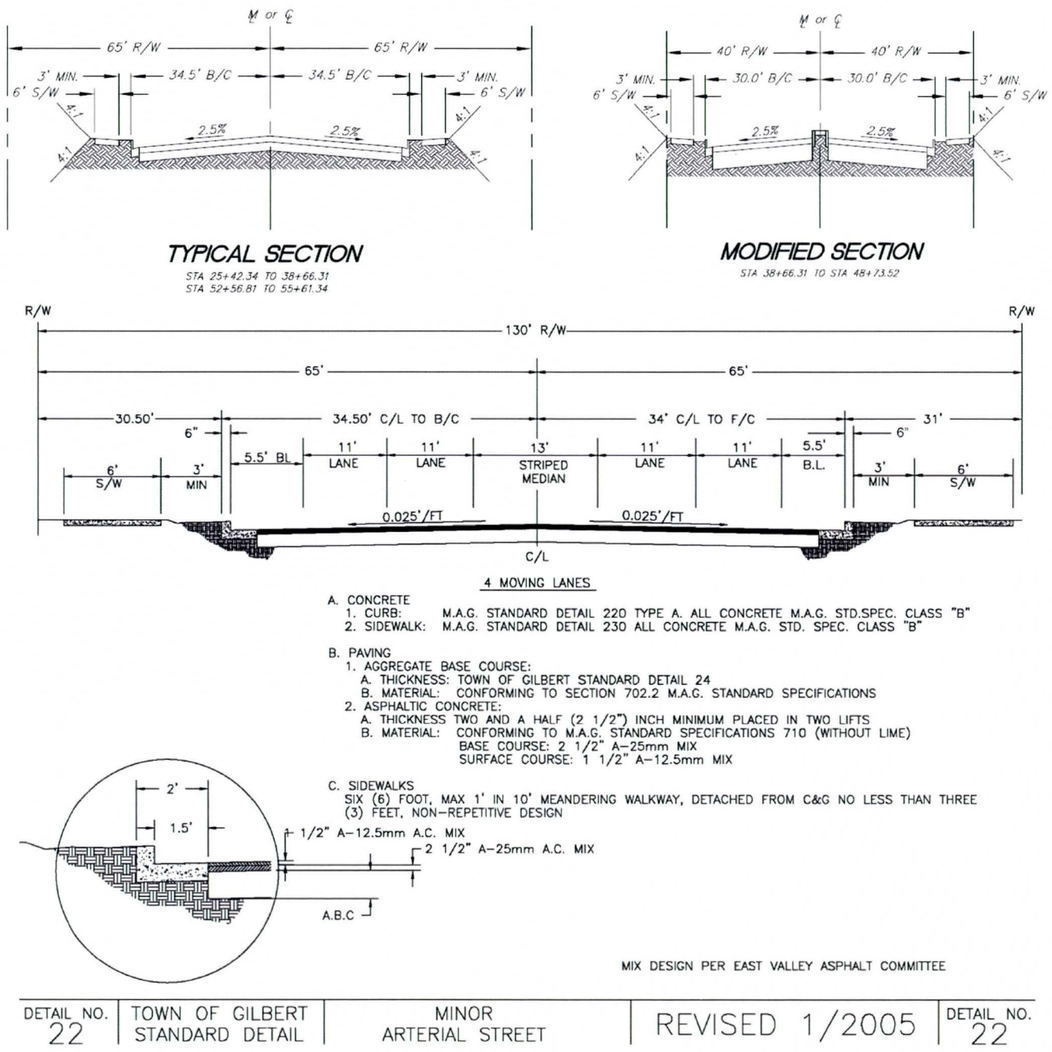


Figure 6.1: *Town of Gilbert typical section and modified bridge section of Ocotillo Road (Town of Gilbert, 2006a)*

Heights Basin and to maximize sight distance in the area of the vertical curves over each of these features. Sight distances in these areas are an important design consideration because each crest vertical curve is followed by a horizontal curve. Final design activities should evaluate sight distances carefully to ensure that the crest vertical curve does not hinder the driver's view of the horizontal curve. Final design activities should work to maximize the sight distance to this point of curvature in the horizontal alignment. Stopping sight distance was evaluated for the proposed vertical alignment in accordance with AASHTO (AASHTO, 2004) criteria and the associated design speed (Table 6.1).

The portion of Ocotillo Road that traverses the Chandler Heights Basin is presently anticipated to be in an embankment condition situated above the basin bottom at elevation differences exceeding 12 feet. Elevation differences between the roadway surface and the bottom of the basin could vary from a minimum of 10 feet to 20 feet. Final roadway design will need to examine the embankment heights and their associated fill-slopes carefully in order to maintain clear zone vehicle recovery areas. The roadway prism will impact the capacity of Chandler Heights Basin and careful attention will need to be given to minimizing the embankment fill material while maintaining appropriate roadway recovery areas and clear zones for vehicles that may leave the roadway.

For the purpose of this study the minimum recoverable fill slopes were used for the purpose of estimating earthwork and impact to the capacity of Chandler Heights Basin (Table 6.1). Recoverable slopes are all embankment slopes 4:1 (H:V) or flatter (AASHTO, 2004) that are relatively smooth and traversable so that motorists can generally stop their vehicles or slow them down enough to recover and return to the roadway. Fixed obstacles such as culvert headwalls or other barriers should be kept free of the clear zone. Appropriate recovery areas for Ocotillo Road should extend 20 feet to 40 feet (depending on final cross-section and embankment slope geometry) from the outside travel lane to the edge of a recoverable slope. Elevation differences between the roadway and the basin bottom are significant and consideration should be given in final design to extend the clear zone beyond the toe of slope with a clear run-out area at the base and/or flattening all or portions of the embankment slope to increase the ability for vehicles that leave the roadway to recover. Guardrails may be used to shield motorists from hazards for areas that do not provide adequate recovery slopes and clear zones during final design of the roadway (AASHTO, 2004).

6.6 RIGHT-OF-WAY

6.6.1 Existing

There is no existing right-of-way for the majority of the project corridor. Half street right-of-way has been dedicated for the portion of the project corridor abutting Shamrock Farms and Freeman Farms. Additionally, there is an existing 66-foot wide roadway easement that extends across parcels that are owned by the FCDMC; however, significant portions of the preferred alternative alignment are situated outside of the roadway easement. Existing right-of-way and parcel owners are shown on Roadway Plan and Profile Drawings (Appendix G: 1 through 16). Additionally, there are existing easements for utilities including overhead electric, water lines, reuse water lines and sewer lines. These utilities are discussed further in Section 9 and shown on Figure 9.1 the Roadway Plan and Profile Drawings (Appendix G: 1 through 16).

Table 6.1: *Design Criteria Summary*

Description	Design Criteria
Design Speed	55 mph
Minimum Freeboard (Low Bridge Chord to Calculated Water Surface Elevation)	2 feet
Minimum Clearance from Low Bridge Chord to Channel Bottom	13.5 feet
Maximum Roadway Grade Minimum Roadway Grade	3% 0.25%
Stopping Sight Distance	500 feet
Minimum Curve Radius (Without Superelevation)	1,200 feet
Lane Width (Travel Lane) Lane Width (Bicycle Lane)	11 feet 5.5 feet
Superelevation (Maximum)	0.04 ft/ft
Fill Slopes	4:1 (H:V)
Hazards and Nuisances to Pedestrian Traffic	Pedestrian/Vehicular Traffic Bridge Barrier
Calculated 100-yr Water Surface Elevation – Queen Creek Wash	1,310.65 feet
Calculated 100-yr Water Surface Elevation – EMF	1,306.01 feet
Design Water Surface Elevation – Chandler Heights Basin	1,308.12 feet

6.6.2 Proposed

Right-of-way or roadway easements for the proposed roadway alignment will need to be acquired from four distinct property owners through the corridor. Estimates for right-of-way to be acquired were developed for this study using the typical section for a minor arterial roadway as illustrated in Figure 6.1. Additionally, estimates for right-of-way to be acquired were also developed based on the modified roadway section present in Figure 6.1. These estimates, listed by property owner, are presented in Table 6.2 below.

The segment of Ocotillo Road traversing the Chandler Heights basin has a vertical alignment positioning the roadway significantly above the proposed elevation of the basin bottom and high water elevation for the basin. Because of this, the roadway will be in an embankment condition with respect to the basin. The embankment slope for this portion of the roadway will extend outside of the right-of-way. Slope easements and maintenance and access easements may be required in order to maintain fill slopes in this area.

Table 6.2: *Right-of-Way Requirements*

Owner	Roadway Section Right-of-Way (sq ft)	
	Standard	Modified
Freeman 304-77-006G	9,291	---
Freeman 304-77-006H	14,030	---
RWCD	19,294	---
FCDMC	180,304	124,645

6.6.3 Earthwork

Earthwork estimates were developed using AutoCAD Civil 3D software. An existing and proposed surface model was developed using field survey data collected for this project and proposed horizontal and vertical alignments for the preferred alternative. Earthwork estimates for construction of Ocotillo Road are closely tied to the next phase of construction for Chandler Heights Basin. The preferred roadway alignment is situated within a portion of Chandler Heights Basin that has not been constructed. The vertical alignment for Ocotillo Road presented in this report was developed to correspond to the ultimate improvements for this basin. Consequently, much of the roadway alignment is situated below existing ground surface that is expected to be modified during the

construction of the remaining phase of Chandler Heights Basin. Should the roadway be constructed prior to the improvements for Chandler Heights Basin, the project will generate significant amounts of excess material that will need to be removed from the project. Stantec estimates that for the roadway itself, the material will roughly balance based on current existing conditions, requiring an estimated 250 cubic yards of fill to construct.

Should improvements to portions of Chandler Heights Basin be constructed concurrently with the roadway improvements this quantity of fill material will decrease commensurate with the quantity of excavation associated with the basin improvements undertaken for that phase. Should the construction of Chandler Heights Basin be undertaken prior to roadway improvements, Stantec estimates that the construction of the roadway will require over 90,000 cubic yards of fill to be placed in Chandler Heights Basin in order to construct the roadway. For that reason, the project team recommends that roadway improvements undertaken by the Town be closely coordinated with Chandler Heights Basin improvements undertaken by FCDMC and vice versa.

6.7 CHANDLER HEIGHTS BASIN INTEGRATION

Preliminary coordination between FCDMC and the Town of Gilbert has been undertaken to coordinate improvements to both Chandler Heights Basin and Ocotillo Road to ensure that improvements to both of these facilities are coordinated in order to reduce costs and ensure that both projects are constructible. In order to provide data to assist in assessing the impact of the proposed roadway improvements on the capacity of Chandler Heights Basin earthwork calculations were undertaken using the proposed basin and roadway configurations. Stantec estimates that the roadway embankment will reduce basin capacity by approximately 40 acre-feet using the design information developed for this study.

6.8 CONSTRUCTABILITY AND TRAFFIC CONTROL

The Stantec project team evaluated the preferred alignment in order to provide information for assessing constructability and traffic control. Key constructability issues identified are tied to RWCD irrigation facilities and the construction of all or a portion of the next phase of Chandler Heights Basin. The proposed improvements contained in the preferred alignment will impact existing RWCD distribution canal, check structure, and turn-outs. Coordination with RWCD with respect to design and construction will be necessary to facilitate timely design and construction schedules that will coordinate with scheduled canal dry-up times.

Similarly, close coordination with FCDMC will be necessary during design and construction phases for this project because the preferred alignment crosses EMF, Queen Creek Wash, and Chandler Heights Basin. FCDMC is the largest landowner along the project corridor and the proposed improvements will have a significant impact on FCDMC facilities, land ownership, and access. Early identification of staging areas during construction and close coordination to maintain access to FCDMC and RWCD facilities as well as private property along the corridor will be a key consideration.

Construction schedules will be dependent on the final scope of work, particularly with respect to improvements to Chandler Heights Basin. Generally, bridge construction for pre-stressed concrete girder superstructures will be on the order of 6 to 8 months. Bridges and roadway construction can be undertaken concurrently. Total construction time is estimated to be 16 to 24 months.

Since there is no existing roadway for the majority of the project corridor traffic control will not be needed for much of the construction with the exception of the areas at the east and west terminus of the project and the Higley Road intersection. If significant construction activities result in disrupting traffic they are to be performed during off-peak hours. Final design should consider measures to minimize the duration and disruption of construction. Traffic control plans should be prepared during final design and maintained for the duration of construction activities.

6.9 INTERSECTIONS AND ACCESS TO FACILITIES

The project corridor is situated between Greenfield Road, a minor arterial, on the West and Higley Road, a major arterial, on the east. The project corridor will connect to the existing improvements east and west of these intersections respectively and no modifications to these intersections are anticipated in connection with the improvements undertaken as part of this project. Additionally, two other intersections abut the project corridor providing access to single-family residential subdivisions. These intersections are Freeman Farms Road, immediately west of the beginning of project and Banning Street, near the east terminus of the project (see Appendix G). Each of these intersections are unchannelized T-intersections providing access to Freeman Farms and Shamrock Estates respectively.

The horizontal geometrics developed for this project do not necessitate any modifications to the existing improvements for these intersections. However, the turning movements onto south-bound Banning Street from east-bound Ocotillo Road will occur approximately 300 feet east of the crest of the vertical curve on the Ocotillo Road bridge over Queen Creek Wash. Due to the proximity of this turning movement to the crest vertical curve, consideration may be given to the addition of a dedicated right-turn lane during final design activities. The addition of a right-turn lane would impact the existing curb, gutter, pavement, street light, sidewalk, and sidewalk ramps at this location; however, a dedicated right-turn lane would assist in protecting traffic turning onto south-bound Banning Street from east-bound Ocotillo Road.

In addition to the intersections noted above access will be provided to FCDMC and RWCD facilities from Ocotillo Road. Access driveways and median breaks will be provided prior to each bridge approach and will consist of a paved turnout with appropriate grading to provide access to maintenance roads abutting faculties. Access locations typical fall adjacent to the bridge approach the proposed roadway is elevated above the adjacent ground. This dissimilar elevation between the proposed roadway and the access roads for these facilities will necessitate grading to be undertaken on the access roadways to provide a smooth transition. Photograph 6.1 shows a typical configuration where the RWCD canal and FCDMC EMF facility are immediately adjacent and the transition from the bridge approach to the existing access roads is visible in the photograph. A shared driveway between the EMF and the canal provides access to both. Driveways and access points are shown in Appendix G - Roadway Plan and Profile drawings (1 of 16) at end of report.

***Photograph 6.1**: Taken from RWCD access road looking north at Pecos Road. The RWCD canal is in the foreground with the EMF and the Pecos Road bridge across the EMF in the upper right corner. Access to RWCD and the west bank of the EMF is provided via driveways extending from Pecos Road that are visible in the central portion of the photograph. Stantec understands that similar access will be provided to the RWCD and FCDMC facilities during final design activities.*

6.10 PAVEMENT DESIGN

Pavement design was not evaluated with location specific materials testing. The pavement section presented in Figure 6.2 was used for estimating purposes and taken from the Town of Gilbert standard detail for minor arterial street section in Figure 6.1 (Town of Gilbert, 2006a). Pavement design and coordination with the Town of Gilbert will be required during final design activities in order to develop a final design pavement section.

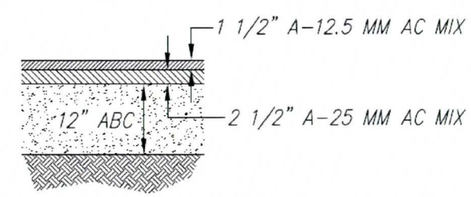


***Figure 6.2:** Pavement Structural Section for Ocotillo Road*

7. BRIDGE STRUCTURAL CONFIGURATION

7.1 EAST MARICOPA FLOODWAY BRIDGE

7.1.1 Bridge Geometry

Ocotillo Road over the EMF is symmetrical in section about its construction centerline. The construction centerline is not concurrent with the section line. Both the eastbound and westbound roadways consist of two 11'-0" through lanes, one 5'-6" bike lane, and one 6'-6" raised sidewalk with 1'-0" wide Combination Pedestrian - Traffic Bridge Railing (parapet). A 4'-0" wide raised median separates eastbound and westbound. The resulting out-to-out superstructure width is 74'-0" (Figure 7.1).

The Ocotillo Road horizontal alignment is on a tangent through the EMF crossing and the roadway is sloped away from the construction centerline at 0.025 ft/ft. The alignment crosses the EMF construction centerline at a skew angle of 37°38'54" right. The Ocotillo Road profile consists of a crest vertical curve through the EMF channel. Using the proposed Ocotillo Road profile will provide a minimum of 13'-6" clearance from the low chord of the bridge to the channel floor and 6'-6" to the 100-year High Water Elevation used for this study (Table 6.1). The structure has a total length of 358'-2½" that consists of three spans of 116'-8". This configuration in the ultimate condition allows for minimal disturbance within the channel.

7.1.2 Bridge Superstructure

Several bridge superstructures were evaluated:

- Pre-cast, prestressed, concrete AASHTO girders
- Cast-in-place, post-tensioned concrete box girders
- Pre-cast, prestressed box beams

A superstructure utilizing precast, prestressed, concrete AASHTO girders is most feasible for this site due to historically lower costs than cast-in-place, post-tensioned concrete box girder structures built on falsework over active washes. In addition, a precast, prestressed box beam superstructure is not recommended due the construction problems associated with skewed beam bridges with skews greater than 30 degrees.

7.1.3 Bridge Substructure

Abutments: A stub abutment cap supported by drilled shafts is most feasible at this location due to low allowable bearing capacity for spread footing foundations and better performance in locations where scour will occur. Shallow spread footings may be considered if scour can be prevented at the abutments and if allowable bearing pressures of four ksf or more are presented in the final geotechnical investigation foundations report.

Piers: A dropped pier cap supported by columns on drilled shafts is most feasible for supporting the AASHTO girder superstructure. Drilled shafts are most feasible at this location due to low allowable bearing capacity for spread footing foundations and better performance in locations where scour will occur. Piers will be located at two locations within the EMF and will be oriented parallel to the flow. Four 4-foot diameter pier columns supported by five-foot diameter drilled shafts will be used at each pier and will be sized to accommodate the dead and live loads acting on the superstructure.

7.1.4 Constructability

The length and weight of the girders is not excessive therefore special hauling vehicles will not be required. The contractor will be able to haul the girders with standard vehicles and should not have any difficulties accessing the bridge site. Overhead power lines, which are discussed further in the following section, will hamper the placement of the girders. Drilled shaft and column cages can be fabricated on site and then set into place with cranes. As falsework is not being used for the superstructure, the overall disturbance to the wash will be limited to substructure construction and girder erection. Steel stay-in-place deck forms are not recommended because they prevent inspection of the underside of the bridge deck, increase the volume of deck concrete and thus increase the load on the girders.

7.1.5 Utilities

An existing 69 kV overhead power line is located in the middle on the west side of the EMF bridge structure and continues to the bottom of the southeast side of the EMF bridge structure. The 69 kV power line should be relocated to north of the EMF bridge to allow proper clearances with the existing utilities located on the south side of the bridge. See Photograph 7.1 for a typical finished construction project that includes a bridge over the EMF SRP 69 kV power lines and RWCD Main Canal.

***Photograph 7.1**: Typical bridge, 69 kV power pole, canal, and roadway*

There is an existing underground 18-inch reclaimed waterline and a 33-inch sewer line that runs along the south side of the EMF bridge; however, these lines do not conflict with the structure and relocation would not be required. There are also 24- and 36-inch underground waterlines that run along the south side of the structure. These lines will not conflict with the roadway and bridge structure. Conduits for overdeck lighting will be required in the structure and will most likely be located within the sidewalk or parapet. Utility sleeves and conduits will be incorporated into the bridge decks to accommodate potential future utility installation. The structure is not anticipated to support underdeck lighting.

7.1.6 Recommendation for Bridge Type Selection

A superstructure utilizing precast, prestressed, concrete AASHTO girders supported by stub abutments on drilled shafts and dropped pier caps supported by columns on drilled shafts is recommended for this site based on better performance at waterways, distinct construction advantages, total cost, geotechnical parameters, vertical profile, clearance requirements and aesthetic considerations.

7.2 QUEEN CREEK WASH

7.2.1 Bridge Geometry

Ocotillo Road over Queen Creek Wash is symmetrical in section about its construction centerline. The construction centerline is not concurrent with the section line. Both the eastbound and westbound roadways consist of two 11'-0" through lanes, one 5'-6" bike lane, and one 6'-6" raised sidewalk with 1'-0" wide Combination Pedestrian - Traffic Bridge Railing (parapet). A 4'-0" wide raised median separates eastbound and westbound. The resulting out- to-out superstructure width is 74'-0" as shown in Figure 7.1.

The Ocotillo Road horizontal alignment is on a tangent through the Queen Creek Wash crossing and the roadway is sloped away from the construction centerline at 0.025 ft/ft. The alignment crosses Queen Creek Wash construction centerline at a skew angle of 33°16'32" right.

The Ocotillo Road profile consists of a crest vertical curve through Queen Creek Wash. Using the proposed Ocotillo Road profile will provide a minimum of 13'-6" clearance from the low chord of the bridge to the floor of the wash and 4'-10" to the 100-yr High Water Elevation used for this study (Table 6.1).

The structure has a total length of 357'-9 5/16" that consists of three spans of 116'-8". This configuration in the ultimate condition allows for minimal disturbance within the wash.

7.2.2 Bridge Superstructure

Several bridge superstructures were evaluated:

- Pre-cast, prestressed, concrete AASHTO girders

- Cast-in-place, post-tensioned concrete box girders
- Pre-cast, prestressed box beams

A superstructure utilizing precast, prestressed, concrete AASHTO girders is most feasible for this site due to historically lower costs than cast-in-place, post-tensioned concrete box girder structures built on falsework over active washes. In addition, a precast, prestressed box beam superstructure is not recommended due the construction problems associated with skewed beam bridges with skews greater than 30 degrees.

7.2.3 Bridge Substructure

Abutments: A stub abutment cap supported by drilled shafts is most feasible at this location due to low allowable bearing capacity for spread footing foundations and better performance in locations where scour will occur. Shallow spread footings may be considered if scour can be prevented at the abutments and if allowable bearing pressures of 4 ksf or more are presented in the final geotechnical investigation foundations report.

Piers: A dropped pier cap supported by columns on drilled shafts is most feasible for supporting the AASHTO girder superstructure. Drilled shafts are most feasible at this location due to low allowable bearing capacity for spread footing foundations and better performance in locations where scour will occur. Piers will be located at two locations within Queen Creek Wash and will be oriented parallel to the flow. Four 4-foot diameter pier columns supported by 5-foot diameter drilled shafts will be used at each pier and will be sized to accommodate the dead and live loads acting on the superstructure.

7.2.4 Constructability

The length and weight of the girders is not excessive, therefore special hauling vehicles will not be required. The contractor will be able to haul the girders with standard vehicles and should not have any difficulties accessing the bridge site. Overhead power lines, which are discussed further in the following section, will hamper the placement of the girders. Drilled shaft and column cages can be fabricated on site and then set into place with cranes. Since falsework is not being used for the superstructure, the overall disturbance to the wash will be limited to substructure construction and girder erection. Steel stay-in-place deck forms are not recommended because they prevent inspection of the underside of the bridge deck, increase the volume of deck concrete and thus increase the load on the girders.

7.2.5 Utilities

Existing 69 kV overhead power lines cross over the northwest quadrant of the Queen Creek Wash bridge structure to northeast quadrant. Similar to the EMF bridge crossing, coordination with SRP will be required for relocating the 69 kV lines to the north, away from the bridges drilled piles.

There is an existing underground 18-inch reclaimed waterline and a 33-inch sewer line that run along the south side of the Queen Creek Wash structure. These lines cross under the south end of the east abutment (Abutment 2); however, coordination during the construction for drilled shaft reinforcing cages and abutment cap could eliminate the relocation of the 18- and 33-inch utilities. It will be necessary to pothole the lines so that southern most drilled shaft can be located away from these lines. The final designer will need to coordinate the required offset with the owner of the utility (Town of Gilbert).

There are 24- and 36-inch underground waterlines that run along the south side of the Queen Creek Wash structure. These lines should not conflict with the bridge as currently shown for the preferred alternative.

Conduits for overdeck lighting will be required in the structure and will most likely be located within the sidewalk or parapet. Utility sleeves and conduits will be incorporated into the bridge decks to accommodate potential future utility installation. The structure is not anticipated to support underdeck lighting.

7.2.6 Recommendation for Bridge Type Selection

A superstructure utilizing precast, prestressed, concrete AASHTO girders supported by stub abutments on drilled shafts and dropped pier caps supported by columns on drilled shafts is recommended for this site based on better performance at waterways, distinct construction advantages, total cost, geotechnical parameters, vertical profile, clearance requirements and aesthetic considerations.

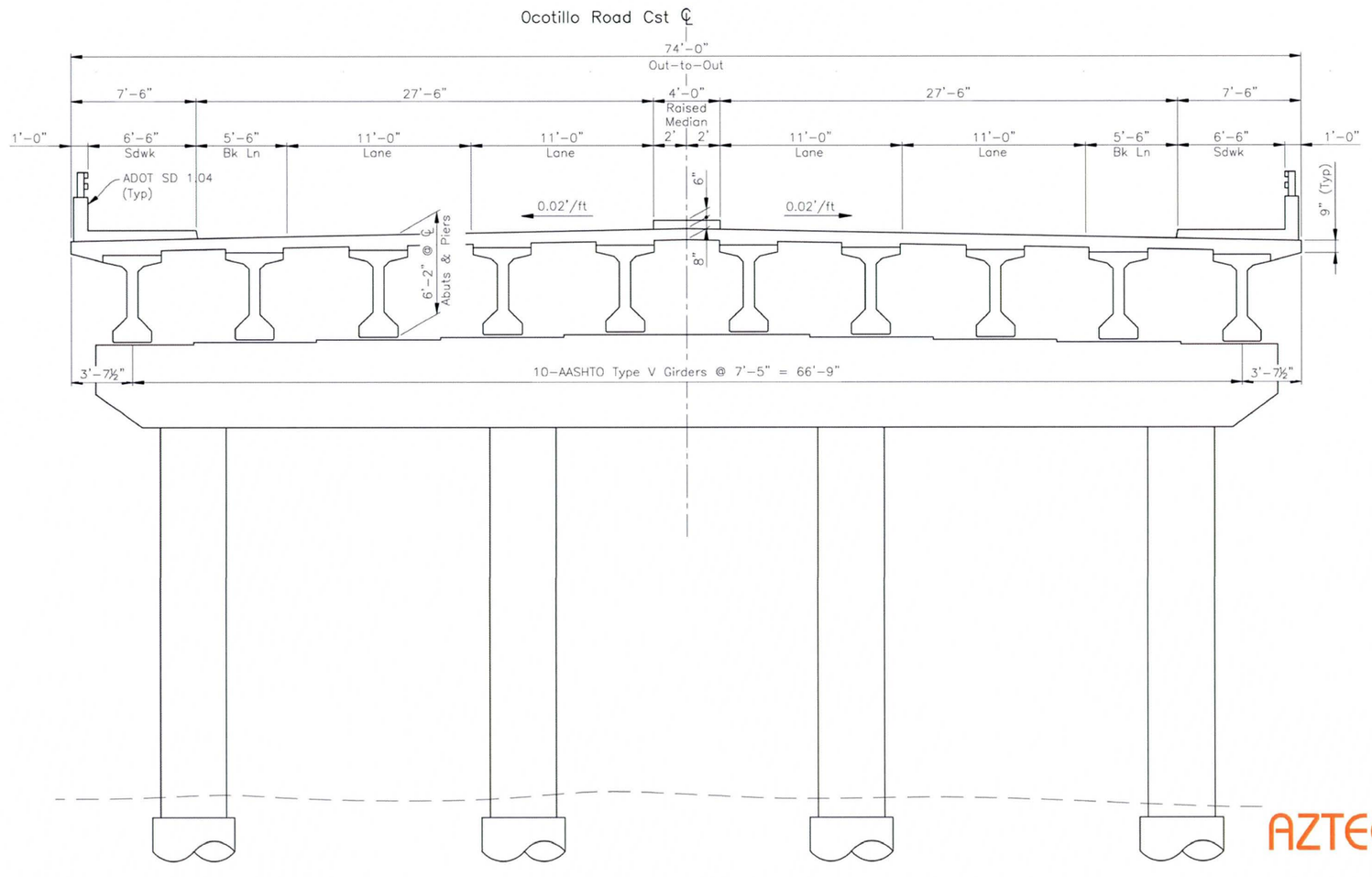


Figure 7.1: *Bridge cross-section for Queen Creek Wash and East Maricopa Floodway Bridges*

8. DRAINAGE

8.1 OFFSITE STORMWATER

8.1.1 General

Three major water courses converge within the Ocotillo Road Alignment Study project boundaries. These three water courses include the Sonoqui Wash, Queen Creek Wash, and East Maricopa Floodway. Floodplains that historically existed within this area of Gilbert have been removed with the development of these three floodway improvement projects. In addition to these three water courses, there is a major surface water detention facility partially constructed from the Ocotillo Road alignment south to Chandler Heights Road. Additional construction is proposed and currently designed to extend the basin north across the proposed Ocotillo Road alignment to Queen Creek Road. This detention facility, identified as the Chandler Heights Basin, is located just west of Higley Road (see Figure 1.2). Most of the proposed road options evaluated and the selected road option recommend modifying the current basin design into two cells with a box culvert connecting the two.

Both Sonoqui and Queen Creek Washes traverse southwesterly across the Ocotillo Road alignment and outfall about one-half mile south near Chandler Heights Road. Specific watercourse orientation includes:

- Sonoqui Wash discharges to Queen Creek Wash within their confluence just north of the Ocotillo Road project alignment and Higley Road.
- Queen Creek Wash continues southwest to the Chandler Heights Basin spillway structure, which is located just south of the Ocotillo Road project alignment and west of Higley Road. The spillway structure provides for discharge and attenuation of the peak Queen Creek Wash floodway flows. Queen Creek Wash then continues southwest to its confluence with the East Maricopa Floodway near Chandler Heights and Greenfield Roads.

8.1.2 Floodplain Origin and Watershed

Sonoqui Wash originates in Pinal County and passes through the towns of Queen Creek and Gilbert. As Sonoqui Wash crosses Power Road about two miles east of the project area, it enters Maricopa County. It continues flowing to the west and terminates west of Higley Road along the north side of the Ocotillo Road alignment. The wash has a contributing watershed area of about 70 square miles and is comprised of farm fields, unimproved desert including the San Tan Mountains and medium density residential subdivisions. According to the HEC-1 regional watershed model, the 100-year discharge for Sonoqui Wash ranges from 1,800 cfs near the upstream project limit to 2,400 cfs at the downstream end.

Queen Creek Wash flows from east to west across the northern portion of Pinal County, but its 60-mile length is within the Middle Gila Watershed and its headwaters originate from Queen Creek Canyon in the mountains above Superior. Queen Creek Wash has one dam included on its watershed (Whitlow Ranch Dam), constructed by the Army Corps of Engineers upstream of Queen Valley as a result of a significant storm event in 1954. Queen Creek Wash crosses US 60 north and west of Florence Junction, and discharges into the East Maricopa Floodway southwest of the Ocotillo Road Project area. The wash has a contributing area of around 150 square miles and is comprised of mountainous watershed, unimproved desert lands, farm fields, downstream clusters of developing commercial areas and medium density residential subdivisions. According to regional watershed studies, the 100-year discharge for Queen Creek Wash ranges from 600 cfs just downstream of Whitlow Ranch Dam to 6,525 cfs near its confluence with the East Maricopa Floodway.

Photograph 8.1: *Looking west along the Ocotillo Road alignment across Queen Creek Wash*

The East Maricopa Floodway is the major flood control outfall for the entire east valley. It bisects the southeastern part of the Town of Gilbert's planning area and extends onto the Gila River Indian Community. The East Maricopa Floodway's ultimate outfall location is to the Gila River within the Gila River Indian Community at a location west of Arizona Highway 587. The capacity of the EMF is approximately 8,000 cubic feet per second (cfs). The existing condition 100-year flows are approximately 16,000 cfs. The Flood Control District of Maricopa County attenuates the excess runoff with the construction of the off-line basin bisected by the Ocotillo Road alignment and identified as the Chandler Heights Basin.

Photograph 8.2*: EMF looking southwest across RWCD Main Canal and private property south of Ocotillo Road alignment.*

8.1.3 Runoff Management

The most significant off-site stormwater facility related to Ocotillo Road within this region is the East Maricopa Floodway (EMF), which serves as an outfall channel for both the Sonoqui and Queen Creek drainage facilities. The EMF was designed and constructed by the Soil Conservation Service (SCS, currently known as the Natural Resources Conservation Service, NRCS) to be the east valley's primary regional storm water outfall. The EMF was originally designed to accommodate storm water runoff from existing agricultural or undeveloped mountainous and desert regions of the east valley. However, due to development of agricultural and undeveloped desert lands during recent years, the floodway is currently undersized for the current and ultimate development 100-year storm events. The EMF serves as an outfall drainage channel for a watershed area of approximately 260 square miles and Queen Creek and Sonoqui Washes are major contributors to the ultimate discharge.

The East Maricopa Floodway Mitigation Basins Project is the result of studies completed on the EMF channel in relation to the District's Queen Creek/Sonoqui Wash hydraulic master plan. The basin project impacting the Ocotillo Road alignment consists of a large off-line detention basin of about 233 acres that is bisected by Ocotillo Road. Half of the basin lies south of Ocotillo Road and has already been constructed. The other half of the basin lies north of Ocotillo Road and will likely be constructed after the Ocotillo Road improvements are completed. It is proposed that the construction of the north basin facilities will be completed as part of the Ocotillo Road improvements to the north edge of the Ocotillo Road easement. This will eliminate the need for a future Flood Control District contractor to complete construction within the roadway right-of-way.

8.2 FLOODWAY DESIGN CRITERIA AND PARAMETERS

8.2.1 East Maricopa Floodway

The East Maricopa Floodway has several basins and channels within the East Mesa Area Drainage Master Plan (ADMP) area that

have not been constructed, including areas along Sonoqui Wash and the Rittenhouse Basin and the Chandler Heights Basin. The latest formal study of the existing conditions in the EMF was prepared by HNTB Corporation (HNTB) under the East Maricopa Floodway Capacity Assessment Study (FCD 97-06). For the existing conditions flows, the HNTB hydraulic model assumed that flows, even if higher than the EMF channel banks, could not escape the channel and the maximum discharge is 12,990 cfs. FCDMC recommended using 6,900 cfs for the channel design discharge flow rate for this reach of the EMF (Email communication with Cathy Regester on January 29, 2008). The maximum water surface elevation in the EMF at Ocotillo Road at this discharge is 1306.01 feet (NAVD 88).

Photograph 8.3: *Looking northwest from Ocotillo Road alignment across East Maricopa Floodway*

A bridge is proposed across the EMF with the low chord elevation of the bridge proposed to be at least 2.0 feet above the water surface elevation of the recommended design discharge water surface elevation. This results in a low chord elevation of no less than 1,308.01. However, as discussed in Section 7.2.1, the governing vertical criteria is 13.5 foot clearance for equipment which exceeds the 2.0 foot criteria. Hydraulics for bridge piers have been conceptually reviewed for this study, but their affect on the floodway hydraulics will also need to be reviewed during the predesign phase of the roadway design.

8.2.2 Chandler Heights Basin

The Chandler Heights Basin was designed as an off-line detention basin to attenuate flows from the Sonoqui and Queen Creek Washes. Flow enters the basin from a side weir located just south of the Ocotillo Road alignment and exits through a multiple box culvert located just north of Chandler Heights Road. It is proposed that the Basin will be bisected into two 100-acre plus segments, with one segment located north and one segment located south of Ocotillo Road. Currently the first basin cell south of the Ocotillo Road alignment is constructed. It is currently anticipated by FCDMC that the north basin cell will be scheduled for construction during the 2011 or 2012 fiscal year.

It is proposed for this project that a box culvert be constructed for Ocotillo Road roadway access between the north and south basin cells. The box culvert would be designed for the ultimate roadway design width and adequate capacity to equalize the two basins without adversely creating hydraulic backwater affects to the south half basin.

The proposed box culvert design is based on the following criteria:

- Maintain velocities through the box culvert to less than seven feet per second.
- Maintain a 13'-6" clearance for equipment.

The maximum spillway flow rate discharging to the Chandler Heights Basin is 2,360 cfs and the maximum basin storage volume is reached at an elevation of 1,308.12. (Kirkham Michael, 2004a, NAVD 88). Appendix B includes the hydraulic analysis summary prepared for preliminary box culvert sizing. The proposed box culvert design consists of a 5-barrel box culvert, 12 feet wide by 13 feet, six-inches tall.

Design of the Ocotillo Road improvements will require close coordination with FCDMC related to construction of the Chandler Heights Basin north cell. It will be required that the roadway design engineer coordinate the construction requirements for the two projects so that there is a clear delineation of construction scope between the roadway and the basin construction. Included in this coordination effort will be a requirement to modify the existing FCDMC project plans for the north basin cell based upon the developed roadway and box culvert plans. The responsibility for insuring that the FCDMC plans are modified will belong to the selected roadway design engineer.

8.2.3 Queen Creek Wash

Sonoqui Wash enters Queen Creek Wash just west of Higley Road and north of Ocotillo Road. Queen Creek Wash continues to flow to the southwest and joins with the EMF just north of Chandler Heights Road. A side inlet weir, located just south of Ocotillo Road, allows flow from Queen Creek Wash to enter the Chandler Heights Basin. The 100-year event water surface elevation in Queen Creek Wash is elevation 1,310.65 feet (NAVD 88) and was obtained from a HEC-RAS model developed by Kirkham Michael (Kirkham Michael, 2004a).

Photograph 8.4: *Looking southeast from Ocotillo Road alignment toward Chandler Heights Basin spillway and south cell of basin*

It is proposed for this study that a bridge be constructed across Queen Creek Wash with the low chord elevation of the bridge proposed to be at least 2.0 feet above the 100-year event water surface elevation. This results in a low chord elevation of no less than 1,312.65. Hydraulics for bridge piers have been conceptually reviewed for this study, but their affect on the floodway hydraulics will also need to be reviewed during the predesign phase of the roadway design.

8.2.4 Floodway Scour analysis

This section summarizes the study-level results of the scour analysis completed for the crossing of the EMF and Queen Creek Wash. Scour analysis was not conducted for the Chandler Heights basin because excessive velocities in the basin are not anticipated. The total scour that can be expected to occur is the sum of individual scour components.

Scour components typically considered are:

- Long-term degradation
- General scour
- Local scour
- Bend scour (when not considered as part of local scour)
- Bedform movement
- Low-flow incisement
- Bridge Pier

Methodologies and procedures utilized for estimating each component of scour are discussed in the following sections and follow the procedures given in the *Drainage Design Manual for Maricopa County, Hydraulics: Sedimentation* (FCDMC, 2007). Hydraulic parameters used in the scour calculations were obtained from the *Design Calculation and Analysis Notebook, Rittenhouse and Chandler Heights Detention Basins*, by Kirkam Michael Consulting Engineers, dated March 2004 (Kirkam Michael Consulting Engineers, 2004a). Physical parameters used in the bridge pier scour calculations were obtained from Aztec Engineering.

Long-term Degradation: Long-term degradation is a general, progressive lowering of the channel bed over the length of a watercourse. It is generally considered to be a result of a "system-wide" change in the morphology of the watercourse or watershed. The long-term degradation was calculated using the Level 1 equation for long-term degradation in the *State Standard 5-96, Watercourse System Sediment Balance*, dated September 1996 (ADWR, 1996). A conservative approach for the calculations was utilized, which included an assumption that downstream controls do not exist on the system.

General Scour: General scour occurs during a flood and/or during a series of floods that are expected to occur during the design life of a structure. General scour was calculated using the empirical equations (i.e. Abbot equation, Lacey equation and Blench equation for zero-bed-transport) by the Bureau of Reclamation (Pemberton and Lara, 1984). Bend scour was added to the Lacey and Blench equation using the coefficients found in the Pemberton and Lara publication. The Neill equation was not used since the channel was not constricted by a bridge or contraction structure. Engineering judgment was used to select a value for general scour based on the results of each of the equations.

Local Scour: Local scour is caused by flow irregularities due to restrictions along the bank or by structures in the watercourse. It was set to zero because the existing washes do not have any constrictions.

Bend Scour: Bend scour was included in the general scour equation.

Bedform Movement: Bedforms are a result of the interaction of hydraulic forces (boundary shear stress) and the bed sediment. Typically, bedforms consist of alternating "mounds" and "troughs" that move longitudinally along the watercourse. The type and magnitude of the bedform is a function of the flow regime. The dune scour was calculated by using the formula included in the *Flood Control District Maricopa County Drainage Design Manual* (FCDMC, 2007).

Low-flow Incisement: In discussions with the FCDMC, there are plans to add a low flow channel in the EMF and low flow incisement was set to 2.5 feet. For Queen Creek Wash the low flow incisement was set to 1.5 feet since this is a minor watercourse.

Bridge Pier: The Colorado State University (CSU) equation was used to predict the maximum pier scour depth (ACOE, 2001). Physical parameters for the piers were provided by Aztec Engineering for the proposed bridge and included pier diameter, pier spacing and bridge skew. Abutment scour was not calculated because it was assumed that the bridges would not encroach into the washes.

Safety Factor: A 20 to 30 percent factor of safety is normally added to the estimated sum of all scour components to account for non-uniformity of hydraulic and sediment data in the channel (FCDMC, 2007). A thirty percent safety factor was added to the total scour depth calculated for each wash crossing.

Scour Analysis Results: Appendix C Tables 1 and 2 include summaries of the scour analysis for EMF and Queen Creek Wash. The total scour for EMF and Queen Creek Wash is approximately 32 and 28 feet, respectively.

8.3 ON-SITE STORMWATER RUNOFF MANAGEMENT

The Town of Gilbert requires on-site retention for all subdivisions and new development. Retention areas are designed to accommodate water runoff generated by a 50 year, 24 hour storm event, areas onsite, and one half of adjacent right-of-ways. Retention basins are to be designed to be no more that 3 feet in depth and of an acceptable aesthetic quality using no more that 50% of the right-of-way and landscape setbacks. Retention basins are to be drained within 36 hours by a storm drain or dry well. Drywells are to follow ADEQ standards and are to be registered and maintained by the property owner. Preliminary roadway pavement drainage analysis conducted for this study is focused on minimizing storm drain and retention facilities, while maintaining Town of Gilbert criteria for dry lane and stormwater storage standards. For the purpose of this study, pavement drainage has been separated into three distinct sections that coincide with the drainage divides created by the roadway vertical alignment:

- From the beginning of project to the crest vertical curve over the EMF
- From the crest vertical curve over the EMF through Chandler Heights Basin to the crest vertical curve over Queen Creek Wash
- From the crest vertical curve over Queen Creek Wash to the east end of the project near the intersection of Ocotillo Road and Higley Road

Each of these areas will require separate stormwater collection, conveyance and storage systems.

For the purposes of this study, combination curb opening/grated catch basins are proposed to capture stormwater runoff and convey it to nearby retention basins using short lengths of pipe. Retention volume estimates were developed using Town of Gilbert guidelines. Supporting hydrologic calculations, catch basin size calculations, storm drain calculations, and retention calculations are presented in Appendix D. Additionally, first flush calculations were developed for stormwater storage using Town of Gilbert and Flood Control District of Maricopa County guidelines for the purpose of comparison. Conceptual storage basin locations and size were developed based on full retention calculations and are presented in Appendix G, found at end of report.

The central section of the project, extending from the crest vertical curve over the EMF through Chandler Heights Basin to the crest vertical curve over Queen Creek Wash, comprises the majority of the project. Stormwater runoff generated within the right-of-way will be directed to the adjacent Chandler Heights Basin owned and maintained by FCDMC via retention basins situated adjacent to the roadway. The use of first flush basins in lieu of full retention may be a consideration for discussion with FCDMC in order to minimize the necessary easement area and volume of detention storage.

Photograph 8.5: *Shamrock Estate retention basin south of Ocotillo Road looking east.*

The western section of Ocotillo Road extending from the beginning of project to the crest vertical curve over the EMF will capture stormwater runoff and direct it to retention facilities within the right-of-way or adjacent properties. The availability of adjacent property is limited to two privately owned parcels along the south side of the roadway. Consideration during final design may need to be given to utilizing subsurface retention if the two privately owned parcels are not acquired or are inadequate for the full retention volume required.

The eastern section of Ocotillo Road extending from the crest vertical curve over Queen Creek Wash to the east end of project near the intersection of Ocotillo Road and Higley Road will also require separate stormwater collection and retention facilities. Available adjacent property is limited to the FCDMC parcel to the north. A temporary basin is currently located on this parcel. Proposed improvements for Ocotillo Road will eliminate the existing basin, requiring it to be enlarged and relocated.

8.4 ON-SITE STORMWATER DRAINAGE CRITERIA AND PARAMETERS

Pavement grade changes to Ocotillo Road between the East Maricopa Floodway and Queen Creek Wash are necessary to provide vertical clearance requirements for access and maintenance beneath the bridges proposed for the two flood control facilities. The grade changes required to elevate the roadway up and over the EMF and Queen Creek Wash create three distinct regions for roadway surface runoff. The three drainage regions are divided by the EMF and Queen Creek Wash. These regions and the approximate surface area that will require retention facilities will consist of:

1. The surface drainage between the middle of EMF to the west. The roadway area to be included for determination of stormwater runoff retention facilities will include the south half of Ocotillo Road right-of-way from the centerline of the EMF to a point approximately 1,400 feet west.
2. The surface drainage between the middle of EMF to the middle of Queen Creek Wash. The roadway surface area to be included for determination of stormwater retention runoff facilities will include the full roadway right-of-way between the centerline of EMF to the centerline of Queen Creek Wash, which includes a total roadway length of about 1,400 feet.
3. The surface drainage between the middle of Queen Creek Wash east to Higley Road. The roadway surface area to be included for determination of stormwater retention runoff facilities will include the north half of the Ocotillo Road right-of-way between the centerline of Queen Creek Wash to the edge of the Higley Road intersection, which includes a total roadway length of about 1,200 feet.

The total retention volume required for the project was obtained by following the procedures in the TOG drainage engineering standards (TOG, 2005). It was also based on using the TOG typical section for a minor arterial street and assuming a 130 feet wide right-of-way width. The total retention volume required is approximately 1.87 acre-feet. Summary of the retention volume calculations are included in Appendix D.

It is proposed that retention facilities be designed and constructed for all three roadway regions that meet Town of Gilbert design standards. As shown in Appendix G, 1 through 16 at end of report, this will require the acquisition of approximately 0.5 acres of easement for the basin located west of EMF and approximately 1.35 acres of Flood Control District easement for the multiple basins located between EMF and Higley Roads. Alternatively, the western retention basins shown on partially on private property could be replaced with underground storage (large diameter buried pipelines) in lieu of purchasing additional right-of-way from the private property owners on the southwestern side of the RWCD Main Canal.

Stantec also met with FCDMC to discuss the possibility of constructing only first flush retention basins for the EMF to Queen Creek Wash reach. The rainfall that will land on the roadway would normally have fallen into the Chandler Heights Basin; therefore, it is reasonable to consider allowing the roadway drainage for this reach to enter the Basin; however, FCDMC is concerned about potential contamination from the roadway in the storm water and will definitely require collection and/or treatment of the first flush storm water.

Final roadway drainage options will be addressed in preliminary and final design of the roadway.

8.5 FLOODPLAIN PERMITTING PROCEDURES

Floodplain permits will be required to construct within the right-of-way of the EMF and Queen Creek Wash. FCDMC will expect that the numerous flood control design and construction issues related to this project are adequately addressed before the floodplain permits will be issued. This will require that the roadway designer's surface drainage engineer coordinate closely with FCDMC throughout the duration of the project for design input and review, land acquisition coordination and submittals, and construction coordination.

Some of the anticipated flood control issues that will require coordination with FCDMC prior to issue of floodplain permits may include the following:

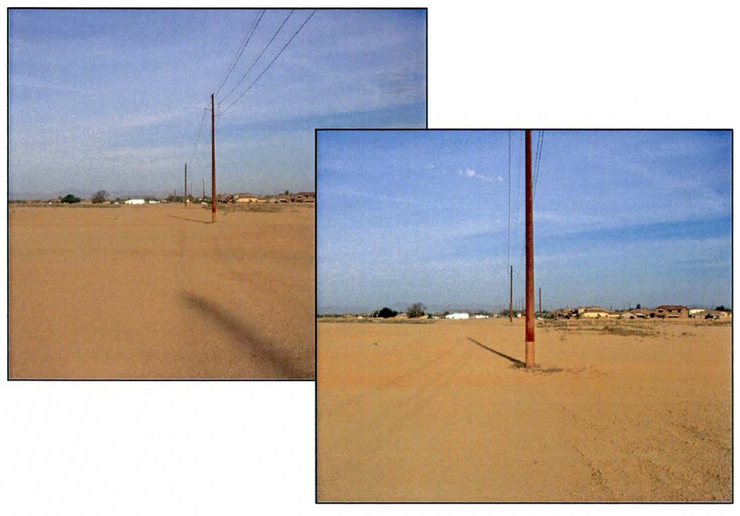
- Design phase concepts and requirements for FCDMC land acquisition requirements.
- Exhibits and legal descriptions of proposed land acquisition parcels.
- Potential FCDMC impacts and schedule of necessary RWCD check structure and box culvert crossing modifications.
- Predesign and design plans and specifications for bridge crossings.
- Predesign and design concepts for bridge pier locations.
- Hydraulic assessment and scour calculations for EMF and Queen Creek Wash at proposed bridge and pier locations.
- Predesign and design plans and specifications for Chandler Heights Basin box culvert.
- Completed construction plan modifications for the north phase (cell) of the Chandler Heights Basin that incorporate the necessary modifications of the proposed roadway design.
- Pre-design and design calculations for pavement drainage and stormwater collection facilities.
- Designer verification of 404 permit coordination.
- Anticipated construction schedule.

9. UTILITY CONDITIONS AND PROPOSED MODIFICATIONS

A variety of utilities that parallel or cross the Ocotillo Road corridor including SRP electric, the RWCD Canal, Town of Gilbert water, sewer and reclaimed water and City of Chandler water (see Figure 9.1). The FCDMC features (the EMF, Chandler Heights Basin and Queen Creek Wash) are not considered utilities and impacts to the project by these features are addressed separately in Section 8. Various alignments for the roadway were evaluated, in part to reduce or eliminate the impacts of the potential roadway on the utilities. The following discussion addresses the specifics of the various utilities, the proposed changes based on the preferred alignment and the cost and schedule impacts to the construction.

9.1 SALT RIVER PROJECT POWER

SRP has a 69 kV overhead along the northern road alignment from Greenfield to Higley Roads (see Figure 9.1). This alignment falls along the road right-of-way boundary as currently defined. Therefore, from the RWCD Main Canal to Higley Road, the power line is located 33 feet north of the section line. Name plate information identifies that these power poles were only recently installed. The preferred Ocotillo Road alignment selected, in addition to all of the alternative alignments evaluated, requires the relocation of some or several of these 69 kV power poles. In particular, the preferred alignment shown on Figure 9.1 will require the relocation of seven power poles for the construction of the new Ocotillo Road roadway section.



Photographs 9.1 & 9.2: *Looking east along the SRP 69 kV power lines alignment that runs east west from Greenfield Road to Higley Road. The alignment is located approximately 33 feet north of the section line.*

The relocation of the SRP electric alignment will need to be coordinated with the proposed roadway alignment and with the proposed relocation of the RWCD check structure and turnout. RWCD has identified that they require adequate overhead clearance to remove and maintain their check structure gates. In addition, SRP occasionally adds lower voltage lines at lower elevations which could impact RWCD maintenance if the two are co-located in the same area. Therefore, it is proposed that the 69 kV lines be relocated north of their current location, but close to the proposed roadway alignment to prevent conflict with the relocated RWCD check structure.

SRP also has an underground 12 kV line that parallels the existing Ocotillo Road on the south side from Greenfield Road to the northwest corner of the private Freeman Property near the approximate western beginning point of this project (see Figure 9.1). The 12 kV line continues overhead from there to the RWCD Main Canal where it currently terminates. This line was used primarily to feed a retired groundwater well located on the west side of the RWCD Canal. Because the groundwater well is no longer in use, it would be recommended that the reach of overhead power line connecting to the well be abandoned and removed. Final resolution of the 12 kV power line will depend on how the property owners close out their power requirement or change their power requirement. The cost estimate includes cost to underground this line in the event that the line is still active when roadway construction is completed.

9.2 ROOSEVELT WATER CONSERVATION DISTRICT

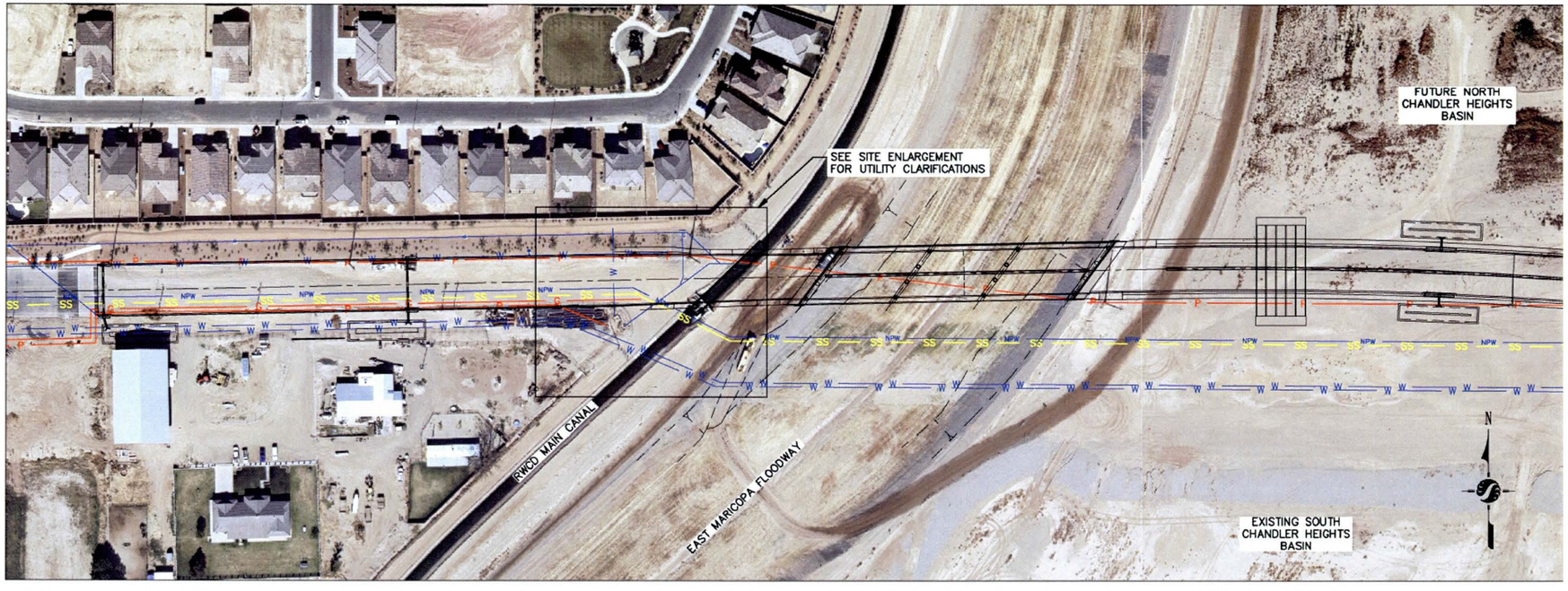
Although a variety of utilities are affected by the proposed Ocotillo Road extension, the RWCD features will have the greatest impact on construction and schedule. To that end, separate face to face discussions with RWCD staff were held on April 10, 2009 to collect their input on design requirements, construction requirements, and sequencing of events (see Appendix F - Stakeholder Meetings and Correspondence). Although RWCD modifications represent only about 5% of the overall project costs, RWCD utility relocations can significantly affect the design, construction and overall schedule. RWCD should be re-contacted early in the design phase of the project to reconfirm design criteria.

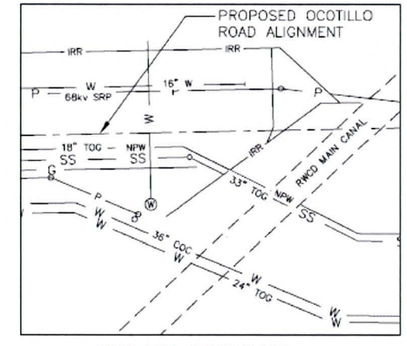
9.2.1 RWCD Existing Features

RWCD operates and delivers water to several features in the Ocotillo Road corridor (see Figure 9.1). The most prominent feature is the Main Canal that follows the natural contours of the area with water flowing from the northeast to the southwest crossing the proposed Ocotillo Road alignment. The second RWCD feature is a parallel lateral that runs from the Main Canal turnout west along the northern edge of the Ocotillo Road alignment. RWCD also turns out water to a private irrigation lateral that delivers water to the farm field located south of the Ocotillo Road alignment and just west of the Main Canal. A check structure is located in the canal on the southern edge of the proposed Ocotillo Road crossing and the turnout for the RWCD lateral and private farm lateral is located on the northern edge of the proposed alignment. A crossing feature such as a box culvert or a bridge is required to allow Ocotillo Road to pass over the RWCD Main Canal. The check structure and turnouts require relocation depending on roadway alignment and crossing feature selected.

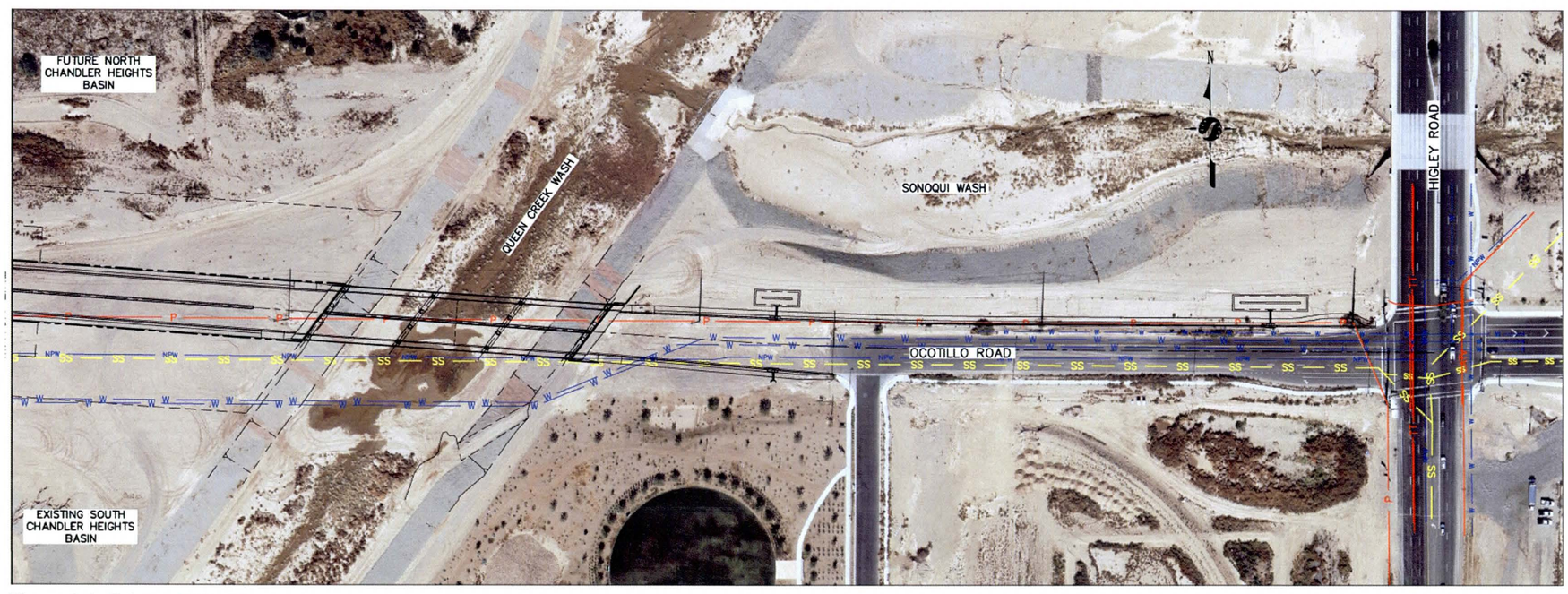
Photograph 9.3: *Looking south along the RWCD Main Canal at the approximate location of the proposed box culvert. The existing check structure and turnout (not in view) will be relocated upstream of this location.*

Ocotillo Road and the Greenfield intersection were improved in 2007, as part of the construction of the subdivision north of Ocotillo Road. Approximately 2,000 feet of curb, gutter and sidewalk were constructed as part of that improvement. The east/west RWCD irrigation lateral on the north side of Ocotillo Road was converted from open ditch to pipeline and relocated north of the constructed and proposed future sidewalk along the northern edge of Ocotillo Road. The current east/west RWCD lateral relocation should not conflict with the future potential road extension and no further work should be required for the lateral except for the modification of the turnout discussed as part of the RWCD Main Canal modifications below. The existing check structure and turnout will require relocation north of the proposed Ocotillo Road alignment. The private irrigation lateral is piped from the turnout to the headwall of the private ditch south of the proposed Ocotillo Roadway alignment options. This private irrigation lateral will need to be extended north to connect to the relocated turnout structure as part of the RWCD Main Canal construction. These modifications are discussed further below.





SITE ENLARGEMENT



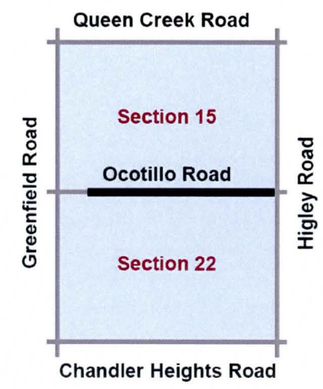
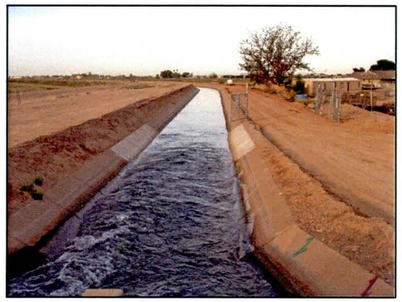


Figure 9.1: *Existing Utility Map*

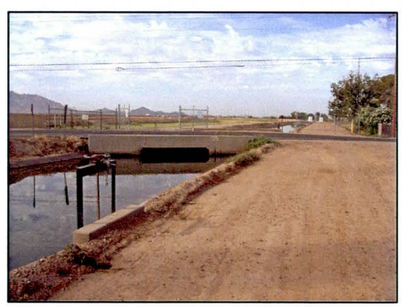
Paralleling the Main Canal are maintenance roads that run roughly north / south alongside the Canal (see Photograph 9.4). The RWCD Main Canal also parallels the FCDMC EMF located east of the canal. The eastern maintenance road of the Main Canal parallels the western EMF maintenance road and forms a wide level area between the two channels. Separate egress and ingress are required for the EMF and the Main Canal. Egress and ingress for both the eastern and western maintenance roads will be required. The non-right angle corners formed with the proposed roadway will increase the complexity of designing the roadway and maintenance road crossings. Attention to safety and ease of accessibility while crossing the proposed road is of primary concern to RWCD as the proposed roadway and maintenance road crossings are designed.



Photograph 9.4: *RWCD Main Canal and parallel maintenance roads looking south from check structure, western RWCD maintenance road parallel to EMF eastern maintenance road*

9.2.2 General Design Considerations for RWCD Main Canal Modifications

Various options were briefly considered for the roadway crossing of the RWCD features including various road alignments, a bridge spanning the entire EMF and RWCD features, separate bridges for the EMF and RWCD Main Canal and a box culvert for the RWCD Main Canal. However, based on cost, schedule, and functionality of the features, it was determined that the best option includes the construction of a box culvert (see Appendix G: Sheet 3 of 16). In order to install the box culvert, the check structure and associated turnout will need to be relocated upstream. RWCD, and its engineering consultant, will complete the design of all RWCD facilities impacted by the project. However, RWCD's requirements for the safe transit of its operation and maintenance traffic across the Ocotillo Road alignment will need to be addressed in the roadway and bridge design. Additionally, RWCD will require unobstructed access at all times (24 hours a day, 7 days a week) to its facilities for normal operation, maintenance and repair activities throughout the construction phase of the project and upon completion of the project.



Photograph 9.5: *Typical RWCD box culvert crossing*

The construction sequencing of specific RWCD modifications will also have a project impact. The RWCD Main Canal box culvert must be completed prior to the construction of the roadway segment that will pass over it. Construction of the box culvert will require the relocation of the check structure and turnout structure. Adjacent, existing Salt River Project (SRP) 69kV power lines will need to be coordinated with the relocated RWCD check structure to ensure that the new power line alignment does not conflict with the installation, maintenance and repair of the check structure radial gates. The need for RWCD to continue water deliveries during relocation of RWCD features and roadway construction and the acquisition of temporary construction easement to augment the limited space available within the RWCD Main Canal right-of-way must be considered during the planning phase of the project.

The construction of RWCD facilities for this project will necessitate at least one dry-up of the Main Canal. Seasonal demands for irrigation water dictates that a dry-up can only occur during the winter months and for a maximum three-week period. RWCD identified that it does not schedule an annual dry-up of the Main Canal as a part of its routine operation and maintenance practice. Specific dry-up dates for this project must be planned and negotiated directly with RWCD. In the past, these dry-ups have occurred in late December/early January.

Specific criteria and considerations regarding the relocation of the RWCD facilities involved in this project were provided by RWCD during the April 10, 2009 review meeting. These design requirements should be re-verified prior to commencing design of the roadway and crossing features:

- The RWCD engineering consultant will design all irrigation facilities involved in this project in accordance with the criteria, standards and specifications established and maintained by RWCD. The RWCD facility relocations anticipated for this project include a box culvert to convey Main Canal flows beneath the Ocotillo Road alignment and a new check structure with appurtenant turnout facilities.
- The proposed RWCD Main Canal box culvert design will employ a modified ADOT design that RWCD has used at other locations. The integration of the vertical, horizontal, and structural components of the box culvert will require close coordination between the roadway design engineer and the RWCD engineering consultant.
- All roadway and bridge features affecting RWCD access or facilities must be coordinated with and approved by RWCD.
- The design of any private irrigation relocations that are not addressed as a part of the RWCD relocation design must be coordinated with and approved by RWCD, if located in RWCD easement or if affecting RWCD facilities.
- Bid documents prepared for the roadway and bridge project must include special provisions specifically addressing RWCD requirements and issues, including full RWCD access to its facilities at all times during the construction of the project. The roadway design engineer will need to closely coordinate the preparation of the special provisions with RWCD and/or the RWCD engineering consultant.

Photograph 9.6: *Existing RWCD Main Canal eastern maintenance road security fence looking north*

9.2.3 Construction Sequencing of RWCD Features

As documented in the meeting minutes, RWCD would prefer separate, early construction of the Main Canal and turnout modifications prior to design and construction of the roadway, bridges and other features. One advantage of completing RWCD construction first would be to phase the overall construction costs into smaller portions. Further, the approach could ensure reduced impacts to the roadway construction if RWCD features are addressed separately and completed ahead of the roadway construction.

A major disadvantage is that the roadway design must commence to a certain point prior to the SRP and RWCD design to ensure appropriate relocation recommendations. The TOG design/build approach for projects may not lend itself well to separating the project into distinct phases over a longer period of time. In addition, the cost of the construction could be greater and it would not be the first time that a project changed course from initial concept to final requiring relocation of utility features that have just been relocated.

The proposed construction schedule presented in Chapter 11 assumes the RWCD construction modifications will be included just prior the roadway construction and that the project will progress as a single project.

The basic sequence of construction of RWCD modifications should be as follows:

1. Build a new turn-out and lateral connections to the RWCD east/west lateral and the private irrigation ditch,
2. Build a new check structure,
3. Remove the existing check structure and
4. Build the box culvert.

The proposed realignment for the power poles is a minimal relocation to the north from their existing location. In order to accommodate the RWCD box culvert, the existing check structure and associated turn-out changes will be located significantly farther north. There will be limited to no conflict with the existing or future SRP 69 kV power line and the new proposed RWCD features (see Appendix G: Sheet 3 of 16). The construction schedule is significantly affected by the construction sequencing of the RWCD components; therefore, Stantec evaluated two options:

1. Complete all construction in short winter dry-ups
2. Construct by-passes and construct at leisure

Construction Sequencing without Bypasses: Relocation of RWCD facilities could be completed during two separate dry-up periods occurring in consecutive years. Construction of the new check structure and appurtenant turnout facilities could be completed during the initial dry-up period, along with the demolition of the existing facilities. Portions of the new turnout facility could be constructed prior to the start of the scheduled dry-up period and then completed during the dry-up. The construction of the new box culvert in the RWCD Main Canal could be completed the following year during a second scheduled dry-up period. Any remaining demolition of the old check and turnout structure, and any associated canal-lining repair would also be completed during this second dry-up period.

All work in the canal must be completed within three weeks if using short dry-ups. If feasible, this is usually the least cost approach to the construction. However, the RWCD check structure incorporates large radial gates. These gates and the concrete to support them may require longer than a three-week construction period. Temporary bypasses may be a better option for construction.

Construction Sequencing with Bypasses: The tie-in of the bypass facilities could be constructed during a scheduled dry-up of the Main Canal so that subsequent operational canal flows would be conveyed around the work site. This would provide an extended time period for the construction of the RWCD facility relocations (see Figure 9.2). The bypass option includes upstream and downstream cofferdams, pipelines to convey the canal flow around the construction site and plugs to isolate various reaches of the canal. A pipeline bypass will be required if check structure, box culvert and field turnout are to be constructed simultaneously during a single dry-up period. The proposed by-pass pipeline capacity and size would be similar to the 84-inch concrete bypass used in the 2009 Chandler Heights and Greenfield Road project. Additionally, the bypass design would need to include facilities for the diversion of irrigation water from the canal for continued delivery to local users.

Both bypasses A and B are constructed in the first dry-up and coffer dams 1 and 2 are dropped into the canal. Bypass A is open and bypass B is closed. Flow passes through bypass A and the existing

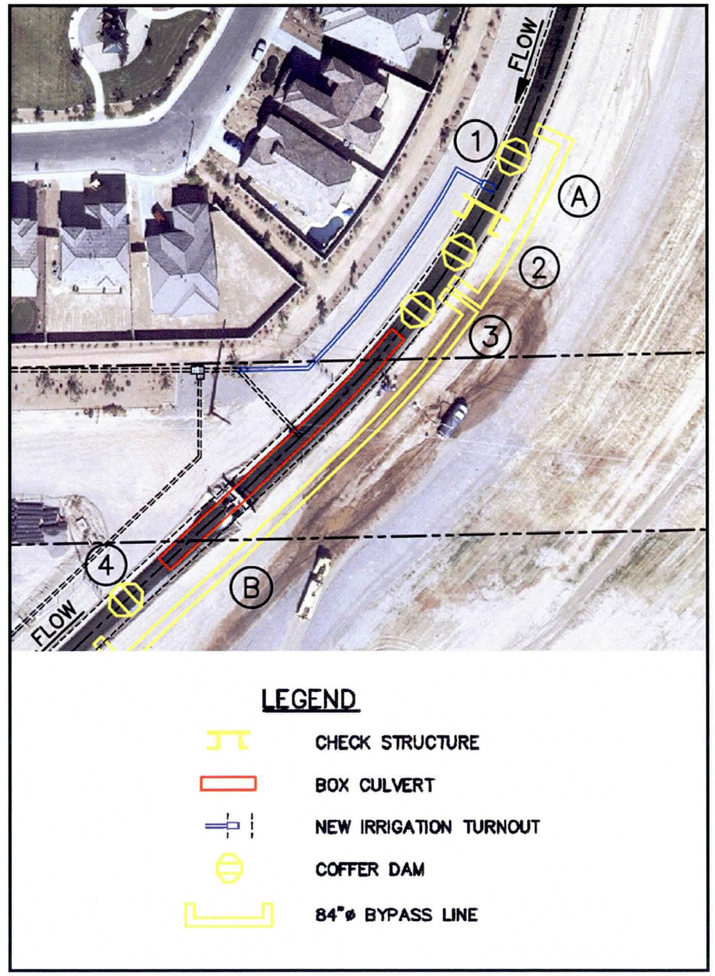


Figure 9.2 *RWCD Bypass Construction Sequence*

check structure checks the flow up to allow continued irrigation delivering through the existing turnout. The new check structure and turnout are constructed in the dry area created by coffer dams 1 and 2 and bypass A. Once this construction is complete, the new turn out is connected to the existing lateral and private farm ditch. This connection can be made in a few hours and can be completed between normal irrigation cycles.

Bypass A is then plugged and bypass B plugs are removed. Coffer dams 3 and 4 are dropped into the canal and the existing check is now in a dry area. The check can be removed and the box culvert constructed. Upon completion, the coffer dams are removed and bypass B is either plugged again or both bypasses A and B are removed in the next dry-up.

9.2.4 RWCD Maintenance Road Egress and Ingress Design Criteria

Accessibility requirements for RWCD vehicles and equipment traversing the Main Canal operations and maintenance roads must be fully and adequately addressed by the roadway and bridge design. RWCD has developed minimum standards for canal roadway crossings that will need to be incorporated into the roadway plans to address the non-rectangular geometry of these crossings. The following roadway design considerations should be re-verified when design proceeds:

- The design of all RWCD access features that will be detailed on the roadway construction plans must be coordinated with, and fully reviewed by RWCD.
- Open sight lines at each of the four RWCD access driveways are necessary to facilitate the safe crossing of the roadway by RWCD vehicles and large, slow-moving, heavy equipment.
- The proposed roadway will be elevated above the grade of the existing Main Canal operation and maintenance roads. Appropriately designed access ramps will be needed to address this change in grade. Level "holding bays" where RWCD vehicles and equipment can safely wait for a clearing in traffic before crossing the roadway should be incorporated into the ramp design.
- Additional right-of-way, and/or retaining walls may be necessary to accommodate the operation and maintenance road access ramps.
- Landscaping improvements and/or features proposed for the road right-of-way must be evaluated for potential conflicts with RWCD access.
- Gates, or other security features to restrict public access to the RWCD operation and maintenance roads must be coordinated with RWCD. Any facilities included for this purpose must be located a sufficient distance from the roadway so that they can be safely accessed and operated by RWCD.
- "On-Demand" traffic signalization of the operation and maintenance road intersection with Ocotillo Road is desired by RWCD.

9.3 TOWN OF GILBERT AND CITY OF CHANDLER MUNICIPAL UTILITIES

Located underground through the proposed alignment are an 18-inch diameter reclaimed water line and a 33-inch diameter gravity sewer collector. These lines parallel the section line at approximately 10 feet and 18 feet south of the section lines on the west end of the proposed roadway alignment and approximately 11 feet and 20 feet south of the section line on the east end of the proposed roadway alignment. The reclaimed water line and the sewer line jog south as they cross the RWCD Main Canal to account for the quarter section offset near the RWCD Main Canal and EMF (see Figure 9.1).

These two pipelines are relatively deep (approximately 12 feet below the existing EMF and QCW inverts), but they do fall along the various proposed roadway alignments and one of the evaluating criteria for selection of the proposed alignment was the avoidance of these two utilities.

The proposed roadway alignment will not affect, or even be close to, the sewer or reuse line except at the eastern side of the QCW Bridge. At this location, care will be required to avoid conflict, but it should not be a problem to avoid either line.

Two potable waterlines were installed in 2008 along the south boundary of the proposed roadway alignment; a 24-inch for the Town of Gilbert and a 36-inch for the City of Chandler. Both of these pipelines were constructed 79 feet and 74 feet (respectively) south of the section line through the RWCD, EMF, CHB and QCW areas to provide adequate room for the future Ocotillo Road alignment (see Figure 9.1). Neither of these waterlines will affect the roadway or the bridge piers across the EMF or Queen Creek Wash for the proposed alignment.

Detailed scour analysis will be required for all four underground wet utility lines as the bridge design is completed to verify that there is no impact to these waterlines. If required, grade control structures could be added to protect the wet utility lines, but the maintenance of these grade control structures would fall to the Town of Gilbert and should be avoided if possible.

9.4 TELECOMMUNICATION, CABLE TV AND NATURAL GAS LINES

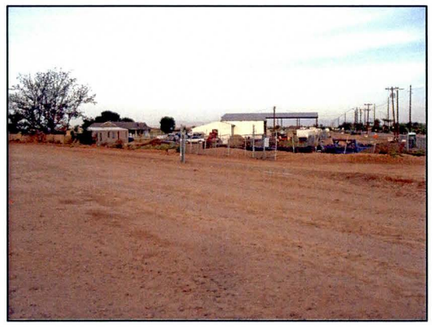
At present, there are no telecommunication lines paralleling or crossing the proposed roadway alignment. At present, there are no cable TV lines paralleling or crossing the proposed roadway alignment. A natural gas line runs along the south side of Ocotillo Road from the Greenfield Road intersection to the RWCD Main Canal and terminates at the last property adjacent to the Main Canal. At present, there are no natural gas lines paralleling or crossing the proposed roadway alignment from the RWCD Main Canal to Higley Road. This gas line will not be affected by the new roadway design or construction.

At present, there are no telecommunication lines or cable TV lines paralleling or crossing the proposed Ocotillo Road alignment. However, it is common practice to incorporate utility sleeves and conduits into the bridge decks to accommodate future potential utility installations. A preliminary recommendation is to incorporate five welded steel casing sleeves within the bridge decks, consisting of two 24-inch diameter casings and three 16-inch casings. Cost to include these conduits is nominal now and can save significant cost in future utility construction.

9.5 PRIVATE IRRIGATION FEATURES

As mentioned in Section 9.2.3, a turnout on the RWCD Main Canal feeds both the RWCD lateral system located on the north side of Ocotillo Road from the Main canal west to Greenfield Road and the private irrigation line that parallels the RWCD main canal south to the Freeman properties. The private irrigation lateral consists of an 18-inch diameter pipeline connecting the RWCD turnout to a head wall and private irrigation ditch. The proposed Ocotillo Roadway alignment crosses the 18-inch diameter pipeline and should not affect the private irrigation ditch or headwall.

As also discussed in Section 9.2.3, the turnout that feeds this lateral will require relocation north to accommodate the construction of a box culvert for the roadway and the relocation of the check structure. The existing private pipe lateral will require extension northerly along the Main Canal to the new turnout location. The existing private pipeline is located within the existing RWCD ROW which is not normally allowed under current RWCD criteria. However, RWCD identified that extension of the existing pipeline within their ROW would be acceptable given the existing lateral has been in place for several years.



Photograph 9.7: *Private irrigation lateral parallel RWCD Main Canal maintenance road and is underground pipe through the Ocotillo Road alignment*

9.6 PRIVATE IRRIGATION WELL

An existing private irrigation well has been abandoned just south of the proposed roadway alignment on the northeast corner of the Private Freeman property. This well should not affect or be affected by the proposed roadway improvements.

10. ENVIRONMENTAL OVERVIEW

10.1 INTRODUCTION

This overview is prepared for the purpose of identifying and describing potential environmental issues that may occur within the area of potential effect (APE) for a proposed new roadway extension between Greenfield Road and Higley Road in Gilbert, Maricopa County, Arizona. The proposed project consists of the planned extension of Ocotillo Road a distance of about three-quarters of a mile, between Greenfield Road to Higley Road. The project includes construction of approximately 3,800 linear feet of new roadway. This is an initial assessment based on general potential impacts, and is not meant to serve as "environmental clearance" for the project.

10.2 SOCIOECONOMIC ENVIRONMENT

Socioeconomic considerations include the land use, zoning, general plan land use, jurisdictional boundaries, and demographic data for the project area. Information was obtained from existing planning documents relevant to the project area. The Maricopa Association of Governments (MAG) and U.S. Census Bureau websites were accessed for demographic information and environmental justice data.

10.2.1 Jurisdiction and Ownership

Land ownership, or land management in the project area related to the project corridor is under the jurisdiction of the Town of Gilbert, the Roosevelt Water Conservation District, the Flood Control District of Maricopa County, and private land owners.

10.2.2 Existing Land Use and Zoning

An investigation of land uses throughout the study area was conducted by accessing GIS coverage of the project area, aerial photography and satellite imagery, and general plans prepared for the project area and surrounding regions. The land in the project area is former agricultural land that is either developing or planned for development. The Ocotillo Road alignment extends through several areas zoned single family developments, while other zoning designations include Community Commercial and Public Facilities/Institutional District.

10.2.3 Prime and Unique Farmland

In response to the Farmland Protection Policy Act of 1981, efforts should be made to ensure that no Prime or Unique farmland is impacted by the project. The Farmland Protection Policy Act defines Prime farmland as that being the quality of soil, the water supply, and an appropriate growing season to economically produce high yields when managed appropriately. Therefore, the existing use of land could actually be any type except urban or water. Prime or Unique farmland is protected under the Farmland Protection Policy Act of 1981. The Act requires agencies to "minimize the extent to which programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses and to assure that programs are administered in a manner that, to the extent practicable, will be compatible with state, local government, and private programs and policies to protect farmland." If the project requires the use of federal funds, the specific corridor selected should be investigated in more detail to verify the potential impacts to Prime or Unique farmland.

10.2.4 Demographic Composition

Demographic data was acquired from the U.S. Census Bureau 2000 website, as well as information from the MAG website. The data was obtained for Maricopa County and the Town of Gilbert.

Demographic categories occur as follows:

Table 10.1: *Population*

	1990	2000	2005
Maricopa County	2,122,101	3,072,149	3,700,516
Town of Gilbert	29,188	109,697	226,013

Table 10.2: *Population Composition*

Race	Maricopa County (% of total)	Gilbert (% of total)
White	77.4	85.7
African American	3.7	2.4
Native American	1.8	0.6
Asian/Pacific Islander	2.3	3.7
Other	14.8	-
Total	100	100
Hispanic Heritage*	24.8	~7.6

(Source: U.S. Census Bureau, April 1, 2000 Census and MAG website)

As the project corridor is currently defined, no residential units will require relocation.

10.2.5 Title VI of the Civil Rights Act of 1964 as amended

In the event that federal funding is utilized for this project, the following would apply. Executive Order 12898 requires that federal actions assess impacts to low-income and minority populations. Specifically, the Order outlines the following responsibilities of federal agencies for federal actions:

"Considerations of environmental justice are included to the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions...."

The population of Gilbert is a mix of races similar to that of most other areas in the Phoenix Basin. Per capita income in the area is not below the poverty level. No residences exist in the project corridor, so no displacements will occur. There will be no disproportional impacts to low income or Native American populations. The extension of the roadway will not reduce the standard of living of nearby residents. No residents will be relocated and no low-income or minority neighborhoods will be divided as a result of the proposed action.

10.2.6 Section 4(f) Resources

Title 49 United States Code, Section 1653(f), refers to the need to consider publicly owned wildlife and waterfowl refuges, publicly owned park and recreational lands, and historic sites in transportation project planning (school playgrounds may qualify if they are publicly owned and meet several other criteria). If historic sites are listed on, or eligible for the National Register of Historic Places (NRHP), they are afforded protection under Section 4(f). If Section 4(f) lands are determined to be near projects that use federal funds, a Section 4(f) evaluation must be conducted. No Section 4(f) properties are known to exist in, or near the project corridor.

10.2.7 Section 6(f) Resources

The Land and Water Conservation Fund (LWCF) was established in 1964 by passage of the Land and Water Conservation Fund Act. The purpose of the Act was to provide funding for parks and recreational areas to benefit local, state and federal governments:

Section 6(f) (3): No property acquired or developed with assistance under this section shall, without the approval of the Secretary, be converted to other than public outdoor recreation uses. The Secretary shall approve such conversion only if he finds it to be in accord with the then existing comprehensive statewide outdoor recreation plan and only upon such conditions as he deems necessary to assure the substitution of other recreation properties of at least equal fair market value and of reasonable equivalent usefulness and location.

No Section 6(f) land is currently located near the project corridor, according to the 2008 Arizona Statewide Outdoor Recreation Plan (Arizona State Parks, 2007). The Act applies to projects regardless of funding source. If parks are constructed with LWCF funding in the future within the project area, Section 6(f) may apply and coordination must occur with the Grants Coordinator at Arizona State Parks.

10.3 PHYSICAL AND NATURAL ENVIRONMENT

The land within and surrounding the project area is urban and agricultural in character and has been completely disturbed. Prior to development, the area was described as being within the Sonoran desert scrub biome (Brown, et. al., 1979).

10.3.1 Physiography

The project lies within the Basin and Range physiographic province, generally characterized by steep and linear mountain ranges separated by wide and deep valley segments filled with alluvial deposits. Arizona further divides the Basin and Range province into a Desert and a Mountain region, and the project is within the Desert Region. The Desert Region includes both the Mojave Desert of California and the Sonoran Desert of southern Arizona and New Mexico, and portions of northern Mexico.

Photograph 10.1: *Looking across the EMF south to the San Tan Mountains from the RWCD check structure*

Mountain ranges within this region seldom rise above 4,000 feet, but rise steeply from the adjacent valley floors. Most ranges follow a northwest-southeast trending axis and vary from two to 100 miles long and one to 20 miles wide. Alluvial basins fill the generally vast spaces between these ranges, with some, such as the Phoenix and Tucson basins, containing up to 2,000 feet of alluvial accumulation. The project area consists of a single linear corridor within an urban and agricultural area. Soils in the area include those classified as the Mohall-Contine association; a well-drained association of loams, sandy clay and clay loams associated with older alluvial fans; and soils of Gilman-Estrella-Avondale association; very similar in characteristics with the Mohall-Contine association, but also occurring on floodplains.

10.4 BIOLOGY

Stantec Consulting reviewed the online databases, Arizona Game and Fish Department (AGFD) and the United States Fish and Wildlife Service (USFWS). The AGFD On-line Environmental Review Tool and the USFWS web site were accessed on January 22, 2009 for current records of possible species. The records indicate the possible occurrence of Athene cunicularia hypugaea (Western Burrowing Owl) within the project vicinity (3-mile buffer). The Burrowing Owl is a Species of Concern. This project does not occur in the vicinity of any proposed or designated Critical Habitat.

The Sonoran Desert Scrub zone is the largest biotic community in Arizona, encompassing most of southwestern Arizona, northwestern Mexico and portions of southern California. Local agricultural efforts have altered the natural drainage patterns sufficiently to reduce the natural plant associations, introduce new species to the environment, and isolate portions of the region ecologically. Elevations of the project area range from 1,308 to 1,444 feet. Disturbance in the area includes existing roadways, agricultural fields and residences. The area of potential effect has been completely disturbed.

10.4.1 Native Vegetation Community

Turner and Brown (1994) have identified five subdivisions of the Sonoran Desert, including the Lower Colorado River Valley, the Arizona Upland, the Plains of Sonora, Vizcaino, and the Central Gulf Coast. The project area is within the Lower Colorado River Valley subdivision, often described as a microphyllous desert, but shares some characteristics with the Arizona Uplands subdivisions (also described as a depauperate thornscrub community) due to the high frequency of arborescent plants of low stature (Turner and Brown, 1994).

The USFWS species list for Maricopa County as well as the AGFD Online Review Tool were referenced to determine whether any threatened or endangered plant species may exist on the proposed site.

Plant Community Succession: When lands are cleared, either by fire, agriculture, or some other factor, and then allowed to return to their natural state, the path of succession species is generally regular, and has been explored in some detail by Karpiscak and Gross (1979). The first species to occupy the vacated areas, the Pioneer species, are often exotic annuals such as Russian Thistle (Salsola kali), which quickly follows the abandonment of agricultural fields.

These species are replaced in two-three years by several species of mustards, which are in turn quickly replaced by a dense growth of introduced annual grass species along with other non-native species, such as Filaree (Erodium circutarium) and Prickly Lettuce (Lactuca serriola), with a few other native plants, such as Sphaeralcea. Subsequent to this, ruderal shrubs, such as Baccharis sarothroides and Isocoma, move in before the area is finally reoccupied by the Climax species of Larrea or Atriplex.

10.4.2 Vegetation In The Project Area

Pre-development species in the project areas included those found in the description above. Species remaining in the Area of Potential Effect are limited to various grasses.

10.4.3 General Wildlife in the Project Area

As indicated, wildlife species common to former agricultural and new urban areas are present; there are no undisturbed areas within the project corridor. Wildlife habitat and populations are widely varied in the Sonoran desert due to habitats ranging from cultivated fields to native riparian habitats. The U.S. Fish and Wildlife service (USFWS) species list for Maricopa County was referenced to determine whether any threatened or endangered animal species may exist in the Area of Potential Effect.

One species of concern was mentioned as being possibly located within three miles of the project vicinity by the Arizona Game & Fish Online Tool. The Western Burrowing Owl is a small bird with long legs and a short tail. It is 19-25 cm with a wingspan of 55 cm. It is the only owl normally seen on the ground during the day. Habitat includes open areas with either mammal burrows or natural small caves or clefts. The areas normally occur on level to gently sloping ground, and can be within otherwise developed areas. Burrowing owls are often found in fields, within road rights-of-ways, and other urban areas (Klute, et. al., 2003). Several field investigations have produced no evidence of Athene cunicularia hypugaea, or burrows and it is considered highly unlikely that Western Burrowing Owls utilize the project area.

10.4.4 Wetlands and Other Waters of the U.S.

A Section 404 permit from the U.S. Army Corps of Engineers (ACOE) will be required per the Clean Water Act (33 United States Code 1251 et esq.). Jurisdictional delineations of all "Waters of the U.S." must be conducted for the project corridor. Coordination with the ACOE should begin early in the planning process, as permit application processing timelines have recently been increased due to guidelines developed in response to the Rapanos (Rapanos et ux., et al. v. United States) decision.

Specifically, the East Maricopa Floodway and Queen Creek Wash have both previously been determined to be jurisdictional. Storm water pollution prevention plans will also be required for all construction activities. The plans must be in response to requirements of the Clean Water Act.

Sole Source Aquifers, Unique Waters: No unique waters, as defined by Arizona Administrative Code R18-11-112 have been identified in, or near any of the alternatives. No sole source aquifers are located in, or near, any of the alternatives.

100-Year Floodplains: The Flood Insurance Rate Map produced by the Federal Emergency management Agency (FEMA) was reviewed for the project area. The water features that will be crossed by the

new roadway are designated Zone A, while all other areas within the corridor are designated Zone X, which are described as "0.2% annual chance flood; areas of 1% annual chance flood with average depths of <1 foot, or with a drainage area less than 1 square mile; and areas protected by levees from 1% annual chance flood" (Panel 04013C3075H).

10.5 VISUAL CHARACTER

Scenic quality is generally determined by the existence and diversity of natural features in and surrounding a specific region. The natural scenic quality of the project area is medium to low, based upon surrounding urbanization. Specific design characteristics will be utilized to harmoniously integrate the roadway into the landscape while maintaining a positive visual experience for the roadway user.

10.5.1 Air Quality

The Clean Air Act of 1970, along with the amendments of 1990, requires that the potential air quality impacts of transportation projects be addressed in environmental documents. Depending upon the project, this could range from a simple description to a detailed micro-scale analysis. Under the Act, designated permitting authorities must comply with the requirements of the National Ambient Air Quality Standards (NAAQS). The standards for particulate matter and ozone were revised by the EPA in 1997. The PM10 (particulate matter less than 10 microns in size) standard was revised, the standards for particulates with diameters of 2.5 microns or less was added (PM2.5), and an eight hour standard replaced the one hour standard for ozone. The standard for ozone was also lowered to 0.08 parts per million (ppm) from 0.12 ppm. The standards for the state of Arizona are the same as the NAAQS.

Table 10.3: *National Ambient Air Quality Standards*

Pollutant	Averaging Period	Primary (µg/m³)	Secondary (µg/m³)
Nitrogen Dioxide	Annual	100	100
Sulfur dioxide	3 hours	-	1,300
	24 hours	365	-
	Annual	80	-
Carbon Monoxide	1 hour	40	-
	8 hours	10	-
Ozone	1 hour	240	240
	8 hours	160	160
PM2.5	24 hours	65	65
	Annual	15	15
PM10	24 hours	150	150
	Annual	50	50
Lead	Calendar quarter	1.5	1.5

µg/m³ - micrograms per cubic meter / Source: EPA 2006

Non-attainment Areas

As a result of the Clean Air Act, the EPA was authorized to identify areas that had not met the NAAQS. Of relevance to the project corridor are three pollutants: particulate matter, carbon monoxide and ozone. The project corridor is within the Phoenix Metropolitan non-attainment areas for carbon monoxide (with maintenance plan), PM10, and ozone.

Conformity

Since 1977, all transportation projects under the guidance of Federal agencies and metropolitan planning organizations have been required by the Act to ensure that the projects conform to the approved air quality State Implementation Plan (SIP). Determinations of conformity for Federal projects must be in compliance with 40 CFR Parts 51 and 93.

For any project located in non attainment areas, they will need to be part of an approved transportation improvement program (TIP). The TIP must conform to the SIP.

In addition, temporary deterioration of air quality is expected due to construction, but will be localized and controlled by the terms of a County Earthmoving Permit, issued under County Air Pollution Regulations.

10.6 NOISE

The Town of Gilbert has a noise ordinance that must be addressed when noise impacts are evaluated. During the design phase of the roadway extension, specific requirements regarding the potential need for noise monitoring or abatement will be determined.

10.7 HAZARDOUS MATERIALS

Hazardous materials are regulated by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). CERCLA is implemented by the Arizona Department of Environmental Quality (ADEQ) and is referred to as Superfund, as well as the Superfund amendments. Investigations into past or existing hazardous materials locations and solid waste facilities in or near the project will be necessary in order to prevent impacts to public health.

10.8 CULTURAL RESOURCES

Records at the Arizona State Historic Preservation Office (SHPO), the Arizona State Museum (ASM), the Bureau of Land Management (BLM), and the AZSITE database were accessed for information regarding previous archaeological work and known sites within a 1 mile (1.6 km) radius of the project area. The State and National Registers of Historic Places were also reviewed. The records check revealed that a number of cultural resources have been previously recorded within or immediately adjacent to the subject property.

Thirteen surveys have taken place within a 1-mile radius of the project area and nine sites have been recorded within the same radius (Table 10.4).

Master Title Plat #1432 of August 17, 1868 (on file at the Bureau of Land Management State Office, Phoenix) was accessed for historical information in the project area. No evidence of additional historic resources was indicated.

10.8.1 Previous Surveys

One site is located within the APE: AZ T:10:83(ASM) - Roosevelt Water Conservation District Canal

The Roosevelt Water Conservation District canal was constructed in 1929 as an earthen channel, but many sections were later lined with concrete during the 1960's (Newsome and Berg, 2001). It receives water from the South Canal and irrigates land in eastern Mesa above the Eastern Canal. It has functioned in a similar capacity as two other significant canals; the Consolidated and Eastern Canals, and is associated with the agricultural and economic development of the eastern Salt River Valley. At the proposed crossing at Ocotillo Road, the canal is concrete-lined and is approximately 25 feet wide and six feet deep. It is located between earthen levees. The canal does maintain integrity of location, but the historical characteristics and setting at this location have been compromised by modern constructed elements.

While other segments of the Roosevelt Canal are considered eligible for the NRHP under Criterion A, the portion within the project APE is not representative of the elements of the canal that contribute to eligibility.

10.8.2 Cultural Historical Overview

There are five general cultural-historical periods that describe the prehistoric and historic occupation of the region. These include the Paleo-Indian, the Archaic, the Hohokam, the Protohistoric, and the Historic period. For further detailed information on these periods, please see Appendix E.

10.9 COORDINATION

Coordination of future environmental analyses should include all agencies and stakeholders that own or manage land and resources in the project vicinity. This should include, at a minimum:

- Maricopa County Department of Transportation
- United States Fish & Wildlife Service
- U.S. Army Corps of Engineers
- Arizona Department of Transportation
- Arizona Department of Agriculture
- Arizona Game & Fish Department
- State Historic Preservation Office
- Arizona State Museum
- Town of Gilbert and Area Municipalities

Table 10.4: *Cultural Resource Surveys Conducted within One-Mile of the Project Area*

ASM Survey No.	Sites Within One-Mile of Project	Site Number	Site Type/Name	Eligibility	Reference
1995-441	0	----	----		Griffith 1995
1997-190	0	----	----		Olson 1997
2001-596	2	AZ U:10:15(ASU)	Ceramic Scatter	Not Eligible*	Rodgers 2002
		AZ U:10:16(ASU)	Ceramic Scatter	Not Eligible*	Rodgers 2002
2001-602	0	----	----	----	Lundin 2001
2003-311	0	----	----	----	Schmidt & Mitchell 2002
2003-684	3	AZ U:14:340(ASM)	Sherd/Lithics	Eligible	Hohmann & Lange 2001
		AZ U:14341(ASM)	Sherd/Lithics/Historic	Eligible	Hohmann & Lange 2001
		AZ U:14342(ASM)	Sherd/Lithics	Eligible	Hohmann & Lange 2001
2003-821	0	----	----	----	Smith et. al. 2002
2004-116	0	----	----	----	Rodgers 2004
2004-122	0	----	----	----	Marshall 2003
2005-69	1	AZ U:10:17(ASU)	Ceramic Scatter	Not Evaluated	Foster & Schmidt 2004
75-024.ASU	1	AZ T:10:83(ASM)	Roosevelt Canal	Eligible	(see Newsome & Berg 2001)
SHPO-2001-543	0		----	----	Howard 2001
None	1	AZ U:14:1(ASU)	Sherd Scatter	Not Evaluated	Unknown
AZSITE Ref. 11024	1	AZ U:14:383(ASM)	Hohokam Farmstead	Eligible	Mitchell 2002

**Destroyed by modern development*

11. PROJECT SCHEDULE

At present, FCDMC has sealed plans that provide construction direction to complete the third phase of the EMF, Chandler Heights Basin and Queen Creek Wash between Queen Creek and Chandler Heights Roads. These plans call for the removal of approximately 500 feet of material along the Ocotillo Road alignment. One of the purposes of this study was to provide recommendations for construction sequencing and coordination between FCDMC and the Town of Gilbert for the completion of the Chandler Heights Basin and Ocotillo Road.

During the course of developing this proposed plan, development in the TOG area has slowed drastically. Neither FCDMC nor TOG can project when construction of the Basin or the road will proceed. Therefore, providing detailed recommendations for coordination cannot be fully defined at this time, however; some basic concepts can be established and an understanding between the two parties documented.

Discussion with FCDMC (documented in Appendix F) has resulted in confirmation that construction of two separate basins connected via a box culvert under the proposed Ocotillo Road connection is acceptable to FCDMC. In addition, both FCDMC and TOG would like to see the construction proceed in such a way that either party can proceed in the future with the least impact to the other (see Figure 11.1). In general, if FCDMC moves forward first, construction limits for the proposed roadway prism should be established and an opening will need to be provided for the box culvert. If TOG moves forward first, TOG would be responsible for construction of the northern segment of the Chandler Heights Basin south cell in conjunction with the construction of the roadway prism. The box culvert would be constructed as part of the roadway improvements and then plugged until the north cell construction is completed by FCDMC at a later date. It is suggested that the coordination effort for the two construction projects include the following components in order to be effective for both FCDMC and the TOG:

1. Kickoff meeting prior to final design (FCDMC) or preliminary design (TOG) to discuss proposed construction elements and schedule.
2. FCDMC and TOG will determine those construction elements that will include overlapping construction interests and will require special consideration for design, construction, and construction sequencing.
3. FCDMC and TOG will negotiate the general scope of the elements to be constructed and the responsible party for the element cost.
4. TOG shall be responsible for modifications (or cost of modifications) to the existing FCDMC plans for completion of the Chandler Heights Basin in a manner that will accommodate the common construction goals of both agencies prior to either agency proceeding with construction.

The opinion of probable construction cost presented and discussed below, attempts to address potential unknowns in the construction sequencing of the project. The construction schedule presented below addresses potential construction sequencing of the SRP power line relocation, the RWCD features that are to be relocated and the roadway design and construction itself.

11.1 OPINION OF PROBABLE COSTS

The opinion of probable costs for the project is presented on Table 11.1. The cost estimate has been broken into basic components of roadway improvements, roadway storm drainage, RWCD modifications and FCDMC features modifications. It should be noted that the cost estimate is set up as a funding estimate based on today's dollars and should be escalated for the projected year it will appear in the CIP. In addition, the cost estimate has several place holder items for the Chandler Heights Basin that should be sufficient to cover the unknown sequence of construction with FCDMC discussed above.

11.2 CONSTRUCTION SCHEDULE

A potential design and construction schedule has been prepared to pictorially capture the requirements for roadway and bridge construction and the inter-relationship with RWCD, FCDMC and potential utility relocations (Figure 11.2). The schedule assumes a design-build construction contract; overlapping final design of the roadway with construction of some of the RWCD modifications.

Under the preferred TOG schedule (Figure 11.2), all design begins at the same time based on the general layout of the roadway in the attached exhibits. The SRP power lines should be constructed prior to commencing with the roadway construction to avoid conflicts. Relocation of the SRP power line is not required in order to construct the RWCD features or to commence construction of the bridges, but care during construction will be required.

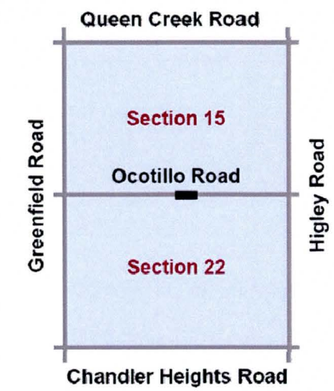
Actual roadway and bridge construction is anticipated to only require approximately one year. It is anticipated that RWCD design, coordination and approval will have the largest impact on the design and construction schedule.

The preferred schedule is based on the RWCD-proposed use of by-passes; RWCD identified that this form of construction would reduce impacts to their functionality while new RWCD features were constructed. On the proposed schedule, by-passes are constructed in a dry-up and this task leads the construction schedule sequencing. As discussed in Section 9.2.3, RWCD typically only allows dry-ups of adequate length in late December. A full dry-up may not be allowed and minor pump-around may be required. Initially the southern by-pass will be plugged to allow construction of the new check structure and turnout while using the existing check structure and turnout. The schedule further assumes that coffer dams can be inserted and removed in wet conditions and that the southern by-pass can be unplugged during the wet. The proposed schedule may be extended if these construction sequences are not feasible or acceptable to RWCD. In addition, it is anticipated that three dry-ups may be required if dual by-passes are not used for construction. Details in the scheduling depend on the timing of the dry-ups in relationship to the funding and design.

RWCD has suggested that constructing the new RWCD features before the roadway and bridge construction would allow selection of a contractor specializing in irrigation structures and provide a clear path for the roadway and bridge construction. Therefore, an alternative to the attached schedule would be to initiate the RWCD design elements and complete construction of the RWCD features well in advance of the roadway design. This would potentially spread out the schedule over a four year period or two separate construction phases. Constructing RWCD modifications prior to proceeding with the roadway construction would allow construction funding to be phased and would allow for any delays in RWCD design, review, construction or dry-up sequencing. This schedule is not favored by TOG.

Table 11.1: *Opinion of Probable Costs*

ITEM	QUANTITY	UNIT	UNIT COST	ITEM TOTAL
Roadway Improvements				
A.C. Pvmt (3,863 TON)	17,170	SY	$17.00	$291,890.00
A.B.C. (11,203 TON)	17,170	SY	$13.00	$223,210.00
Tack Coat (7.2 TON)	17,170	SY	$0.15	$2,575.50
Subgrade Preparation	17,170	SY	$3.00	$51,510.00
Vert. Curb & Gutter	4,959	LF	$6.00	$29,754.00
Single Curb	1,705	LF	$6.00	$10,230.00
Median Paving	2,718	SF	$8.00	$21,744.00
Concrete Sidewalk	29,512	SF	$2.50	$73,780.00
Concrete Driveway	3,360	SF	$7.50	$25,200.00
Mountable Curb	240	LF	$10.00	$2,400.00
Type V Girder Bridge	2	EA	$2,700,000.00	$5,400,000.00
Roadway Storm Drain System				
24" RGRCP	222	LF	$70.00	$15,540.00
15" RGRCP	70	LF	$50.00	$3,500.00
Catch Basin	7	EA	$2,500.00	$17,500.00
Headwall	7	EA	$2,200.00	$15,400.00
5 Barrel 12'x12' CBC	1	EA	$1,300,000.00	$1,300,000.00
Roadway Incidentals & Utilities				
Street Lights	12	EA	$3,500.00	$42,000.00
Landscaping	10,036	SY	$5.00	$50,180.00
Traffic Control	1	LS	$75,000.00	$75,000.00
SWPPP	1	LS	$20,000.00	$20,000.00
Utility Relocation	1	LS	$85,000.00	$85,000.00
69kV Pole Relocation	7	EA	$45,000.00	$315,000.00
Signing & Striping	1	LS	$50,000.00	$50,000.00
RWCD Modifications				
RWCD Turnout Features	1	LS	$72,500	$72,500.00
Radial Gate Check Structure	1	LS	$210,100	$210,100.00
RWCD Box Culvert	1	LS	$571,000	$571,000.00
Demolition of Existing Gate Check Structure, Turnout and Canal Lining	1	LS	$39,400	$39,400.00
Main Canal By-Pass	1	LS	$275,000	$275,000.00
EMF, CHB & QCW Modifications				
CHB Construction	93,000	CY	$10.00	$930,000.00
Channel Restoration and Stabilization	2	EA	$1,250,000.00	$2,500,000.00
Access Roadway	5	EA	$15,000.00	$75,000.00
Pedestrian Underpass	1	EA	$200,000.00	$200,000.00
Modifications to Exist. Improvements	1	LS	$25,000.00	$25,000.00
Construction Survey	1	LS	$100,000.00	$100,000.00
			CONSTRUCTION SUB-TOTAL	**$13,119,413.50**
Contingency (15%)	1	LS	$1,967,912.03	$1,967,912.03
			CONSTRUCTION TOTAL	**$15,087,325.53**
Professional Services (14%)	1	LS	$2,112,225.57	$2,112,225.57
Construction Management (10%)	1	LS	$1,508,732.55	$1,508,732.55
Land / Right-of-Way				
Freeman Right-of-Way	22,471	SF	$5.00	$112,355.00
RWCD Right-of-Way	19,294	SF	$5.00	$96,470.00
FCDMC Right-of-Way	180,304	SF	$5.00	$901,520.00
Drainage Easement (Freeman)	15,653	SF	$2.50	$39,132.50
Drainage Easement (FCDMC)	41,797	SF	$2.50	$104,492.50
			PROJECT FUNDING ESTIMATE	**$19,962,253.65**



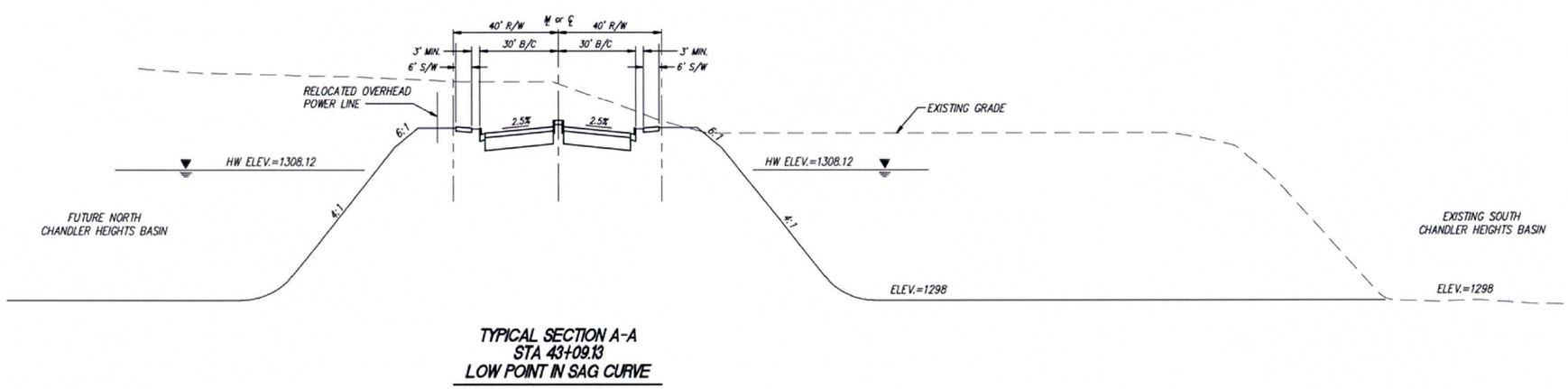


Figure 11.1: *Chandler Heights Basin Cross-Section*

Construction Timeline

Task #	Construction Tasks	Year 1				Year 2				Year 3			
		Month 1-3	Month 3-6	Month 6-9	Month 9-12	Month 1-3	Month 3-6	Month 6-9	Month 9-12	Month 1-3	Month 3-6	Month 6-9	Month 9-12
69 KV Power Line Relocation													
101	Power Line Relocation Design												
102	Power Pole Relocation to Final Alignment Across RWCD & EMF												
103	Power Pole Relocation to Final Alignment EMF to Higley Road												
RWCD Facilities Relocation													
201	RWCD Facility Relocation Design												
202	Build Duel By-Pass in First Dry-Up & Install Coffer Dams												
203	New Check Structure and Turnout Facilities												
204	Close Upstream By-Pass & Relocate Coffer Dams												
205	Existing Check Structure and Turnout Facility Demolition												
206	Construct New RWCD Main Canal Box Culvert Crossing												
207	Remove Coffer Dams & Dual By-Passes												
Right-of-Way and Construction Easement Coordination & Acquisition													
Chandler Heights Basin Box Culvert													
301	Box Culvert Design												
302	Chandler Heights Basin Design Modifications												
303	Box Culvert Construction												
304	Headwall Construction												
305	Basin Associated Grading												
306	Preliminary Roadway Grading												
Bridge Structure Across EMF													
401	Bridge Design												
402	Bridge Piers												
403	Bridge Substructure												
404	Bridge Superstructure												
405	Preliminary Roadway Grading												
Bridge Structure Across Queen Creek Wash													
501	Bridge Design												
502	Bridge Piers												
503	Bridge Substructure												
504	Bridge Superstructure												
505	Preliminary Roadway Grading												
Roadway Construction and Paving													
601	Roadway Construction and Paving Design												
602	Detention Basin Construction												
603	Roadway Embankment Construction												
604	Curb, Gutter, Sidewalk Construction												
605	Roadway Subgrade												
606	Pavement Construction												

Overall Task Duration | Task Duration | Critical Task for Schedule | RWCD Dry-Up Required

Figure 11.2: *Construction Schedule*

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RELATED ENVIRONMENTAL WEBSITES

Arizona Department of Commerce:

http://www.azcommerce.com/doclib/COMMUNE/Maricopa%20County.pdf

http://www.azcommerce.com/doclib/COMMUNE/ft%20mcdowell%20yavapai.pdf

http://www.azcommerce.com/doclib/COMMUNE/salt%20river%20pima-maricopa.pdf

Arizona Department of Environmental Quality:

http://www.azdeq.gov/environ/water/permits/download/uniquewat.pdf

Arizona Department of Transportation:

http://www.azdot.gov/Highways/OES/AZ_WildLife_Linkages/assessment.asp

U.S. Fish and Wildlife Service:

http://www.fws.gov/southwest/es/arizona/

Maricopa Association of Governments:

http://www.mag.maricopa.gov/display.cms

Arizona Game & Fish Department:

http://www.azgfd.gov/hgis-er/default.aspx

AZSITE Database:

http://www.azsite.arizona.edu/

Salt River Project:

http://www.srpnet.com/water/dams/granitereef.aspx
http://www.srpnet.com/water/canals/history.aspx#arizona_canal

U.S. Census Bureau:
http://www.census.gov

Environmental Protection Agency:
http://www.epa.gov/safewater/sourcewater/pubs/qrg_ssamap_reg9.pdf
http://www.epa.gov/air/oaqps/

APPENDIX A – GEOTECHNICAL REPORT

PRELIMINARY GEOTECHNICAL EVALUATION
OCOTILLO ROAD BRIDGE OVER THE EMF,
QUEEN CREEK, AND CHANDLER HEIGHTS BASIN
GILBERT, ARIZONA

PREPARED FOR:
Stantec Consulting
8211 South 48th Street
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PREPARED BY:
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December 11, 2008
Project No. 602332001

December 11, 2008
Project No. 602332001

Ms. Maria Brady, P.E.
Stantec Consulting
8211 South 48th Street
Phoenix, Arizona 85044

Subject: Preliminary Geotechnical Evaluation
Ocotillo Road Bridge Over the EMF, Queen Creek, and Chandler Heights Basin
Gilbert, Arizona

Dear Ms. Brady:

In accordance with our proposal dated April 14, 2008, and your authorization, Ninyo & Moore has performed a preliminary geotechnical evaluation for the above-referenced site. The attached report presents our methodology, findings, conclusions, and preliminary recommendations regarding the geotechnical conditions at the project site.

We appreciate the opportunity to be of service to you during this phase of the project.

Sincerely,
NINYO & MOORE

Jeff S. Rodgers, R.G.
Senior Staff Geologist

Steven D. Nowaczyk, P.E.
Principal Engineer

EXPIRES 6/30/09

JSR/SDN/SAH/hle

Distribution: (3) Addressee

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1. INTRODUCTION

In accordance with our proposal dated April 14, 2008, and your authorization, we have performed a preliminary geotechnical evaluation for the proposed bridge crossing of Ocotillo Road over the East Maricopa Floodway (EMF), over Queen Creek, and over Chandler Heights Basin, in Gilbert, Arizona. The purpose of our evaluation was to review known subsurface conditions at nearby sites and formulate preliminary geotechnical recommendations for design and construction. This preliminary report presents the results of our evaluation, our preliminary geotechnical conclusions and recommendations regarding the proposed construction.

2. SCOPE OF SERVICES

The scope of our services for the project generally included:

- Reviewing background information including published geologic and engineering data, aerial photographs, and topographic mapping.
- Reviewing previously prepared geotechnical reports from nearby projects.
- Preparing this report presenting our findings, conclusions, and preliminary recommendations regarding the design of the project.

Our scope of services did not include environmental consulting services, such as hazardous waste sampling or analytical testing, at the site. A detailed scope of services and estimated fee for such services can be provided upon request.

3. SITE DESCRIPTION

The proposed project alignment is situated along the southern boundary of Section 15 and northern boundary of Section 22 in Township 2 South, Range 6 East, and follows the current alignment of Ocotillo Road in Gilbert, Arizona. The proposed project alignment crosses the Roosevelt Water Conservation District (RWCD) Canal, EMF, Queen Creek, and Chandler Heights Basin. The approximate location of the site is depicted on the Site Location Map (see Figure 1). At the time of our evaluation, Ocotillo Road was

an east-west traversing paved roadway that terminated at the RWCD Canal, just west of the EMF, and resumed on the east side of Chandler Heights Basin. Scattered vegetation was observed in the EMF, Queen Creek, and Chandler Heights Basin. The concentration of vegetation was observed to be thicker in Queen Creek than the rest of the site. The RWCD Canal had water flowing at the time of our evaluation, and the EMF, Chandler Heights Basin, and Queen Creek were dry. The Chandler Heights Basin was graded during our evaluation.

According to the *Higley, Arizona-Maricopa Co. (1981) United States Geological Survey (USGS), 7.5-Minute Topographic Quadrangle Map Series,* the proposed project alignment elevation is approximately 1,320 feet relative to mean sea level (MSL) at the eastern limits, and at approximately 1,310 feet MSL at the western limits. Based on the information provided on this topographic map, the general topography along the alignment slopes from the east down to the west.

Six aerial photographs from the Flood Control District of Maricopa County were reviewed for this project. Aerial photographs from 1937 and 1949 depicted the project site as agricultural land to the west, and undeveloped land to the east. The RWCD Canal was situated near the western limits of the project site. Aerial photographs from 1993 and 1996 depicted the previously undeveloped land east of Queen Creek used for agricultural purposes, and the development of the EMF. A 2006 aerial photograph depicted residential development to the south of the site, and the development of the Chandler Heights Basin and a 2007 aerial photograph depicted the site as being similar to its current condition, with residential development to the northwest and southeast of the site, the Roosevelt Canal, Queen Creek, and Chandler Heights Basin passing through the site.

4. PROPOSED CONSTRUCTION

The project will generally consist of the design and construction of the Ocotillo Road Bridge that will cross over the RWCD Canal, EMF, Queen Creek, and Chandler Heights Basin. We understand that the bridges that are planned to cross the EMF and Queen

Creek will be multi-span structures, and the bridge to cross Chandler Heights Basin will be a single-span structure founded on either shallow foundations (i.e. spread footings) or drilled shafts at the abutments. At the time of this report, this project is in the preliminary design phase, and information such as survey, drainage, and structural loads were not yet available.

5. GEOLOGY AND SUBSURFACE CONDITIONS

The geology and subsurface conditions observed at nearby sites are described in the following sections.

5.1. Geologic Setting

The project site is located in the Sonoran Desert Section of the Basin and Range physiographic province, which is typified by broad alluvial valleys separated by steep, discontinuous, subparallel mountain ranges. The mountain ranges generally trend north-south and northwest-southeast. The basin floors consist of alluvium with thickness extending to several thousands of feet.

The basins and surrounding mountains were formed approximately 10 to 18 million years ago during the mid- to late-Tertiary. Extensional tectonics resulted in the formation of horsts (mountains) and grabens (basins) with vertical displacement along high-angle normal faults. Intermittent volcanic activity also occurred during this time. The basins filled with alluvium from the erosion of the surrounding mountains as well as from deposition from rivers. Coarser-grained alluvial material was deposited at the margins of the basins near the mountains.

The surficial geology of the site is described as being Holocene (<10,000 years) age alluvial stream and channel deposits. These deposits generally consist of clay, silt, sand, gravel, cobbles, and boulders. Minor caliche cementation is described in these soils (Pearthree, 1994).

5.2. Boring Logs From Nearby Sites

Our knowledge of the subsurface conditions near the project site is based on previous geotechnical projects near by, specifically:

- *East Maricopa Floodway Chandler Heights Basin, 2002, Geotechnical Evaluation, Ninyo & Moore Project No. 600198001, borings B-1 through B-7*, and
- *Higley Road Bridge Improvements, Gilbert, Arizona, 2008, Geotechnical Evaluation, Ninyo & Moore Project No. 602130001*, borings CH-1 trough Ch-26.

The boring logs from these previous geotechnical studies are presented in Appendix A.

5.3. Groundwater

Groundwater was not encountered in the soil borings drilled at nearby sites. Based on well data information provided by the Arizona Department of Water Resources, the depth to the regional groundwater table in this area has been estimated to be approximately 140 feet bgs, or deeper. Groundwater levels can fluctuate due to seasonal variations, intermittent flow in the EMF, Queen Creek, and the Chandler Heights Basin, irrigation, groundwater withdrawal or injection, and other factors. In general, groundwater is not anticipated to be a constraint to the construction of the project, except possibly during periods of flow in the EMF and/or Queen Creek due to intense precipitation.

6. GEOLOGIC HAZARDS

The following sections describe potential geologic hazards at the site, including land subsidence and earth fissures, faulting and seismicity, and liquefaction.

6.1. Land Subsidence and Earth Fissures

Groundwater depletion, due to groundwater pumping, has caused land subsidence and earth fissures in numerous alluvial basins in Arizona. It has been estimated that subsidence has affected more than 3,000 square miles and has caused damage to a variety of engineered structures and agricultural land (Schumann and Genualdi,

1986). From 1948 to 1983, excessive groundwater withdrawal has been documented in several alluvial valleys where groundwater levels have been reportedly lowered by up to 500 feet. With such large depletions of groundwater, the alluvium has undergone consolidation resulting in large areas of land subsidence.

In Arizona, earth fissures are generally associated with land subsidence and pose an on-going geologic hazard. Earth fissures generally form near the margins of geomorphic basins where significant amounts of groundwater depletion have occurred. Reportedly, earth fissures have also formed due to tensional stress caused by differential subsidence of the unconsolidated alluvial materials over buried bedrock ridges and irregular bedrock surfaces (Schumann and Genualdi, 1986).

Based on our field reconnaissance and review of the referenced material, there are no known earth fissures underlying the project site. Based on our research, the closest earth fissure to the project site is located approximately 3 miles to the south of the project site (Shipman, 2007). Continued groundwater withdrawal in the area may result in subsidence and the formation of new fissures or the extension of existing fissures. While the future occurrence of land subsidence and earth fissures cannot accurately be predicted, these phenomena are not expected to be a constraint to the construction of this project.

6.2. Faulting and Seismicity

The site is within the Sonoran zone, which is described as a relatively stable tectonic region located in southwestern Arizona, southeastern California, southern Nevada, and northern Mexico (Euge et al., 1992). This zone is characterized by sparse seismicity and few Quaternary faults. Based on our field observations, review of pertinent geologic data, and analysis of aerial photographs, faults are not located on or adjacent to the property. The closest Quaternary age fault to the site is the Sugarloaf Fault Zone, located approximately 30 miles to the northeast of the site. The Sugarloaf Fault Zone is situated along the western margin of a small sedimentary basin near the bottom of the Mazatzal Mountains. This fault zone is a series of northwest striking normal faults that generally dip to the northeast. Move-

ment along this fault last happened approximately 130,000 years ago during the Middle to Late Pleistocene epoch. The slip-rate category of this fault is less than 0.2 millimeters per year. (Pearthree, 1998).

Based on a Probabilistic Seismic Hazard Assessment for the Western United States, issued by the USGS (2008), the site is located in a zone where the peak ground accelerations that have a 10 percent and 2 percent probability of being exceeded in 50 years are 0.03g and 0.08g, respectively. Seismic design parameters according to the 2006 International Building Code (IBC) are presented in Table 1. These values are anticipated based on the previous field exploration performed at nearby project sites.

Table 1 – Seismic Design Parameters

Parameter	Value	2006 IBC Reference
Site Class Definition	D	Table 1613.5.2
Site Coefficient, F_a	1.6	Table 1613.5.3(1)
Site Coefficient, F_v	2.4	Table 1613.5.3(2)

6.3. Liquefaction Potential

Based on the general lack of near surface water and the low ground motion hazard (relatively low ground accelerations), the likelihood or potential for liquefaction is not considered to be a constraint to this project.

7. PRELIMINARY RECOMMENDATIONS

The following sections present our preliminary geotechnical recommendations for the proposed construction. The preliminary recommendations should be used for planning purposes. Field exploration (soil borings), laboratory testing, and engineering analysis should be conducted prior to the final design of this project.

7.1. Earthwork

The earthwork specifications described in Maricopa Association of Governments (MAG), *Uniform Standard Specifications and Details for Public Works Construction*, as with any Town of Gilbert amendments, are expected to apply, except as noted.

7.1.1. Excavations

Our evaluation of the excavation characteristics of the on-site materials is based on our experience and boring logs from nearby project sites. In our opinion, excavation of the on-site materials can be accomplished to shallow depths heavy-duty earthmoving equipment in good operating condition. Cobbles and possible boulders were encountered in some of the borings at depths generally greater than 10 feet. If encountered, they may cause slower and/or more difficult excavation conditions during construction.

The contractor should provide a safely sloped or adequately constructed and braced shoring system, in compliance with the Occupational Safety and Health Administration (OSHA) regulations for employees working in an excavation that may expose them to the danger of moving ground. If material is stored or equipment is operated near an excavation, stronger shoring should be used to resist the extra pressure due to superimposed loads.

7.2. Grading, Fill Placement, and Compaction

Vegetation, debris from the clearing operation, and demolition debris should be removed from the site and disposed of at a legal dumpsite. Obstructions that extend below the finish grade, if present, should be removed, the exposed subgrade should be evaluated, and the resulting holes filled with compacted soil.

The geotechnical consultant should carefully evaluate any areas of soft or wet soils prior to placement of grade-raise fill or other construction. Drying or overexcavation of some materials may be appropriate.

Imported soils and soils generated from on-site excavation activities that exhibit relatively low plasticity indices and very low-to-low expansive potential are generally

suitable for use as engineered fill. Relatively low plasticity indices are defined as a value of 20 or less. Very low to low expansive potential soils are defined as having an Expansion Index (by the American Society for Testing and Materials [ASTM] D 4829) of 50 or less.

In addition, suitable fill should not include organic material, clay lumps, construction debris, rock particles, and other non-soil fill materials larger than 6 inches in dimension. This material should be disposed of offsite or in non-structural areas.

Imported fill, if utilized, should consist of granular material with a very low or low expansion potential. The geotechnical consultant should evaluate such materials and details of their placement prior to importation.

7.3. Foundations

We understand that the proposed bridges will be founded on drilled shafts and/or spread footings. Since the project was in its preliminary stages, the loads of the proposed structure are unknown at this time. Drilled Shafts will exhibit low settlement potentials, generally less than 0.5 inches. Shallow spread footings may settle significantly more than drilled shafts, possibly up to 1 inch or more. The magnitude of footing settlements cannot be accurately predicted until site specific borings, laboratory testing, and loading conditions are available. The following paragraphs present our preliminary geotechnical recommendations for the proposed drilled shaft or shallow foundations.

7.3.1. Spread Footings

Spread footings may be used for the crossing of Chandler Heights Basin at the abutments. The spread footings, if used, should be founded on a zone of moisture-conditioned and compacted engineered fill to depths ranging from approximately 2 to 4 feet below the foundation bearing elevation. The footings may be designed for allowable bearing pressures ranging from about 3,000 to 5,000 pounds per square foot, assuming a footing width of 3 feet or more.

7.3.2. Drilled Shafts

Drilled Shaft Design Charts (see Figures 2 through 6) that summarize our axial loading recommendations for single drilled shafts at the abutment and pier locations for the planned bridge structures are attached. The recommendations were generally formulated using skin friction resistance, end bearing, and an assumed factor of safety of 2.5.

The design charts reflect the shallowest allowable drilled shaft depths recommended and shaft diameters ranging from 3 to 6 feet based on the loads given and the anticipated soil profiles. Larger diameter shafts or deeper shafts could be used if this proves to be more convenient or if they are needed due to lateral load concerns.

The axial capacities presented in the design charts above are for single drilled shafts, with no group reduction factor applied. For a drilled shaft center-to-center spacing of 3B (where B is the diameter of the shaft in question), the above axial capacities should be multiplied by 0.67 (reduction factor = 0.67). This reduction factor should linearly increase until a spacing of 4B is achieved, at which point no reduction factor is applied (reduction factor = 1.0). For intermediate spacing, the reduction factor may be evaluated by linear interpolation.

7.3.3. Drilled Shaft Construction Considerations

Our evaluation of the excavation characteristics of the on-site materials is based on the results of exploratory borings from the general site vicinity and our experience with similar materials. In our opinion, excavation of the on-site materials can generally be accomplished with conventional equipment in good operating condition. Due to the possibility of encountering cobbles and possible boulders, drilled shaft diameters less than 3 feet are generally not recommended. Larger diameter shafts or deeper shafts could be used if this proves to be more convenient or if they are needed due to lateral load concerns.

The drilled shafts should be observed and evaluated to check adequate bearing material has been reached and that the bearing surface has been suitably

cleaned. This evaluation can typically be done from the ground surface. We recommend that the drilled shafts be constructed and foundation concrete mix be designed according to ADOT Standard Specification 609 (ADOT, 2008).

Where possible, the drilled shafts should be constructed in the "dry" (i.e., no more than 2 inches of water covering the bottom of the shaft excavation). In such cases, the concrete may be placed by the free-fall method. This method consists of using a vertical section of concrete chute (or other means) to allow the concrete to flow out of the mixing truck in a vertical stream of concrete with a relatively small discharge diameter. The stream should be diverted to avoid hitting the sides of the drilled shaft or the reinforcing steel, which could cause concrete segregation.

If the drilled shafts are constructed in the "wet," a tremie pipe connected either to a hopper or concrete pump should be used to displace the water in the drilled shaft excavation upwards as the concrete is placed. If this method of concrete placement is used, Ninyo & Moore should be consulted and the shafts will need to be equipped with special casing to house equipment that can be used to evaluate the integrity of the concrete after it has been cured.

Due to the presence of sandy soils, it may be appropriate to use a temporary casing or the slurry method while installing the shafts at some locations. The contractor should be prepared to use a temporary full-length casing, if needed. The contractor's drilling means and methods should also anticipate that cobbles and possible boulders might be encountered. Due to the sandy soils and the possibility of encountering cobbles and possible boulders, concrete overruns should also be anticipated.

7.4. Site Drainage

Surface drainage should be provided to divert water off of and away from new structures. Positive drainage for this project would be on the order of a slope of 2 percent or more for a distance of 5 feet or more away from the pavements.

8. LIMITATIONS

The geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed nearby site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activi-

ties of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or re-use of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

9. SELECTED REFERENCES

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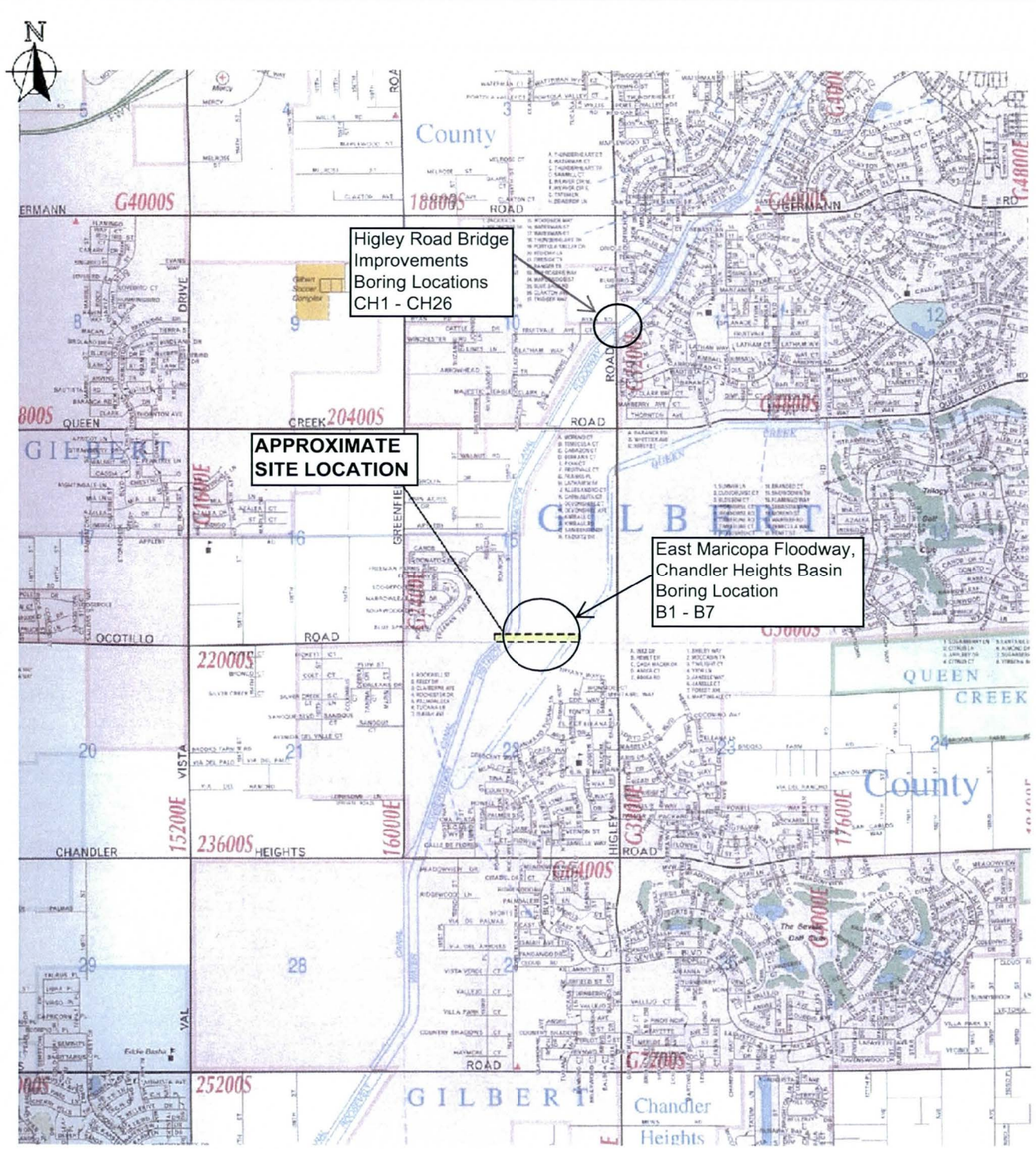
Aerial Photographs Reviewed

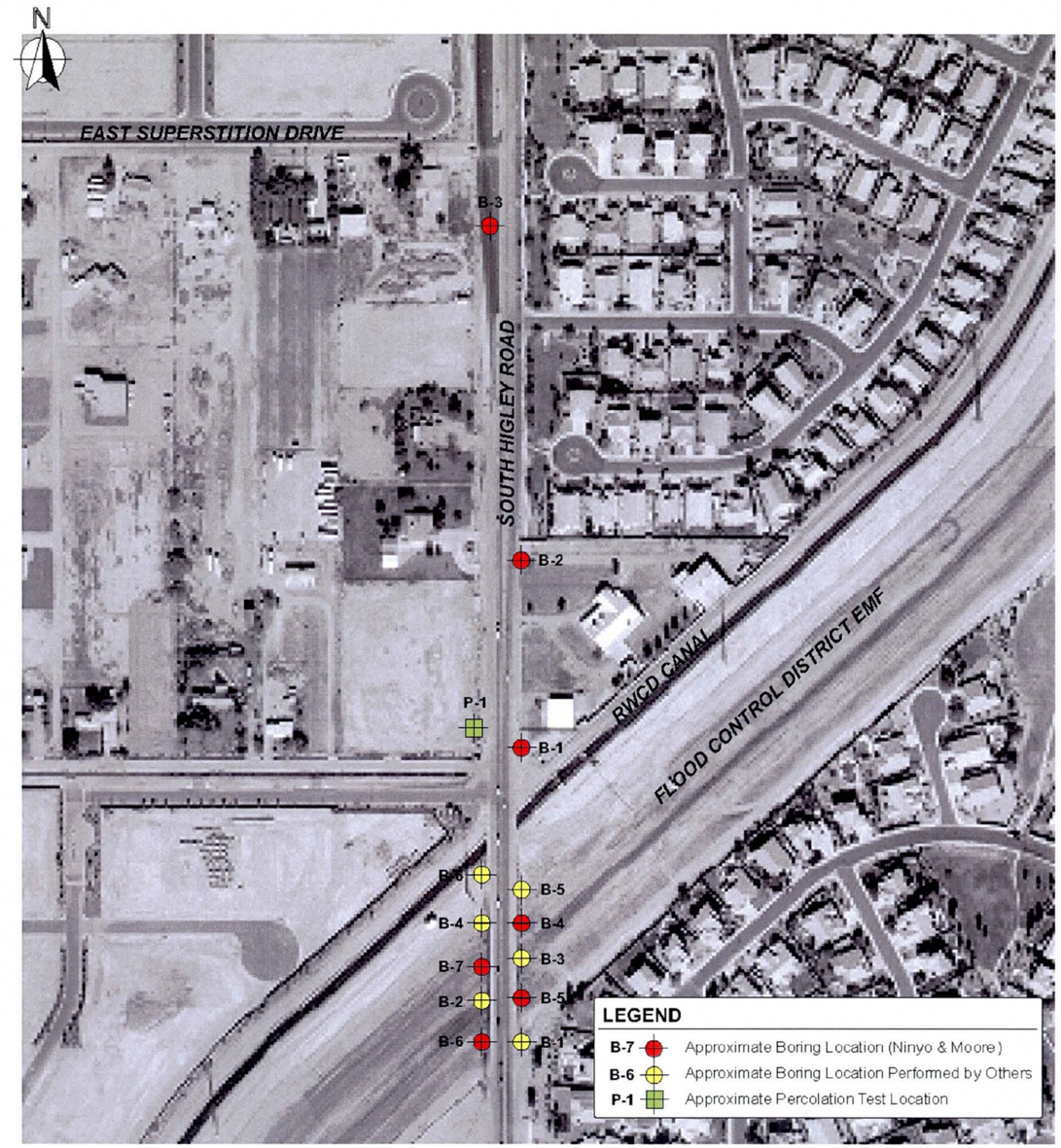
Source	Date	Scale/Resolution
Flood Control District of Maricopa County	1937, 1949, 1993, 1996, 2006, 2007	NA



Source: Phoenix Mapping Company, Phoenix Metro Edition, 2007.

Ninyo & Moore		SITE LOCATION MAP	FIGURE 1.1
PROJECT NO: 602332001	DATE: 12/08	OCOTILLO ROAD BRIDGE OVER THE EMF, QUEEN CREEK AND CHANDLER HEIGHTS BASIN GILBERT, ARIZONA	

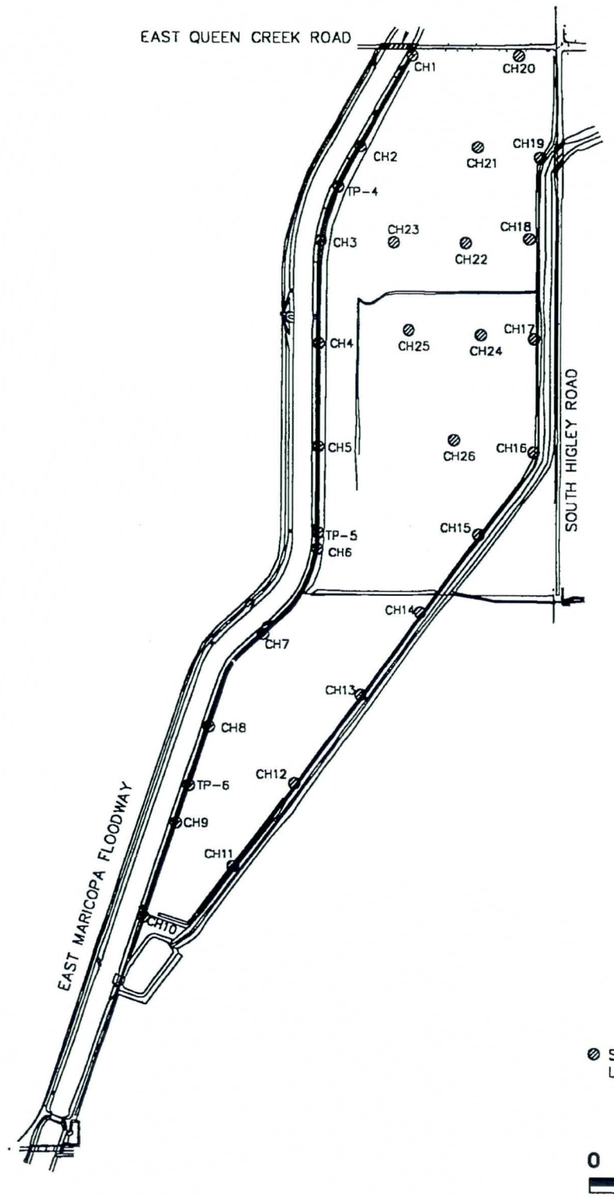
file no: 2332vmap1208



Source: Aerial photograph supplied from Maricopa County Assessor's GIS Dept, 2008.

Ninyo & Moore		SITE LOCATION MAP	FIGURE 1.2
PROJECT NO: 602130001	DATE: 9/08	HIGLEY ROAD BRIDGE IMPROVEMENTS EAST MARICOPA FLOODWAY TO 1,370 FEET NORTH GILBERT, ARIZONA	

file no: 2130blm0708b



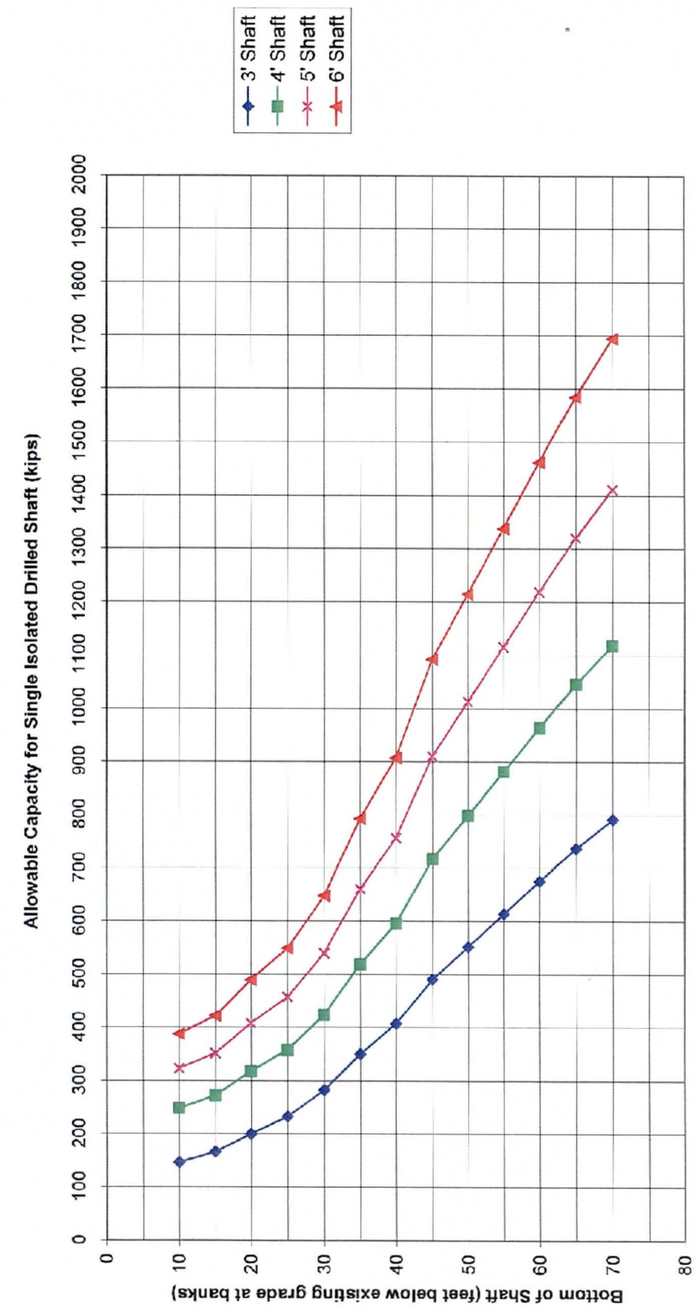
Ninyo & Moore

BORING AND TEST PIT LOCATION MAP

EAST MARICOPA FLOODWAY
CHANDLER HEIGHTS DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT #	DATE	FIGURE
600198001	01/02	1.3

PRELIMINARY ALLOWABLE CAPACITY FOR SINGLE DRILLED SHAFT
OCOTILLO ROAD BRIDGE ABUTMENTS OVER THE EMF
GILBERT ARIZONA



Note: Axial group reduction factor must be applied to the results of this chart as discussed in our report.

Ninyo & Moore

DRILLED SHAFT CAPACITY CHART

OCOTILLO ROAD OVER THE EMF QUEEN CREEK AND CH/ANDLER HEIGHTS
GILBERT, ARIZONA

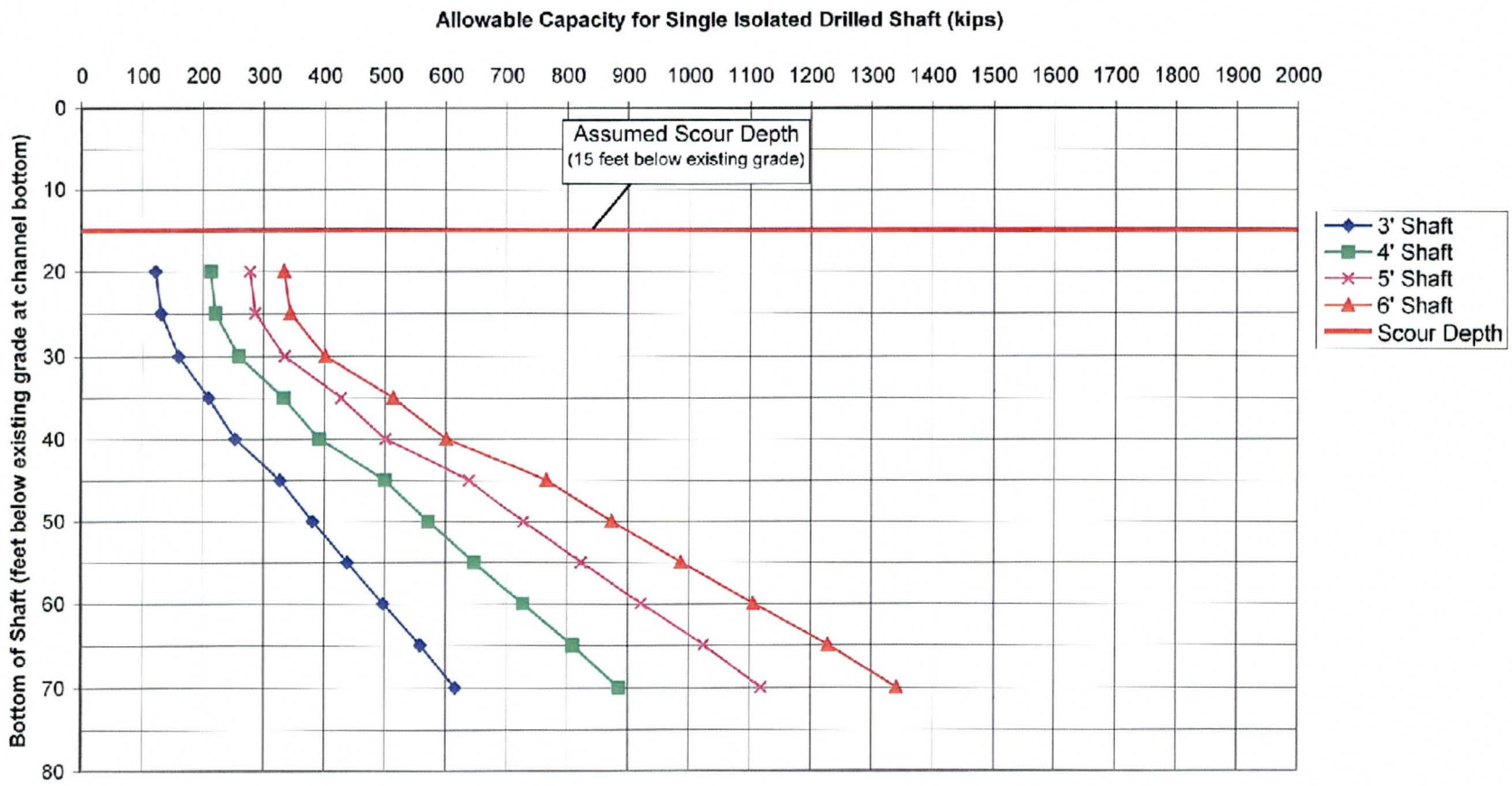
PROJECT NO: 602332001

DATE: 12/08

FIGURE 2

File no: 2332chi:208c2

PRELIMINARY ALLOWABLE CAPACITY FOR SINGLE DRILLED SHAFT
OCOTILLO ROAD BRIDGE PIERS OVER THE EMF
GILBERT ARIZONA

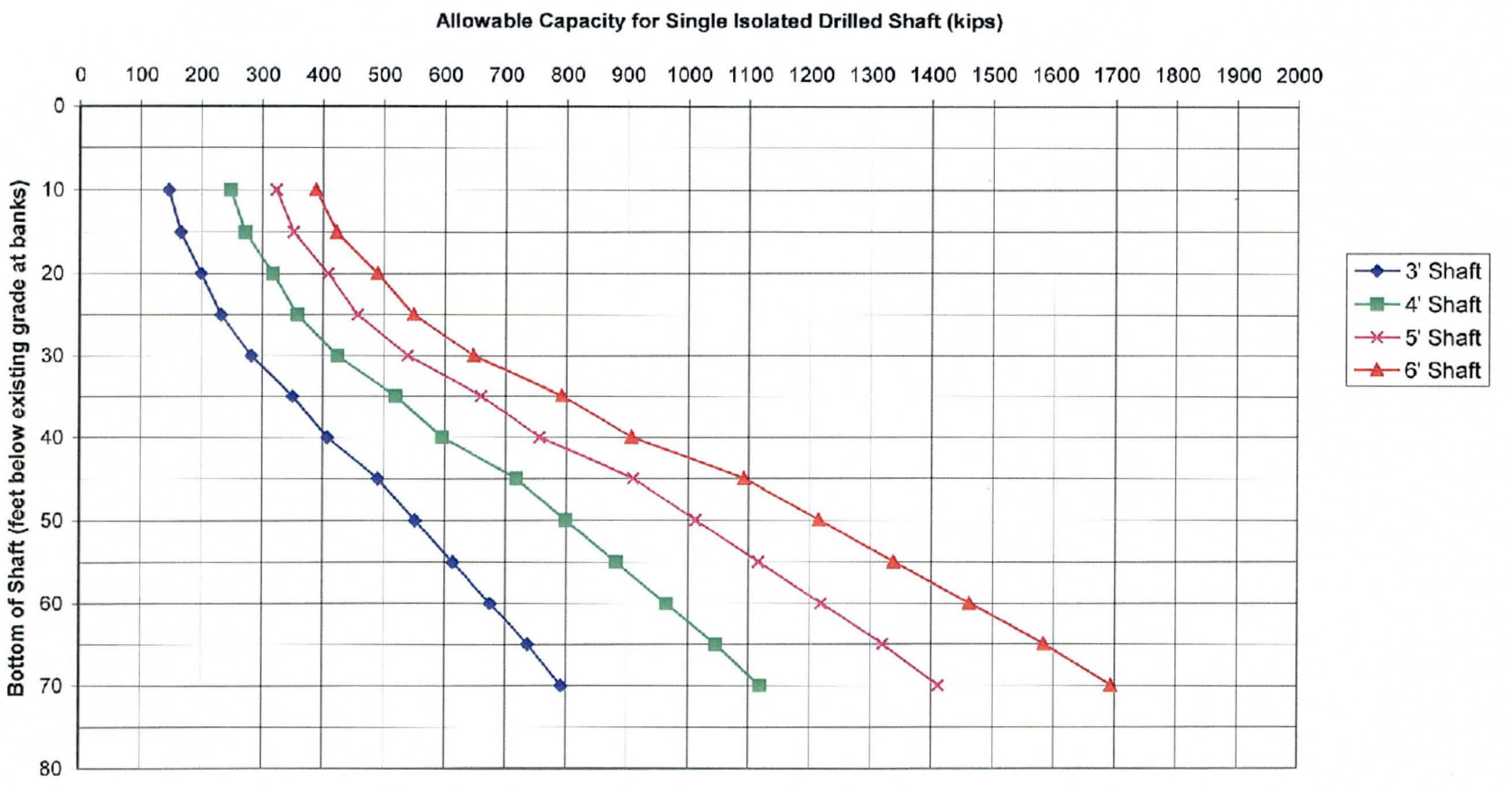


Note: Axial group reduction factor must be applied to the results of this chart as discussed in our report.

Ninyo & Moore		DRILLED SHAFT CAPACITY CHART	FIGURE
PROJECT NO: 602332001	DATE: 12/08	OCOTILLO ROAD OVER THE EMF QUEEN CREEK AND CHANDLER HEIGHTS GILBERT, ARIZONA	3

file no. 2332chl12908d2

PRELIMINARY ALLOWABLE CAPACITY FOR SINGLE DRILLED SHAFT
OCOTILLO ROAD BRIDGE ABUTMENTS OVER QUEEN CREEK
GILBERT ARIZONA

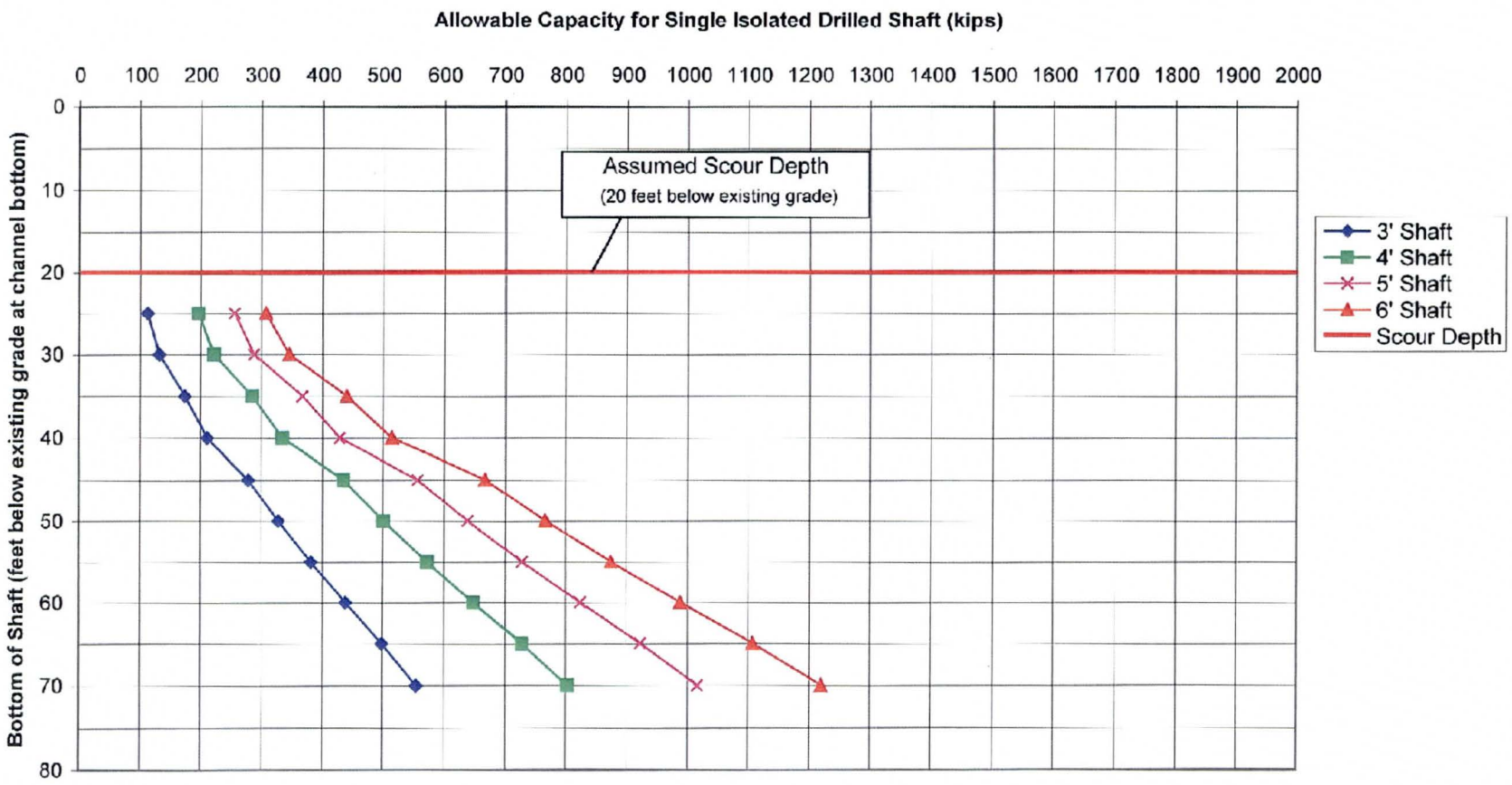


Note: Axial group reduction factor must be applied to the results of this chart as discussed in our report.

Ninyo & Moore		DRILLED SHAFT CAPACITY CHART	FIGURE
PROJECT NO: 602332001	DATE: 12/08	OCOTILLO ROAD OVER THE EMF QUEEN CREEK AND CHANDLER HEIGHTS GILBERT, ARIZONA	4

file no. 2332chl12908d2

PRELIMINARY ALLOWABLE CAPACITY FOR SINGLE DRILLED SHAFT
OCOTILLO ROAD BRIDGE PIERS OVER QUEEN CREEK
GILBERT ARIZONA

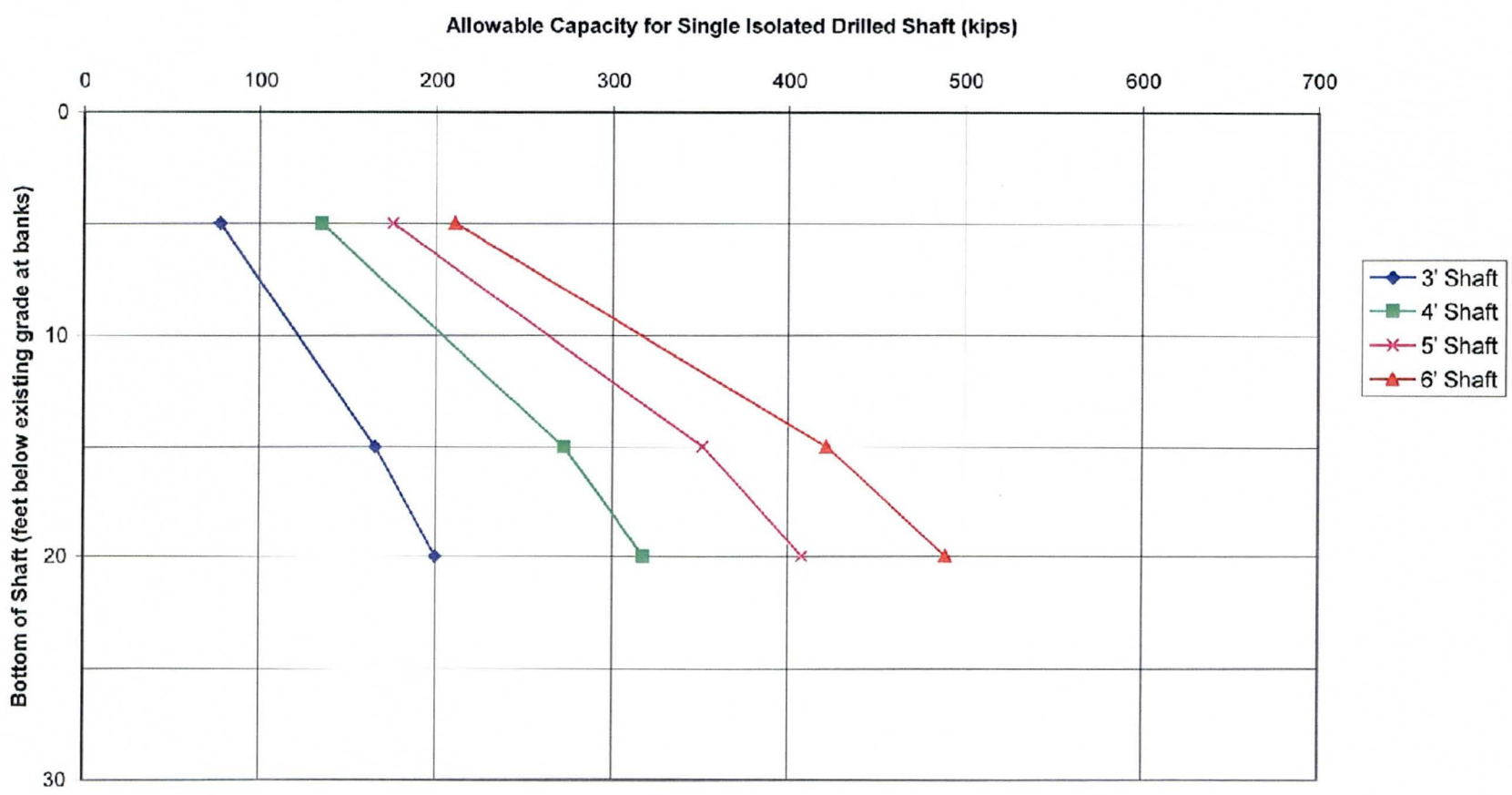


Note: Axial group reduction factor must be applied to the results of this chart as discussed in our report.

Ninyo & Moore		DRILLED SHAFT CAPACITY CHART	FIGURE
PROJECT NO: 602332001	DATE: 12/08	OCOTILLO ROAD OVER THE EMF QUEEN CREEK AND CHANDLER HEIGHTS GILBERT, ARIZONA	5

file no: 2332chrt12586

PRELIMINARY ALLOWABLE CAPACITY FOR SINGLE DRILLED SHAFT
OCOTILLO ROAD BRIDGE ABUTMENTS OVER CHANDLER HEIGHTS BASIN
GILBERT ARIZONA



Note: Axial group reduction factor must be applied to the results of this chart as discussed in our report.

Ninyo & Moore		DRILLED SHAFT CAPACITY CHART	FIGURE
PROJECT NO: 602332001	DATE: 12/08	OCOTILLO ROAD OVER THE EMF QUEEN CREEK AND CHANDLER HEIGHTS GILBERT, ARIZONA	6

file no: 2332chrt12586

APPENDIX A
BORING LOGS FROM NEARBY SITES

DATE DRILLED 6/13/08 BORING NO. B-1
GROUND ELEVATION 1,314' ± MSL SHEET 1 OF 1
METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							CL	FILL: Dark brown, moist, stiff, sandy CLAY.
			8					
			6					Firm to stiff.
5								
								Total Depth = 8 feet. Groundwater not encountered during drilling. Backfilled on 6/13/08 promptly after completion of drilling. Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
10								
15								
20								

Ninyo & Moore

BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-1

DATE DRILLED 6/13/08 BORING NO. B-3

GROUND ELEVATION 1,310' ± MSL SHEET 1 OF 1

METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL-ML	ALLUVIUM: Brown, moist, stiff, silty CLAY with sand.
		8					
		5					Firm to stiff.
5							
						SC	Brown, moist, loose, clayey SAND.
		13	18.3	107.3			
						CL	Brown, damp, hard, sandy CLAY; few gravel; scattered caliche nodules.
		39					
10							Total Depth = 10 feet. Groundwater not encountered during drilling. Backfilled on 6/13/08 promptly after completion of drilling. Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
15							
20							

Ninyo & Moore

BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-2

DATE DRILLED 6/10/08 BORING NO. B-4

GROUND ELEVATION 1,300' ± MSL SHEET 1 OF 5

METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown, damp, very stiff, sandy CLAY; scattered caliche nodules.
		16					
		19					
5							
						SM	Brown, damp, dense, silty SAND with gravel.
		51					
		29					Dense.
10							
						SC	Brown, moist, dense, clayey SAND with gravel.
		55	10.9	112.1			
15							
						SM	Brown, damp, medium dense, silty SAND; trace gravel.
		16					
20							

Ninyo & Moore

BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-3

DATE DRILLED 6/10/08 BORING NO. B-4
GROUND ELEVATION 1,300' ± MSL SHEET 2 OF 5
METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						SM	ALLUVIUM: (continued) Brown, damp, medium dense, silty SAND; trace gravel.
		15	6.8	102.6			
25							
		50					Very dense.
30							
						CL	Brown, moist, hard, sandy CLAY.
		64	20.3	94.8			
35							
						SM	Brown, moist, medium dense, silty SAND.
		16					
40							

Ninyo & Moore

BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-4

DATE DRILLED 6/10/08 BORING NO. B-4
GROUND ELEVATION 1,300' ± MSL SHEET 3 OF 5
METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40						SM	ALLUVIUM: (continued) Brown, moist, medium dense, silty SAND.
		46	11.4	97.7			Dense.
45							
		57					Very dense.
50							
						SC	Brown, moist, medium dense, clayey SAND with gravel.
		40	11.9	120.9			
55							
		27					Dense; scattered caliche nodules.
60							

Ninyo & Moore

BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-5

DATE DRILLED 6/10/08 BORING NO. B-4

GROUND ELEVATION 1,300' ± MSL SHEET 4 OF 5

METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
60						SC	ALLUVIUM: (continued) Brown, damp, dense, clayey SAND with gravel; scattered caliche nodules.
		52	9.2	123.8		SM	Brown, moist, dense, silty SAND with gravel.
65							
		43					Very dense.
70							
		50/1"	8.3	102.4			
75							
						CL	Brown, damp, stiff, sandy CLAY; scattered caliche filaments and nodules.
		16					
80							

Ninyo & Moore

BORING LOG

HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO	DATE	FIGURE
602130001	8/08	A-6

DATE DRILLED 6/10/08 BORING NO. B-4

GROUND ELEVATION 1,300' ± MSL SHEET 5 OF 5

METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
80							Total Depth = 80 feet. Groundwater not encountered during drilling. Backfilled on 6/10/08 promptly after completion of drilling. Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
85							
90							
95							
100							

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BORING LOG

HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-7

DATE DRILLED 6/4/08 BORING NO. B-5

GROUND ELEVATION 1,300' ± MSL SHEET 1 OF 5

METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown, damp, hard, sandy CLAY.
		28					
						ML	Brown, damp, medium dense, sandy SILT.
		14					
5						SC	Brown, damp, medium dense, clayey SAND.
		15					
						SM	Brown, moist, loose, silty SAND with gravel.
		5					
10							
		43	15.6	110.6			Dense; scattered caliche nodules.
15							
		21					
20							

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BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-8

DATE DRILLED 6/4/08 BORING NO. B-5

GROUND ELEVATION 1,300' ± MSL SHEET 2 OF 5

METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						SM	ALLUVIUM: (continued) Brown, damp, dense, silty SAND with gravel; scattered caliche nodules.
		58	6.4	112.0			
25							
		32					
30							
						CL	Brown, moist, hard, sandy CLAY.
		50/5"	14.7	108.9			
35							
		24					Increase in gravel content.
40							

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BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-9

DATE DRILLED 6/4/08 BORING NO. B-5
GROUND ELEVATION 1,300' ± MSL SHEET 3 OF 5
METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40						CL	ALLUVIUM: (continued) Brown, moist, hard, sandy CLAY with gravel.
		50/6"	9.7	109.8			
45							
						SM	Brown, damp, very dense, silty SAND with gravel.
		41					
50							
						SC	Brown, damp, dense, clayey SAND with gravel.
		21					
55							
		51	3.7	120.7			Scattered caliche nodules.
60							

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BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-10

DATE DRILLED 6/4/08 BORING NO. B-5
GROUND ELEVATION 1,300' ± MSL SHEET 4 OF 5
METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
60						SC	ALLUVIUM: (continued) Brown, damp, dense, clayey SAND with gravel; scattered caliche nodules.
						SM	Brown, damp, dense, silty SAND with gravel; scattered caliche nodules.
		23					
65							
						CL	Brown, damp, hard, sandy CLAY; scattered caliche nodules.
		50/3"					
70							
						SM	Brown, damp, very dense, silty SAND.
		40					
75							
						CL	Reddish brown, damp, hard, sandy CLAY.
		79					
80							

Ninyo & Moore

BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-11

DATE DRILLED 6/4/08 BORING NO. B-5

GROUND ELEVATION 1,300' ± MSL SHEET 5 OF 5

METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
80								Total Depth = 80 feet. Groundwater not encountered during drilling. Backfilled on 6/4/08 promptly after completion of drilling. Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
85								
90								
95								
100								

Ninyo & Moore

BORING LOG

HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-12

DATE DRILLED 6/5/08 BORING NO. B-6

GROUND ELEVATION 1,301' ± MSL SHEET 1 OF 5

METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							CL	ALLUVIUM: Brown, damp, stiff, sandy CLAY.
			12					
			18					Very stiff.
5								
			24					Scattered caliche nodules.
							SC	Brown, moist, medium dense, clayey SAND with gravel; scattered caliche nodules.
			14					
10								
			29	17.4	111.9			
15								
							SM	Brown, moist, dense, silty SAND with gravel.
			21					
20								

Ninyo & Moore

BORING LOG

HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-13

DATE DRILLED 6/5/08 BORING NO. B-6
GROUND ELEVATION 1,301' ± MSL SHEET 2 OF 5
METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						SM	ALLUVIUM: (continued) Brown, moist, dense, silty SAND with gravel.
						SC	Brown, damp, medium dense, clayey SAND; scattered caliche nodules.
		24	6.6	116.5			
25							
		28					Dense.
30							
		50/4"	16.9	104.2			Moist; scattered caliche nodules.
35							
		20					Medium dense to dense.
40							

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BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-14

DATE DRILLED 6/5/08 BORING NO. B-6
GROUND ELEVATION 1,301' ± MSL SHEET 3 OF 5
METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40						SC	ALLUVIUM: (continued) Brown, moist, medium dense to dense, clayey SAND; scattered caliche nodules.
						SM	Brown, moist, medium dense, silty SAND with gravel.
		31	9.9	110.8			
45							
		20					Medium dense to dense.
50							
						SC	Brown, damp, dense, clayey SAND.
		53	5.3	111.8			
55							
		23					
60							

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BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-15

DATE DRILLED 6/5/08 BORING NO. B-6
GROUND ELEVATION 1,301' ± MSL SHEET 4 OF 5
METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
60						SC	ALLUVIUM: (continued) Brown, damp, dense, clayey SAND.
						SM	Brown, moist, medium dense, silty SAND with gravel.
		27	11.1	109.9			
65							
		64					Very dense.
70							
						ML	Brown, moist, dense, sandy SILT.
		52	13.3	107.2			
75							
						CL	Brown, damp, hard, sandy CLAY.
		38					
80							

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BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-16

DATE DRILLED 6/5/08 BORING NO. B-6
GROUND ELEVATION 1,301' ± MSL SHEET 5 OF 5
METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
80							Total Depth = 80 feet. Groundwater not encountered during drilling. Backfilled on 6/5/08 promptly after completion of drilling. Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
85							
90							
95							
100							

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BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-17

DATE DRILLED 6/3/08 BORING NO. B-7

GROUND ELEVATION 1,302' ± MSL SHEET 1 OF 4

METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SC	ALLUVIUM: Brown, damp, medium dense, clayey SAND with gravel.
		33					
						SM	Brown, damp, medium dense, silty SAND; trace gravel.
		13					
5							
		10					Loose; no caliche observed.
		5					
10							
		26	17.7	100.7			Moist; medium dense.
15							
		11					Damp; increase in gravel content.
20							

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BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-18

DATE DRILLED 6/3/08 BORING NO. B-7

GROUND ELEVATION 1,302' ± MSL SHEET 2 OF 4

METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						SM	ALLUVIUM: (continued) Brown, damp, medium dense, silty SAND with gravel.
		39	5.1	112.1			
25							
		24					Dense.
30							
						CL	Brown, damp, hard, sandy CLAY.
		50/6"					
35							
						SM	Brown, damp, dense, silty SAND with gravel.
		22					
40							

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BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-19

DATE DRILLED 6/3/08 BORING NO. B-7
GROUND ELEVATION 1,302' ± MSL SHEET 3 OF 4
METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40						SM	ALLUVIUM: (continued) Brown, damp, dense, silty SAND with gravel.
		50/6"					Very dense.
45							
		27					Dense; decrease in gravel content.
50							
						CL	Brown, damp, hard, sandy CLAY; scattered caliche nodules.
		39	5.7	120.4			
55							
		50/5"					
60							

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BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-20

DATE DRILLED 6/3/08 BORING NO. B-7
GROUND ELEVATION 1,302' ± MSL SHEET 4 OF 4
METHOD OF DRILLING CME-75, 7" Diameter Hollow-Stem Auger (Enviro-Drill, Inc.)
DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"
SAMPLED BY AJG LOGGED BY AJG REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
60						CL	ALLUVIUM: (continued) Brown, damp, hard, sandy CLAY; scattered caliche nodules.
65							
						SM	Brown, damp, very dense, silty SAND; scattered caliche nodules.
		70					
70							
		50/4"					Few gravel.
75							Total Depth = 74.9 feet. Groundwater not encountered during drilling. Backfilled on 6/3/08 promptly after completion of drilling. Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
80							

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BORING LOG
HIGLEY ROAD BRIDGE IMPROVEMENTS
GILBERT, ARIZONA

PROJECT NO.	DATE	FIGURE
602130001	8/08	A-21

DATE DRILLED 7/10/01 BORING NO. CH-1

GROUND ELEVATION 1312' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						ML	ALLUVIUM: Brown (7.5 YR 5/4), damp, loose to dense, clayey SILT. Stage I cementation, weakly cemented by calcium carbonate, weak reaction with HCL, sparse calcium carbonate filaments.
		42					
5		9	10.7				Medium dense.
		11	11.1	88.4			
10		26	8.9			SM	Pale brown (10 YR 6/3), dry to damp, dense, silty SAND; trace fine, subrounded gravel. Stage I cementation, weakly cemented by calcium carbonate, weak reaction with HCL, sparse calcium carbonate filaments.
		28	10.2	90.1		CL	Reddish brown (5 YR 5/4), damp, hard, silty CLAY. Stage I cementation, weakly cemented by calcium carbonate, weak reaction with HCL, sparse calcium carbonate filaments.
15		16	15.9				Very stiff.
		9				ML	Brown (7.5 YR 5/4), damp, loose, clayey SILT. Stage I cementation, non-cemented, no reaction to HCL.
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-1

DATE DRILLED 7/10/01 BORING NO. CH-1

GROUND ELEVATION 1312' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		21				SM	ALLUVIUM: (continued) Very pale brown (10 YR 7/4), dry, medium dense, silty SAND. Soil type change from ML to SM within sample interval.
							Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/10/01.
25							
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-2

DATE DRILLED 7/17/01 BORING NO. CH-2

GROUND ELEVATION 1309' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4), dry, stiff, silty CLAY; scattered caliche filaments, weakly cemented. Stage I, weak reaction with HCL.
		12	9.8	85.5			
5		45					Hard.
		12	8.0				Very stiff.
10		37	4.7	100.8			Hard.
		82/9"	13.3				Stage I cementation, scattered caliche filaments, weakly cemented, weak to no reaction with HCL.
15		39				SM	Pale brown (10 YR 6/3), dry, medium dense, silty SAND.
		53	5.5			CL	Brown (7.5 YR 5/4), dry, hard, silty CLAY. Stage II cementation, scattered caliche nodules, moderately cemented.
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-3

DATE DRILLED 7/17/01 BORING NO. CH-2

GROUND ELEVATION 1309' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		27	6.0	94.2		CL	ALLUVIUM: (continued) Brown (7.5 YR 5/4), dry, hard, silty CLAY. Stage II cementation, scattered calcium carbonate nodules.
							Total Depth = 21.5' Groundwater not encountered. Piezometer installed on 7/17/01.
25							
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-4

DATE DRILLED 7/11/01 BORING NO. CH-3
GROUND ELEVATION 1309' SHEET 1 OF 2
METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger
DRIVE WEIGHT 140 lbs. (Auto) DROP 30"
SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	FILL: Brown (7.5 YR 5/4), damp, stiff, silty CLAY. Stage II cementation, scattered calcium carbonate filaments, weakly cemented.
		12	14.6	84.2			
5		17					Very stiff.
		34	8.4				Hard; few sand.
10		35	5.4	102.1		ML	ALLUVIUM: Reddish brown (5 yr 5/4), damp, medium dense, sandy SILT. Stage I cementation, weakly cemented, moderage reaction with HCL.
		55	3.0			SM	Brown (7.5 YR 5/4), damp, dense to very dense, silty SAND; some fine subrounded gravel. Stage II cementation, moderate cementation by caliche, color change to light gray.
15		67/11"	6.3				
		68	7.4	95.8		CL	Brown (7.5 YR 5/4), damp, hard, silty CLAY. Stage II cementation, trace caliche nodules less than 1/2" in diameter.
20							

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BORING LOG
East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-5

DATE DRILLED 7/11/01 BORING NO. CH-3
GROUND ELEVATION 1309' SHEET 2 OF 2
METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger
DRIVE WEIGHT 140 lbs. (Auto) DROP 30"
SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		70	7.1			ML	ALLUVIUM: (continued) Brown (7.5 YR 5/4), damp, hard, silty CLAY, trace nodules. Stage II cementation, trace carbonate nodules less than 1/2" in diameter.
							Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/11/01.
25							
30							
35							
40							

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BORING LOG
East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-6

DATE DRILLED 7/11/01 BORING NO. CH-4
GROUND ELEVATION 1308' SHEET 1 OF 2
METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger
DRIVE WEIGHT 140 lbs. (Auto) DROP 30"
SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 Yr 5/4), damp, very stiff, silty CLAY. Stage I cementation, scattered calcium carbonate filaments.
		14					
5		13	6.0				Thin layer of silty fine sand.
		35	13.0	72.5			Hard, scattered calcium carbonate filaments.
10		12	7.7				Very stiff.
		90/11"	6.3	93.8			Hard.
15		21	3.1			ML	Very pale brown (10 YR 7/4), dry to damp, dense, clayey SILT; few fine gravel, trace coarse gravel. Stage II cementation below 15 feet moderate reaction with HCL.
		82/11"	2.3	117.0		SP-SM	Light bluish gray (10B 8/1), dry to damp, very dense, silty SAND. Stage II cementation, grains coated by calcium carbonate, matrix loose, moderate reaction with HCL on coatings.
20							

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BORING LOG
East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-7

DATE DRILLED 7/11/01 BORING NO. CH-4
GROUND ELEVATION 1308' SHEET 2 OF 2
METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger
DRIVE WEIGHT 140 lbs. (Auto) DROP 30"
SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		30				SM	ALLUVIUM: (continued) Light bluish gray (10B 8/1), dry, dense, silty SAND.
							Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/11/01.
25							
30							
35							
40							

Ninyo & Moore

BORING LOG
East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-8

DATE DRILLED 7/11/01 BORING NO. CH-5

GROUND ELEVATION 1307' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4), damp, very stiff, silty CLAY. Stage I cementation, scattered calcium carbonate filaments.
		15	7.0	90.3			
5		14	12.8				
		83	7.4			ML	Pale brown (10 YR 6/3), dry, dense to very dense, clayey SILT. Stage I cementation, scattered calcium carbonate filaments.
10		85/11"					
		33	5.3				
15		43					
		37	3.9			CL	Reddish brown (5 YR 5/4) to pale brown (10 YR 6/3), damp, hard, silty CLAY; some medium to fine sand.
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-9

DATE DRILLED 7/11/01 BORING NO. CH-5

GROUND ELEVATION 1307' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		54	4.6	96.1		CL	ALLUVIUM: (continued) Pale brown (10 YR 6/3), damp to dry, hard, silty CLAY. Stage I cementation, scattered calcium carbonate filaments.
							Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/11/01.
25							
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-10

DATE DRILLED 7/17/01 BORING NO. CH-6

GROUND ELEVATION 1308' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4), dry, very stiff, silty CLAY. Stage I cementation, sparse calcium carbonate filaments, non -to weakly cemented.
		22					
5		13	6.6			ML	Brown (7.5 YR 5/4), dry to damp, medium dense to very dense, clayey SILT; scattered caliche stringers. Stage I cementation, sparse calicium carbonate filaments, non -to weakly cemented.
		29	4.9	96.1			
10		41	4.2				
		24				SM	Brown (7.5 YR 5/4) to reddish brown (5 YR 3/4), dry to damp, medium dense, silty SAND; few fine gravel. Stage I cementation, trace calcium carbonate filaments, non -to weakly cemented, weak to no reaction with HCL.
15		11	0.6				
		34	1.8	121.5			Stage II cementation below 17.5 feet; continuous coatings of calcium carbonate on fine gravel grains, matrix loose.
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-11

DATE DRILLED 7/17/01 BORING NO. CH-6

GROUND ELEVATION 1308' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		63	1.6	127.1		SM	ALLUVIUM: (continued) Pale brown (10 YR 6/3), dry to damp, dense, silty SAND; few fine gravel. Stage II cementation.
							Total Depth = 21.5' Groundwater not encountered. Piezometer installed on 7/17/01.
25							
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-12

DATE DRILLED 7/11/01 BORING NO. CH-7

GROUND ELEVATION 1306' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						ML	ALLUVIUM: Brown (7.5 YR 5/4), damp, medium dense, clayey SILT. Stage I cementation, weakly cemented by scattered calcium carbonate filaments.
		21	6.9	92.7			
5		24	5.9	96.8		CL	Brown (7.5 YR 5/4), damp, very stiff, silty CLAY; some fine sand. Stage I cementation, weakly cemented by scattered calcium carbonate filaments.
		51	5.6				Hard.
10		62	5.3	99.8			
		15	1.8			SM	Pale brown (5 YR 6/2), dry to damp, medium dense, silty SAND; scattered fine gravel.
15		74	1.0	129.6		SP	Pale brown, dry to damp, very dense, SAND with fine to coarse gravel. Stage II cementation below 15 feet; weak to moderate reaction with HCL.
		51	1.2				
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-13

DATE DRILLED 7/11/01 BORING NO. CH-7

GROUND ELEVATION 1306' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		66				GM	ALLUVIUM: (continued) Pale brown (10 YR 6/3), dry, dense, silty GRAVEL. Stage II cementation, thin calcium carbonate coating, matrix loose, weak to no reaction with HCL.
							Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/11/01.
25							
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-14

DATE DRILLED 7/11/01 BORING NO. CH-8

GROUND ELEVATION 1306' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4), damp, very stiff, silty CLAY. Stage I cementation, sparse calcium carbonate filaments, weakly cemented, moderate reaction with HCL.
		22	6.0	91.8			
5		6					Stiff.
		9	2.8			SM	Pale brown (10 YR 6/3), dry to damp, medium dense, silty SAND; trace fine gravel. Stage I cementation, no calcium carbonate coatings on gravel grains, weak reaction with HCL on sand particles.
10		24	2.8	105.1			
		12					Loose.
15		20	3.6				Medium dense to dense.
		52	2.8	117.5		SM/GM	Light yellowish brown (10 YR 6/4), dry to damp, dense, silty SAND with fine gravel; increase in gravel content. Stage II cementation, moderately cemented by calcium carbonate.
20							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-15

DATE DRILLED 7/11/01 BORING NO. CH-8

GROUND ELEVATION 1306' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		27	3.9			SM/GM	ALLUVIUM: (continued) Light yellowish brown (10 YR 6/4), dry to damp, dense, silty SAND with gravel. Stage II cementation.
							Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/11/01.
25							
30							
35							
40							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-16

DATE DRILLED 7/17/01 BORING NO. CH-9

GROUND ELEVATION 1306' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SM	ALLUVIUM: Pale brown (10 YR 6/3), dry, loose, silty SAND; few fine gravel. Stage I cementation.
		13					
5		31				ML	Pale brown (10 YR 6/3) to brown (7.5 YR 5/4), dry to damp, medium dense, clayey SILT.
		11	9.3			SM	Pale brown (10 YR 6/3) to brown (10 YR 5/3), dry to damp, medium dense, silty SAND; few fine gravel.
10		30	1.7	107.4			
		32	1.5				Dense.
15		56					Few fine gravel; trace cobbles. Stage II cementation below 15 feet, continuous calcium carbonate coatings on gravel grains, matrix loose.
		21	0.7				
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-17

DATE DRILLED 7/17/01 BORING NO. CH-9

GROUND ELEVATION 1306' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		46	12.0	108.2		SC	ALLUVIUM: (continued) Pale brown (10 YR 6/3), damp, dense, clayey SAND. Stage II cementation.
							Total Depth = 21.5' Groundwater not encountered. Piezometer installed on 7/17/01.
25							
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-18

DATE DRILLED 7/11/01 BORING NO. CH-10

GROUND ELEVATION 1306' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4), dry to damp, hard, silty CLAY. Stage II cementation, scattered caliche filaments, weakly cemented.
		72/11"					
5		40					
		83/11"					
10		25	5.8				
		50/4"	7.4	92.0			
						SM	Pale brown (10 YR 6/3), dry to damp, very dense, silty SAND. Stage II cementation below 14.5 feet; moderately cemented.
15		72	13.2				
						SC	Pale brown (10 YR 6/3), dry to damp, very dense, clayey SAND.
		71	11.3	105.9			Scattered fine gravel. Stage II cementation, continuous calcium carbonate coatings on gravel grains.
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-19

DATE DRILLED 7/11/01 BORING NO. CH-10

GROUND ELEVATION 1306' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		24	3.3			SM	Pale brown (10 YR 6/3), dry to damp, medium dense, silty SAND; scattered fine gravel. Stage II cementation, moderately cemented.
							Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/11/01.
25							
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-20

DATE DRILLED 7/13/01 BORING NO. CH-11

GROUND ELEVATION 1307' SHEET 1 OF 1

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4), dry, very stiff to hard, silty CLAY. Stage I cementation, scattered caliche filaments, weakly cemented by calcium carbonate, moderate reaction with HCL.
		24	6.2	101.1			
5		57					Hard.
		23	11.1				
10		32	16.7	104.4			Few sand.
		15	0.3			SW-SM	Very pale brown (10 YR 7/4), dry, medium dense, SAND with silt; few fine gravel. Stage II cementation.
15		32	4.4	110.7			
20							Total Depth = 17.0' Groundwater not encountered. Backfilled on 7/13/01.

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-21

DATE DRILLED 7/13/01 BORING NO. CH-12

GROUND ELEVATION 1309' SHEET 1 OF 1

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Light brown (7.5 YR 6/4), dry, very stiff, silty CLAY. Stage I cementation, weakly cemented by calcium carbonate.
		16					
5		16	2.2				
		31	3.4	111.1		SM	Light brown (7.5 YR 6/4) to reddish brown (5 YR 5/4), dry, dense to medium dense, silty SAND; few fine gravel. Stage II cementation.
10		19	0.8				
		50/5""					
15		67/11"	3.8				
20							Total Depth = 16.5' Groundwater not encountered. Backfilled on 7/13/01.

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-22

DATE DRILLED 7/13/01 BORING NO. CH-13

GROUND ELEVATION 1310' SHEET 1 OF 1

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4) to light brown (7.5 YR 6/4), damp, very stiff, silty CLAY. Stage I cementation, non-cemented to weakly cemented, few calcium carbonate filaments.
		22	7.0	86.8			
5						ML	Brown (7.5 YR 5/4), damp, loose to medium dense, clayey SILT.
		14	5.0	71.0			
						CL	Brown (7.5 YR 5/4) to light brown (7.5 YR 6/4), damp, very stiff, silty CLAY.
		16					
10		17	6.2	87.1			
						ML	Light brown (7.5 YR 6/4), dry, dense, clayey SILT; few sand. Stage II cementation, scattered calcium carbonate filaments, continuous
		43					Stage II cementation, few sand.
15						SM	Light brown (7.5 YR 6/4), damp, medium dense, silty SAND.
		40	5.0				
							Total Depth = 16.5' Groundwater not encountered. Backfilled on 7/13/01.
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-23

DATE DRILLED 7/13/01 BORING NO. CH-14

GROUND ELEVATION 1310' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Light brown (7.5 YR 6/4), dry to damp, very stiff, silty CLAY. Stage I cementation, trace calcium carbonate filaments, weakly cemented by calcium carbonate, weak reaction with HCL.
		15	9.0				
5		9	5.4				Stiff.
		47					Hard; scattered caliche filaments.
10		47	3.9				
		31	5.2				Few sand.
						SW-SM	Light brown (7.5 YR 6/4) to light bluish gray (10 B 8/1), dry, medium dense, SAND with silt and sand; few gravel, trace cobbles. Stage II cementation below 15 feet; calcium carbonate coatings on gravel grains.
15		31	1.3	105.3			
		27					Shoe plugged by cobble.
							Total Depth = 19.0' Groundwater not encountered.
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-24

DATE DRILLED 7/13/01 BORING NO. CH-14

GROUND ELEVATION 1310' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20							Backfilled on 7/13/01.
25							
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-25

DATE DRILLED 7/13/01 BORING NO. CH-15

GROUND ELEVATION 1313' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4), dry to damp, stiff to very stiff, silty CLAY. Stage I cementation, scattered calcium carbonate nodules less than 1/4" in diameter, weakly cemented.
		22	5.5	82.4			
5		13	3.3				
		35					Hard.
10		76/9"	5.7				
		63					Stage II cementation below 12.5 feet; color changes to pale brown (10 YR 6/3), moderate reaction to HCL, calcium carbonate nodules less than 1/4" in diameter.
15		52	2.9				
		86/9"	3.4	99.7		ML	Light brown to reddish brown, dry to damp, very dense, sandy SILT; sparse fine gravel, calcium carbonate nodules less than 1/4" in diameter, gravel fraction coated by calcium carbonate. Stage II cementation. Total Depth = 18.3'
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-25

DATE DRILLED 7/13/01 BORING NO. CH-15

GROUND ELEVATION 1313' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20								Groundwater not encountered. Backfilled on 7/13/01.
25								
30								
35								
40								

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-26

DATE DRILLED 7/13/01 BORING NO. CH-16

GROUND ELEVATION 1315' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							CL	ALLUVIUM: Light brown (7.5 YR 6/4), dry to damp, very stiff, silty CLAY. Stage I cementation, weakly cemented by calcium carbonate, moderate reaction with HCL.
			15					
5			24	5.6	81.1			
			15					
10			34					Hard.
			16	2.0			SM	Light brown (7.5 YR 6/4) to light bluish gray (10 B 8/1), dry, medium dense, silty SAND. Stage I cementation, weakly cemented by calcium carbonate, moderate reaction with HCL.
15			40	2.0			CL	Light brown (7.5 YR 6/4), dry, hard, silty CLAY. Stage I cementation.
			45				SM	Light bluish gray (10 B 8/1), dry, very dense, silty SAND; scattered fine gravel. Stage II cementation below 18 feet.
20								

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-27

DATE DRILLED 7/13/01 BORING NO. CH-16

GROUND ELEVATION 1315' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		54	3.8	112.8		SM	Light bluish gray (10 B 8/1) to reddish brown (5 YR 5/4), dry to damp, dense, silty SAND. Stage II cementation, trace to few cobbles, calcium carbonate coatings on cobbles.
		49	0.1				Very dense; poor recovery, cobble fragments only.
25		87/9"				CL	Brown (7.5 YR 5/4) to pale brown (10 YR 6/3), dry to damp, hard, silty CLAY. Stage II cementation, scattered caliche nodules.
		50/4"					
30		64	1.9	116.7		SM	Reddish brown (5 YR 5/4), dry to damp, dense, silty SAND; sparse fine gravel. Stage II cementation, gravel fraction has thin calcium carbonate coatings on all sides.
		81/9"	3.0			CL	Pale brown (10 YR 6/3) to reddish brown (5 YR 5/4), damp, hard, silty CLAY. Stage II cementation, thin calcium carbonate layers less than 1/8" thick.
35							Total Depth = 33.3' Groundwater not encountered. Backfilled on 7/13/01.
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-28

DATE DRILLED 7/13/01 BORING NO. CH-17

GROUND ELEVATION 1316' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4), dry to damp, very stiff, silty CLAY with fine sand. Stage I cementation, scattered caliche filaments.
		15	2.8	103.1			
5		12	3.7				
		30	9.5	85.3			Hard.
10		18	4.2				Very stiff.
		38					Hard. Stage I cementation, scattered fine gravel, trace filaments of calcium carbonate.
15		68				SM	Light bluish gray (10 B 8/1), dry to damp, very dense, silty SAND. Stage II cementation, sparse fine gravel, gravel fraction has calcium carbonate coatings.
		64	3.3	107.4			Dense.
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-29

DATE DRILLED 7/13/01 BORING NO. CH-17
GROUND ELEVATION 1316' SHEET 2 OF 2
METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger
DRIVE WEIGHT 140 lbs. (Auto) DROP 30"
SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20			21	1.3			SM	ALLUVIUM: (continued) Brown (7.5 YR 5/4), dry to damp, dense, silty SAND; sparse fine gravel.
			68	6.0			CL	Light brown (7.5 YR 6/3), damp, dense, sandy CLAY; sparse fine gravel. Stage II cementation, moderately cemented by calcium carbonate.
25								Total Depth = 24.0' Groundwater not encountered. Backfilled on 7/13/01.
30								
35								
40								

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BORING LOG
East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-30

DATE DRILLED 7/13/01 BORING NO. CH-18
GROUND ELEVATION 1318' SHEET 1 OF 2
METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger
DRIVE WEIGHT 140 lbs. (Auto) DROP 30"
SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							CL	FILL: Brown (7.5 YR 5/4), dry to damp, hard, silty CLAY; trace fine sand, no rootlets.
			56	7.7	105.0			
5			15					Very stiff.
								No recovery.
							SM	Brown (7.5 YR 5/4), dry to damp, dense, silty SAND. Stage I cementation, weakly cemented, weak reaction with HCL.
10			24	2.7	108.6			Few fine sand.
			93/10"	3.1			CL	ALLUVIUM: Pale brown (10 YR 6/3), dry to damp, hard, silty CLAY with sand. Stage I cementation, scattered caliche filaments.
15			36					
			88/8"	5.1				
20								

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BORING LOG
East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-31

DATE DRILLED 7/13/01 BORING NO. CH-18

GROUND ELEVATION 1318' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		61	11.5	90.4		CL	ALLUVIUM: (continued) Pale brown (10 YR 6/3), dry to damp, hard, silty CLAY with sand and fine gravel. Stage II cementation, scattered caliche filaments, sand and gravel grains coated on all sides.
							Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/13/01.
25							
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-32

DATE DRILLED 7/12/01 BORING NO. CH-19

GROUND ELEVATION 1318' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SM	FILL: Brown (7.5 YR 5/4), damp, dense, silty SAND.
		67	9.3	113.4			
5		9	6.8			CL	ALLUVIUM: Light brown (7.5 YR 6/4), damp, stiff, silty CLAY. Stage I cementation, scattered caliche filaments.
		15					Very stiff.
10		38					Hard.
		78	6.2	98.8			
15		54	9.1				
		65					Few sand.
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-33

DATE DRILLED 7/12/01 BORING NO. CH-19

GROUND ELEVATION 1318' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		38	4.1			SM	ALLUVIUM: (continued) Pale brown (10 YR 6/3), dry to damp, very dense, silty SAND. Stage II cementation, moderately cemented by calcium carbonate, continuously cemented matrix.
		77	3.1	106.6			
25							Total Depth = 24.0' Groundwater not encountered. Backfilled on 7/12/01.
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-34

DATE DRILLED 7/11/01 BORING NO. CH-20

GROUND ELEVATION 1316' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	FILL: Pale brown (10 YR 5/4) to brown (7.5 YR 5/4), dry to damp, very stiff, silty and sandy CLAY. Stage I cementation.
		20					
5		12	3.9	98.6			Stiff.
		13	4.7				Very stiff.
10						ML	ALLUVIUM: Pale brown (10 YR 6/3), dry, medium dense, SILT; few gravel and sand. Stage I cementation, scattered caliche filaments.
		31	3.9	109.6		SM	Very pale brown (10 YR 7/4), dry to damp, medium dense, silty SAND; few gravel. Stage II cementation.
		48	4.7				
15		50/6"	7.8	88.5			
						CL	Pale brown (10 YR 6/3), dry, hard, silty CLAY. Stage II cementation, few caliche nodules less than 1/2" in diameter.
		75					
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-35

DATE DRILLED 7/11/01 BORING NO. CH-20

GROUND ELEVATION 1316' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		49				CL	ALLUVIUM: (continued) Pale brown (10 YR 6/3), dry, hard, silty CLAY. Stge II cementation, few caliche layers with contiuous cementation
		14	1.5			SP	Pale brown (10 YR 6/3), dry, medium dense, SAND, few fine gravel. Stage II cementation, continuous coatings on gravel grains, moderate to weak reaction with HCL.
25		36	1.3				
							Total Depth = 26.5' Groundwater not encountered. Backfilled on 7/11/01.
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-36

DATE DRILLED 7/12/01 BORING NO. CH-21

GROUND ELEVATION 1315' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	FILL: Brown (7.5 YR 5/4), dry to damp, very stiff, silty CLAY. Stage I cementation.
		21	6.0	91.4			
5		12					
		35	5.1	85.9		ML	ALLUVIUM: Brown (7.5 YR 5/4), dry to damp, medium dense, SILT. Hard. Stage I cementation.
						CL	Brown (7.5 YR 5/4), dry to damp, very stiff, silty CLAY. Stage I cementation.
10		55	4.7				
		34					
15		32	2.8			SM	Pale brown (10 YR 6/3), dry, dense, silty SAND. Stage II cementation.
		49					Trace fine gravel.
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-37

DATE DRILLED 7/12/01 BORING NO. CH-21
GROUND ELEVATION 1315' SHEET 2 OF 2
METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger
DRIVE WEIGHT 140 lbs. (Auto) DROP 30"
SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		34	1.9			SM	ALLUVIUM: (continued) Pale brown (10 YR 6/3), dry, medium dense, silty SAND. Stage II cementation.
		45	1.4	108.5			Dense; scattered fine gravel.
25		38					Medium dense.
							Total Depth = 25.5' Groundwater not encountered. Backfilled on 7/12/01.
30							
35							
40							

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BORING LOG
East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-38

DATE DRILLED 7/12/01 BORING NO. CH-22
GROUND ELEVATION 1319' SHEET 1 OF 2
METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger
DRIVE WEIGHT 140 lbs. (Auto) DROP 30"
SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	FILL: Brown (7.5 YR 5/4), dry to damp, hard, silty CLAY. Stage I cementation, weak cementation by trace of caliche filaments.
		81/11"					
5		18					Very stiff.
		13					
10		26	5.8	91.6		CL	ALLUVIUM: Light brown (7.5 YR 6/4), dry to damp, very stiff to hard, silty CLAY. Stage I cementation, few to some caliche filaments.
		27	6.9				Hard.
15		79	10.9	106.6			
		100	6.6				
20							

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BORING LOG
East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO	DATE	FIGURE
600198001	10/02	A-39

DATE DRILLED 7/12/01 BORING NO. CH-22

GROUND ELEVATION 1319' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		89				CL	ALLUVIUM: (continued) Light brown (7.5 YR 6/4), dry to damp, hard, silty CLAY.
		44	7.9				
25		44	6.3	108.6		SM	Brown (7.5 YR 5/4), dry to damp, dense, silty SAND. Stage II cementation, carbonate grain coatings.
							Total Depth = 26.5' Groundwater not encountered. Backfilled on 7/12/01.
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-40

DATE DRILLED 7/12/01 BORING NO. CH-23

GROUND ELEVATION 1318' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	FILL: Brown (7.5 YR 5/4), dry to damp, hard, silty CLAY.
		87	3.4	109.6			
5		30	6.1				
		50	3.7	100.9		CL-ML	Brown (7.5 YR 5/4), damp, hard, silty CLAY. Stage I cementation, trace caliche.
10		13	6.2			CL	ALLUVIUM: Pale brown (10 YR 6/3), dry to damp, very stiff, silty CLAY. Stage II cementation, few caliche nodules less than 1/2" in diameter.
		65					Hard.
15		91	5.2				
		73	4.3	107.2		ML	Pale brown (10 YR 6/3), dry to damp, very dense, sandy SILT. Stage II cementation, scattered caliche nodules less than 1/2" in diameter.
20							Total Depth = 19.0' Groundwater not encountered.

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-41

DATE DRILLED 7/12/01 BORING NO. CH-23

GROUND ELEVATION 1318' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20								Backfilled on 7/12/01.
25								
30								
35								
40								

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-42

DATE DRILLED 7/12/01 BORING NO. CH-24

GROUND ELEVATION 1316' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							CL	ALLUVIUM: Brown (7.5 YR 5/4), dry to damp, very stiff, silty CLAY. Stage I cementation.
			22	3.4	94.7			
5			10					
			17	6.4				
10			27					Hard.
			65/11"	5.8	91.0			
15			32	5.2				Weak cementation by caliche.
			90	6.6	109.4		SM	Pale brown (10 YR 6/3), dry to damp, very dense, silty SAND; scattered fine subrounded to rounded gravel. Stage II cementation, carbonate coatings on grains.
20								

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-42

DATE DRILLED 7/12/01 BORING NO. CH-24

GROUND ELEVATION 1316' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		37	5.8			CL	ALLUVIUM: (continued) Pale brown (10 YR 6/3), dry to damp, hard, sandy CLAY.
		89				SM	Pale brown (10 YR 6/3), dry, very dense, silty SAND. Stage II cementation, carbonate coatings on grains.
25							Total Depth = 24.0' Groundwater not encountered. Backfilled on 7/12/01.
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-43

DATE DRILLED 7/12/01 BORING NO. CH-25

GROUND ELEVATION 1312' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Pale brown (10 YR 6/3), dry, silty CLAY.
		15	1.1	96.1		SM	Pale brown (10 YR 6/3) to light bluish gray (10 B 8/1), dry, medium dense, silty SAND. Stage I cementation.
5		16	1.3				Trace fine gravel.
		49				CL	Pale brown (10 YR 6/3) to brown (7.5 YR 5/4), damp, hard, silty CLAY. Stage I cementation.
10		71/10"					
		36	5.5	105.7			
15		32					
		92				GM	Pale brown (10 YR 6/3) to light bluish gray (10 B 8/1), dry to damp, very dense, silty GRAVEL with sand. Stage II cementation.
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-44

DATE DRILLED 7/12/01 BORING NO. CH-25

GROUND ELEVATION 1312' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		76/11"	4.0	116.0		SM	ALLUVIUM: (continued) Pale brown (10 YR 6/3) to light bluish gray (10 B 8/1), dry to damp, very dense, silty SAND with gravel. Stage II cementation.
							Total Depth = 21.4' Groundwater not encountered. Backfilled on 7/12/01.
25							
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-45

DATE DRILLED 7/12/01 BORING NO. CH-26

GROUND ELEVATION 1313' SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Light brown (7.5 YR 6/4) to brown (7.5 YR 5/4), dry to damp, very stiff, silty CLAY. Stage I cementation.
		19	3.7	94.6			
5		18					
		29	6.0				Hard.
10		60	4.8	104.9			
		17	1.5			SM	Pale brown (10 YR 6/3), dry, medium dense, silty SAND with fine gravel.
15		84				GM	Pale brown (10 YR 6/3) to light bluish gray (10 B 8/1), dry, very dense, silty GRAVEL with fine sand; trace cobbles. Stage II cementation.
		68	1.7				
20							

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BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-46

DATE DRILLED 7/12/01 BORING NO. CH-26

GROUND ELEVATION 1313' SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20							SM	ALLUVIUM: (continued)
			50/4"	5.3	105.0		CL	Pale brown (10 YR 6/3) to light bluish gray (10 B 8/1), dry, very dense, silty SAND with fine gravel; trace cobbles. Stage II cementation, carbonate coatings on grains.
								Brown, dry to damp, hard, silty CLAY with sand.
								Total Depth = 21.5'
								Groundwater not encountered.
								Backfilled on 7/12/01.
25								
30								
35								
40								

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Chandler Heights Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	10/02	A-47

APPENDIX B – CHANDLER HEIGHTS BASIN BOX CULVERT ANALYSIS

Table 1 - Summary of Culvert Flows at Crossing: Chandler Basin Box Culvert

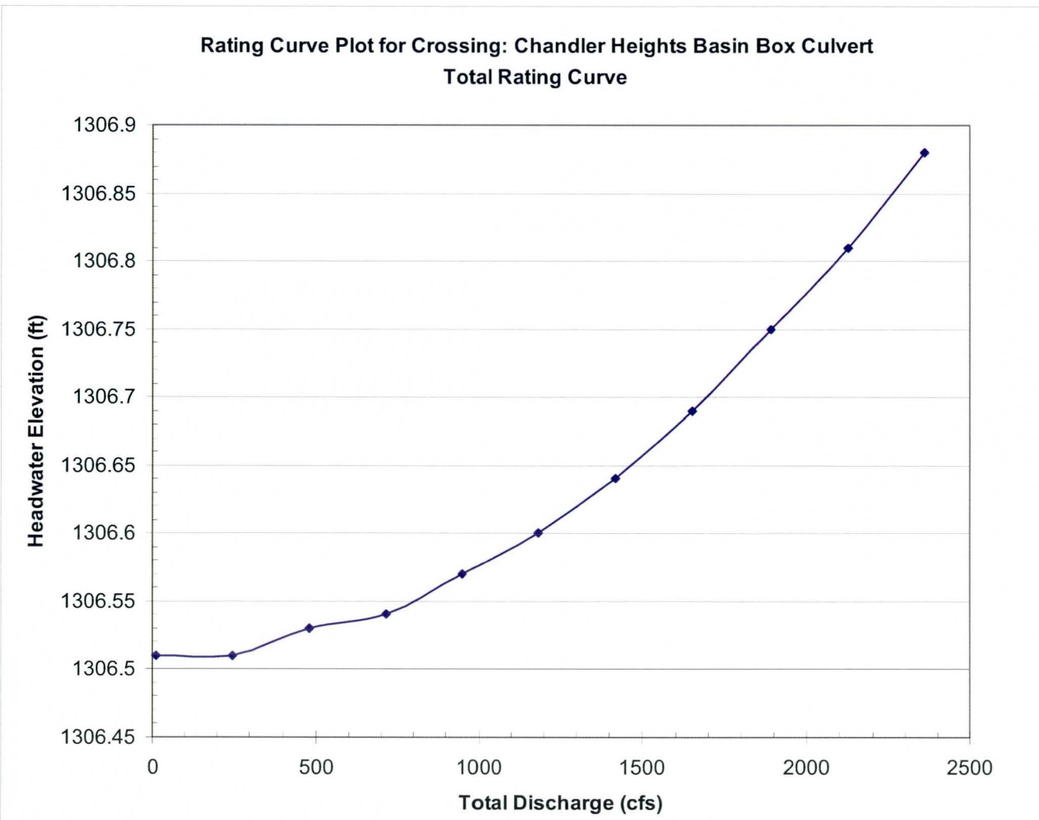
Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1306.51	10	10	0	1
1306.51	245	245	0	1
1306.53	480	480	0	1
1306.54	715	715	0	1
1306.57	950	950	0	1
1306.6	1185	1185	0	1
1306.64	1420	1420	0	1
1306.69	1655	1655	0	1
1306.75	1890	1890	0	1
1306.81	2125	2125	0	1
1306.88	2360	2360	0	1

Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
10.00	10.00	1306.51	0.882	8.411	1-S1t	0.036	0.084	8.510	8.510	0.016	0.000
245.00	245.00	1306.51	1.407	8.415	3-M1t	0.872	0.713	8.510	8.510	0.400	0.000
480.00	480.00	1306.53	1.932	8.427	3-M1t	1.472	1.116	8.510	8.510	0.783	0.000
715.00	715.00	1306.54	2.510	8.444	3-M1t	1.921	1.455	8.510	8.510	1.167	0.000
950.00	950.00	1306.57	3.038	8.470	3-M1t	2.369	1.759	8.510	8.510	1.550	0.000
1185.00	1185.00	1306.60	3.511	8.503	3-M1t	2.741	2.038	8.510	8.510	1.934	0.000
1420.00	1420.00	1306.64	3.945	8.544	3-M1t	3.106	2.299	8.510	8.510	2.318	0.000
1655.00	1655.00	1306.69	4.367	8.592	3-M1t	3.472	2.547	8.510	8.510	2.701	0.000
1890.00	1890.00	1306.75	4.777	8.646	3-M1t	3.814	2.782	8.510	8.510	3.085	0.000
2125.00	2125.00	1306.81	5.166	8.708	3-M1t	4.143	3.008	8.510	8.510	3.468	0.000
2360.00	2360.00	1306.88	5.538	8.778	3-M1t	4.472	3.226	8.510	8.510	3.852	0.000

Inlet Elevation (invert): 1298.10 ft
Culvert Length: 86.10 ft

Outlet Elevation (invert): 1298.00 ft
Culvert Slope: 0.0012



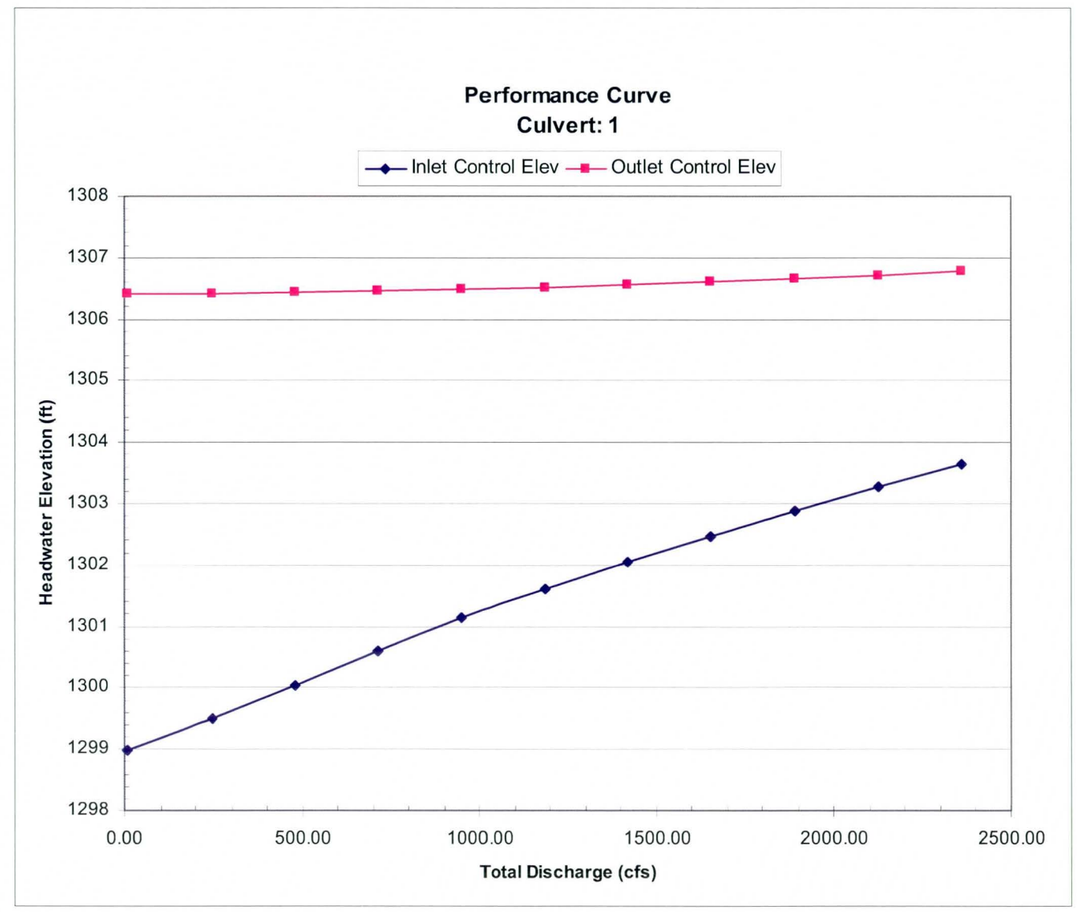


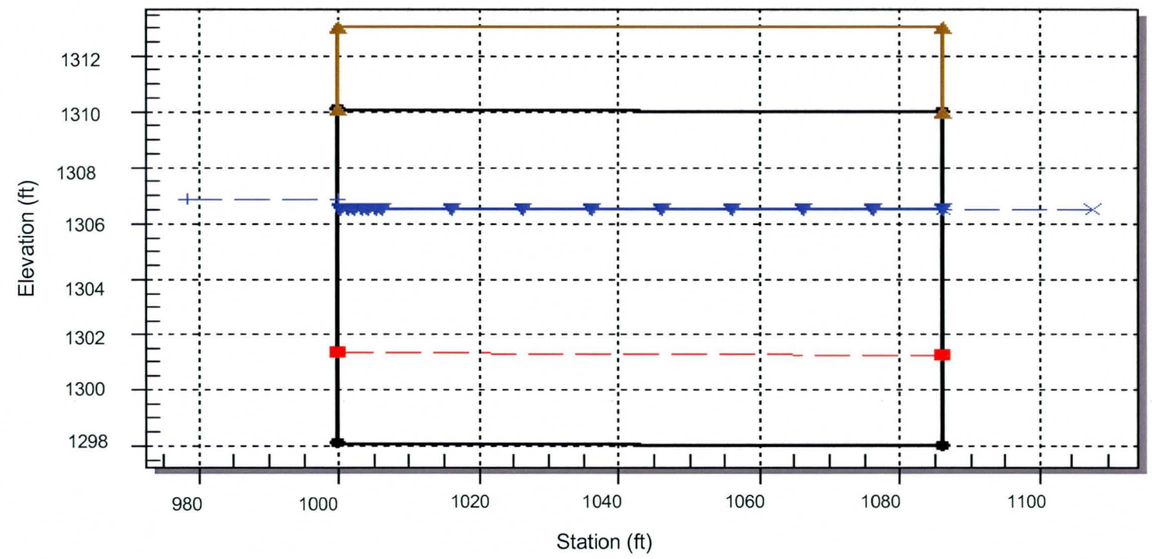
Table 3 - Downstream Channel Rating Curve (Crossing: Chandler Basin Box Culvert)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
10.00	1306.51	8.51
245.00	1306.51	8.51
480.00	1306.51	8.51
715.00	1306.51	8.51
950.00	1306.51	8.51
1185.00	1306.51	8.51
1420.00	1306.51	8.51
1655.00	1306.51	8.51
1890.00	1306.51	8.51
2125.00	1306.51	8.51
2360.00	1306.51	8.51

Tailwater Channel Data - Chandler Basin Box Culvert
Tailwater Channel Option: Enter Constant Tailwater Elevation
Constant Tailwater Elevation: 1306.51 ft

Roadway Data for Crossing: Chandler Basin Box Culvert
Roadway Profile Shape: Constant Roadway Elevation
Crest Length: 200.00 ft
Crest Elevation: 1313.00 ft
Roadway Surface: Paved
Roadway Top Width: 86.00 ft

Water Surface Profile Plot for Culvert



Crossing - Chandler Basin Box Culvert, Design Discharge - 2360.0 cfs
Culvert 1: Discharge - 2360.0 cfs

Site Data - Culvert 1

Site Data Option: Culvert Invert Data
Inlet Station: 1000.00 ft
Inlet Elevation: 1298.10 ft
Outlet Station: 1086.10 ft
Outlet Elevation: 1298.00 ft
Number of Barrels: 6.00

Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box
Barrel Span: 12.00 ft
Barrel Rise: 12.00 ft
Barrel Material:
Barrel Manning's n: 0.0130
Inlet Type:
Inlet Edge Condition:
Inlet Depression: None

APPENDIX C – SCOUR CALCULATIONS SUMMARY

Table 1
Scour Calculations - East Maricopa Floodway
TOG Ocotillo Road Waterline
Project Number: 181379103
Future Flows

Event	Sta	Design Q_{100} Discharge (cfs)	Channel Velocity (ft/s)	Hydraulic Depth (ft)	Flow Area (ft^2)	Minimum Channel Elevation (ft)	Water Surface Elevation (ft)	Maximum Depth (ft)	Top Width (ft)	Froude Number	E.G. Slope (ft/ft)	Scour Components: General Scour (ft)	Dune Scour (ft)	Local Scour (ft)	Bend Scour (ft)	Long-Term Scour (ft)	Low-Flow Incisement (ft)	Total Scour (ft)	Total Scour with 30% SF (ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
100-yr	12.600	3844.67	2.78	5.87	1381.49	1295.29	1304.71	9.42	235.4	0.20	0.00050	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.552	3844.46	2.74	5.97	1404.40	1295.04	1304.60	9.56	235.4	0.20	0.00048	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.488	3844.09	2.79	5.82	1376.41	1295.04	1304.42	9.38	236.4	0.20	0.00051	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.441	3843.75	2.88	5.71	1335.93	1295.04	1304.28	9.24	233.8	0.21	0.00056	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.349	3838.72	2.94	5.72	1305.89	1295.04	1304.01	8.97	228.2	0.22	0.00058	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.302	3838.61	3.01	5.61	1275.44	1295.04	1303.85	8.81	227.4	0.23	0.00628	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.245	3838.38	3.06	5.61	1255.62	1294.09	1303.65	9.56	223.9	0.22	0.00064	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.177	3837.95	2.99	5.59	1282.18	1294.78	1303.43	8.65	229.6	0.24	0.00062	4.9	0.3	0	0	3	2.5	10.7	13.9

Notes:
2-12 Valves obtained from Design Calculations and Analysis Notebook, Rittenhouse and Chandler Heights Detention Basins
by Kirkham Michael consulting Engineers, FCD 2000C040, PCN 121.03.32 and 121.03.33 dated March 2004
14 Bend scour is included in the general scour values.

Table 1
Scour Calculations - East Maricopa Floodway
TOG Ocotillo Road Waterline
Project Number: 181379103

General Scour

Abbott				Lacey						Blench						Summary			
Sta	Unit Water Discharge q (ft^3/s / ft)	K	Depth of Scour ds (ft)	Design Discharge Q (ft^3/s)	Lacy's Silt Factor f	Mean Grain Size D_m (mm)	Mean Depth d_m (ft)	Z	Depth of Scour d_s	Unit Water Discharge q_f (ft^3/s / ft)	Mean Grain Size D (ft)	Zero Bed Factor F_{bo} (ft/s^2)	Depth d_{to} (ft)	Z	Depth of Scour d_s	Albott (ft)	Lacey (ft)	Bench (ft)	Selected (ft)
1	2	3	4	5	6.0	7	8	9	10	11	12	13	14	15	16	17	18	19	20
12.600	16.3	2.45	4.8	3844.67	0.43	0.06	9.75	0.50	4.9	16.3	0.0002	0.5	8.1	0.6	4.87	4.8	4.9	4.9	4.9
12.552	16.3	2.45	4.8	3844.46	0.43	0.06	9.75	0.50	4.9	16.3	0.0002	0.5	8.1	0.6	4.87	4.8	4.9	4.9	4.9
12.488	16.3	2.45	4.8	3844.09	0.43	0.06	9.75	0.50	4.9	16.3	0.0002	0.5	8.1	0.6	4.85	4.8	4.9	4.9	4.9
12.441	16.4	2.45	4.8	3843.75	0.43	0.06	9.75	0.50	4.9	16.4	0.0002	0.5	8.1	0.6	4.89	4.8	4.9	4.9	4.9
12.349	16.8	2.45	4.8	3838.72	0.43	0.06	9.74	0.50	4.9	16.8	0.0002	0.5	8.3	0.6	4.96	4.8	4.9	5.0	4.9
12.302	16.9	2.45	4.8	3838.61	0.43	0.06	9.74	0.50	4.9	16.9	0.0002	0.5	8.3	0.6	4.97	4.8	4.9	5.0	4.9
12.245	17.1	2.45	4.8	3838.38	0.43	0.06	9.74	0.50	4.9	17.1	0.0002	0.5	8.4	0.6	5.03	4.8	4.9	5.0	4.9
12.177	16.7	2.45	4.8	3837.95	0.43	0.06	9.74	0.50	4.9	16.7	0.0002	0.5	8.2	0.6	4.94	4.8	4.9	4.9	4.9

Notes:
2, 5, & 11 - Values obtained from Design Calculations and Analysis Notebook, Rittenhouse and Chandler Heights Detention Basins
7 & 12 - Values obtained from Geotechnical Evaluation Ocotillo Road Water Mains, Gilbert Road to Higley Road, Gilbert AZ dated 4 June 2007
3 - Constant from Pemberton & Lara, page 32
9, 15 - Values from Table 7 - Multiplying factors for use in scour depths by regime equations from Pemberton & Lara, page 36 assuming moderate bend
13 - Value read from Figure 9 - Chart for estimating F_{bo} from Pemberton & Lara, page 35

Table 2
Scour Calculations - Queen Creek
TOG Ocotillo Road
Project Number: 181300001

Dune Scour

Sta	Hydraulic Depth of Flow Y_h (ft)	Dune Height d_h (ft)	Scour Component $Z_{bedform}$ (ft)
1	2	3	4
6525	7.35	0.7	0.4
6425	7.37	0.7	0.4
6325	7.39	0.7	0.4
6135	7.29	0.7	0.4
5935	7.31	0.7	0.4
5735	7.32	0.7	0.4
5535	7.34	0.7	0.4

Long Term Scour

Sta	Discharge Q_{100} (ft^3/s)	Scour d_{lts} (ft)
5	6	7
6525.000	3930.00	3
6425.000	3930.00	3
6325.000	3930.00	3
6135.000	5536.37	3.6
5935.000	5536.37	3.6
5735.000	5536.37	3.6
5535.000	5536.37	3.6

2 & 6 - Value obtained from Design Calculations and Analysis Notebook, Rittenhouse and Chandler Heights Detention Basins
3 - Dune height equation obtained from Drainage Design Manual for Maricopa County, Hydraulics: Sedimentation February 2007 (Draft).
7 - Long Term Scour equation obtain from State Standard Attachment SSA5-96, Watercourse System Sediment Balance, dated September 1996

Table 2
Scour Calculations - Queen Creek
TOG Ocotillo Road
Project Number: 181300001

Bridge Scour

Flow Depth Y1 ft	Cor. Fac. for Pier Nose Shp K1	No. of Piers	Pier Dia a ft	Length L ft	L/a	Angle degrees	Cor. Fac. for Angle of Attach K2	Cor Fac. for Bed Condition K3	Cor. Fac. for Armoring K4	Froude Number Fr	Scour Depth ys ft	Scour Depth w/ 25% FS ft
1	2	3	4	5	6	7	8	9	10	11	12	13
8.88	1	4	6	24	4	10	1.4	1.1	1	0.10	7.9	9.8
8.90	1	4	6	24	4	10	1.4	1.1	1	0.10	7.9	9.9
8.93	1	4	6	24	4	10	1.4	1.1	1	0.10	7.9	9.9
8.85	1	4	6	24	4	10	1.4	1.1	1	0.19	10.4	13.0
8.87	1	4	6	24	4	10	1.4	1.1	1	0.19	10.4	13.0
8.89	1	4	6	24	4	10	1.4	1.1	1	0.19	10.4	13.0
8.91	1	4	6	24	4	10	1.4	1.1	1	0.19	10.4	13.0

Use the equation Pier Scour Equation based on CSU Equation (HEC 18, 2001)

2 - selected correction factor for a group of cylinders
3 - from email dated 2008/11/10 from AZTEC
4 - from email dated 2008/11/10 from AZTEC
5 - from email dated 2008/11/10 from AZTEC
7 - from email dated 2008/11/10 from AZTEC
9 - from above calculations dune are less than 0.6 m used correction factor for plane bed and antidune flow
10 - D50 is less than 2 mm

Table 1
Scour Calculations - East Maricopa Floodway
TOG Ocotillo Road Waterline
Project Number: 181379103
Future Flows

Event	Sta	Design Q_{100} Discharge (cfs)	Channel Velocity (ft/s)	Hydraulic Depth (ft)	Flow Area (ft^2)	Minimum Channel Elevation (ft)	Water Surface Elevation (ft)	Maximum Depth (ft)	Top Width (ft)	Froude Number	E.G. Slope (ft/ft)	Scour Components: General Scour (ft)	Dune Scour (ft)	Local Scour (ft)	Bend Scour (ft)	Long-Term Scour (ft)	Low-Flow Incisement (ft)	Total Scour (ft)	Total Scour with 30% SF (ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
100-yr	12.600	3844.67	2.78	5.87	1381.49	1295.29	1304.71	9.42	235.4	0.20	0.00050	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.552	3844.46	2.74	5.97	1404.40	1295.04	1304.60	9.56	235.4	0.20	0.00048	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.488	3844.09	2.79	5.82	1376.41	1295.04	1304.42	9.38	236.4	0.20	0.00051	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.441	3843.75	2.88	5.71	1335.93	1295.04	1304.28	9.24	233.8	0.21	0.00056	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.349	3838.72	2.94	5.72	1305.89	1295.04	1304.01	8.97	228.2	0.22	0.00058	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.302	3838.61	3.01	5.61	1275.44	1295.04	1303.85	8.81	227.4	0.23	0.00628	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.245	3838.38	3.06	5.61	1255.62	1294.09	1303.65	9.56	223.9	0.22	0.00064	4.9	0.3	0	0	3	2.5	10.7	13.9
	12.177	3837.95	2.99	5.59	1282.18	1294.78	1303.43	8.65	229.6	0.24	0.00062	4.9	0.3	0	0	3	2.5	10.7	13.9

Notes:

2-12 Valves obtained from Design Calculations and Analysis Notebook, Rittenhouse and Chandler Heights Detention Basins by Kirkham Michael consulting Engineers, FCD 2000C040, PCN 121.03.32 and 121.03.33 dated March 2004

14 Bend scour is included in the general scour values.

Table 1
Scour Calculations - East Maricopa Floodway
TOG Ocotillo Road Waterline
Project Number: 181379103

General Scour

Abbott				Lacey						Blench						Summary			
Sta	Unit Water Discharge q	K	Depth of Scour ds	Design Discharge Q	Lacy's Silt Factor f	Mean Grain Size D_m	Mean Depth d_m	Z	Depth of Scour d_s	Unit Water Discharge q_f	Mean Grain Size D	Zero Bed Factor F_{bo}	Depth d_{fo}	Z	Depth of Scour d_s	Albott	Lacey	Bench	Selected
	(ft^3/s / ft)		(ft)	(ft^3/s)		(mm)	(ft)			(ft^3/s / ft)	(ft)	(ft/s^2)	(ft)			(ft)	(ft)	(ft)	(ft)
1	2	3	4	5	6.0	7	8	9	10	11	12	13	14	15	16	17	18	19	20
12.600	16.3	2.45	4.8	3844.67	0.43	0.06	9.75	0.50	4.9	16.3	0.0002	0.5	8.1	0.6	4.87	4.8	4.9	4.9	4.9
12.552	16.3	2.45	4.8	3844.46	0.43	0.06	9.75	0.50	4.9	16.3	0.0002	0.5	8.1	0.6	4.87	4.8	4.9	4.9	4.9
12.488	16.3	2.45	4.8	3844.09	0.43	0.06	9.75	0.50	4.9	16.3	0.0002	0.5	8.1	0.6	4.85	4.8	4.9	4.9	4.9
12.441	16.4	2.45	4.8	3843.75	0.43	0.06	9.75	0.50	4.9	16.4	0.0002	0.5	8.1	0.6	4.89	4.8	4.9	4.9	4.9
12.349	16.8	2.45	4.8	3838.72	0.43	0.06	9.74	0.50	4.9	16.8	0.0002	0.5	8.3	0.6	4.96	4.8	4.9	5.0	4.9
12.302	16.9	2.45	4.8	3838.61	0.43	0.06	9.74	0.50	4.9	16.9	0.0002	0.5	8.3	0.6	4.97	4.8	4.9	5.0	4.9
12.245	17.1	2.45	4.8	3838.38	0.43	0.06	9.74	0.50	4.9	17.1	0.0002	0.5	8.4	0.6	5.03	4.8	4.9	5.0	4.9
12.177	16.7	2.45	4.8	3837.95	0.43	0.06	9.74	0.50	4.9	16.7	0.0002	0.5	8.2	0.6	4.94	4.8	4.9	4.9	4.9

2, 5, & 11 - Values obtained from Design Calculations and Analysis Notebook, Rittenhouse and Chandler Heights Detention Basins
7 & 12 - Values obtained from Geotechnical Evaluation Ocotillo Road Water Mains, Gilbert Road to Higley Road, Gilbert AZ dated 4 June 2007
3 - Constant from Pemberton & Lara, page 32
9, 15 - Values from Table 7 - Multiplying factors for use in scour depths by regime equations from Pemberton & Lara, page 36 assuming moderate bend
13 - Value read from Figure 9 - Chart for estimating F_{bo} from Pemberton & Lara, page 35

Table 1
Scour Calculations - East Maricopa Floodway
TOG Ocotillo Road Waterline
Project Number: 181379103

Dune Scour

Sta	Hydraulic Depth of Flow Y_h	Dune Height d_h	Scour Component $Z_{bedform}$
	(ft)	(ft)	(ft)
1	2	3	4
12.600	5.87	0.6	0.3
12.552	5.97	0.6	0.3
12.488	5.82	0.6	0.3
12.441	5.71	0.5	0.3
12.349	5.72	0.5	0.3
12.302	5.61	0.5	0.3
12.245	5.61	0.5	0.3
12.177	5.59	0.5	0.3

Long Term Scour

Sta	Discharge Q_{100}	Scour d_{ls}
	(ft^3/s)	(ft)
5	6	7
12.600	3844.67	3
12.552	3844.46	3
12.488	3844.09	3
12.441	3843.75	3
12.349	3838.72	3
12.302	3838.61	3
12.245	3838.38	3
12.177	3837.95	3

2 & 6 - Value obtained from Design Calculations and Analysis Notebook, Rittenhouse and Chandler Heights Detention Basins
3 - Dune height equation obtained from Drainage Design Manual for Maricopa County, Hydraulics: Sedimentation February 2007 (Draft).
7 - Long Term Scour equation obtain from State Standard Attachment SSA5-96, Watercourse System Sediment Balance, dated September 1996

APPENDIX D – DRAINAGE CALCULATIONS

DRAINAGE CALCULATION SHEET

Project: Ocotillo Road: Greenfield to Higley, Preliminary Engineering Scoping Report
Project No.: 181300001
Date: September 17, 2008
Prepared By: CSB

Purpose: Evaluate the total retention volume required for the project
Assumptions:
1. Right of way width 130-feet (65-foot half-street).
2. Assume desert Landscaping for weighted C calculations

References:
1. Public Works and Engineering Standards and Details, Article 2, Drainage Engineering, Town of Gilbert, Arizona.
2. Typical Section for Minor Arterial Street, Town of Gilbert Standard Detail 22
3.

Methodology:
V = DAC
V = volume (cubic feet)
D = fifty-year, twenty-four-hour rainfall depth – (0.25 feet)
A = area (square feet)
C = weighted run-off coefficient

Calculate weighted C (Cw) for Ocotillo Road Typical Section:

Surface	C	Width [lft]
Asphalt Pavement	0.9	65
Concrete	0.95	16
Landscaping	0.7	49

Cw = 0.83

D = 0.25 [ft
A = 130.00 [ft]
Cw = 0.83
V = 26.98 [cu ft/ft]

Calculate Total Retention Volume Required for the Project
Beginning Project Station = 025+40
Ending Project Station = 055+60

V_T = 81,479.60 [cu ft]
V_T = 1.87 [acre-ft]

Conclusions:
The project will require approximately 1.87 acre-feet of storage capacity to store runoff within the standard right of way section.

DRAINAGE CALCULATION SHEET

Project: Ocotillo Road: Greenfield to Higley, Preliminary Engineering Scoping Report
Project No.: 181300001
Date: October 22, 2008
Prepared By: CSB

Purpose: Evaluate the runoff generated in the right of way per linear foot of roadway.
Assumptions:
1. Right of way width 130-feet.
2. Miinimum time of concentration is 10 minutes
3. Composite C = 0.85

References:
1. Article 2: Drainage Engineerin, Public Works and Engineering Standards adn Details, Town of Gilbert, Arizona
2. Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology, January 1, 1996
3. Street Capacity Calculations, Stantec, October 2008

Methodology:
Rational Method Hydrologic Analysis
Q=CIA
WhereQ = Peak Discharge (cfs)
I=Rainfall Intensity (in/hr)
C= Runoff Coefficient

Calculations:

I_{10} = 4.5 [in/hr] (Reference 2)
A = 0.0030 [acres/ft] (Right of way width, Assumption 1)
C= 0.85

Q_{10}= 0.0115 [cfs/ft-Roadway]

Calculate maximum distance between inlets at minimum and maximum slopes:

S_{Min} = 0.25% (Reference 3)
S_{Max} = 3.00% (Reference 3)

Capacity at S_{Min} = 6.2 (Reference 3)
Capacity at S_{Max} = 21.5 (Reference 3)

Inlet Spacing = Street Capacity/Unit Flowrate
Inlet Spacing at S_{Min} = 539.13
Inlet Spacing at S_{Max} = 1869.57

DRAINAGE CALCULATION SHEET

Project: Ocotillo Road: Greenfield to Higley, Preliminary Engineering Scoping Report
Project No.: 181300001
Date: October 22, 2008
Prepared By: CSB

Purpose: Evaluate the capacity of the typical street section in accordance with dry lane criteria.
Assumptions:
1. Right of way width 130-feet, typical street section 68-ft face-of-curb to face-of-curb

References:
1. Article 2: Drainage Engineerin, Public Works and Engineering Standards adn Details, Town of Gilbert, Arizona
2.
3.

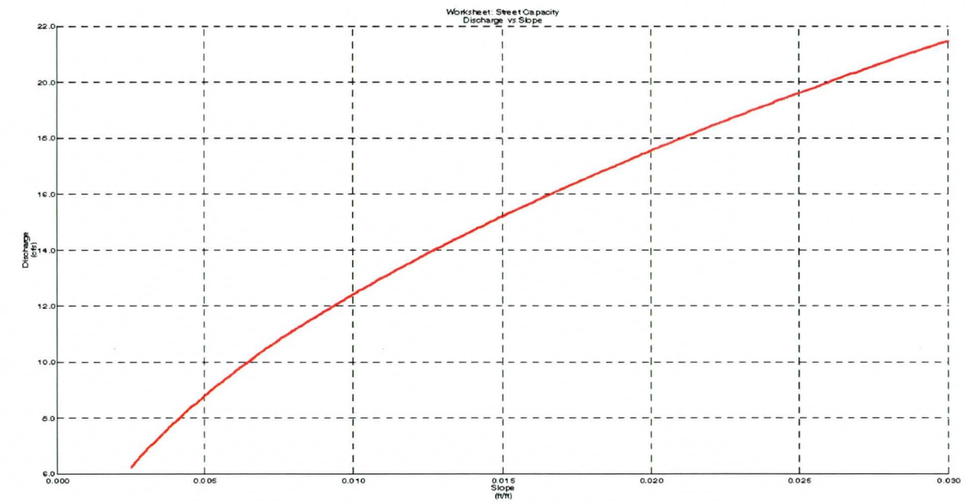
Methodology:
Manning's equation for open channel flow using Flowmaster software to peform calculations and generate rating curves for longitudinal slope vs discharge.

Criteria:
For major and minor arterials, major collectors, and primary collector streets the 10-yr, one-hour storm event shall only inundate one lane of traffic per half street.t (Reference 1).

Calculations:
See attached FlowMaster Rating Table, Rating Curve, and Cross-Section

Conclusions:
Street capacity for the project typical section varies from 6.2 cfs at S=0.25% to 21.5 cfs at S=3.0% while maintaining the dry lane criteria (flow depth = 0.22 ft)

Street capacity for the project typical section when superelevated varies from 4.64 cfs at S=0.25% to 11.18 cfs at S=1.45% while maintaining the dry lane criteria (flow depth = 0.458 ft)



RATING TABLE (Depth = 0.458 ft)

Slope (ft/ft)	Discharge	Velocity (ft/	Flow Area	Wetted Pe	Top Width (ft)
0.0025	6.2	1.81	3.4	16.8884	16.493
0.005	8.76	2.56	3.4	16.8884	16.493
0.0075	10.73	3.14	3.4	16.8884	16.493
0.01	12.39	3.62	3.4	16.8884	16.493
0.0125	13.85	4.05	3.4	16.8884	16.493
0.015	15.18	4.44	3.4	16.8884	16.493
0.0175	16.39	4.79	3.4	16.8884	16.493
0.02	17.52	5.12	3.4	16.8884	16.493
0.0225	18.59	5.43	3.4	16.8884	16.493
0.025	19.59	5.73	3.4	16.8884	16.493
0.0275	20.55	6.01	3.4	16.8884	16.493
0.03	21.46	6.28	3.4	16.8884	16.493

DRAINAGE CALCULATION SHEET

Project: Ocotillo Road: Greenfield to Higley, Preliminary Engineering Scoping Report
Project No.: 181300001
Date: October 22, 2008
Prepared By: CSB

Purpose: Evaluate the minimum inlet spacing criteria using street capacity calculations for the typical roadway section.
Assumptions:
1. Right of way width 130-feet, typical street section 68-ft face-of-curb to face-of-curb

References:
1. Street Capacity Calculations, Stantec, 10/08.
2. Unit Roadway Peak Discharge Calculations, Stantec, 10/08.

Methodology:
Use the street capacity calculations (Ref. 1) in conjunction with Unit Roadway Peak Discharge Calculations (Ref.2) to develop a rating table of minimum inlet spacing required to maintain dry lane calculations.

Criteria:
Minimum inlet spacing to be developed to maintain dry lane criteria (Ref. 1)

Calculations:

Minimum Inlet Spacing = Capacity/Unit Flow Rate

Slope [ft/ft]	Capacity [cfs]	Minimum Spacing [ft]
0.0025	6.2	539
0.005	8.76	762
0.0075	10.73	933
0.01	12.39	1077
0.0125	13.85	1204
0.015	15.18	1320
0.0175	16.39	1425
0.02	17.52	1523
0.0225	18.59	1617
0.025	19.59	1703
0.0275	20.55	1787
0.03	21.46	1866

Conclusions:
Minimum spacing between inlets varies from approximately 365 feet at minimum slope analyzed to 880 feet at the maximum slope analyzed.

DRAINAGE AREA RETENTION VOLUME CALCULATION SHEET

Project: Ocotillo Road: Greenfield to Higley, Preliminary Engineering Scoping Report
Project No.: 181300001
Date: April 02, 2009
Prepared By: RMS

Purpose: Evaluate the retention volume for project drainage areas to determine basin volume
Assumptions:
1. Right of way width 130-feet (65-foot half-street).
2. Assume desert Landscaping for weighted C calculations

References:
1. Public Works and Engineering Standards and Details, Article 2, Drainage Engineering, Town of Gilbert, Arizona.
2. Hydrologic calculations-Retention Volume Analysis prepared by Stantec
3. Proposed Ocotillo Road profile prepared by Stantec

Methodology:
$V_{ret} = L \times V$
V = unit volume (cubic feet/ft)
L = Length of drainage area along proposed centerline

Calculate weighted C (Cw) for Ocotillo Road Typical Section = 26.98 cf/ft

Drainage Area 1 - Begin project to EMF Bridge Crest
Sta 25+42.34 to 36+82.16, L=1139.82'
1139.82 ft x 26.98 cf/ft = **30,752 cf**

Drainage Area 2 - EMF Bridge Crest to Queen Creek Bridge Crest
Sta 36+82.16 to 50+61.61, L=1379.45'
1379.45 ft x 26.98 cf/ft = **37,218 cf**

Drainage Area 3 - Queen Creek Bridge Crest to West return of Banning Street
Sta 50+61.61 to 55+60, L=498.39'
1379.45 ft x 26.98 cf/ft = **13,447 cf**

Drainage Area 4 - Banning Street east to End of Project
Sta 55+60 to 62+75.72, L=715.72'
715.72 ft x 26.98 cf/ft = 19,310 cf
Improvements limited to North Half of Roadway
Retention Required = 19,310/2 = **9655 cf**

Conclusions:
Project retention basins must be designed to contain the above calculated volumes within the criteria disclosed in Reference 1 above

FIRST FLUSH RETENTION VOLUME CALCULATION SHEET

Project: Ocotillo Road: Greenfield to Higley, Preliminary Engineering Scoping Report
Project No.: 181300001
Date: April 02, 2009
Prepared By: RMS

Purpose: Evaluate the first flush retention volume for project drainage areas to determine basin volumes

Assumptions:
1. Right of way width varies - 130-feet (65' half-street) to 80 feet (40' half-street).
2. Weighted Runoff Coefficient = 0.83

References:
1. Maricopa County Drainage Policies and Standards, Section 6.4, Stormwater Quality Standard 6.4.1 First Flush
2. Hydrologic calculations-Retention Volume Analysis prepared by Stantec
3. Proposed Ocotillo Road profile prepared by Stantec
4. Public Works and Engineering Standards and Details, Article 2, Drainage Engineering, Town of Gilbert, Arizona
5. Proposed Ocotillo Road realignment prepared by Stantec

Methodology:
V_{ff}= C(P/12)A
V_{ff} = minimum first flush volume in ac-ft
C = runoff coefficient
P = depth of initial direct runoff considered first flush (**0.5" MCDOT, 1.0" TOG**)
A = area of project site, in acres

1 ac-ft = 43,560 cf

Drainage Area 1 - Begin project to EMF Bridge Crest
Area 1 = 135,444 sf = 3.1094 ac
MCDOT First Flush Volume = 0.83(0.5/12)(3.1094) = 0.1075 ac-ft = 4683 cf
TOG First Flush Volume = 0.83(1.0/12)(3.1094) = 0.2151 ac-ft = 9370 cf

Drainage Area 2 - EMF Bridge Crest to Queen Creek Bridge Crest
Area 2 = 108,950 sf = 2.5011 ac
MCDOT First Flush Volume = 0.83(0.5/12)(2.5011) = 0.0865 ac-ft = 3768 cf
TOG First Flush Volume = 0.83(1.0/12)(2.5011) = 0.1730 ac-ft = 7536 cf

Drainage Area 3 - Queen Creek Bridge Crest to West return of Banning Street
Area 3 = 57,531 sf = 1.3207 ac
MCDOT First Flush Volume = 0.83(0.5/12)(1.3207) = 0.0457 ac-ft = 1991 cf
TOG First Flush Volume = 0.83(1.0/12)(1.3207) = 0.0913 ac-ft = 3977 cf

Drainage Area 4 - Banning Street east to End of Project
Area 4 = 48,668 sf = 1.1173 ac
MCDOT First Flush Volume = 0.83(0.5/12)(1.1173) = 0.0386 ac-ft = 1681 cf
TOG First Flush Volume = 0.83(1.0/12)(1.1173) = 0.0773 ac-ft = 3367 cf

Conclusions:
First Flush retention basins must be designed to contain the above calculated volumes within the criteria disclosed in Reference 4 above

RETENTION BASIN VOLUME CALCULATION SHEET

Project: Ocotillo Road: Greenfield to Higley, Preliminary Engineering Scoping Report
Project No.: 181300001
Date: April 03, 2009
Prepared By: RMS

Purpose: Evaluate the retention basin volumes designed to accommodate calculated retention volumes for full retention and first flush retention

Criteria:
1. Retention Basin Depth = 2.5'
2. Stormwater Storage depth = 2.0'
3. Retention Basin Area not to exceed 50% of area between back of sidewalk & right-of-way

References:
1. Public Works and Engineering Standards and Details, Article 2, Drainage Engineering, Town of Gilbert, Arizona
2. Hydrologic calculations-Retention Volume Analysis prepared by Stantec
3. Proposed Ocotillo Road profile prepared by Stantec
4. Proposed Ocotillo Road realignment prepared by Stantec

Methodology:
Average End Area
V_{basin}= ((A_{hw} + A_{btm})/2) x depth
V_{basin} = Retention Basin Volume in cubic feet
A_{hw} = Area at High Waater Elevation
A_{btm} = Area at Bottom Elevation

Basin 1A

Full Retention	A_{top}=9893 sf, A_{hw}=8715 sf, A_{btm}=4326 sf V_{basin}=((8715+4326)/2) x 2 =13,041 cf
First Flush Retention (MCDOT)	A_{top}=2600 sf, A_{hw}=2112 sf, A_{btm}=480 sf V_{basin}=((2112+480)/2) x 2 =2592 cf
First Flush Retention (TOG)	A_{top}=3800 sf, A_{hw}=3264 sf, A_{btm}=1440 sf V_{basin}=((3264+1440)/2) x 2 =4704 cf

Basin 1B

Full Retention	A_{top}=13,435 sf, A_{hw}=11,852 sf, A_{btm}=5917 sf V_{basin}=((11,852+5917)/2) x 2 =17,769 cf
First Flush Retention (MCDOT)	A_{top}=2600 sf, A_{hw}=2112 sf, A_{btm}=480 sf V_{basin}=((2112+480)/2) x 2 =2592 cf
First Flush Retention (TOG)	A_{top}=3800 sf, A_{hw}=3264 sf, A_{btm}=1440 sf V_{basin}=((3264+1440)/2) x 2 =4704 cf

Basin 2A

Full Retention	A_{top}=13,954 sf, A_{hw}=12,414 sf, A_{btm}=6577 sf V_{basin}=((12,414+6577)/2) x 2 =18,991 cf
First Flush Retention (MCDOT)	A_{top}=2306 sf, A_{hw}=1815 sf, A_{btm}=170 sf V_{basin}=((1815+170)/2) x 2 =1985 cf
First Flush Retention (TOG)	A_{top}=4072 sf, A_{hw}=3313 sf, A_{btm}=599 sf V_{basin}=((3313+599)/2) x 2 =3912 cf

APPENDIX E – CULTURAL HISTORICAL OVERVIEW

Cultural Historical Overview
There are five general cultural-historical periods that describe the prehistoric and historic occupation of the region. These include the Paleo-Indian, the Archaic, the Hohokam, the Protohistoric, and the Historic period.

The Paleo-Indian Period: The Paleo-Indian period is generally viewed as that extending from first entry into North America until the end of the Pleistocene Epoch, approximately from 12,000 to 8,000 years before the present. This cultural pattern focused on a hunting and gathering resource obtainment pattern, which included the exploitation of Pleistocene megafauna such as mammoth, mastodon, giant ground sloth, bison, and horse. No Paleo-Indian sites have been confirmed for the immediate vicinity of the project area, although evidence of the lithic technologies associated with the Paleo-Indian cultural traditions have been observed throughout the state.

The Archaic Period: The Archaic Period includes the interval between the end of the Pleistocene Epoch and the emergence of the Hohokam cultural tradition at the beginning of the millennium, around A.D. 1. The Archaic people shifted their resource obtainment patterns from the Pleistocene megafauna to a greater reliance on the gathering of wild plant foods and the exploitation of smaller faunal assemblages. This shift is reflected in the lithic assemblage, which contains more ground stone tools and a diverse assortment of projectile points. There is no recorded evidence of Archaic sites in the vicinity of the Project Area.

The Hohokam: The Hohokam is the archaeological culture that occupied the project area region from the end of the Archaic period in approximately A.D. 1 to the beginning of the Proto-Historic period around A.D. 1450. The Hohokam occupation is traditionally divided into five periods, including the Pioneer, Colonial, Sedentary, Classic, and Post-Classic. The Hohokam resource obtainment patterns included a reliance on horticultural and agricultural subsistence, utilizing such crops as corn, beans and squash. Traits associated with the Hohokam began appearing by the end of the Archaic period (Cable 1987), and several theories regarding the origin of the Hohokam have been presented, including both in situ development and in-migration. The transition between the Archaic and the Ceramic Period cultures is generally defined by the introduction of the Upper Sonoran Agricultural Complex (Haury, 1976; Gumerman and Haury, 1979; Cordell, 1984). This complex includes several attributes directly associated with the subsistence strategy, such as increased sedentism and an increasing reliance on plant food production. Other characters that are indicative of this complex include rectangular single-unit dwellings; cremations; and the appearance of red-on-buff ceramics constructed with the paddle and anvil technique (Haury, 1976; Gumerman and Haury, 1979).

Pioneer Period: This period generally exhibits sites composed of large square structures with slightly depressed floors and walls of pole and brush (Cordell, 1984). Later structures in the period may have been rectangular, with rounded corners and one or two entrances, but the basic architectural design remained the same until the Classic period (Cordell, 1984). Although flexed and extended inhumations occurred during this period, cremations were the norm, and were primarily secondary burials in pits or trenches, and found in association with crushed and burned ceramics. The overall lack of calcined skeletal material in these situations suggests a separate crematory location (Morris, 1969). The majority of ceramics were well made but undecorated wares, of brown to grey color with an occasional red slip. Late in the period decorated varieties appear with red-painted geometric designs on a buff background. Stone bowls, palettes, adzes and axes also appeared, with the occasional occurrence of ceramic figurines and shell articles with origins in the Pacific Ocean and the Gulf of California.

Colonial Period: The Colonial period was one of both geographic and cultural expansion, with the appearance of novel features such as ball courts and platform mounds. Platform mounds appear as masses of caliche-capped refuse, and ball courts as large elongated cleared areas with expanded ends and an east-west orientation. The ball courts have been interpreted as anything from dance grounds, to wells, to ball courts of similar etiology to those found in Mesoamerica (Haury, 1976; Cordell, 1984). Cremations include both primary and secondary burials in both pits and trenches, with burial associations including ceramics, projectile points, stone vessels, slate palettes and stone axes (Haury, 1976; Cordell, 1984).

Plain ware ceramics are the most typical form during this period, and vessel sizes are generally larger than those of earlier periods. Incising and grooving of ceramics no longer appear during this period, but an increase in the types of geometric designs, and bands with small animal motifs are evident (Haury, 1976; Cordell, 1984). Additional animations appear in the form of well made and intricate figurines, stone palettes, bowls effigies, and mosaic mirrors of fitted iron pyrite. These objects all testify to the higher level of craftsmanship evidenced during this period (Haury, 1976; Cordell, 1984).

Sedentary Period: Domestic architecture remained very similar throughout the Hohokam occupation, but the Sedentary period evidenced smaller and more oval ball courts, and remodeled or extended platform mounds (Haury, 1976; Cordell, 1984). Some storage vessels appear much larger, with the characteristic pronounced angular shoulder, less animated figures and more geometric designs (Haury, 1976; Cordell, 1984). Ceramic figurines appear only as heads, but with hollow bases which may have been fastened to bodies constructed of another material (Cordell 1984). Less diversity also appears in the assemblage of carved stone bowls, palettes and the number of shell varieties utilized. An innovation of this period is the use of the copper bell, which may have been a Mesoamerican intrusive (Haury, 1976; Cordell, 1984).

Classic Period: The Classic period signals a time of change for the Hohokam, with, among other things, an increase in aggregation into fewer and larger sites. Significant changes occurred which have been interpreted as evidence for the incursion of non-Hohokam peoples into the region, such as the construction of multistoried great houses, the introduction of polychrome ceramics, and an increase in the number of inhumations. Domestic structures remain primarily single-unit structures, but now appear to be grouped and surrounded by compound walls. The single-unit construction techniques changed to solid clay walls or those reinforced with wooden poles. Cremations were secondary and generally placed in jars, with inhumations being less associated grave goods. Luxury items also appear to decrease in frequency, and shell items, while frequent, less elaborate decoration.

Post-Classic Period: The latter portion of the Classic period was initially called the Recent period (Gladwin and Gladwin, 1934; and Roberts, 1935), and was thought to best evidence the transition between the Hohokam and the Pima and Papago peoples, as encountered by the Spanish in the 16th century. However, recent research suggests significant social and economic changes occurred during this time. The archaeological components of this period are primarily defined by the Polvorón phase (Sires, 1984, Hackbarth 1995, Larkin and Giacobbe, 1998).

The Protohistoric-Historic Period: The Protohistoric period (A.D. 1450 to 1750) represents the transition from the Hohokam Post-Classic period to the Spanish mission period in Arizona and the Southwest. The Bachi phase has been proposed for the Picacho Mountains and the Middle Gila (Doyel, 1991a, 1991b), and phase diagnostics for this interval include shallow pithouses, of round house or ki styles; polished red ware ceramics; small village and rancheria settlement patterns; and a mixed subsistence base. In the late seventeenth century the Spanish recorded six Pima villages along the Middle Gila west of Casa Grande Ruins; another village was located along the Santa Cruz River near Picacho Peak. The total population was estimated between 2,000-3,000 people, although the number of villages and the population estimates may be low (Ezell, 1983).

Villages appear to have been self-sufficient, politically autonomous, and organized along the lines of patrilineal extended families, with each having a civil leader and possibly a shaman. The Blackwater phase (A.D. 1750-1870) is similar to the Bachi phase with the addition of wheat and other introduced elements, including domesticated crops; horses, cattle, and other livestock; metal implements; trade; and slave raiding. Settlement patterns tended toward nucleated villages due to pressure from the Apache (Doyel,

1988). Pima (Akimel O'odham) agricultural technology included dams, dikes, ditches, and perhaps irrigation canals, although the presence of canals at the time of contact remains disputed (Ezell, 1983; Haury, 1976). The southwestern triad of corn, beans, and squash were cultivated, along with cotton. The Pima also depended on mesquite beans, cactus fruits, and other native products, and trade in foodstuffs was common practice (Ezell, 1983; Hackenberg, 1983). Trade was maintained with the New Mexican Pueblos, the Maricopa, and other groups (Doelle, 1984; Riley, 1987).

Several non-Piman groups were also prominent in the late prehistoric and historic periods. Yuman-speaking peoples occupied the Lower Gila. There is evidence that Yuman-Piman interaction began by A.D. 1000 (Doelle and Wallace, 1988; Wasley and Johnson, 1965). Endemic warfare, trade, shifting alliances, and economic competition characterized relationships among the Pima, Maricopa, Cocomaricopa, and Quechan peoples (Ezell, 1983), and the Pima and their Maricopa allies were engaged in extended warfare with the Apache (Ezell, 1983).

By the 1840s the Pima were participating in cash markets to supply beef and wheat to non-native groups passing through the area (Ezell, 1983). The Mexican-American War and the subsequent Gadsden Purchase resulted in the American takeover of some Piman homelands, but no non-Pima religious or military facilities were constructed on the Middle Gila (Barnes, 1984; Weber, 1982). Thousands of non-Indians settled in southern Arizona after the American Civil War. By 1870 the first non-native canal was constructed by Jack Swilling for the Town of Phoenix (Spicer, 1962). Also by 1870, the waters of the Gila River were diverted by Anglo and Mexican farmers upriver from the new Pima Indian reservation. Many Pima moved to the Salt River Valley due to a lack of water.

The Pima refer to the period between 1870-1910 as the "years of famine" (Ezell, 1983). Due to an absence of irrigation water, they began to disperse, and the locus of political power returned to the village level, and prolonged drought intensified these problems. Severe acculturative pressures were placed on the Pima that included changes in lifestyle, architecture, and economics, and the Pima were also heavily missionized, resulting in some loss of language and traditional beliefs. Much of this history lies buried in Piman ancestral sites. In several surveys, a minimum of 10 percent of hundreds of sites contained Piman components, some of which are thought to be Protohistoric to early contact period in age (Wilcox 1979:94). New archaeological research is needed to advance our knowledge of issues related to the history of the region.

The regional history of individuals of European ancestry began with the first mountain men and the intrusion of the earliest mining explorations. Mountain men entered the region in search of furs, especially valuable beaver pelts for the American fur trade, and their searches followed the local rivers including the Verde, Salt , and Gila all the way to the Colorado River. These individuals were followed by the early mineral prospectors in search of gold during the Arizona Gold Rush of 1858, when placer gold was discovered along the Gila River.

Mining activity north of the Gila River dates from the late 1850s and the early 1860s, and in 1863 prospectors were searching near Tonto Foothills for precious metals. Their trips into the region were of short duration, since prolonged prospecting could mean detection by roving bands of hostile Yavapai or Apache. The later historic activities of the 1870s and 1880s are economically and socially linked to the vicinity of Cave Creek, rather than the vicinity of Scottsdale, which did not emerge until the 1930s.

Until the end of the American Civil War, the defense of settlers and settlements was the responsibility of volunteer units from New Mexico and California. By 1863, Camp Clark was established near the Walker Mining District. In 1864 Camp Lincoln was established on the Verde River and by September 1865 seven officers and 464 men established Camp McDowell at a point on the Verde River. The presence of Camp McDowell encouraged increased activity in the surrounding area, and by 1867, J.Y.T. Smith was running a successful hay camp in the Salt River Valley and shipping the harvested wild hay to Camp McDowell. That same year, Jack Swilling, an entrepreneur of questionable character, visited Smith and noticed that the Salt River could be channeled to irrigate the valley. The Swilling Irrigation Canal Company was established, and successfully channeled water through prehistoric Hohokam canals, in addition to constructing new canals, providing water for the agricultural development of the area.

The 1880s brought changes to the existing life of the residents of the Salt River Valley, including a period of rapid growth and prosperity for civilians, and outstanding military success for American soldiers. Activities occurring in the area include attempts to establish homestead claims, and through the first decade of the twentieth century, after the area was put under federal ownership, homestead claims were filed within the project area boundaries; however, they were either not granted or were rescinded at a later date, likely as a result of the difficulty in obtaining water and maintaining the land improvements required for homestead status.

The majority of the Area of Potential Effect (APE) for this project has been surveyed in the past for other projects. The small portion of the project area west of the intersection of Ocotillo Road and Greenfield Road has not been surveyed. Prior to cultural resource clearance, this area should be surveyed.

As indicated, one site, a reach of the Roosevelt Canal [AZ T:10:83(ASM)] is located within the APE. Modern improvements have caused a loss of integrity to the canal, resulting in a recommendation of "not eligible" for listing on the National Register of Historic Places. All of the other known sites located within one mile of the project area are beyond the area of potential effect. Once the area has been completely surveyed a report should be submitted to the State Historic Preservation Officer for concurrence. After concurrence is received, if cultural resources are encountered during project construction activities, work shall stop immediately at that location, a qualified archaeologist shall be contacted, and steps shall be taken to secure the preservation of the resources. If human remains are encountered during any phase of the project, all work must stop and John Madsen of ASM (520-621-4795) must be notified immediately pursuant to state law.

APPENDIX F – STAKEHOLDER MEETINGS AND CORRESPONDENCE

Stantec

Meeting Notes

RWCD Canal Construction

Ocotillo Road / FILE 181300001

Date:	October 21, 2008
Place/Time:	Conference Call / 2:00 PM
Next Meeting:	
Attendees:	Burt (Atwell-Hicks), Gary Brady, Walt Cooper, Stephanie Gerlach
Absentees:	
Distribution:	Ron Nadzieja, Maria Brady, Gary Brady, Craig Bolze, Rob Shelley

Item: **Action:**

Dryup

Dry-ups are set by the District in October. They were a month long and start in mid-December. The District has added fish to the system and this may effect the dry-up schedule.

Bypass Options

They have considered both gravity and pump bypass systems. Burt suggested talking to Camille Smithon, who completed the last project that included a box culvert.

Box Culvert

The District prefers box culverts for roadway crossings over bridges. They use an ADOT detail with cast-in-place construction. Precast is not allowed because of the joints.

Construction Observer

Greg New is the construction observer for the District.

Scope and funding

The scope is set by the District and Atwell-Hicks provides costs to complete the engineering design, easement modifications, legal description and exhibit, supplemental topography and construction administration. The District will add an administrative cost to the project.

The District typically requests that funding be provided

up front.

Plans and Specifications

District plans and specifications are stand alone that can be appended to other project work.

Survey on the Main Canal

They may have some survey on the main canal at 100 foot intervals. Burt needs to verify this.

The meeting adjourned at 3:00 PM.
The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

STANTEC CONSULTING INC.

Stephanie Gerlach, PE
Engineer, Water Resources
stephanie.gerlach@stantec.com

Meeting Notes

ST054 – TOG Ocotillo Road Alignment Study – Greenfield to Higley

Coordination Meeting With Roosevelt Water Conservation District (RWCD)

Date:	Friday, April 10, 2009
Place/Time:	RWCD Headquarters, 10:00 am
Next Meeting:	TBD
Attendees:	Mike Leonard, Brad Strader, Stefani Stanage, RWCD
	Walt Cooper, Gary Brady, Maria Brady, Stantec
Absentees:	None
Distribution:	Brad Strader, Stantec attendees

Item: **Action:**

Purpose of the Ocotillo Road Alignment Study

Gary identified that he, Walt and Maria all have about 25 years with Stantec and have extensive irrigation system design and operations background. Stantec's objective is to address relocation of RWCD issues within the TOG Ocotillo Road preliminary engineering report, while accomplishing this in the best possible manner that will meet the District's preferences and needs.

Walt identified his position with Roosevelt Irrigation District (RID) and Buckeye Water Conservation and Drainage District (BWCDD). He discussed some of the development related coordination issues he has had recently and the importance of early coordination of projects with multiple disciplines. Mike identified that he thought this was important to begin the process early so that, in particular, the RWCD facilities can be addressed and relocated before the roadway improvements begin. All were in agreement and Maria identified that the TOG specifically wanted this preliminary engineering study to address the multitude of issues within this corridor, including the RWCD facilities, SRP 69KV power poles and line, and Flood Control District of Maricopa County (FCDMC).

Other Issues Within the Ocotillo Road Realignment Corridor

Maria provided an overview of the project issues, which included a discussion of the following:

- Dual quarter-corner issue within the section line
- Multiple parcel issue for FCDMC
- SRP 69 KV line
- Existing utilities within the corridor
- Chandler Heights Basin and future construction contract for north half of basin
- Relocation of RWCD facilities

RWCD Preferences

Mr. Leonard identified that RWCD will determine for themselves what facilities must ultimately be relocated for the project, and how these can best be addressed. However, Mr. Lenard and the RWCD staff identified the issues noted below as specific concerns in regards to the project at this preliminary stage:

- The project should be addressed in three separate and distinct phases: 1. Relocation of the 69 KV SRP power line, 2. Relocation of the RWCD facilities, 3. Roadway and bridge construction.
- RWCD's previous experience with projects where the general contractor responsible for the roadway construction also addressed the relocation of irrigation and other utilities has been very poor.
  - Because these projects are funded and contracted as "roadway" projects, the contractor's expertise and priority is the construction of the roadway features.
  - Constricted work sites do not allow multiple subcontractors to adequately address the construction of several project features simultaneously.

- Time constraints associated with the contract period have resulted in hurried and poorly constructed irrigation facilities. RWCD is often requested to accept the construction of facilities that do not meet their design and/or construction standards.

- RWCD would prefer that the construction of their relocations be addressed as a separate contact that would be completed prior to the start of roadway construction.

- To avoid significant conflicts with the construction, operation and maintenance of the RWCD facilities involved in this project, the SRP 69 KV line should be relocated prior to the RWCD relocations.
  - The check structure cannot be located beneath the overhead power lines as the use of a crane is required to maintain and repair the radial gates on structure.
  - The check structure may have to be relocated north of the power lines.

- A pipeline bypass will be required if check structure, box culvert and field turnout are to be constructed simultaneously during a single dry-up period. The capacity of the bypass will be the same as required downstream at the Chandler Heights and Greenfield Road project.

- A bypass would not be required if the check structure and box culvert were constructed during separate dry-up periods.
  - Construction of the check structure would be completed during the initial dry-up period, and the box culvert would be completed during the second.
  - Although not specified in the meeting, it is assumed that the construction the turnout would be completed along with the check structure. However portions of the turnout facility could likely be completed prior to the actual dry-up.

- The box culvert required for the road crossing will be a modified ADOT box culvert that RWCD has used at other locations.

- The O&M Road must remain accessible during construction operations.

- Accessibility for RWCD operations and maintenance staff and equipment at the new road crossing is a primary concern.
  - Open site lines are necessary for RWCD's crossing of the roadway with slow moving large equipment.
  - Appropriate design and grading of O&M access ramps and equipment holding bays must be addressed.
  - The location of the check structure and turnout must allow for RWCD operation, maintenance and repair activities to be completed without traffic safety concerns.
  - "On-Demand" signalization of the O&M Road intersections would be desirable.

Preliminary Engineering Report

Gary identified that we were currently in the process of preparing the narrative for the preliminary engineering report. Stantec's objective is to put a draft section together for the RWCD facility relocation and submit to RWCD for comments. This will be accomplished within the next few weeks.

Walt Cooper will coordinate with Brad Strader for report preparation.

The meeting adjourned at 11:15 am
The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

STANTEC CONSULTING INC.

Walt Cooper.
Associate
walt.cooper@stantec.com

Attachment: None

Agenda

Stantec

ST 054—Town of Gilbert Ocotillo Road Alignment Study – EMF to Higley Design Concept Report Alternatives Review

Flood Control District of Maricopa County Office

07 January 2009

Time:	Item:	Action:
1:30	Introductions	
1:35	Project Summary and Significant Project Features • Quarter Section Monument Discrepancy • Existing Right of Way • Existing Utilities: 69 & 12kV OHE, Water, Sewer • Existing Roadway Improvements: Higley Road Intersection, Improvements Constructed by Developers • Existing Residential Development: Freeman Farms, Freeman Property, Shamrock Farms • FCDMC Facilities: EMF, Chandler Heights Basin, Queen Creek, Sonoqui Wash, Maintenance Access • RWCD Facilities: New Box Culvert, Check Structure & Turnout, Maintenance Access	
1:45	Preferred Horizontal and Vertical Alignment • Horizontal Criteria • Vertical Criteria	
1:55	FCDMC and Roadway Coordination Issues • Proposed Crossing Options for EMF, Chandler Heights Basin and Queen Creek Wash • Existing/Proposed Maintenance Access for EMF, Chandler Heights Basin, Queen Creek Wash • Chandler Heights Basin Maintenance Access Crossing • Chandler Heights Basin Box Culvert Sizing • Roadway Drainage • ROW Requirements	
2:10	Projected Construction Schedule	
2:20	Modifications to Existing FCDMC Plans	
2:25	Next Step	

Meeting Notes

Stantec

Ocotillo Road Bridge at EMF

Date: 7 January 2009

Place/Time: Flood Control District of Maricopa County

Next Meeting: None Scheduled

Attendees: See list below

Name	Company	Phone	Email
Cathy Regester	FCDMC	602.506.4001	cwr@mail.maricopa.gov
Bing Zhao	FCDMC	602.506.3293	biz@mail.maricopa.gov
Richard Waskowsky	FCDMC	602.506.4113	rmw@mail.maricopa.gov
Maria Brady	Stantec	602.438.2200	Maria.brady@stantec.com
Gary Brady	Stantec	602.438.2200	Gary.brady@stantec.com
Craig Bolze	Stantec	602.438.2200	Craig.bolze@stantec.com
Rob Shelley	Stantec	602.438.2200	Rob.shelley@stantec.com
Ron Nadzieja	Town of Gilbert	480.503.6179	ronn@ci.gilbert.az.us
John Stock	FCDMC	602.506.5460	jrs@mail.maricopa.gov
Jeff Riddle	FCDMC	602.506.4602	jrr@mail.maricopa.gov
Shelby Brown	FCDMC	602.506.4583	sjb@mail.maricopa.gov
Michael Jones	FCDMC	602.506.4718	Michaeljones@mail.maricopa.gov
Mike C. Ramirez	FCDMC	602.506.2975	mcr@mail.maricopa.gov
Lisa Amos	FCDMC	602.506.4747	lla@mail.maricopa.gov

Attachments: Ocotillo Rd Bridge at EMF – Sign-in Sheet

Agenda: ST 054 – Town of Gilbert Ocotillo Road Alignment Study – EMF to Higley Design Concept Report Alternative Review

Absentees: None

Distribution:

The meeting began with Stantec providing an overview of the project corridor and significant project elements such as current land use within and adjacent to the project corridor, landownership, existing utilities, existing roadway improvements and FCDMC facilities, both existing and proposed.

Stantec then provided an overview of the roadway alignment alternatives evaluated as part of the project and presented the preferred horizontal and vertical alignment. The group discussed the alignment and affects on utilities, FCDMC structures, bridged crossings of the EMF and Queen Creek, existing and proposed right of way, roadway and regional drainage, as well as proposed future improvements for Chandler Heights Basin.

A round-table discussion of the various elements and information surrounding the project was held. Bridge clearance criteria were discussed. FCDMC expressed their desire to maintain 13-feet, six-inches as a minimum bridge clearance from the base of the channel. The criteria used in developing the conceptual alignment maintained a 12-feet minimum clearance. FCDMC indicated that specific design and technical issues such as these would need to be addressed by Scott Vogel (Branch Manager, Design - 602.506.4771) who was not in attendance at the meeting. Shelby Brown expressed her willingness to assist in scheduling a follow-up meeting with Mr. Vogel. The group discussed the proposed project schedule for Chandler Heights Basin construction. Shelby Brown said that construction of the remaining Chandler Heights Basin is not in the budget for next year.

John Stock discussed the section corner discrepancy that exists on FCDMC property near the EMF and expressed his understanding that the discrepancy is a significant impairment to accurately describing right of way and parcels. He would like a follow-up meeting with Ken Green (FCDMC Chief Surveyor, not present) and Jerry Chamberlin (Stantec Survey and Geomatics Principal, not present) to discuss the discrepancy and potential impacts to this project. Mr. Stock also said that Mr. Green will be the primary survey contact for FCDMC.

Bing Zhao discussed the importance of scour analysis during the design phase and agreed to transmit supporting information and guidelines to Stantec following the meeting via e-mail. He also mentioned that FCDMC is considering construction of a low-flow channel the length of the EMF.

FCDMC discussed the need for identifying appropriate locations for staging equipment during construction and to identify needed temporary construction easements during the design phase.

Summary of Technical Issues:

1. Verify Design Q for EMF as part of the report documentation for use in the design phase. There are a variety of design Qs that have been established for EMF and FCDMC is concerned that the correct Q be used in the go forward program.
2. At least 2' of clearance between low cord of bridge and water surface is required in the EMF and Queen Creek Wash. Use the NRCS criteria for freeboard requirements of the EMF bridge.
3. FCDMC preference for bridge equipment clearance is 13'-6" equipment clearance on bridge rather than 12'-0". Lower clearance may be acceptable upon review.
4. Scott is the project manager for the Chandler Heights Basin project and his input regarding project requirements and some of the impacts to the FCDMC facilities is required. In particular, he needs to be involved in the requirements for maintenance crossings in the retention basin and above the retention basin around the full perimeter of the Chandler Heights Basin. Scott Vogel phone number is 602-506-4771.
5. FCDMC would like Ken Green (FCDMC survey manager) to meet with Stantec survey manager (Jerry Chamberlin) to discuss how the two quarter-corners will be addressed for right-of-way between the EMF and Higley Road.

6. FCDMC preference is that any title issues that might come out of this preliminary engineering report or the Ocotillo Road project be addressed and corrected now prior to construction.
7. FCDMC will require this project to provide full retention for roadway runoff.
8. Look at vortex separators on the ADEQ website for bleed-off consideration.
9. Make sure that there is consideration of a contractor staging area when considering the impacts of temporary construction easement requested of FCDMC.

The meeting adjourned at 2:30 p.m.

The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

STANTEC CONSULTING INC.

Meeting Notes

Ocotillo Road Bridge at EMF

Stantec

Date:	February 19, 2009
Place/Time:	Flood Control District of Maricopa County
Next Meeting:	February 24 at 1 pm with Ken Green, FCDMC survey, and Jerry Chamberlin, Stantec survey
Attendees:	See list below

Name	Company	Phone	Email
Cathy Regester	FCDMC	602.506.4001	cwr@mail.maricopa.gov
Stephanie Gerlach	Stantec	602.438.2200	Stephanie.gerlach@stantec.com
Gary Brady	Stantec	602.438.2200	Gary.brady@stantec.com
Craig Bolze	Stantec	602.438.2200	Craig.bolze@stantec.com
Rob Shelley	Stantec	602.438.2200	Rob.shelley@stantec.com
Ron Nadzieja	Town of Gilbert	480.503.6179	ronn@ci.gilbert.az.us
Scott Vogel	FCDMC	602.506.4771	csv@mail.maricopa.gov
Don Rerick	FCDMC	602.506.4878	djr@mail.maricopa.gov
Shelby Brown	FCDMC	602.506.4583	sjb@mail.maricopa.gov
Mike Jones	FCDMC	602.506.4718	michaeljones@mail.maricopa.gov
Lisa Amos	FCDMC	602.506.4747	lla@mail.maricopa.gov

Attachments:	Ocotillo Rd Bridge at EMF – Sign-in Sheet
Absentees:	None
Distribution:	Shelby Brown – FCDMC
	Ron Nadzieja – Town of Gilbert
	Maria Brady, Gary Brady, Craig Bolze, Rob Shelley - Stantec

The meeting began with Gary Brady and Ron Nadzieja providing an overview of the project status and purpose of the meeting. Craig Bolze provided an exhibit and provided an overview of the corridor and significant project elements such as current land use within and adjacent to the project corridor, landownership, existing utilities, existing roadway improvements and FCDMC facilities, both existing and proposed.

Stantec then provided an overview of the roadway alignment alternatives evaluated as part of the project and presented the preferred horizontal and vertical alignment. The group discussed the alignment and affects on utilities, FCDMC structures, bridged crossings of the EMF and Queen Creek, existing and proposed right of way, roadway and regional drainage, as well as proposed future improvements for Chandler Heights Basin.

The meeting then proceeded to a round-table discussion of the various elements and information surrounding the project. Bridge clearance criteria were discussed. As in the

previous meeting FCDMC again expressed their desire to maintain 13-feet, six-inches as a minimum bridge clearance from the base of both the EMF and Queen Creek channels. The criteria used in developing the conceptual alignment was to maintain 12-feet as a minimum clearance.

Don Rerick said that the planned improvement for the upstream Chandler Heights Basin is presently programmed to begin construction in the 2011-2012 fiscal year but that the amount programmed may not be sufficient to construct all of the improvements associated with the basin. Ron Nadzieja reported that the Town of Gilbert is likely at least 5-years away from constructing the roadway and has presently placed all planned construction for project currently in the design phase on-hold. Don Rerick conveyed that if the roadway is constructed prior to the basin that they would like to see all basin modifications from the roadway south completed with the roadway improvements so that future basin construction would not need to take place south of the roadway, obviating the need for cross-roadway construction activities.

Operations and maintenance of FCDMC facilities and maintaining access from Ocotillo Road will be a top consideration of FCDMC. Shelby Brown will ask the FCDMC operations and maintenance group to review the conceptual alignment and offer comments.

Discussed the criteria used to size the box culvert for the Chandler Heights basin. The box is sized for the maximum discharge entering the basin and a maximum velocity of 7 ft/sec. Long term plans for the basin include a recreational trail. Discussed splitting the box culvert, one set of cells for the invert of the basin and one set of cells raised for O&M access.

The group discussed the issue of pavement drainage and some of the complications associated with the use of basins for retention of pavement drainage within the footprint of the Chandler Heights Basin. Mike Jones pointed out that some separator units are being used on other crossings of the EMF and might be suitable for this application. He referred any further discussion on their possible use to Matt Oller of FCDMC (Water Quality).

As part of the discussion of existing utilities the group reviewed the impact of the preferred alignment on the existing 69kV utility poles and their location with respect to easements and right of way presently existing. Don Rerick pointed out that the future improvements for Chandler Heights Basin were considered in the poles' current location and that the basin improvements would need to be taken into account in any future relocation of the poles. The group discussed existing easements and right of way for the OHE and the position of the poles with respect to them. Lisa Amos is to research the status of easements for these poles. Stantec to provide 69 kV easement document and surveyed pole locations to Lisa and cc Shelby.

The group also reviewed conceptual right of way needs for the preferred alignment as well as temporary construction easements. Lisa Amos pointed out that it would be prudent to obtain TCEs encompassing access ramps into both Queen Creek and the EMF for the purpose of construction the bridges as these will likely need to be utilized during construction.

FCDMC reported that a low-flow channel is planned for the EMF beginning at the approximate location of the Ocotillo Road alignment. If we have preliminary pier locations FCDMC will use those to assist in locating the channel to minimize the potential for relocation when the bridge is constructed. The proposed channel is anticipated to be trapezoidal in section and concrete lined. The likely alignment will be along the east toe of

the EMF. Stantec to provide preliminary locations of the EMF bridge piers so the low flow channel can be place around them.

The group discussed the possible need for modification of the existing Chandler Heights improvement plans as a result of Ocotillo Road improvements. The group concurred that the plans will need to be modified to accommodate the roadway and the impact of the roadway improvements on the capacity of the basin will need to be documented and reviewed with respect to the capacity and operation of the basin. Don Rerick conveyed that the alignment is workable with the understanding that considerations for Chandler Heights Basin need to be accommodated in the design of the roadway.

A draft engineering report will be submitted in the next 30 days. Ron said to distribute copies to the FCDMC to their review. Shelby said to send them to her and she will distribute to the correct people.

The meeting adjourned at approximately 3:00 p.m.

The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

STANTEC CONSULTING INC.

Meeting Notes

Ocotillo Road Bridge at EMF

Stantec

Date:	February 24, 2009
Place/Time:	Flood Control District of Maricopa County/ 1:00 pm
Next Meeting:	None
Attendees:	See attached
Attachments:	Ocotillo Rd Bridge at EMF – Sign-in Sheet
Absentees:	None
Distribution:	Shelby Brown – FCDMC
	Ron Nadzieja – Town of Gilbert
	Maria Brady, Gary Brady, Craig Bolze, Rob Shelley - Stantec

The meeting began with Maria Brady and Ron Nadzieja providing an overview of the project status and purpose of the meeting. The purpose of the meeting was the following:

1. Discuss quarter section monument error
2. The description for the RWCD main canal centerline is different than the actual centerline alignment.
3. The actual location of the power poles do not lay within the easement as described in a document given to Stantec by SRP.

Quarter Section Monument Error

There are two quarter section monuments in the field approximately 40 feet apart. TOG would like to obtain an easement for Ocotillo Road from the FCDMC over EMF, Queen Creek Wash and Chandler Heights basin. There are 7 to 9 parcels that will be affected by the roadway. It is unknown if they are contiguous; however, preliminary review by Stantec suggests that the properties are contiguous. Three options for the easement acquisition were discussed in the meeting:

1. Write a strip easement over the parcels – It is unknown whether a strip easement is acceptable. Ron said he would check with his legal department to obtain a legal opinion about strip easements in Arizona. Stantec will also check with Arizona Board of Technical Registration (BTOR) regarding their stance on strip easements. John Stock suggested talking to Stuart Lane at BTOR.
2. If a strip easement is not acceptable, then the FCDMC could convey all parcels to a straw man, and then convey the properties back to the FCDMC as just one parcel. Then the roadway easement could be written for this parcel.
3. If this is not acceptable, then a roadway easement could be written for each parcel. Each parcel would have to be surveyed and verified that they are contiguous.

RWCD Main Canal

John identified the RWCD main canal is a monument and therefore the existing ditch centerline should be used as the monument to establish the 40-foot easement on either side of the existing ditch centerline. He also mentioned that he completed a survey in the area of Ocotillo Road and would send this to us.

SRP Easement

SRP recently relocated the power poles to correct previous easement issues (circa 2004). Therefore, documentation provided by SRP may have been superseded. Lisa will check the FCDMC records to see if they have a more recent version of the easement exists.

The meeting adjourned at approximately 2:00 p.m.

The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

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FCDMC Correspondence

From: Shelby Brown - FCDX [sjb@mail.maricopa.gov]
Sent: Thursday, February 04, 2010 3:41 PM
To: Brady, Maria
Cc: Scott Vogel - FCDX; Don Rerick - FCDX; Jeff Riddle - FCDX
Subject: FW: Ocotillo Road and Chandler Heights Basin Construction Coordination
Attachments: Ocotillo Road Crossing Issues.docx

Good afternoon. Attached is the response received from Scott Vogel in connection with your e-mail of January 26, 2010.

As always, please let me know if you have any questions.

Shelby Brown, CFM

From: Scott Vogel - FCDX
Sent: Wednesday, February 03, 2010 3:30 PM
To: Shelby Brown - FCDX
Cc: Don Rerick - FCDX; Jeff Riddle - FCDX; Felicia Terry - FCDX
Subject: RE: Ocotillo Road and Chandler Heights Basin Construction Coordination

FCD has and will continue to coordinate with the Town of Gilbert regarding the construction of the Chandler Heights Basin and Ocotillo Road improvements. Regarding the draft letter, FCD staff cannot commit to entering an IGA with the Town. This is a Board of Directors action. In addition, specifying exactly how the basin-first or roadway-first scenarios will play out is not something we should commit to at this time.

In an effort to help identify items that should be addressed as part of the design, rights-of-way and construction process, I have attached a Word document with a few issues that I see may be included in those discussions. If the Town would like to work towards an understanding as to the issues that may be involved in this coordination, this document is a start. These issues can be addressed now, or as the projects get closer to construction.

Thanks, Scott

From: Shelby Brown - FCDX
Sent: Wednesday, January 27, 2010 8:48 AM
To: Scott Vogel - FCDX; Felicia Terry - FCDX
Cc: Don Rerick - FCDX; Jeff Riddle - FCDX
Subject: FW: Ocotillo Road and Chandler Heights Basin Construction Coordination

Please see the attached information that came from Maria Brady of Stantec. Although this will eventually become a right-of-way permit, as Project Managers in this area, I believe that your comments sooner rather than later will be beneficial.

As far as a formal response, it may be more appropriate to come from you; however, I would appreciate a copy of the response.

As always, please let me know if you have any questions.

Thanks!

From: Brady, Maria [mailto:maria.brady@stantec.com]
Sent: Tuesday, January 26, 2010 4:37 PM

To: Shelby Brown - FCDX
Cc: Brady, Gary; Woodroffe, Neil
Subject: Ocotillo Road and Chandler Heights Basin Construction Coordination

Shelby,
As you know, FCDMC has completed design plans for the Chandler Heights Basin. Further, the Town of Gilbert (TOG) has spent some time preparing a Preliminary Engineering Assessment that would require modification of the design plans prior to construction of the Chandler Heights Basin. We have completed our report and need to finalize the last chapter that addresses construction schedule and coordination of that schedule with FCDMC.

Attached is the text for Chapter 11 in our report. As you will find, in the opening paragraphs of Chapter 11, we note that FCDMC and TOG have coordinated on this project to prepare a Preliminary Engineering Assessment for the Ocotillo Road alignment and design across Queen Creek Wash, the future Chandler Heights Basin and the EMF between Higley and Greenfield Roads. The text further describes how the two entities (FCDMC and TOG) might work together when construction proceeds for the Chandler Heights Basin or for the roadway.

At your recommendation, I have included a reference to a letter from FCDMC to TOG that acknowledges this coordination and the desire of TOG to modify the current design plans for the completion of Chandler Heights Basin. Attached is a draft letter that could be used if your people are comfortable with the language. In this way both entities, FCDMC through the letter and TOG through the Preliminary Engineering Assessment, would both acknowledge the desire to work together at a future date when either party desires to move forward with construction in the Ocotillo Road alignment at the Chandler Heights Basin.

Please review this information, tell me if it is adequate for your staff to review (you had suggested Scott Vogel or Don Rerick), and if this is still an acceptable method of acknowledging the future working arrangement between FCDMC and TOG. If you would like a full copy of the draft report, please let me know and I will send over copies to you.
Thanks for your time.

Maria J. Brady, PE
Environmental Infrastructure Practice Leader
Stantec
Ph: (602) 438-2200 Ext. 4689
Fx: (602) 431-9562
Cell: (602) 363-5763
maria.brady@stantec.com
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Attachment from Scott Vogel 2/3/2010 email

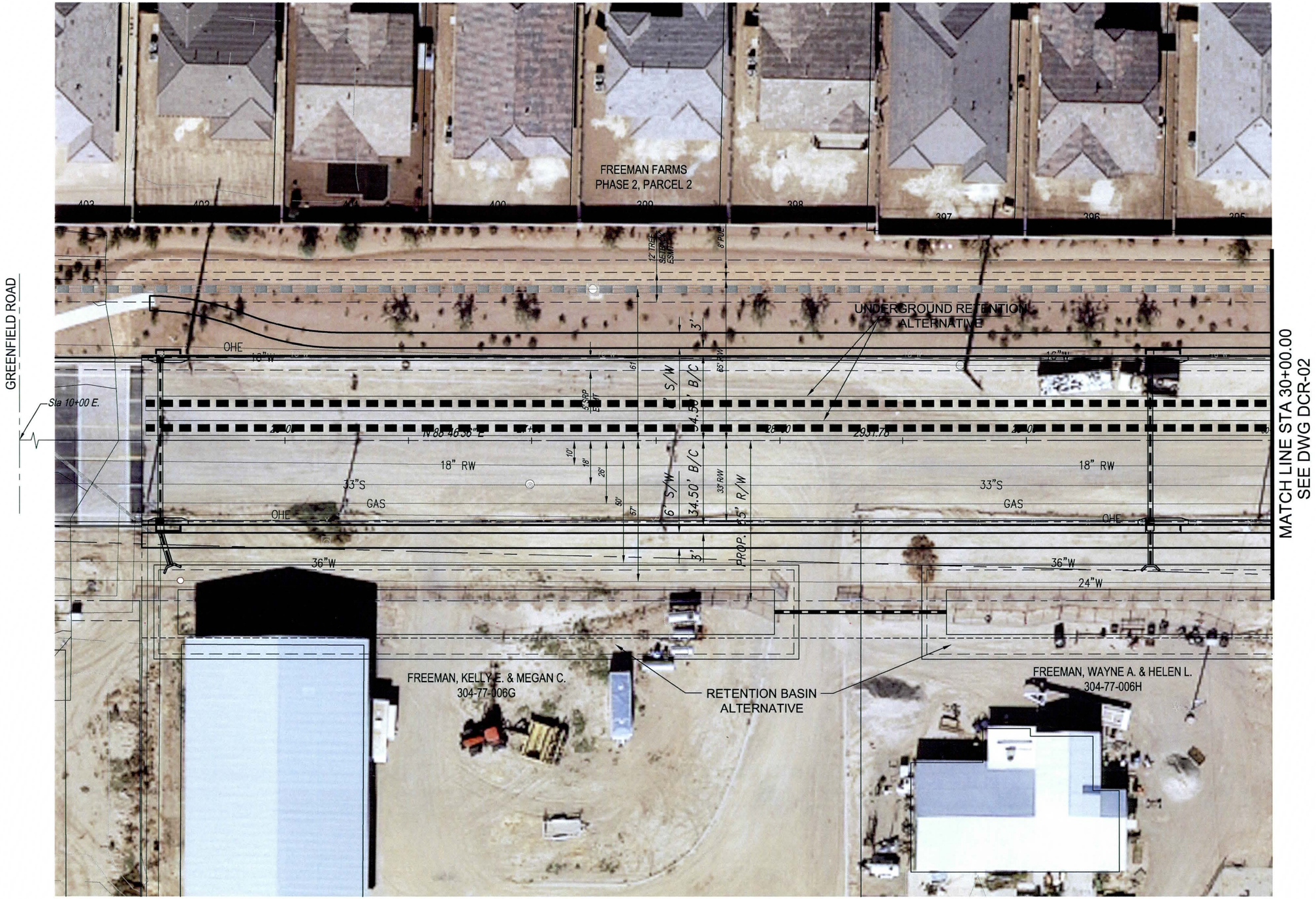
Ocotillo Road Crossing

2/3/10

Some of the issues to be addressed prior to construction of the Ocotillo Road Crossing of the Chandler Heights Basin:

1. Confirmation is needed that the basin volume occupied by the prism of the roadway does not adversely affect the design (or volume is otherwise replaced in the basin).
2. The proposed roadway culvert needs to be large enough to allow the basin to function as designed. For example, the culvert needs to allow peak weir flow to occur, without the WSEL in the basin causing backwater problems for the weir flow.
3. Is there an existing roadway easement in place that is adequate for the proposed Ocotillo Road? Should an easement be required for the entire roadway prism (to where the toe of slope hits the basin invert)?
4. Basin access needs to be maintained. In addition to drive approaches that allow Ocotillo Road to be crossed at the west and east sides of the basin, it may be necessary to ramp all weather maintenance roads into the basin and under the proposed culvert.
5. If the Ocotillo Road Crossing were made prior to basin excavation, the limits of construction would need to be agreed upon (i.e., would the road project construct the entire roadway prism?, with the excavation north of the roadway drained through the culvert?).
6. At some point, concept plans should be developed to show how the roadway crosses the basin, how the roadway prism slopes tie into the basin slopes, etc.

APPENDIX G – PREFERRED ALTERNATIVE PLANS AND PROFILES



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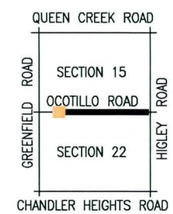

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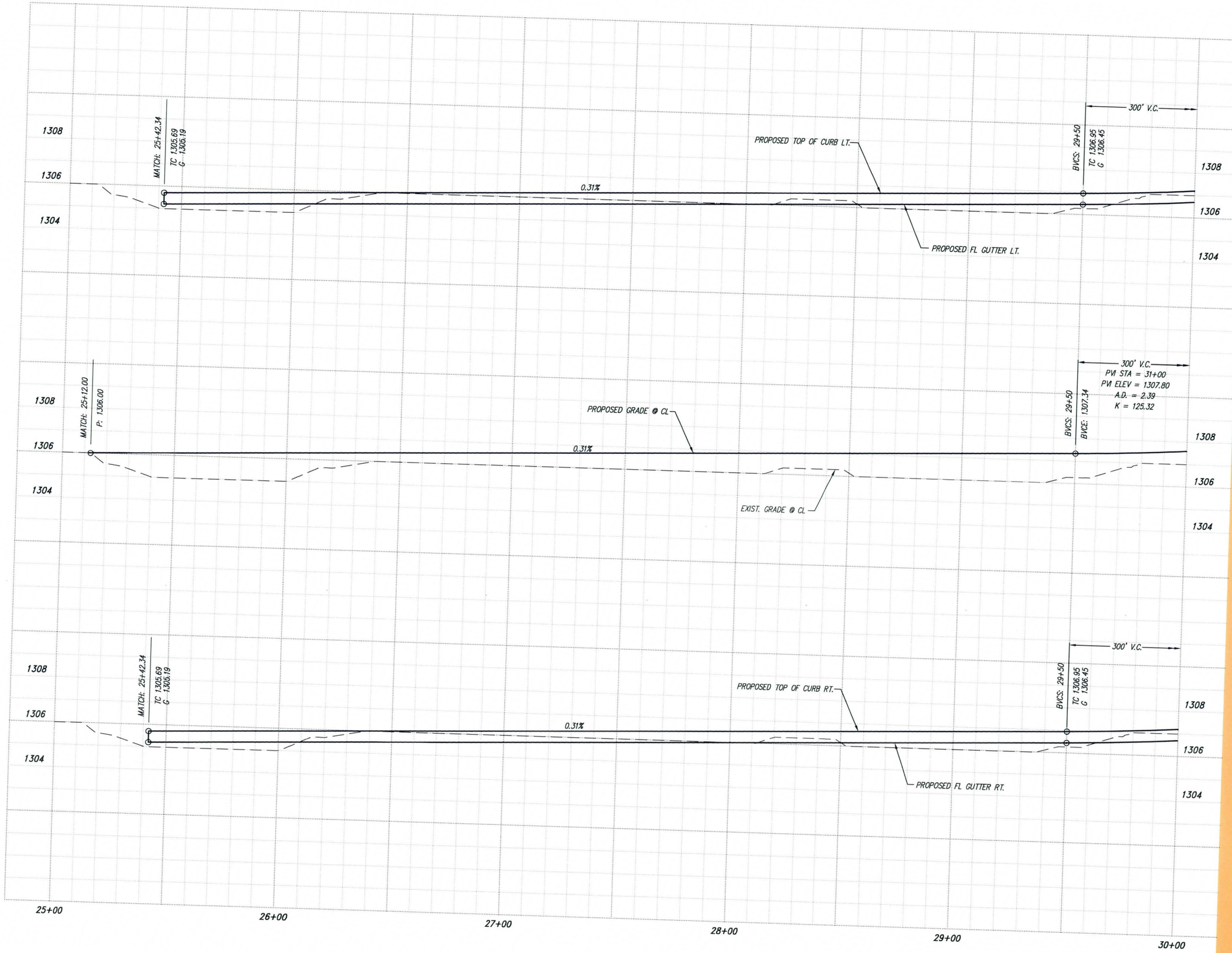

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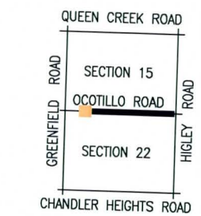

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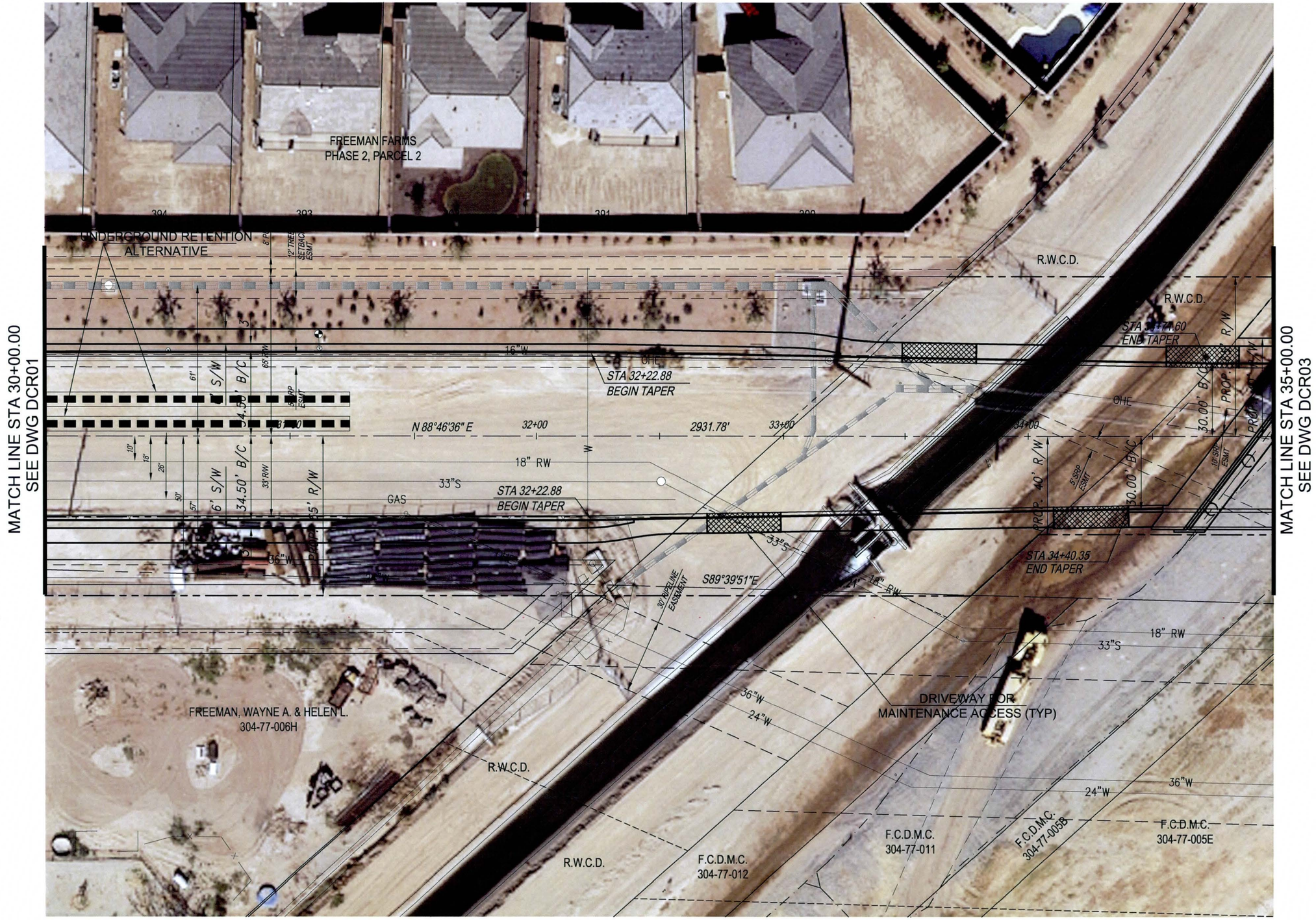

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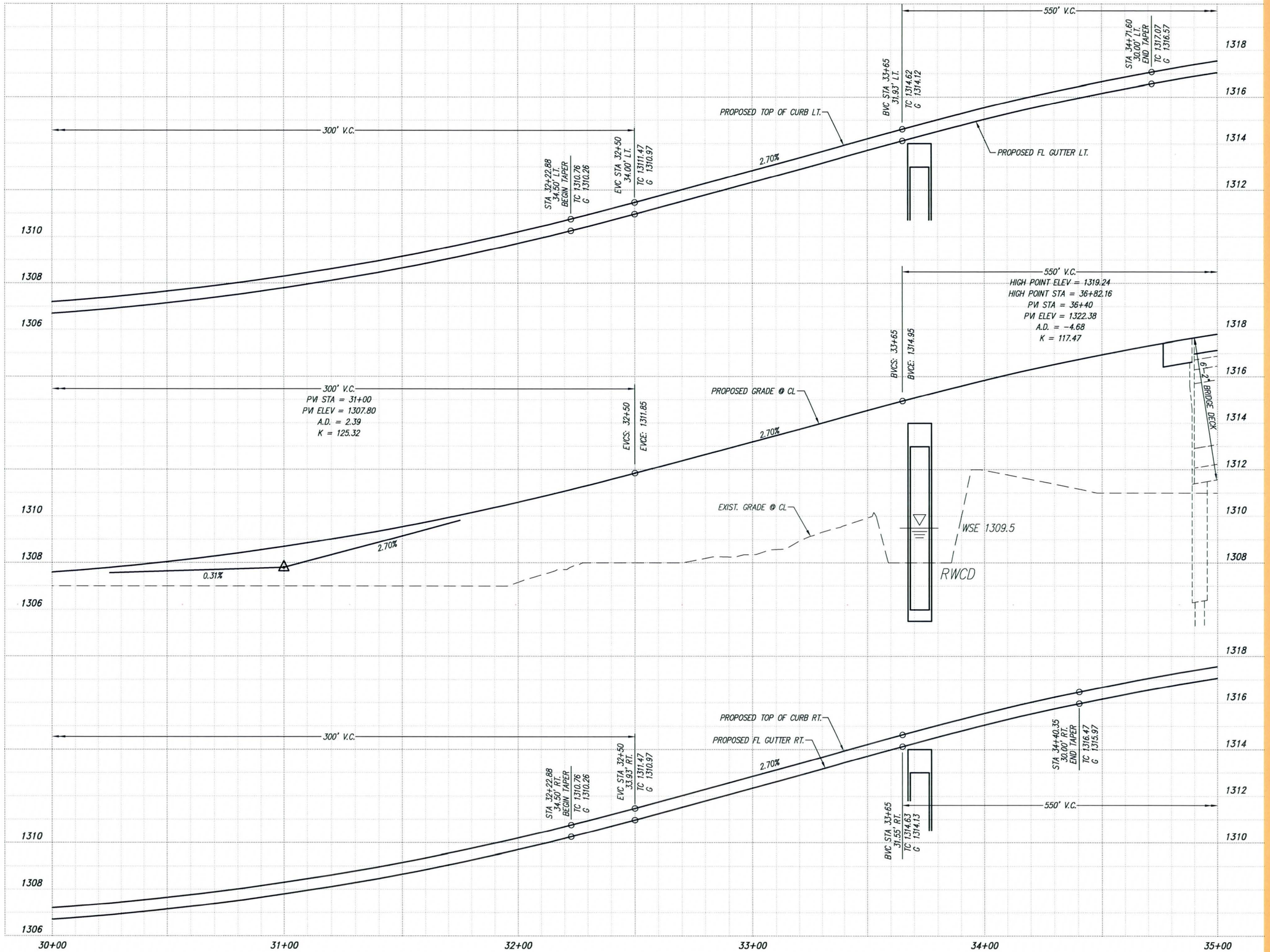

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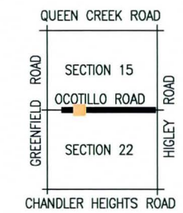

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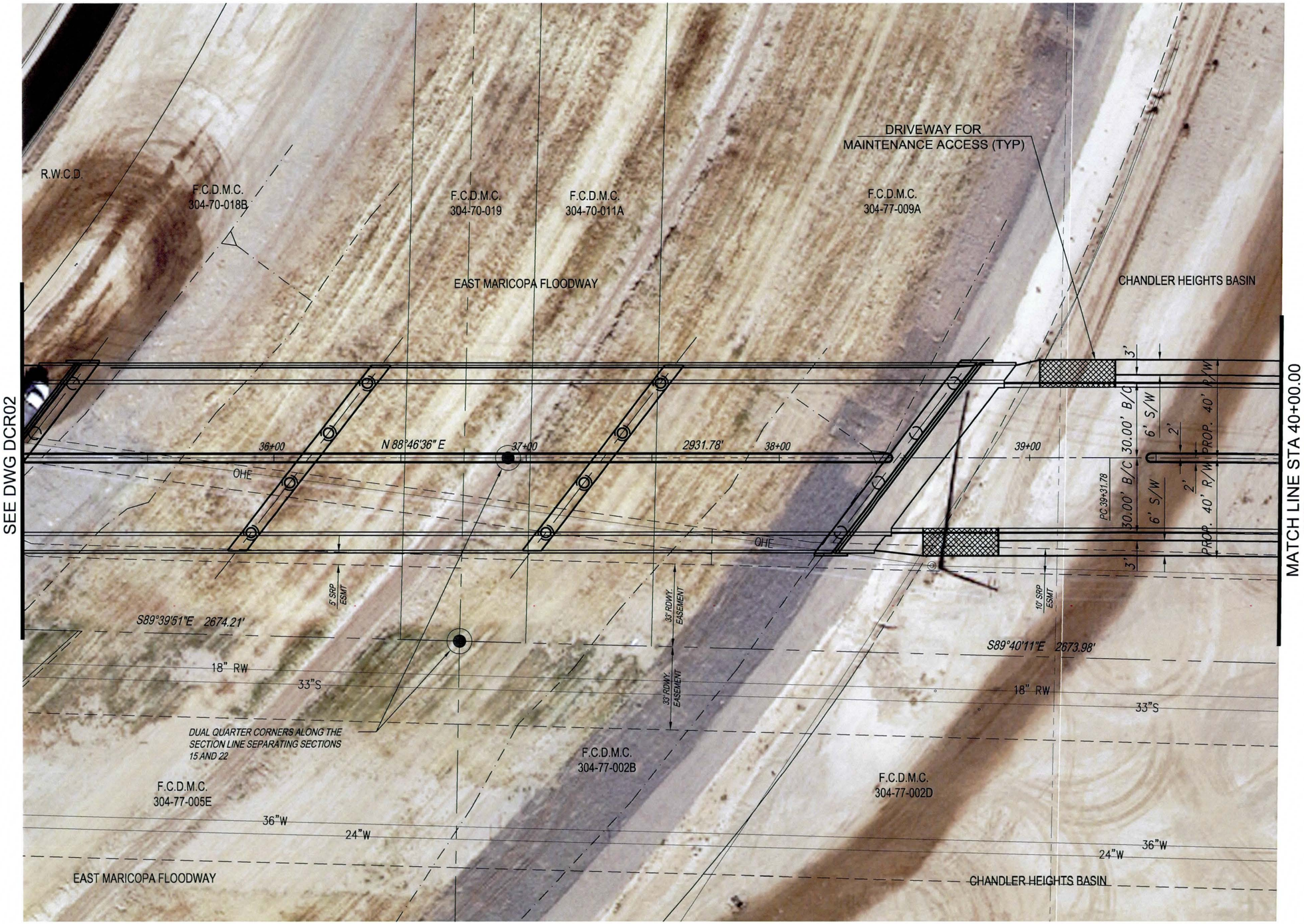

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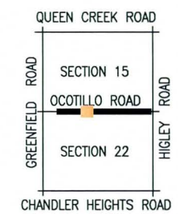

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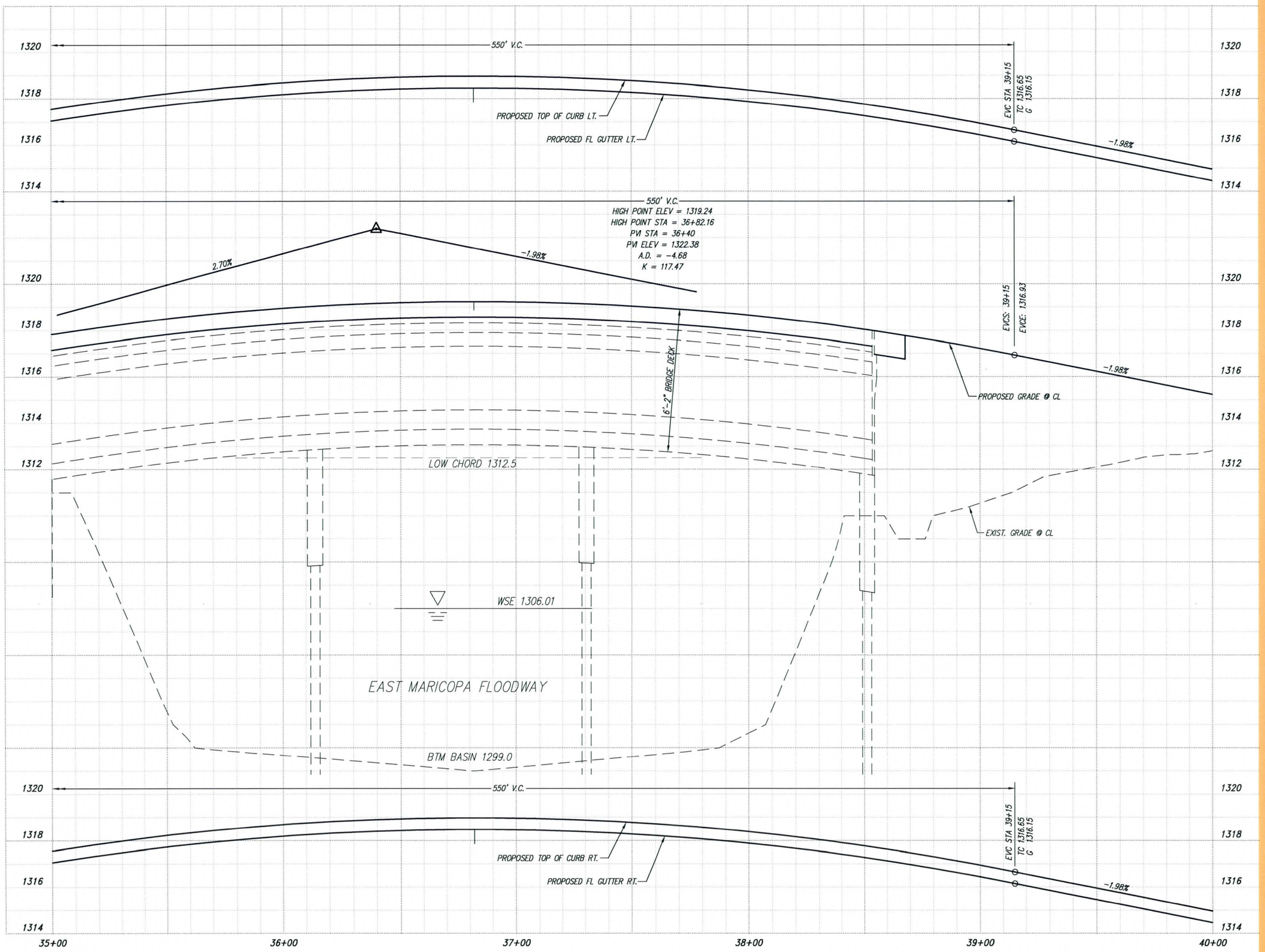

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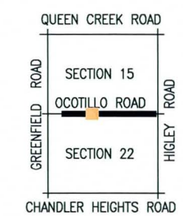

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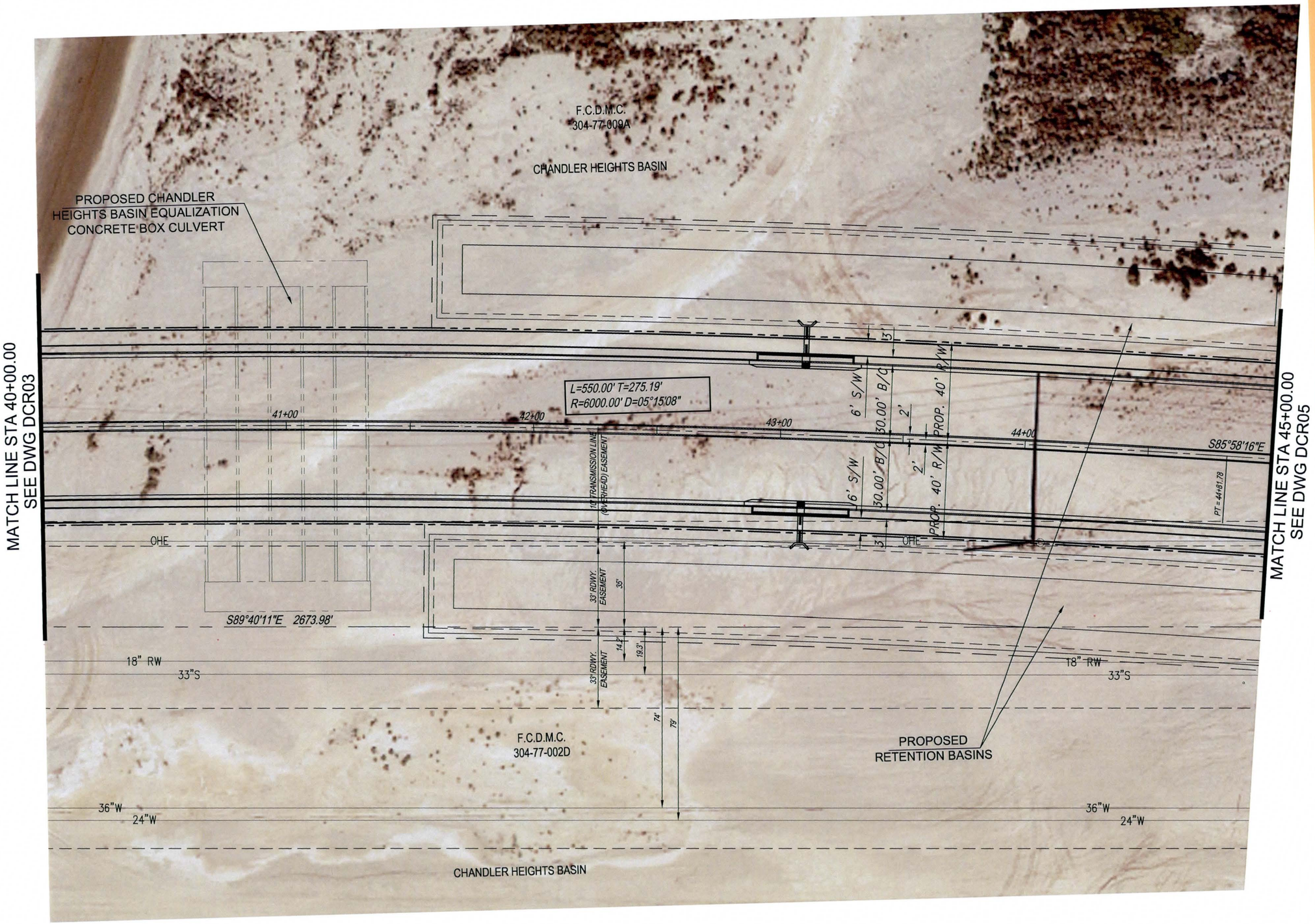

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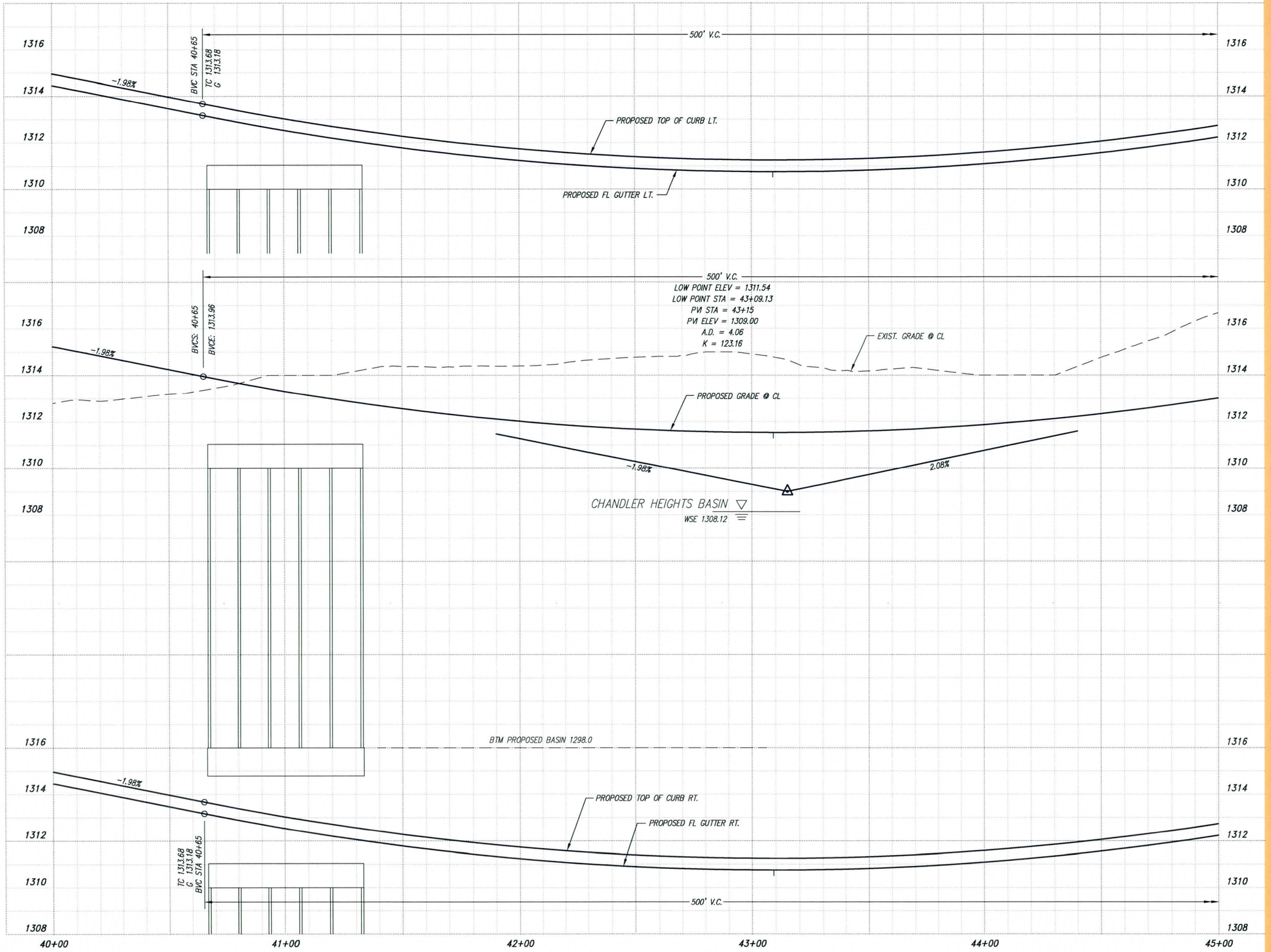

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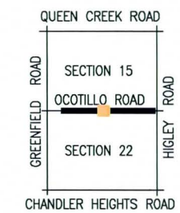

SECTION 15 & 22, T2S, R6E
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Revision	By	Appd.	Date

File Name:

Dwn.	FWC Chkd.	Dsgn.	Date

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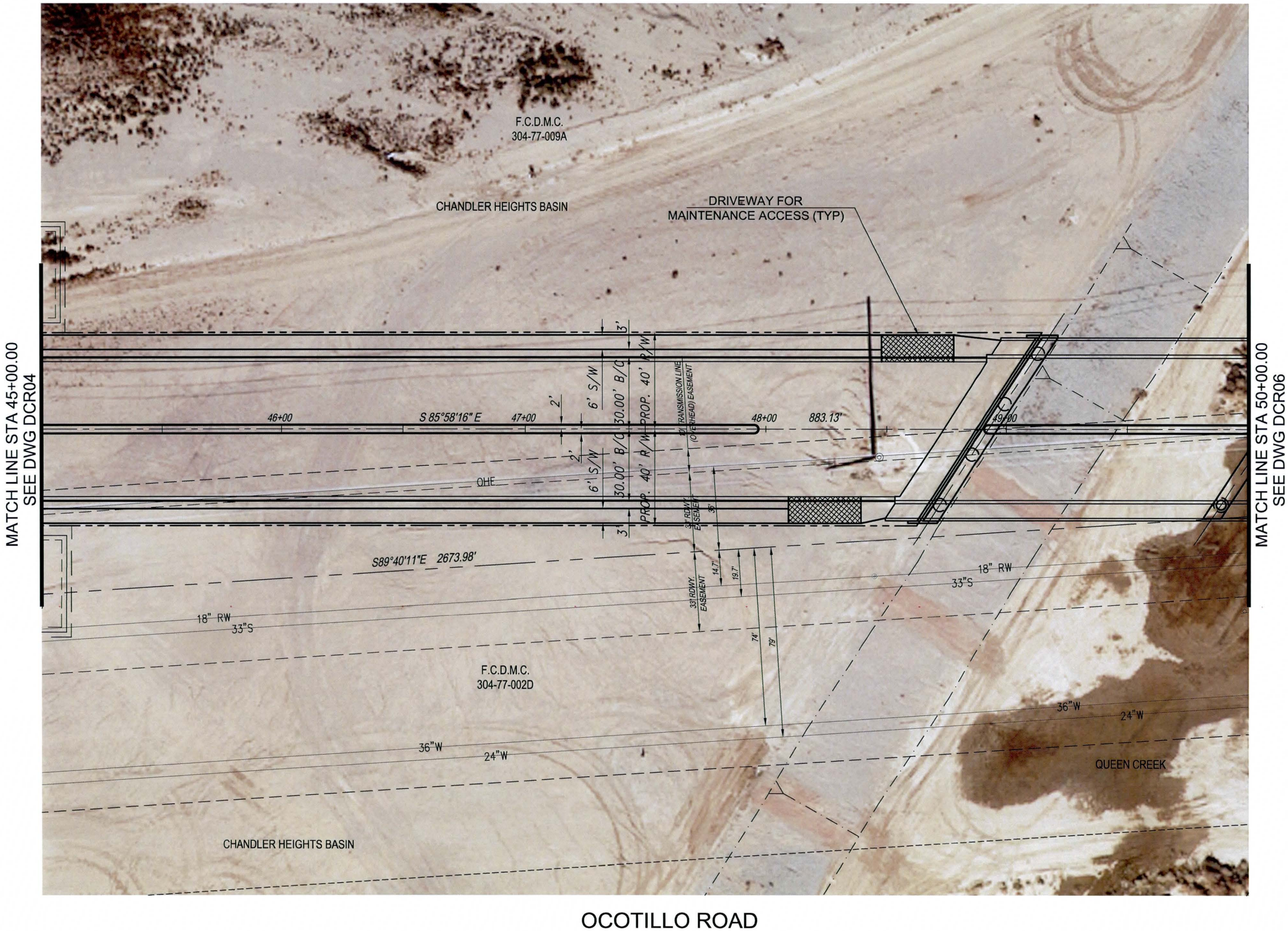
OCOTILLO ROAD
ALIGNMENT STUDY REPORT
GREENFIELD ROAD TO HIGLEY ROAD
GILBERT, ARIZONA

Title
ROADWAY PROFILE

Project No.	Scale	
181300001	1"=40' HOR	1"=4' VERT

Drawing No.	Sheet	Revision
DCR04-pro	8 of 16	0



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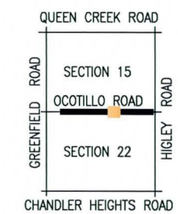
SCALE: 1"=40'



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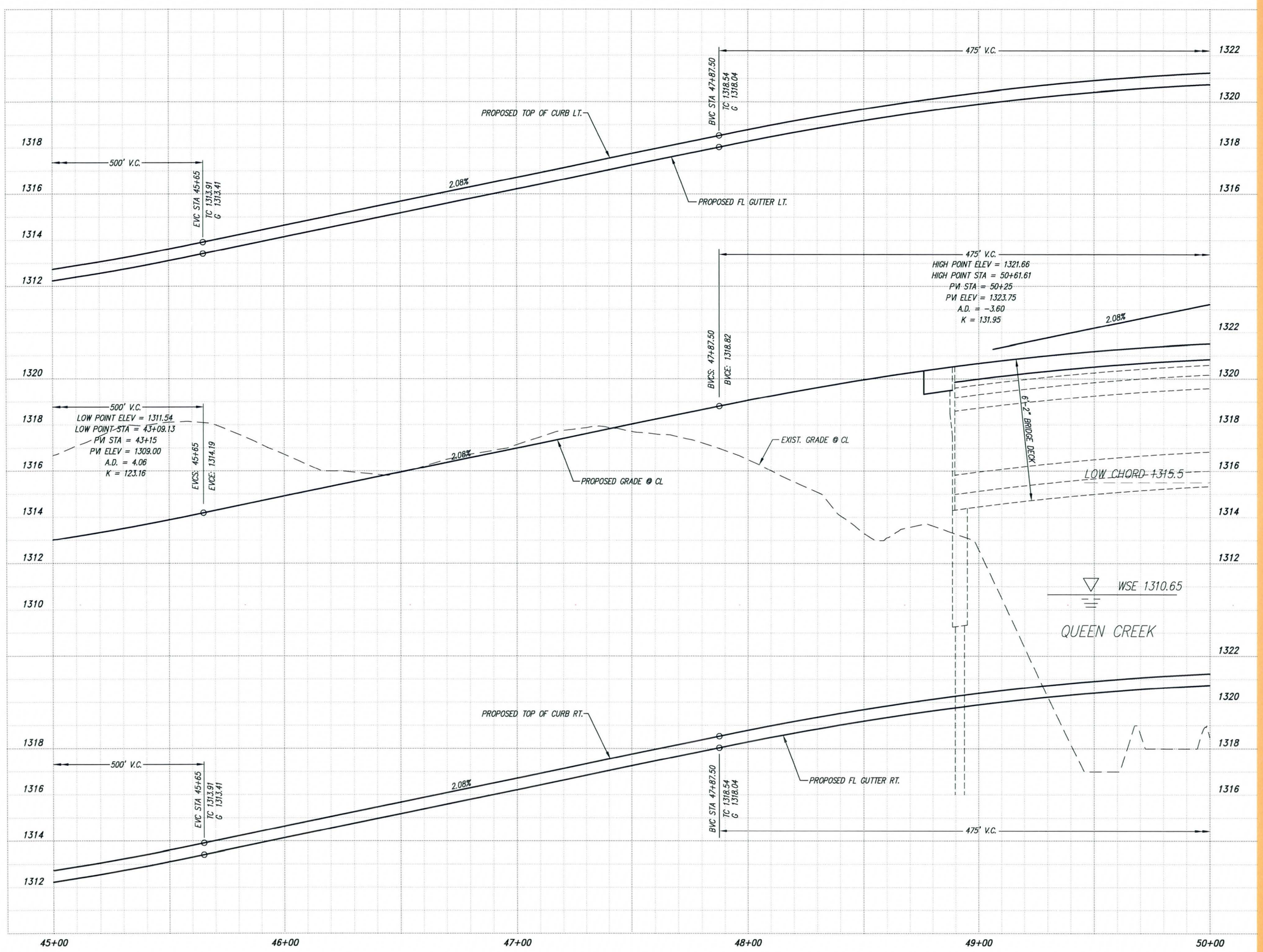
GREENFIELD ROAD TO HIGLEY ROAD
GILBERT, ARIZONA

Title
ROADWAY PLAN

Project No.	Scale	
181300001	AS SHOWN	
Drawing No.	**Sheet**	**Revision**
DCR05-plan	9 of 16	0



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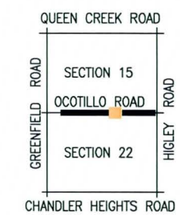
SCALE: 1"=40'

2 1 0 2 4
SCALE: 1"=4'



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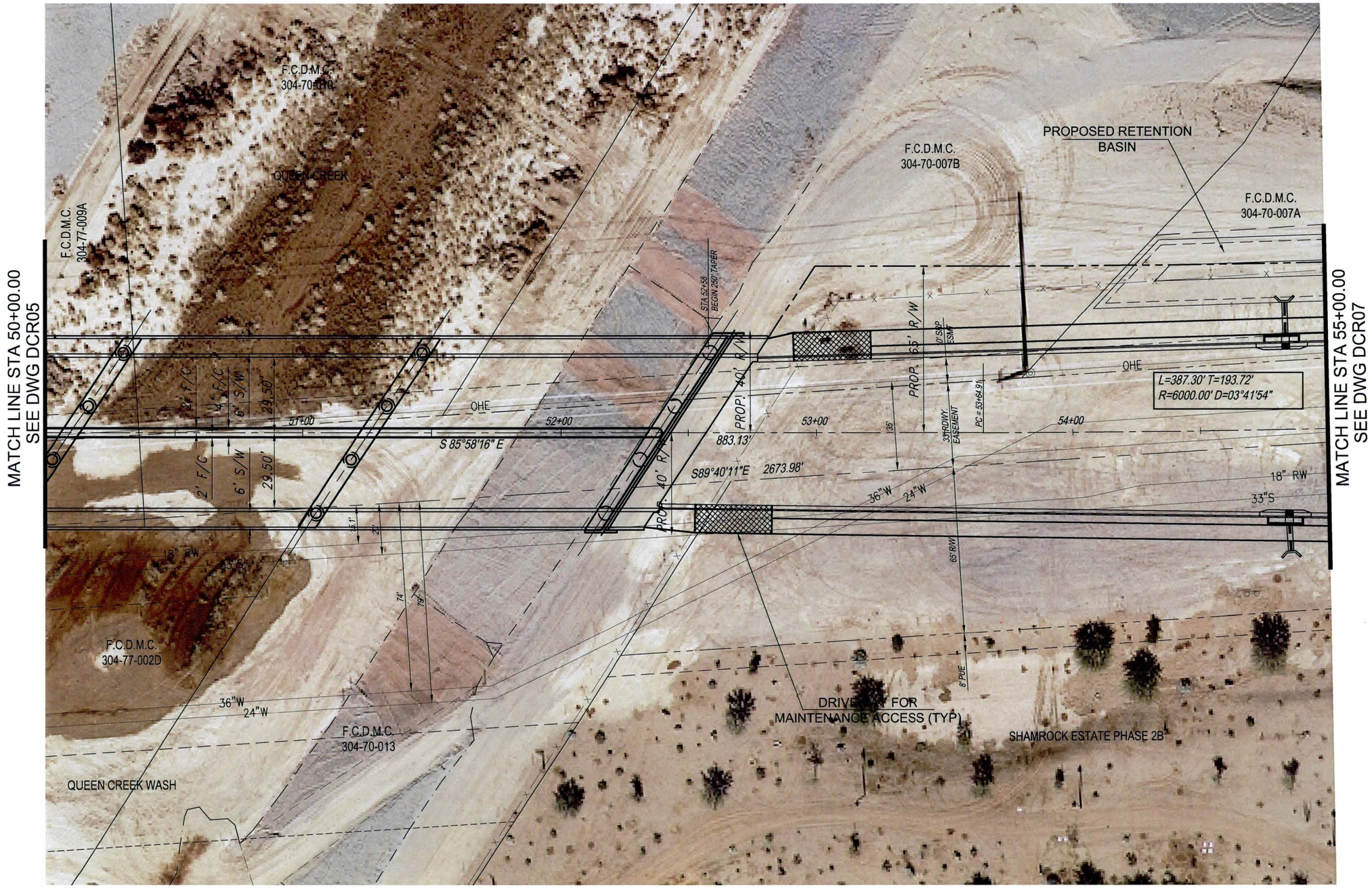
GREENFIELD ROAD TO HIGLEY ROAD
GILBERT, ARIZONA

Title
ROADWAY PROFILE

Project No.	Scale
181300001	1"=40' HOR 1"=4' VERT

Drawing No.	Sheet	Revision
DCR05-pro	10 of 16	0



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SCALE: 1"=40'

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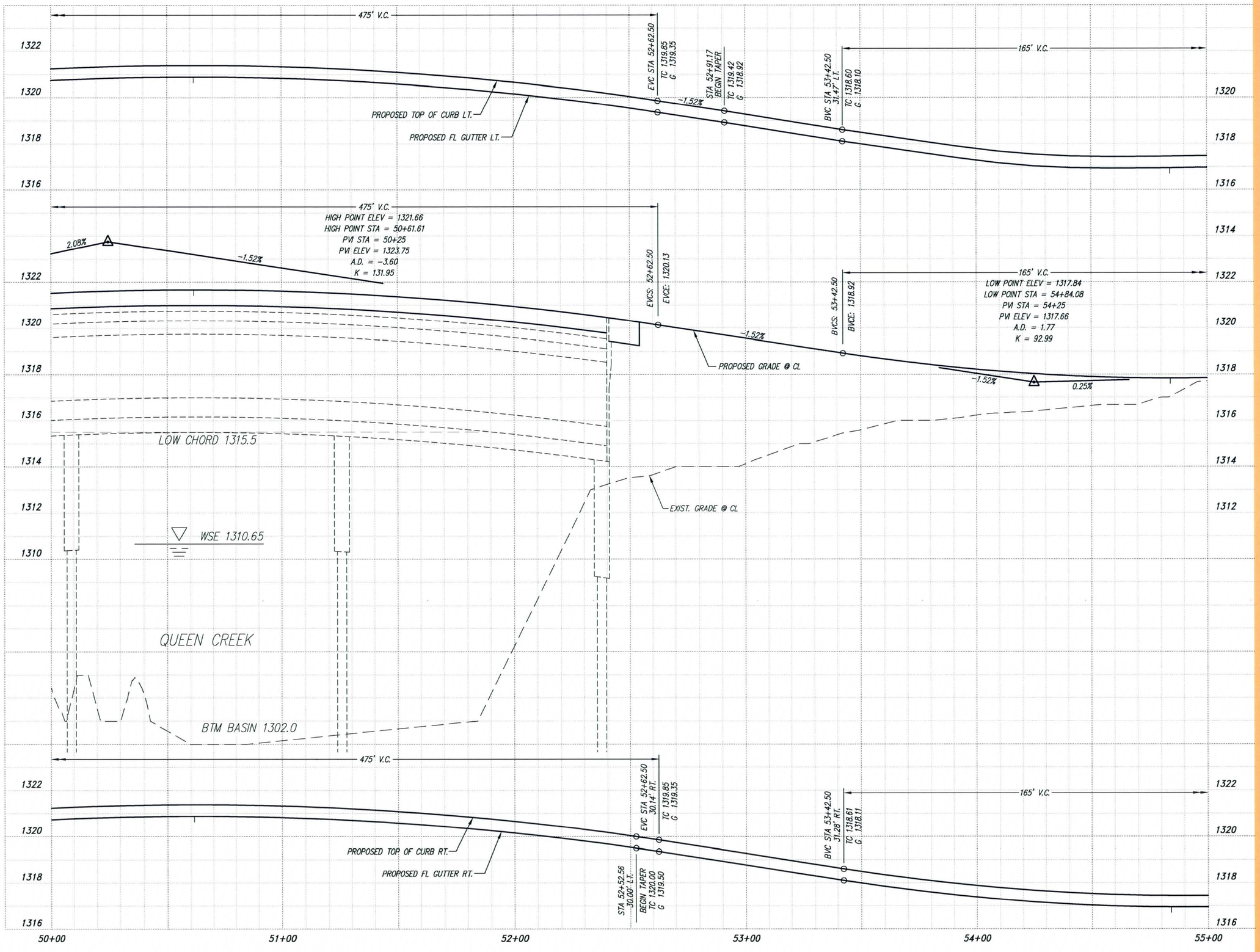
GREENFIELD ROAD TO HIGLEY ROAD
GILBERT, ARIZONA

Title
ROADWAY PLAN

Project No.	Scale	
181300001	AS SHOWN	
Drawing No.	**Sheet**	**Revision**
DCR06-plan	11 of 16	0



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SCALE: 1"=40'

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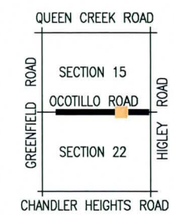
SCALE: 1"=4'



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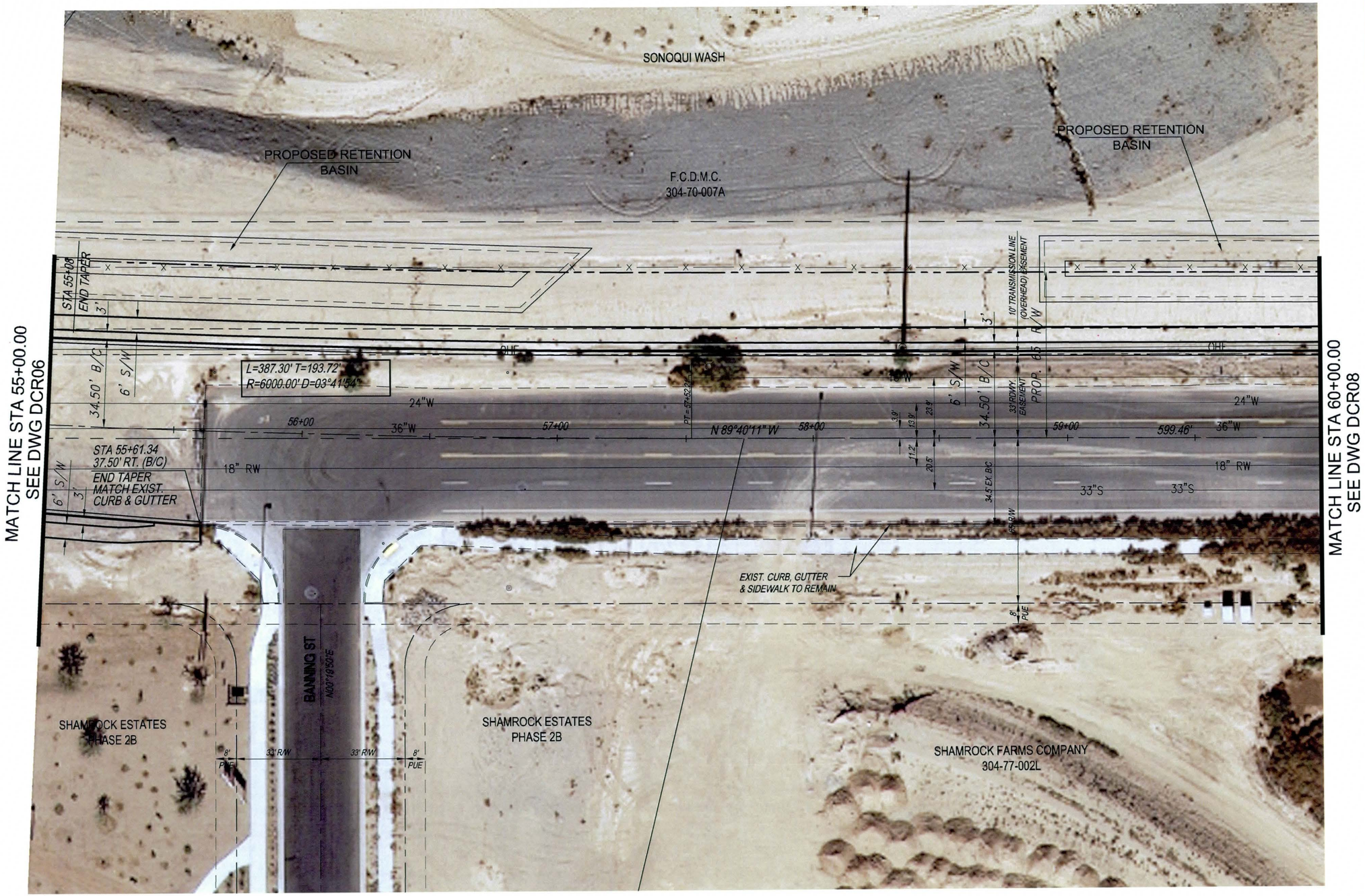
ALIGNMENT STUDY REPORT
GREENFIELD ROAD TO HIGLEY ROAD
GILBERT, ARIZONA

Title
ROADWAY PROFILE

Project No.	Scale	
181300001	1"=40' HOR	1"=4' VERT
Drawing No.	**Sheet**	**Revision**
DCR06-pro	12 of 16	0



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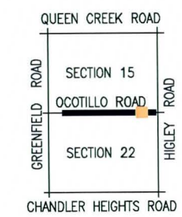
SCALE: 1"=40'



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GILBERT, ARIZONA

Title
ROADWAY PLAN

Project No.	Scale	
181300001	AS SHOWN	
Drawing No.	**Sheet**	**Revision**
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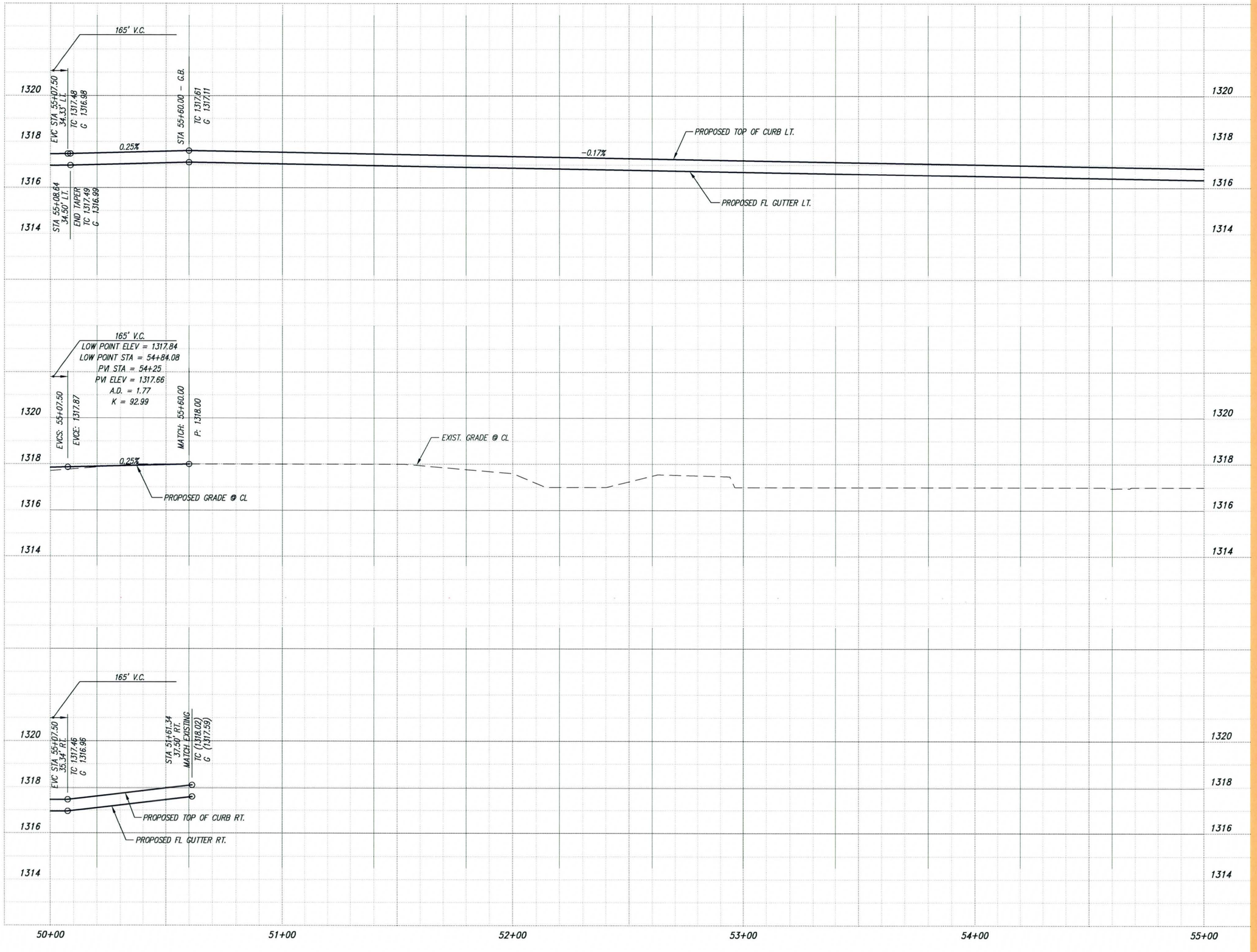

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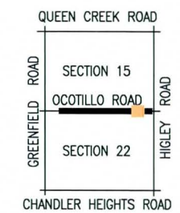
SCALE: 1"=40'

2 1 0 2 4
SCALE: 1"=4'



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GREENFIELD ROAD TO HIGLEY ROAD
GILBERT, ARIZONA

Title
ROADWAY PROFILE

Project No.	Scale
181300001	1"=40' HOR 1"=4' VERT

Drawing No.	Sheet	Revision
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SEE DWG DCR07

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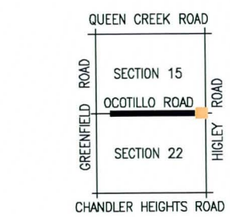
SCALE: 1"=40'



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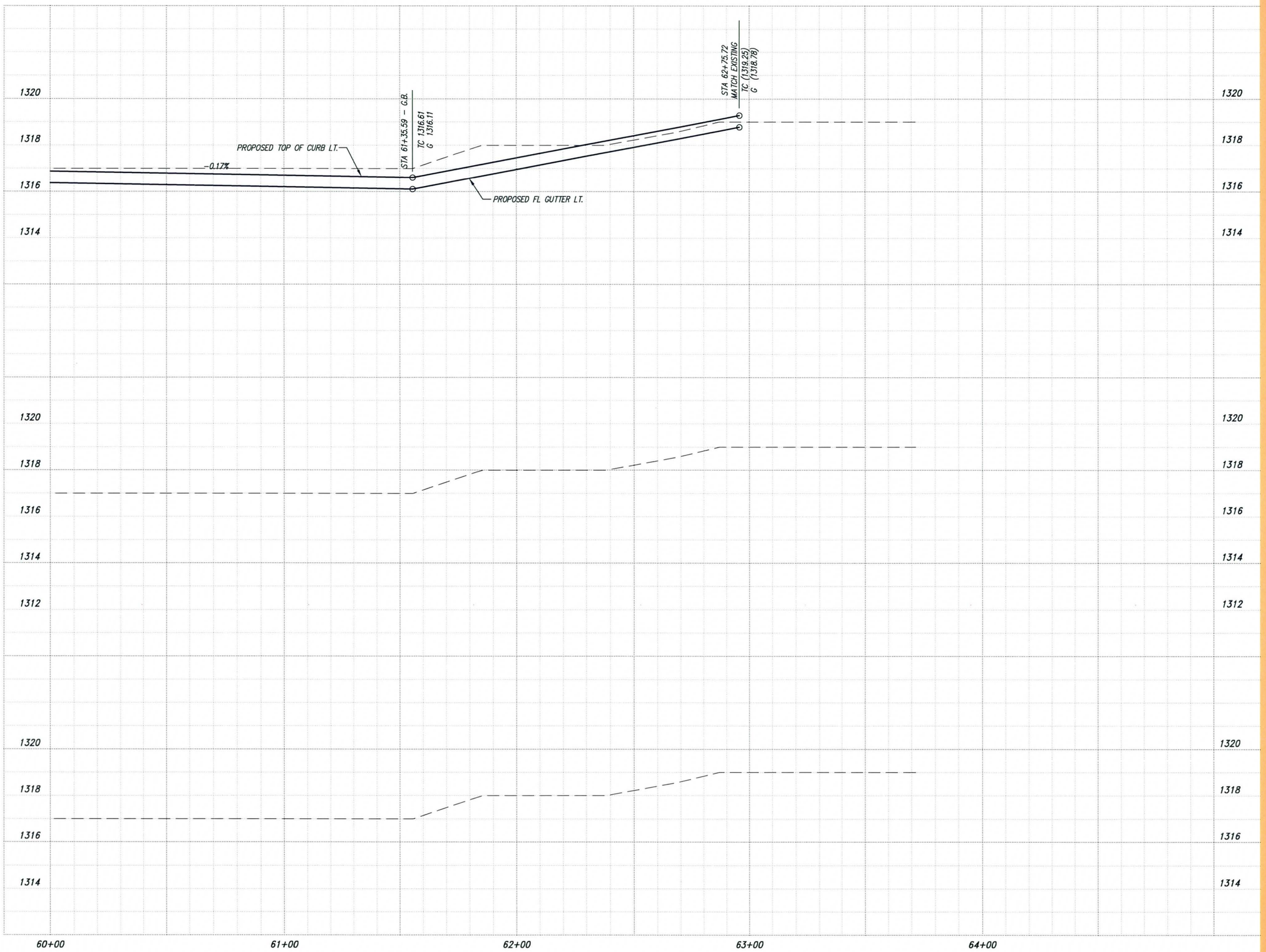
Title
ROADWAY PLAN

Project No.	Scale	
181300001	AS SHOWN	
Drawing No.	**Sheet**	**Revision**
DCR08-plan	15 of 16	0



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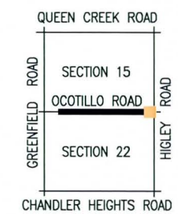
2 1 0 2 4
SCALE: 1"=4'



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GILBERT, ARIZONA

Title
ROADWAY PROFILE

Project No.	Scale	
181300001	1"=40' HOR	1"=4' VERT

Drawing No.	Sheet	Revision
DCR08-pro	16 of 16	0