Project Number 139105

Rio de Flag Flood Control Design Concept Project

City of Flagstaff

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Submitted by

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EXECUTIVE SUMMARY

The City of Flagstaff contracted Michael Baker Jr., Inc. (Baker) to provide engineering services for the Rio de Flag Flood Control Design Concept Project. Baker teamed with Shephard Wesnitzer Inc. (SWI) to provide utility and surface improvement analyses, design, and recommendations; and for their strong local knowledge and history with the project. Baker also teamed with Hunter Contracting (Hunter) to provide constructability reviews, cost estimated, and value engineering services. The Baker/SWI/Hunter team worked closely with city staff to develop project alternatives that align closely with city goals, and that are feasible, economical, and constructible.

The Rio de Flag Flood Control project is located in the northwest quadrant of the City of Flagstaff, Arizona and consists of two primary conveyance alignments, the Rio de Flag and Clay Avenue Wash. The Rio de Flag alignment generally follows the existing Rio de Flag alignment from Beale Road to Route 66. Once south of Route 66, the Rio de Flag is re-aligned south of and generally parallel with the BNSF railroad until its terminus at Butler Road at which point it rejoins the existing Rio de Flag alignment. Project components also extend to Lone Tree Road along the existing Rio de Flag alignment. The Clay Avenue Wash alignment starts north of W. Chateau Drive, continues south of and generally parallel to W. Clay Avenue to the intersection of W. Clay Avenue and Milton Road (Five Points). From Five Points the Clay Avenue Wash reach continues down Mike's Pike to a confluence with the Rio de Flag alignment. It is the City's goal to develop a flood control project design concept project that will contain the existing Rio de Flag floodplain for the 100-year event, within proposed flood control structures.

Recently the City of Flagstaff has partnered with the U.S. Army Corps of Engineers (USACE) to facilitate the stated goal. Due to continued funding issues at the Federal Level, the City is exploring the option of delivering this project without the assistance of the USACE. A project alignment and design have been developed to 90% level of completion by the USACE using USACE hydrology and hydraulic modeling (not available). In addition, the City has developed 90% plans for the replacement of City owned utilities and surface replacements relative to the USACE flood control plans.

In an effort to explore the City's options for completing the Rio de Flag Flood Control project without federal funding support, the City contracted Michael Baker Jr., Inc. to develop a Design Concept Report (DCR). The scope of the DCR is to use Federal Emergency Management Agency (FEMA) criteria, with the USACE Rio de Flag and Clay Avenue Wash alignments to develop up to four separate project alternative recommendations. A preferred alternative was then selected based on several criteria including cost, ease of construction, level of protection, and minimizing disruptions to existing infrastructure. The DCR also includes an outline of the requirements for the City of Flagstaff to ultimately contain the Rio de Flag floodplain and obtain CLOMR prior to, and LOMR upon completion of construction for the preferred alternative.

Alternative 4 was selected as the preferred alternative. Alternative 4 follows the USACE alignment from the upstream project extents along the Rio de Flag to Route 66, and then follows the current Rio de Flag channel alignment through Route 66 and the BNSF railroad before returning the USACE alignment adjacent to the railroad. For Clay Avenue Wash, Alternative 4 follows the USACE alignment for the entire reach, but reduces structure sizes considerably. The overall cost of the USACE project has escalated to $107M. The approximate cost of Alternative 4 is $63M.

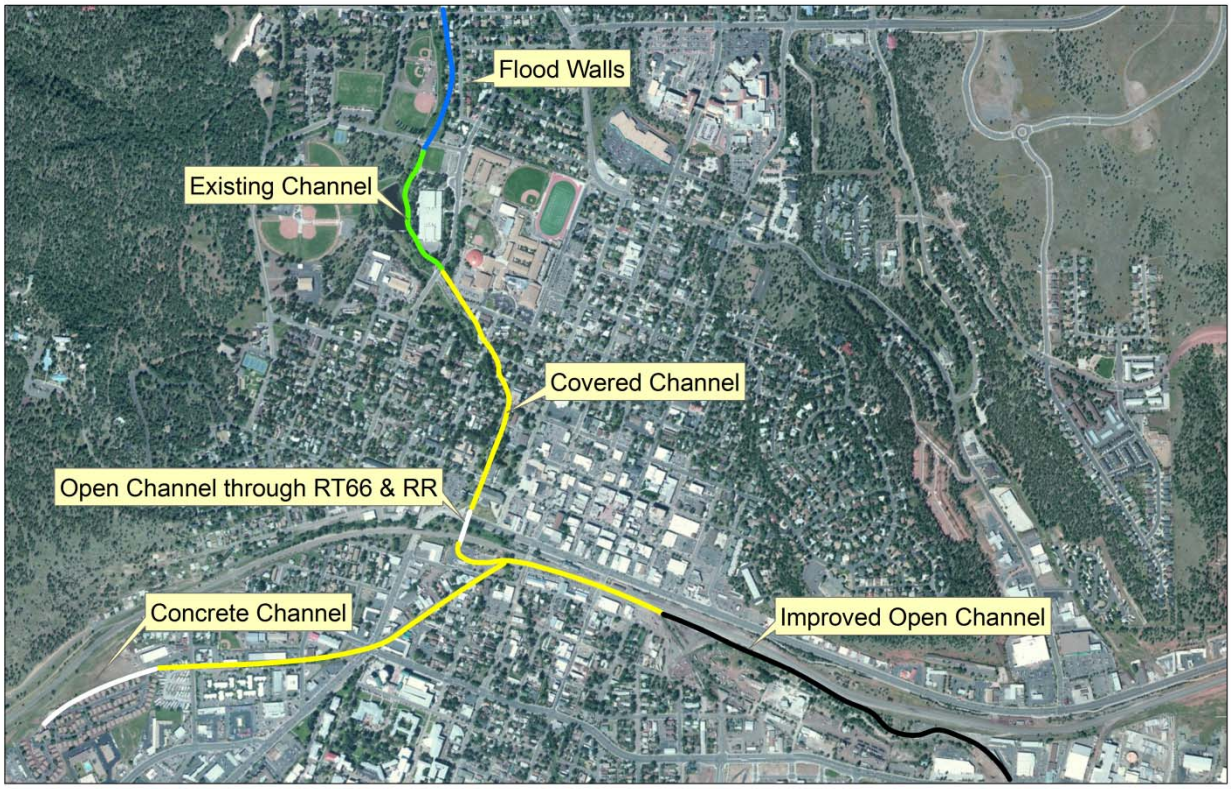
SECTION 1. PROJECT BACKGROUND

The U.S. Army Corps of Engineers (USACE) began studying flooding problems in the City of Flagstaff in 1996. In September 2000, USACE published the Rio de Flag Flagstaff, Arizona Feasibility Report and Final Environmental Impact Statement documenting the history and nature of the flooding problems, the portions of the City impacted, preliminary existing and future conditions hydrology, and acceptable solutions to mitigate flooding. The solutions were ranked to identify a preferred solution, and included preliminary hydraulic calculations.

Since publication of the feasibility report in 2000, USACE has refined their analyses, and produced a number of design document reports for both hydrology and hydraulics specific to the Rio de Flag and Clay Avenue Wash. In addition, USACE has refined the preferred solution since 2000, in large part based on the results of the design document reports. In April 2009, 90% improvement plans were completed by USACE, and since that time several project elements have been built. Built elements have been City sponsored, and include the Clay Avenue detention basin, the Thorpe Road Bridge, and the Butler Avenue culvert.

While these project components are a step in the right direction, they represent a very small portion of the overall required improvements to mitigate flooding in downtown Flagstaff. Project costs have soared since the original estimates published in the feasibility report, now estimated to be approximately $107M. In addition, USACE has no definable path forward to complete construction because a lack of funding appropriations from Congress. Based on these considerations, the City of Flagstaff decided to investigate the feasibility of building a flood control project for the Rio de Flag and Clay Avenue Wash that mimics the USACE footprint, but utilizes FEMA current regulatory peak flows. The City project would also utilize industry standard details and specifications for structures and construction instead of USACE specifications. The intent of this project is to identify the overall cost and construction approach for a City administered and built flood control project for the Rio de Flag and Clay Avenue Wash through downtown Flagstaff at a feasibility level. It should be noted that the above described details and timeline of USACE publication and analyses is not conclusive, and only represents the data that has been made available to the City. The following figure shows a general schematic of the USACE project and the general area.

Figure 1 - USACE Project Schematic



SECTION 2. DESIGN CRITERIA AND ASSUMPTIONS

For the Rio de Flag Flood Control Design Project, the design criteria was centered around the use of FEMA's regulatory flow rates for the Rio de Flag and Clay Avenue Wash, instead of the 100-year peak flows developed by USACE. The following table shows a comparison of FEMA vs. USACE flows at various locations along each reach upstream to downstream.

Table 1 - FEMA vs. USACE 100-Year Flow (Rio de Flag)

Location	FEMA Design Discharge(cfs) - Rio de Flag	USACE Design Discharge(cfs) - Rio de Flag
Rio de Flag above Crescent Drive	1300	
Rio de Flag at Meade Lane		2100
Rio de Flag above Clay Avenue Wash	1450	2100
Rio de Flag below Clay Avenue Wash		2700
Rio de Flag at Butler		2700

Table 2 - FEMA vs. USACE 100-Year Flow (Clay Avenue Wash)

Location	FEMA Design Discharge(cfs) - Clay Avenue Wash	USACE Design Discharge(cfs) - Clay Avenue Wash
Clay Avenue Wash at inlet		1400
Clay Avenue Wash above Rio de Flag		1400
Clay Avenue Wash at confluence with Rio de Flag	450	

FEMA flows are significantly lower along both the Rio de Flag and Clay Avenue Wash. The main reason is that FEMA flows represent existing conditions, while USACE flows were for 50-year build out condition starting in 2003. For the Rio de Flag, 1450 cfs was used the entire project reach, since the flow change location at Crescent Drive is significantly upstream of the project boundary. For Clay Avenue Wash, 450 cfs was used as the design flow for the project.

For this project, several assumptions were made for hydraulic design. The first was that for underground pipes, no freeboard is required. Pipes are designed for full flow, and in many case, with energy grade lines (EGL) above the top of pipe but below the ground surface. The USACE project incorporated a significant freeboard requirement. Also, for the upper reach of Clay Avenue Wash, flow is supercritical in the steeper portions. Pipes in these segments were design with the EGL above the ground surface.

Other design criteria include the use of standard ADOT or ConArch structures for hydraulic design and cost estimating purposes.

SECTION 3. GENERAL DESCRIPTION OF EACH OF THE ALTERNATIVES CONSIDERED

3.1 ALTERNATIVE 1

Alternative 1 utilized the USACE preferred alternative alignment and structure configuration (open vs. underground), but investigated structure size reductions resulting from the use of the lower FEMA 100-year flow amounts. Using the lower FEMA flows also facilitated the elimination of floodwalls along the Rio de Flag north of Beal Road. A comparison between project structures and USACE structures is provided in the following table. The total project cost for Alternative 1 is approximately $67M.

Table 3 – Alternative 1 Structure Comparison

Station (USACE 90% Plans)	USACE Structure	Project Structure
	Rio de Flag	
Upstream Project Boundary	2-10' x 7' RCBC at Beal Road	2-10' x 7' RCBC at Beal Road
236+51.17 to 215+00 (USACE Floodwall Plans, Beale Rd to Thorpe Rd)	Existing channel with floodwalls	Existing channel, no floodwalls
86+17 to 69+85	28' x 7' Concrete Arch	20'x 7' ConArch
69+85 to 62+60	28' x 8' Concrete Arch	20'x 7' ConArch
62+60 to 61+65	28' x 10' Concrete Arch	20'x 7' ConArch
61+65 to 60+30	15' x 28' Rectangular Concrete Channel	20'x 7' ConArch
60+30 to 59+45	16' x 28' Rectangular Concrete Channel	4-7' dia. Steel Pipes
59+45 to 58+95	28' x 9' Concrete Arch	20'x 7' ConArch
58+95 to 57+65	28' x 8' Concrete Arch	20'x 7' ConArch
57+65 to 54+65	28' x 7' Concrete Arch	20'x 7' ConArch
54+65 to 53+15	28' x 10' Concrete Arch	20'x 7' ConArch
53+15 to 51+80	28' x 12' Concrete Arch	20'x 7' ConArch
51+80 to 48+90	28' x 13' Concrete Arch	20'x 7' ConArch
48+90 to 48+30	28' x 12' Concrete Arch	20'x 7' ConArch
48+30 to 44+65	28' x 11' Concrete Arch	20'x 7' ConArch
44+65 to 42+65	28' x 12' Concrete Arch	20'x 7' ConArch
42+65 to 39+65	28' x 14' Concrete Arch	20'x 7' ConArch
39+65 to 36+65	28' x 15' Concrete Arch	20'x 7' ConArch
36+65 to 32+00	28' x 16' Concrete Arch	20'x 7' ConArch
32+00 to 6+85	Open Channel with 10' Bottom, 2:1 Side Slopes	Open Channel with 10' Bottom, 2:1 Side Slopes transitioning to existing channel
	Clay Avenue Wash	
49+06 to 48+55	Concrete Inlet Structure	Concrete Inlet Structure
48+55 to 42+00	12' Bottom Width Rectangular Concrete Channel (Height Varies)	5' Bottom Width Rectangular Concrete Channel (Height Varies)
42+00 to 36+95	10' Bottom Width Rectangular Concrete Channel (Height Varies)	5' Bottom Width Rectangular Concrete Channel (Height Varies)

Station (USACE 90% Plans)	USACE Structure	Project Structure
36+95 to 33+65	16' x 6' Concrete Arch	8.5'x 8' ConArch
33+65 to 31+00	24' x 6' Concrete Arch	8.5'x 8' ConArch
31+00 to 27+90	24' x 9' Concrete Arch	8.5'x 8' ConArch
27+90 to 22+50	24' x 8' Concrete Arch	8.5'x 8' ConArch
22+50 to 17+70	24' x 9' Concrete Arch	8.5'x 8' ConArch
17+70 to 15+30	24' x 9' Concrete Arch	2-7' dia. Steel Pipes
15+30 to 6+00	24' x 9' Concrete Arch	8.5'x 8' ConArch
6+00 to 0+17	24' x 10' Concrete Arch	8.5'x 8' ConArch

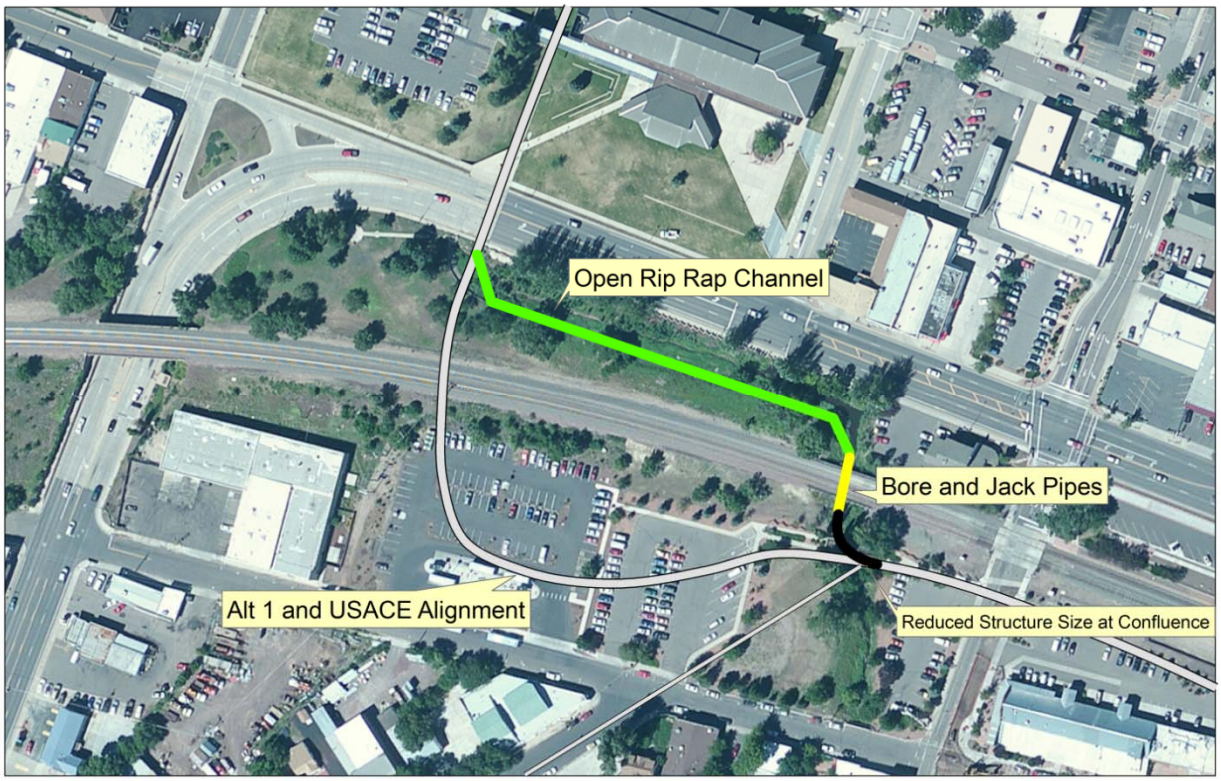
All alternatives include a composite channel for the upper reach of the Rio de Flag. The composite channel would put flood flows underground, while maintaining low flows in a 'natural' open channel. It is anticipated that a low flow split would be designed just downstream of Francis Short Pond so that all low flow events remain as surface flow to maintain the character of the Rio de Flag through the upper reach. Large flows would be routed underground to mitigate the flood hazard to residents.

Some notable deviations from the USACE design in addition to structure size reductions include the use of steel pipes under the BNSF railroad and the Milton Road/Butler Avenue intersection. For Alternative 1, construction costs included jack and boring the pipes under the roadway and railroad to minimize traffic and train disruptions. Alternative 1 also utilizes as much of the existing channel along the lower reach of the Rio de Flag as feasible. The covered channel section outlets several feet below the existing ground surface, so channel improvements and grading are necessary just to the point where the improved channel can daylight with the existing channel bottom at a minimum channel slope.

3.2 ALTERNATIVE 2

Alternative 2 investigated utilizing the existing Rio de Flag alignment from upstream of Route 66 to downstream of the BNSF railroad trestle bridge. The buried 2-10' x 7' RCBC upstream of Route 66 would transition to an open rectangular channel on the downstream side of Route 66, and to the railroad, 4-84" steel pipes under the railroad (jack and bore), and back to an underground channel downstream. This would require a new road construction for Route 66, and penetrating under the existing railroad trestle. The remaining portion of Alternative 2 is the same as Alternative 1. The total project cost of Alternative 2 is approximately $65M. The following figure shows the Alternative 2 alignment through Route 66 and the BNSF railroad.

Figure 2 - Alternative 2 Alignment



3.3 ALTERNATIVE 3

The initial intent of Alternative 3 was to investigate routing Clay Avenue Wash down Butler Avenue and out letting into the existing Rio de Flag channel at San Francisco Street. This would disconnect Clay Avenue Wash flows from the Rio de Flag improvements along the BNSF railroad alignment. This configuration would also allow the project to utilize an existing 10' x 3' RCBC in Butler Avenue. According to the design report, the existing culvert has a capacity of 210 cfs. The results of the hydraulic modeling showed that an additional 12' x 3' RCBC would be required parallel to the existing culvert to convey the entire portion of the Clay Avenue 100-year flow to the Rio de Flag channel at San Francisco Street. Significant problems were identified for this alternative when analyzing the channel and structure capacities downstream of San Francisco Street. Channel capacity would need to be increased, and most structures at road crossings replaced. There also appears to be significant utility conflicts on the south side of Butler Road along the most likely culvert alignment.

Because of these identified constraints, Alternative 3 was modified to split the flows at the Milton/Butler intersection, and route the additional required capacity along Mike's Pike to the Rio de Flag. This configuration allows the use of the existing 10' x 3' RCBC along Butler without significant channel improvements downstream. It also takes advantage of less utility conflicts along Mike's Pike. Channel improvements downstream of San Francisco Street appear, based on limited topographic data and field reconnaissance, to be limited to maintenance type activities to clear significant accumulated sediment, debris, and vegetation. This activity has been included in the preliminary cost estimate for

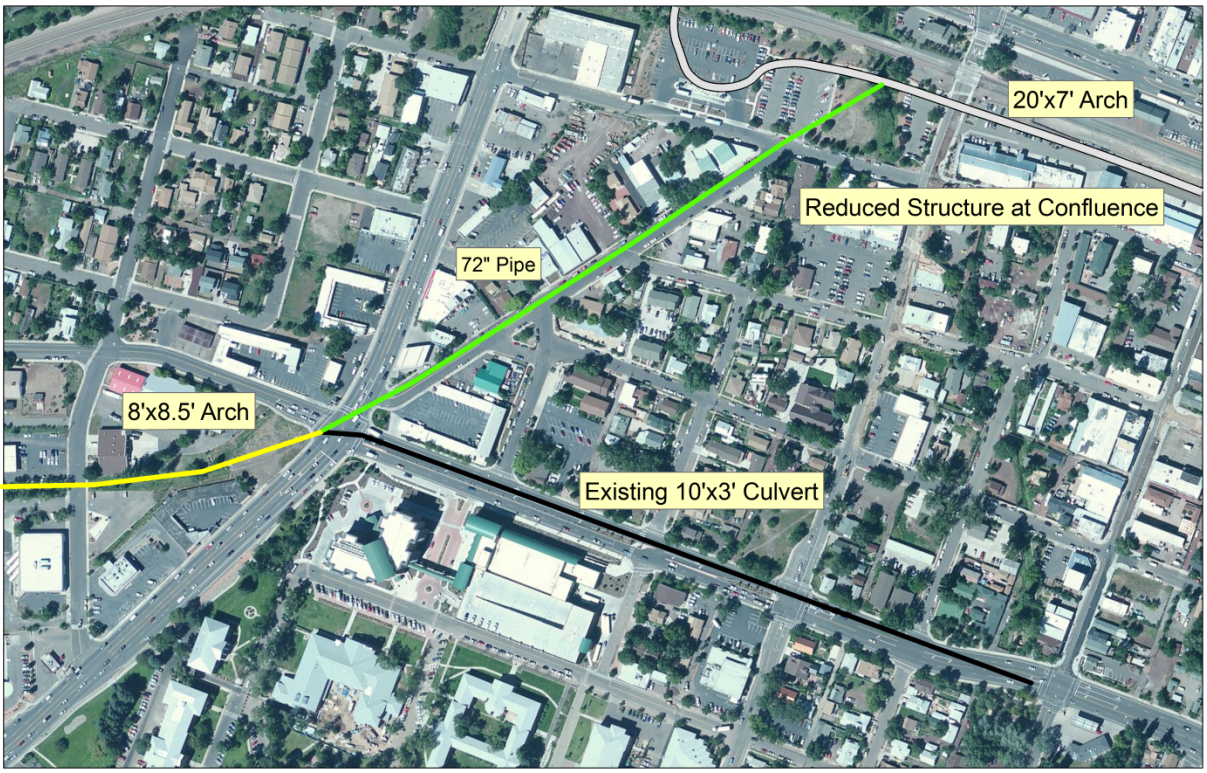
Alternative 3. The following table shows the structure size changes between Alternative 3 and Alternative 1. These changes are limited to the portion of the project from just upstream of the Five Points intersection (Milton/Butler), to the confluence with the Rio de Flag at Beaver Street. The total project cost of Alternative 2 is approximately $64M.

Table 4 – Alternative 3 Structure Comparison

Station (USACE 90% Plans)	USACE Structure	Project Structure
Clay Avenue Wash		
17+70 to 0+17	24' x 9' Concrete Arch	6' dia. RCP

The following figure shows the Alternative 3 schematic for Clay Avenue Wash.

Figure 3 - Alternative 3 Schematic



3.4 ALTERNATIVE 4

Alternative 4 was developed after the first three alternatives, and combines elements from each. Alternative 4 was an outgrowth of value engineering the first three alternatives and the incorporation of City goals for the project. Alternative 4 combines Alternative 2 for the Rio de Flag, and the use of circular pipes exclusively for Clay Avenue Wash. In addition, Alternative 4 refined some of the common design elements from the other alternatives based on the value engineering exercise. Because of the refinements, and the genesis of this alternative, Alternative 4 was selected as the preferred alternative, and is defined more thoroughly in the next section. The total project cost of Alternative 4 is approximately $63M.

3.5 THORPE PARK DETENTION

As part of the USACE feasibility analyses, detention in the Thorpe Park area was investigated to mitigate flooding from the Rio de Flag upstream of downtown Flagstaff. For this project, detention in the same area was investigate at a very preliminary level to determine the feasibility as a viable alternation specific to the lower FEMA flows. For the detention analyses, a flood volume is required. To estimate volume, the USACE developed hydrograph from their HEC-1 100-year existing conditions model was scaled to the lower FEMA 100-year peak flow. This was necessary because the FEMA data is limited to peak flow. The scaled hydrograph provides a reasonable approximation of the flood response for the contribution watershed at Thorpe Road. The USACE model had a peak of 1913 cfs at Thorpe. The DCR model was scaled to 1450 cfs to match the FEMA regulatory flow rate. The 1450 cfs hydrograph had an approximate volume of 872 acre-feet. It was estimated that a basin between Beal Road and Thorpe Road could be reasonable constructed to provide 53 acre-feet while still maintaining the current park configuration. Routing the hydrograph though this basin reduced the peak flow downstream by approximately 112 cfs.

There is potential additional storage area downstream of Thorpe Road adjacent to and including Francis Short Pond. Preliminary investigation of this area indicates that extensive grading, high floodwalls, and a berm 10-12' in height on the downstream side of the pond would likely be required to achieve any significant storage. The basin footprint would also likely eliminate the current ball field configuration. These improvements would likely reduce the peak flow a maximum of another 300 cfs, routing approximately 1000 cfs downstream. The existing Rio de Flag channel capacity is 250-275 cfs, thus still requiring closed conduit or open channel improvement along most of the project reach downstream of the detention basin. For these reasons, no further investigation of this alternative was conducted.

SECTION 4. GENERAL DESIGN APPROACH AND RESULTS FOR THE PREFERRED ALIGNMENT

Section 4 describes the general design approach for all alternatives, and specific detail for the preferred alternative. As described above, Alternative 4 was selected as the preferred alternative, but Alternative 4 was really formulated as the preferred alternative by selecting the most desirable features from each of the first three alternatives.

4.1 HYDROLOGY

As discussed in Section 2, the FEMA regulatory flows for Rio de Flag and Clay Avenue Wash were used for the hydraulic design. These flows are significantly lower than the flows used for the USACE design. In the absence of detailed hydrology through downtown Flagstaff, the flow amount at the confluence with Clay Avenue Wash was used for the Rio de Flag design. This flow amount is 1450 cfs. The next flow change location according to the Flood Insurance Study is significantly upstream of the project boundary. For Clay Avenue Wash, the FEMA 100-year peak flow amount of 450 cfs was used for design. Both peak flow amounts were used for every alternative.

4.2 HYDRAULICS

For the hydraulic analyses, HEC-RAS 4.1.0 was used to perform the hydraulic calculations. The design approach was to use the full capacity of closed conduit pipes wherever feasible while maintaining an EGL below the existing ground surface. For the upper most reach of Clay Avenue Wash, this was not feasible due to flows running supercritical in the 7' reinforced concrete pipe. For this reach, the EGL is significantly above the existing ground surface, but pushing the pipe deeper would result in adverse conditions extending all the way to the project outfall on the Rio de Flag. This is the only reach where the EGL extends above the ground surface.

For freeboard in open channel sections, the City of Flagstaff criteria as listed in the drainage criteria manual was verified as part of the design. The channel alignment for the Rio de Flag does include some significant bends, particularly downstream of Route 66 and upstream of the BNSF railroad. These were modeled by increasing the expansion and contraction coefficients of the corresponding cross sections to account for the associated losses. These bends would need specific attention to ensure a sound design during final design, but this level of analyses was deemed appropriate for the DCR.

4.3 CONVEYANCE STRUCTURES

The design approach was to use either standard ADOT box culvert sizes, or standard concrete circular pipe sizes for the analyses of the closed conduit sections of the project. For Alternative 4, the open channel section between Route 66 and the BNSF railroad was designed as a rip rap lined, 20' bottom, 2:1 side slopes trapezoidal channel. There is flexibility in this design, as rip rap represents the highest Manning's n-value of feasible channel linings (assumed 0.04), so thus the highest water surface elevations. The open channel section of the Rio de Flag Lower Reach was designed as a turf lined, 10' bottom, 3:1 side slopes trapezoidal channel. Here there is also design flexibility as the channel is

significantly below the natural grade at the closed conduit outlet, thus there is significant additional capacity as the channel transitions to the existing channel downstream.

For costing purposes, equivalent size ConArch structures were used in the development of the plans and cost analyses. These structures were not specifically modeled, but vendor generated equivalent size charts were used to determine the required structure size. These structures would require hydraulic modeling as part of a final design. It was also assumed that the confluence of the Rio de Flag and Clay Avenue Wash could be built as a simple pipe/box culvert junction (7'/10'x7'), eliminating the elaborate junction structure designed by USACE.

Other cost saving design features of Alternative 4 include converting the large concrete inlet structure for Clay Avenue Wash to graded rip rap protected channel banks, and a standard wing wall/headwall inlet structure. Alternative 4 also incorporates steel pipes that would be jack and bored under the Milton Road/Butler Avenue intersection, and under the BNSF railroad. This approach minimizes traffic impacts at the five point's intersection, and railroad disruptions for BNSF. At five points, the jack and bore pipe is a single 7' diameter round steel pipe transitioning back to concrete downstream and along Mike's Pike. For the railroad jack and bore, four 7' diameters round steel pipes are required, and the transition is back to a 10'x7' concrete box culvert.

4.4 ASSOCIATED UTILITY IMPROVEMENTS

Several existing utilities are impacted by this project. Franchise utilities are required to relocate their utilities prior to construction of this project. Existing water, reclaimed water, and sewer lines were analyzed to determine which utilities will need to be relocated and which utilities could potentially remain in place. All utility relocations will occur prior to the construction of the culvert structures.

There were several conflicts with existing sanitary sewer that required complete relocations. Since sewer lines rely on gravity to convey sewage, the conflicts were more challenging than that of a water line. Every effort was made to adjust the culvert invert elevations to allow for existing sewer lines to cross under or over the culverts, or even utilize encasing allowing the sewer to penetrate the culverts. In addition to adjusting the box culvert invert elevations, several hundred feet upstream of every conflict was analyzed to determine if the depth of the sewer line can be adjusted in order to cross the box culverts. In most cases the sewer lines were relocated and re-routed. Minimum depths and slopes per City code were maintained for all sewer relocations.

The relocations of existing domestic and reclaimed water lines were not as extensive as the sewer line relocations. Domestic and reclaimed water lines do not rely on gravity flow and are pressurized, making vertical realignments possible without re-routing similar to the sewer lines. Minimum water line depths per City code were maintained for all water relocations.

Rio De Flag Channel

The utility analysis for the Rio De Flag channel started just upstream of Bonito Street where the existing open channel transitions into the proposed box culvert structures, and continued downstream almost all the way to Butler Avenue.

<u>Sewer</u>

There were several sewer conflicts throughout the RDF channel. In most cases the invert elevations of the box culverts could not be adjusted enough to allow existing sewer lines to cross under or over the culverts, resulting in significant amounts of sewer relocation work. Starting at Bonito Street, an existing 8" line will be rerouted and will follow the north/east sides of the box culverts all the way to and across Route 66. The box culverts transition into an existing open channel south of the Route 66. An existing 18" sewer line will be relocated in this area to allow for the channel to be upsized. The sewer will cross the Rio de Flag/Clay Avenue Wash confluence structure and connect to an existing manhole at the intersection of Beaver Street and Phoenix Avenue. The relocated sewer will still be able to collect sewer service lines for structures, as well as additional sewer mains that were originally routed in this area.

The box culverts create additional conflicts at both Birch Avenue and Aspen Avenue, and in both cases, the existing sewer lines were unable to cross the culverts. The lines were re-routed to the south, across Route 66 and the train tracks, and into Phoenix Avenue. The sewer line flows east along Phoenix Avenue, across the top of the Clay Avenue Wash culvert, and connects to an existing manhole at the intersection of Beaver Street and Phoenix Avenue.

Water/Reclaimed Water

The intersections of Bonito Street and Elm Avenue, Sitgreaves Street and Dale Avenue, Kendrick Street and Cherry Avenue, and Birch Avenue and Kendrick Street all had conflicts with existing water lines. In each case the water lines were vertically realigned and are able to cross under the box culverts.

Similar to the domestic water lines, the reclaimed water conflicts were vertically aligned and are able to cross under the box culverts. There will be reclaimed water relocations just north of Route 66, as well as in areas between Route 66 and the Rio de Flag/Clay Avenue Wash confluence structure.

Clay Avenue Wash

The analysis for the Clay Avenue Wash channel started on the northwest corner of the Millpond Village Apartments, approximately 1,300 feet upstream of Kaibab Lane. The Clay Avenue Wash reach continues through Blackbird Roost and Malpais Lane, crosses the intersection of Milton Road/Butler Avenue/Clay Avenue/Mike's Pike (five points), and continues along Mike's Pike until it reaches the Rio de Flag/Clay Avenue Wash confluence on the west side of Beaver Street.

Sewer

Similar to the Rio de Flag channel, there were several sewer conflicts throughout the Clay Avenue Wash channel. There was more opportunity to adjust the invert elevations of the existing sewer lines to allow them to cross under the culvert between Kaibab Lane and the upper end of Clay Avenue Wash. There was however significant sewer relocations from Blackbird Roost all the way down to Milton Road. The invert elevations of the Clay Avenue Wash culvert could not be adjusted enough to provide utility crossings, so there are areas where parallel sewer lines follow the culvert alignment on both sides.

The culvert will be jack and bored under the five points intersection. A junction structure on the northeast corner of the intersection will allow the culvert to transition from a steel pipe to a reinforced concrete pipe (RCP). The junction structure will be large enough to allow for a sewer to penetrate through the structure and still provide adequate hydraulics within the culvert.

There is an existing sewer line in south/southeast side of Mike's Pike that will remain in place during construction. The sewer line provides sewer service for the buildings on the north/northwest side of Mikes Pike. A new sewer line will be constructed to provide sewer service for the existing buildings, and will flow to a manhole near the five points intersection, cross the junction structure, and connect to an existing manhole on Butler Avenue.

Water/Reclaimed Water

There are water conflicts in Kaibab Lane, Blackbird Roost, McCracken Street, Malpais Lane, the five points intersection, and at the intersection of Mikes Pike and Phoenix Avenue. The existing water lines were vertically realigned and are able to cross under or over the culvert. There were no reclaimed water relocations for the Clay Avenue Wash channel.

4.5 ASSOCIATED SURFACE IMPROVEMENTS

Surface improvements include paving, grading, surface restorations, and storm drain and inlets. Most of the surface improvements associated with the project will be at existing intersections where asphalt, curb and gutter, and sidewalk will be replaced. There will be several locations where existing storm drain and inlets will need to be relocated and rerouted. The storm drains will connect to the culvert structures.

It is assumed that the City will take advantage of the construction within Mike's Pike and Phoenix Avenue to incorporate a beautification project. The project will include reducing the width of both roads, adding new curb and gutter, sidewalk, landscaping, and relocating the overhead electric or placing it underground.

4.6 ASSOCIATED ENVIRONMENTAL IMPLICATIONS

For the design concept study, it was assumed the environmental impacts would be similar to those identified by USACE for the feasibility report. For the cost analyses, two areas potential requiring hydrocarbon removal were included. These were the Milton Road/Butler Avenue intersection, and the Paramount Petroleum area along the Rio de Flag lower reach. It was assumed for this study that these areas would require mitigation per Arizona Department of Environments Quality requirements.

Other environmental considerations include the removal/relocation of tree along the Rio de Flag upper reach. These costs were included in the Alternative 4 estimate. It is also likely that a final design project would require an individual Section 404 permit with USACE, but further investigation of this requirement was beyond the scope of this project.

4.7 ASSOCIATED GEOTECHNICAL IMPLICATIONS

Geotechnical implications for costing and design of the preferred alternative was based on the report prepared by USACE titled *Rio de Flag Mainstream Geotechnical Appendix to the "60% completion" DDR product, Rio de Flag Flood-control project, Flagstaff, AZ, Coconino County,* published in March, 2005. No new geotechnical investigations or analyses were completed for this project. Based on the above report,

the main geotechnical constraint for construction and cost is the presence of hard rock throughout the project area. These implications are accounted for in the cost estimates for each alternative.

4.8 ENGINEERING PRINCIPLES FOR FUTURE FULL SCALE DESIGN AND CONSTRUCTION

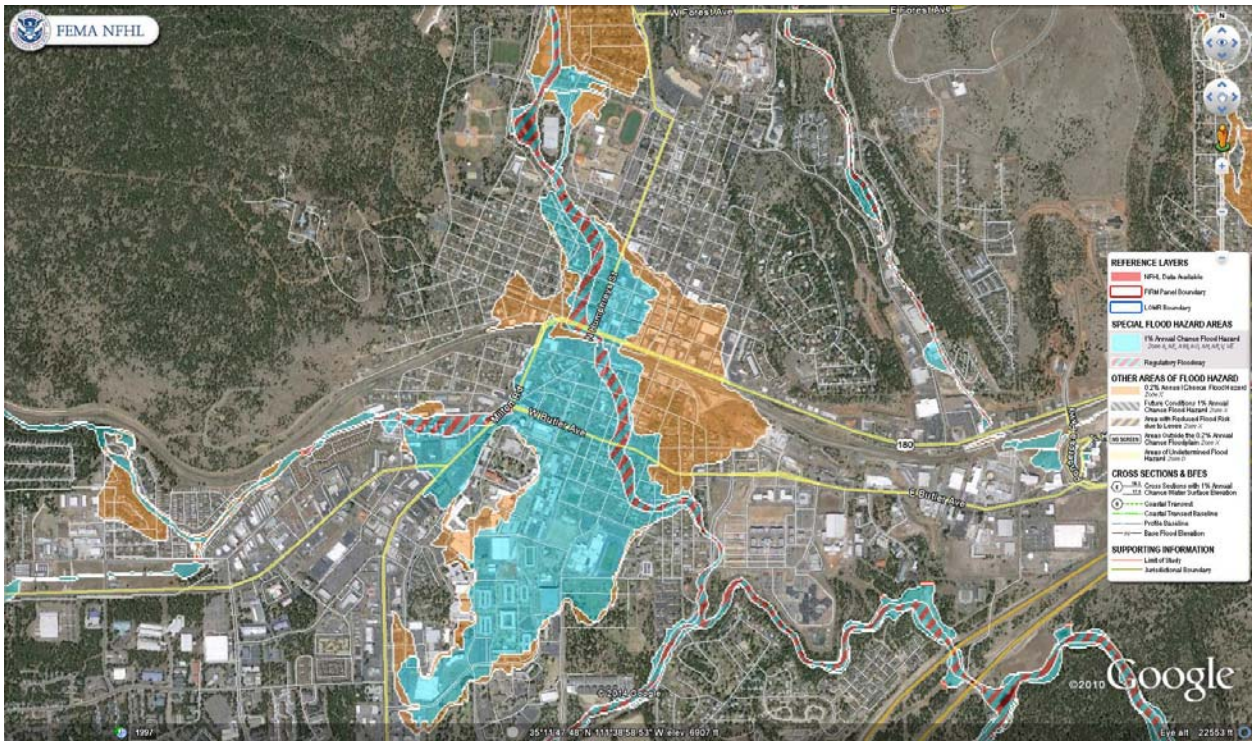
The principles assumed for the DCR can carry over to final design and construction if the project progresses as a City administered and funded project. Namely, those principles area:

- The use of FEMA regulatory flows as the basis of design
- Standard COF and/or ADOT details and specifications for construction
- Relaxed USACE freeboard requirements while still meeting FEMA guidelines
- Value engineering where possible

4.9 FEMA FOOTPRINTS

The existing FEMA Special Flood Hazard Area (SFHA) footprint is shown in the figure below.

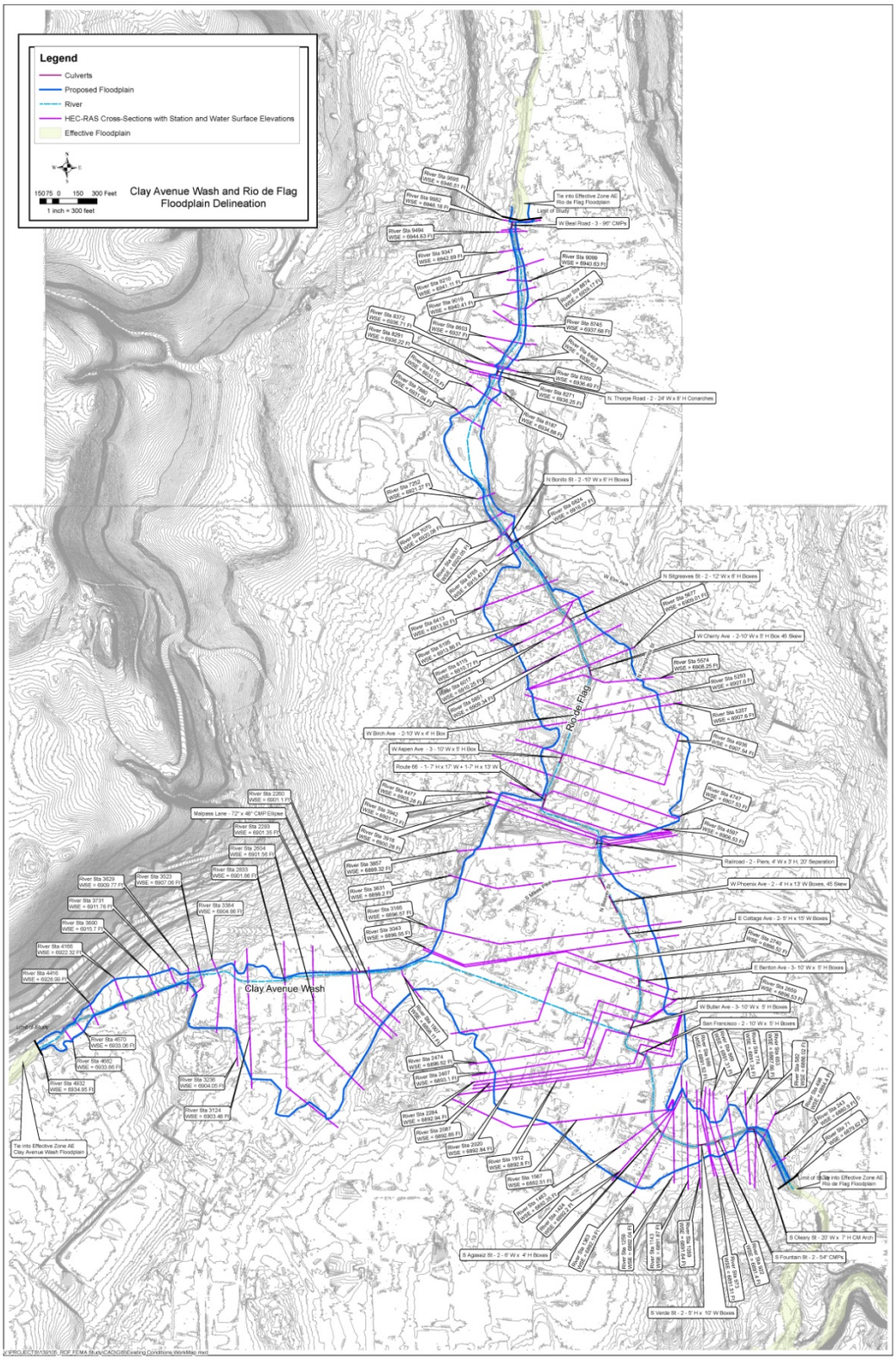
Figure 4 - Existing FEMA SFHA



Because the existing delineation is dated and supporting data is unavailable, existing conditions floodplain delineation was completed for this project. The existing conditions model and delineation would be required as the Pre Project model for a CLOMR and LOMR submittal. The floodplain

delineation completed for this project is shown in the figure below. Full size versions, along with the supporting HEC-RAS existing conditions model, are included in Appendices C and D.

Figure 5 - Existing Conditions Floodplain



The Rio de Flag flood control project, whether built by USACE or the City of Flagstaff would eliminate the FEMA SFHA from Beal Road to Lone Tree Drive on the Rio de Flag, and from approximately Chateau Drive to the confluence with the Rio de Flag on Clay Avenue Wash.

4.10 CLOMR REQUIREMENTS

All requirements for a CLOMR submittal have been completed for this project with the exception of the following items:

- FEMA MT-2 forms
- Brief project description specific to CLOMR application
- Proposed conditions workmap
- Annotated FIRM

Items completed that are required for CLOMR submittal include:

- Pre Project hydraulic model and workmap
- Proposed project hydraulic model
- 15% design plans

4.11 ESTIMATED CONSTRUCTION COSTS

The estimated construction costs for Alternative 4 are $63M. The following table summarizes the cost analyses. Appendix A includes a detailed cost breakdown and plan sheets for Alternative 4.

Table 5 – Summary of Estimated Cost Analyses for Alternative 4

	Description	Quantity	UoM	Unit Cost	Total Cost
	Prime Bond	1.00	LS	$	337,860
	Price % Add-On	1.00	LS	$	8,452,466
1	Generals	1.00	LS	$	3,398,675
2	Rio De Flag East Reach	1.00	LS	$	9,838,233
3	Rio De Flag North Reach	1.00	LS	$	7,667,335
4	Clay Avenue "West" Reach	1.00	LS	$	9,761,789
5	Trapazoid Channel	2,110.00	LF	$1,099.27	$ 2,319,457
6	Route 66 Bridge Replacement	1.00	LS	$	991,427
7	Storm Damage	1.00	LS	$	300,000
8	Electrical & Signals	1.00	LS	$	150,000
9	Design Completions 15%	1.00	LS	$	4,438,022
10	Construction Contingency 10%	1.00	LS	$	2,958,681
	TOTAL ESTIMATE CONSTRUCTION COST			$	50,613,946
	Real Estate Acquisition			$	7,142,000
	Remaining Design Fee Estimate			$	1,500,000
	Construction Administration (6%)			$	3,036,837
	Total Estimated Cost			$	62,292,782

4.12 VE CONSIDERATIONS

Alternative 4 was developed as a direct result of the value engineering effort. The consultant team, including the contractor, coordinated before the selection of the preferred alternative to refine the analyses and identify areas for further investigation. Subsequent to this coordination, the project team, including City staff, held a value engineering charette to further discuss ideas and areas of refinement. Alternative 4 is a direct result of these discussions, and represents a refinement of the components of the previous three alternatives (Alts 1-3) to best satisfy the project goals.

The value engineering efforts were a direct collaboration between the design consultants, contractor and City staff, and were a major focus of this project. The three main areas of value engineering that were focused on include structure type selection and construction techniques, property/structure impacts, and eliminating the inverted siphon at the five points intersection.

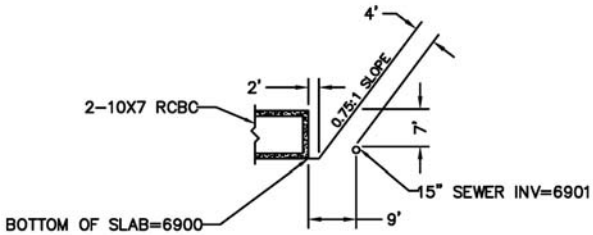
Structure Type and Construction

For every reach segment, analyses of the most economical structure type sized to convey the required flows were made. These analyses resulted in converting the Clay Avenue Wash structure exclusively to round pipes; concrete everywhere but the jack and bore segment under the five points intersection. Steel pipe is required for the jack and bore. For the Rio de Flag, a 20'x7' concrete arch structure was determined to be the most feasible for all of the underground segments except the jack and bore pipes under the BNSF railroad. Pipes in all segments were kept as shallow as feasible to avoid excess excavation, while still maintaining minimum channel slopes. In addition, existing open channel segments were utilized where ever feasible when they had sufficient capacity.

Property/Structure Impacts

When each of the four different culvert alternatives was analyzed, the main priority was determining how the existing utilities would be able to cross the new culverts. The relocated utilities generally followed the same horizontal alignment as the original USACE design, which was significantly wider than this design. This resulted in more impacts to adjacent properties and structures and ultimately required larger Temporary Construction Easements (TCE's). During the value engineering process the design team worked to shift the relocated utilities closer to the box culverts.

The design team coordinated with the contractor to establish a desired offset from the box culverts in order to minimize the amount of trench shoring during the construction of the box culvert construction. The excavation for the box culverts will include a two foot flat surface from the edge of the culvert, then a ¾:1 slope to the top of the trench. All sewer relocations were offset far enough so they would be located under the ¾:1 slope. The detail on the next page shows a typical cross section.



TYPICAL SEWER OFFSET
N.T.S.

Shifting the relocated utilities closer to the box culverts had very minimal impacts to the overall required surface improvements. Property and structure impacts were minimized, but both the Rio de Flag and Clay Avenue Wash structures still cross several intersections and parking lots. The overall surface improvements will look very similar to the original USACE design.

Inverted Siphon

The original USACE design included an inverted sanitary sewer siphon at the five points intersection. The siphon was designed to receive flows from an existing 10" sewer in Milton Road, a relocated 8" sewer line from Malpais Lane, and another relocated 8" sewer from Mike's Pike. The siphon would allow the sewer to flow under the culverts and back up to a manhole on the other side of the culverts. The initial construction costs for the siphon were not significant, but the City was concerned about maintenance costs and the potentially short lifespan of the structure. Several different options of eliminating the siphon from the design were analyzed:

1. Attempts were made to adjust the culvert invert elevations and dimension and the number of culverts to allow the existing sewer to cross the culvert via gravity flow. The slope of this portion of the Clay Avenue Wash culvert is flat and operating under pressure flow conditions. It was decided that the flow conditions in the culvert were not ideal for penetrating the culvert with a sewer line. To meet City code, the 12" sewer would require a 24" casing and would negatively impact the culvert hydraulics. The culvert dimensions and invert elevations could not be adjusted enough to eliminate the siphon.

2. The existing 10" sewer upstream from the siphon was analyzed to determine if the sewer could be replaced at a flatter slope, allowing it to cross over the culvert. Survey results showed the sewer was already close to minimum allowable slopes and could not be rebuilt at a flatter slope.

3. This portion of Clay Avenue Wash is a 7' diameter steel pipe that will be jack and bored underneath the five points intersection to avoid closing the road during construction. At the northeast corner of the intersection the pipe will enter a junction structure, then transition into a 7' diameter RCP. The size of the junction structure will be large enough to allow the sewer line to cross through the structure and still maintain the hydraulics of the culvert. This option eliminated the siphon altogether.

SECTION 5.FINAL RECOMMENDATIONS

The City of Flagstaff has three likely paths forward for the flood control project. The first is to stay the course with USACE, and hope for congressional appropriations in a reasonable timeframe. The second path would be to pursue a completely City administered and funded project built per a design directed by the results of this DCR or a yet to be identified alternative. A third option would be to pursue both concurrently. The City can continue to work with USACE while furthering the design process of an independent project. While this may cost the City more in design fees if a USACE sponsored project breaks ground, the additional expenditures may provide valuable 'insurance' if the USACE project stalls. While City funding requirements under any scenario are a significant determining factor, The City's path forward should ultimately be decided by the best way to remove a significant number of residents from the FEMA designated flood hazard area, and more importantly by the best way to expeditiously mitigate the actual flood hazard.

If the City of Flagstaff decides to further the design of the preferred alternative, the project components along each reach are as follows:

Rio de Flag

- The project starts upstream at Beal Road, where the bridge would be upsized to a double barrel 10'x7' concrete box culvert.
- At Bonito Street, the Rio de Flag flood flows enter into a closed conduit 20'x7' concrete arch structure under the existing channel alignment.
- Low flows will be routed in an improved open channel along the current alignment.
- The closed conduit arch pipe will outlet downstream of Route 66 in the existing open channel.
- The existing open channel between Route 66 and the BNSF railroad will be improved and rip rap lined to accommodate 1450 cfs.
- The open channel will flow into a drop inlet just upstream of the railroad.
- Four 7' diameter steel pipes will convey flow through the railroad under the existing trestle.
- The jack and bore pipes will transition back to a 20'x7' concrete arch downstream of the railroad.
- The project alignment turns to the East just upstream of Beaver Street, and runs adjacent to the railroad.
- At this same approximate location, the Clay Avenue Wash conveyance structure joins with the Rio de Flag.
- The closed conduit, underground arch pipe outlets downstream of the end of Phoenix Avenue near the beginning of the existing open channel along the railroad.
- The improved open channel with turf lined banks extends approximately 2000' downstream to where it daylights with the existing open channel at a minimum channel slope.

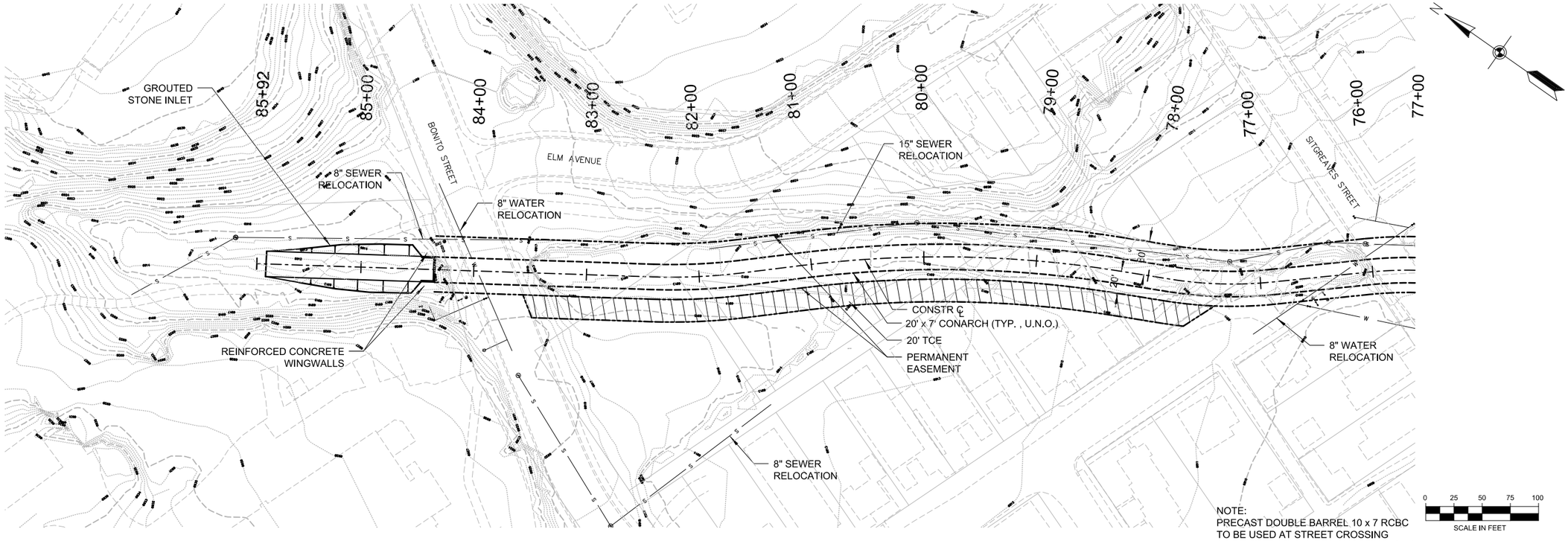
Clay Avenue Wash

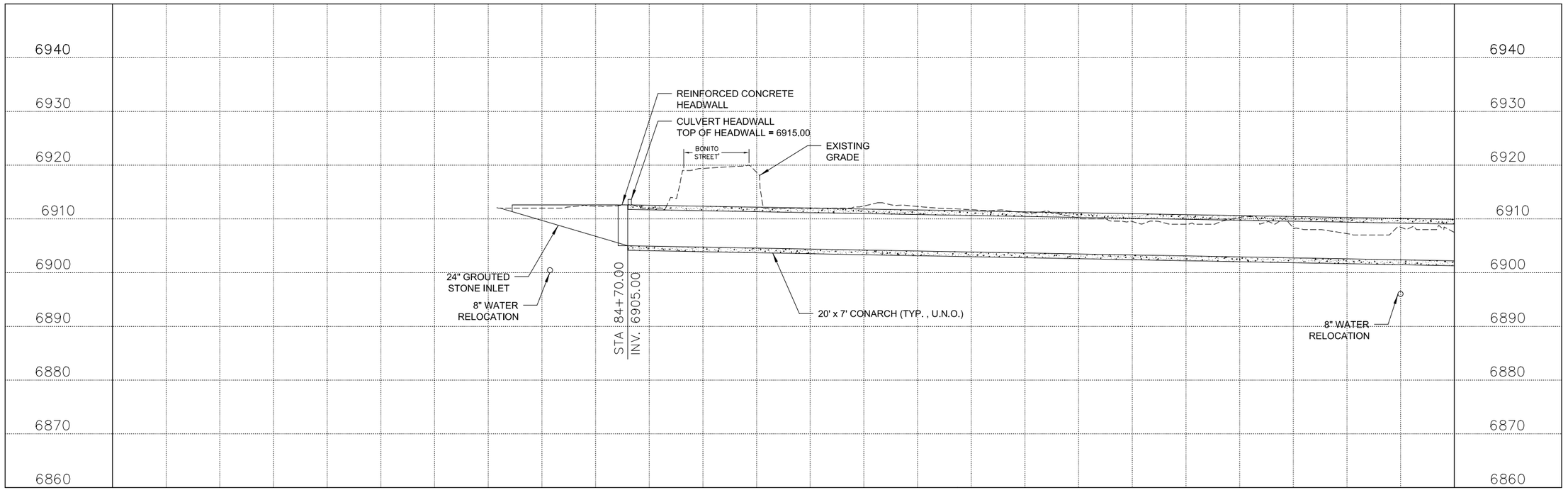
- The Clay Avenue Wash inlet is located near Chateau Drive.
- At the inlet, Clay Avenue Wash flows into a 7' diameter concrete pipe to just downstream of Blackbird Roost Street.

- As grades flatten out, the pipe size increases to 8' diameter to just upstream of the Milton Road/Butler Avenue intersection.
- At the five points intersection, a steel 7' diameter pipe will be jack and bored to the beginning of Mike's Pike.
- Flow will return to a 7' diameter concrete pipe running along Mike's Pike to the confluence with the Rio de Flag just upstream of Beaver Street.

APPENDIX A PREFERRED ALIGNMENT PLANS & ESTIMATED CONSTRUCTION COSTS

Alternative 4 Plans





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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

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ALTERNATE 4
PLAN AND PROFILE
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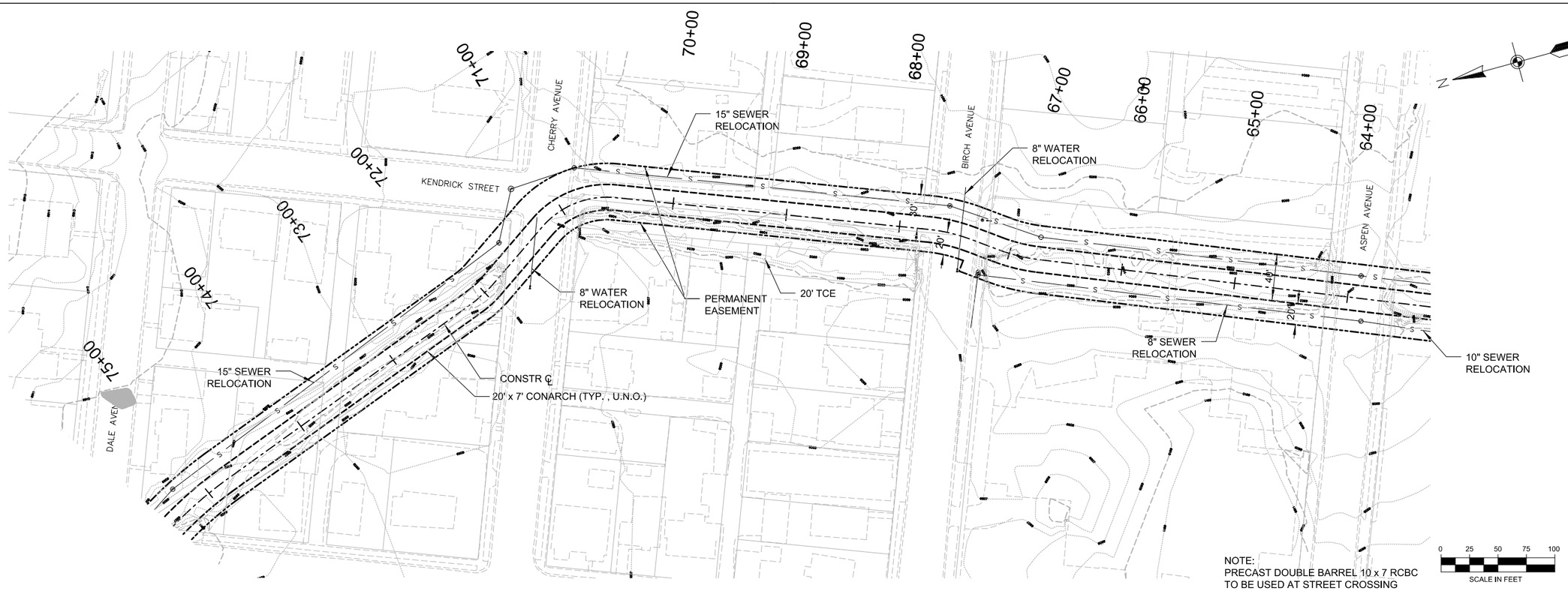

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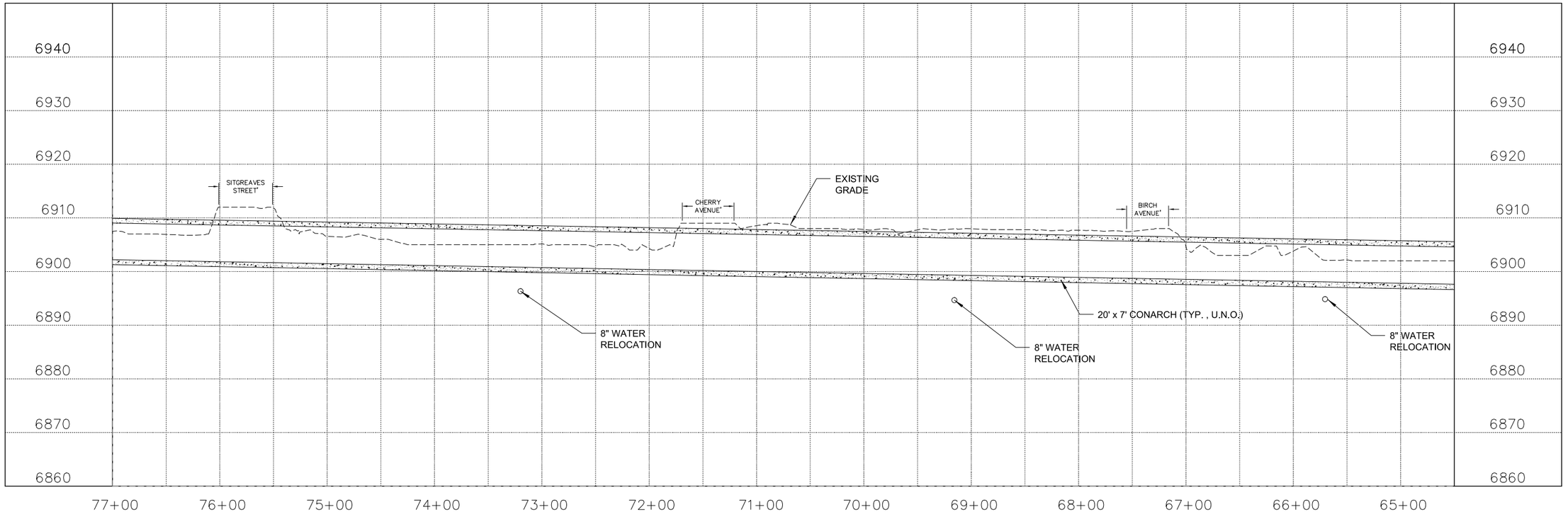

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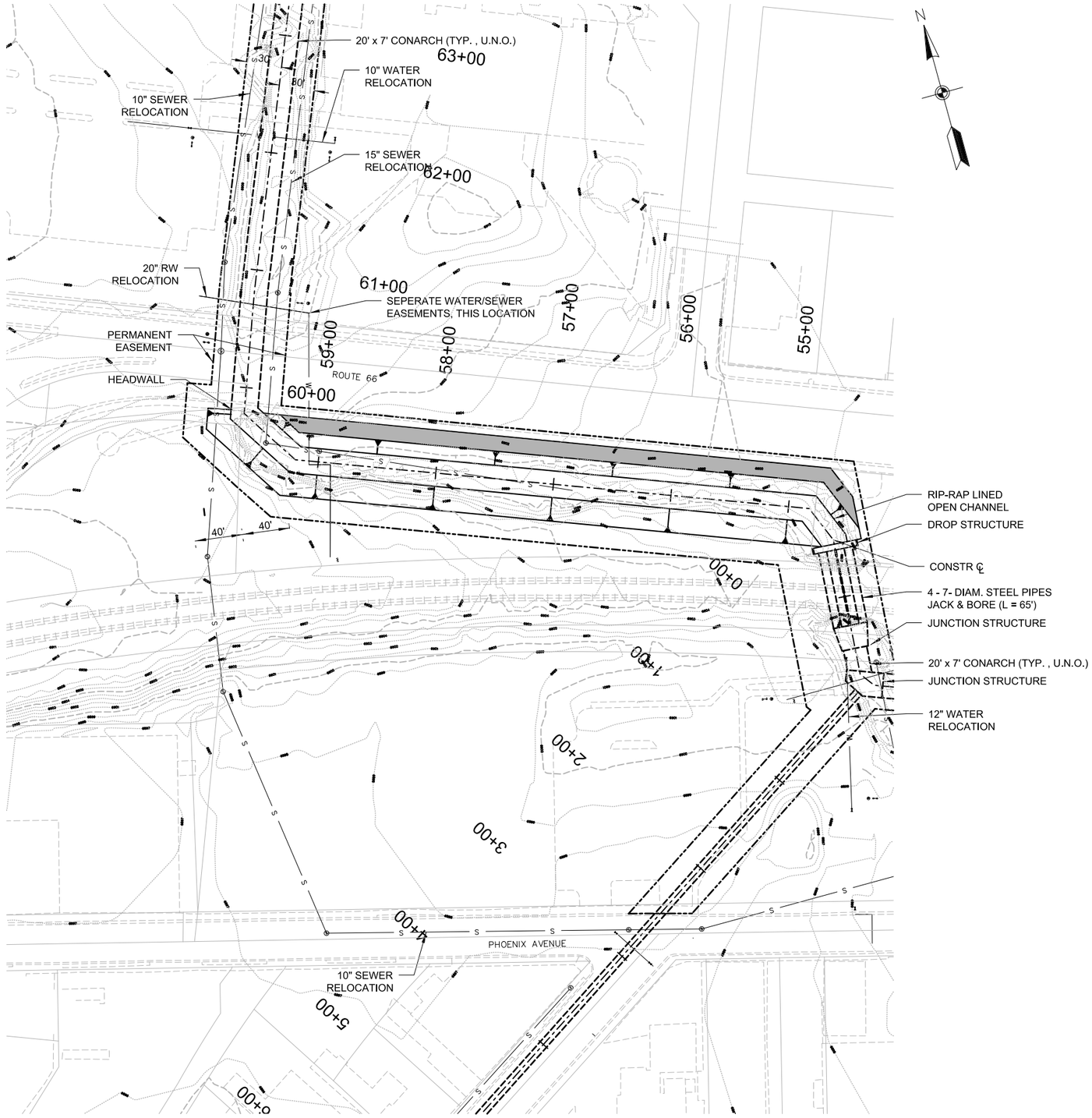

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RIO DE FLAG FLOOD CONTROL PROJECT
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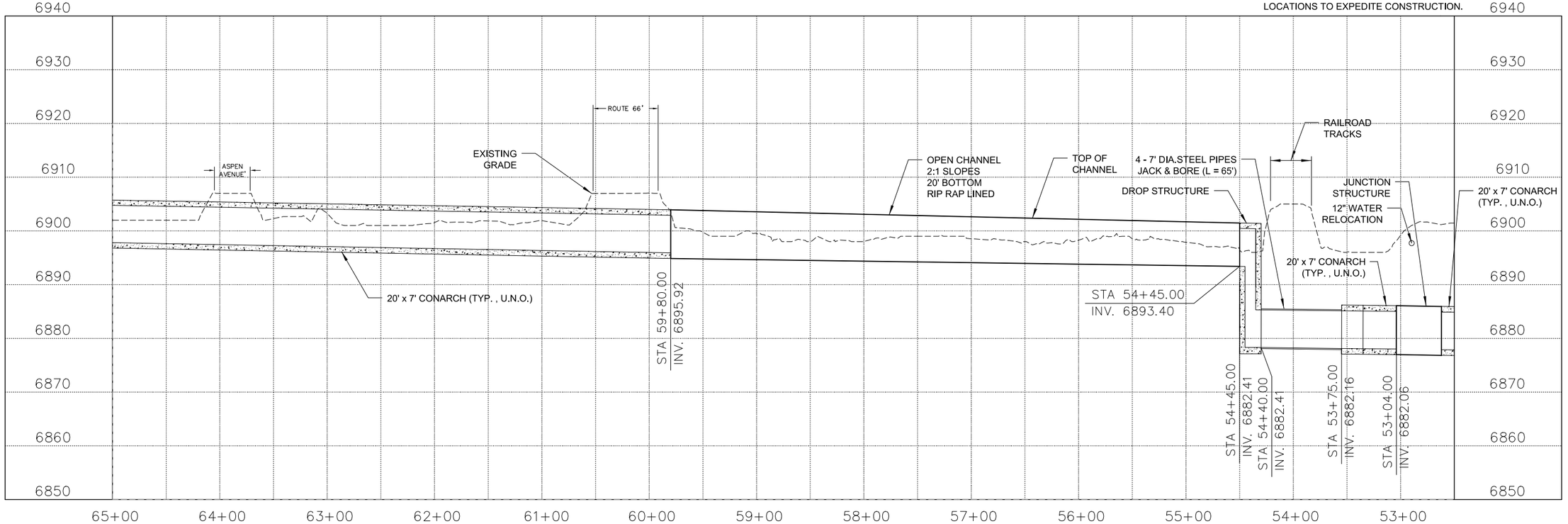

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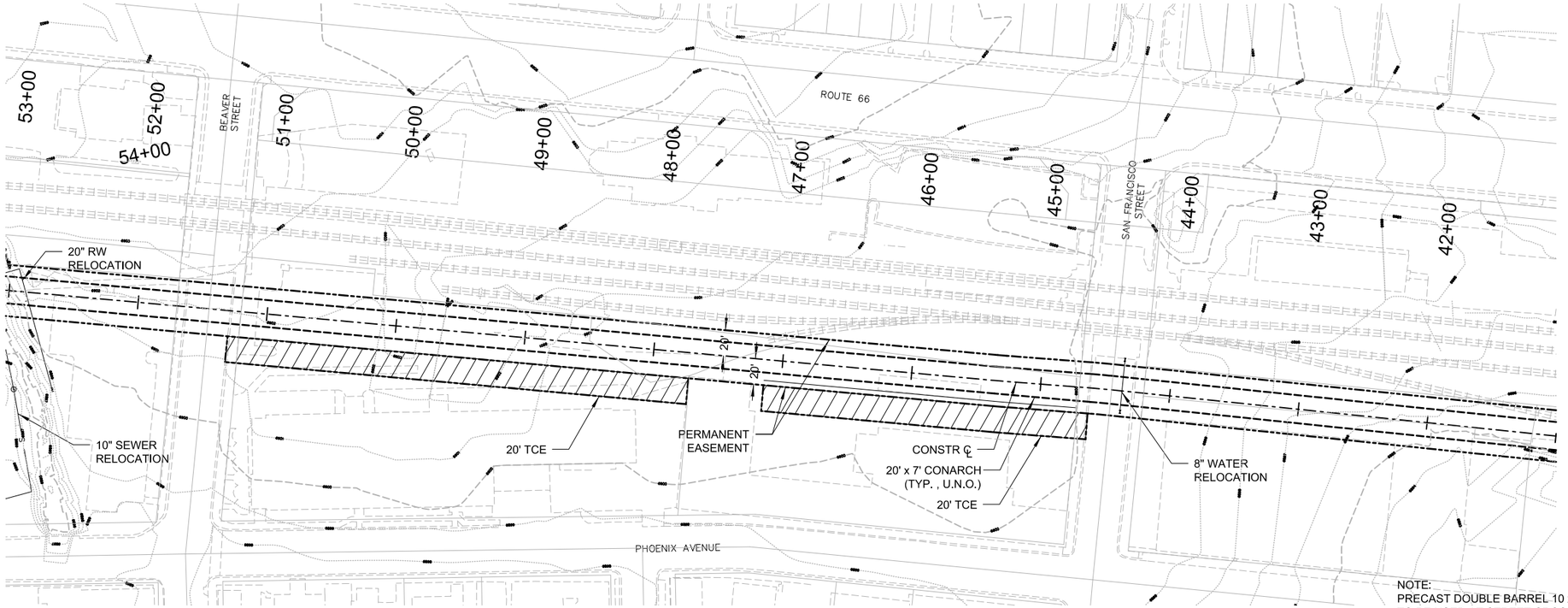

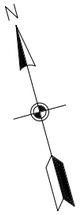

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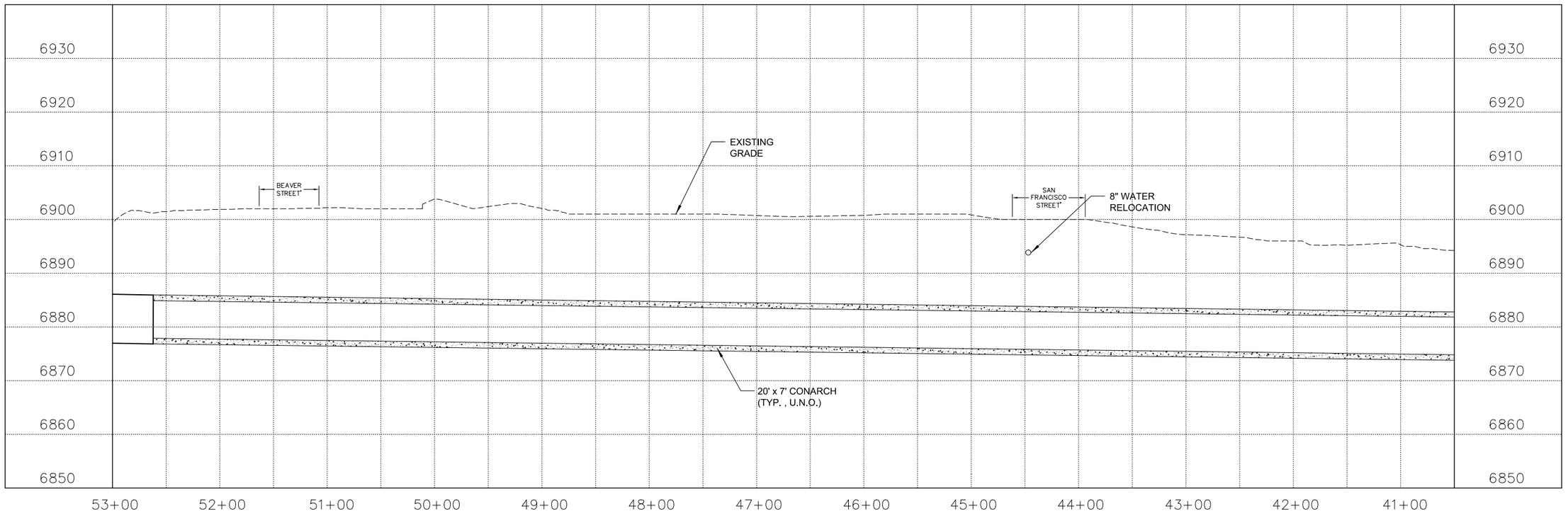

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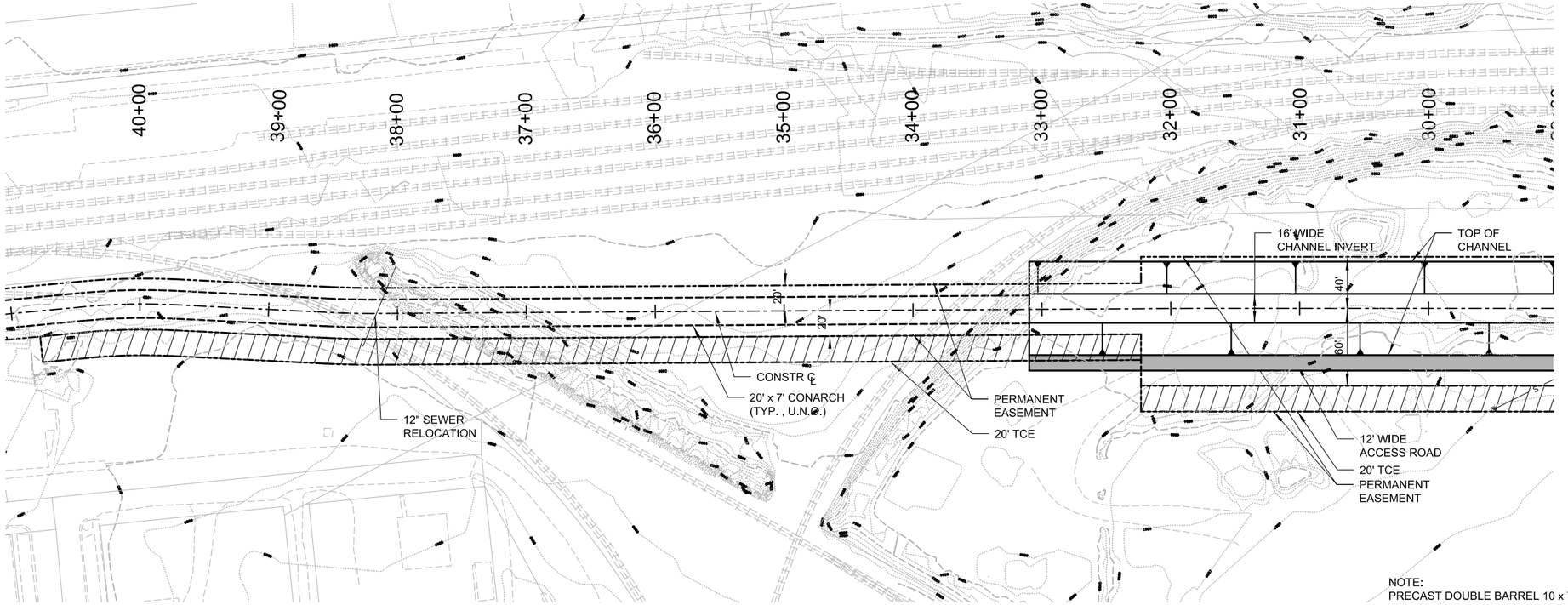

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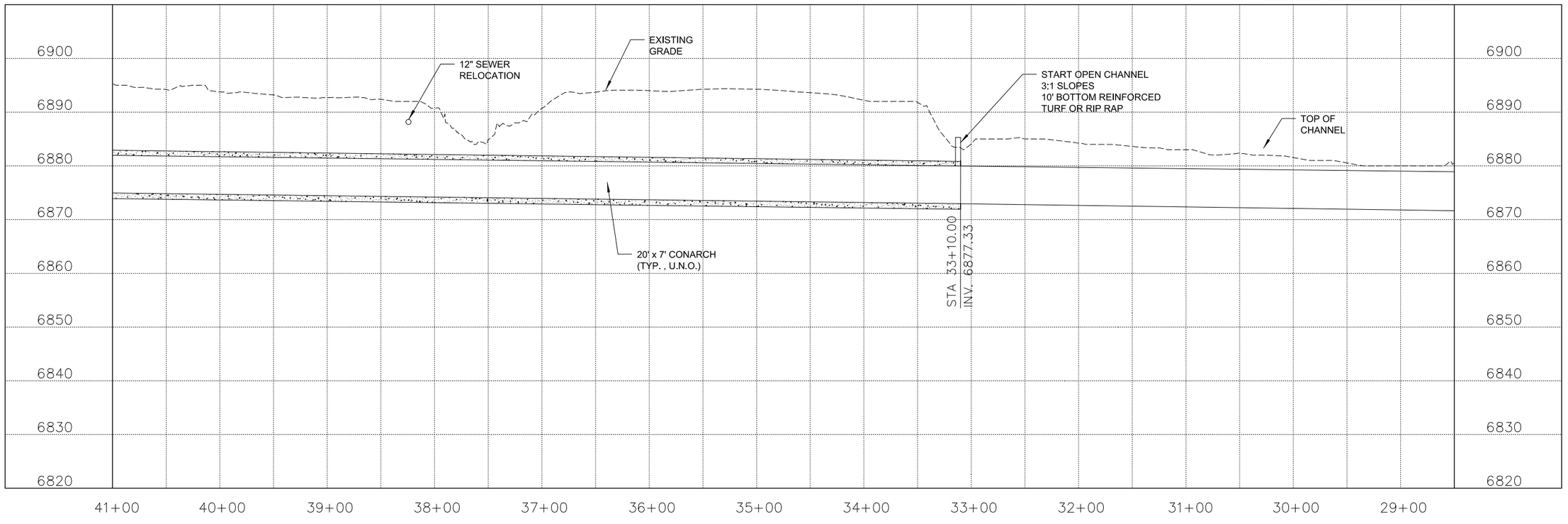

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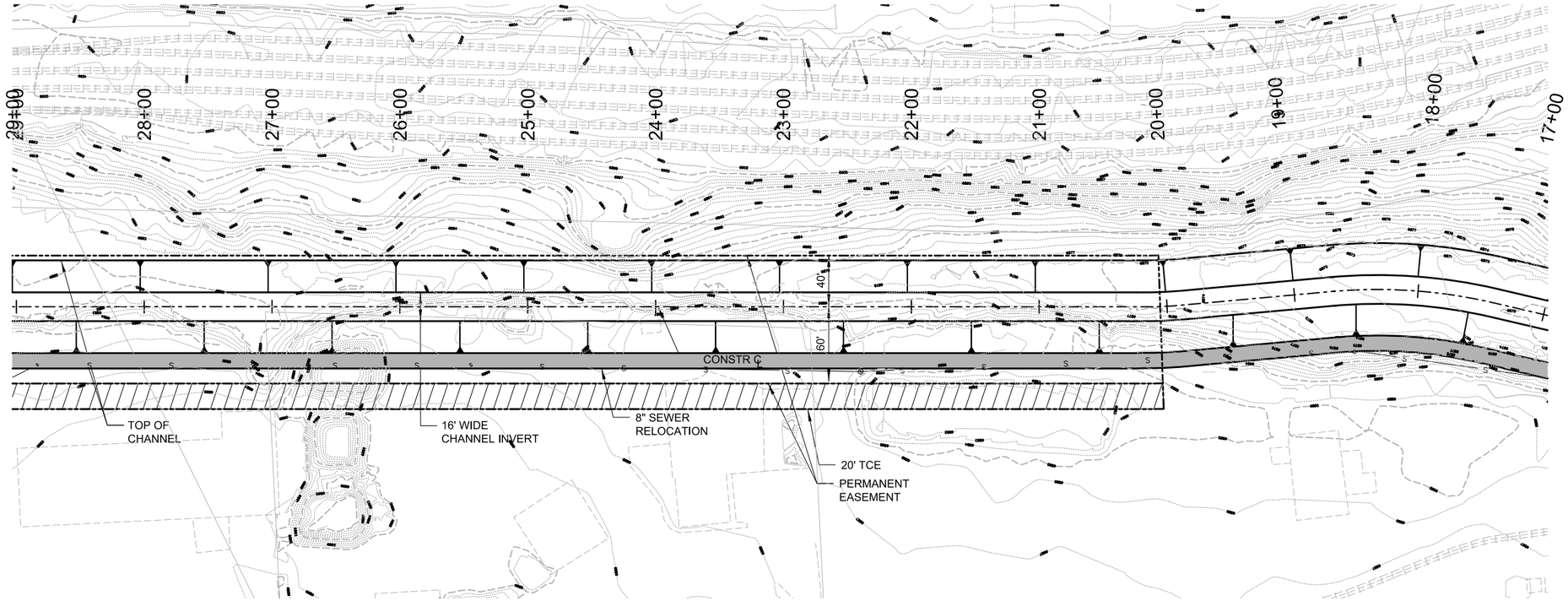

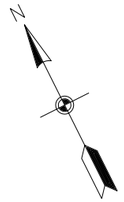

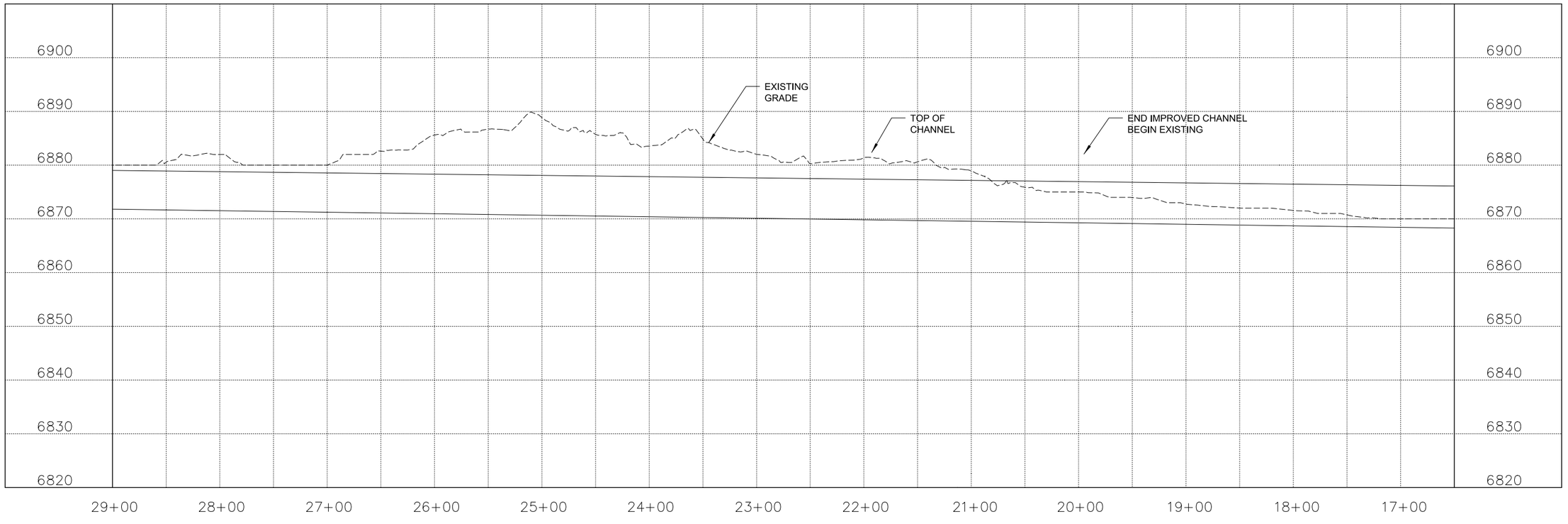

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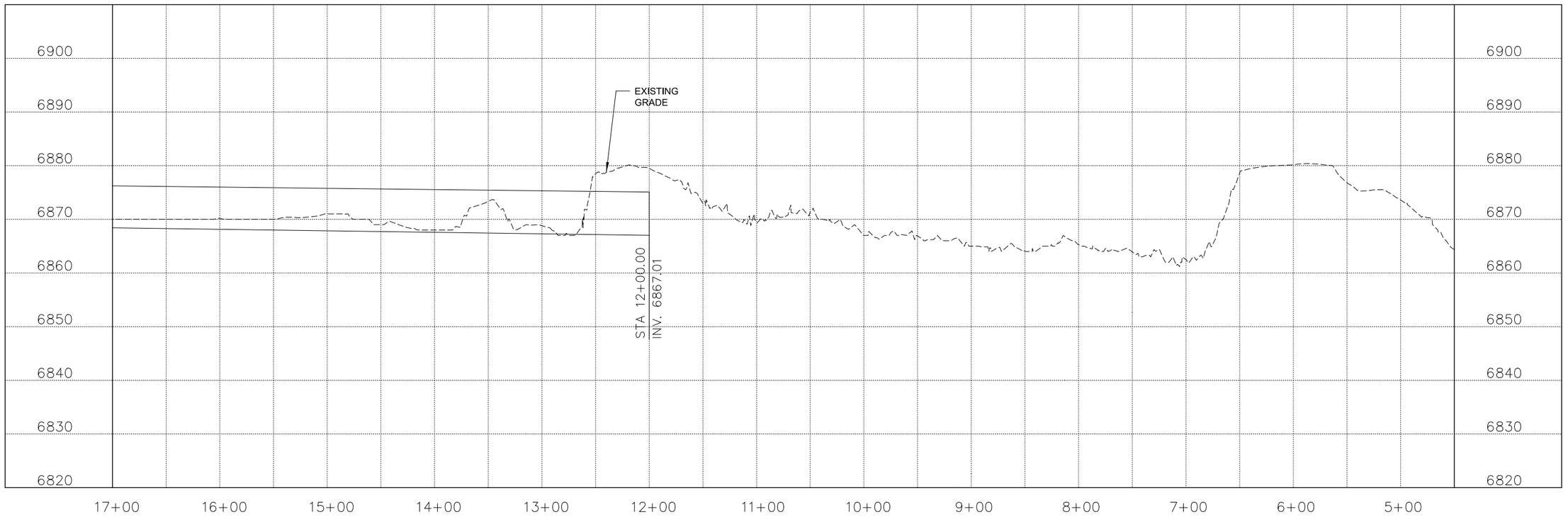

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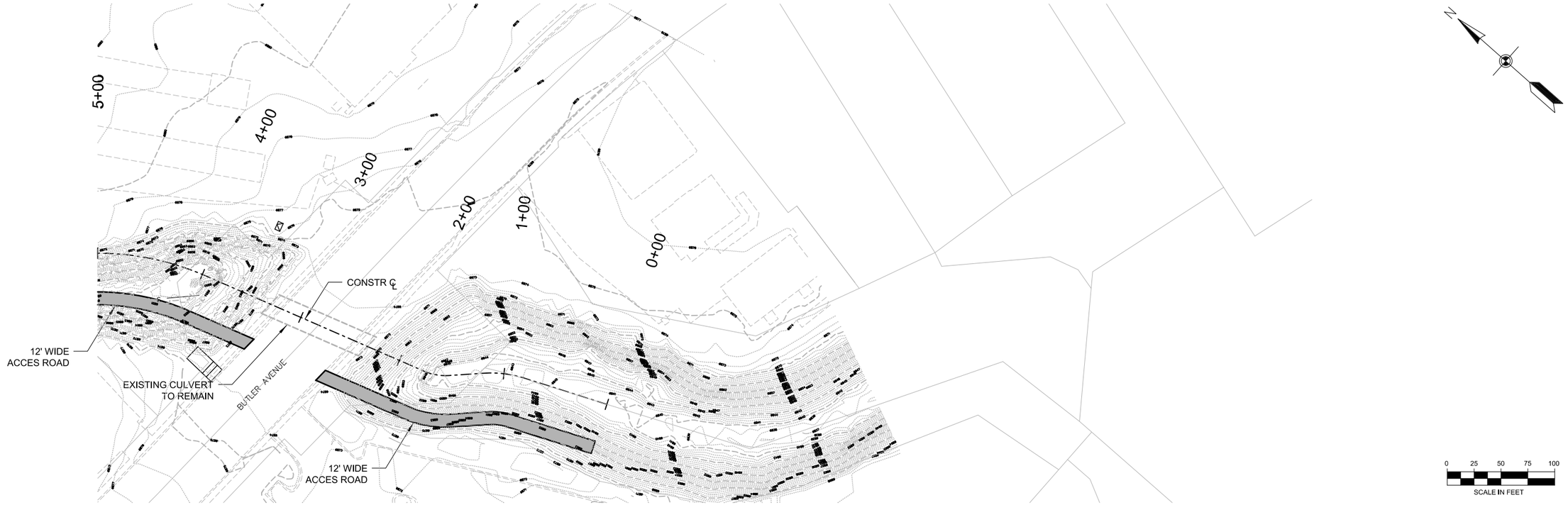

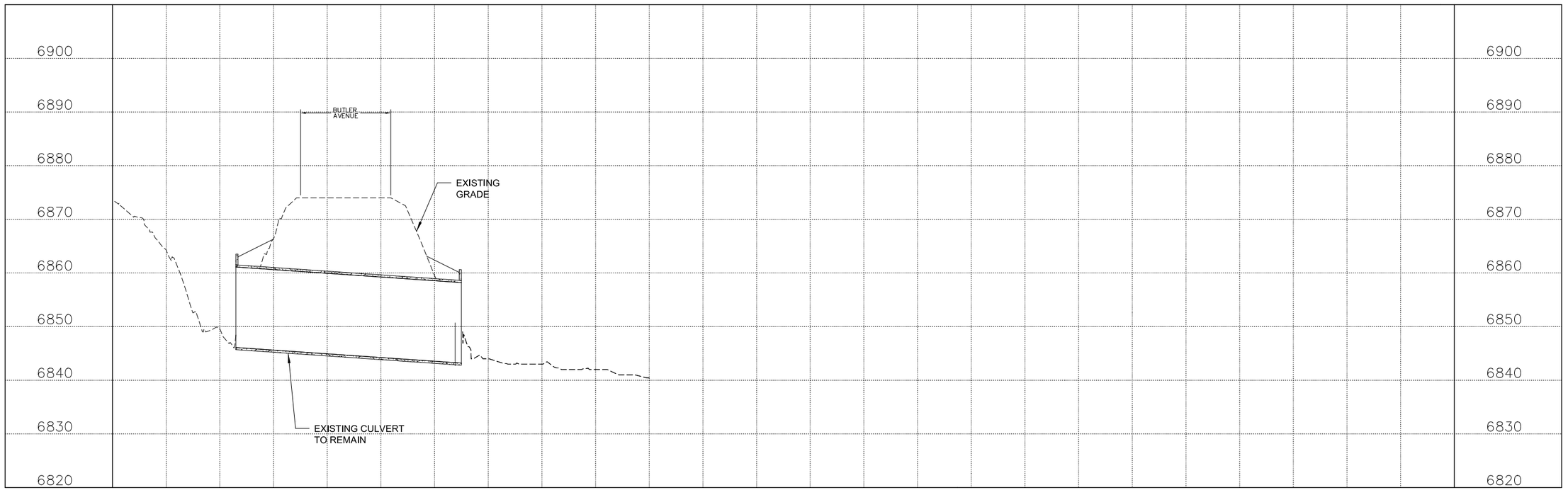

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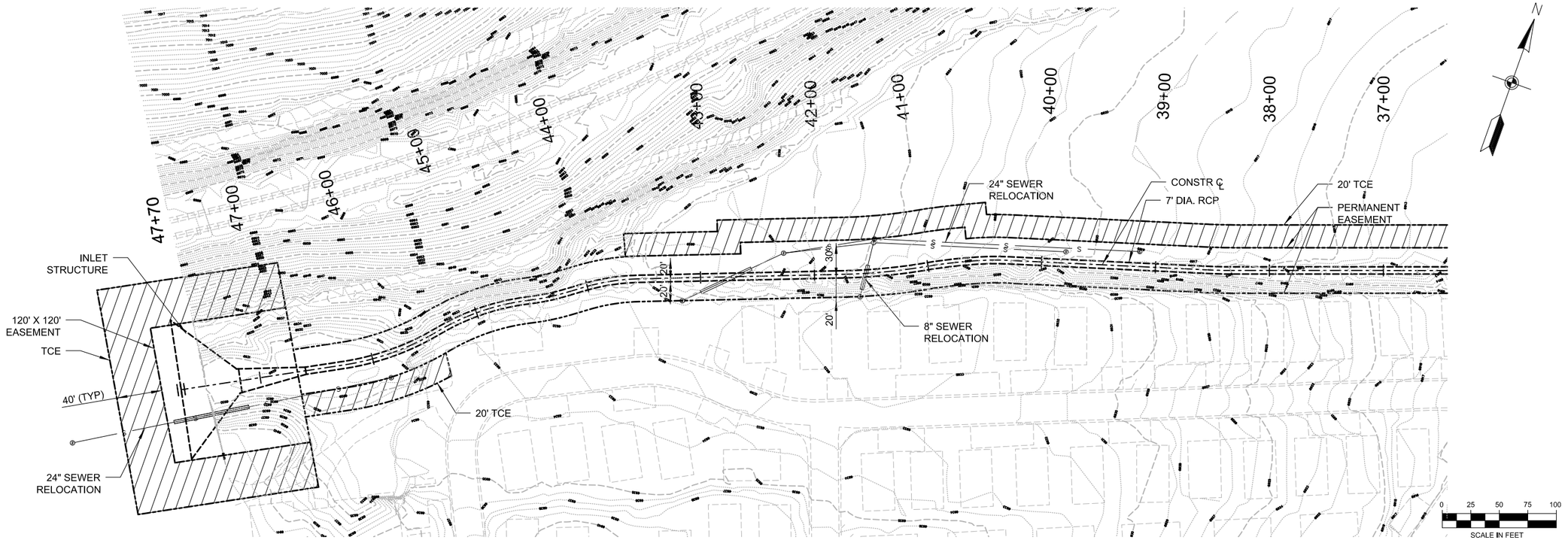

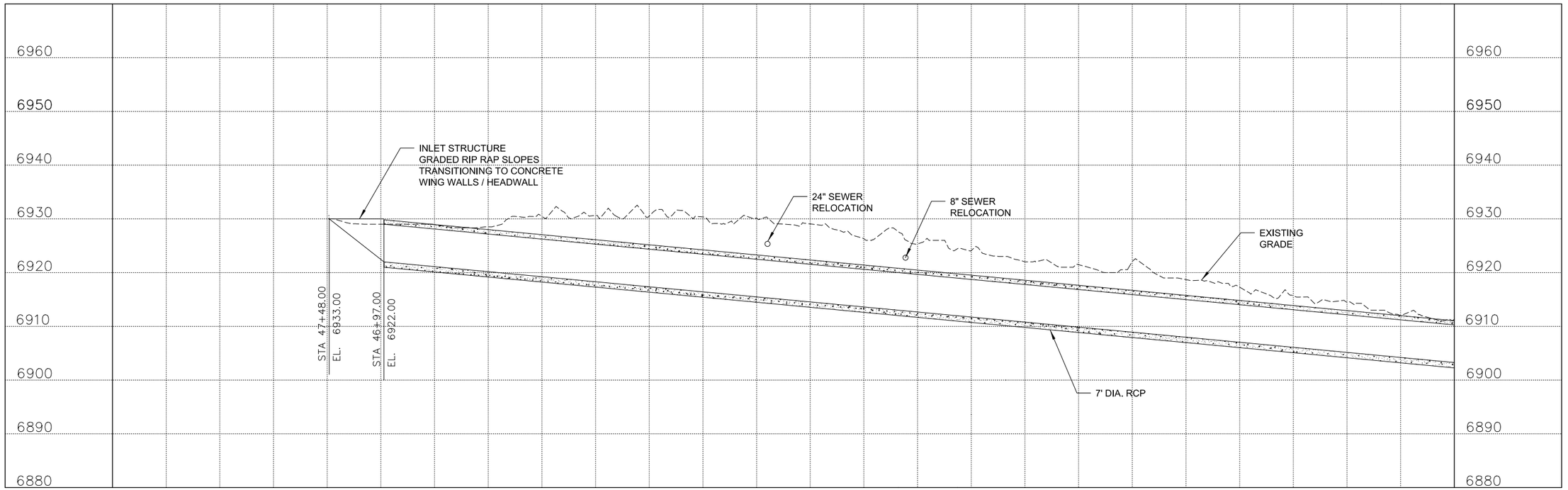

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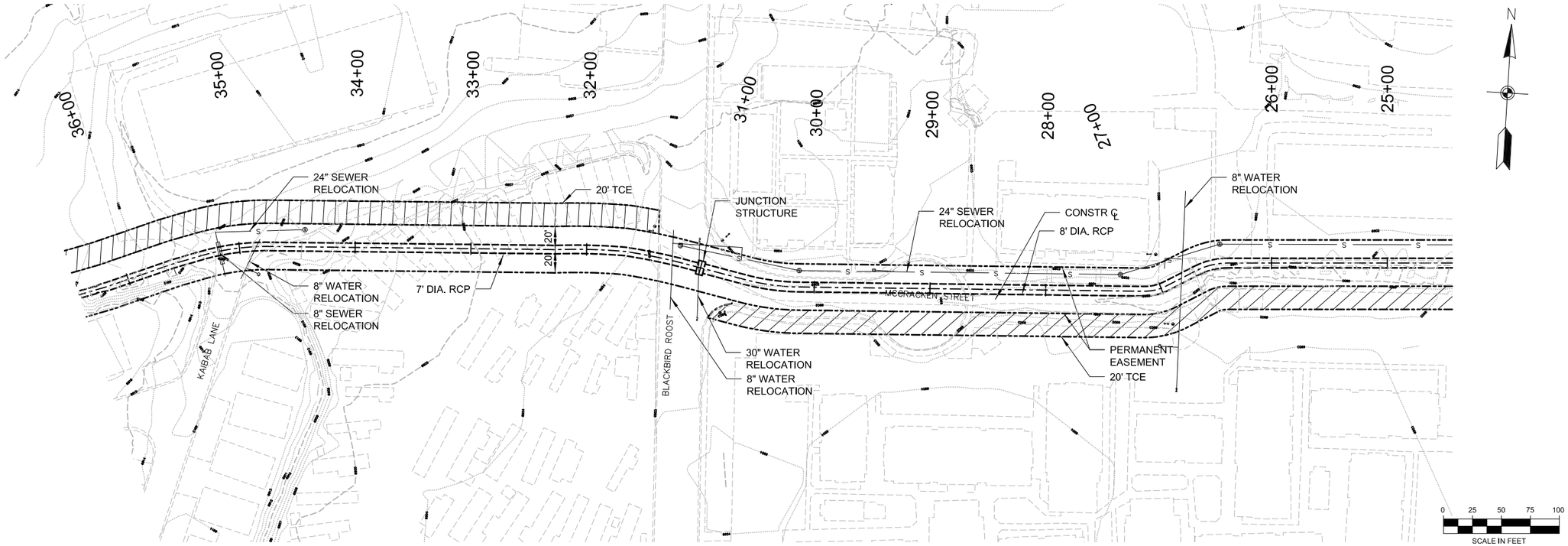

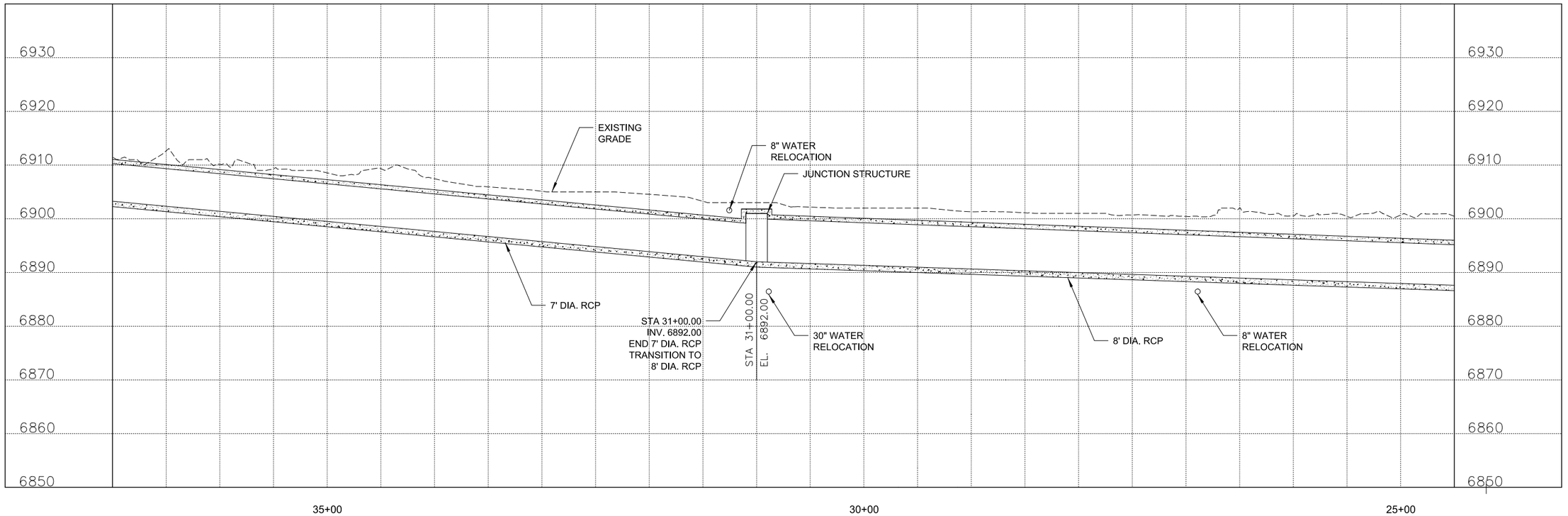

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RIO DE FLAG FLOOD CONTROL PROJECT

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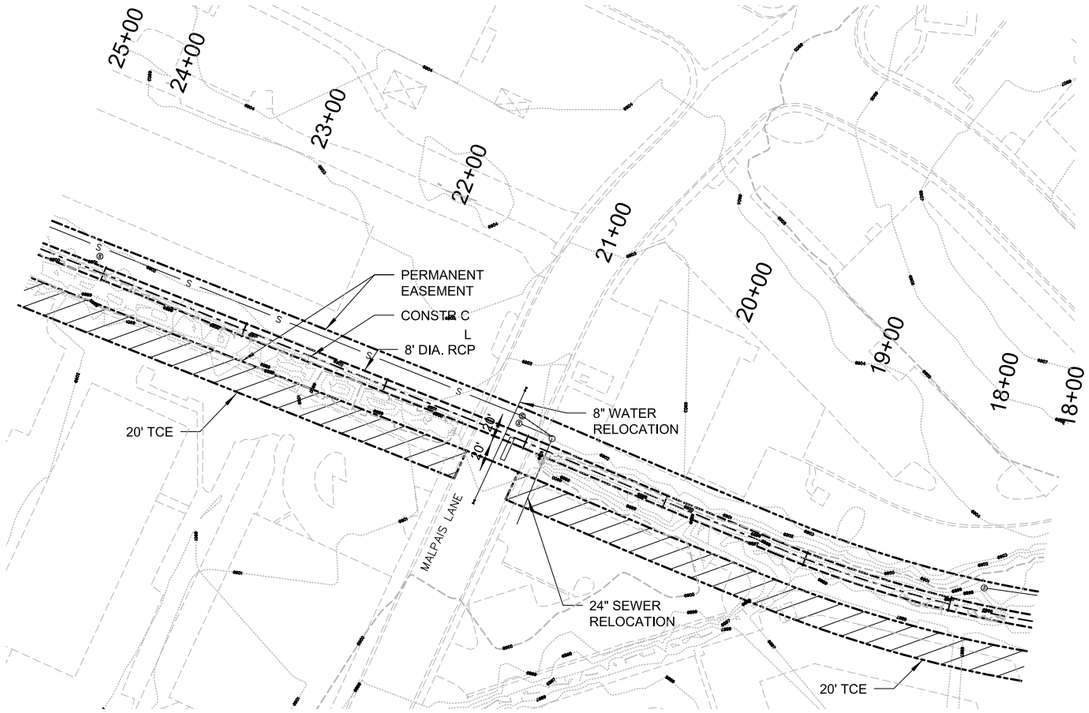

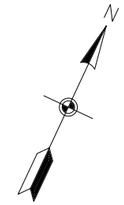

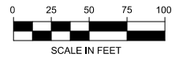

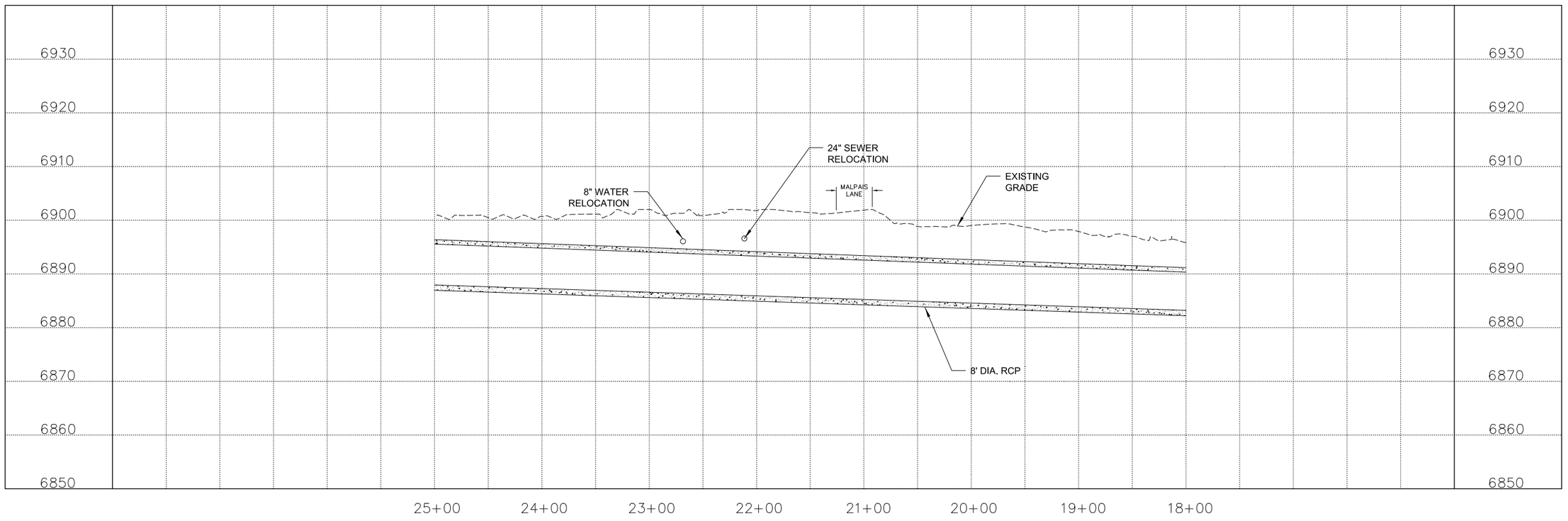

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RIO DE FLAG FLOOD CONTROL PROJECT
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ALTERNATE 4
PLAN AND PROFILE
STA 19+00 TO 28+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

NO.	DESCRIPTION	DATE	BY

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CALL TWO WORKING DAYS BEFORE YOU DIG
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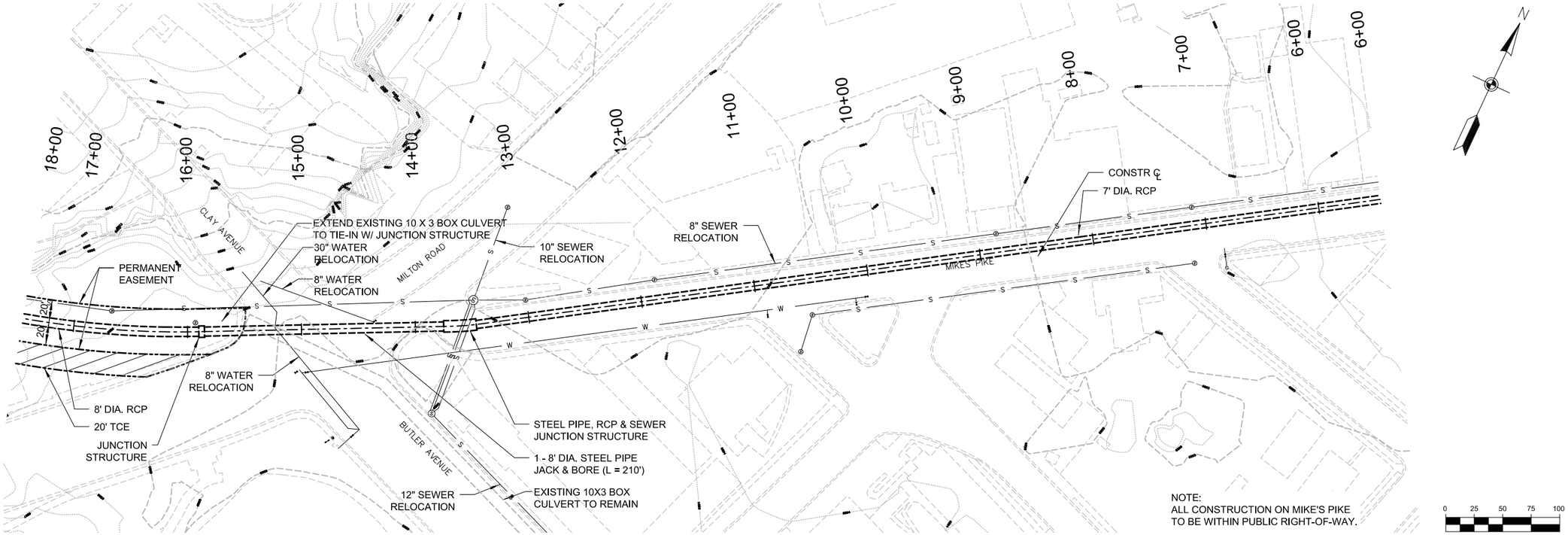

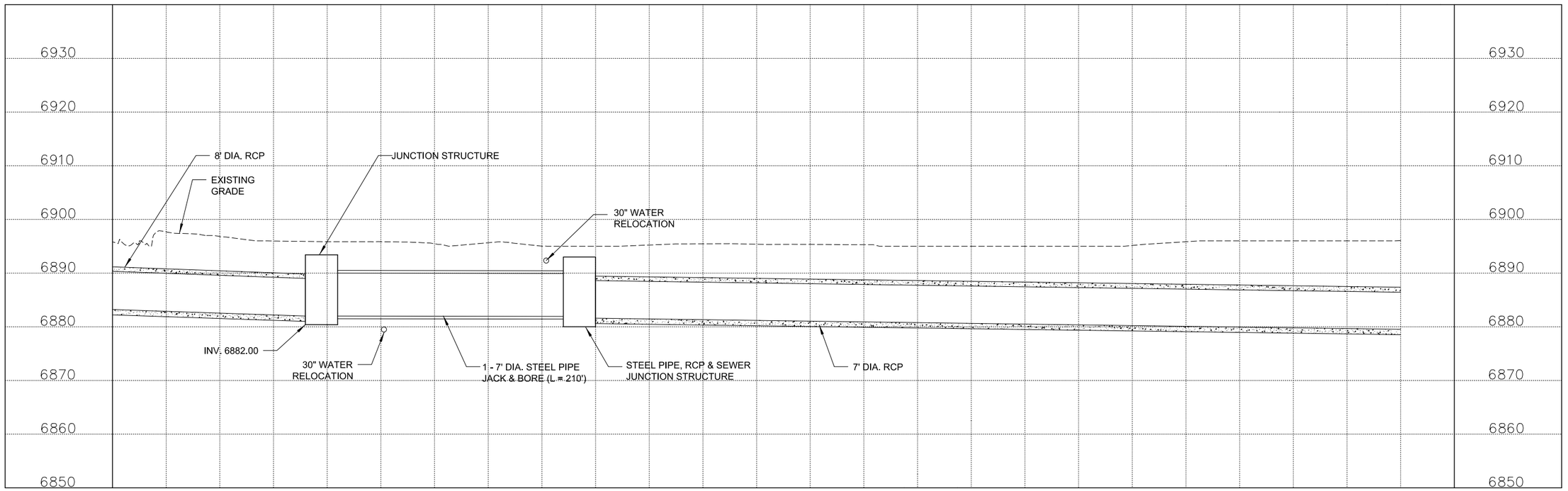

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

CLAY AVENUE / MIKES PIKE IMPROVEMENTS

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ALTERNATE 4
PLAN AND PROFILE
STA 7+00 TO 19+00

Baker
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2929 N. Central Avenue
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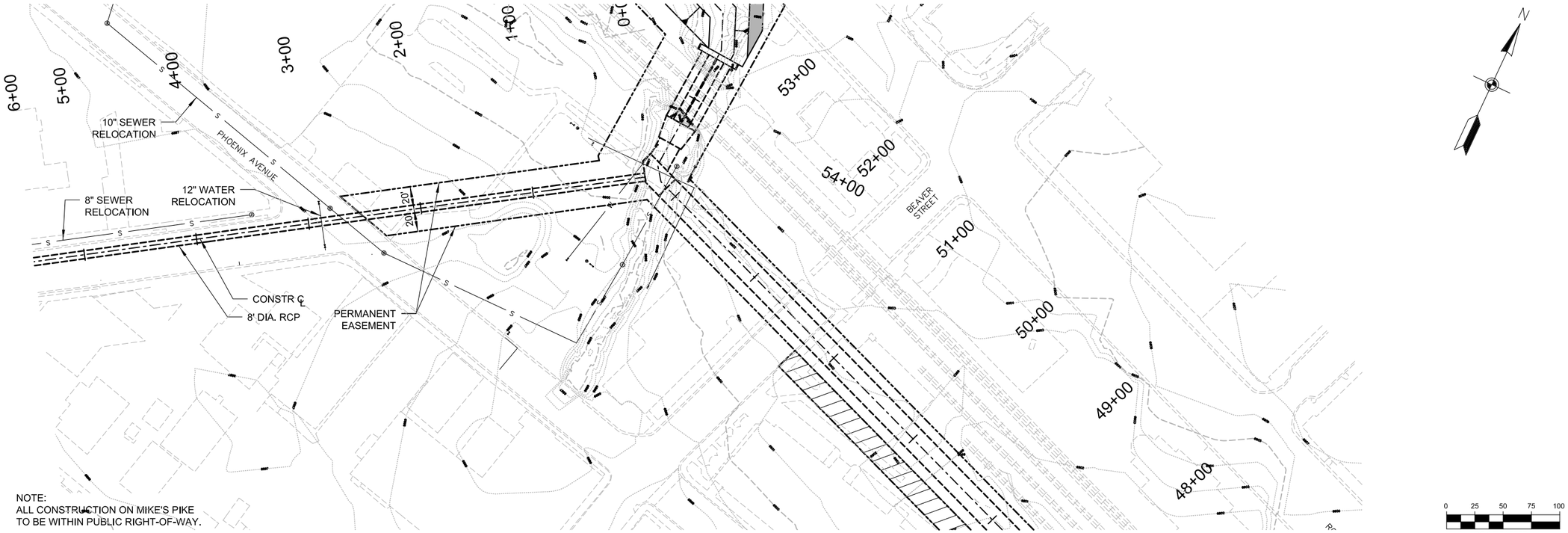

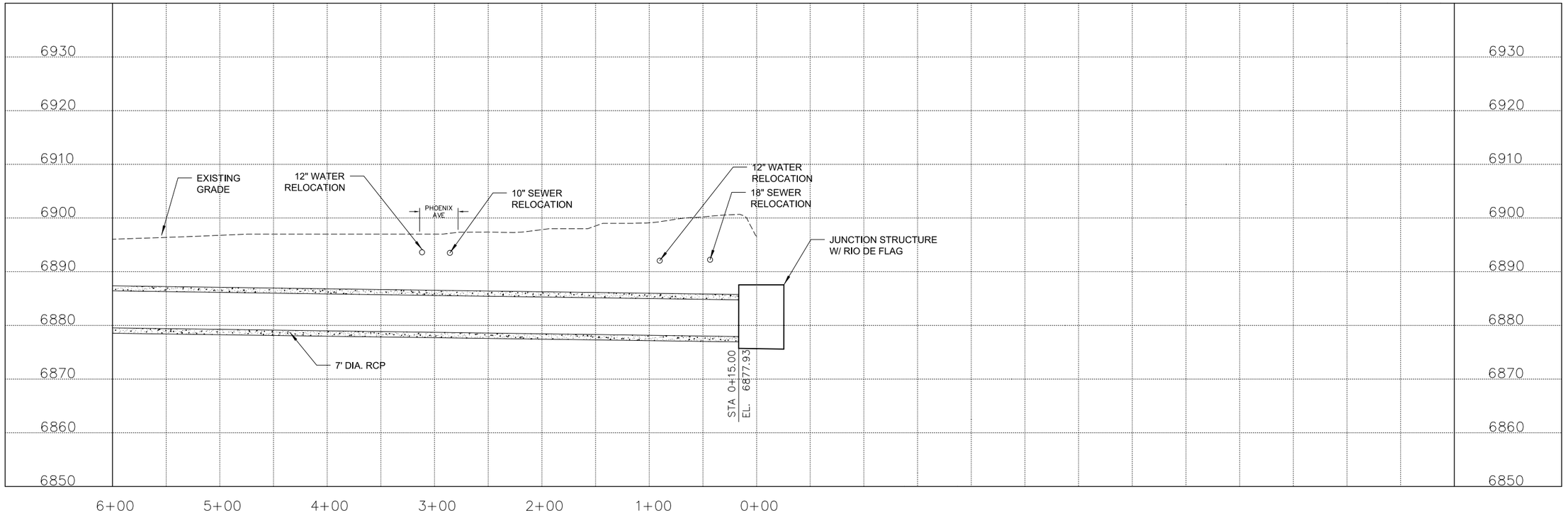

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

MIKES PIKE / CONFLUENCE IMPROVEMENTS

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ALTERNATE 4
PLAN AND PROFILE
STA 0+00 TO 7+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
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Phoenix, Arizona 85012

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Alternative 4 Cost Sheet

CITY OF FLAGSTAFF
RIO DE FLAG FLOOD CONTROL DESIGN CONCEPT PROJECT
ALTERNATE 4 - COST ESTIMATE (DRAFT)
Sheet 1 of 2 - May 23, 2014

Michael Baker Jr., Inc.

		Description	Quantity	UoM		Unit Cost		Total Cost
		Prime Bond	**1.00**	**LS**			**$**	**337,860**
		Price % Add-On	**1.00**	**LS**			**$**	**8,452,466**
1		**Generals**	**1.00**	**LS**			**$**	**3,398,675**
	1.1	**Fixed Costs**	**1.00**	**LS**			**$**	**487,085**
	1.2	**Duration Driven Costs (By Month)**	**30.00**	**MO**	**$**	**97,053.00**	**$**	**2,911,590**
2		**Rio De Flag East Reach**	**1.00**	**LS**			**$**	**9,838,233**
	2.1	**Removals**	**1.00**	**LS**			**$**	**23,756**
	2.2	**Clear and Grub**	**10.00**	**AC**	**$**	**3,442.58**	**$**	**34,426**
	2.3	**Water Utility Relocation and Realignments**	**1.00**	**LS**			**$**	**93,178**
	2.4	**Sewer Utility Relocation and Realignments**	**1.00**	**LS**			**$**	**626,118**
	2.5	**Structural Excavation and Backfill**	**1.00**	**LS**			**$**	**2,797,942**
	2.5.1	Channel Excavation to Haul off	69,705.00	CY	$	15.45	$	1,077,065
	2.5.2	Channel Excavation Contaminated Soil Haul off	500.00	CY	$	136.00	$	68,002
	2.5.3	Hard Dig Contingency	7,000.00	CY	$	69.11	$	483,753
	2.5.4	Import from stockpile, Place & Compact	55,000.00	CY	$	20.88	$	1,148,514
	2.5.5	Site Grading	18,000.00	SY	$	1.14	$	20,608
	2.6	**Concrete Structures**	**1.00**	**LS**			**$**	**3,148,406**
	2.6.1	Con-Arch 1 Barrel x 20 x 7	1,959.00	LF	$	830.48	$	1,626,907
	2.6.2	2 10x7 Precast Box Culvert	106.00	LF	$	1,278.54	$	135,525
	2.6.3	Rip Rap Channel	551.00	LF	$	311.71	$	171,750
	2.6.4	Jack and Bore Rail Road for box *	65.00	LF	$	9,415.38	$	612,000
	2.6.5	Transition - Arched or Box to Pre-cast Box 20 x 7	4.00	EA	$	17,246.00	$	68,984
	2.6.6	Junction Sturcture - Arched to Steel Pipe: at rt 66, confluence...(20 lf per locati	4.00	EA	$	48,657.81	$	194,631
	2.6.7	Grouted Rip Rap 12"	1,226.00	CY	$	109.10	$	133,755
	2.6.8	Slide Rail	4.00	MO	$	51,213.59	$	204,854
	2.7	**Street and Road Reconstruction**	**1.00**	**LS**			**$**	**71,429**
	2.8	**Landscaping Restoration**	**10.00**	**AC**	$	76,230.00	**$**	**762,300**
	2.9	**Tree Replacement**	**40.00**	**EA**	$	2,500.00	**$**	**100,000**
	2.10	**Striping**	**1.00**	**LS**			**$**	**30,678**
	2.11	**Rail Road Shoring 1600 lf Butler to east of San Francisco**	**1.00**	**LS**			**$**	**2,000,000**
	2.12	**Rail Road Insurance, Flagging, Inspection**	**1.00**	**LS**			**$**	**150,000**
3		**Rio De Flag North Reach**	**1.00**	**LS**			**$**	**7,667,335**
	3.1	**Removals**	**1.00**	**LS**			**$**	**239,715**
	3.2	**Clear and Grub**	**6.00**	**AC**	**$**	**8,652.76**	**$**	**51,917**
	3.3	**Water Utility Relocation and Realignments**	**1.00**	**LS**			**$**	**419,016**
	3.4	**Sewer Utility Relocation and Realignments**	**1.00**	**LS**			**$**	**1,019,671**
	3.5	**Structural Excavation and Backfill**	**1.00**	**LS**			**$**	**1,973,510**
	3.5.1	Channel Excavation to Haul off	44,716.00	CY	$	17.40	$	778,053
	3.5.2	Channel Excavation Contaminated Soil Haul off	500.00	CY	$	120.40	$	60,199
	3.5.3	Hard Dig Contingency	5,400.00	CY	$	69.42	$	374,889
	3.5.4	Jack and bore for sewer	1.00	LS			$	227,500
	3.5.5	Import from stockpile, Place & Compact	25,000.00	CY	$	20.77	$	519,131
	3.5.6	Site Grading	12,000.00	SY	$	1.14	$	13,739
	3.6	**Concrete Structures**	**1.00**	**LS**			**$**	**2,765,538**
	3.6.1	Con-Arch 1 Barrel x 20 x 7 end at sta 52+00 arbitrarily chosen	1,920.00	LF	$	821.94	$	1,578,128
	3.6.2	10x7 Precast Box Culvert * added 60' box at Beal*	470.00	LF	$	1,220.20	$	573,495
	3.6.3	Transition - Arched to Pre-cast Box 20 x 7	10.00	EA	$	17,246.00	$	172,460
	3.6.4	Grouted Rip Rap 24" *	840.00	CY	$	96.46	$	81,024
	3.6.5	Sewage By-Pass while installing new box	1.00	EA	$	59,309.45	$	59,309
	3.6.6	Slide Rail	6.00	MO	$	50,187.01	$	301,122
	3.7	**Street and Road Reconstruction**	**1.00**	**LS**			**$**	**613,834**
	3.8	**Signage**	**1.00**	**LS**			**$**	**13,913**
	3.9	**Striping**	**1.00**	**LS**			**$**	**25,343**
	3.10	**Landscaping Restoration**	**6.00**	**AC**	**$**	**76,230.00**	**$**	**457,380**
	3.11	**Tree Replacement**	**35.00**	**EA**	**$**	**2,500.00**	**$**	**87,500**
4		**Clay Avenue "West" Reach**	**1.00**	**LS**			**$**	**9,761,789**
	4.1	**Removals**	**1.00**	**LS**			**$**	**162,519**
	4.2	**Clear and Grub**	**5.00**	**AC**	**$**	**7,873.28**	**$**	**39,366**
	4.3	**Water Utility Relocation and Realignments**	**1.00**	**LS**			**$**	**718,775**
	4.4	**Sewer Utility Relocation and Realignments**	**1.00**	**LS**			**$**	**1,375,126**
	4.5	**Site Grading**	**13,000.00**	**SY**	**$**	**1.14**	**$**	**14,884**
	4.6	**84" RGRCP**	**2,982.00**	**LF**	**$**	**1,019.28**	**$**	**3,039,491**
	4.6.1	Purchase 84" RGRCP, Adj Class __	2,982.00	LF	$	286.54	$	854,454
	4.6.2	Purchase ABC	18,672.51	TN	$	10.00	$	186,725
	4.6.3	Dig and lay - 84" RGRCP (Avg. Depth: _vft)	2,982.00	LF	$	120.16	$	358,303
	4.6.4	Haul-Off (Adjust Loads / Hour) (Trucks, Super 16s) (15cy, 23tn)	3,726.00	LD	$	190.00	$	707,940
	4.6.5	Import from stockpile, Place & Compact Adjusted	31,576.00	CY	$	9.50	$	299,972
	4.6.6	Backfill - 84" RGRCP	2,982.00	LF	$	61.13	$	182,302
	4.6.7	Pothole Utilities	93.36	EA	$	335.57	$	31,330
	4.6.8	Trench Safety, by Day	93.36	DY	$	400.00	$	37,345
	4.6.9	Channel Excavation Contaminated Soil Haul off	250.00	CY	$	136.00	$	34,001
	4.6.10	Hard Dig Contingency	5,000.00	CY	$	69.42	$	347,119

CITY OF FLAGSTAFF
RIO DE FLAG FLOOD CONTROL DESIGN CONCEPT PROJECT
ALTERNATE 4 - COST ESTIMATE (DRAFT)
Sheet 1 of 2 - May 23, 2014

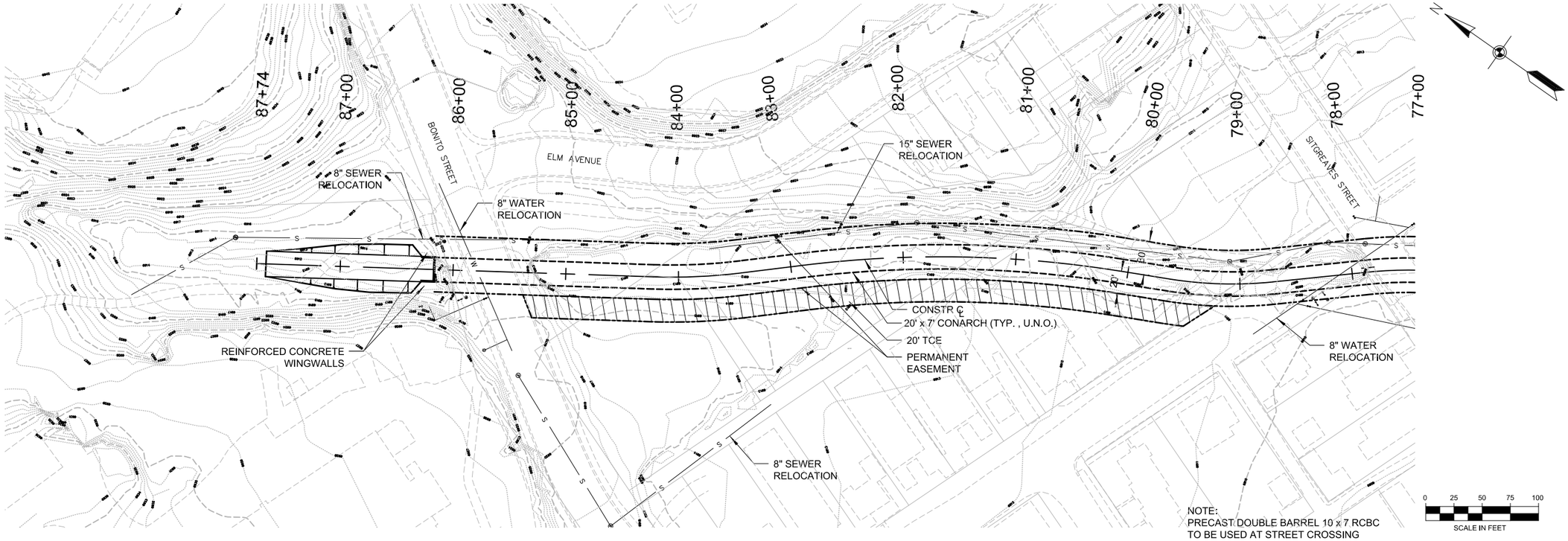
Michael Baker Jr., Inc.

		Description	Quantity	UoM		Unit Cost		Total Cost
4.7		**96" RGRCP**	**1,500.00**	**LF**	**$**	**1,394.57**	**$**	**2,091,855**
	4.7.1	Purchase 96" RGRCP, Adj Class __	1,500.00	LF	$	420.00	$	630,000
	4.7.2	Purchase ABC	10,000.00	TN	$	10.00	$	100,000
	4.7.3	Dig and lay - 96" RGRCP (Avg. Depth: _vft)	1,500.00	LF	$	106.21	$	159,317
	4.7.4	Haul-Off (Adjust Loads / Hour) (Trucks, Super 16s) (15cy, 23tn)	1,923.00	LD	$	190.00	$	365,370
	4.7.5	Import from stockpile, Place & Compact Adjusted	16,000.00	CY	$	19.00	$	304,000
	4.7.6	Backfill - 96" RGRCP	1,500.00	LF	$	61.13	$	91,701
	4.7.7	Pothole Utilities	50.00	EA	$	838.94	$	41,947
	4.7.8	Trench Safety, by Day	46.00	DY	$	400.00	$	18,400
	4.7.9	Channel Excavation Contaminated Soil Haul off	250.00	CY	$	136.00	$	34,001
	4.7.10	Hard Dig Contingency	5,000.00	CY	$	69.42	$	347,119
	4.7.11	Jack and Bore Rail Road	215.00	LF	$	2,553.49	$	549,000
	4.7.12	Junction Sturcture - Arched or Box to Steel Pipe:	3.00	EA	$	45,276.15	$	135,828
	4.7.13	Tie In replacing box transition	1.00	EA	$	34,491.99	$	34,492
4.8		**Street and Road Reconstruction**	**1.00**	**LS**			**$**	**892,327**
4.9		**Signage**	**1.00**	**LS**			**$**	**13,913**
4.10		**Striping**	**1.00**	**LS**			**$**	**30,468**
4.11		**Landscaping Restoration**	**5.00**	**AC**	**$**	**76,230.00**	**$**	**381,150**
4.12		**Tree Replacement**	**24.00**	**EA**	**$**	**2,500.00**	**$**	**60,000**
4.13		**ABC Service Road**	**1,600.00**	**SY**	**$**	**3.31**	**$**	**5,304**
4.14		**Restore Earthen channel**	**1.00**	**LS**			**$**	**217,291**
	4.14.1	Clear and restore Earthen channel , Butler to Oleary	2.00	AC	$	40,194.81	$	80,390
	4.14.2	Hydroseeding	2.00	AC	$	3,200.00	$	6,400
	4.14.3	Excavate and Grade Channel tight fit	1,840.00	CY	$	30.16	$	55,502
	4.14.4	Tree Replacement	30.00	EA	$	2,500.00	$	75,000
5		**Trapazoid Channel**	**2,110.00**	**LF**	**$**	**1,099.27**	**$**	**2,319,457**
5.1		**Site Clearing, Grubbing**	**5.05**	**AC**	**$**	**5,832.13**	**$**	**29,478**
5.2		**Excavate Trapazoid Channel**	**64,000.00**	**CY**	**$**	**24.19**	**$**	**1,548,328**
5.3		**Retaining wall 4 - 11 ft tall**	**400.00**	**LF**	**$**	**334.77**	**$**	**133,906**
5.4		**Install Turf Reinforcement Mat**	**25,673.00**	**SY**	**$**	**2.85**	**$**	**73,234**
5.5		**Hydroseeding**	**4.81**	**AC**	**$**	**3,200.00**	**$**	**15,404**
5.6		**Grouted rip rap**	**300.00**	**CY**	**$**	**130.41**	**$**	**39,123**
5.7		**Parkway grading**	**20,000.00**	**SY**	**$**	**0.80**	**$**	**15,952**
5.8		**Landscaping Restoration**	**4.81**	**AC**	**$**	**76,230.00**	**$**	**366,947**
5.9		**Tree Replacement**	**33.00**	**EA**	**$**	**2,500.00**	**$**	**82,500**
5.10		**ABC Service Road**	**4,400.00**	**SY**	**$**	**3.31**	**$**	**14,586**
6		**Route 66 Bridge Replacement**	**1.00**	**LS**			**$**	**991,427**
6.1		**Detour Construct and Demolish 2 lanes east/west bound**	**1.00**	**LS**			**$**	**313,275**
6.2		**North Phase**	**1.00**	**LS**			**$**	**368,859**
6.3		**South Phase**	**1.00**	**LS**			**$**	**309,292**
7		**Storm Damage**	**1.00**	**LS**			**$**	**300,000**
8		**Electrical & Signals**	**1.00**	**LS**			**$**	**150,000**
9		**Design Completions 15%**	**1.00**	**LS**			**$**	**4,438,022**
10		**Construction Contingency 10%**	**1.00**	**LS**			**$**	**2,958,681**

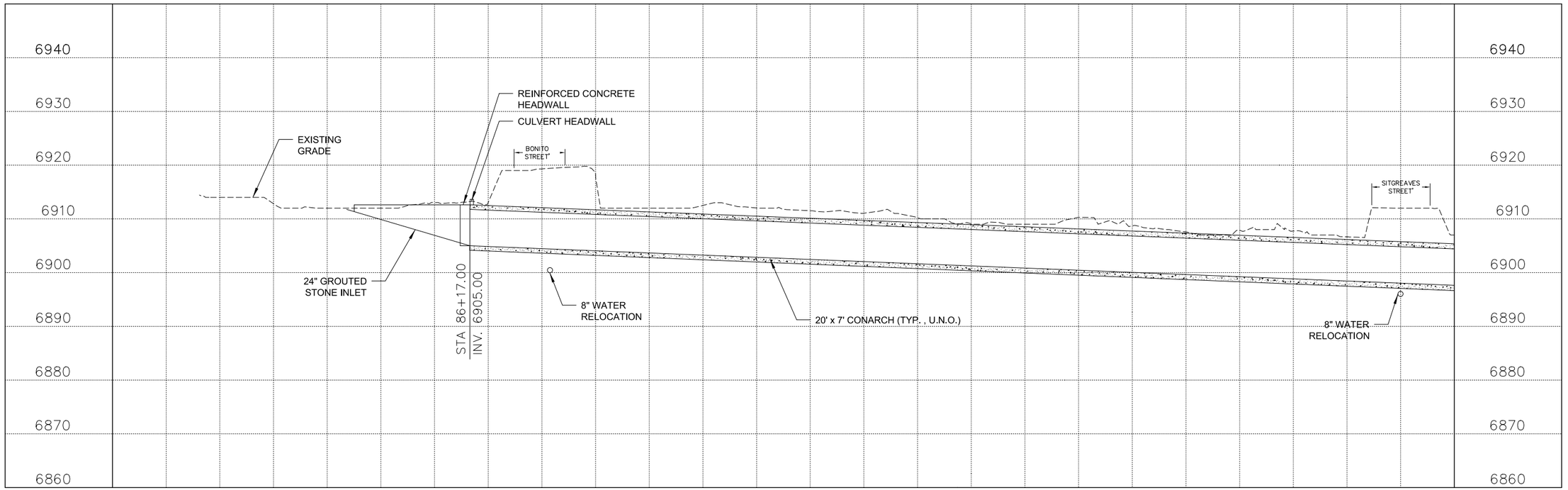
TOTAL ESTIMATE CONSTRUCTION COST	**$**	**50,613,946**
Real Estate Acquisition	**$**	**7,142,000**
Remaining Design Fee Estimate	**$**	**1,500,000**
Construction Administration (6%)	**$**	**3,036,837**
Total Estimated Cost	**$**	**62,292,782**

APPENDIX B DETAILED BACK-UP DOCUMENTATION FOR ESTIMATED CONSTRUCTION COSTS

Alternative 1 Plans



NOTE:
PRECAST DOUBLE BARREL 10 x 7 RCBC
TO BE USED AT STREET CROSSING
LOCATIONS TO EXPEDITE CONSTRUCTION.



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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
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ALTERNATE 1
PLAN AND PROFILE
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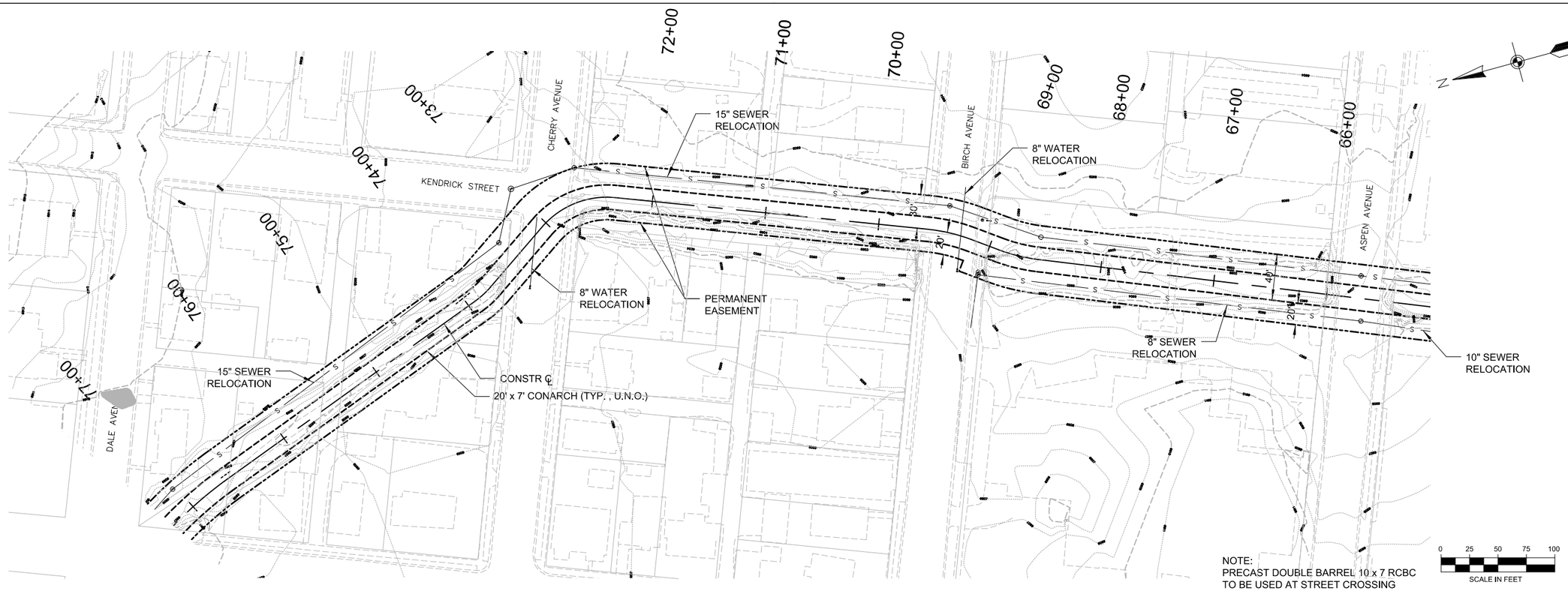
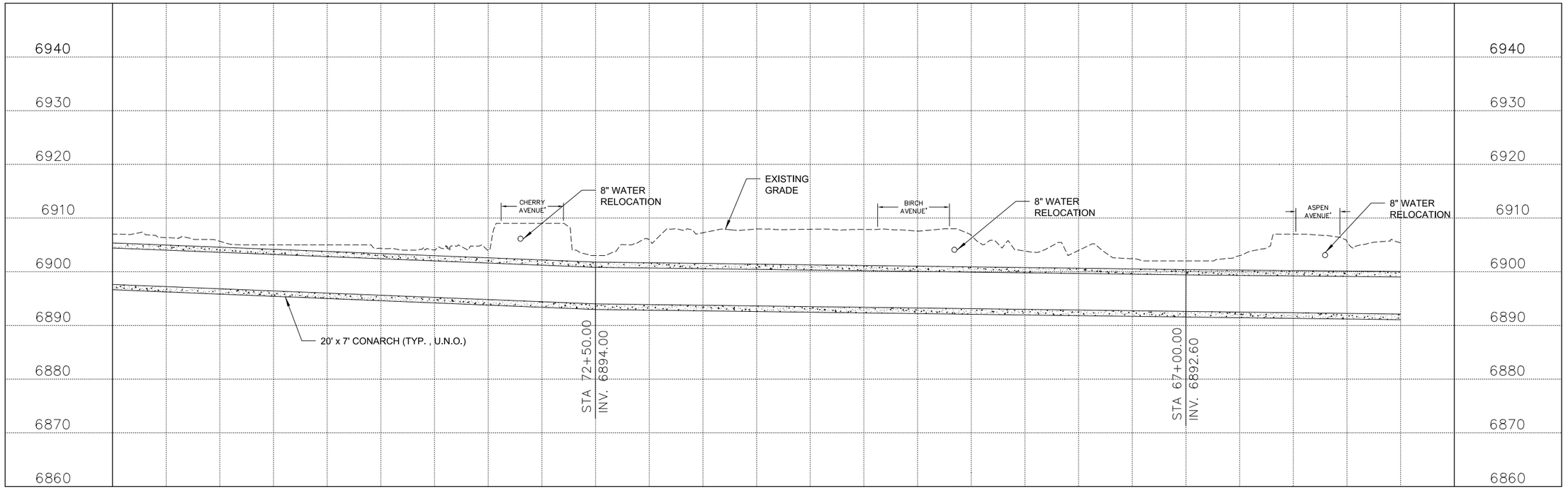


NOTE:
PRECAST DOUBLE BARREL 10 x 7 RCBC TO BE USED AT STREET CROSSING LOCATIONS TO EXPEDITE CONSTRUCTION.



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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
DATE:
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ALTERNATE 1
PLAN AND PROFILE
STA 77+00 TO 65+00

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DRAWING NO.
C-3.02

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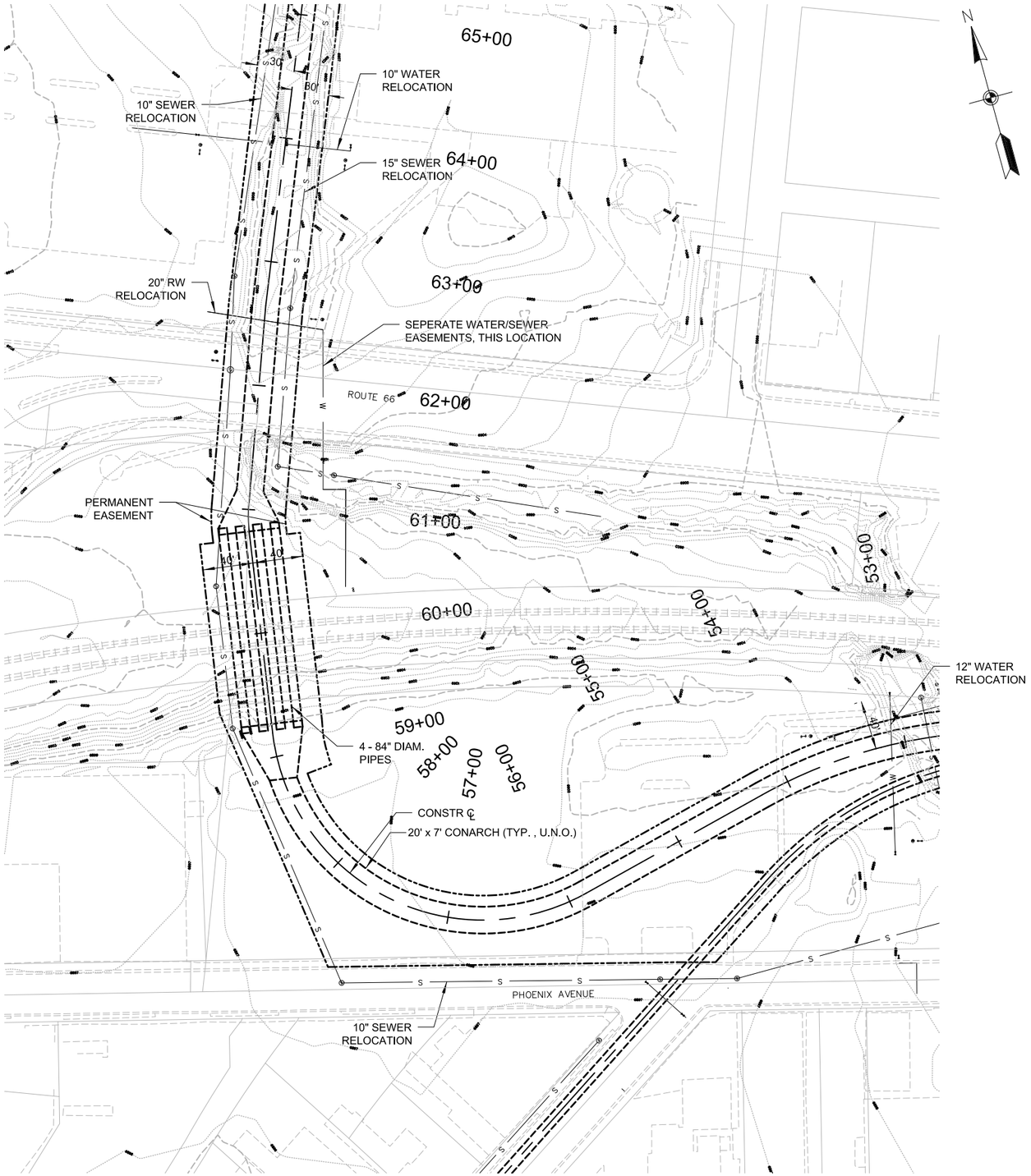

NOTE:
PRECAST DOUBLE BARREL 10 x 7 RCBC TO BE USED AT STREET CROSSING LOCATIONS TO EXPEDITE CONSTRUCTION.

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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
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ALTERNATE 1
PLAN
STA 53+00 TO 65+00

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NOTE:
PRECAST DOUBLE BARREL 10 x 7 RCBC
TO BE USED AT STREET CROSSING
LOCATIONS TO EXPEDITE CONSTRUCTION.

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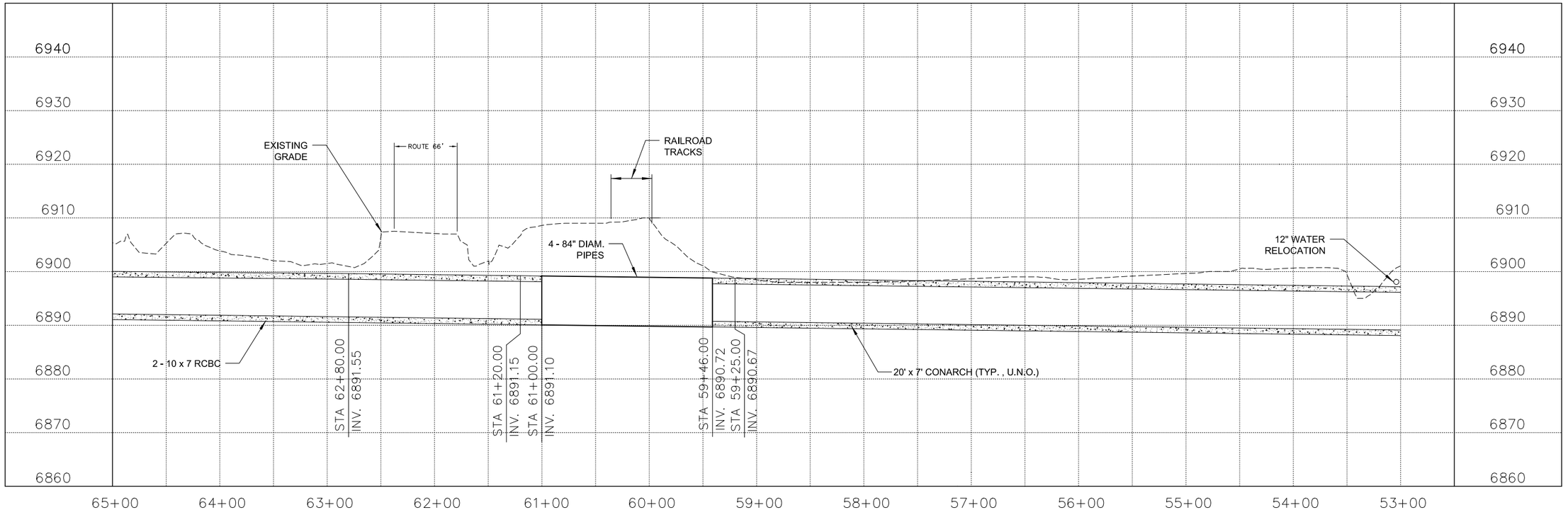

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
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ALTERNATE 1
PROFILE
STA 53+00 TO 65+00

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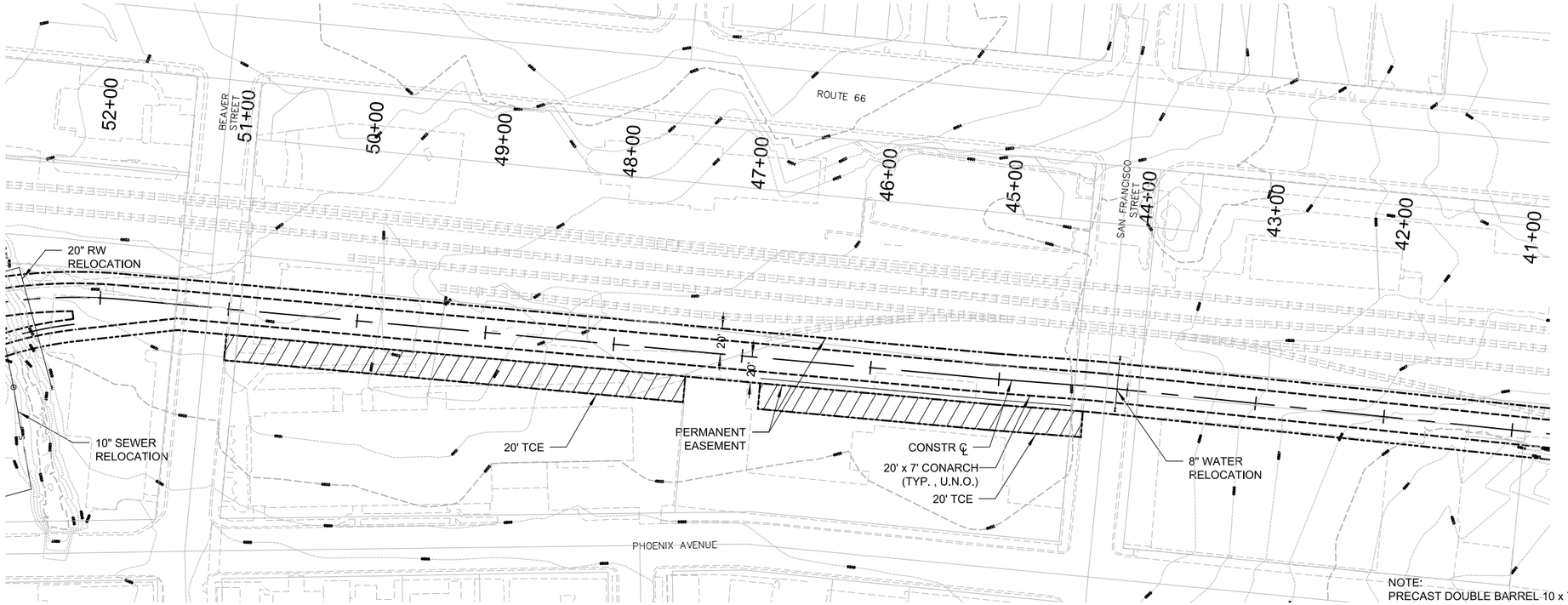

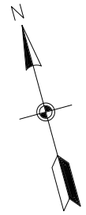

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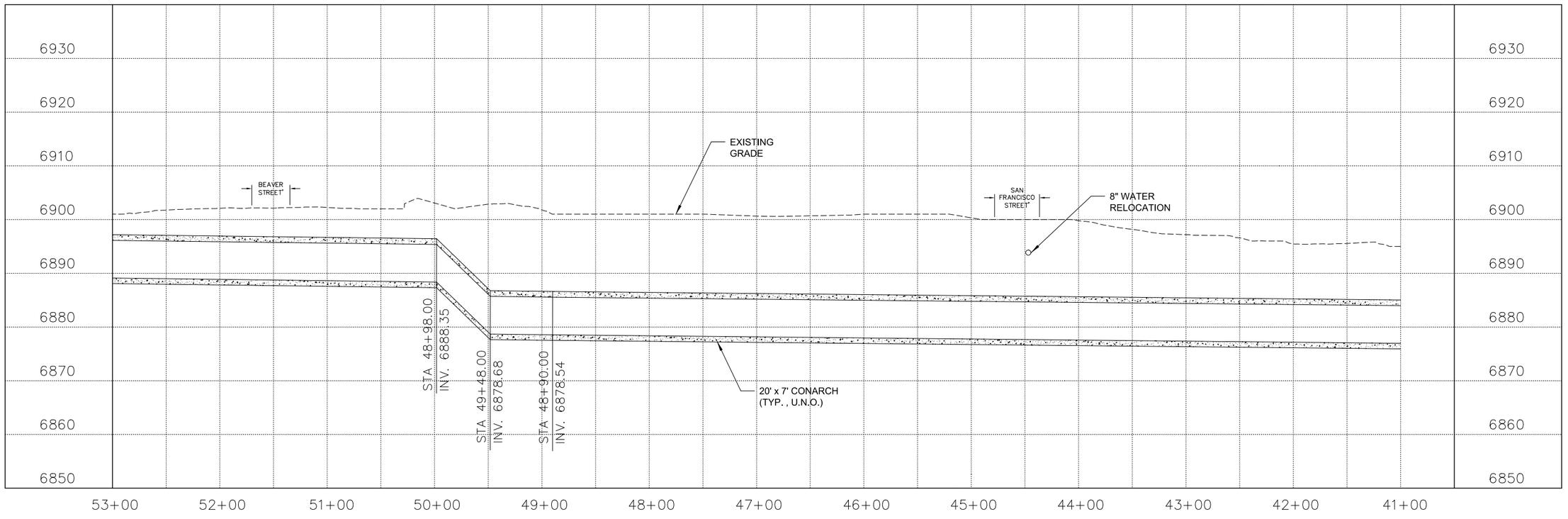
NOTE:
PRECAST DOUBLE BARREL 10 x 7 RCBC TO BE USED AT STREET CROSSING LOCATIONS TO EXPEDITE CONSTRUCTION.



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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 1
PLAN AND PROFILE
STA 41+00 TO 53+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

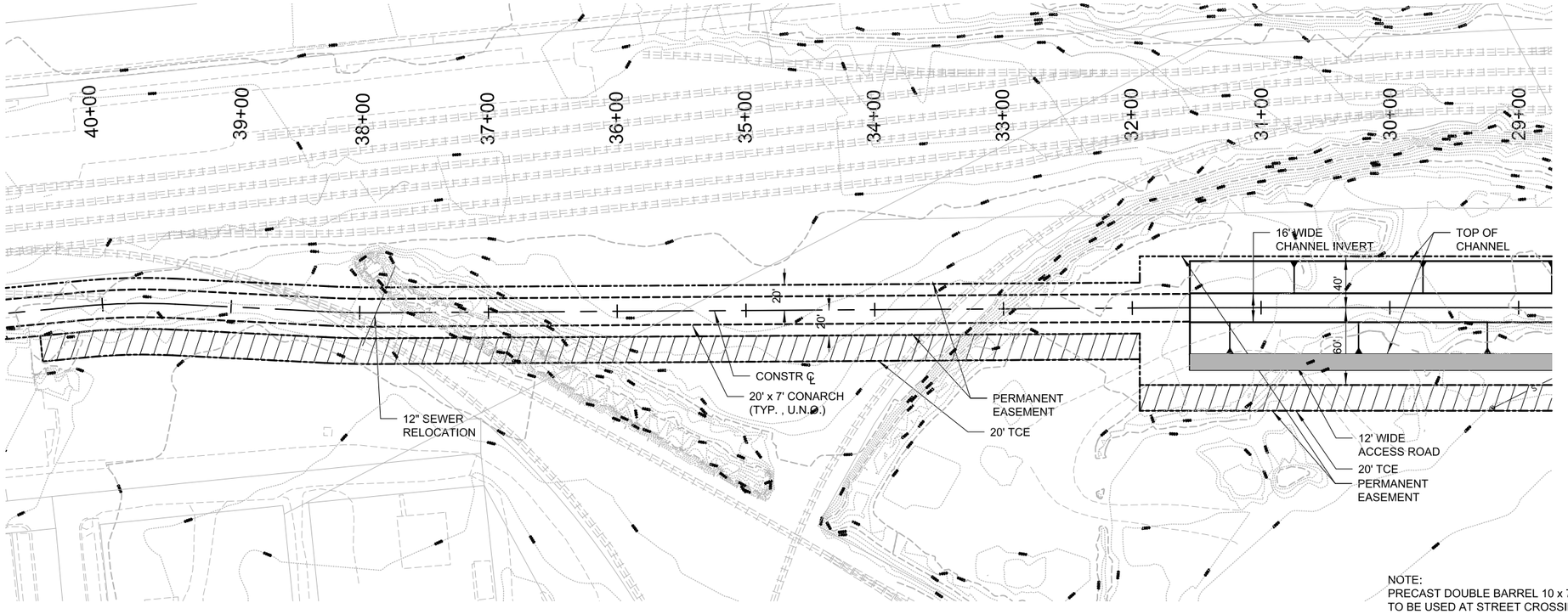
REVISIONS

NO.	DESCRIPTION	DATE	BY

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-3.05

SHT NO. OF



NOTE:
PRECAST DOUBLE BARREL 10 x 7 RCBC
TO BE USED AT STREET CROSSING
LOCATIONS TO EXPEDITE CONSTRUCTION.

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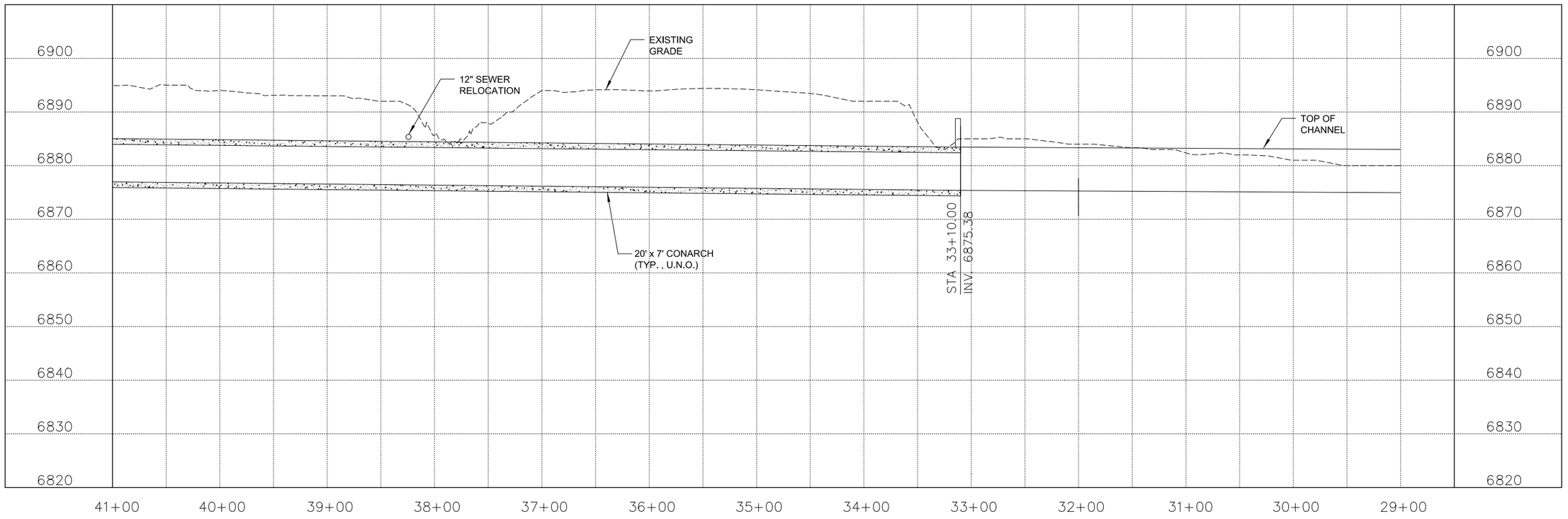
SCALE IN FEET



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RIO DE FLAG CHANNEL IMPROVEMENTS

RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF
ARIZONA

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 1
PLAN AND PROFILE
STA 29+00 TO 413+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

REVISIONS

NO.	DESCRIPTION	DATE	BY

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-3.06

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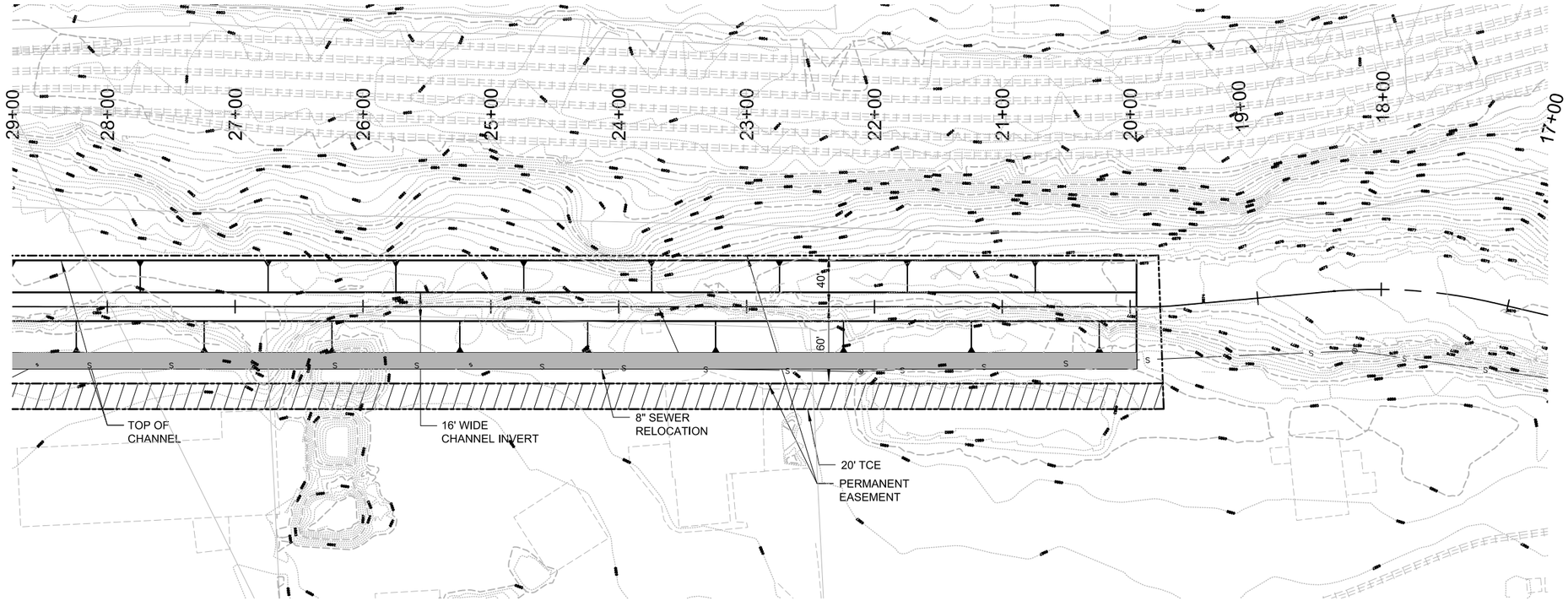

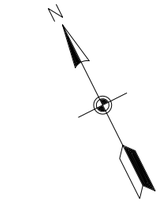

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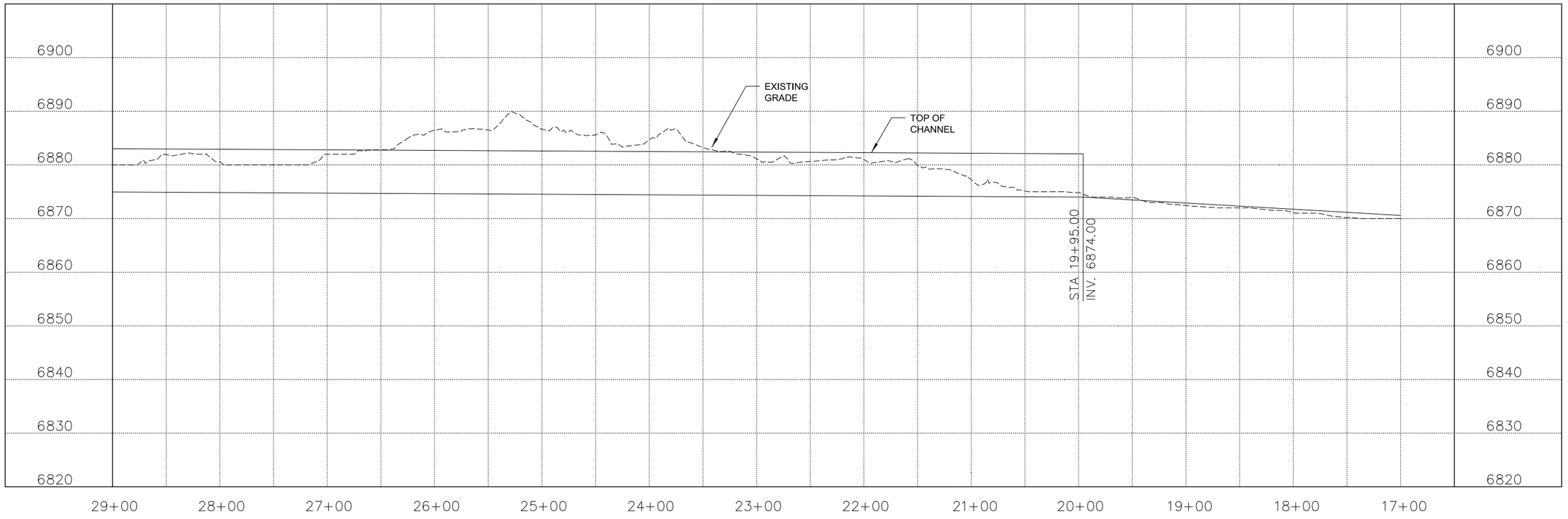

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
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CHECKED:

ALTERNATE 1
PLAN AND PROFILE
STA 17+00 TO 29+00

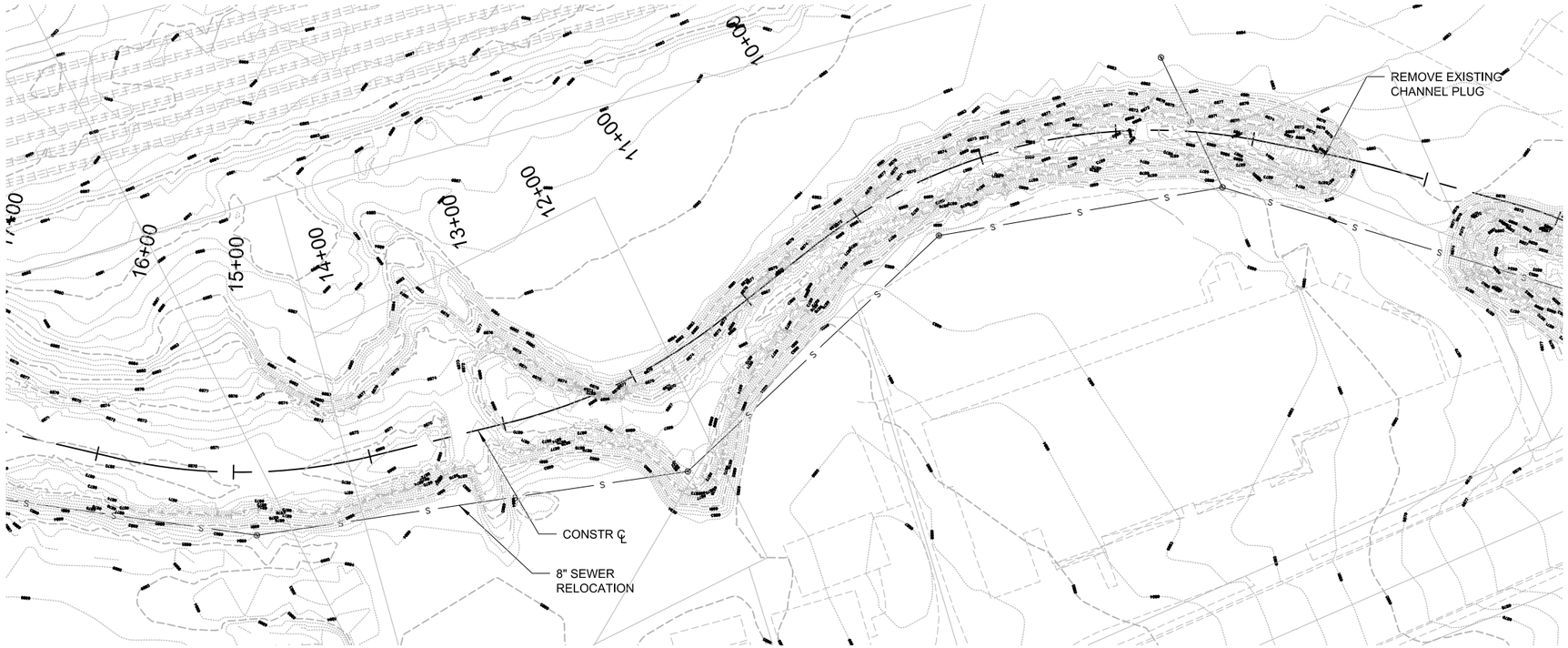
Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

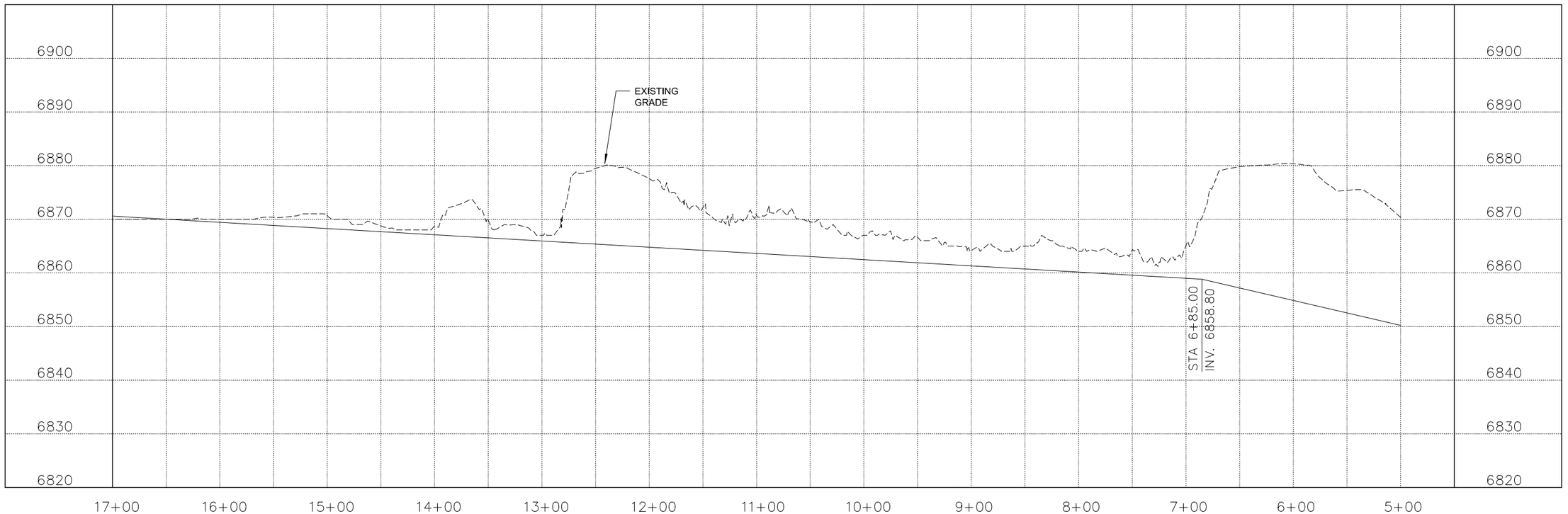
REVISIONS			
NO.	DESCRIPTION	DATE	BY

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-3.07

SHT NO. OF





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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
DATE:
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CHECKED:

ALTERNATE 1
PLAN AND PROFILE
STA 5+00 TO 17+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

REVISIONS			
NO.	DESCRIPTION	DATE	BY

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-3.08

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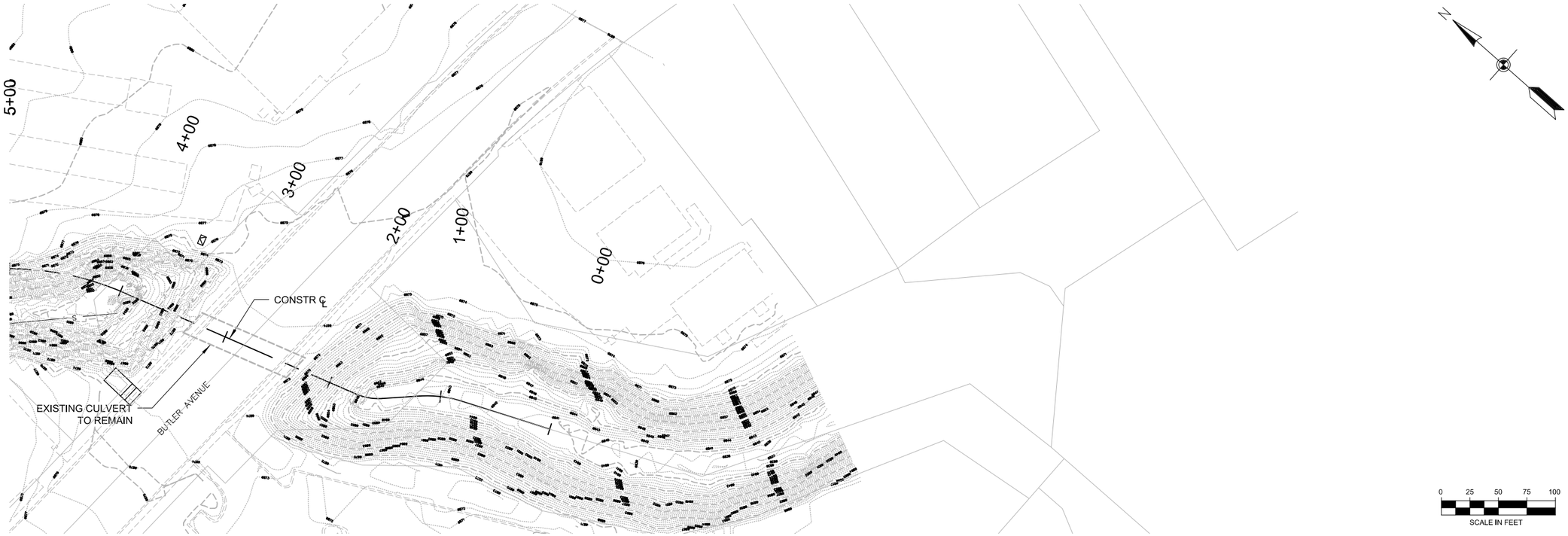

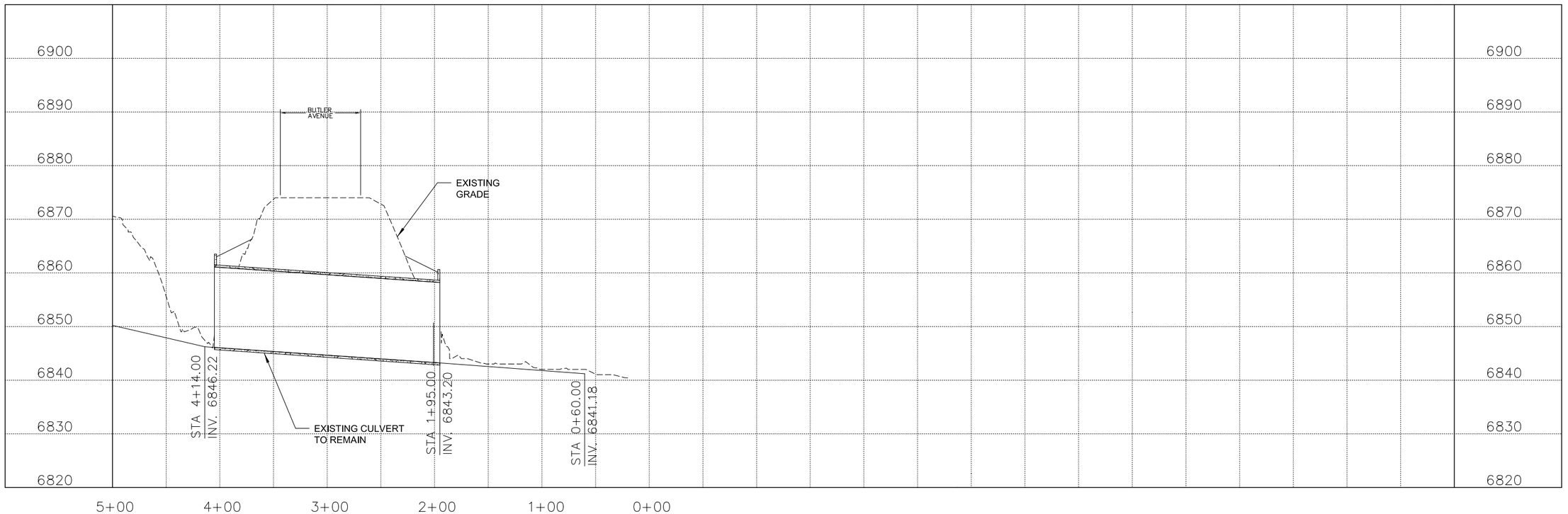

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 1
PLAN AND PROFILE
STA 0+00 TO 5+00

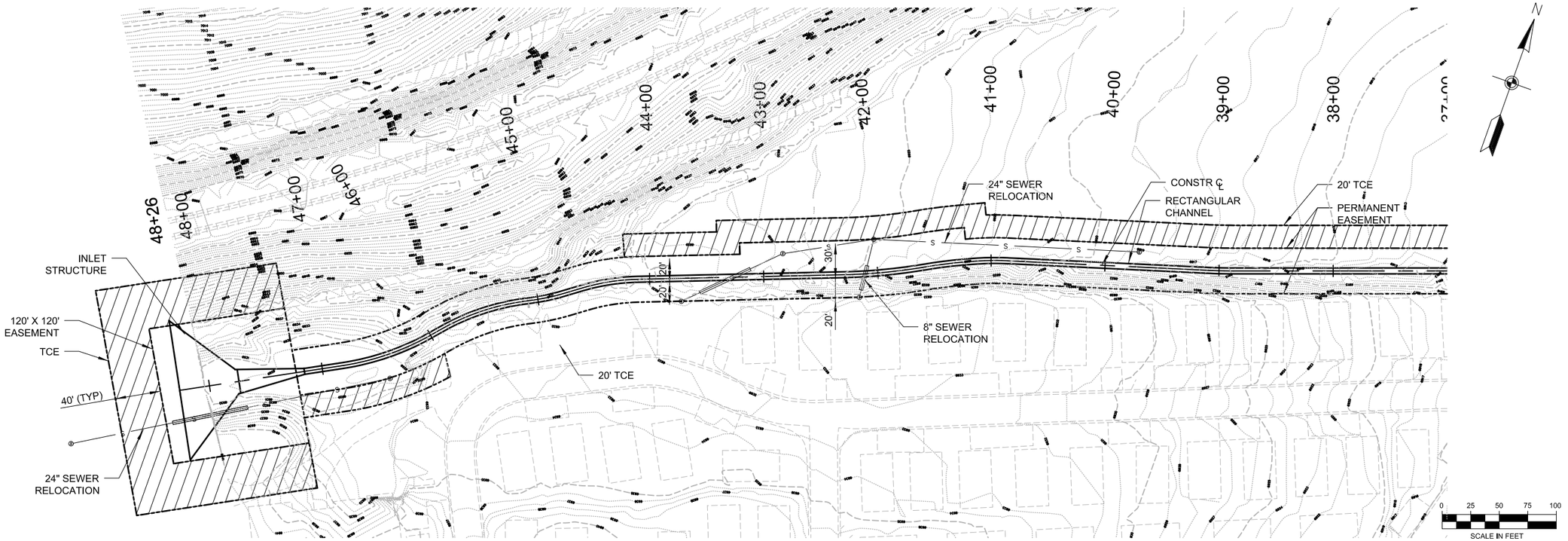
Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

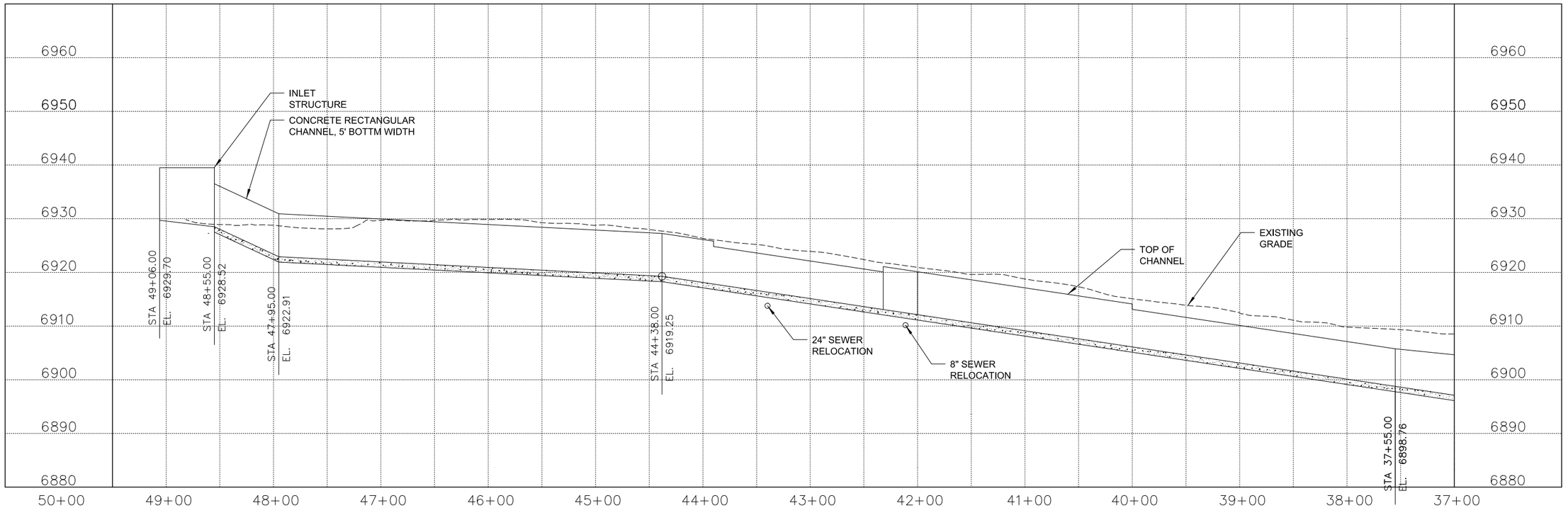
NO.	DESCRIPTION	DATE	BY
	REVISIONS		

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-3.09

SHT NO. | OF





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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

CLAY AVENUE IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 1
PLAN AND PROFILE
STA 38+00 TO 49+06

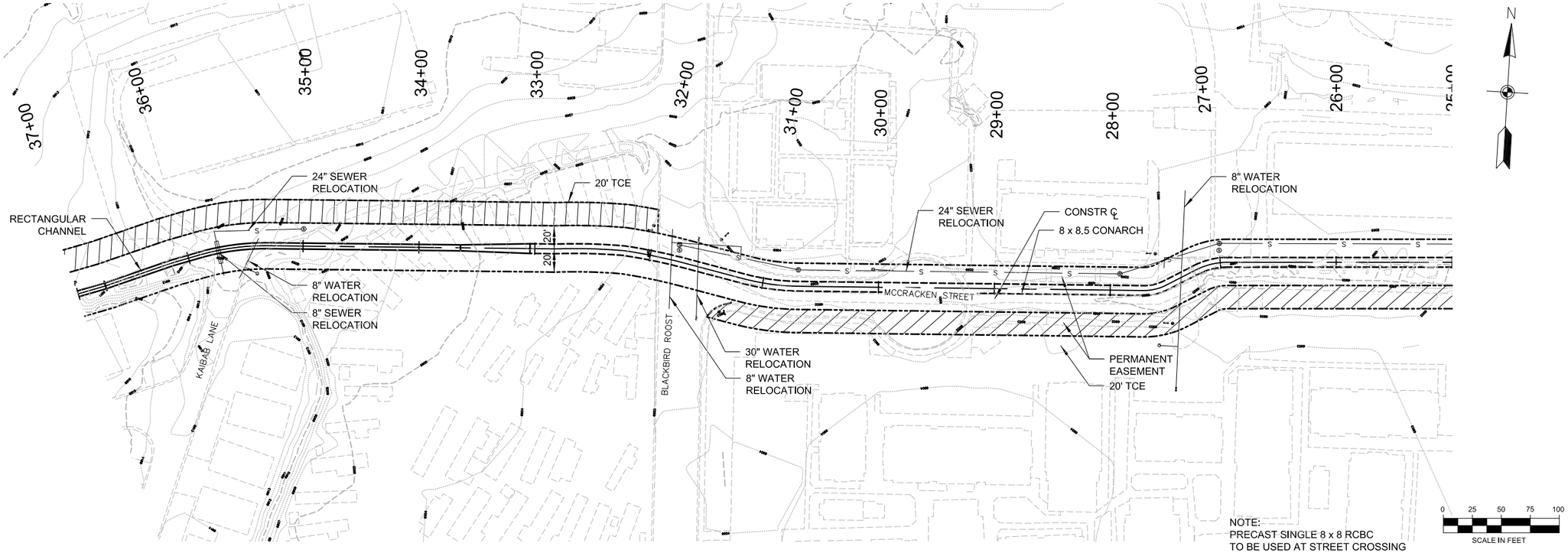
Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

REVISIONS			
NO.	DESCRIPTION	DATE	BY

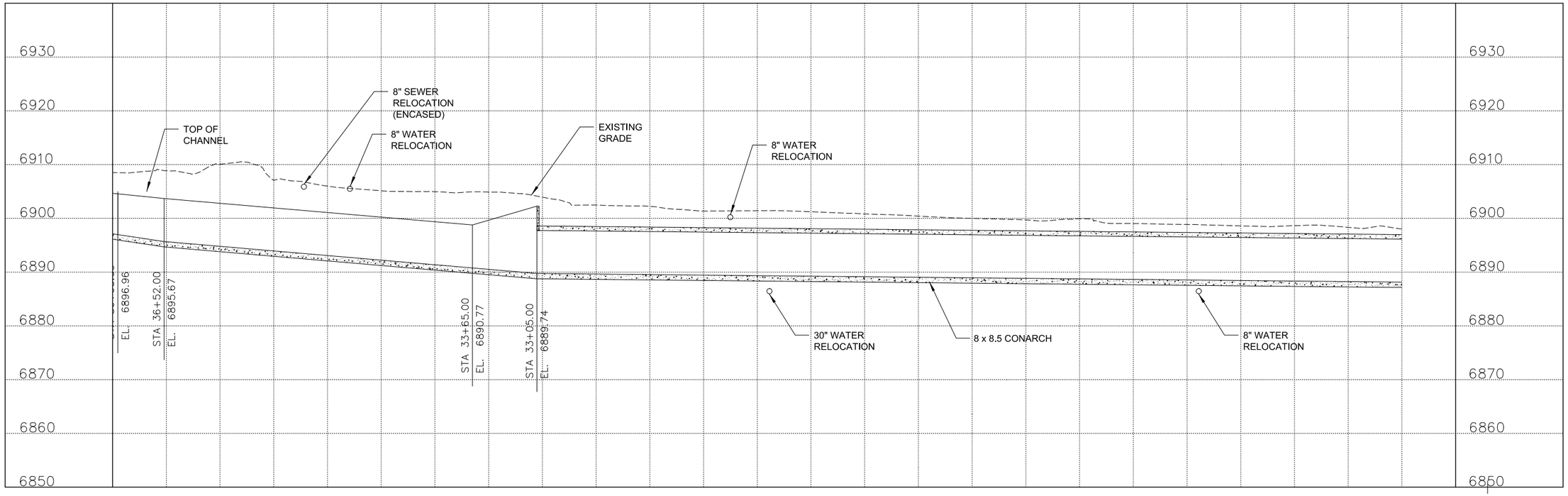
CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-3.10

SHT NO. OF



NOTE:
PRECAST SINGLE 8 x 8 RCBC
TO BE USED AT STREET CROSSING
LOCATIONS TO EXPEDITE CONSTRUCTION.



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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

CLAY AVENUE IMPROVEMENTS

JOB NO:
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CHECKED:

ALTERNATE 1
PLAN AND PROFILE
STA 26+00 TO 36+95

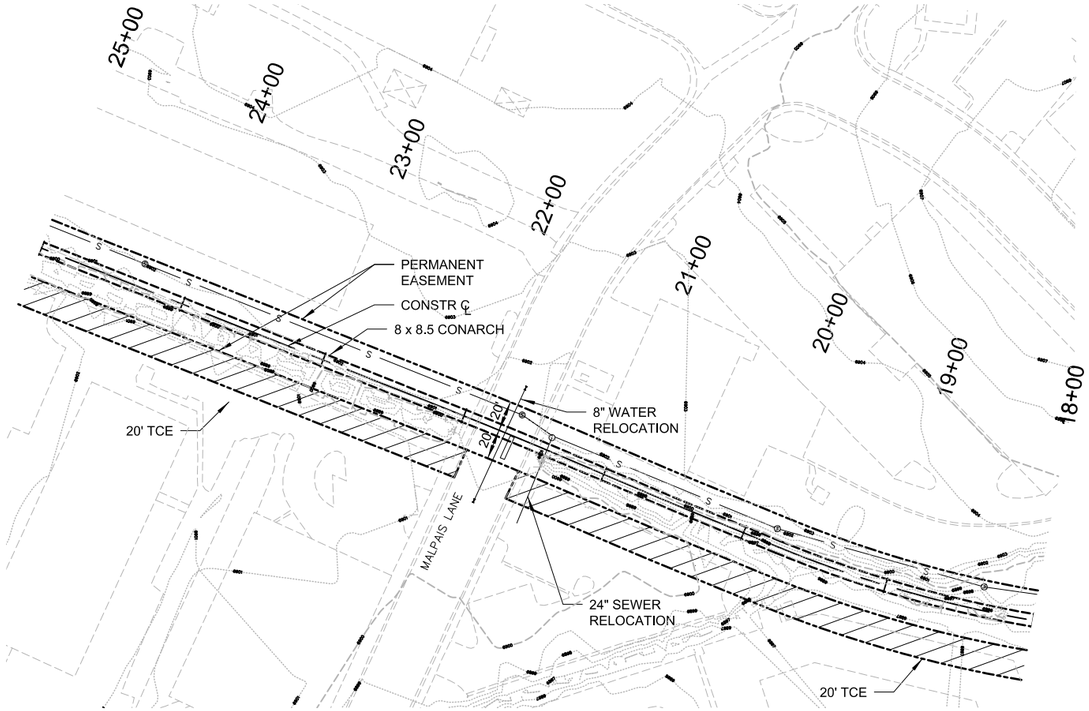
Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

REVISIONS			
NO.	DESCRIPTION	DATE	BY

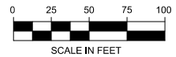
CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

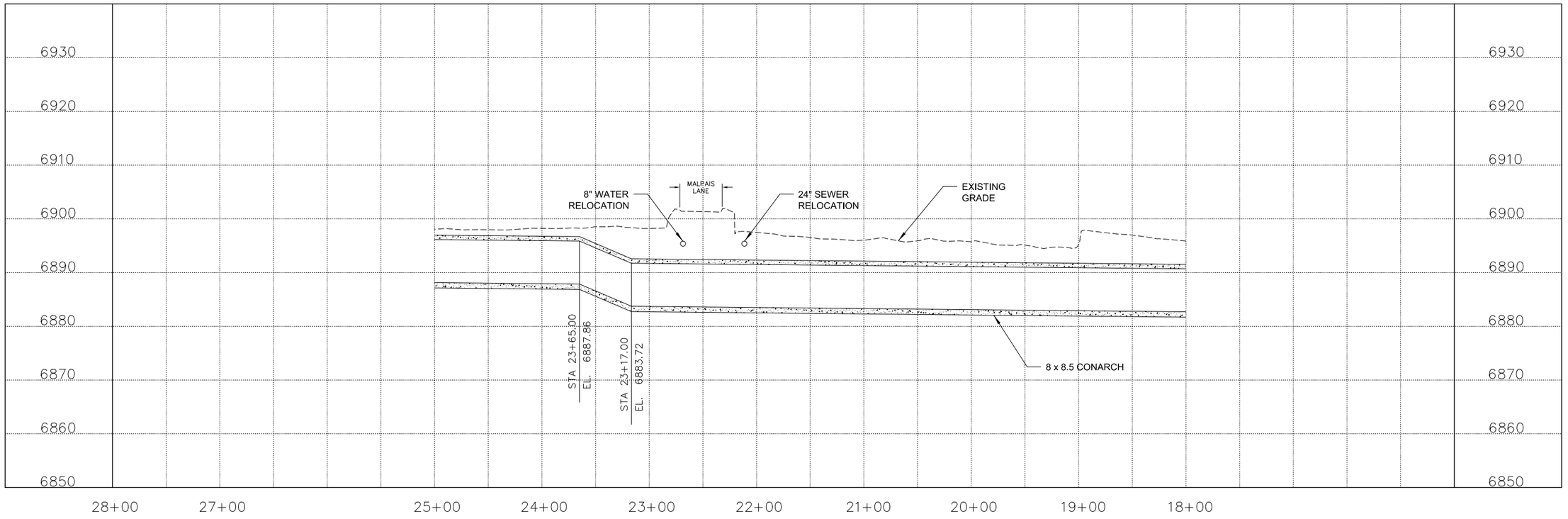
DRAWING NO.
C-3.11

SHT NO. OF



NOTE:
PRECAST SINGLE 8 x 8 RCBC
TO BE USED AT STREET CROSSING
LOCATIONS TO EXPEDITE CONSTRUCTION.





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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

CLAY AVENUE IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 1
PLAN AND PROFILE
STA 19+00 TO 28+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

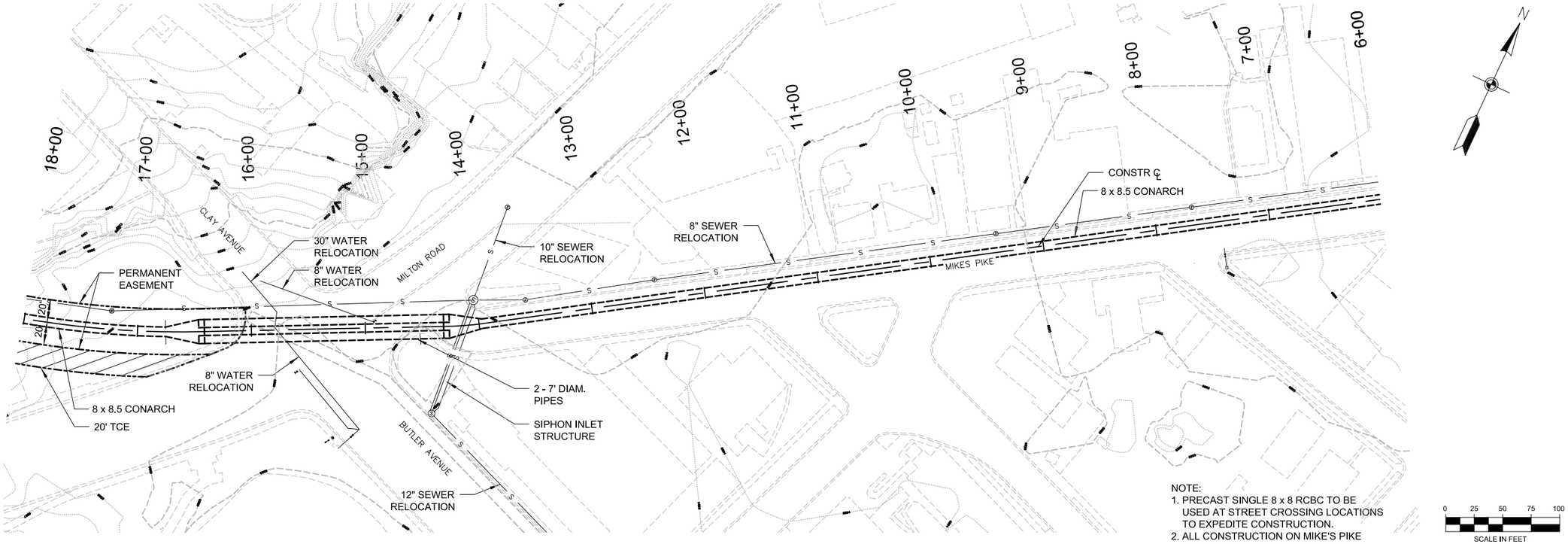
REVISIONS

NO.	DESCRIPTION	DATE	BY

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

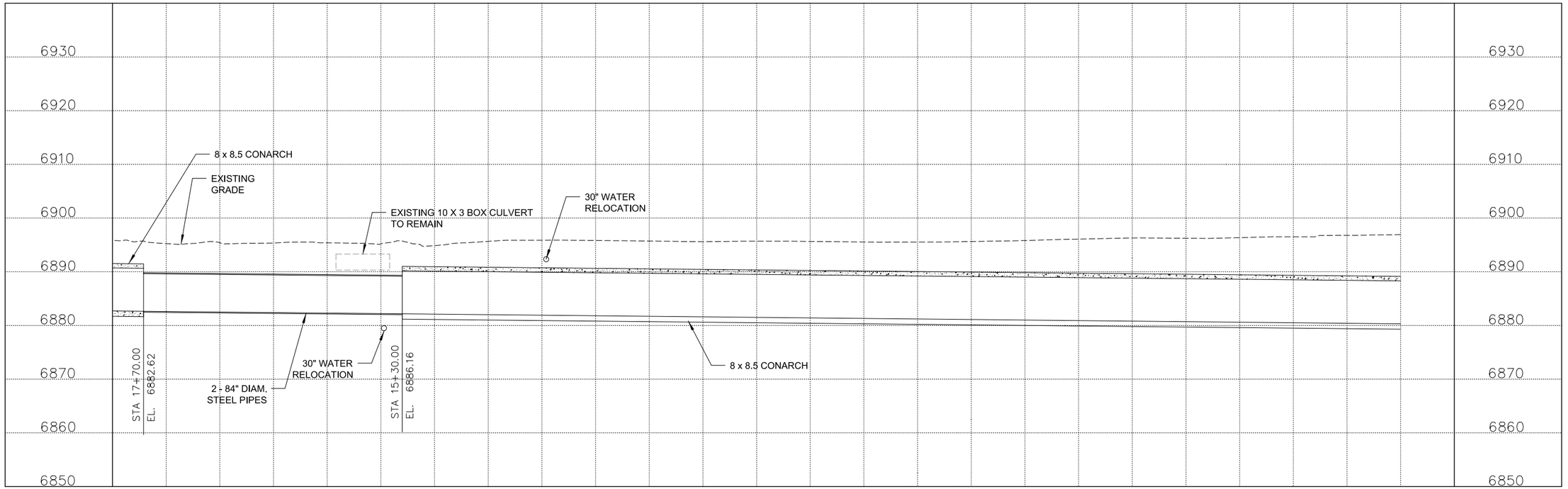
DRAWING NO.
C-3.12

SHT NO. | OF



NOTE:
1. PRECAST SINGLE 8 x 8 RCBC TO BE USED AT STREET CROSSING LOCATIONS TO EXPEDITE CONSTRUCTION.
2. ALL CONSTRUCTION ON MIKE'S PIKE TO BE WITHIN PUBLIC RIGHT-OF-WAY.

0 25 50 75 100
SCALE IN FEET



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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

CLAY AVENUE / MIKES PIKE IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 1
PLAN AND PROFILE
STA 7+00 TO 19+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

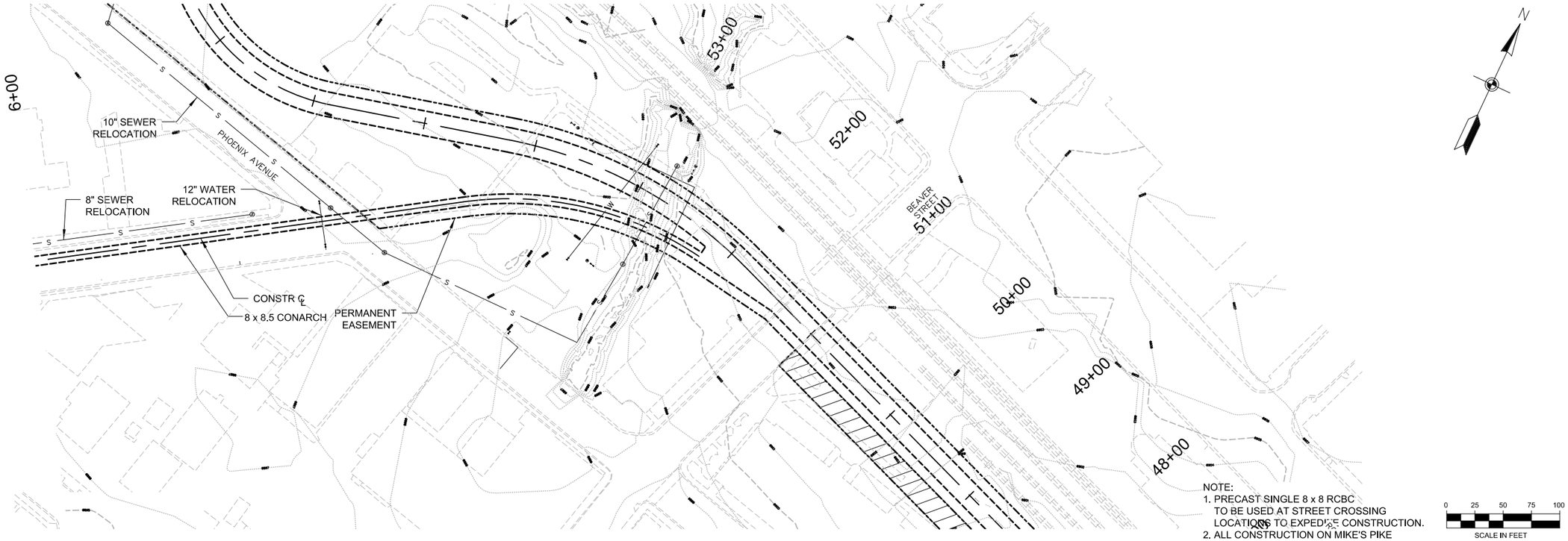
REVISIONS

NO.	DESCRIPTION	DATE	BY

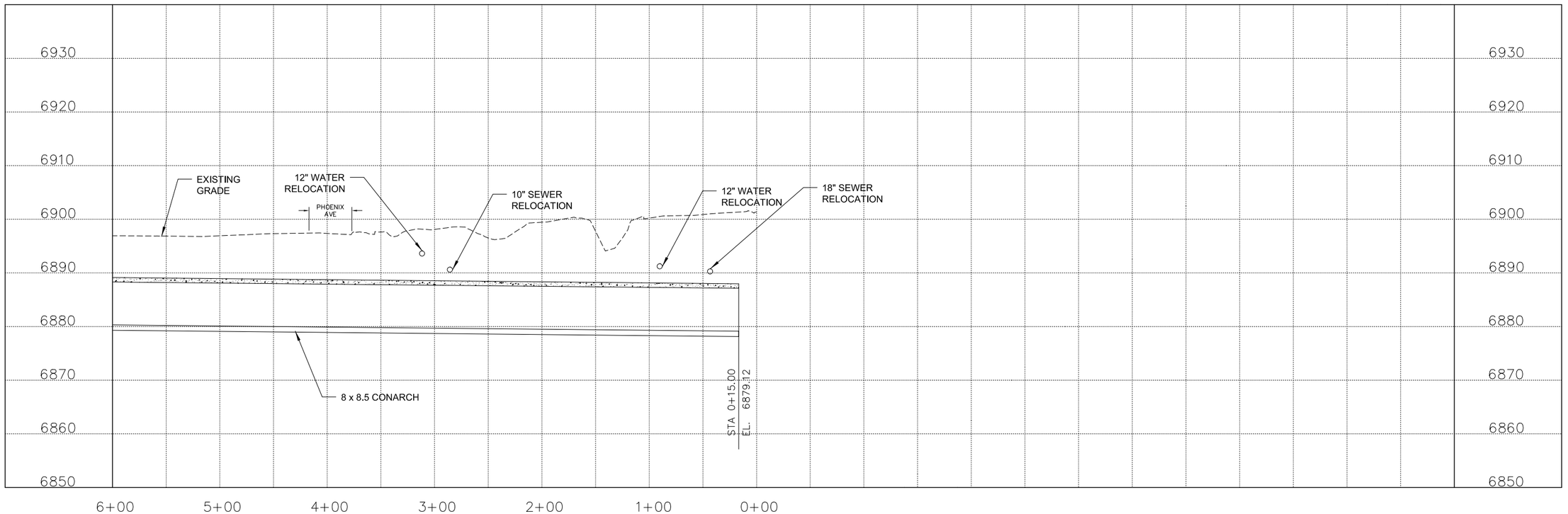
CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-3.13

SHT NO. OF



NOTE:
1. PRECAST SINGLE 8 x 8 RCBC TO BE USED AT STREET CROSSING LOCATIONS TO EXPEDITE CONSTRUCTION.
2. ALL CONSTRUCTION ON MIKE'S PIKE TO BE WITHIN PUBLIC RIGHT-OF-WAY.



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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

MIKES PIKE / CONFLUENCE IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 1
PLAN AND PROFILE
STA 0+00 TO 7+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

REVISIONS			
NO.	DESCRIPTION	DATE	BY

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-3.14

SHT NO. | OF

Alternative 1 Cost Sheet

CITY OF FLAGSTAFF

RIO DE FLAG FLOOD CONTROL DESIGN CONCEPT PROJECT

ALTERNATE 1 - COST ESTIMATE (DRAFT)

Sheet 1 of 2 April 22, 2014

Michael Baker Jr., Inc.

	Description	Quantity	UoM	Unit Cost	Total Cost
	Prime Bond	**1.00**	**LS**		**$356,944.75**
	Price % Add-On	**1.00**	**LS**		**$8,937,088.80**
1	**Generals**	**1.00**	**LS**		**$3,938,641.21**
2	**Rio De Flag East Reach**	1.00	LS		**$9,457,453.43**
2.1	**Removals**	**1.00**	**LS**		**$23,546.79**
2.2	**Clear and Grub**	**10.00**	**AC**	**$3,404.09**	**$34,040.94**
2.3	**Water Utility Relocation and Realignments**	**1.00**	**LS**		**$94,500.47**
2.4	**Sewer Utility Relocation and Realignments**	**1.00**	**LS**		**$639,634.38**
2.5	**Structural Excavation and Backfill**	**1.00**	**LS**		**$2,463,246.55**
2.5.1	Channel Excavation to Haul off	66,000.00	CY	$15.38	$1,015,172.40
2.5.2	Channel Excavation Contaminated Soil Haul off	500.00	CY	$136.00	$67,998.63
2.5.3	Hard Dig Contingency	6,600.00	CY	$68.75	$453,764.98
2.5.4	Import from stockpile, Place & Compact	41,000.00	CY	$22.10	$906,067.64
2.5.5	Site Grading	18,000.00	SY	$1.12	$20,242.90
2.6	**Concrete Structures**	**1.00**	**LS**		**$2,917,129.81**
2.6.2	Con-Arch 1 Barrel x 20 x 7	2,191.00	LF	$907.56	$1,988,473.99
2.6.3	2 10x7 Precast Box Culvert	112.00	LF	$1,277.09	$143,034.57
2.6.4	Slide Rail	4.00	MO	$51,082.42	$204,329.66
2.6.5	Transition	234.00	LF	$1,186.65	$277,677.13
2.6.7	Grouted Rip Rap 12"	1,226.00	CY	$178.60	$218,967.48
2.6.8	Transition - Arched or Box to Pre-cast Box 20 x 7	5.00	EA	$16,929.40	$84,646.98
2.7	**Street and Road Reconstruction**	**1.00**	**LS**		**$79,055.62**
2.8	**Landscaping Restoration**	**10.00**	**AC**	**$76,230.00**	**$762,300.00**
2.9	**Tree Replacement**	**40.00**	**EA**	**$2,500.00**	**$100,000.00**
2.10	**Striping**	**1.00**	**Each**	**$30,677.68**	**$30,677.68**
2.11	**Rail Road Shoring 1600 lf Butler to east of San Francisco**	**1.00**	**Each**	**$2,000,000.00**	**$2,000,000.00**
2.12	**Rail Road Insurance, Flagging, Inspection**	**1.00**	**LS**		**$150,000.00**
2.13	**Shore and lagging for building**	**350.00**	**LF**	**$466.63**	**$163,321.20**
3	**Rio De Flag North Reach**	1.00	LS		**$9,387,905.46**
3.1	**Removals**	1.00	LS		**$237,637.85**
3.2	**Clear and Grub**	6.00	AC	$8,551.52	**$51,309.10**
3.3	**Water Utility Relocation and Realignments**	1.00	LS		**$432,088.52**
3.4	**Sewer Utility Relocation and Realignments**	1.00	LS		**$1,045,404.50**
3.5	**Structural Excavation and Backfill**	1.00	LS		**$3,165,442.45**
3.5.1	Channel Excavation to Haul off	50,000.00	CY	$17.33	$866,476.35
3.5.2	Channel Excavation Contaminated Soil Haul off	500.00	CY	$120.39	$60,195.06
3.5.3	Hard Dig Contingency	5,000.00	CY	$69.07	$345,332.07
3.5.4	Jack and Bore Rail Road for box *	100.00	LF	$9,200.00	$920,000.00
3.5.6	Jack and bore for sewer	1.00	LS	$415,000.00	$415,000.00
3.5.7	Import from stockpile, Place & Compact	25,000.00	CY	$21.80	$544,943.70
3.5.8	Site Grading	12,000.00	SY	$1.12	$13,495.27
3.6	**Concrete Structures**	1.00	LS		**$3,039,630.19**
3.6.2	Con-Arch 1 Barrel x 20 x 7 *	2,399.00	LF	$899.28	$2,157,374.20
3.6.3	10x7 Precast Box Culvert at Beal*	60.00	LF	$1,219.99	$73,199.12
3.6.4	48" Culverts at Roadway Crossings	269.00	LF	$100.00	$26,900.00
3.6.5	Slide Rail	6.00	MO	$50,064.03	$300,384.18
3.6.6	Grouted Rip Rap 24" *	840.00	CY	$166.19	$139,595.75
3.6.7	Junction Sturcture - Arched to Steel Pipe: at rt 66, confluence	3.00	EA	$43,510.66	$130,531.98
3.6.8	Transition - Arched or Box to Pre-cast Box 20 x 7	9.00	EA	$16,929.40	$152,364.56
3.6.9	Sewage By-Pass while installing new box*	1.00	EA	$59,280.40	$59,280.40
3.7	**Street and Road Reconstruction**	1.00	LS		**$705,439.62**
3.8	**Signage**	1.00	LS		**$13,912.50**
3.9	**Striping**	1.00	Each	$25,342.68	**$25,342.68**
3.10	**Concrete Trail with foot soft Shoulders**	25,540.00	SF	$4.97	**$126,818.06**
3.11	**Landscaping Restoration**	6.00	AC	$76,230.00	**$457,380.00**
3.12	**Tree Replacement**	35.00	EA	$2,500.00	**$87,500.00**
4	**Clay Avenue "West" Reach**	1.00	LS		**$11,508,236.93**
4.1	**Removals**	1.00	LS		**$161,406.89**
4.2	**Clear and Grub**	5.00	AC	$7,780.62	**$38,903.09**
4.3	**Water Utility Relocation and Realignments**	1.00	LS		**$743,909.55**
4.4	**Sewer Utility Relocation and Realignments**	1.00	LS		**$1,581,733.35**
4.5	**Structural Excavation and Backfill**	1.00	LS		**$3,567,904.78**
4.5.1	Channel Excavation to Stockpile	52,000.00	CY	$19.63	$1,020,832.80
4.5.2	Channel Excavation Contaminated Soil Haul off	500.00	CY	$136.00	$67,998.63
4.5.3	Hard Dig Contingency	10,400.00	CY	$69.07	$718,290.71
4.5.4	Jack and Bore 5 Points	215.00	LF	$4,493.02	$966,000.00
4.5.5	Import from stockpile, Place & Compact	31,000.00	CY	$25.17	$780,162.77
4.5.6	Site Grading	13,000.00	SY	$1.12	$14,619.87

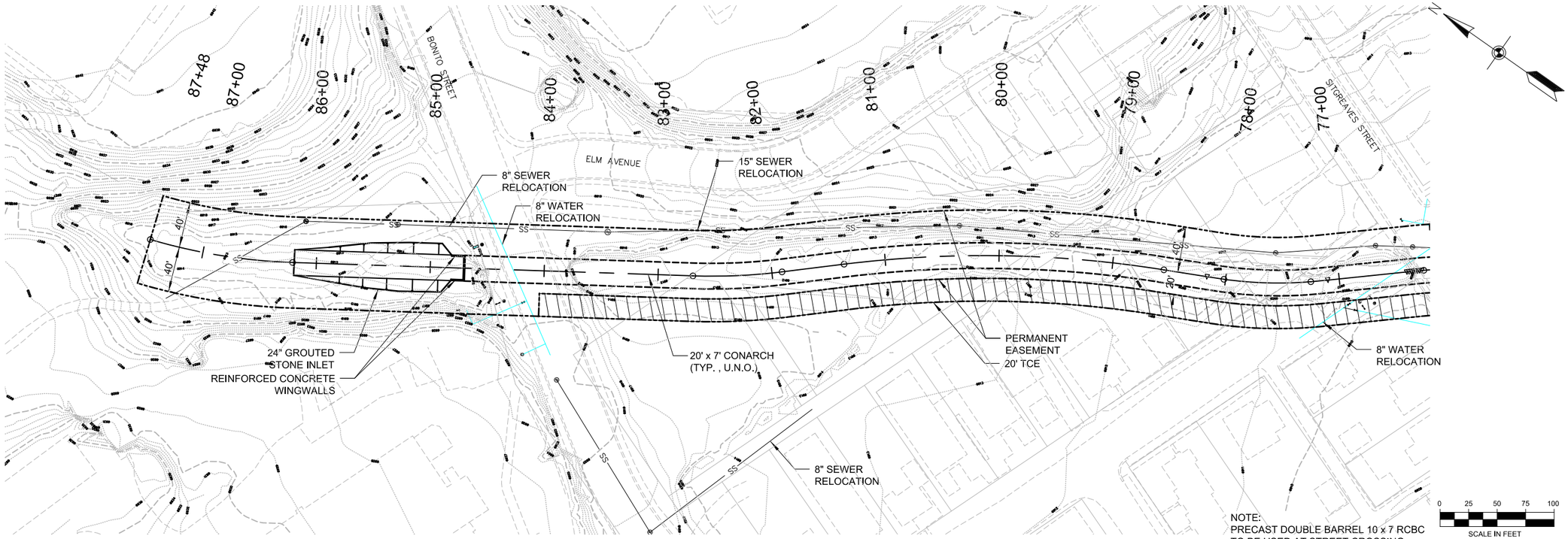
CITY OF FLAGSTAFF
RIO DE FLAG FLOOD CONTROL DESIGN CONCEPT PROJECT
ALTERNATE 1 - COST ESTIMATE (DRAFT)
Sheet 2 of 2

Michael Baker Jr., Inc.

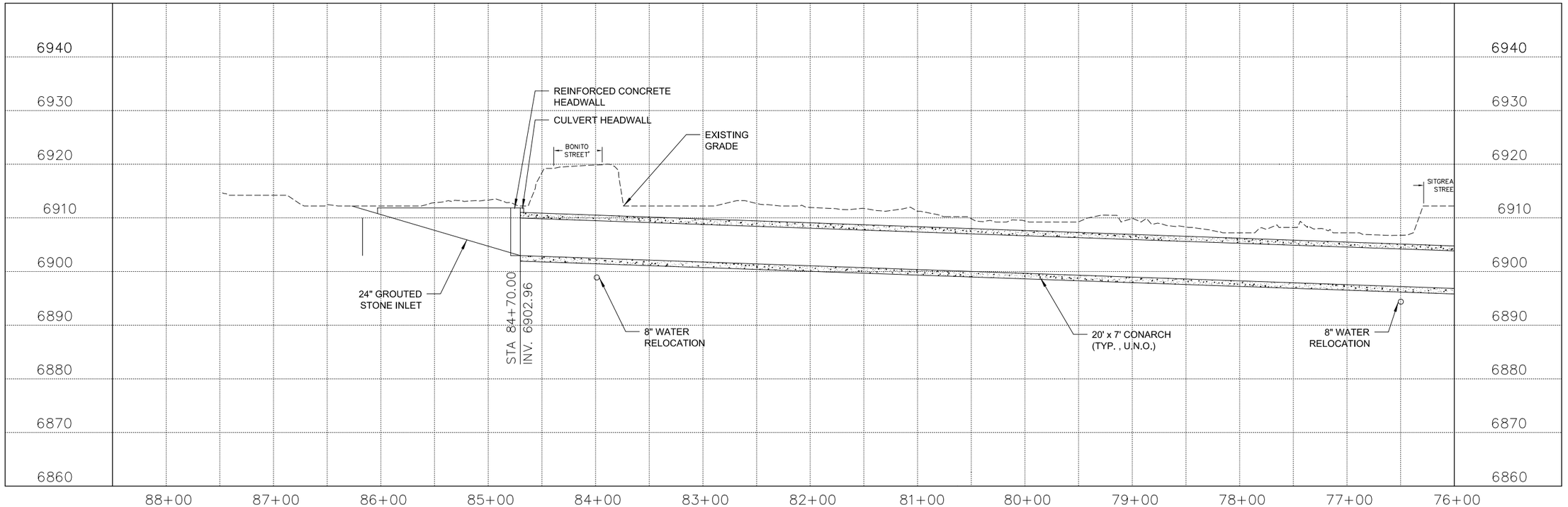
	Description	Quantity	UoM	Unit Cost	Total Cost
4.6	**Concrete Structures**	1.00	LS		**$3,905,478.16**
4.6.1	Cast in Place Open U-channel	1,040.00	LF	$809.86	$842,257.73
4.6.3	Con-Arch 1 Barrel x 8 x 8.5	3,426.00	LF	$632.57	$2,167,176.78
4.6.5	Single 8x8 Precast Box Culvert	378.00	LF	$949.99	$359,094.43
4.6.6	Slide Rail	5.00	MO	$59,082.42	$295,412.08
4.6.7	Cast in Place Inlet Stucture	1.00	EA	$92,579.01	$92,579.01
4.6.8	Transition CIP to Pre-cast - 8 x 8.5	6.00	Each	$10,322.80	$61,936.81
4.6.9	Junction Sturcture - Arched to Steel Pipe	2.00	EA	$43,510.66	$87,021.32
4.7	**Street and Road Reconstruction**	1.00	LS		**$1,017,571.94**
4.7.1	Street Paving 4on6	4,725.00	SY	$17.96	$84,865.21
4.7.2	Street Paving 3on6	2,702.00	SY	$18.49	$49,959.41
4.7.3	Parking lot Paving	363.00	SY	$31.62	$11,478.92
4.7.4	ADOT Paving	2,809.00	SY	$58.98	$165,672.81
4.7.5	Misc Concrete surfaces	32,461.00	SF	$6.78	$220,139.81
4.7.6	Valley Gutter/Aprons Mag Dtl 240 modified	1,408.00	SF	$9.82	$13,819.85
4.7.7	Vertical Curb & Gutter Mag Dtl 220 Type A, H=6"	4,400.00	LF	$14.43	$63,484.10
4.7.8	Single Curb Mag Dtl 222 Type A, H=6"	99.00	LF	$12.01	$1,189.38
4.7.9	Sidewalk ADOT c5.30	1,044.00	SF	$4.71	$4,912.79
4.7.10	Sidewalk Mag Dtl 230 or P-1230 (Hand Placed Only)	17,545.00	SF	$6.14	$107,807.59
4.7.11	Sidewalk Stamped	3,601.00	SF	$5.97	$21,483.00
4.7.12	Sidewalk Ramp Mag 235-1	1,133.00	SF	$6.06	$6,863.55
4.7.13	Driveway Entrance Mag Dtl 250-1or2	3,949.00	SF	$6.78	$26,780.82
4.7.14	Driveway Entrance Mag Dtl MOD	70.00	SF	$6.78	$474.72
4.7.15	Bus Bay Ramp COF type F	266.00	SF	$33.35	$8,872.23
4.7.16	Install Salvaged Bus Shelters	3.00	EA	$5,932.12	$17,796.36
4.7.17	Construct Trash enclosure	2.00	EA	$13,084.80	$26,169.60
4.7.18	Aggregate Base Course Driveway	181.00	SY	$8.68	$1,570.96
4.7.19	Adjust Water Meter Box	20.00	EA	$655.06	$13,101.24
4.7.20	Adjustment - 5' Manhole Mag Dtl 420 & 424	15.00	EA	$215.00	$3,225.00
4.7.21	Adjustment - Gate Valve, Valve Box & Cover	13.00	EA	$185.00	$2,405.00
4.7.22	Adjust Clean Out	1.00	EA	$150.00	$150.00
4.7.23	Catchbasin MAG 531 5'-6"	18.00	EA	$2,290.67	$41,232.01
4.7.24	533 Catch Basins Type D	1.00	EA	$4,556.96	$4,556.96
4.7.25	Catch Basin 550 Catchbasin street wide	2.00	EA	$9,424.80	$18,849.59
4.7.26	Catchbasin MAG 537	1.00	EA	$4,795.72	$4,795.72
4.7.27	18" RGRCP	388.00	LF	$109.54	$42,500.80
4.7.28	36" RGRCP, Adj Class __	59.00	LF	$355.01	$20,945.35
4.7.29	24" RGRCP, Adj Class __	21.00	LF	$146.92	$3,085.40
4.7.30	48" RGRCP, Adj Class __	59.00	LF	$215.18	$12,695.78
4.7.31	Hand Placed Riprap	5.00	CY	$186.83	$934.14
4.7.33	Parkway Grading	20,000.00	SY	$0.79	$15,753.85
4.8	**Signage**	1.00	LS		$13,912.50
4.9	**Striping**	1.00	EA	$30,467.68	$30,467.68
4.10	**Landscaping Restoration**	5.00	AC	$76,230.00	$381,150.00
4.11	**Tree Replacement**	24.00	EA	$2,500.00	$60,000.00
4.12	**ABC Service Road**	1,600.00	SY	$3.62	$5,799.00
5	**Trapazoid Channel**	1,200.00	LF	$1,272.19	**$1,526,630.78**
5.1	Site Clearing, Grubbing	3.00	AC	$5,771.51	$17,314.53
5.2	Excavate Trapazoid Channel	40,000.00	CY	$24.09	$963,775.54
5.3	Retaining wall 4 - 11 ft tall	400.00	LF	$322.31	$128,925.45
5.4	Install Turf Reinforcement Mat	15,000.00	SY	$2.85	$42,692.98
5.5	Hydroseeding	3.00	AC	$3,200.00	$9,600.00
5.6	Grouted rip rap	300.00	CY	$200.78	$60,232.73
5.7	Parkway grading	12,000.00	SY	$0.79	$9,452.31
5.8	Landscaping Restoration	3.00	AC	$76,230.00	$228,690.00
5.9	Tree Replacement	20.00	EA	$2,500.00	$50,000.00
5.10	ABC Service Road	4,400.00	SY	$3.62	$15,947.24
6	**Route 66 Bridge Replacement**	1.00	LS		**$960,831.89**
7	**Storm Damage**	1.00	LS		**$300,000.00**
8	**Electrical & Signals**	1.00	LS		**$150,000.00**
9	**Design Completions 15%**	1.00	LS		**$4,948,658.77**
10	**Construction Contingency 10%**	1.00	LS		**$3,299,105.85**

Total Estimated Construction Cost		**$54,771,497.88**
Real Estate Acquisition	**$**	**7,142,000**
Remaining Design Fee Estimate	**$**	**1,200,000**
Construction Administration (6%)	**$**	**3,286,290**
Total Estimated Cost	**$**	**66,399,788**

Alternative 2 Plans



NOTE:
PRECAST DOUBLE BARREL 10 x 7 RCBC TO BE USED AT STREET CROSSING LOCATIONS TO EXPEDITE CONSTRUCTION.



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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 2
PLAN AND PROFILE
STA 76+00 TO 87+48

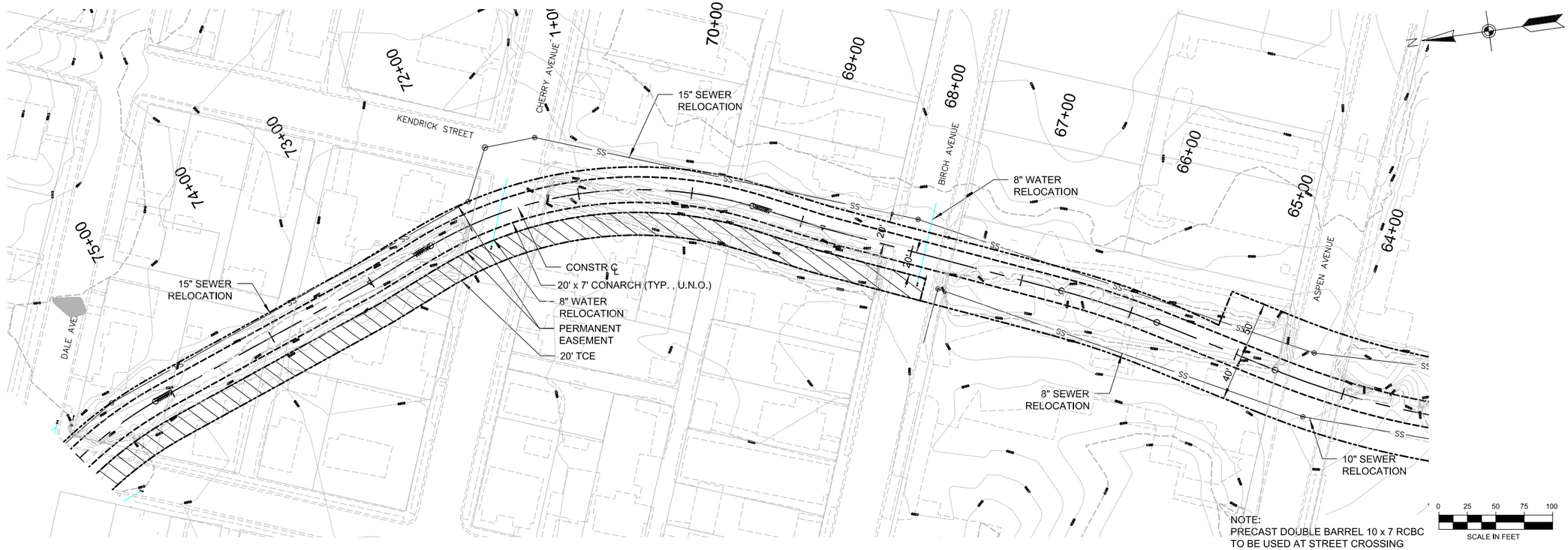
Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

NO.	DESCRIPTION	DATE	BY
REVISIONS			

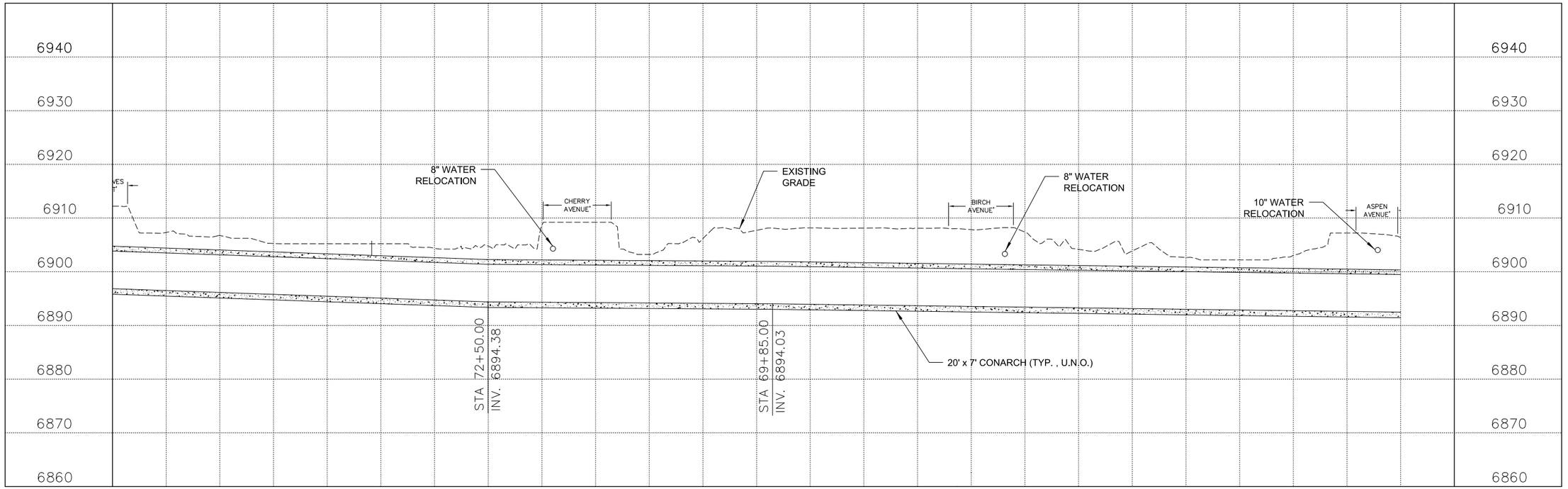
CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-4.01

SHT NO. OF



NOTE:
PRECAST DOUBLE BARREL 10 x 7 RCBC TO BE USED AT STREET CROSSING LOCATIONS TO EXPEDITE CONSTRUCTION.



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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

RIO DE FLAG CHANNEL IMPROVEMENTS

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ALTERNATE 2
PLAN AND PROFILE
STA 64+00 TO 76+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
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Phoenix, Arizona 85012

NO.	DESCRIPTION	DATE	BY

REVISIONS

CALL TWO WORKING DAYS BEFORE YOU DIG
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DRAWING NO.
C-4.02

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NOTE:
PRECAST DOUBLE BARREL 10 x 7 RCBC TO BE USED AT STREET CROSSING LOCATIONS TO EXPEDITE CONSTRUCTION.

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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

RIO DE FLAG CHANNEL IMPROVEMENTS

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Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

REVISIONS			
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CALL TWO WORKING DAYS BEFORE YOU DIG
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TO BE USED AT STREET CROSSING
LOCATIONS TO EXPEDITE CONSTRUCTION.

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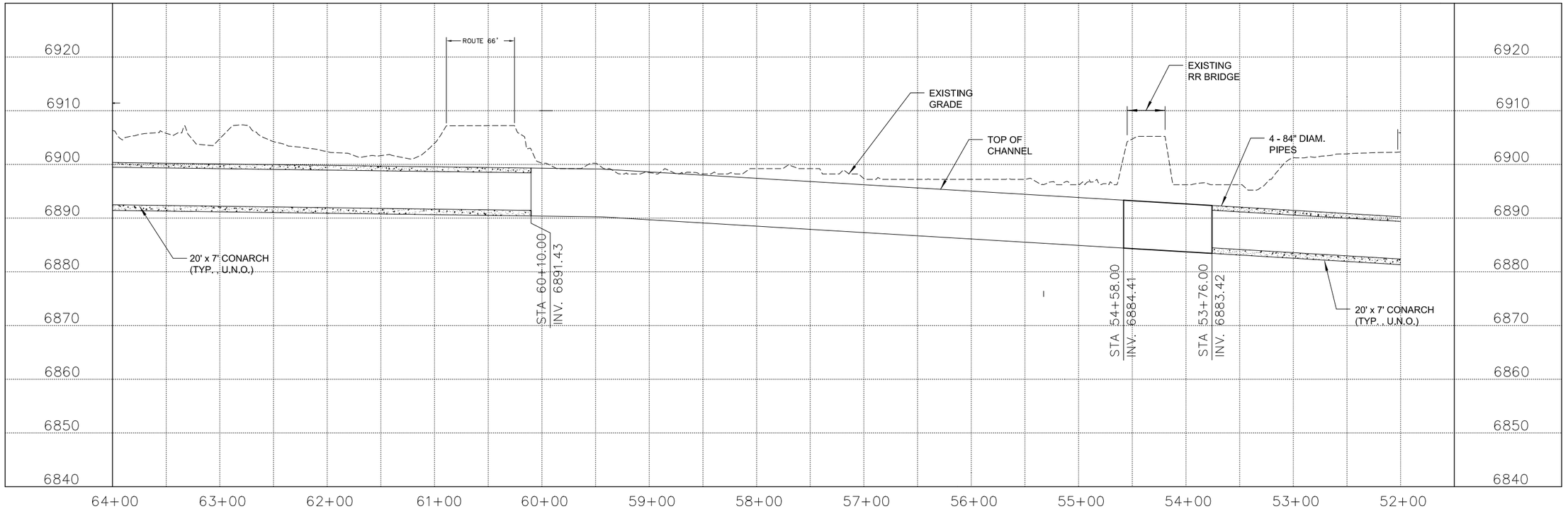

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

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ALTERNATE 2
PROFILE
STA 52+00 TO 64+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
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REVISIONS

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CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

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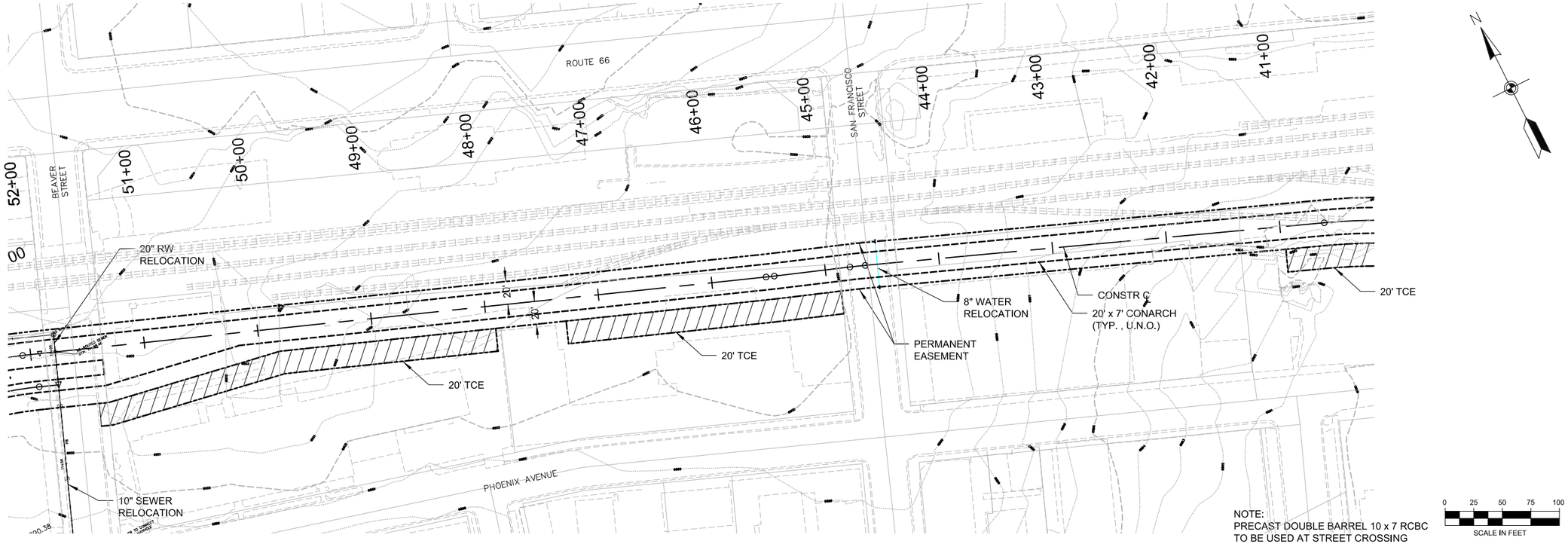

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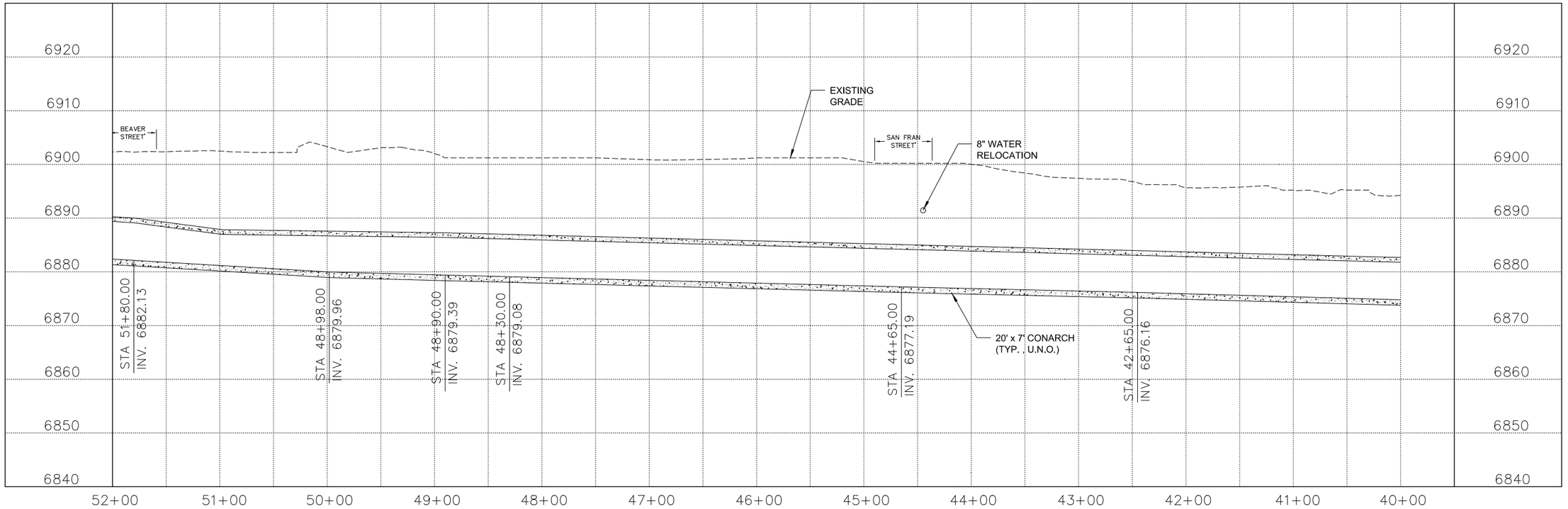

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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

RIO DE FLAG CHANNEL IMPROVEMENTS

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PROFILE AND PROFILE
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Baker
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2929 N. Central Avenue
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Phoenix, Arizona 85012

NO.	DESCRIPTION	DATE	BY

REVISIONS

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1-800-STAKE-IT

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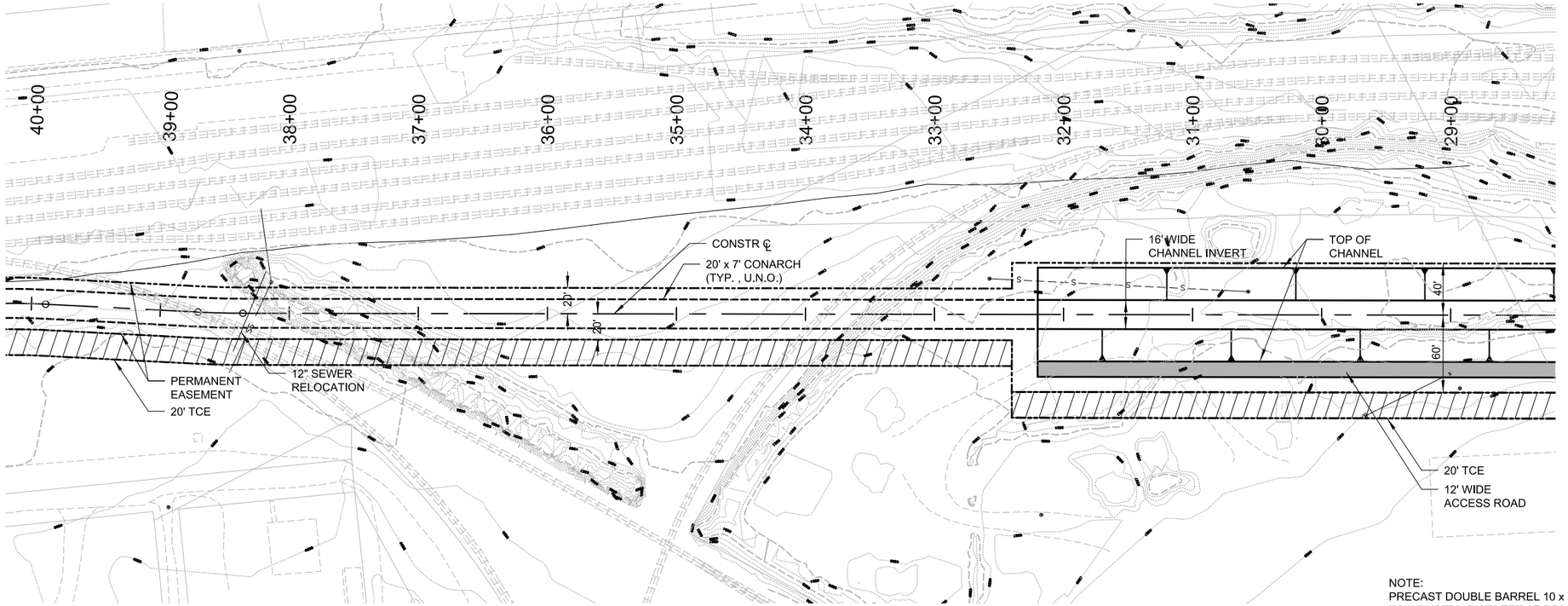

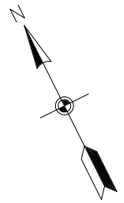

NOTE:
PRECAST DOUBLE BARREL 10 x 7 RCBC
TO BE USED AT STREET CROSSING
LOCATIONS TO EXPEDITE CONSTRUCTION.

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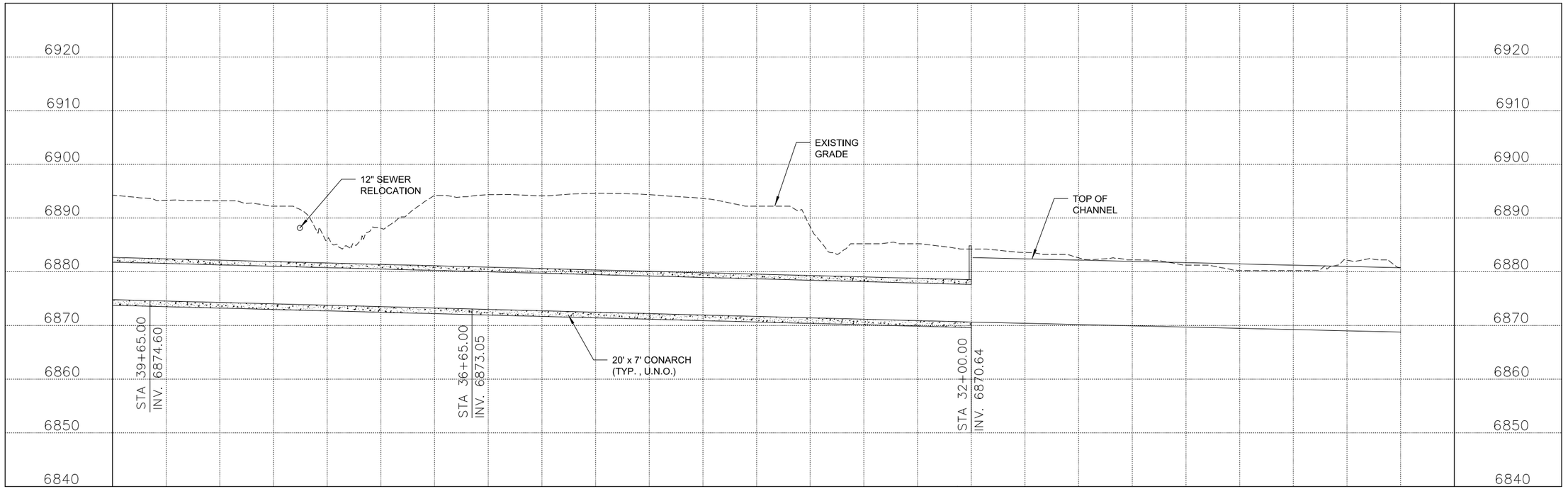

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FLAGSTAFF
ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

RIO DE FLAG CHANNEL IMPROVEMENTS

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ALTERNATE 2
PROFILE AND PROFILE
STA 28+00 TO 40+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
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REVISIONS

NO.	DESCRIPTION	DATE	BY

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1-800-STAKE-IT

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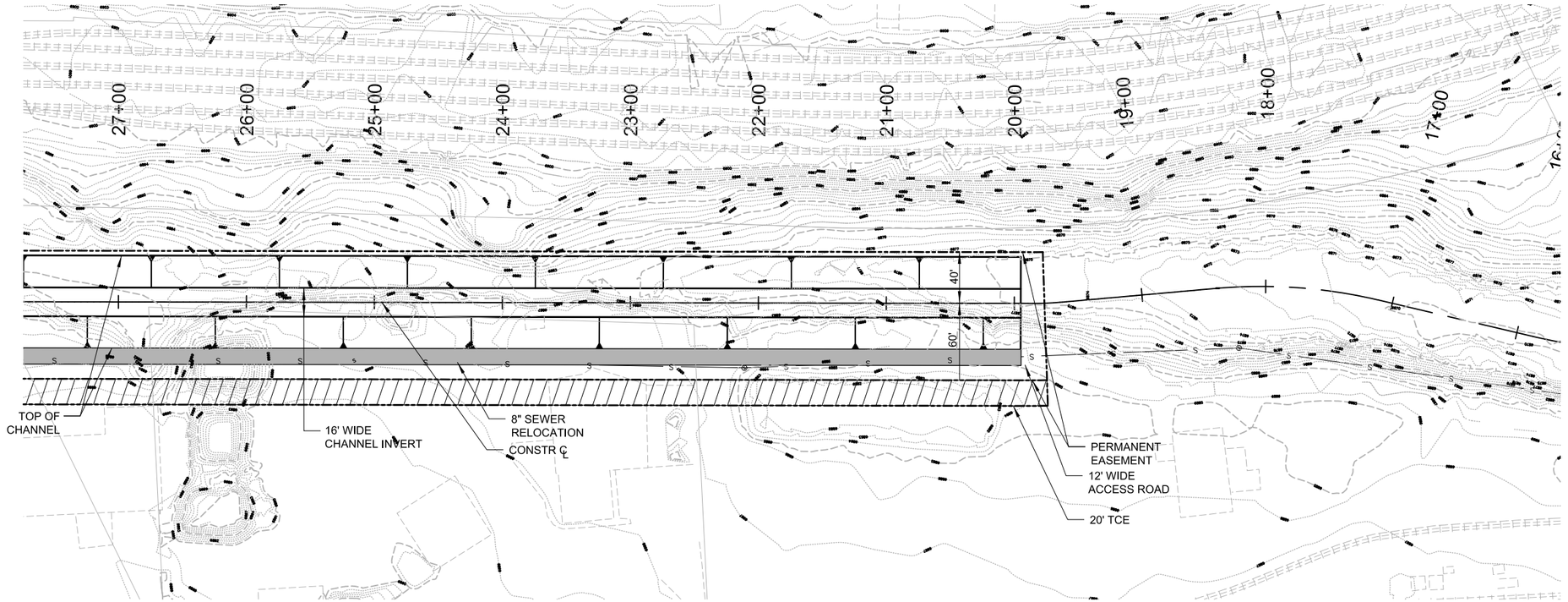

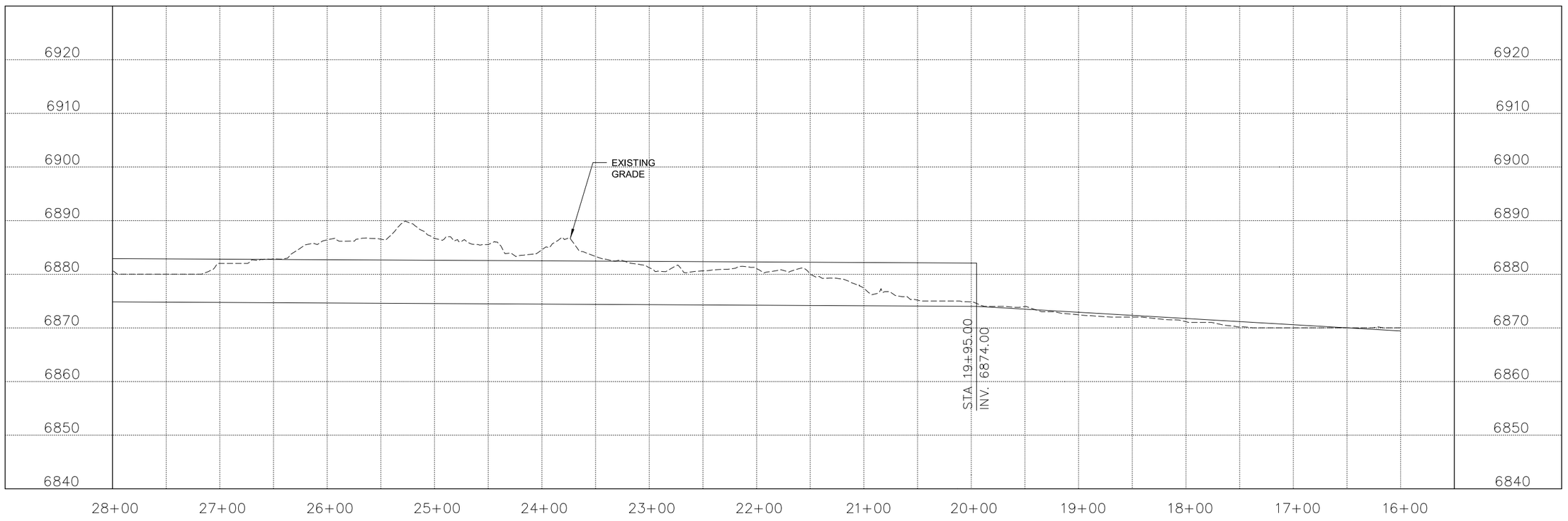

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

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ALTERNATE 2
PROFILE AND PROFILE
STA 16+00 TO 28+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

REVISIONS

NO.	DESCRIPTION	DATE	BY

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

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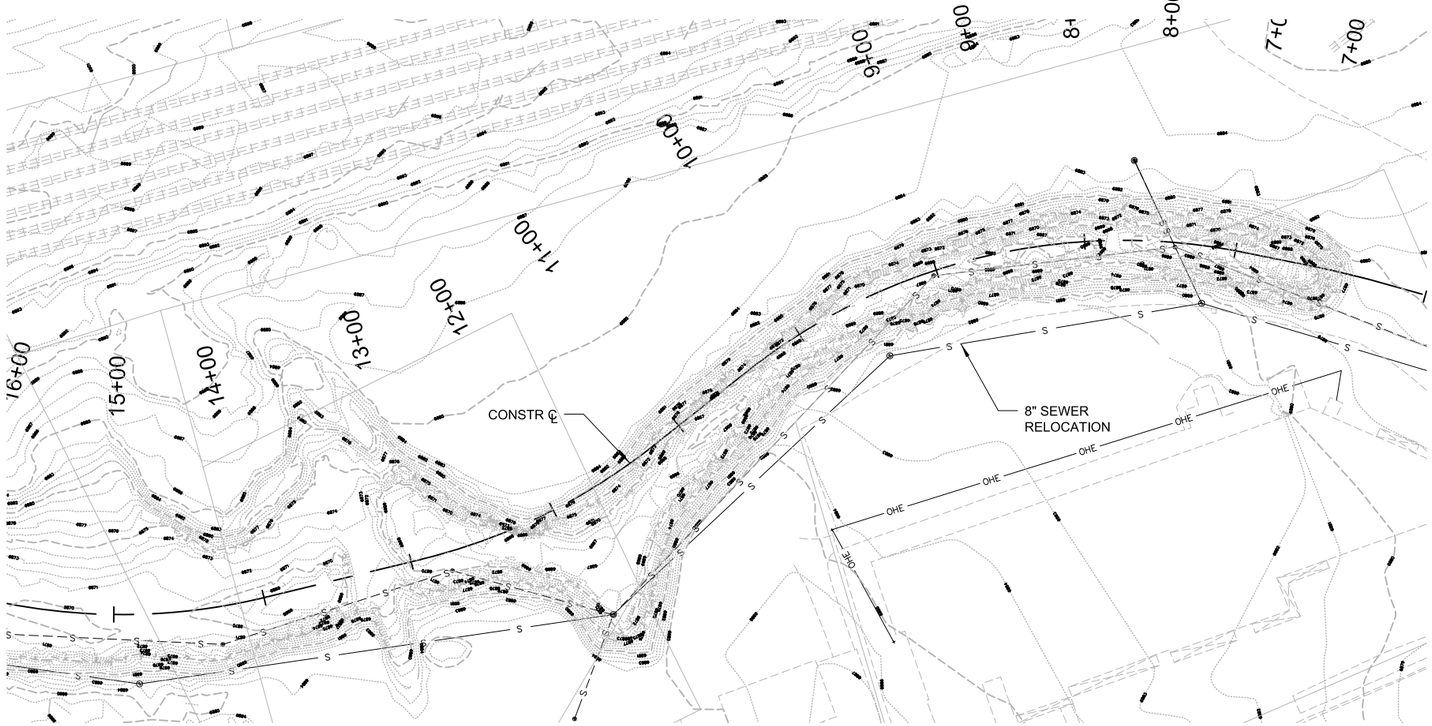

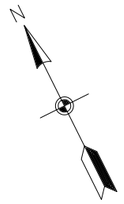

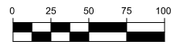

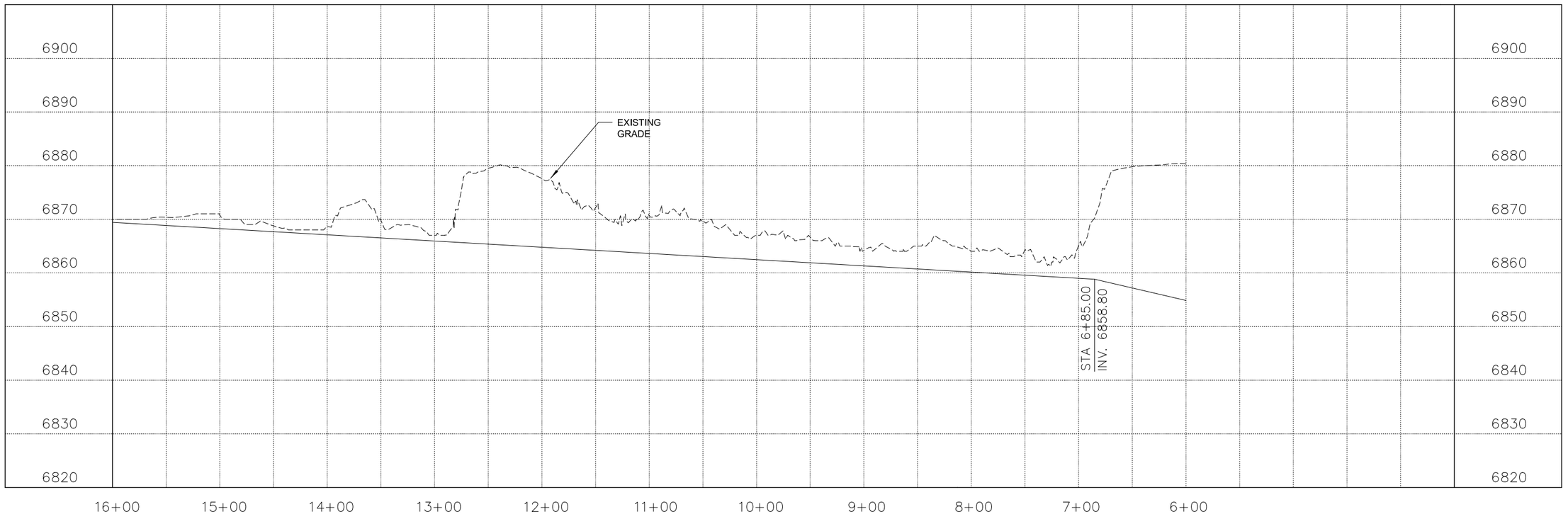

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RIO DE FLAG CHANNEL IMPROVEMENTS

RIO DE FLAG FLOOD CONTROL PROJECT

FLAGSTAFF
ARIZONA

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ALTERNATE 2
PROFILE AND PROFILE
STA 6+00 TO 16+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
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REVISIONS

NO.	DESCRIPTION	DATE	BY

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
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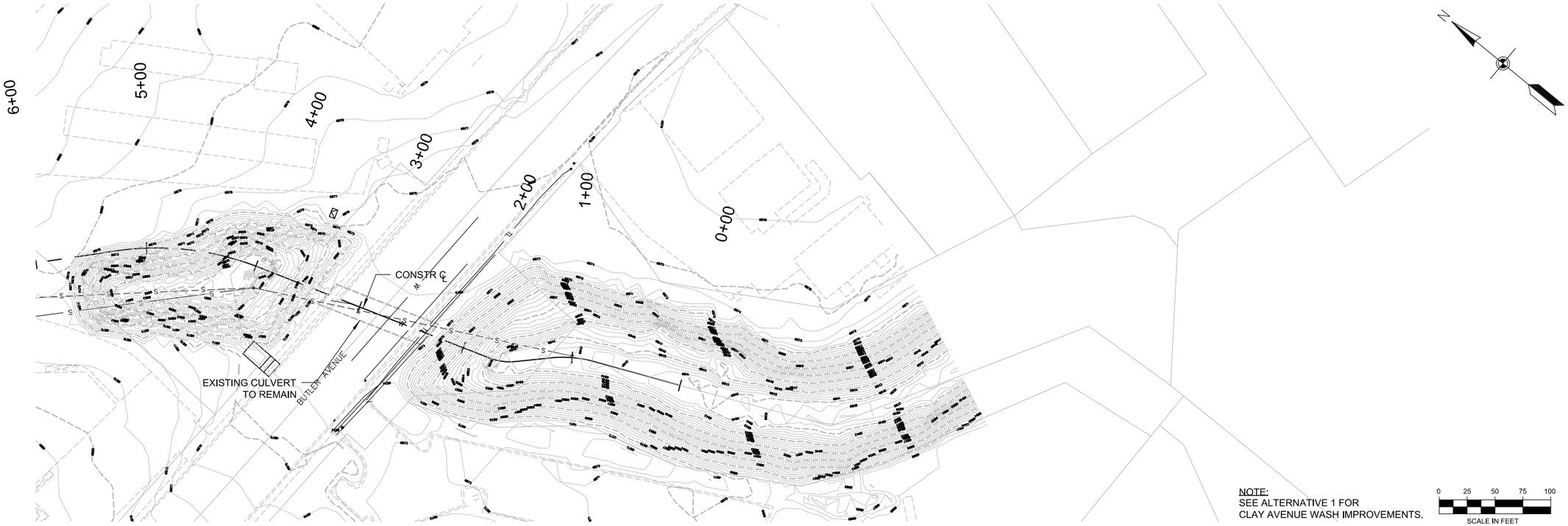

NOTE:
SEE ALTERNATIVE 1 FOR
CLAY AVENUE WASH IMPROVEMENTS.

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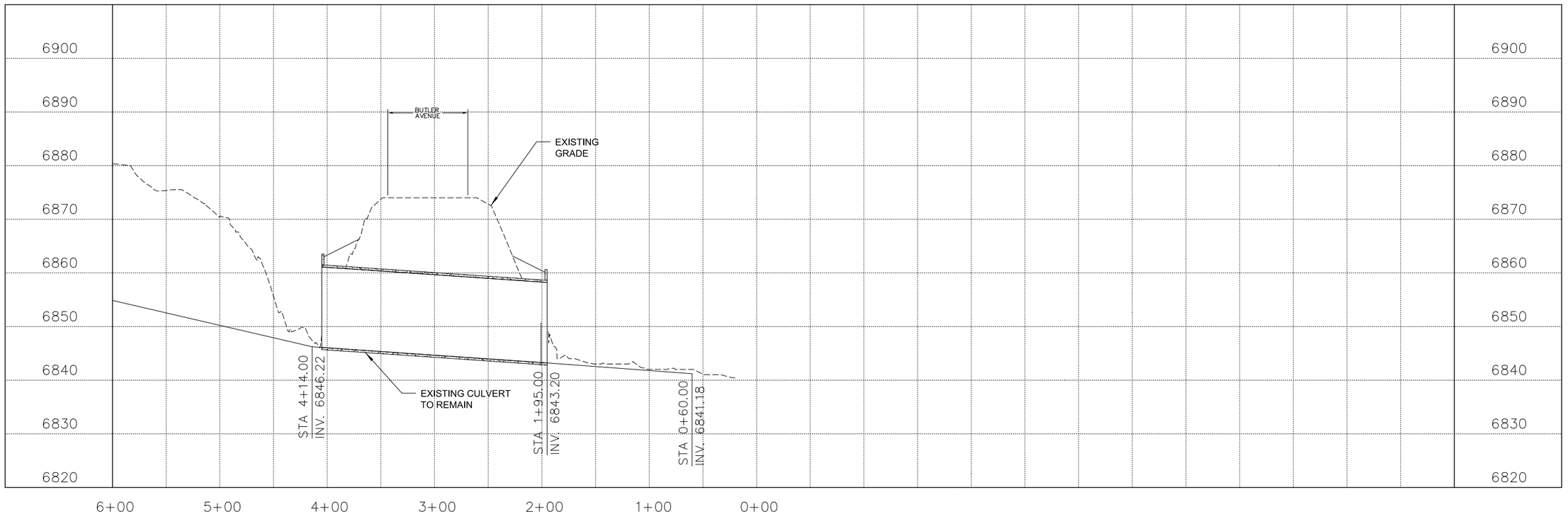

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
DATE:
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ALTERNATE 2
PROFILE AND PROFILE
STA 0+00 TO 6+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

NO.	DESCRIPTION	DATE	BY

REVISIONS

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-4.09

SHT NO. OF

Alternative 2 Cost Sheet

CITY OF FLAGSTAFF

RIO DE FLAG FLOOD CONTROL DESIGN CONCEPT PROJECT

ALTERNATE 2 - COST ESTIMATE (DRAFT)

Sheet 1 of 3 - April 22, 2014

Michael Baker Jr., Inc.

	Description	Quantity	UofM	Unit Cost	Total Cost
	Prime Bond	1.00	LS	$ -	**$ 354,852.06**
	Price % Add-On	1.00	LS	$ -	**$ 8,883,948.11**
1	**Generals**	1.00	LS	$ -	**$ 3,938,641.21**
2	**Rio De Flag East Reach**	1.00	LS	$ -	**$ 9,409,075.81**
2.1	**Removals**	1.00	LS	$ -	**$ 23,546.79**
2.2	**Clear and Grub**	10.00	AC	$ 3,404.09	**$ 34,040.94**
2.3	**Water Utility Relocation and Realignments**	1.00	LS	$ -	**$ 94,500.47**
2.4	**Sewer Utility Relocation and Realignments**	1.00	LS	$ -	**$ 639,634.38**
2.5	**Structural Excavation and Backfill**	1.00	LS	$ -	**$ 2,463,246.55**
2.5.1	Channel Excavation to Haul off	66,000.00	CY	$ 15.38	$ 1,015,172.40
2.5.2	Channel Excavation Contaminated Soil Haul off	500.00	CY	$ 136.00	$ 67,998.63
2.5.3	Hard Dig Contingency	6,600.00	CY	$ 68.75	$ 453,764.98
2.5.4	Import from stockpile, Place & Compact	41,000.00	CY	$ 22.10	$ 906,067.64
2.5.5	Site Grading	18,000.00	SY	$ 1.12	$ 20,242.90
2.6	**Concrete Structures**	1.00	LS	$ -	**$ 2,868,752.19**
2.6.2	Con-Arch 1 Barrel x 20 x 7	2,425.00	LF	$ 907.56	$ 2,200,844.11
2.6.3	2 10x7 Precast Box Culvert	112.00	LF	$ 1,277.09	$ 143,034.57
2.6.4	Slide Rail	4.00	MO	$ 51,082.42	$ 204,329.66
2.6.5	Transition	234.00	LF	$ 1,186.65	$ 277,677.13
2.6.6	72" Pipe Tie In replacing box transition*	1.00	EA	$ 16,929.40	$ 16,929.40
2.6.7	Grouted Rip Rap 12"	1,226.00	CY	$ 178.60	$ 218,967.48
2.6.8	Transition - Arched or Box to Pre-cast Box 20 x 7	5.00	EA	$ 16,929.40	$ 84,646.98
2.7	**Street and Road Reconstruction**	1.00	LS	$ -	**$ 79,055.62**
2.8	**Landscaping Restoration**	10.00	AC	$ 76,230.00	**$ 762,300.00**
2.9	**Tree Replacement**	40.00	EA	$ 2,500.00	**$ 100,000.00**
2.10	**Striping**	1.00	Each	$ 30,677.68	**$ 30,677.68**
2.11	**Rail Road Shoring 1600 lf Butler to east of San Francisco**	1.00	Each	$ 2,000,000.00	**$ 2,000,000.00**
2.12	**Rail Road Insurance, Flagging, Inspection**	1.00	LS	$ -	**$ 150,000.00**
2.13	**Shore and lagging for building**	350.00	LF	$ 466.63	**$ 163,321.20**
3	**Rio De Flag North Reach**	1.00	LS	$ -	**$ 9,467,778.01**
3.1	**Removals**	1.00	LS	$ 205,578.32	**$ 205,578.32**
3.2	**Clear and Grub**	6.50	AC	$ 11,086.11	**$ 72,059.73**
3.3	**Water Utility Relocation and Realignments**	1.00	LS	$ 432,088.52	**$ 432,088.52**
3.4	**Sewer Utility Relocation and Realignments**	1.00	LS	$ 1,045,404.50	**$ 1,045,404.50**
3.5	**Structural Excavation and Backfill**	1.00	LS	$ 2,590,961.55	**$ 2,590,961.55**
3.5.1	Channel Excavation to Haul off	50,000.00	CY	$ 16.70	$ 835,152.58
3.5.2	Channel Excavation Contaminated Soil Haul off	500.00	CY	$ 120.39	$ 60,195.06
3.5.3	Hard Dig Contingency	5,000.00	CY	$ 69.07	$ 345,332.07
3.5.4	Jack and Bore Rail Road for box	100.00	LF	$ 7,400.00	$ 740,000.00
3.5.6	Jack and bore for sewer	1.00	LS	$ -	$ 145,000.00
3.5.7	Import from stockpile, Place & Compact	22,800.00	CY	$ 19.82	$ 451,786.58
3.5.8	Site Grading	12,000.00	SY	$ 1.12	$ 13,495.27
3.6	**Concrete Structures**	1.00	LS	$ -	**$ 3,829,770.66**
3.6.2	Con-Arch 1 Barrel x 20 x 7	1,784.00	LF	$ 908.34	$ 1,620,482.94
3.6.3	10x7 Precast Box Culvert*	329.00	LF	$ 1,219.99	$ 401,375.15
3.6.4	Slide Rail	6.00	MO	$ 58,064.03	$ 348,384.18
3.6.5	Cast in Place Open U-channel qty adjusted for alt 2	695.00	LF	$ 1,406.84	$ 977,755.69
3.6.6	Grouted Rip Rap 24"*	840.00	CY	$ 166.19	$ 139,595.75
3.6.7	Junction Sturcture - Arched or Box to Steel Pipe: at rt 66, confluence	3.00	EA	$ 43,510.66	$ 130,531.98
3.6.8	Transition - Arched or Box to Pre-cast Box 20 x 7	9.00	EA	$ 16,929.40	$ 152,364.56
3.6.9	Sewage By-Pass while installing new box*	1.00	EA	$ 59,280.40	$ 59,280.40
3.7	**Street and Road Reconstruction**	1.00	LS	$ -	**$ 489,512.07**
3.8	**Signage**	1.00	LS	$ -	**$ 13,912.50**
3.9	**Striping**	1.00	Each	$ 25,342.68	**$ 25,342.68**
3.10	**Concrete Trail with foot soft Shoulders**	25,540.00	SF	$ 4.97	**$ 126,818.06**
3.11	**Landscaping Restoration**	6.50	AC	$ 76,230.00	**$ 495,495.00**
3.12	**Tree Replacement**	55.00	EA	$ 2,500.00	**$ 137,500.00**
3.13	**ABC Service Road -U channel**	920.00	SY	$ 3.62	**$ 3,334.42**
4	**Clay Avenue "West" Reach**	1.00	LS	$ -	**$ 11,026,792.02**
4.1	**Removals**	1.00	LS	$ -	**$ 161,406.89**
4.2	**Clear and Grub**	5.00	AC	$ 7,780.62	**$ 38,903.09**
4.3	**Water Utility Relocation and Realignments**	1.00	LS	$ -	**$ 743,464.97**
4.4	**Sewer Utility Relocation and Realignments**	1.00	LS	$ -	**$ 1,581,733.35**

CITY OF FLAGSTAFF
RIO DE FLAG FLOOD CONTROL DESIGN CONCEPT PROJECT
ALTERNATE 2 - COST ESTIMATE (DRAFT)
Sheet 2 of 3 - April 22, 2014

Michael Baker Jr., Inc.

	Description	Quantity	UoM	Unit Cost	Total Cost
4.5	**Structural Excavation and Backfill**	1.00	LS	$ -	**$ 3,567,904.78**
4.5.1	Channel Excavation to Stockpile	52,000.00	CY	$ 19.63	$ 1,020,832.80
4.5.2	Channel Excavation Contaminated Soil Haul off	500.00	CY	$ 136.00	$ 67,998.63
4.5.3	Hard Dig Contingency	10,400.00	CY	$ 69.07	$ 718,290.71
4.5.4	Jack and Bore 5 Points*	215.00	LF	$ 4,493.02	$ 966,000.00
4.5.5	Import from stockpile, Place & Compact	31,000.00	CY	$ 25.17	$ 780,162.77
4.5.6	Site Grading	13,000.00	SY	$ 1.12	$ 14,619.87
4.6	**Concrete Structures**	1.00	LS	$ -	**$ 3,408,723.99**
4.6.1	Cast in Place Open U-channel	1,040.00	LF	$ 809.86	$ 842,257.73
4.6.3	Con-Arch 1 Barrel x 8 x 8.5	1,941.00	LF	$ 632.57	$ 1,227,813.82
4.6.4	72" RGRCP Mikes Pike to transition sta 16+00 to 1+00	1,500.00	LF	$ 295.07	$ 442,608.79
4.6.5	Single 8x8 Precast Box Culvert	378.00	LF	$ 949.99	$ 359,094.43
4.6.6	Slide Rail	5.00	MO	$ 59,082.42	$ 295,412.08
4.6.7	Cast in Place Inlet Stucture	1.00	EA	$ 92,579.01	$ 92,579.01
4.6.8	Transition CIP to Pre-cast - 8 x 8.5	6.00	Each	$ 10,322.80	$ 61,936.81
4.6.9	Junction Sturcture - Arched or Box to Steel Pipe: at rt 66	2.00	EA	$ 43,510.66	$ 87,021.32
4.7	**Street and Road Reconstruction**	1.00	LS	$ -	**$ 1,017,571.94**
4.7.1	Street Paving 4on6	4,725.00	SY	$ 17.96	$ 84,865.21
4.7.2	Street Paving 3on6	2,702.00	SY	$ 18.49	$ 49,959.41
4.7.3	Parking lot Paving	363.00	SY	$ 31.62	$ 11,478.92
4.7.4	ADOT Paving	2,809.00	SY	$ 58.98	$ 165,672.81
4.7.5	Misc Concrete surfaces	32,461.00	SF	$ 6.78	$ 220,139.81
4.7.6	Valley Gutter/Aprons Mag Dtl 240 modified	1,408.00	SF	$ 9.82	$ 13,819.85
4.7.7	Vertical Curb & Gutter Mag Dtl 220 Type A, H=6"	4,400.00	LF	$ 14.43	$ 63,484.10
4.7.8	Single Curb Mag Dtl 222 Type A, H=6"	99.00	LF	$ 12.01	$ 1,189.38
4.7.9	Sidewalk ADOT c5.30	1,044.00	SF	$ 4.71	$ 4,912.79
4.7.10	Sidewalk Mag Dtl 230 or P-1230 (Hand Placed Only)	17,545.00	SF	$ 6.14	$ 107,807.59
4.7.11	Sidewalk Stamped	3,601.00	SF	$ 5.97	$ 21,483.00
4.7.12	Sidewalk Ramp Mag 235-1	1,133.00	SF	$ 6.06	$ 6,863.55
4.7.13	Driveway Entrance Mag Dtl 250-1or2	3,949.00	SF	$ 6.78	$ 26,780.82
4.7.14	Driveway Entrance Mag Dtl MOD	70.00	SF	$ 6.78	$ 474.72
4.7.15	Bus Bay Ramp COF type F	266.00	SF	$ 33.35	$ 8,872.23
4.7.16	Install Salvaged Bus Shelters	3.00	EA	$ 5,932.12	$ 17,796.36
4.7.17	Construct Trash enclosure	2.00	EA	$ 13,084.80	$ 26,169.60
4.7.18	Aggregate Base Course Driveway	181.00	SY	$ 8.68	$ 1,570.96
4.7.19	Adjust Water Meter Box	20.00	EA	$ 655.06	$ 13,101.24
4.7.20	Adjustment - 5' Manhole Mag Dtl 420 & 424	15.00	EA	$ 215.00	$ 3,225.00
4.7.21	Adjustment - Gate Valve, Valve Box & Cover	13.00	EA	$ 185.00	$ 2,405.00
4.7.22	Adjust Clean Out	1.00	EA	$ 150.00	$ 150.00
4.7.23	Catchbasin MAG 531 5'-6"	18.00	EA	$ 2,290.67	$ 41,232.01
4.7.24	533 Catch Basins Type D	1.00	EA	$ 4,556.96	$ 4,556.96
4.7.25	Catch Basin 550 Catchbasin street wide	2.00	EA	$ 9,424.80	$ 18,849.59
4.7.26	Catchbasin MAG 537	1.00	EA	$ 4,795.72	$ 4,795.72
4.7.27	18" RGRCP	388.00	LF	$ 109.54	$ 42,500.80
4.7.28	36" RGRCP, Adj Class __	59.00	LF	$ 355.01	$ 20,945.35
4.7.29	24" RGRCP, Adj Class __	21.00	LF	$ 146.92	$ 3,085.40
4.7.30	48" RGRCP, Adj Class __	59.00	LF	$ 215.18	$ 12,695.78
4.7.31	Hand Placed Riprap	5.00	CY	$ 186.83	$ 934.14
4.7.32	Replace Ped Bridge	1.00	LS	$ -	$ -
4.7.33	Parkway Grading	20,000.00	SY	$ 0.79	**$ 15,753.85**
4.8	**Signage**	1.00	LS	$ -	**$ 13,912.50**
4.9	**Striping**	1.00	EA	$ 30,467.68	**$ 30,467.68**
4.10	**Landscaping Restoration**	5.00	AC	$ 76,230.00	**$ 381,150.00**
4.11	**Tree Replacement**	24.00	EA	$ 2,500.00	**$ 60,000.00**
4.12	**ABC Service Road**	1,600.00	SY	$ 3.62	**$ 5,799.00**
5	**Trapazoid Channel**	1,200.00	LF	$ 1,272.19	**$ 1,526,630.78**
5.1	Site Clearing, Grubbing	3.00	AC	$ 5,771.51	$ 17,314.53
5.2	Excavate Trapazoid Channel	40,000.00	CY	$ 24.09	$ 963,775.54
5.3	Retaining wall 4 - 11 ft tall	400.00	LF	$ 322.31	$ 128,925.45
5.4	Install Turf Reinforcement Mat	15,000.00	SY	$ 2.85	$ 42,692.98
5.5	Hydroseeding	3.00	AC	$ 3,200.00	$ 9,600.00
5.6	Grouted rip rap	300.00	CY	$ 200.78	$ 60,232.73
5.7	Parkway grading	12,000.00	SY	$ 0.79	$ 9,452.31
5.8	Landscaping Restoration	3.00	AC	$ 76,230.00	$ 228,690.00
5.9	Tree Replacement	20.00	EA	$ 2,500.00	$ 50,000.00
5.10	ABC Service Road	4,400.00	SY	$ 3.62	$ 15,947.24

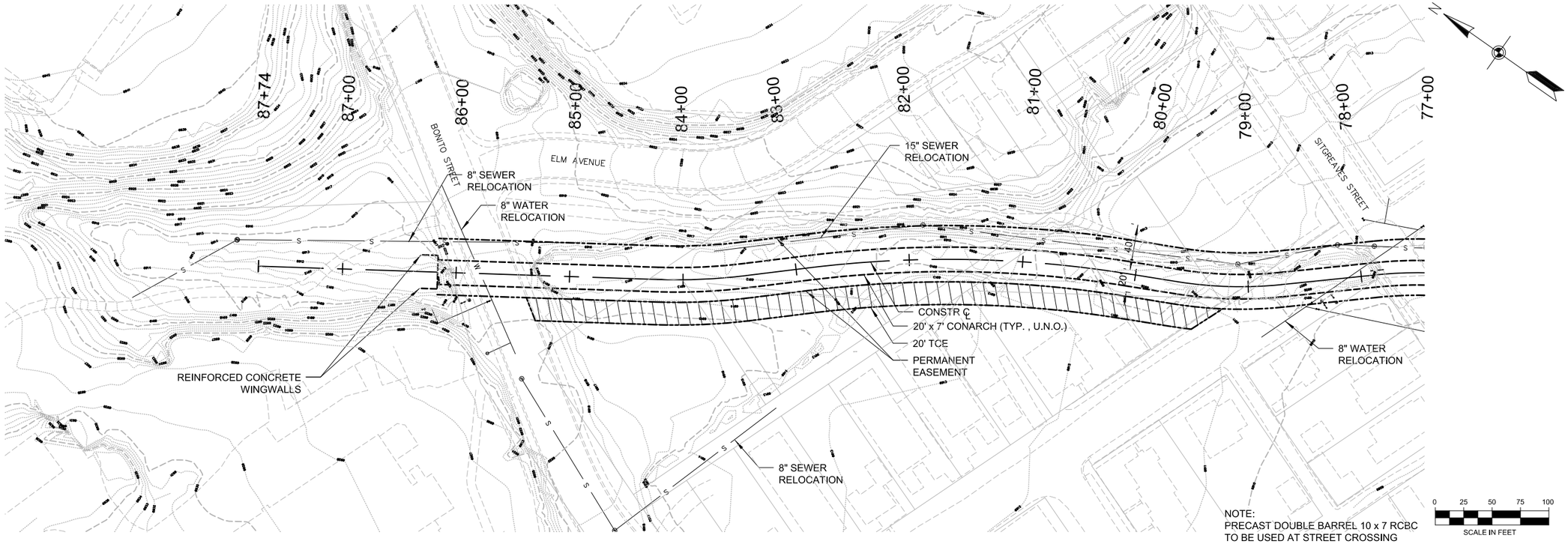
CITY OF FLAGSTAFF
RIO DE FLAG FLOOD CONTROL DESIGN CONCEPT PROJECT
ALTERNATE 2 - COST ESTIMATE (DRAFT)
Sheet 3 of 3 - April 22, 2014

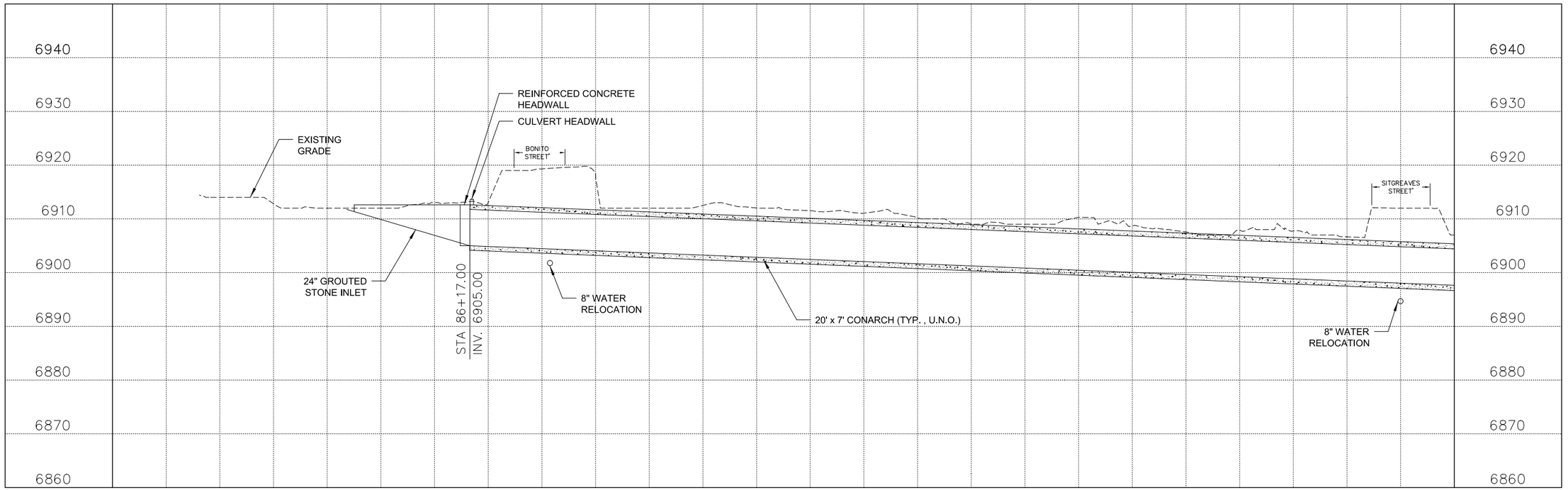
Michael Baker Jr., Inc.

	Description	Quantity	UoM	Unit Cost	Total Cost
6	**Route 66 Bridge Replacement**	1.00	LS	$ -	**$ 960,831.89**
7	**Storm Damage**	1.00	LS	$ -	**$ 300,000.00**
8	**Electrical & Signals**	1.00	LS	$ -	**$ 150,000.00**
9	**Design Completions 15%**	1.00	LS	$ -	**$ 4,881,166.28**
10	**Construction Contingency 10%**	1.00	LS	$ -	**$ 3,254,110.85**

Total Estimated Construction Cost	**$**	**54,153,827**
Real Estate Acquisition	**$**	**7,142,000**
Remaining Design Fee Estimate	**$**	**1,200,000**
Construction Administration (6%)	**$**	**3,249,230**
Total Estimated Cost	**$**	**65,745,057**

Alternative 3 Plans





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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
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ALTERNATE 3
PLAN AND PROFILE
STA 88+69+00 TO 77+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
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REVISIONS			
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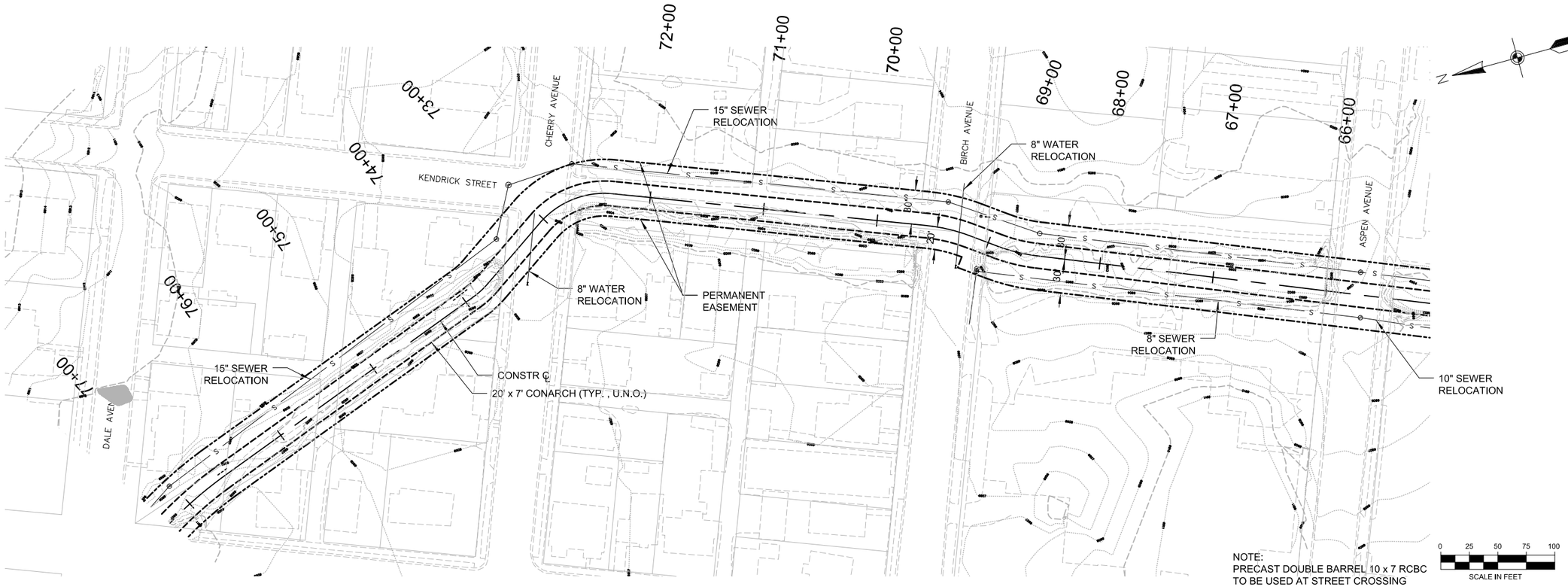

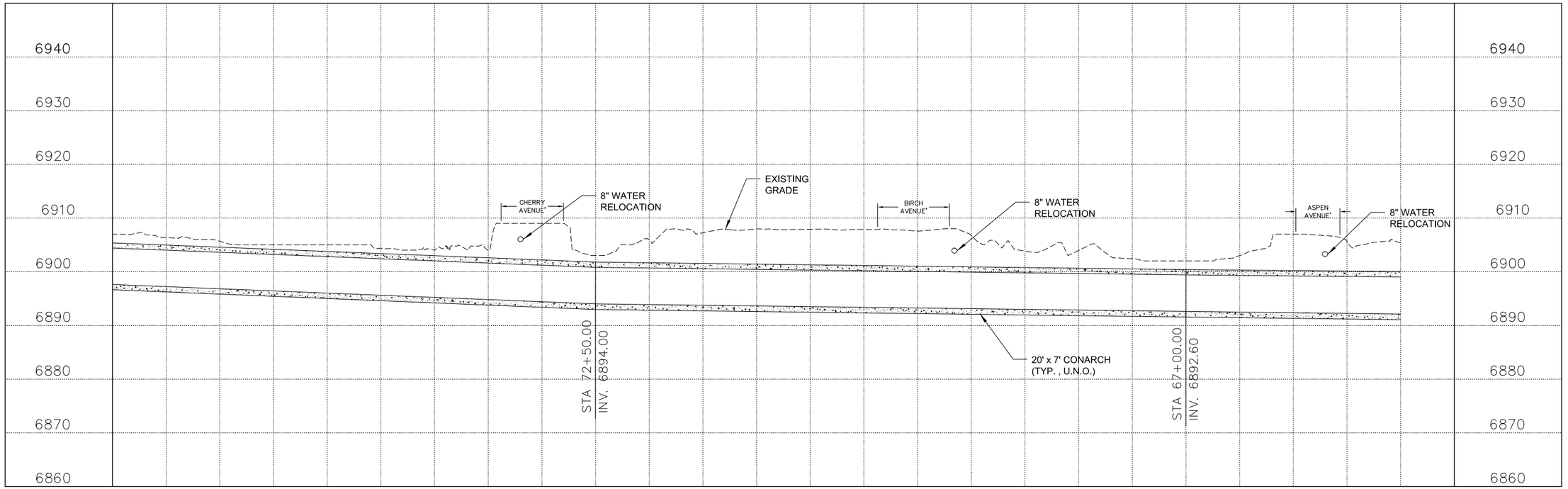

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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

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PLAN AND PROFILE
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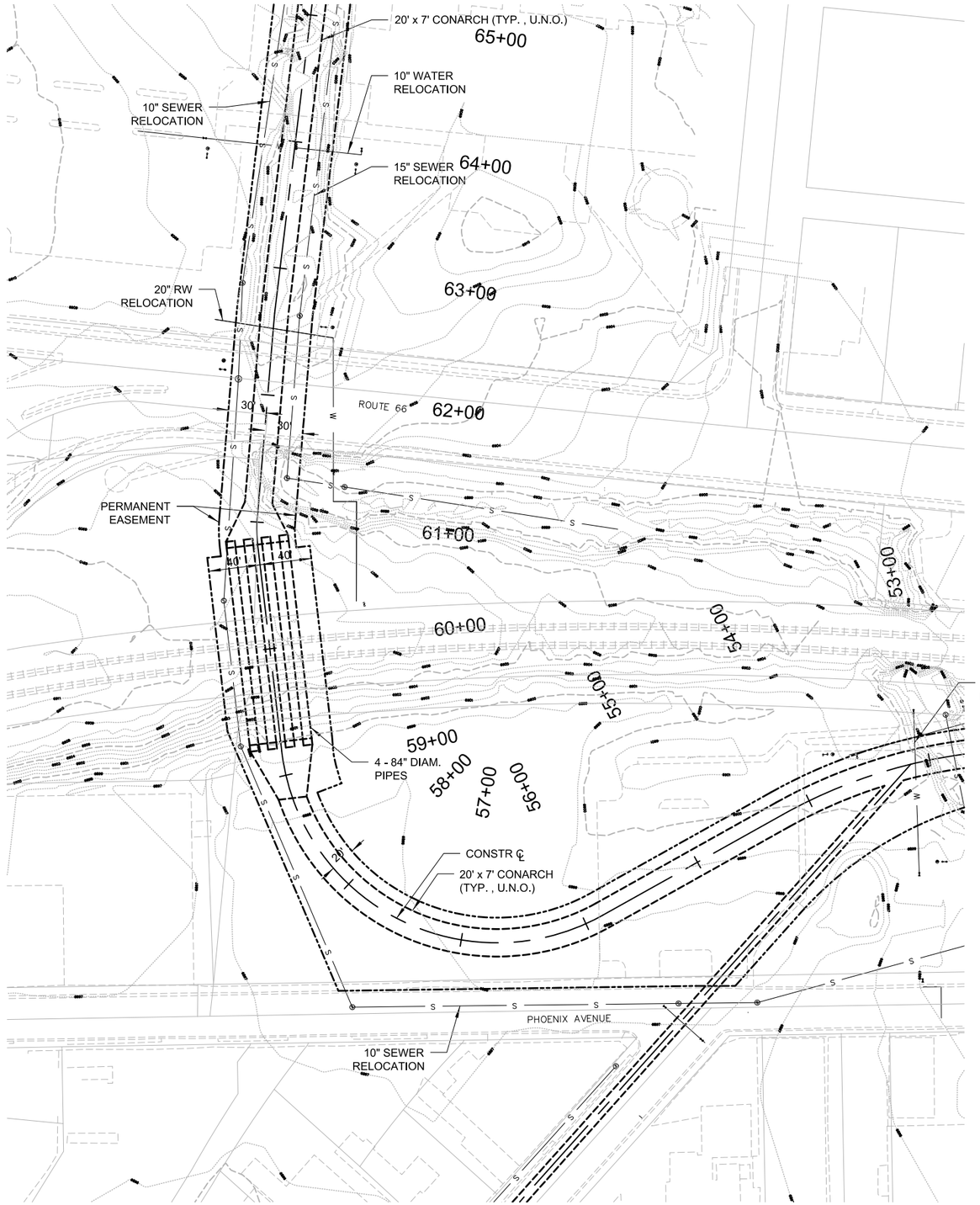

NOTE:
PRECAST DOUBLE BARREL 10 x 7 RCBC TO BE USED AT STREET CROSSING LOCATIONS TO EXPEDITE CONSTRUCTION.

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RIO DE FLAG FLOOD CONTROL PROJECT

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NOTE:
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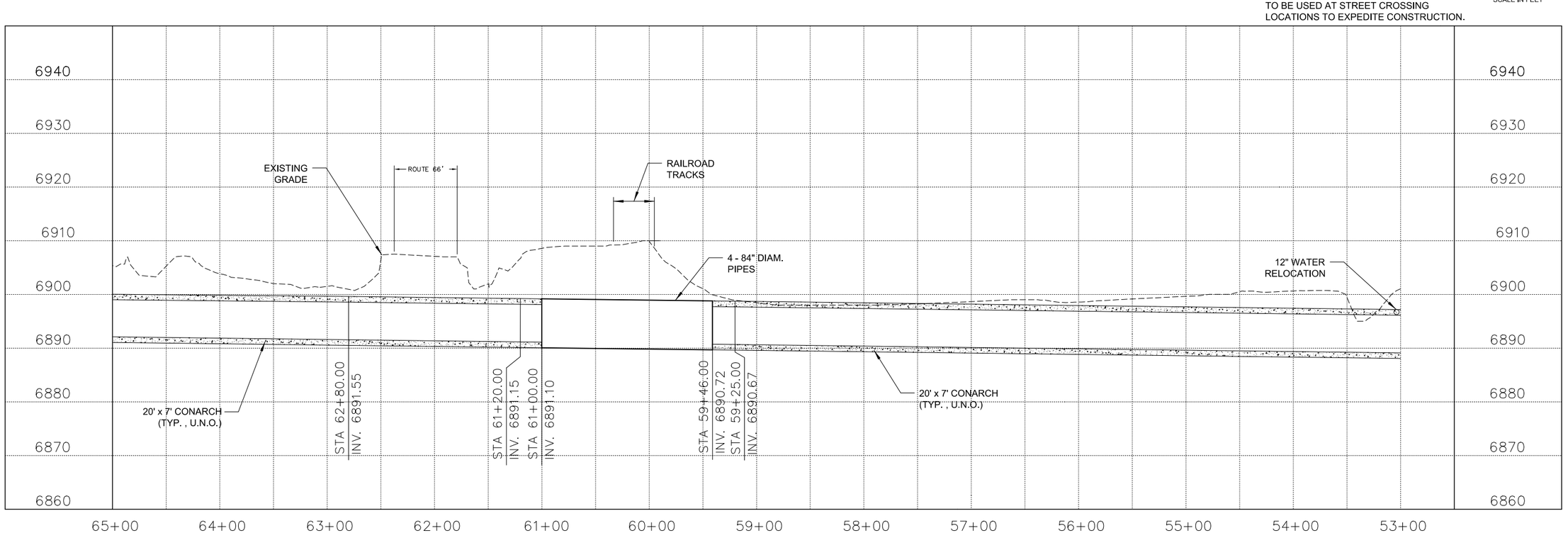

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RIO DE FLAG FLOOD CONTROL PROJECT
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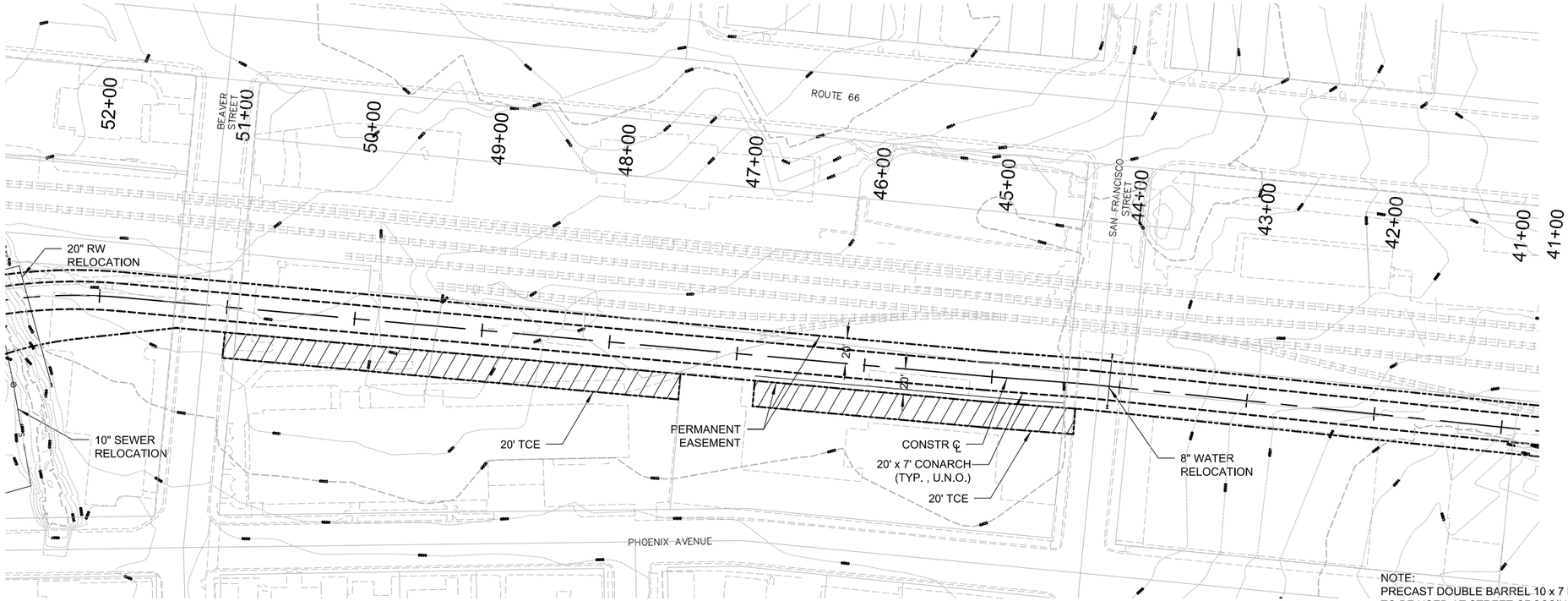

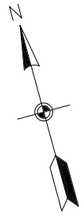

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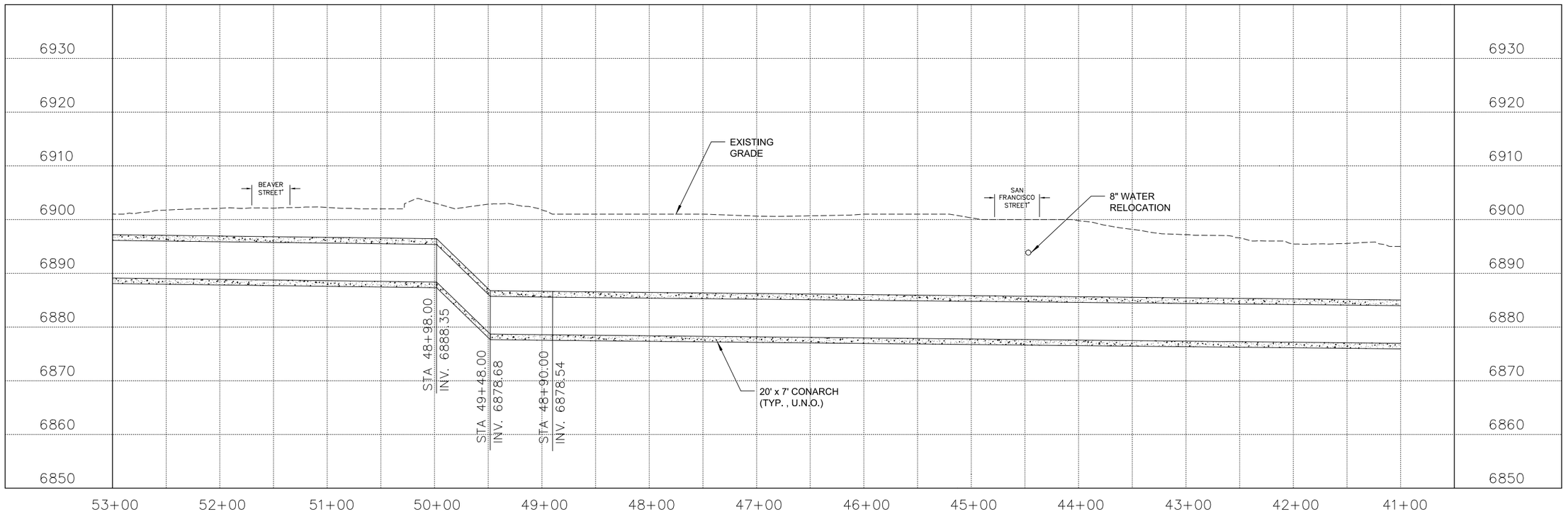

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

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PLAN AND PROFILE
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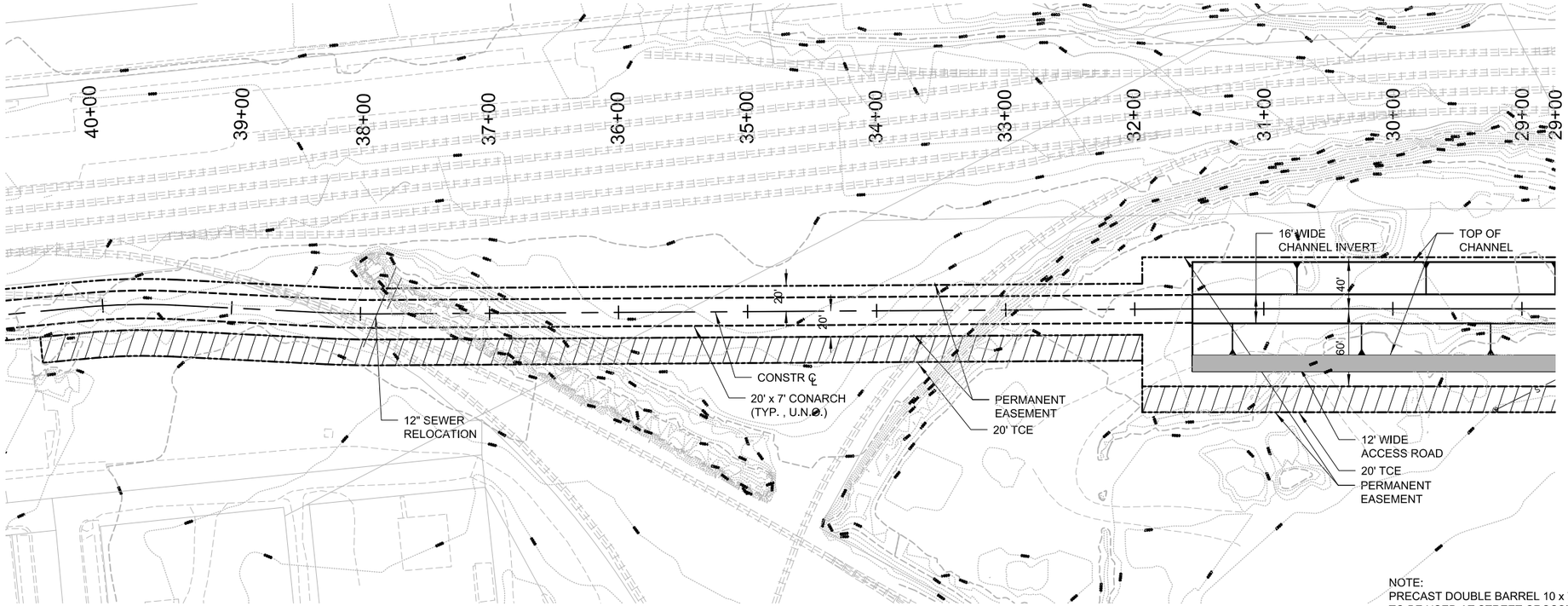

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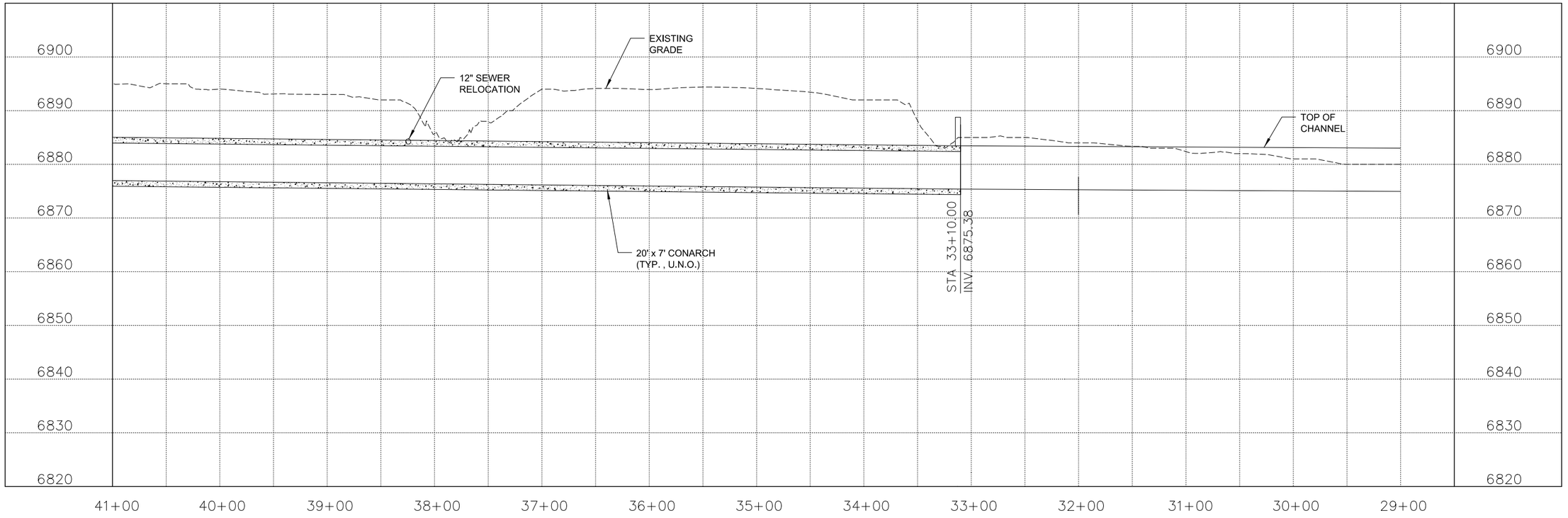

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RIO DE FLAG FLOOD CONTROL PROJECT

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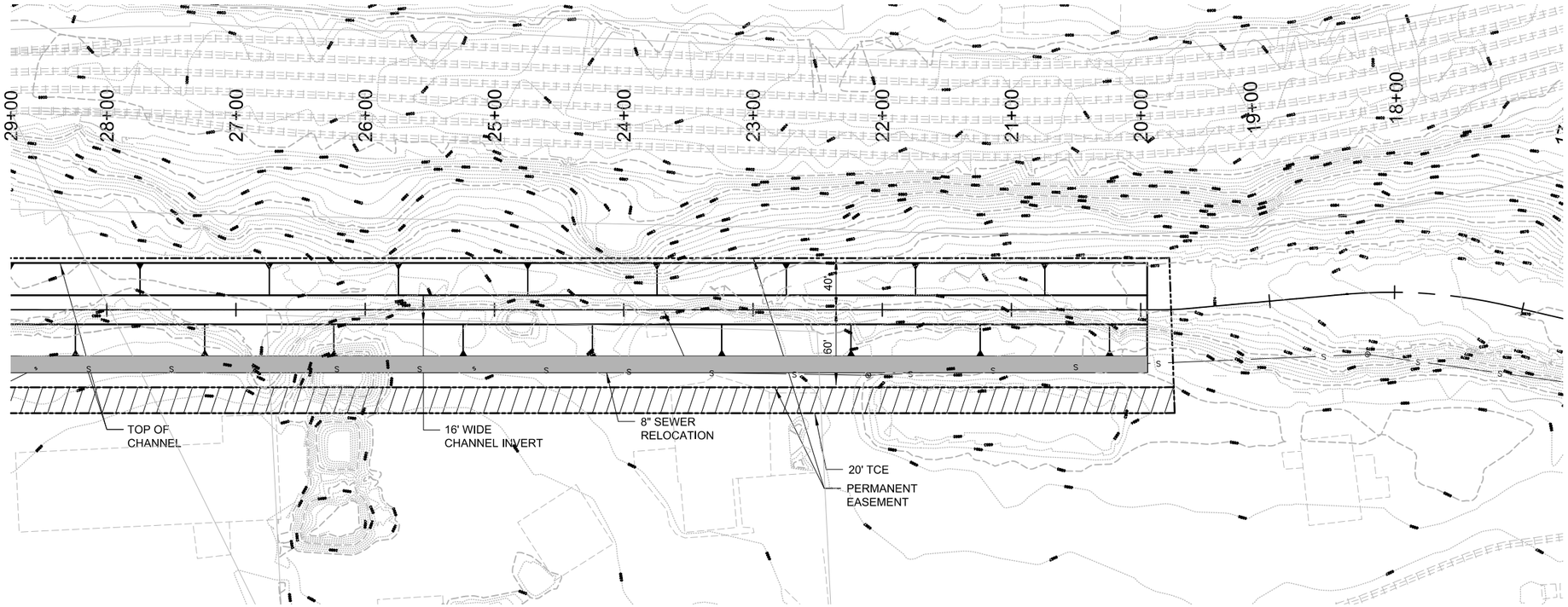

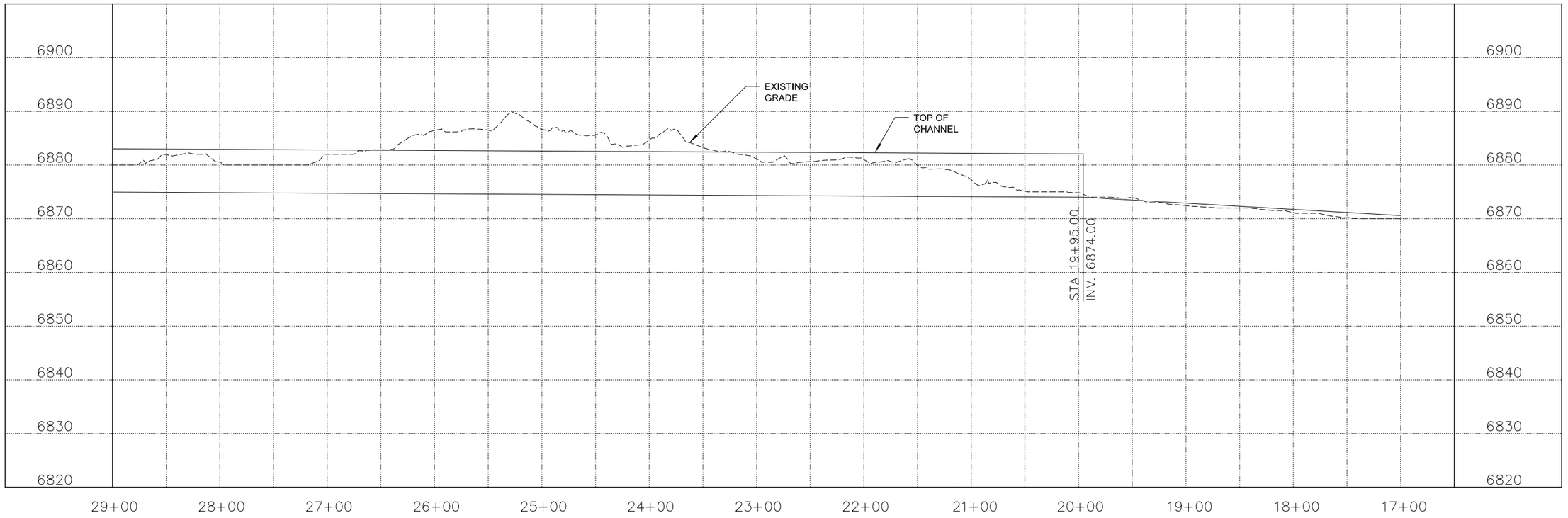

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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

RIO DE FLAG CHANNEL IMPROVEMENTS

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ALTERNATE 3
PLAN AND PROFILE
STA 17+00 TO 29+00

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REVISIONS

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CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

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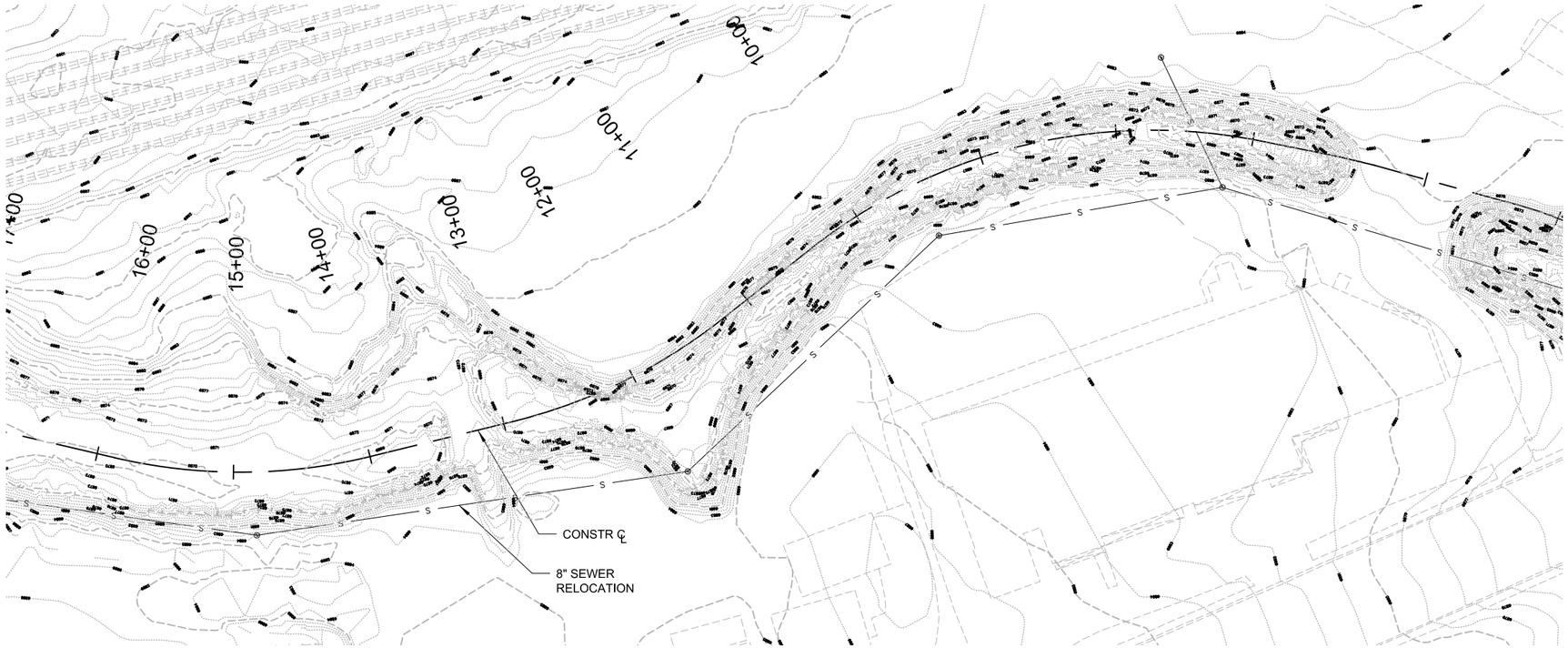

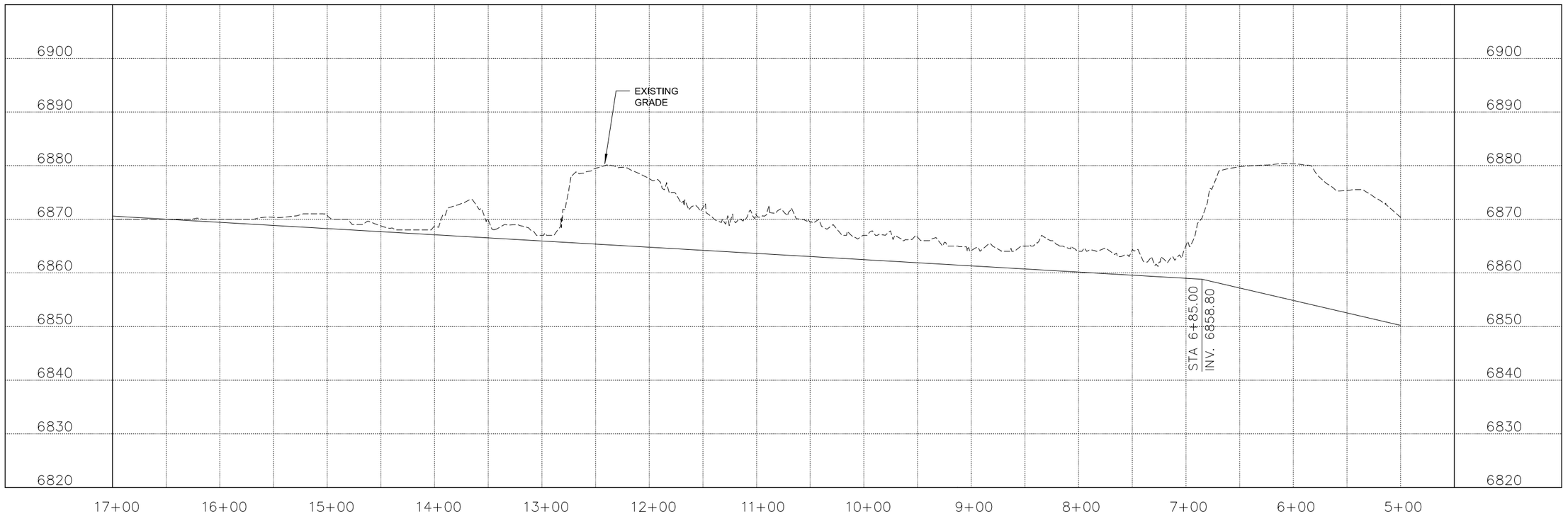

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
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ALTERNATE 3
PLAN AND PROFILE
STA 5+00 TO 17+00

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REVISIONS			
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CALL TWO WORKING DAYS BEFORE YOU DIG
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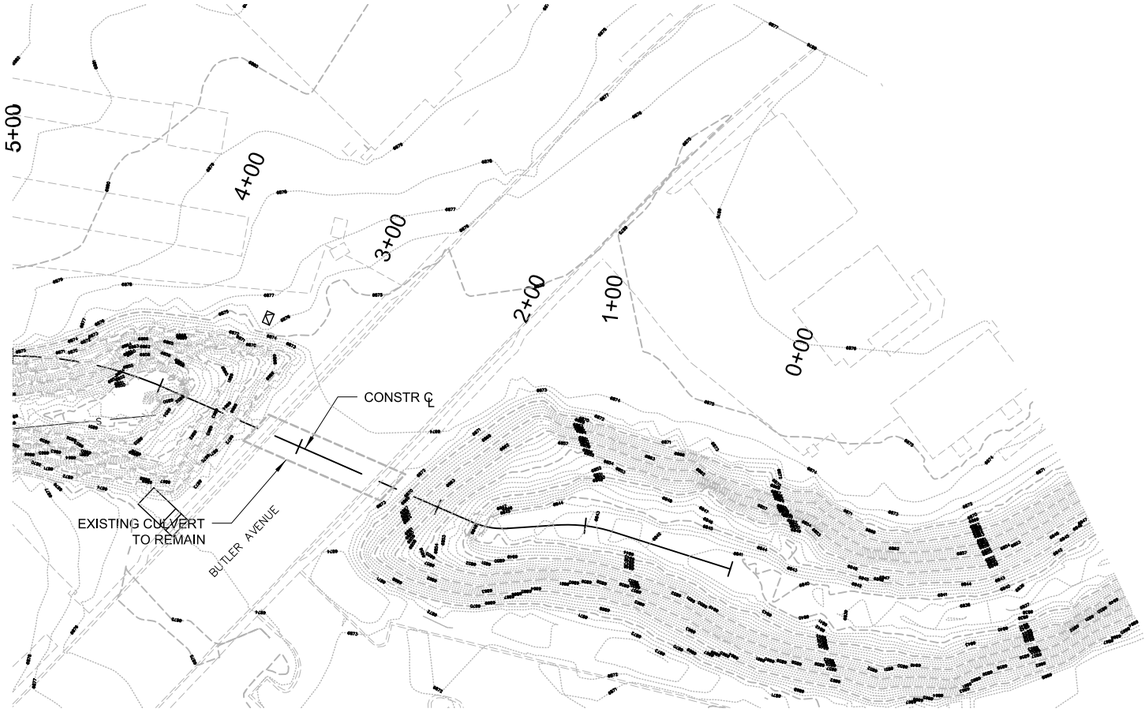

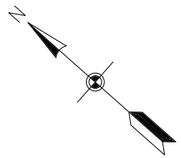

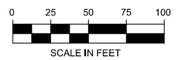

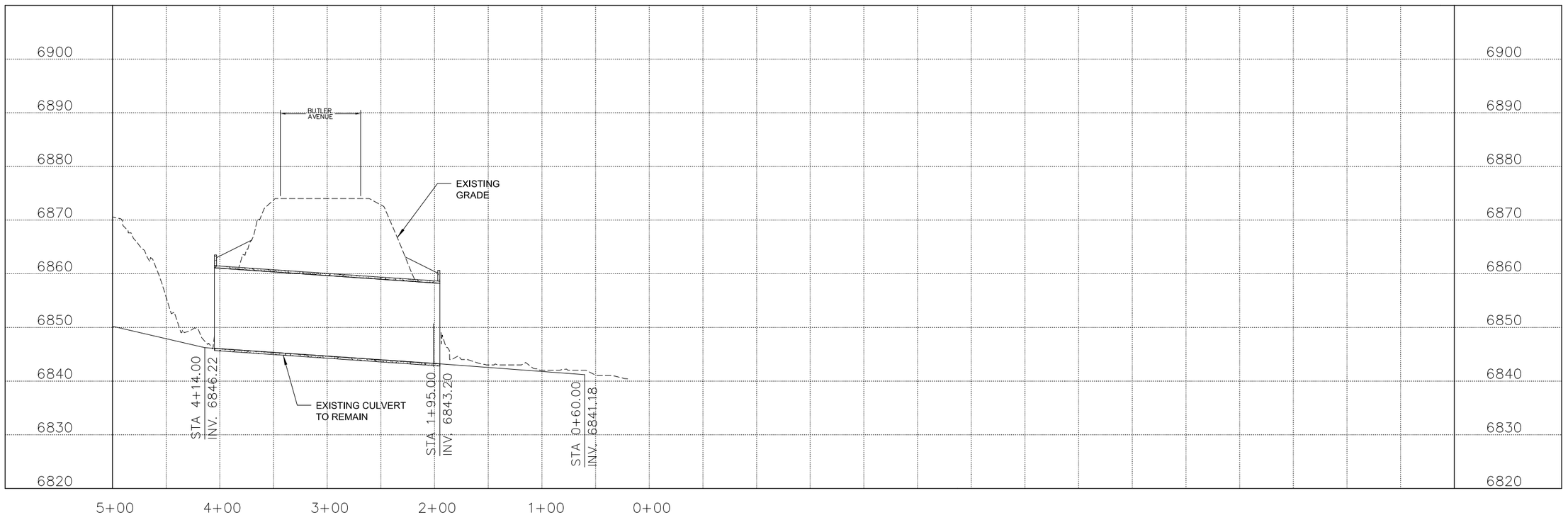

RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

RIO DE FLAG CHANNEL IMPROVEMENTS

JOB NO:
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ALTERNATE 3
PLAN AND PROFILE
STA 0+00 TO 5+00

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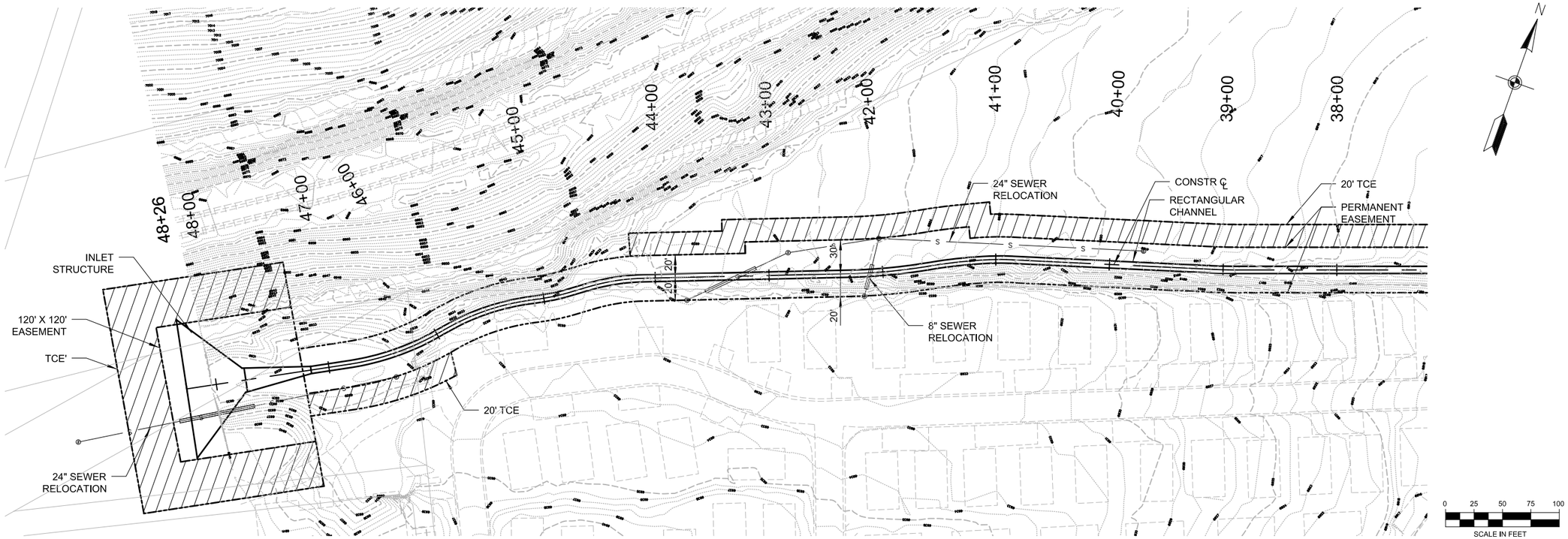

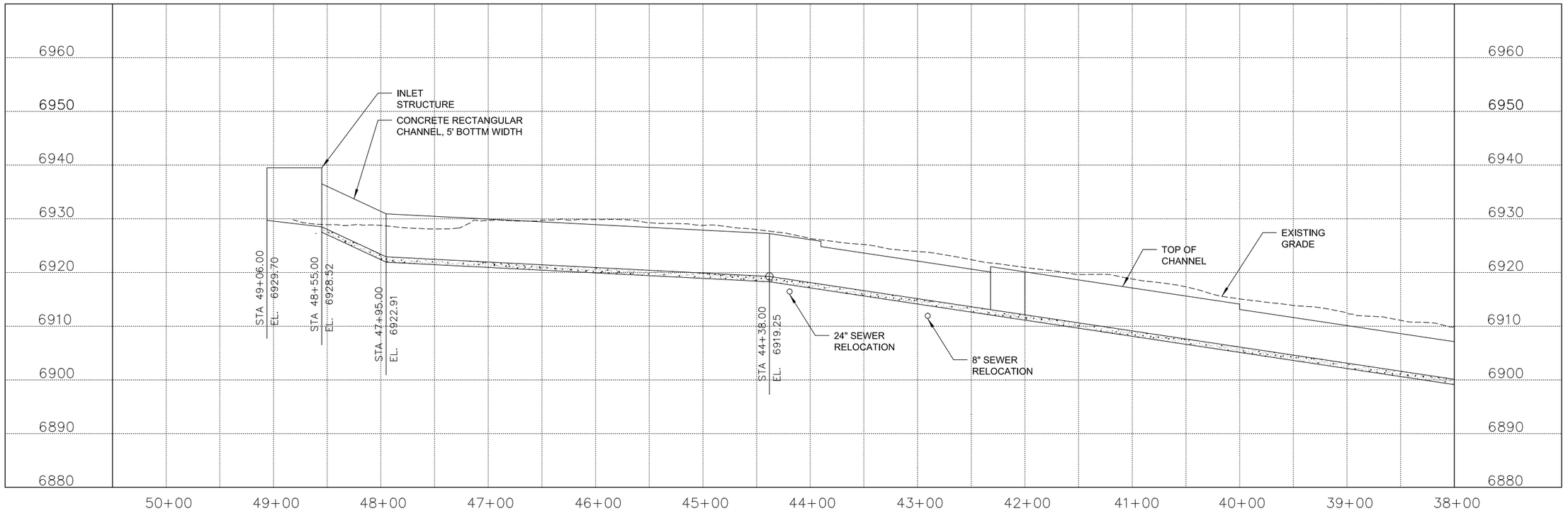

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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

CLAY AVENUE IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 3
PLAN AND PROFILE
STA 38+00 TO 49+06

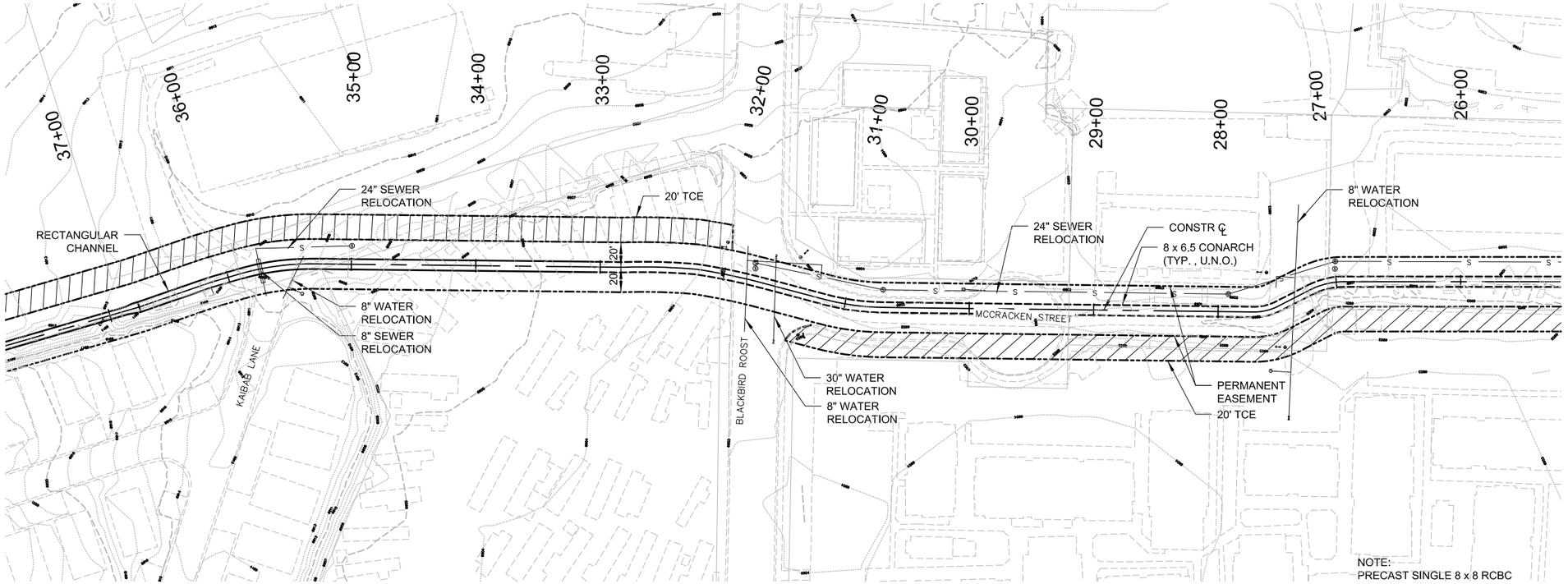
Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

NO.	DESCRIPTION	DATE	BY
REVISIONS			

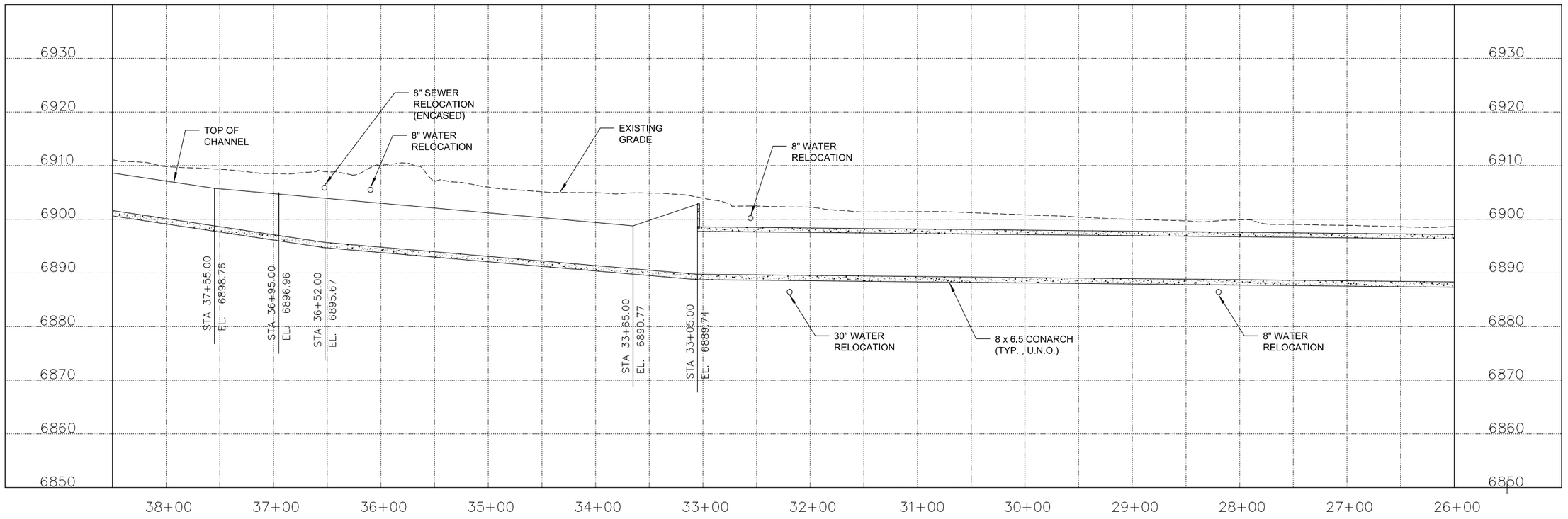
CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-5.10

SHT NO. OF



NOTE:
PRECAST SINGLE 8 x 8 RCBC
TO BE USED AT STREET CROSSING
LOCATIONS TO EXPEDITE CONSTRUCTION.



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FLAGSTAFF ARIZONA

RIO DE FLAG FLOOD CONTROL PROJECT

CLAY AVENUE IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 3
PLAN AND PROFILE
STA 26+00 TO 36+95

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

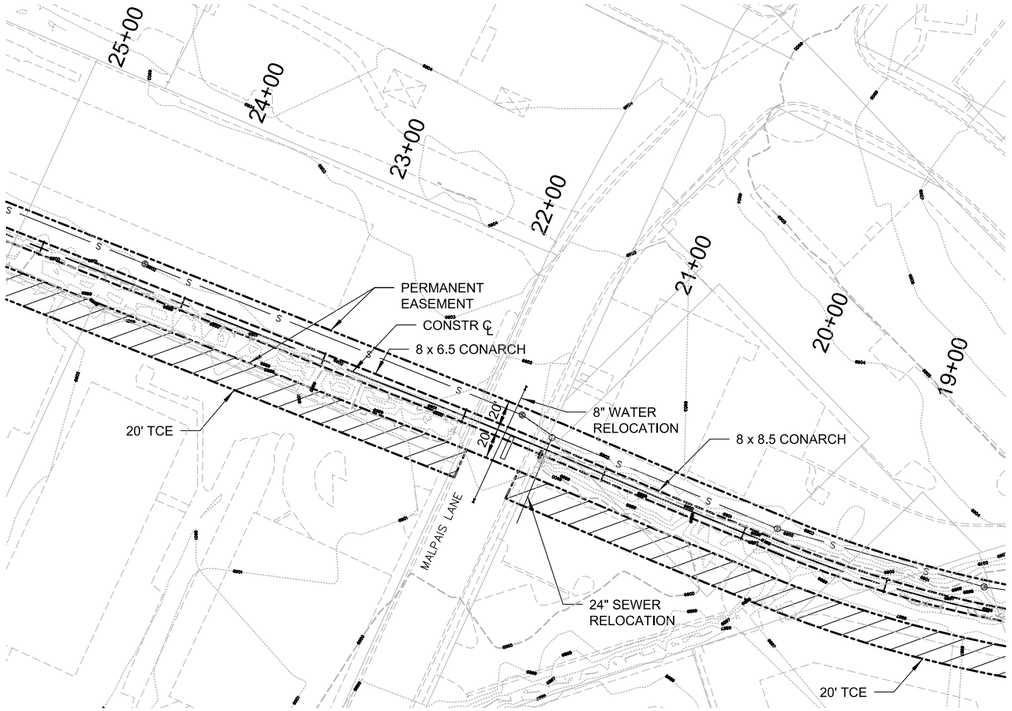
NO.	DESCRIPTION	DATE	BY

REVISIONS

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-5.11

SHT NO. OF



NOTE:
PRECAST SINGLE 8 x 8 RCBC
TO BE USED AT STREET CROSSING
LOCATIONS TO EXPEDITE CONSTRUCTION.

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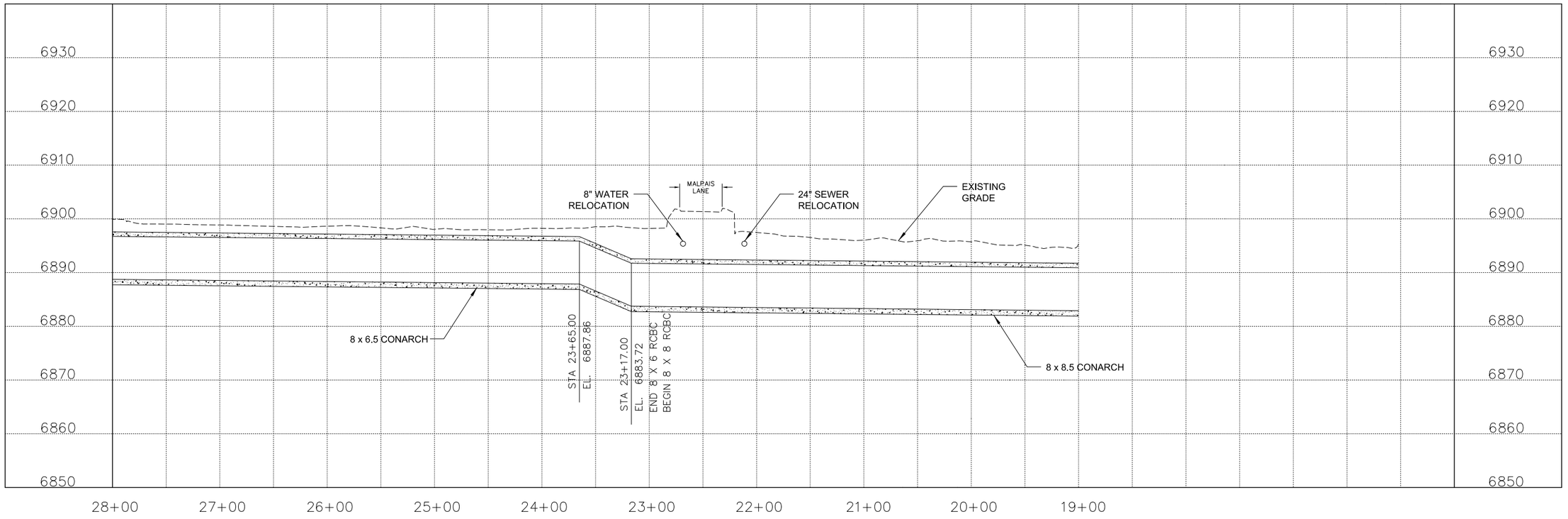

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

CLAY AVENUE IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 3
PLAN AND PROFILE
STA 19+00 TO 28+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

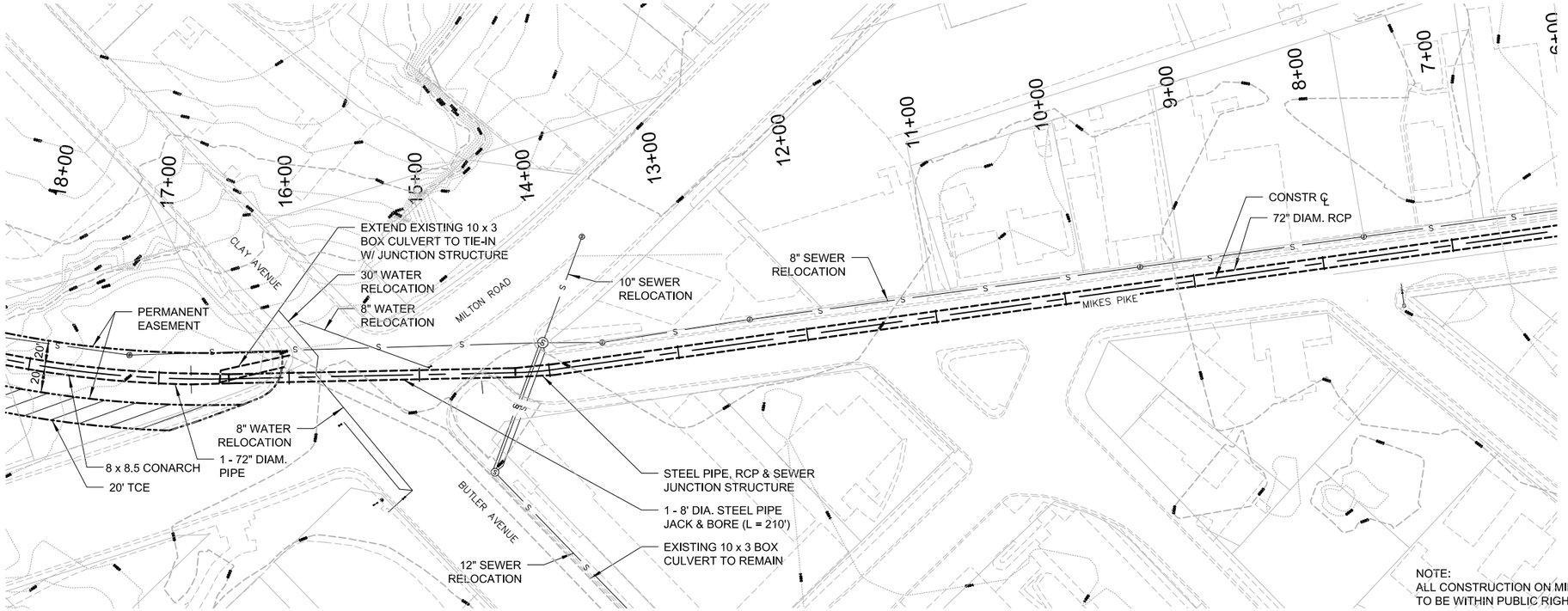
REVISIONS

NO.	DESCRIPTION	DATE	BY

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-5.12

SHT NO. | OF



NOTE:
ALL CONSTRUCTION ON MIKE'S PIKE TO BE WITHIN PUBLIC RIGHT-OF-WAY.

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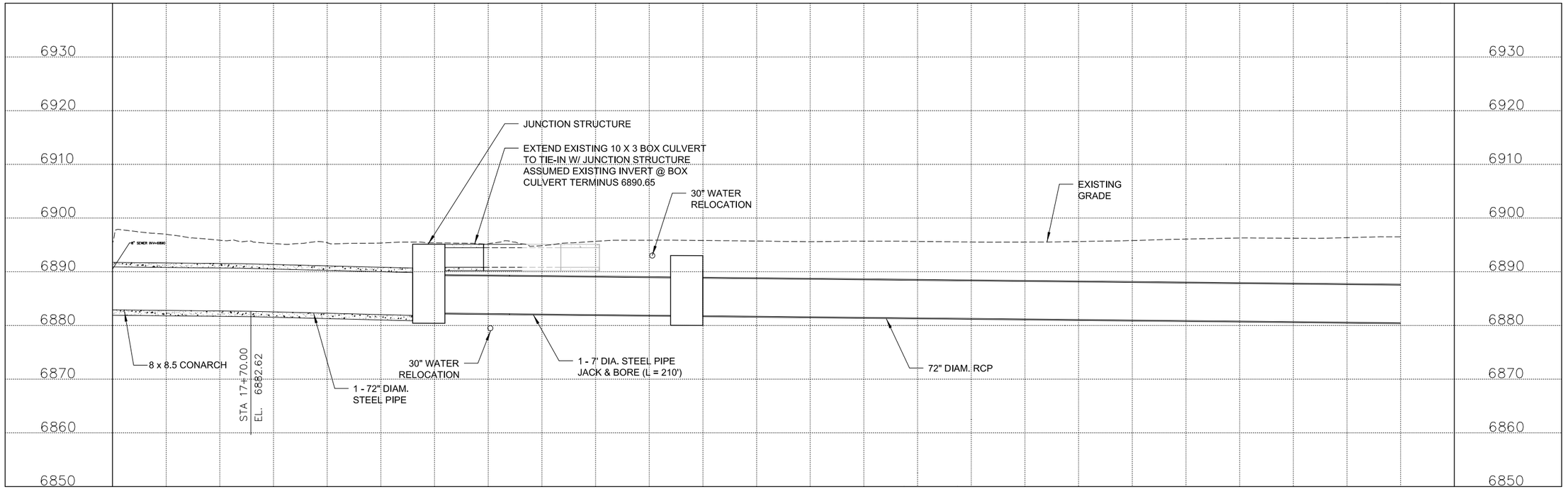

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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

CLAY AVENUE / MIKES PIKE IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 3
PLAN AND PROFILE
STA 7+00 TO 19+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

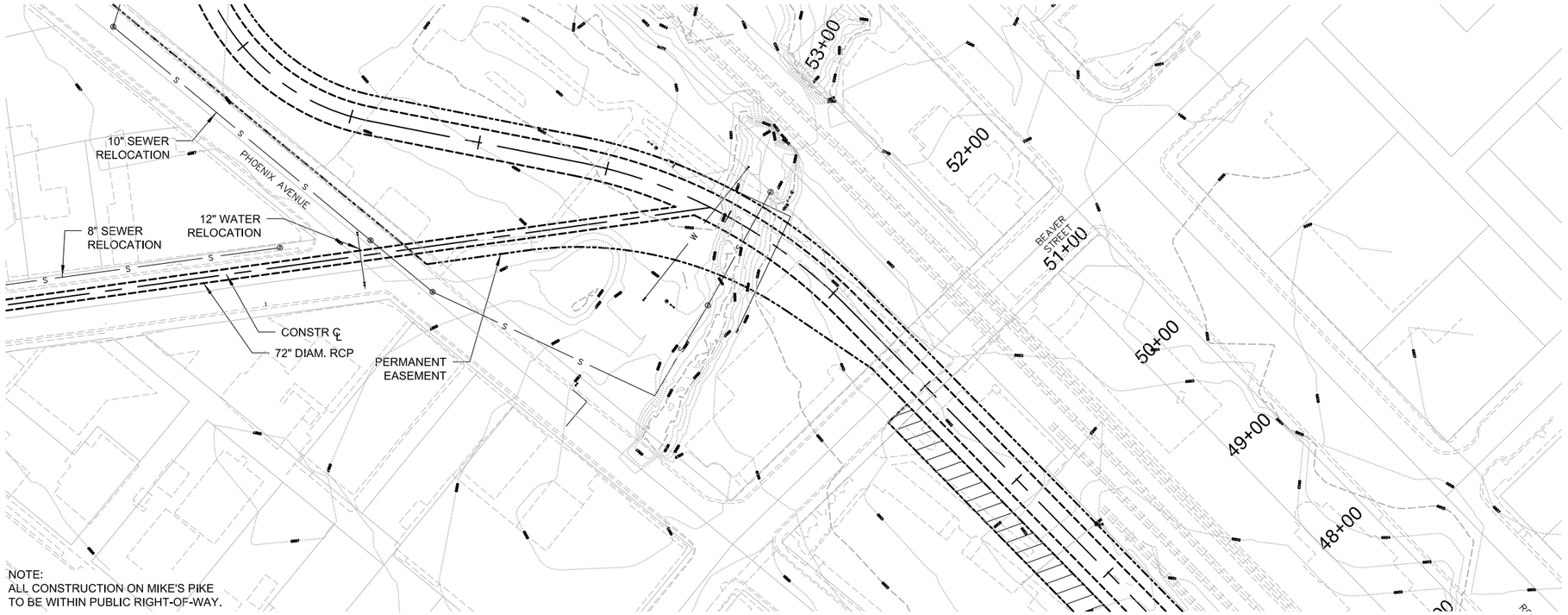
REVISIONS

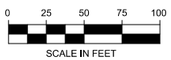
NO.	DESCRIPTION	DATE	BY

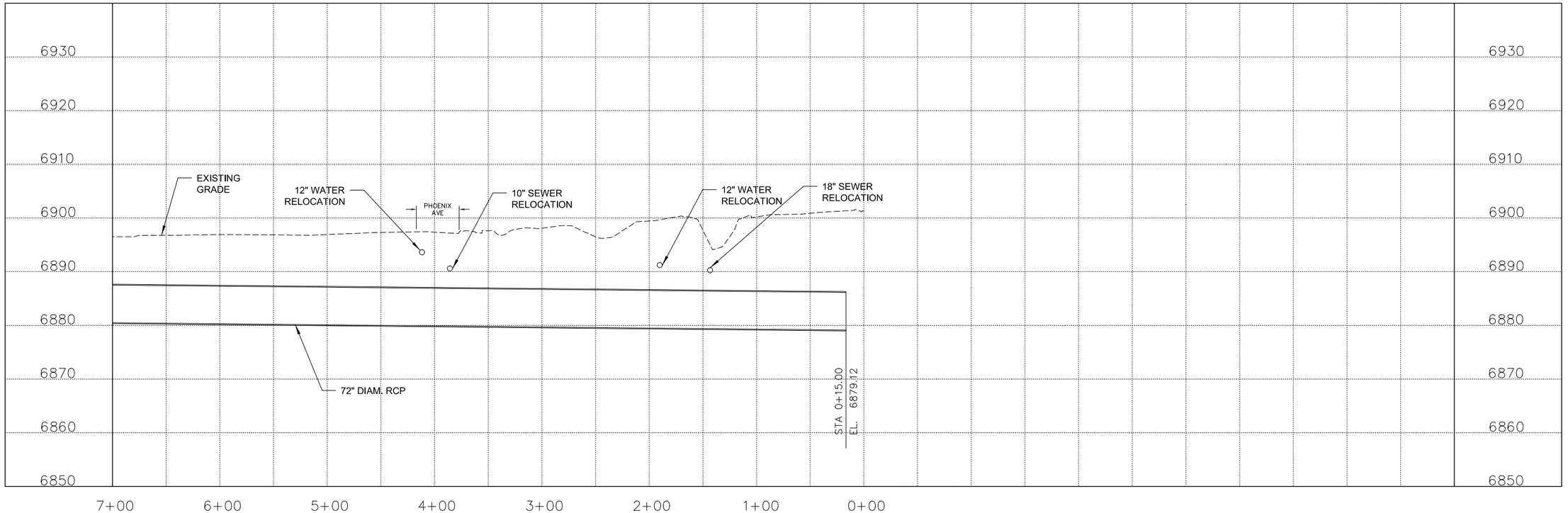
CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-5.13

SHT NO. OF







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RIO DE FLAG FLOOD CONTROL PROJECT
FLAGSTAFF ARIZONA

MIKES PIKE / CONFLUENCE IMPROVEMENTS

JOB NO:
DATE:
SCALE:
DRAWN:
DESIGN:
CHECKED:

ALTERNATE 3
PLAN AND PROFILE
STA 0+00 TO 7+00

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue
Suite 800
Phoenix, Arizona 85012

NO.	DESCRIPTION	DATE	BY

REVISIONS

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT

DRAWING NO.
C-5.14

SHT NO. | OF

Alternative 3 Cost Sheet

CITY OF FLAGSTAFF

RIO DE FLAG FLOOD CONTROL DESIGN CONCEPT PROJECT

ALTERNATE 3 - COST ESTIMATE (DRAFT)

Sheet 1 of 3 April 22, 2014

Michael Baker Jr., Inc.

	Description	Quantity	UofM	Unit Cost	Total Cost
	Prime Bond	1.00	LS		**$352,932.38**
	Price % Add-On	1.00	LS		**$8,835,200.87**
1	**Generals**	1.00	LS		**$3,453,893.21**
2	**Rio De Flag East Reach**	**1.00**	**LS**	**$9,409,075.81**	**$9,409,075.81**
2.1	**Removals**	**1.00**	**LS**	**$23,546.79**	**$23,546.79**
2.2	**Clear and Grub**	**10.00**	**AC**	**$3,404.09**	**$34,040.94**
2.3	**Water Utility Relocation and Realignments**	**1.00**	**LS**	**$94,500.47**	**$94,500.47**
2.4	**Sewer Utility Relocation and Realignments**	**1.00**	**LS**	**$639,634.38**	**$639,634.38**
2.5	**Structural Excavation and Backfill**	**1.00**	**LS**	**$2,463,246.55**	**$2,463,246.55**
2.5.1	Channel Excavation to Haul off	66,000.00	CY	$15.38	$1,015,172.40
2.5.2	Channel Excavation Contaminated Soil Haul off	500.00	CY	$136.00	$67,998.63
2.5.3	Hard Dig Contingency	6,600.00	CY	$68.75	$453,764.98
2.5.4	Import from stockpile, Place & Compact	41,000.00	CY	$22.10	$906,067.64
2.5.5	Site Grading	18,000.00	SY	$1.12	$20,242.90
2.6	**Concrete Structures**	**1.00**	**LS**		**$2,868,752.19**
2.6.2	Con-Arch 1 Barrel x 20 x 7	2,425.00	LF	$907.56	$2,200,844.11
2.6.3	2 10x7 Precast Box Culvert	112.00	LF	$1,277.09	$143,034.57
2.6.4	Slide Rail	4.00	MO	$51,082.42	$204,329.66
2.6.6	72" Pipe Tie In replacing box transition*	1.00	EA	$16,929.40	$16,929.40
2.6.7	Grouted Rip Rap 12"	1,226.00	CY	$178.60	$218,967.48
2.6.8	Transition - Arched or Box to Pre-cast Box 20 x 7	5.00	EA	$16,929.40	$84,646.98
2.7	**Street and Road Reconstruction**	**1.00**	**LS**		**$79,055.62**
2.8	**Landscaping Restoration**	**10.00**	**AC**	**$76,230.00**	**$762,300.00**
2.9	**Tree Replacement**	**40.00**	**EA**	**$2,500.00**	**$100,000.00**
2.10	**Striping**	**1.00**	**Each**	**$30,677.68**	**$30,677.68**
2.11	**Rail Road Shoring 1600 lf Butler to east of San Francisco**	**1.00**	**Each**	**$2,000,000.00**	**$2,000,000.00**
2.12	**Rail Road Insurance, Flagging, Inspection**	**1.00**	**LS**		**$150,000.00**
2.13	**Shore and lagging for building**	**350.00**	**LF**	**$466.63**	**$163,321.20**
3	**Rio De Flag North Reach**	**1.00**	**LS**		**$9,387,905.46**
3.1	**Removals**	**1.00**	**LS**		**$237,637.85**
3.2	**Clear and Grub**	**6.00**	**AC**	**$8,551.52**	**$51,309.10**
3.3	**Water Utility Relocation and Realignments**	**1.00**	**LS**		**$432,088.52**
3.4	**Sewer Utility Relocation and Realignments**	**1.00**	**LS**		**$1,045,404.50**
3.5	**Structural Excavation and Backfill**	**1.00**	**LS**		**$3,165,442.45**
3.5.1	Channel Excavation to Haul off	50,000.00	CY	$17.33	$866,476.35
3.5.2	Channel Excavation Contaminated Soil Haul off	500.00	CY	$120.39	$60,195.06
3.5.3	Hard Dig Contingency	5,000.00	CY	$69.07	$345,332.07
3.5.4	Jack and Bore Rail Road for box *	100.00	LF	$9,200.00	$920,000.00
3.5.6	Jack and bore for sewer*	1.00	LS	$415,000.00	$415,000.00
3.5.7	Import from stockpile, Place & Compact	25,000.00	CY	$21.80	$544,943.70
3.5.8	Site Grading	12,000.00	SY	$1.12	$13,495.27
3.6	**Concrete Structures**	1.00	**LS**		**$3,039,630.19**
3.6.2	Con-Arch 1 Barrel x 20 x 7 *	2,399.00	LF	$899.28	$2,157,374.20
3.6.3	10x7 Precast Box Culvert at Beal*	60.00	LF	$1,219.99	$73,199.12
3.6.4	48" Culverts at Roadway Crossings	269.00	LF	$100.00	$26,900.00
3.6.5	Slide Rail	6.00	MO	$50,064.03	$300,384.18
3.6.6	Grouted Rip Rap 24" *	840.00	CY	$166.19	$139,595.75
3.6.7	Junction Sturcture - Arched to Steel Pipe: at rt 66, confluence	3.00	EA	$43,510.66	$130,531.98
3.6.8	Transition - Arched or Box to Pre-cast Box 20 x 7	9.00	EA	$16,929.40	$152,364.56
3.6.9	Sewage By-Pass while installing new box*	1.00	EA	$59,280.40	$59,280.40
3.7	**Street and Road Reconstruction**	1.00	**LS**		**$705,439.62**
3.8	Signage	1.00	LS		**$13,912.50**
3.9	Striping	1.00	Each	$25,342.68	**$25,342.68**
3.10	Concrete Trail with foot soft Shoulders	25,540.00	SF	$4.97	**$126,818.06**
3.11	Landscaping Restoration	6.00	AC	$76,230.00	**$457,380.00**
3.12	Tree Replacement	35.00	EA	$2,500.00	**$87,500.00**
4	**Clay Avenue "West" Reach**	**1.00**	**LS**		**$10,207,308.76**
4.1	**Removals**	1.00	LS		**$161,406.89**
4.2	**Clear and Grub**	**5.00**	**AC**	**$7,780.62**	**$38,903.09**
4.3	**Water Utility Relocation and Realignments**	**1.00**	**LS**		**$743,909.55**
4.4	**Sewer Utility Relocation and Realignments**	**1.00**	**LS**		**$1,449,742.07**
4.5	**Structural Excavation and Backfill**	**1.00**	**LS**		**$2,601,301.51**
4.5.1	Channel Excavation to Stockpile "52000 is chucks take off quantity	52,000.00	CY	$19.63	$1,020,832.80
4.5.2	Channel Excavation Contaminated Soil Haul off	500.00	CY	$136.00	$67,998.63
4.5.3	Hard Dig Contingency	10,400.00	CY	$69.07	$718,290.71
4.5.5	Import from stockpile, Place & Compact Adjusted	32,240.00	CY	$24.18	$779,559.50
4.5.6	Site Grading	13,000.00	SY	$1.12	$14,619.87

CITY OF FLAGSTAFF

RIO DE FLAG FLOOD CONTROL DESIGN CONCEPT PROJECT

ALTERNATE 3 - COST ESTIMATE (DRAFT)

Sheet 2 of 3 - April 22, 2014

Michael Baker Jr., Inc.

	Description	Quantity	UoM	Unit Cost	Total Cost
4.6	**Concrete Structures**	**1.00**	**LS**		**$2,972,878.57**
4.6.1	Cast in Place Open U-channel	1,040.00	LF	$809.86	$842,257.73
4.6.3	Con-Arch 1 Barrel x 8 x 8.5	1,941.00	LF	$636.05	$1,234,577.19
4.6.4	Single 8x8 Precast Box Culvert	378.00	LF	$949.99	$359,094.43
4.6.5	Slide Rail	5.00	MO	$59,082.42	$295,412.08
4.6.6	Cast in Place Inlet Stucture	1.00	EA	$92,579.01	$92,579.01
4.6.7	Transition CIP to Pre-cast - 8 x 8.5	6.00	Each	$10,322.80	$61,936.81
4.6.8	Junction Sturcture - Arched or Box to Steel Pipe: at rt 66, confluence	2.00	EA	$43,510.66	$87,021.32
4.7	**Street and Road Reconstruction**	**1.00**	**LS**		**$1,017,571.94**
4.7.1	Street Paving 4on6	4,725.00	SY	$17.96	$84,865.21
4.7.2	Street Paving 3on6	2,702.00	SY	$18.49	$49,959.41
4.7.3	Parking lot Paving	363.00	SY	$31.62	$11,478.92
4.7.4	ADOT Paving	2,809.00	SY	$58.98	$165,672.81
4.7.5	Misc Concrete surfaces	32,461.00	SF	$6.78	$220,139.81
4.7.6	Valley Gutter/Aprons Mag Dtl 240 modified with wiremesh 4000 psi conc	1,408.00	SF	$9.82	$13,819.85
4.7.7	Vertical Curb & Gutter Mag Dtl 220 Type A, H=6"	4,400.00	LF	$14.43	$63,484.10
4.7.8	Single Curb Mag Dtl 222 Type A, H=6"	99.00	LF	$12.01	$1,189.38
4.7.9	Sidewalk ADOT c5.30	1,044.00	SF	$4.71	$4,912.79
4.7.10	Sidewalk Mag Dtl 230 or P-1230 (Hand Placed Only)	17,545.00	SF	$6.14	$107,807.59
4.7.11	Sidewalk Stamped	3,601.00	SF	$5.97	$21,483.00
4.7.12	Sidewalk Ramp Mag 235-1	1,133.00	SF	$6.06	$6,863.55
4.7.13	Driveway Entrance Mag Dtl 250-1or2	3,949.00	SF	$6.78	$26,780.82
4.7.14	Driveway Entrance Mag Dtl MOD	70.00	SF	$6.78	$474.72
4.7.15	Bus Bay Ramp COF type F	266.00	SF	$33.35	$8,872.23
4.7.16	Install Salvaged Bus Shelters	3.00	EA	$5,932.12	$17,796.36
4.7.17	Construct Trash enclosure	2.00	EA	$13,084.80	$26,169.60
4.7.18	Aggregate Base Course Driveway	181.00	SY	$8.68	$1,570.96
4.7.19	Adjust Water Meter Box	20.00	EA	$655.06	$13,101.24
4.7.20	Adjustment - 5' Manhole Mag Dtl 420 & 424 with Corrosion Protection	15.00	EA	$215.00	$3,225.00
4.7.21	Adjustment - Gate Valve, Valve Box & Cover Mag Dtl 391-1 Type C	13.00	EA	$185.00	$2,405.00
4.7.22	Adjust Clean Out	1.00	EA	$150.00	$150.00
4.7.23	Catchbasin MAG 531 5'-6"	18.00	EA	$2,290.67	$41,232.01
4.7.24	533 Catch Basins Type D	1.00	EA	$4,556.96	$4,556.96
4.7.25	Catch Basin 550 Catchbasin street wide	2.00	EA	$9,424.80	$18,849.59
4.7.26	Catchbasin MAG 537	1.00	EA	$4,795.72	$4,795.72
4.7.27	18" RGRCP	388.00	LF	$109.54	$42,500.80
4.7.28	36" RGRCP, Adj Class __	59.00	LF	$355.01	$20,945.35
4.7.29	24" RGRCP, Adj Class __	21.00	LF	$146.92	$3,085.40
4.7.30	48" RGRCP, Adj Class __	59.00	LF	$215.18	$12,695.78
4.7.31	Hand Placed Riprap	5.00	CY	$186.83	$934.14
4.7.32	Replace Ped Bridge	1.00	LS		$0.00
4.7.33	Parkway Grading	20,000.00	SY	$0.79	$15,753.85
4.8	Signage	1.00	LS		$13,912.50
4.9	Striping	1.00	Each	$30,467.68	$30,467.68
4.10	Landscaping Restoration	5.00	AC	$76,230.00	$381,150.00
4.11	Tree Replacement	24.00	EA	$2,500.00	$60,000.00
4.12	ABC Service Road	1,600.00	SY	$3.62	$5,799.00
4.13	**Alt. 3 A additions**	**1.00**	**LS**		**$1,221,595.15**
4.13.1	Jack and Bore 5 Points	230.00	LF	$1,821.96	$419,050.00
4.13.2	Junction Sturcture 8x8 to 10x3 box/72"casing, 72" casing to 8x6 box	2.00	EA	$43,510.66	$87,021.32
4.13.3	Single 8x6 Cast in Place Box Culvert	1,545.00	LF	$615.05	$950,249.36
4.13.4	Con-Arch 1 Barrel x 8 x 6.5 x 1545	1,545.00	LF	$561.73	$867,865.41
4.13.5	72" RGRCP Mikes Pike to transition sta 16+00 to 1+00 ~ subtract from box*	1,545.00	LF	$319.32	$493,346.93
4.13.6	Tie into existng 10x3 box	1.00	EA		$6,358.08
4.13.7	Restore Earthen channel , Butler to Oleary	1.00	LS		$215,818.81
5	**Trapazoid Channel**	**1,200.00**	**LF**	**$1,272.19**	**$1,526,630.78**
5.1	Site Clearing, Grubbing	3.00	AC	$5,771.51	$17,314.53
5.2	Excavate Trapazoid Channel	40,000.00	CY	$24.09	$963,775.54
5.3	Retaining wall 4 - 11 ft tall	400.00	LF	$322.31	$128,925.45
5.4	Install Turf Reinforcement Mat	15,000.00	SY	$2.85	$42,692.98
5.5	Hydroseeding	3.00	AC	$3,200.00	$9,600.00
5.6	Grouted rip rap	300.00	CY	$200.78	$60,232.73
5.7	Parkway grading	12,000.00	SY	$0.79	$9,452.31
5.8	Landscaping Restoration	3.00	AC	$76,230.00	$228,690.00
5.9	Tree Replacement	20.00	EA	$2,500.00	$50,000.00
5.10	ABC Service Road	4,400.00	SY	$3.62	$15,947.24

CITY OF FLAGSTAFF

RIO DE FLAG FLOOD CONTROL DESIGN CONCEPT PROJECT

ALTERNATE 3 - COST ESTIMATE (DRAFT)

Sheet 3 of 3 - April 22, 2014

Michael Baker Jr., Inc.

	Description	Quantity	UoM	Unit Cost	Total Cost
6	**Route 66 Bridge Replacement**	1.00	LS		**$960,831.89**
7	**Storm Damage**	1.00	LS		**$300,000.00**
8	**Electrical & Signals**	1.00	LS		**$150,000.00**
9	**Design Completions 15%**	1.00	LS		**$4,746,262.91**
10	**Construction Contingency 10%**	1.00	LS		**$3,164,175.27**
					$52,494,217.33

Real Estate Acquisition	$	**7,142,000**
Remaining Design Fee Estimate	$	**1,200,000**
Construction Administration (6%)	$	**3,149,653**
Total Estimated Cost	$	**63,985,870**

APPENDIX C FLOODPLAIN DELINEATIONS

Existing Conditions Workmap

Legend

- Culverts
- Proposed Floodplain
- River
- HEC-RAS Cross-Sections with Station and Water Surface Elevations
- Effective Floodplain

N
W E
S

150 75 0 150 300 Feet

1 inch = 300 feet

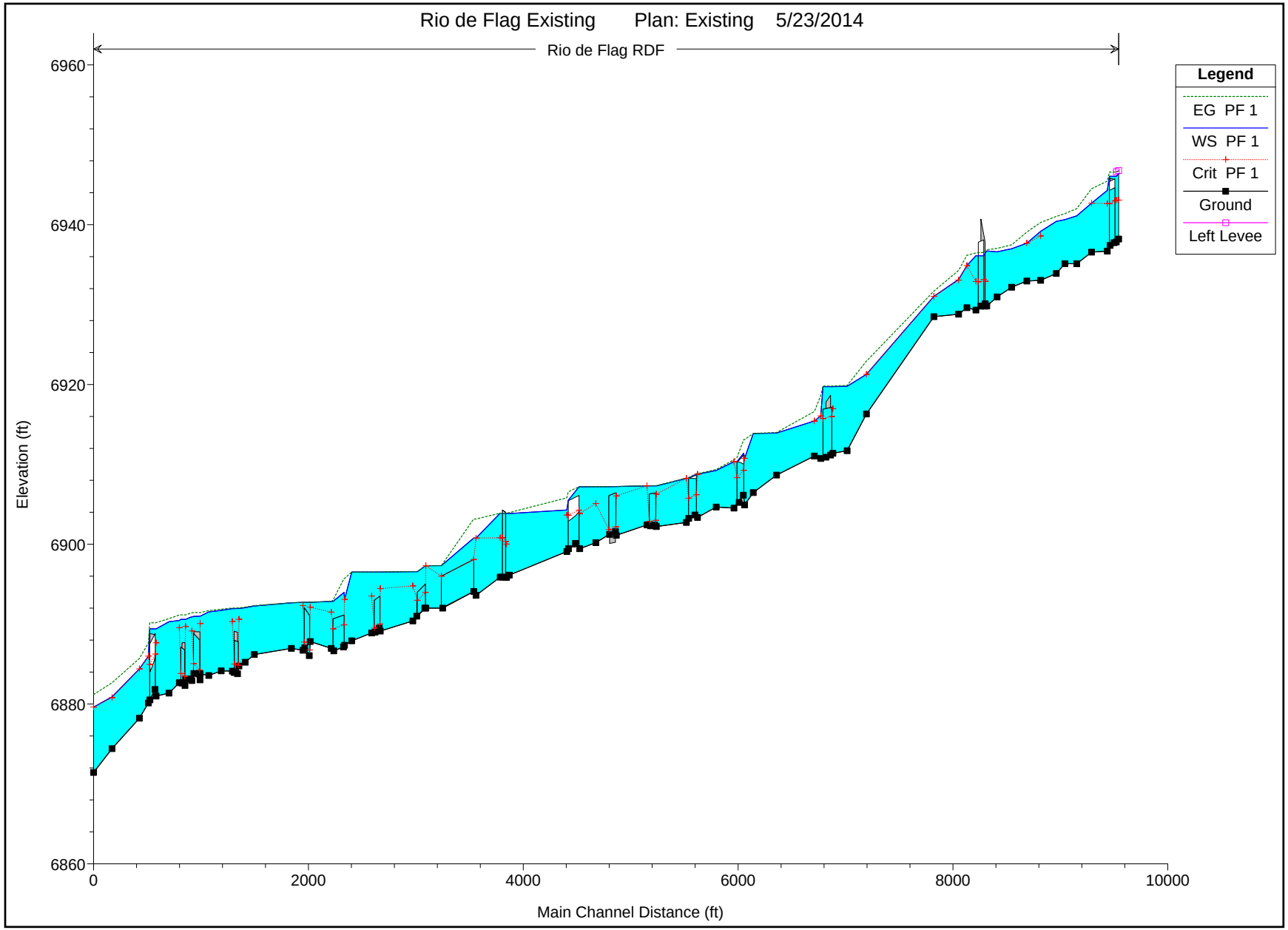
Clay Avenue Wash and Rio de Flag Floodplain Delineation

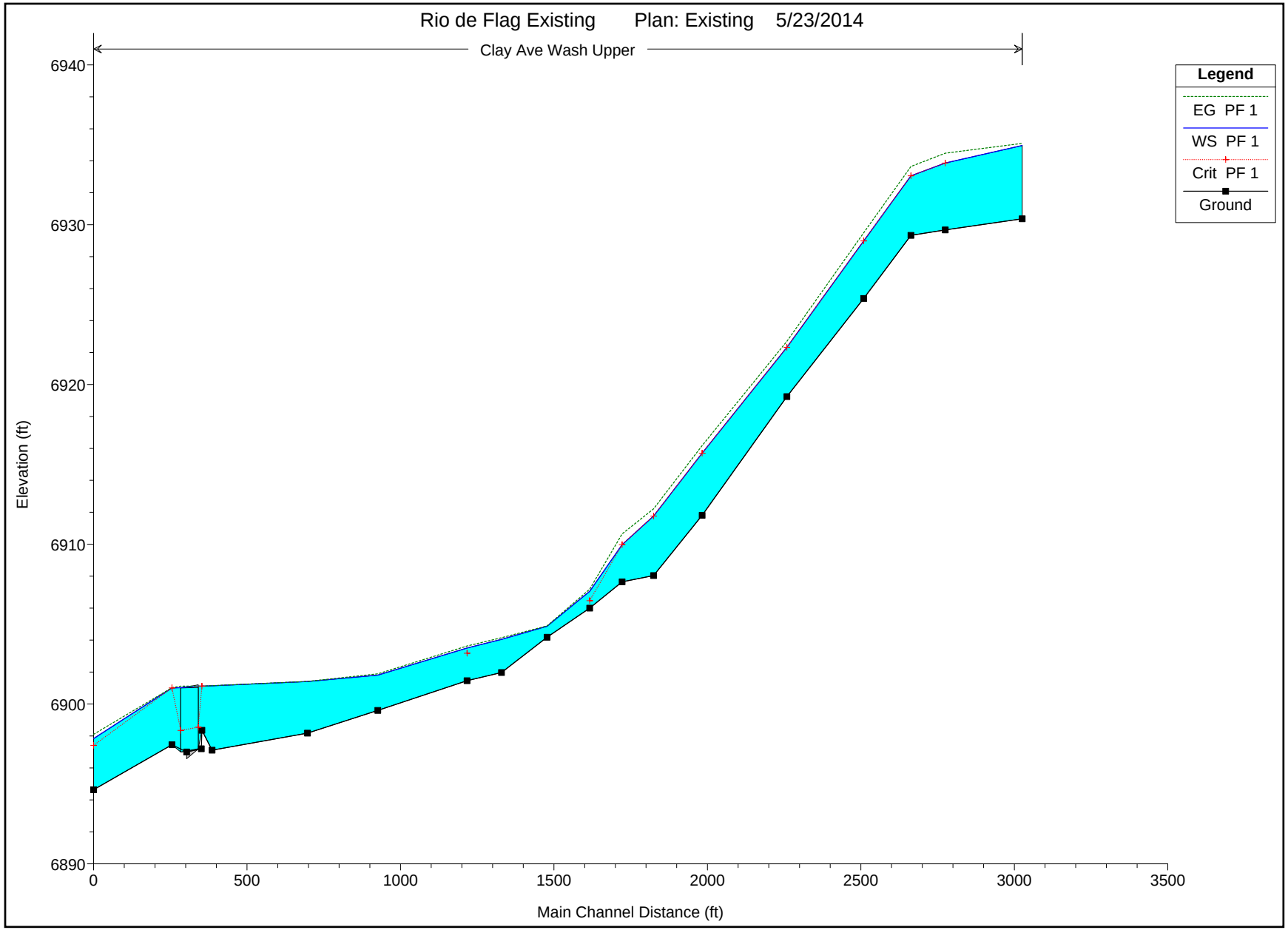
Tie into Effective Zone AE Rio de Flag Floodplain
Limit of Study
River Sta 9595 WSE = 6946.4 Ft
River Sta 9573 WSE = 6946.05 Ft
W Beal Road - 3 - 96" CMPs
River Sta 9507 WSE = 6944.29 Ft
River Sta 9347 WSE = 6942.69 Ft
River Sta 9210 WSE = 6941.11 Ft
River Sta 9099 WSE = 6940.63 Ft
River Sta 9019 WSE = 6940.41 Ft
River Sta 8874 WSE = 6939.17 Ft
River Sta 8874 WSE = 6939.17 Ft
River Sta 8745 WSE = 6937.68 Ft
River Sta 8603 WSE = 6937 Ft
River Sta 8468 WSE = 6936.61 Ft
River Sta 8372 WSE = 6936.7 Ft
N. Thorpe Road - 2 - 24' W x 8' H Conarches
River Sta 8359 WSE = 6936.48 Ft
River Sta 8271 WSE = 6936.12 Ft
River Sta 8187 WSE = 6934.88 Ft
River Sta 8110 WSE = 6933.15 Ft
River Sta 7880 WSE = 6931.04 Ft
River Sta 7070 WSE = 6919.76 Ft
River Sta 6937 WSE = 6919.73 Ft
River Sta 7252 WSE = 6921.27 Ft
N Bonito St - 2 -10' W x 6' H Boxes
River Sta 6765 WSE = 6915.43 Ft
River Sta 6824 WSE = 6916.07 Ft
W Elm Ave
N Sitgreaves St - 2 - 12' W x 6' H Boxes
River Sta 6017 WSE = 6910.33 Ft
River Sta 6413 WSE = 6913.92 Ft
River Sta 5677 WSE = 6908.77 Ft
River Sta 6195 WSE = 6913.86 Ft
W Cherry Ave - 2-10' W x 5' H Box 45 Skew
River Sta 6115 WSE = 6910.77 Ft
N Humphries St
River Sta 5574 WSE = 6908.25 Ft
River Sta 5293 WSE = 6907.3 Ft
W Birch Ave - 2-10' W x 4' H Box
River Sta 5851 WSE = 6909.23 Ft
Rio de Flag
River Sta 5207 WSE = 6907.31 Ft
W Aspen Ave - 3 - 10' W x 4.85' H Box
Route 66 - 1- 7' H x 17' W + 1-7' H x 13' W
River Sta 4920 WSE = 6907.22 Ft
River Sta 4477 WSE = 6904.29 Ft
River Sta 3942 WSE = 6903.84 Ft
River Sta 4747 WSE = 6907.21 Ft
River Sta 3916 WSE = 6903.87 Ft
River Sta 4597 WSE = 6907.19 Ft
Railroad - 2 - Piers, 4' W x 3' H, 20' Separation
River Sta 3857 WSE = 6903.88 Ft
River Sta 3631 WSE = 6900.78 Ft
S Mikes Pike
N Beaver St
W Phoenix Ave - 2 - 4' H x 13' W Boxes, 45 Skew
River Sta 3165 WSE = 6897.31 Ft
E Cottage Ave - 2- 5' H x 15' W Boxes
River Sta 3043 WSE = 6896.58 Ft
River Sta 2740 WSE = 6896.53 Ft
E Benton Ave - 3- 10' W x 5' H Boxes
River Sta 2659 WSE = 6896.53 Ft
River Sta 2474 WSE = 6896.52 Ft
W Butler Ave - 3- 10' W x 5' H Boxes
Limit of Study
San Francisco - 2 - 10' W x 5' H Boxes
River Sta 2087 WSE = 6892.73 Ft
River Sta 1912 WSE = 6892.67 Ft
River Sta 973 WSE = 6890.86 Ft
River Sta 922 WSE = 6890.6 Ft
River Sta 869 WSE = 6890.46 Ft
River Sta 653 WSE = 6889.42 Ft
River Sta 582 WSE = 6886.01 Ft
River Sta 498 WSE = 6884.4 Ft
River Sta 243 WSE = 6880.9 Ft
River Sta 71 WSE = 6879.62 Ft
Limit of Study
Tie into Effective Zone AE Rio de Flag Floodplain
River Sta 3124 WSE = 6903.5 Ft
River Sta 2162 WSE = 6901.01 Ft
River Sta 3236 WSE = 6904.05 Ft
Malpais Lane - 72" x 48" CMP Ellipse
River Sta 2260 WSE = 6901.12 Ft
River Sta 3384 WSE = 6904.87 Ft
River Sta 2293 WSE = 6901.14 Ft
River Sta 3523 WSE = 6907.05 Ft
River Sta 2604 WSE = 6901.41 Ft
River Sta 3629 WSE = 6909.98 Ft
River Sta 2833 WSE = 6901.81 Ft
River Sta 3731 WSE = 6911.77 Ft
River Sta 3890 WSE = 6915.7 Ft
River Sta 4166 WSE = 6922.32 Ft
River Sta 4416 WSE = 6928.99 Ft
Clay Avenue Wash
River Sta 2407 WSE = 6893.1 Ft
River Sta 1907 WSE = 6897.84 Ft
River Sta 2284 WSE = 6892.84 Ft
River Sta 2020 WSE = 6892.73 Ft
River Sta 1567 WSE = 6892.27 Ft
River Sta 1483 WSE = 6892.06 Ft
River Sta 1424 WSE = 6891.96 Ft
S Agassiz St - 2 - 6' W x 4' H Boxes
River Sta 1363 WSE = 6891.95 Ft
River Sta 1259 WSE = 6891.72 Ft
River Sta 1143 WSE = 6891.52 Ft
River Sta 1059 WSE = 6891 Ft
S Oleary St - 20' W x 7' H CM Arch
River Sta 774 WSE = 6890.31 Ft
S Fountain St - 2 - 54" CMPs
River Sta 986 WSE = 6890.89 Ft
S Verde St - 2 - 5' H x 10' W Boxes
Limit of Study
Tie into Effective Zone AE Clay Avenue Wash Floodplain

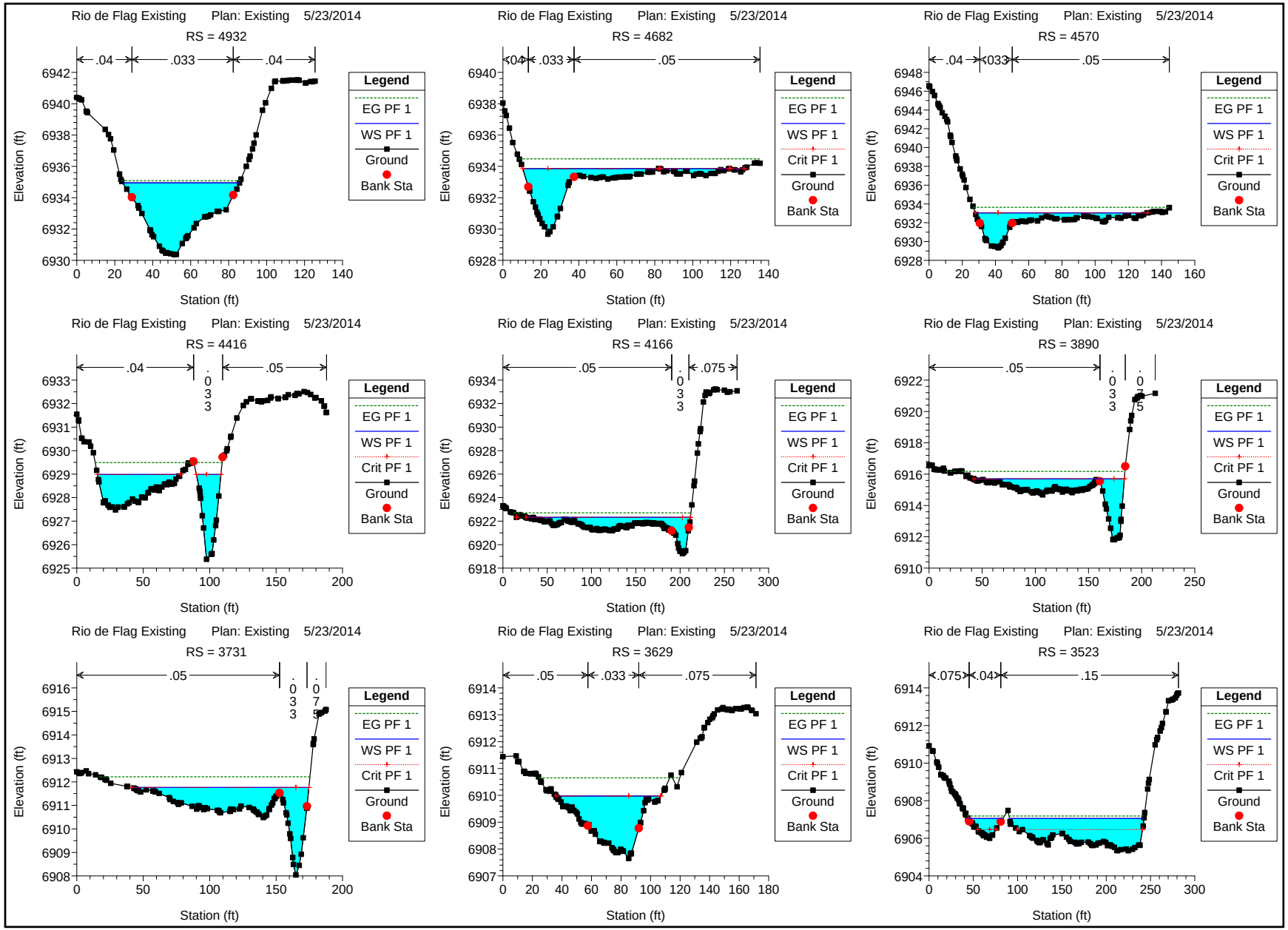
V:\PROJECTS\139105_RDF FEMA Study\CAD\GIS\Existing Conditions WorkMap.mxd

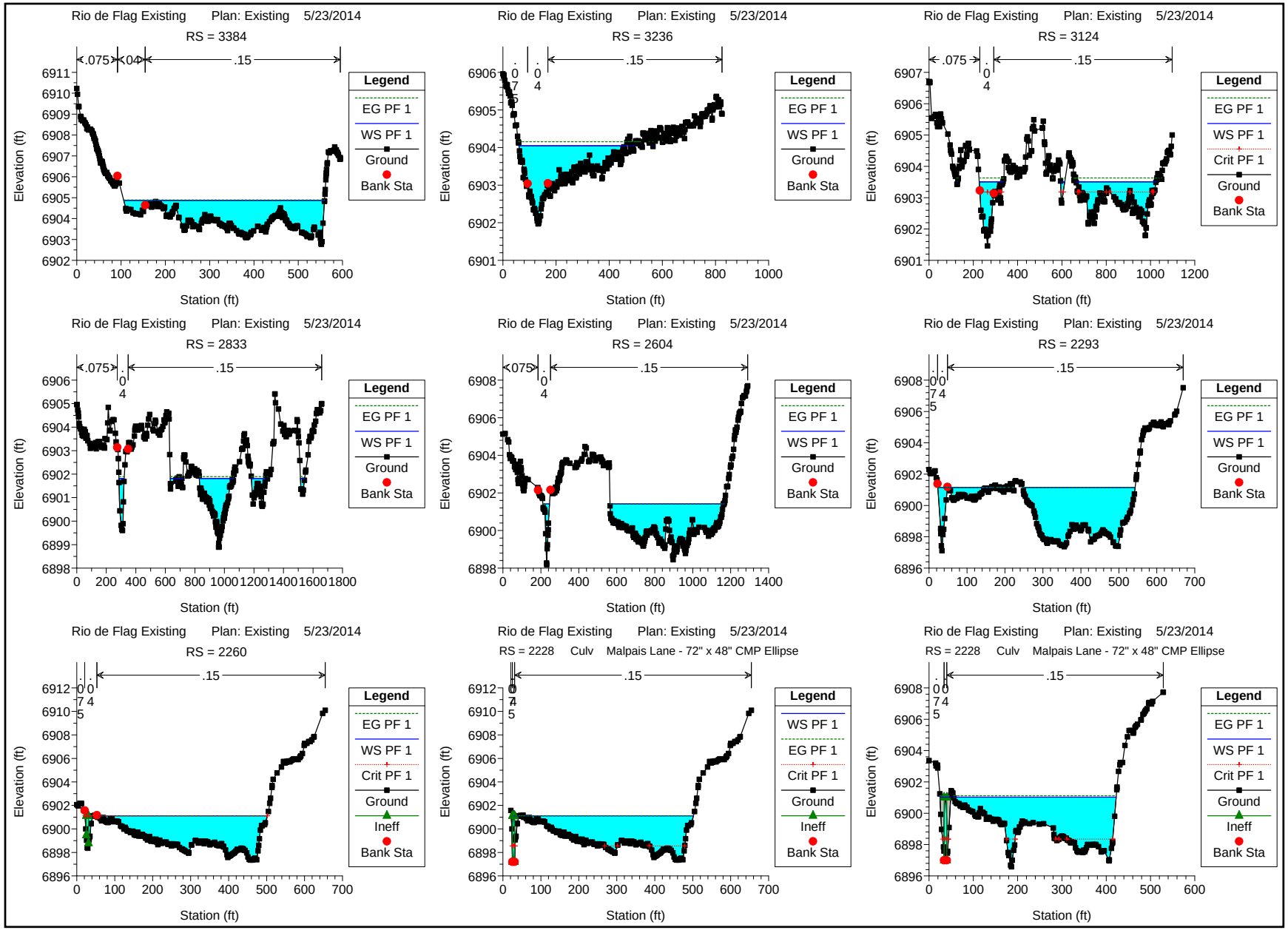
APPENDIX D HYDRAULIC MODELS AND CALCULATIONS

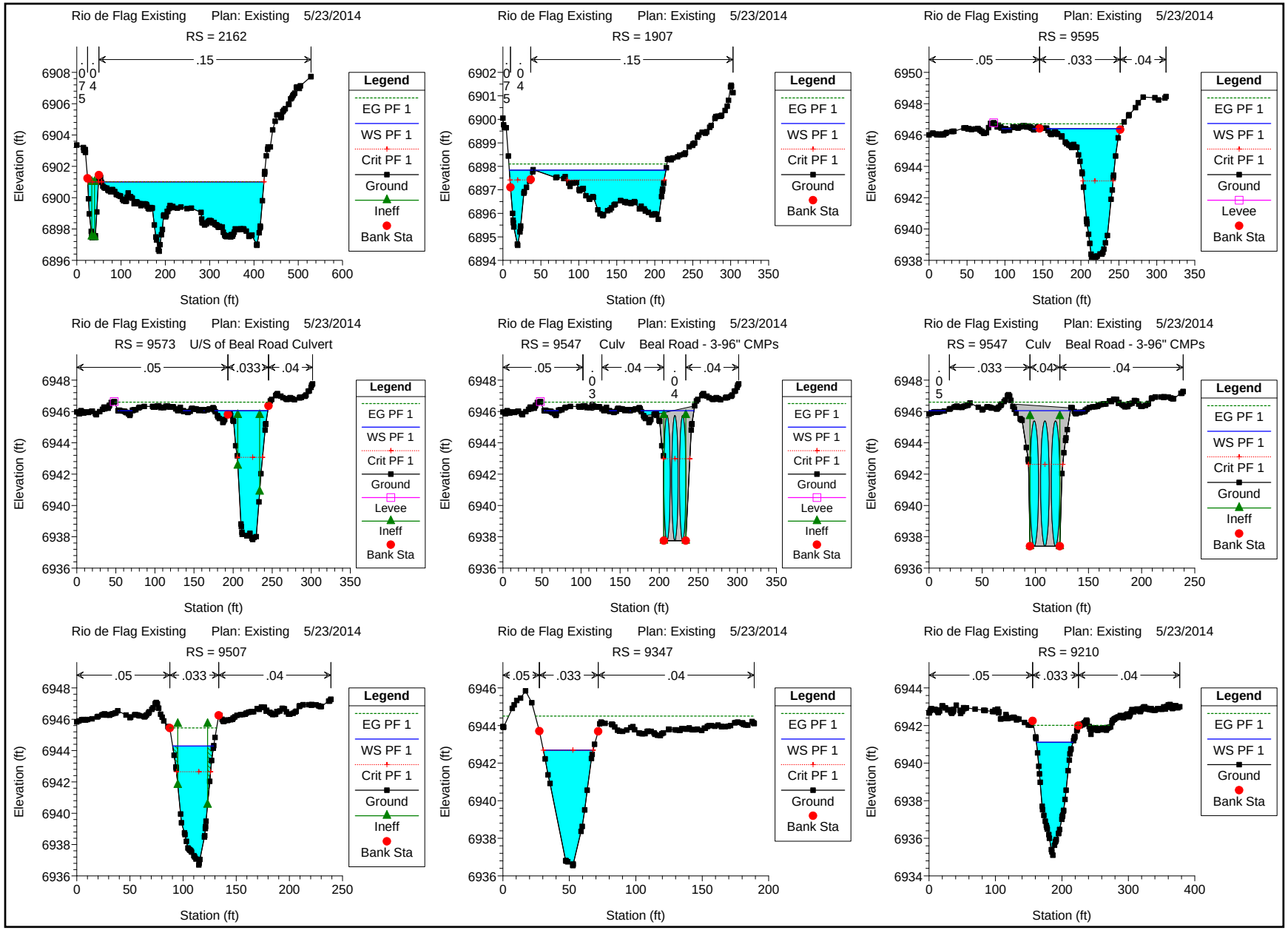
Existing Conditions Model Output

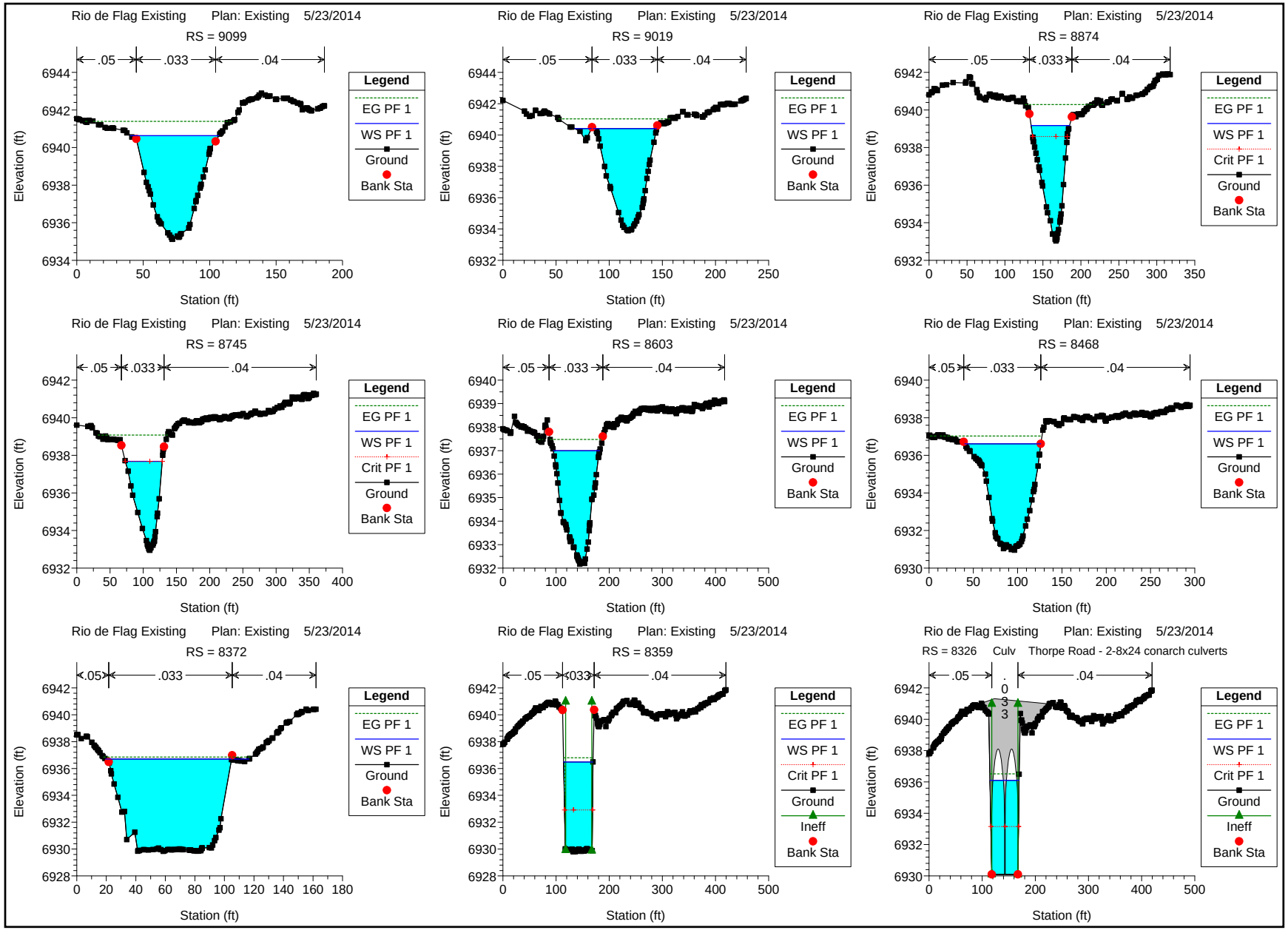

Rio de Flag Existing Plan: Existing 5/23/2014
Rio de Flag RDF
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Left Levee
Elevation (ft)
6960
6940
6920
6900
6880
6860
0
2000
4000
6000
8000
10000
Main Channel Distance (ft)

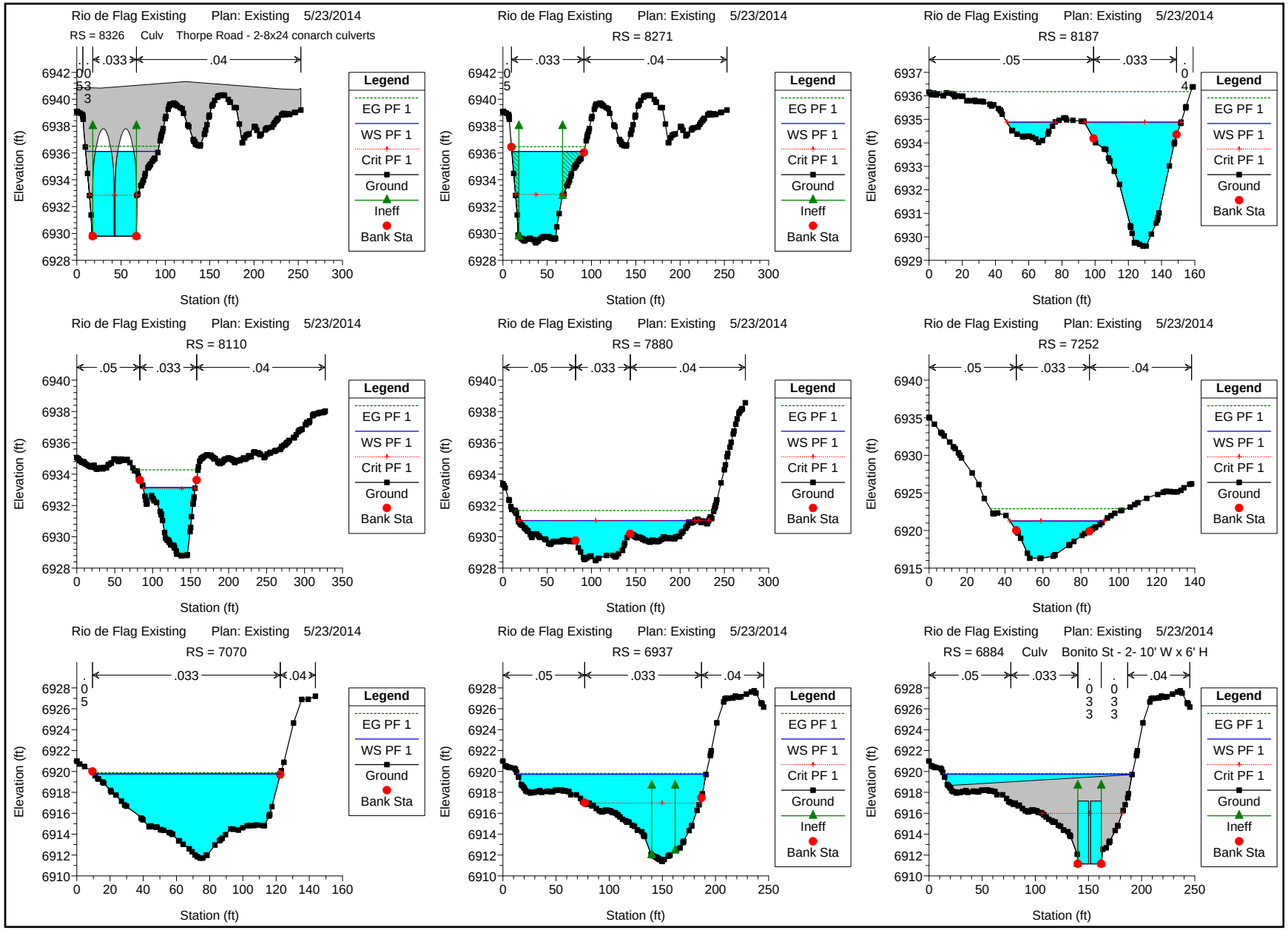

Rio de Flag Existing Plan: Existing 5/23/2014
Clay Ave Wash Upper
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
6940
6930
6920
6910
6900
6890
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)

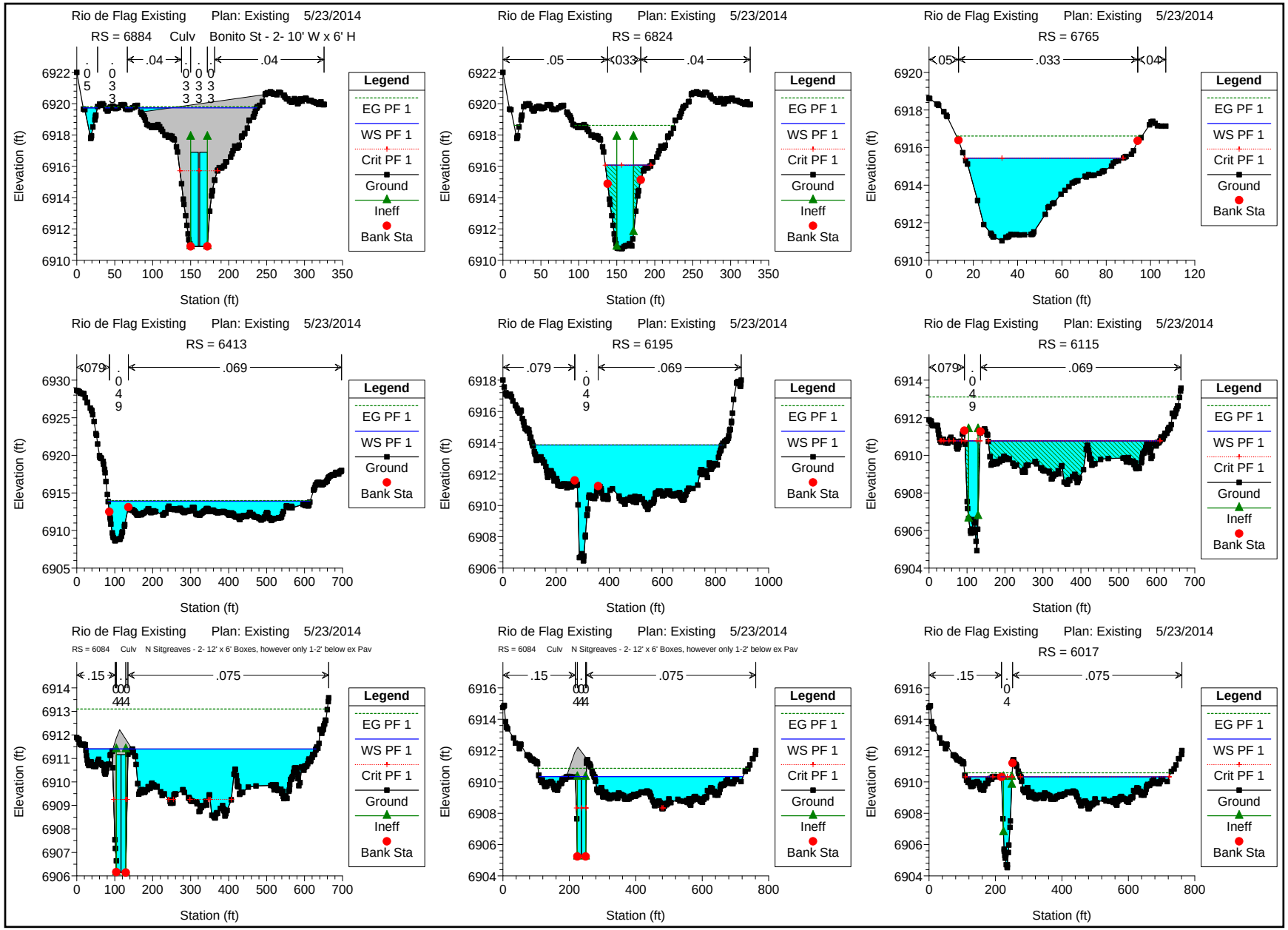

Rio de Flag Existing Plan: Existing 5/23/2014
RS = 4932
.04
.033
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 4682
.04
.033
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 4570
.04
.033
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 4416
.04
.033
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 4166
.05
.033
.075
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 3890
.05
.033
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 3731
.05
.033
.075
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 3629
.05
.033
.075
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 3523
.075
.04
.15
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

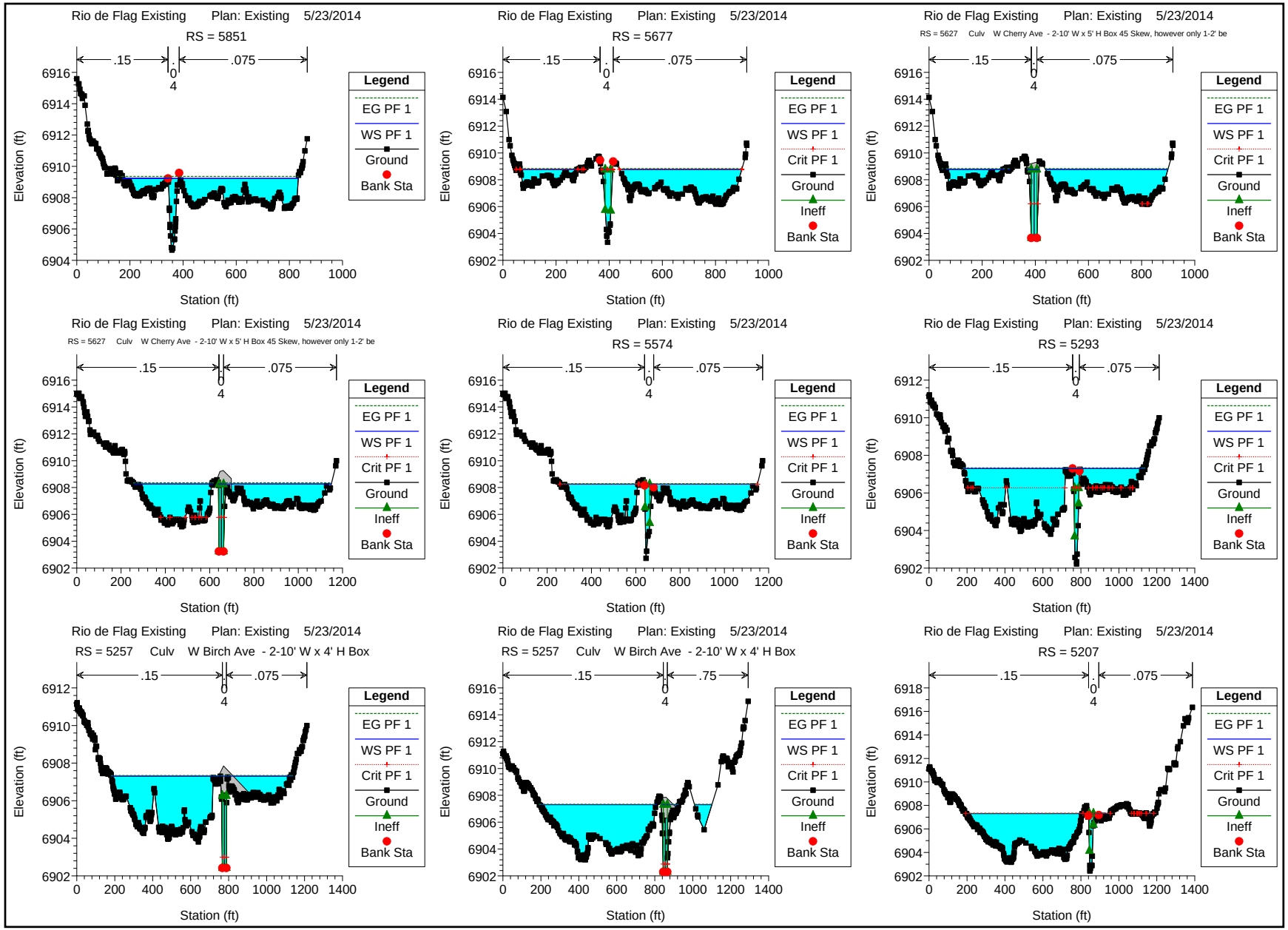

Rio de Flag Existing Plan: Existing 5/23/2014
RS = 3384
RS = 3236
RS = 3124
RS = 2833
RS = 2604
RS = 2293
RS = 2260
RS = 2228 Culv Malpais Lane - 72" x 48" CMP Ellipse
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

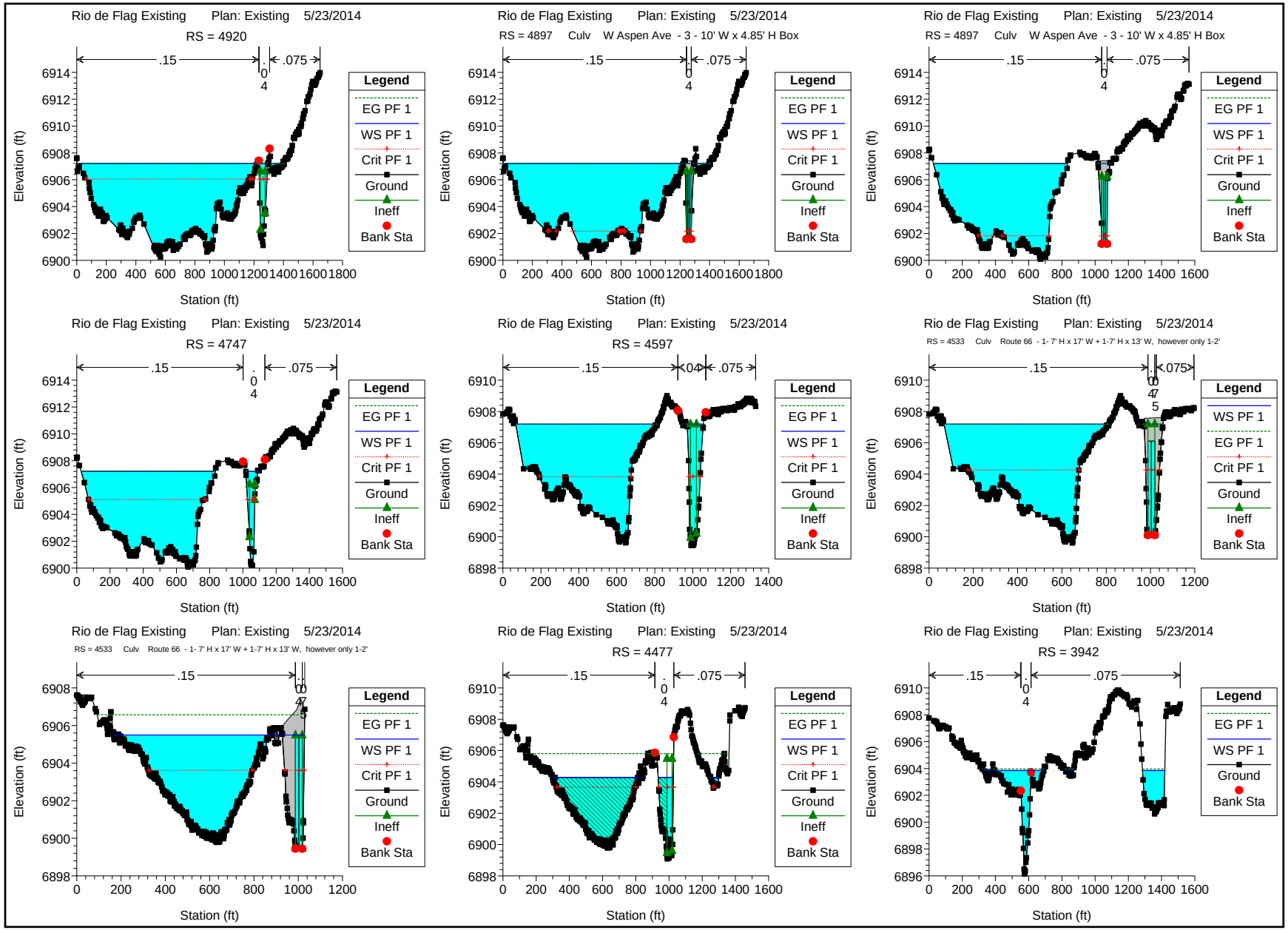

Rio de Flag Existing Plan: Existing 5/23/2014
RS = 2162
RS = 1907
RS = 9595
RS = 9573 U/S of Beal Road Culvert
RS = 9547 Culv Beal Road - 3-96" CMPs
RS = 9547 Culv Beal Road - 3-96" CMPs
RS = 9507
RS = 9347
RS = 9210
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)

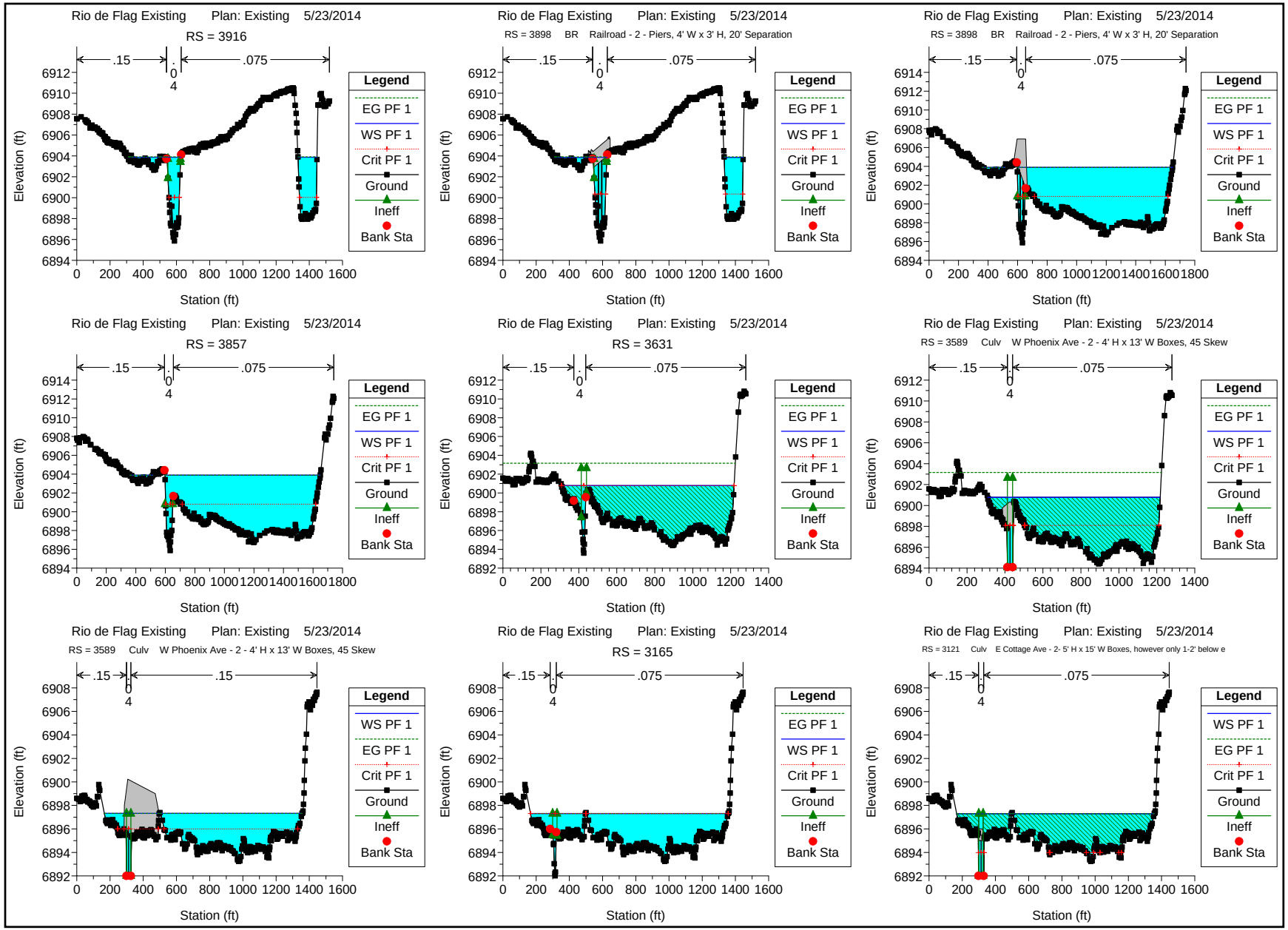

Rio de Flag Existing Plan: Existing 5/23/2014
RS = 9099
.05 .033 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 9019
.05 .033 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 8874
.05 .033 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 8745
.05 .033 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 8603
.05 .033 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 8468
.05 .033 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 8372
.05 .033 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 8359
.05 .033 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 8326 Culv Thorpe Road - 2-8x24 conarch culverts
.05 .033 .04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

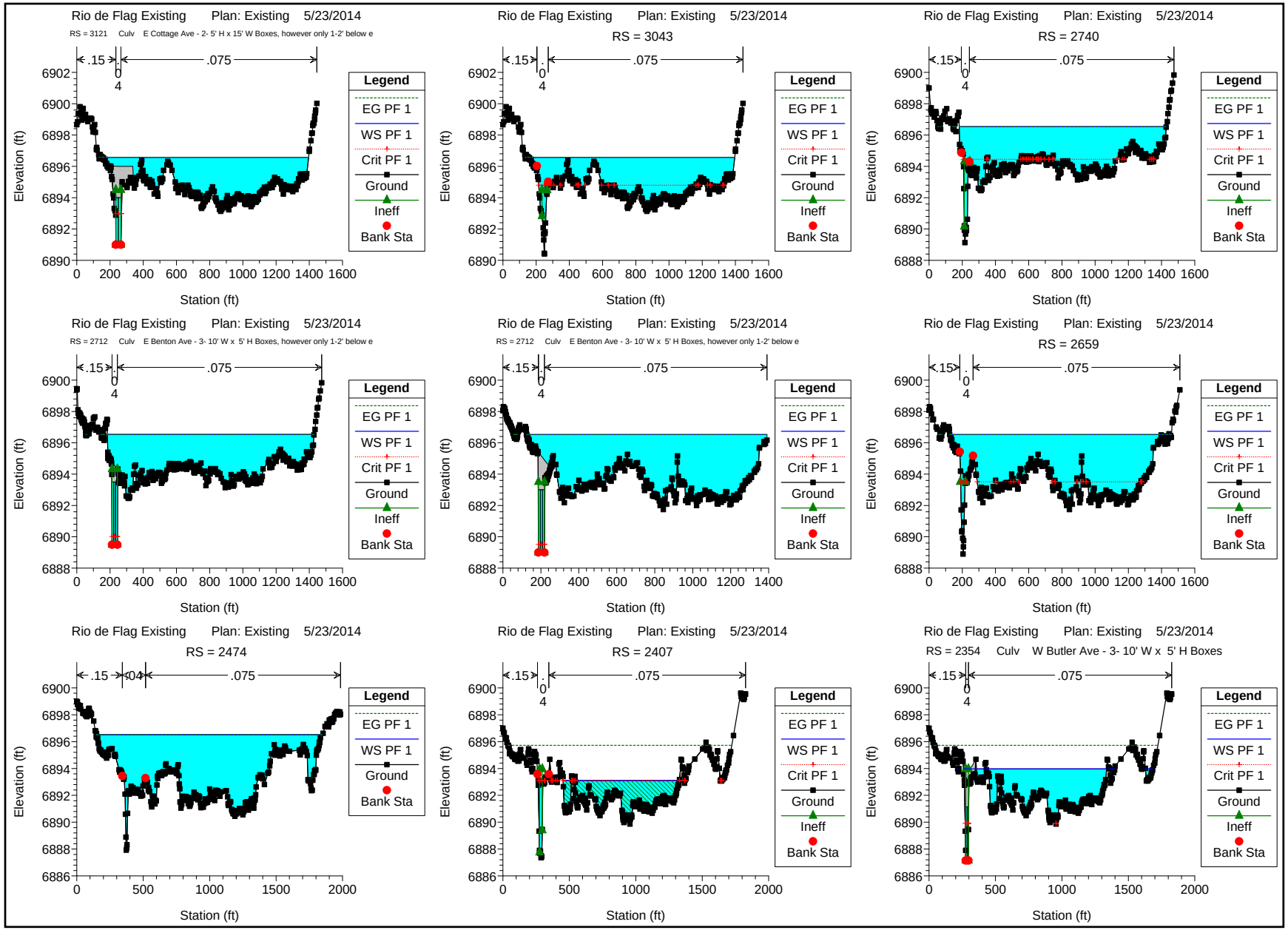

Rio de Flag Existing Plan: Existing 5/23/2014
RS = 8326 Culv Thorpe Road - 2-8x24 conarch culverts
RS = 8271
RS = 8187
RS = 8110
RS = 7880
RS = 7252
RS = 7070
RS = 6937
RS = 6884 Culv Bonito St - 2- 10' W x 6' H
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

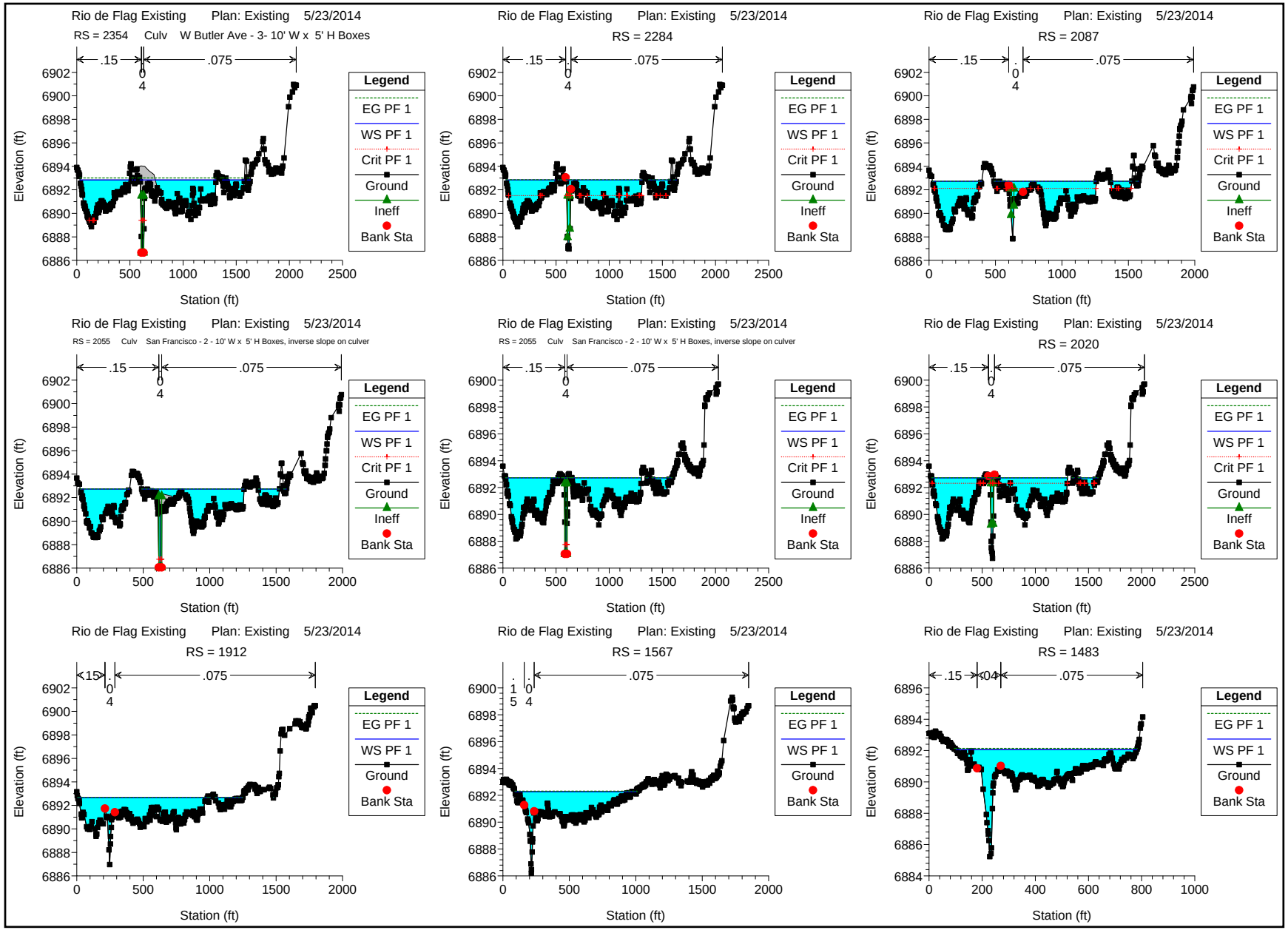

Rio de Flag Existing Plan: Existing 5/23/2014
RS = 6884 Culv Bonito St - 2- 10' W x 6' H
RS = 6824
RS = 6765
RS = 6413
RS = 6195
RS = 6115
RS = 6084 Culv N Sitgreaves - 2- 12' x 6' Boxes, however only 1-2' below ex Pav
RS = 6017
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

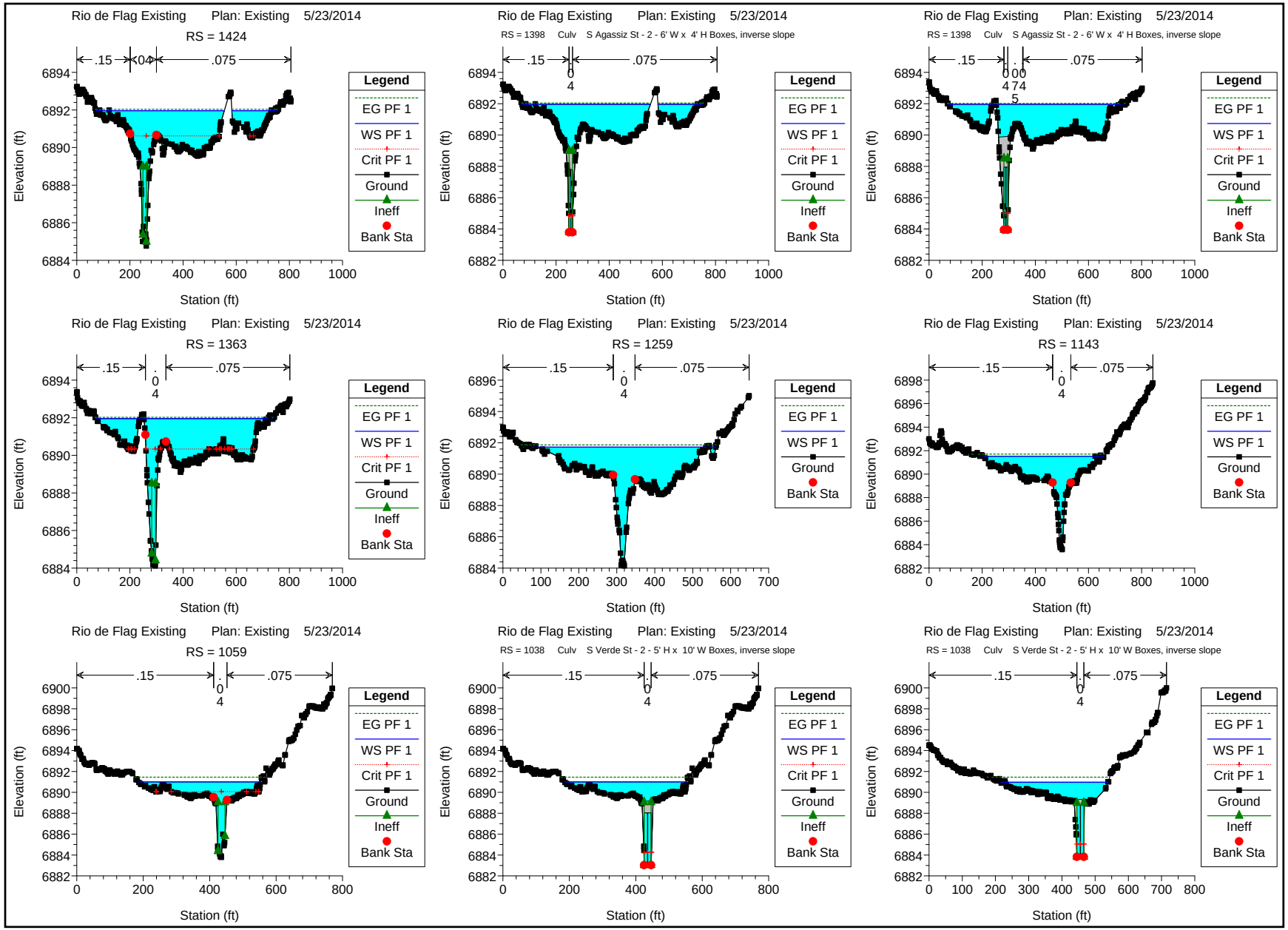

Rio de Flag Existing Plan: Existing 5/23/2014
RS = 5851
RS = 5677
RS = 5627 Culv W Cherry Ave - 2-10' W x 5' H Box 45 Skew, however only 1-2' be
RS = 5574
RS = 5293
RS = 5257 Culv W Birch Ave - 2-10' W x 4' H Box
RS = 5207
.15
.075
.75
0
4
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

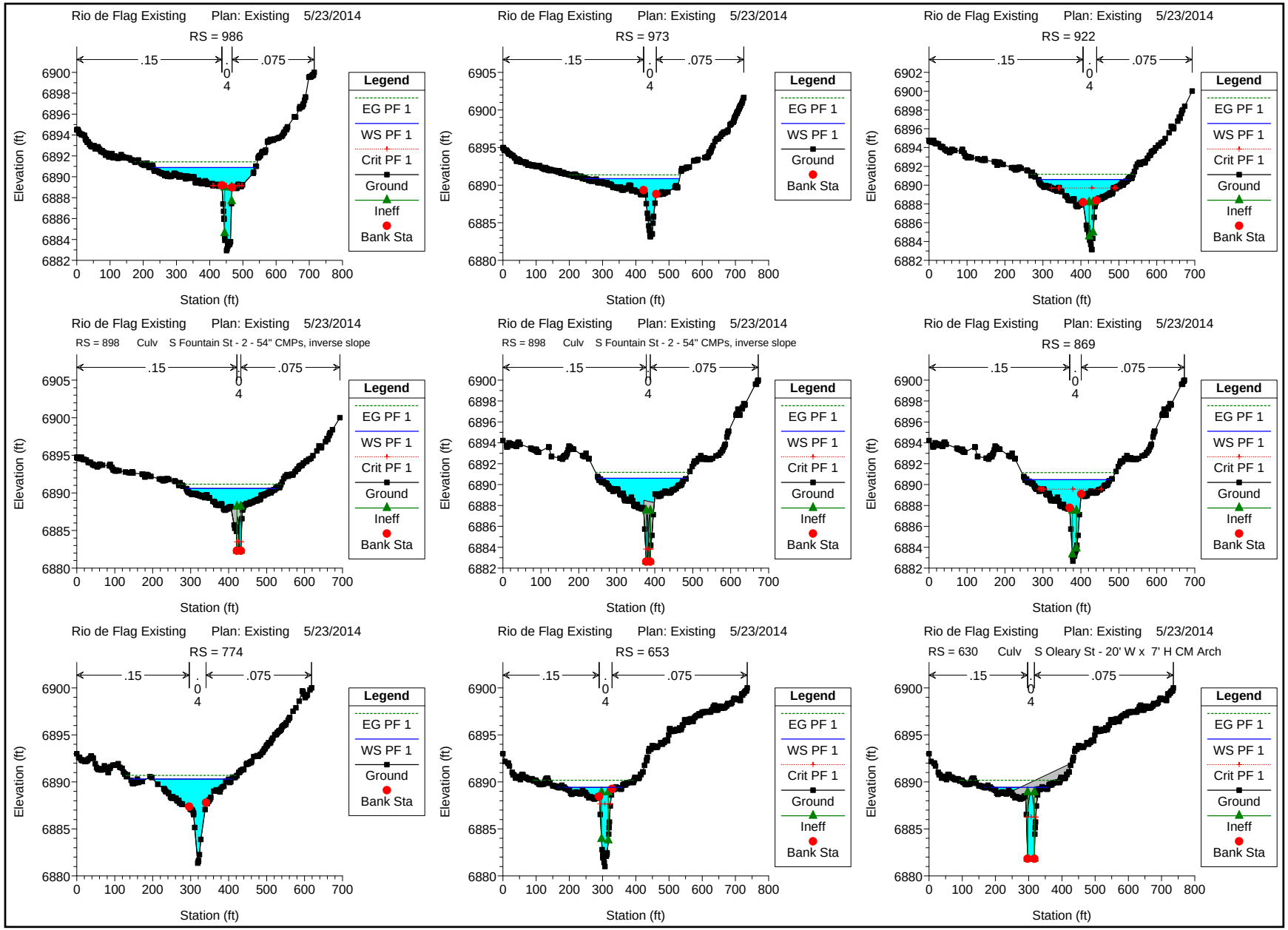

Rio de Flag Existing Plan: Existing 5/23/2014
RS = 4920
RS = 4897 Culv W Aspen Ave - 3 - 10' W x 4.85' H Box
RS = 4747
RS = 4597
RS = 4533 Culv Route 66 - 1- 7' H x 17' W + 1-7' H x 13' W, however only 1-2'
RS = 4477
RS = 3942
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

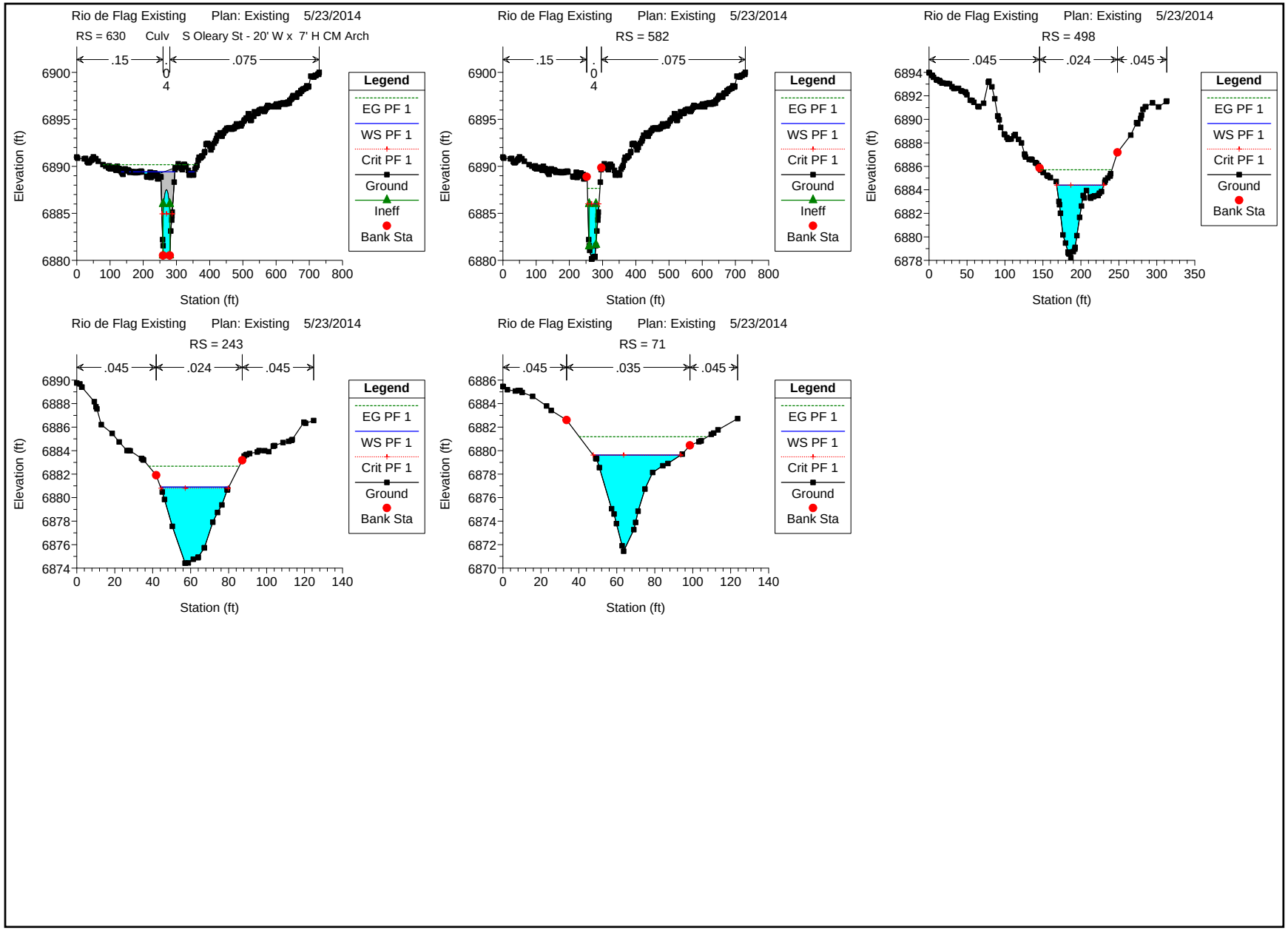

Rio de Flag Existing Plan: Existing 5/23/2014
RS = 3916
RS = 3898 BR Railroad - 2 - Piers, 4' W x 3' H, 20' Separation
RS = 3857
RS = 3631
RS = 3589 Culv W Phoenix Ave - 2 - 4' H x 13' W Boxes, 45 Skew
RS = 3165
RS = 3121 Culv E Cottage Ave - 2- 5' H x 15' W Boxes, however only 1-2' below e
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Rio de Flag Existing Plan: Existing 5/23/2014
RS = 3121 Culv E Cottage Ave - 2- 5' H x 15' W Boxes, however only 1-2' below e
RS = 3043
RS = 2740
RS = 2712 Culv E Benton Ave - 3- 10' W x 5' H Boxes, however only 1-2' below e
RS = 2659
RS = 2474
RS = 2407
RS = 2354 Culv W Butler Ave - 3- 10' W x 5' H Boxes
.15
.04
.075
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Rio de Flag Existing Plan: Existing 5/23/2014
RS = 2354 Culv W Butler Ave - 3- 10' W x 5' H Boxes
RS = 2284
RS = 2087
RS = 2055 Culv San Francisco - 2 - 10' W x 5' H Boxes, inverse slope on culver
RS = 2020
RS = 1912
RS = 1567
RS = 1483
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta


Rio de Flag Existing Plan: Existing 5/23/2014
RS = 1424
RS = 1398 Culv S Agassiz St - 2 - 6' W x 4' H Boxes, inverse slope
RS = 1363
RS = 1259
RS = 1143
RS = 1059
RS = 1038 Culv S Verde St - 2 - 5' H x 10' W Boxes, inverse slope
.15
.04
.075
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Rio de Flag Existing Plan: Existing 5/23/2014
RS = 986
RS = 973
RS = 922
RS = 898 Culv S Fountain St - 2 - 54" CMPs, inverse slope
RS = 898 Culv S Fountain St - 2 - 54" CMPs, inverse slope
RS = 869
RS = 774
RS = 653
RS = 630 Culv S Oleary St - 20' W x 7' H CM Arch
.15
.075
0
4
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Rio de Flag Existing Plan: Existing 5/23/2014
RS = 630 Culv S Oleary St - 20' W x 7' H CM Arch
.15
.075
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 582
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 498
.045
.024
.045
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 243
Rio de Flag Existing Plan: Existing 5/23/2014
RS = 71
.035

Alternative 4 Model Output

Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014

Rio de Flag Middle

Rio de Flag Upper

Legend

EG PF 2

WS PF 2

Crit PF 2

Ground

Elevation (ft)

6960

6940

6920

6900

6880

6860

6840

0

2000

4000

6000

8000

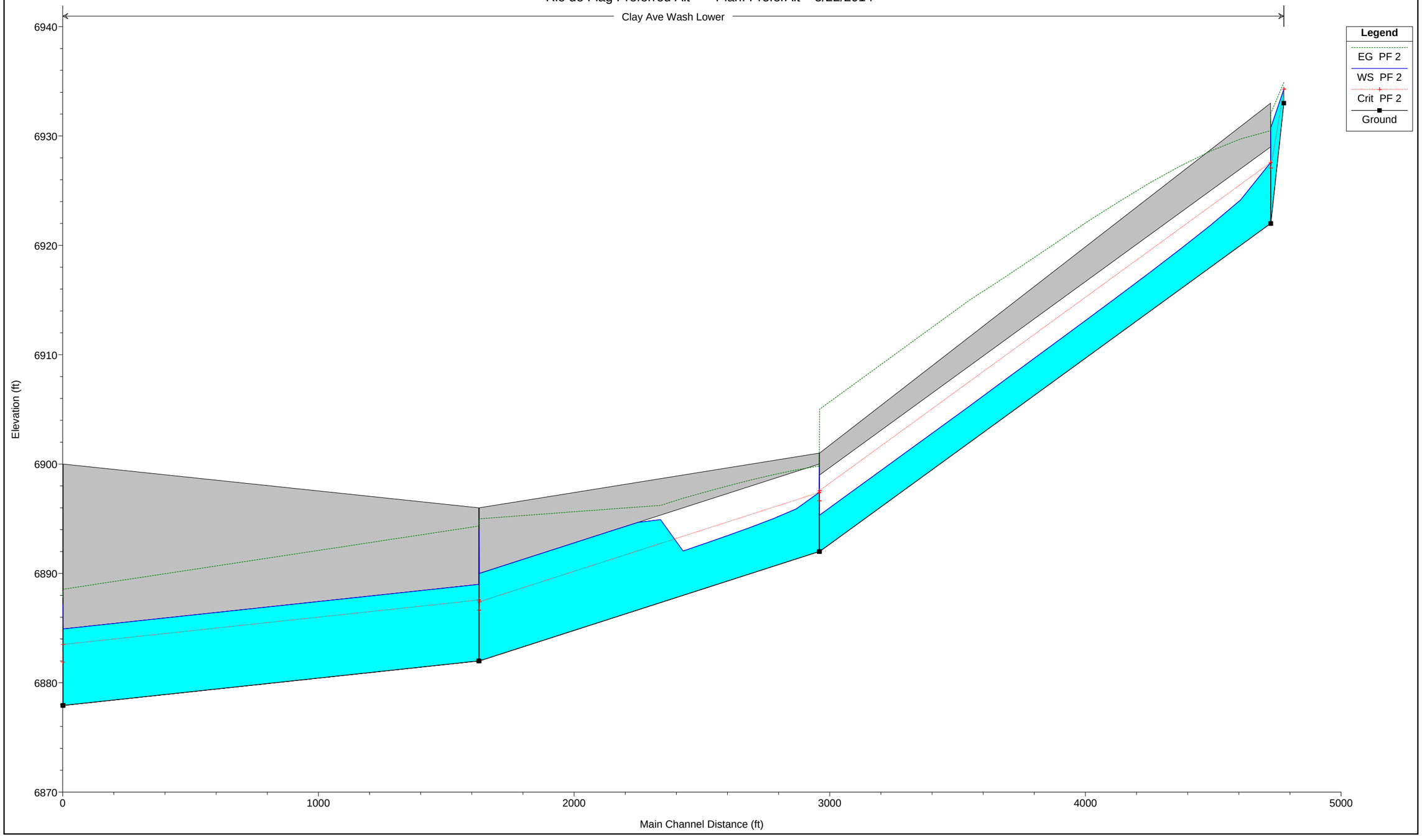
10000

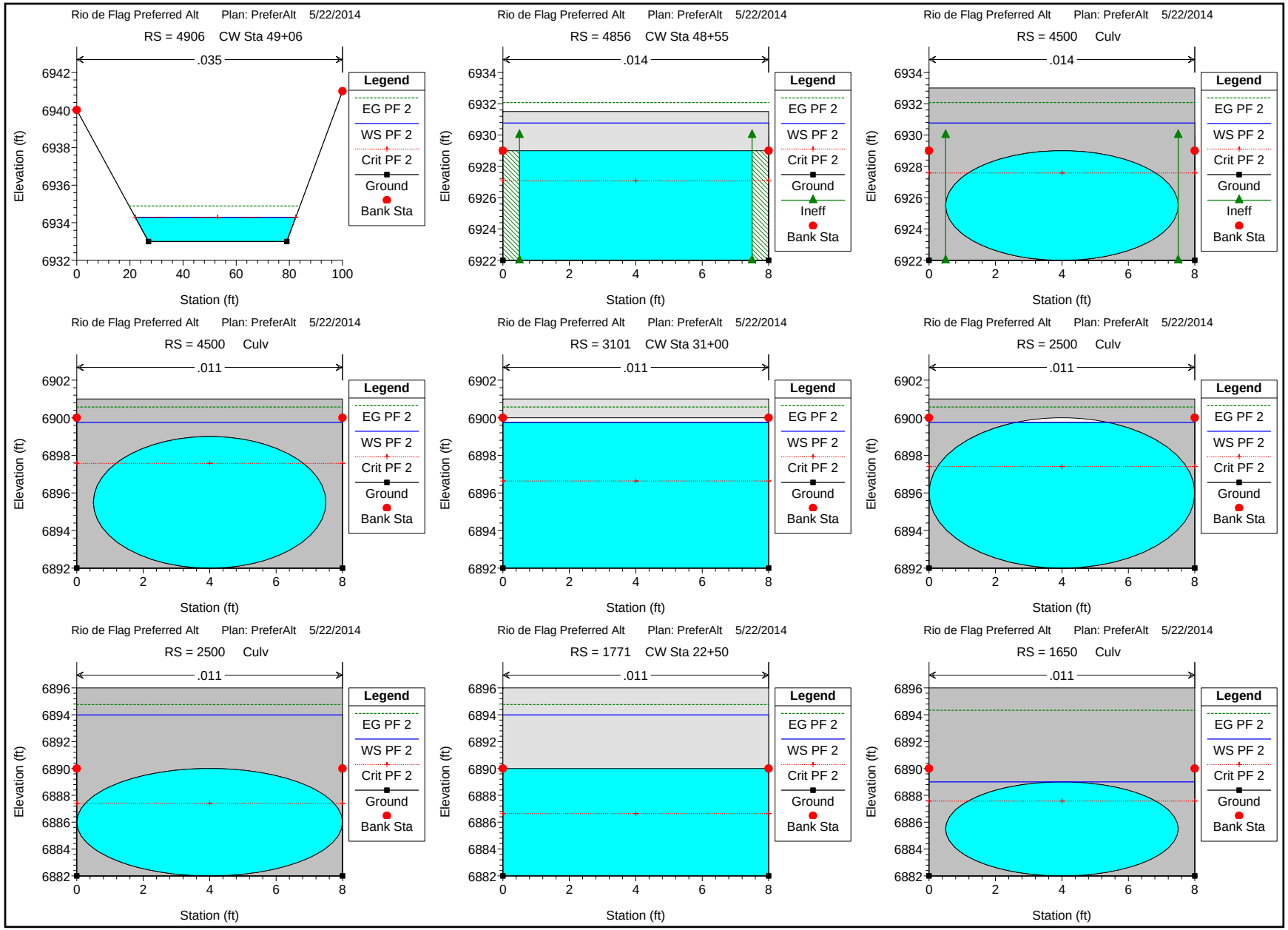
12000

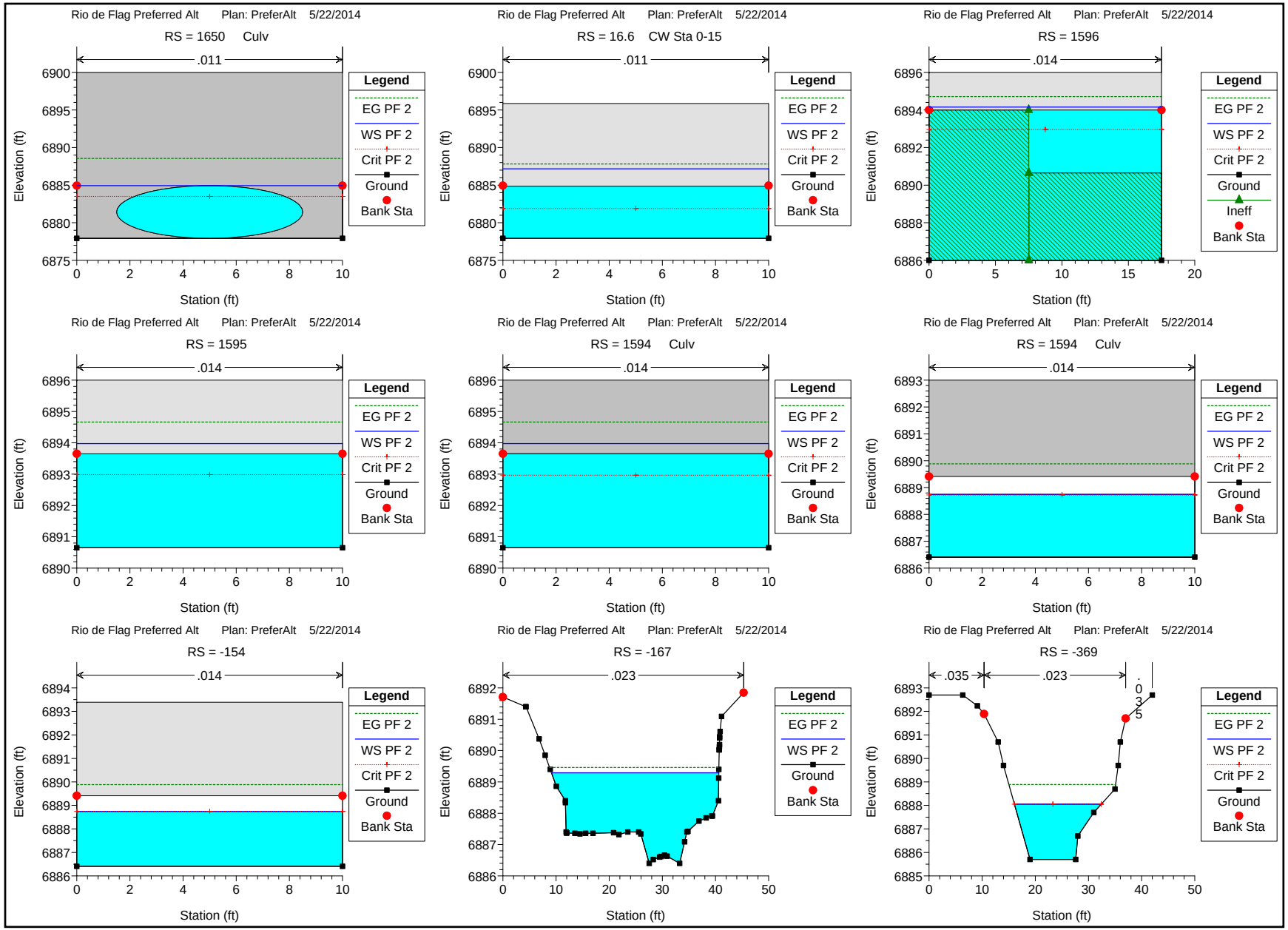
Main Channel Distance (ft)

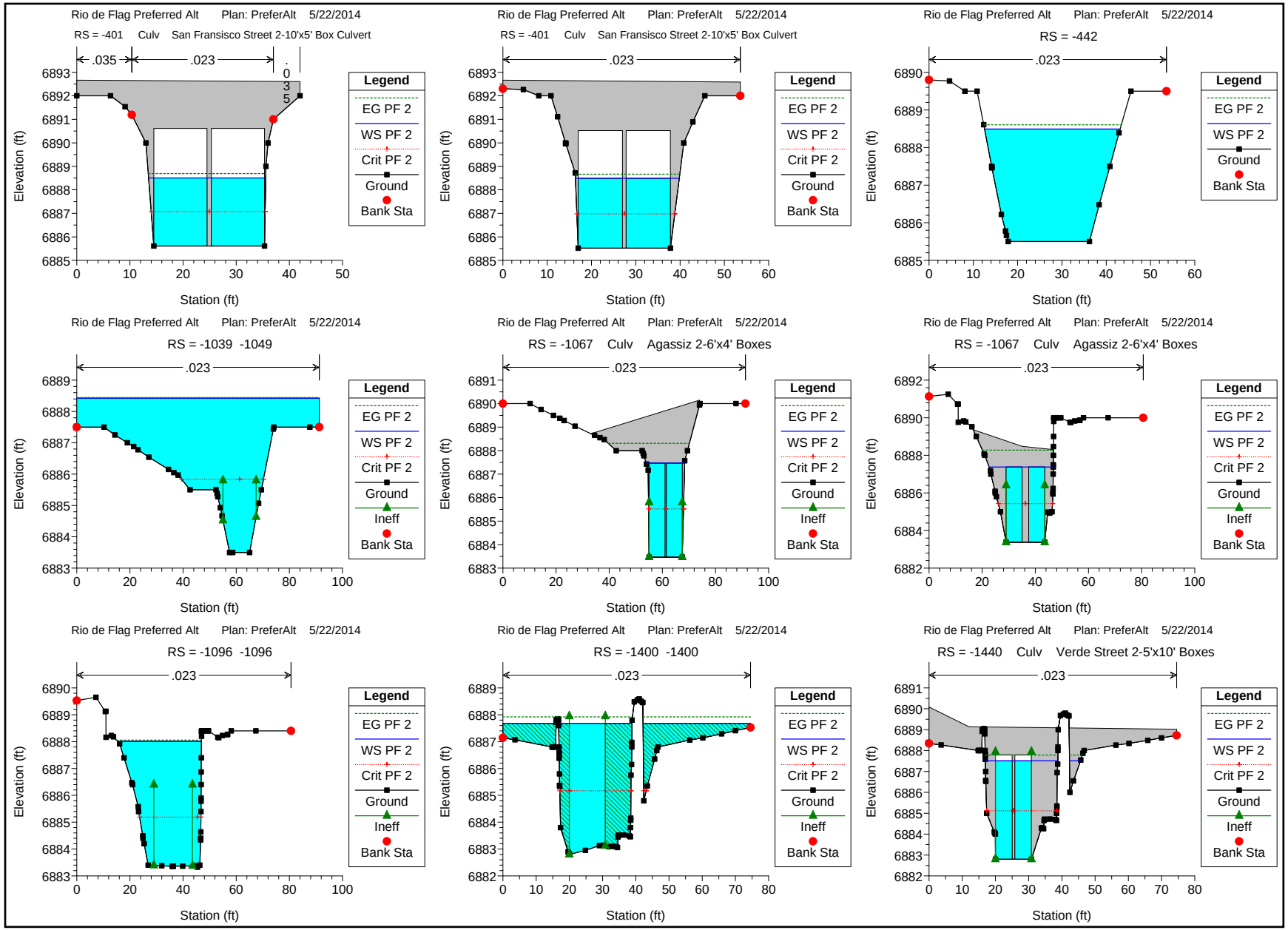
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014

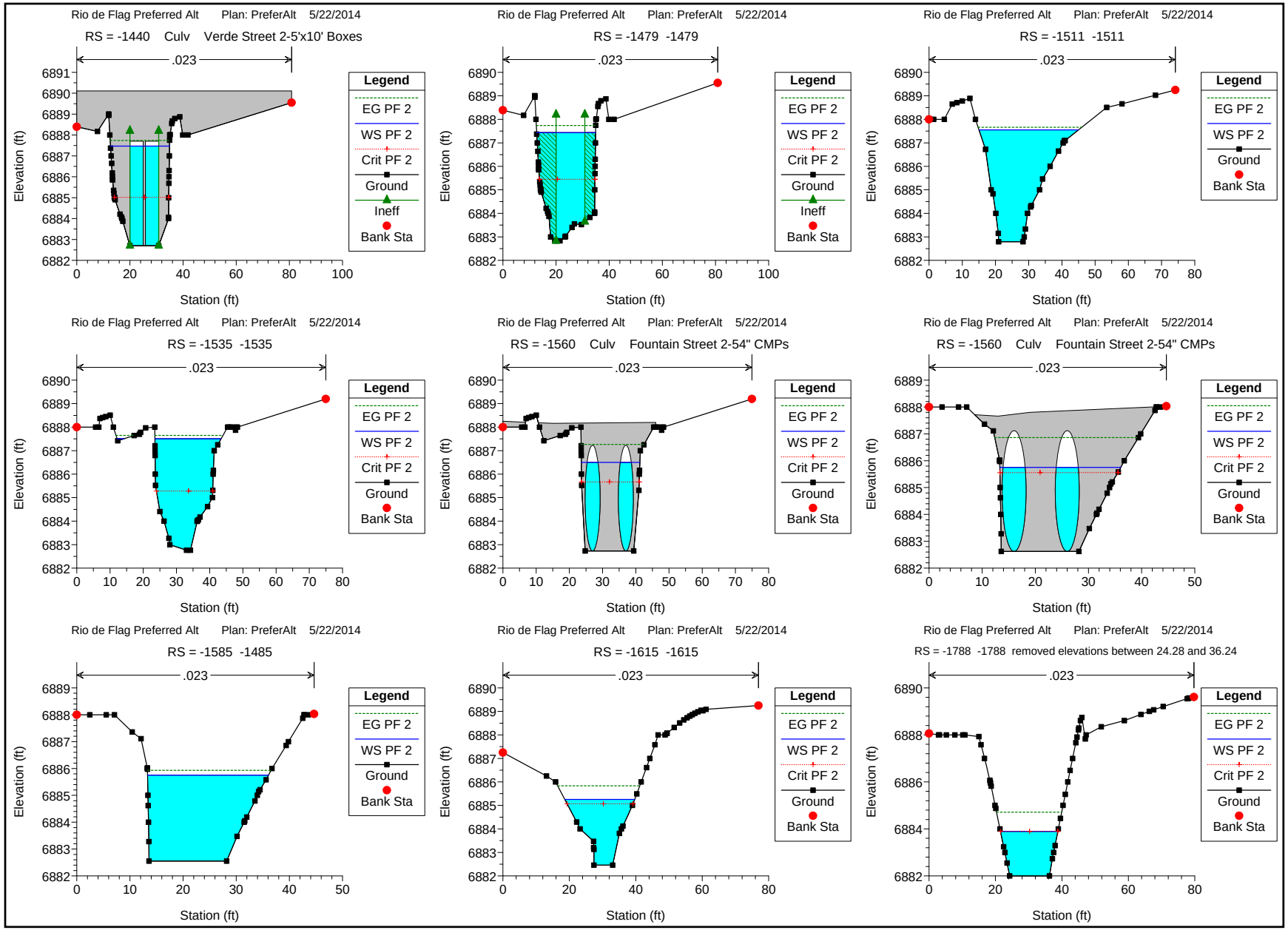
Clay Ave Wash Lower

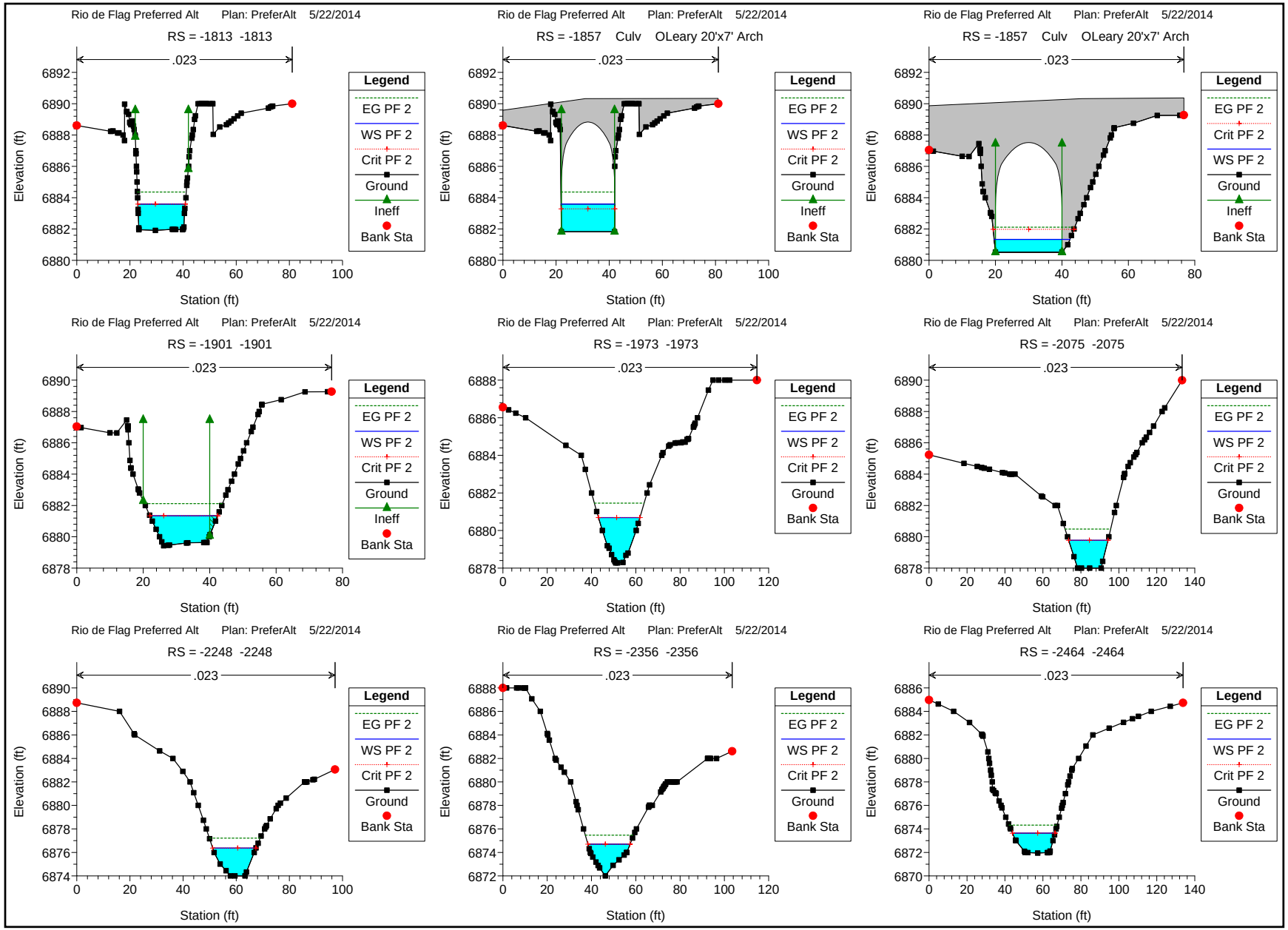


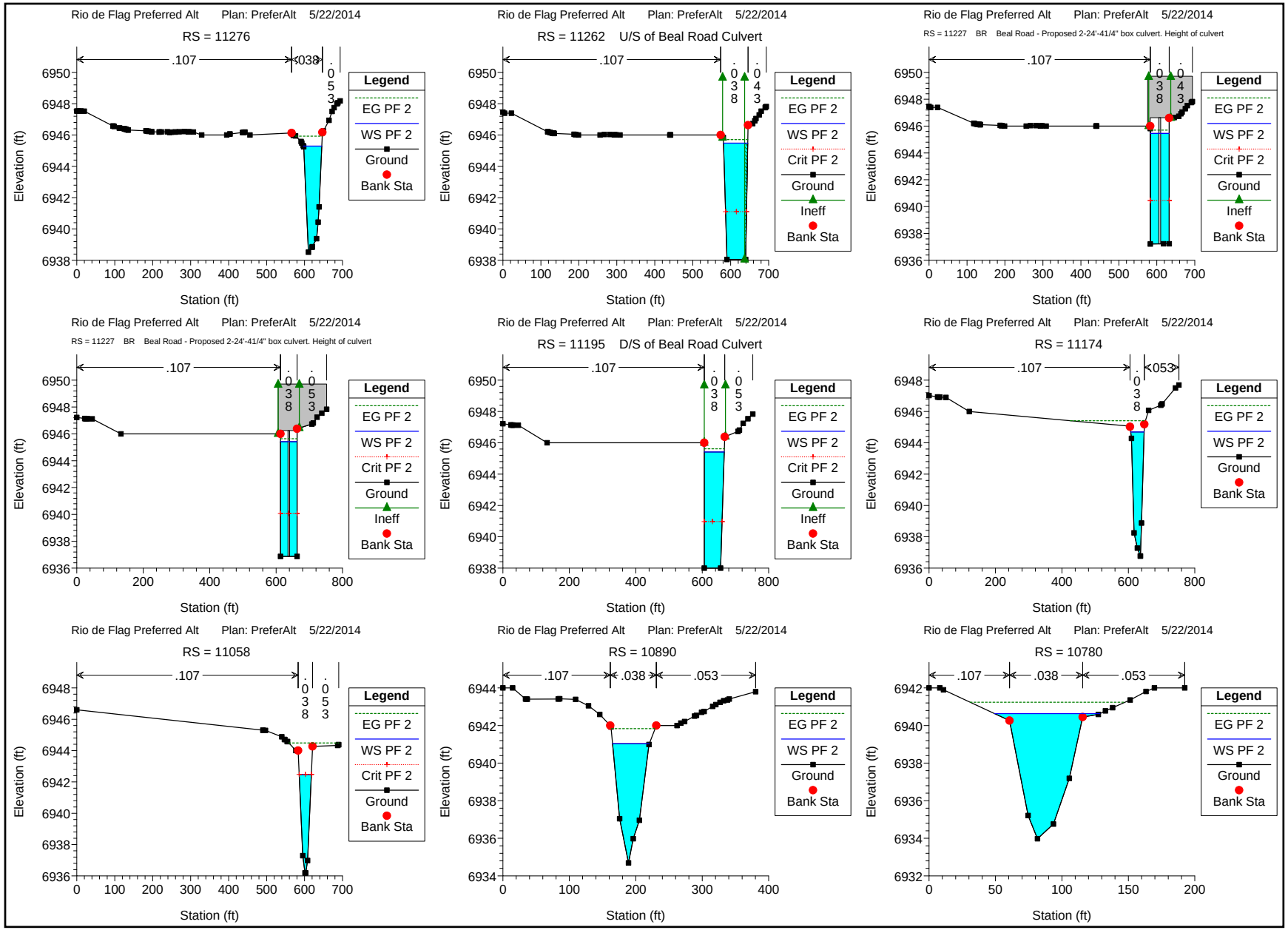

Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 4906 CW Sta 49+06
.035
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 4856 CW Sta 48+55
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 4500 Culv
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 4500 Culv
.011
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 3101 CW Sta 31+00
.011
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 2500 Culv
.011
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 2500 Culv
.011
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 1771 CW Sta 22+50
.011
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 1650 Culv
.011
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta

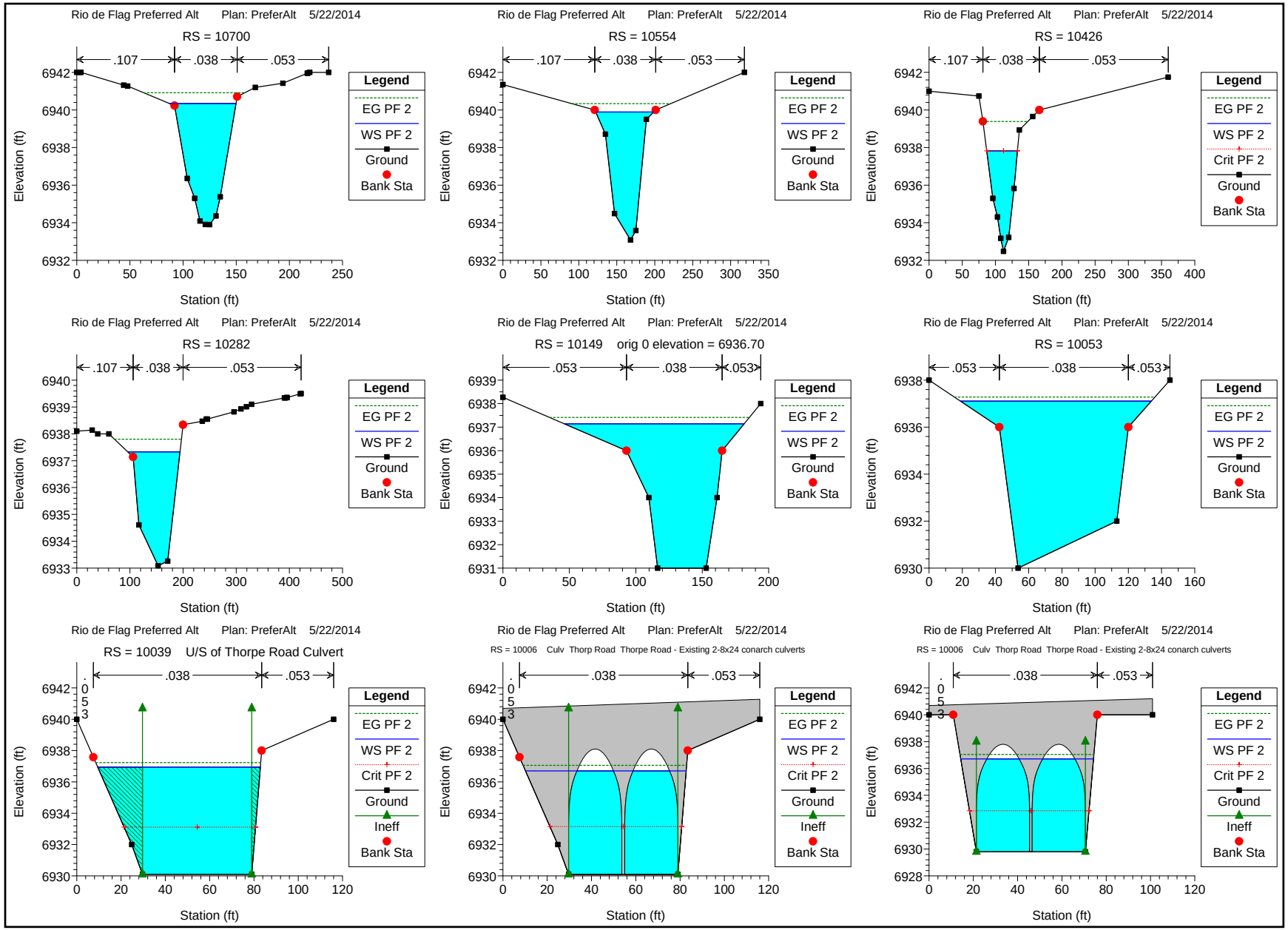

Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 1650 Culv
.011
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 16.6 CW Sta 0-15
.011
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 1596
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 1595
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 1594 Culv
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 1594 Culv
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -154
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -167
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -369
.035
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta

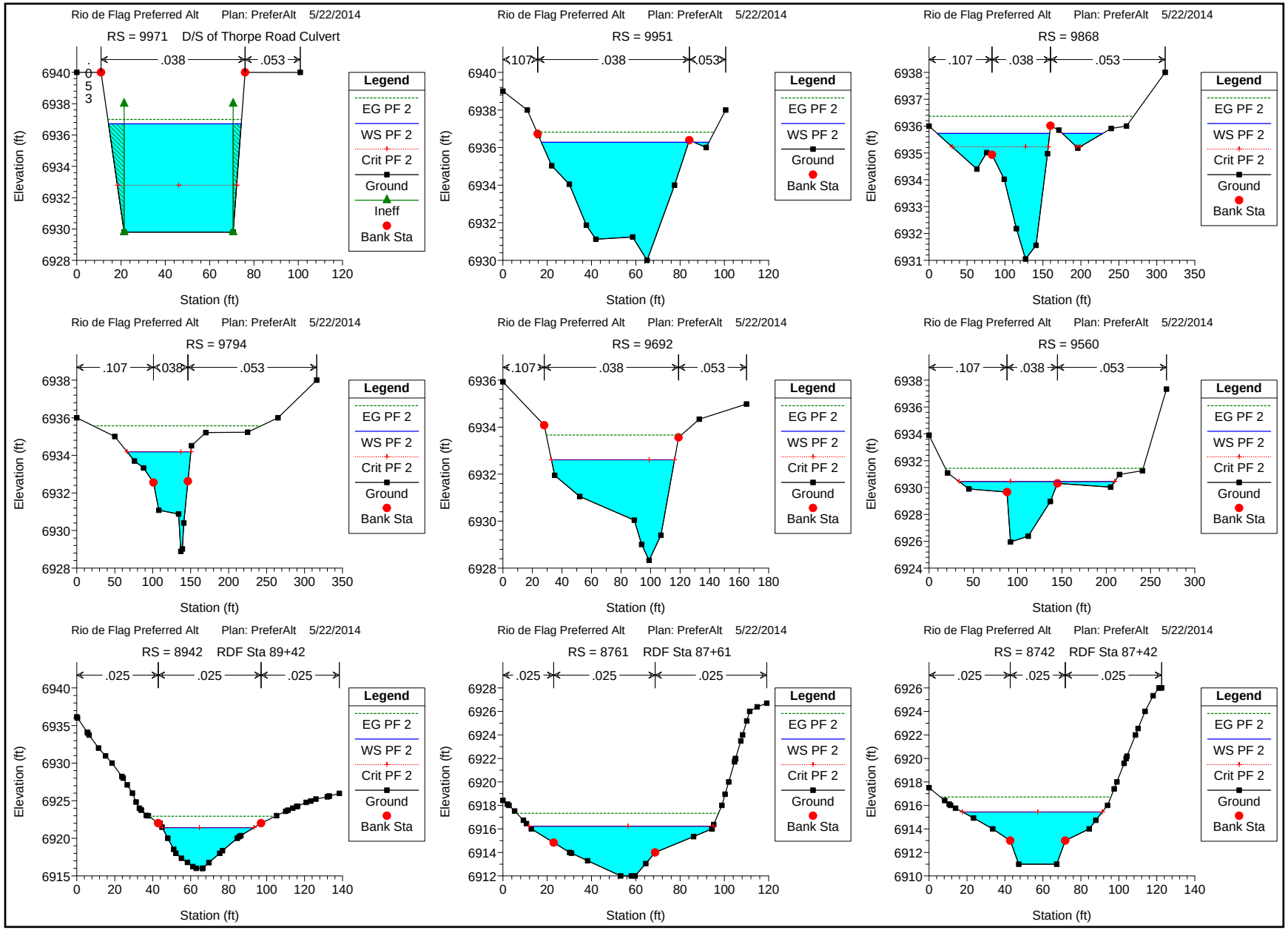

Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -401 Culv San Fransisco Street 2-10'x5' Box Culvert
.035
.023
.035
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -401 Culv San Fransisco Street 2-10'x5' Box Culvert
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -442
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1039 -1049
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1067 Culv Agassiz 2-6'x4' Boxes
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1067 Culv Agassiz 2-6'x4' Boxes
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1096 -1096
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1400 -1400
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1440 Culv Verde Street 2-5'x10' Boxes
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta

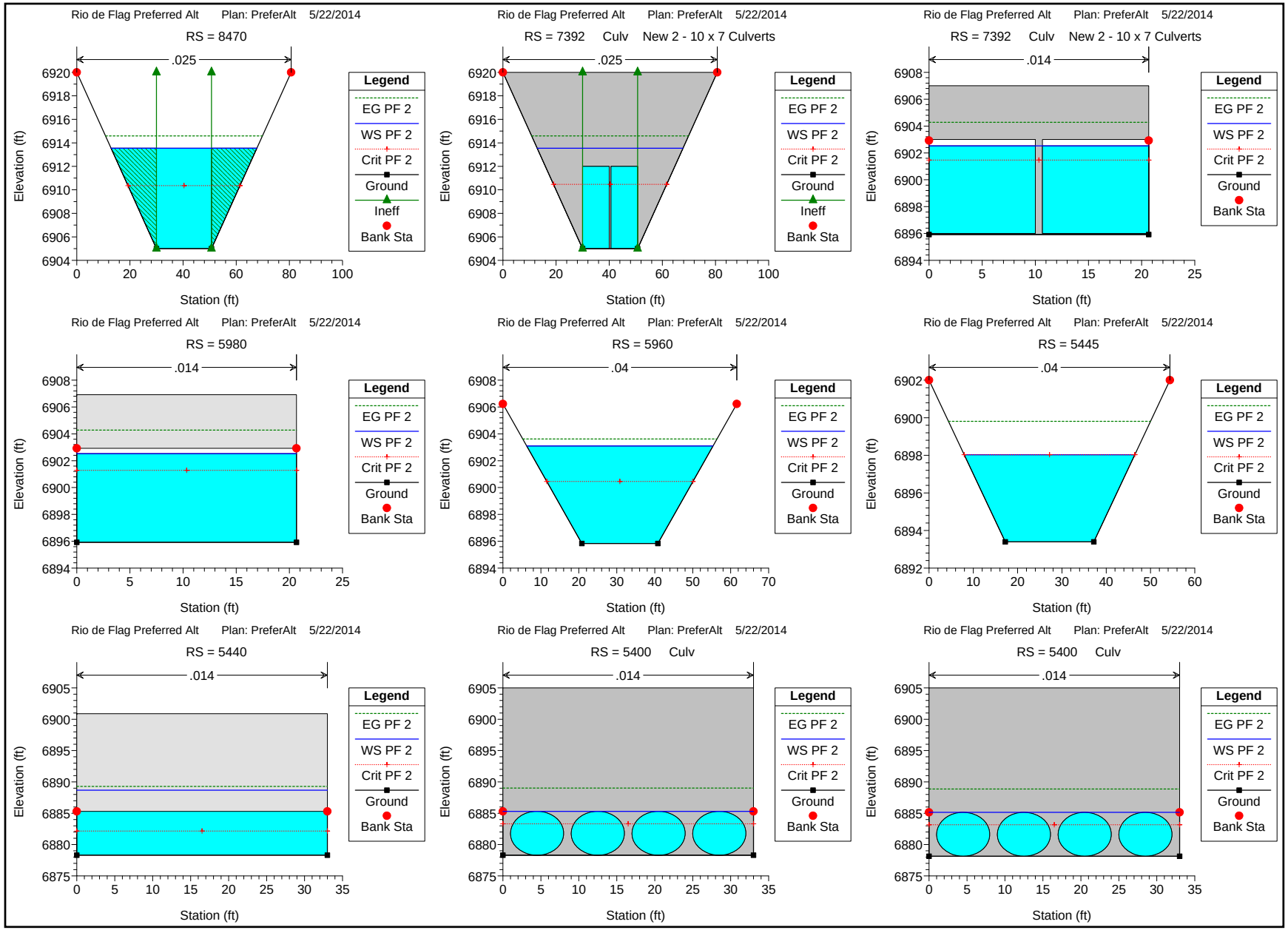

Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1440 Culv Verde Street 2-5'x10' Boxes
RS = -1479 -1479
RS = -1511 -1511
RS = -1535 -1535
RS = -1560 Culv Fountain Street 2-54" CMPs
RS = -1560 Culv Fountain Street 2-54" CMPs
RS = -1585 -1485
RS = -1615 -1615
RS = -1788 -1788 removed elevations between 24.28 and 36.24
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta

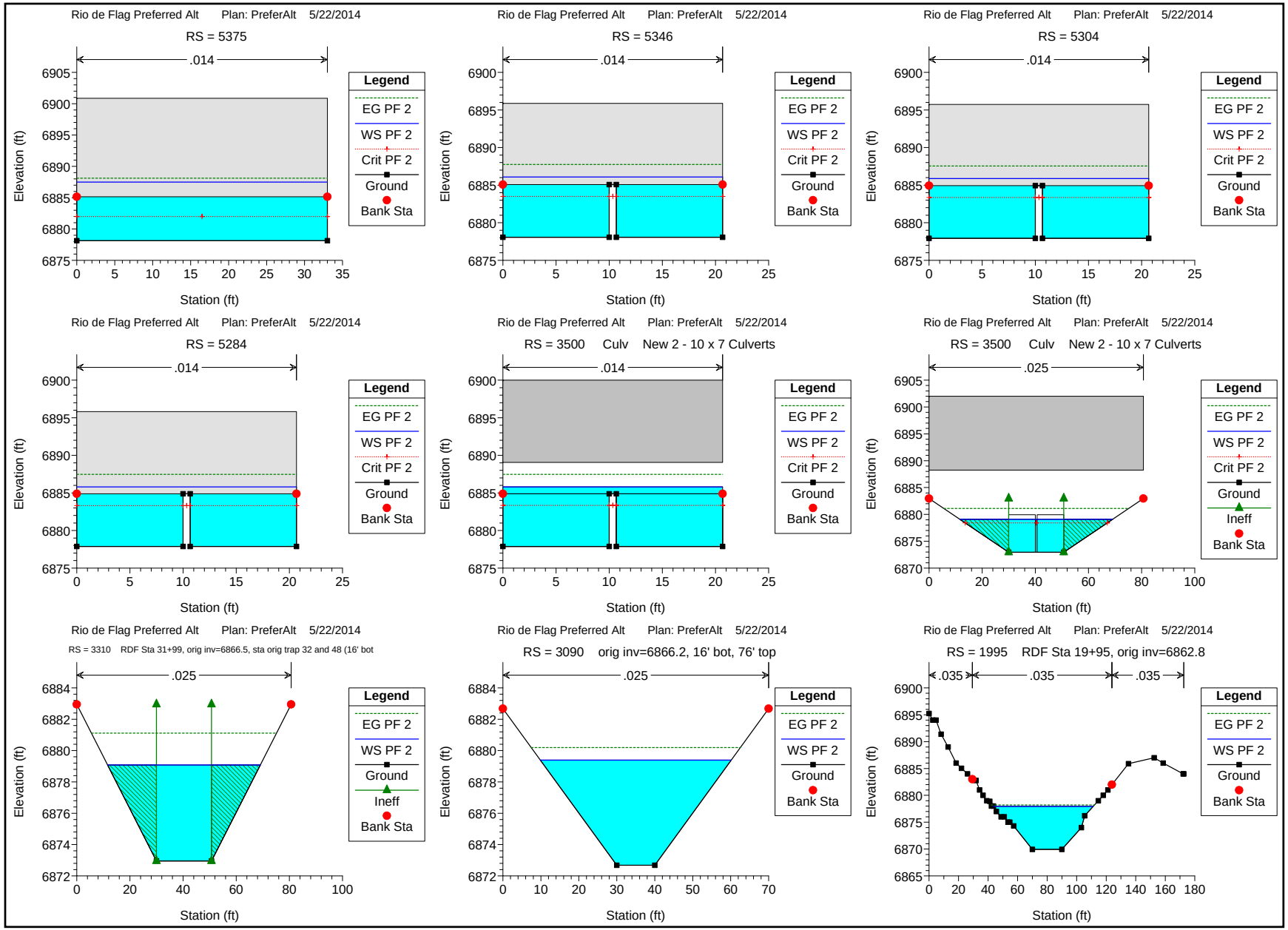

Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1813 -1813
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1857 Culv OLeary 20'x7' Arch
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1857 Culv OLeary 20'x7' Arch
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
Crit PF 2
WS PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1901 -1901
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -1973 -1973
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -2075 -2075
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -2248 -2248
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -2356 -2356
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = -2464 -2464
.023
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta

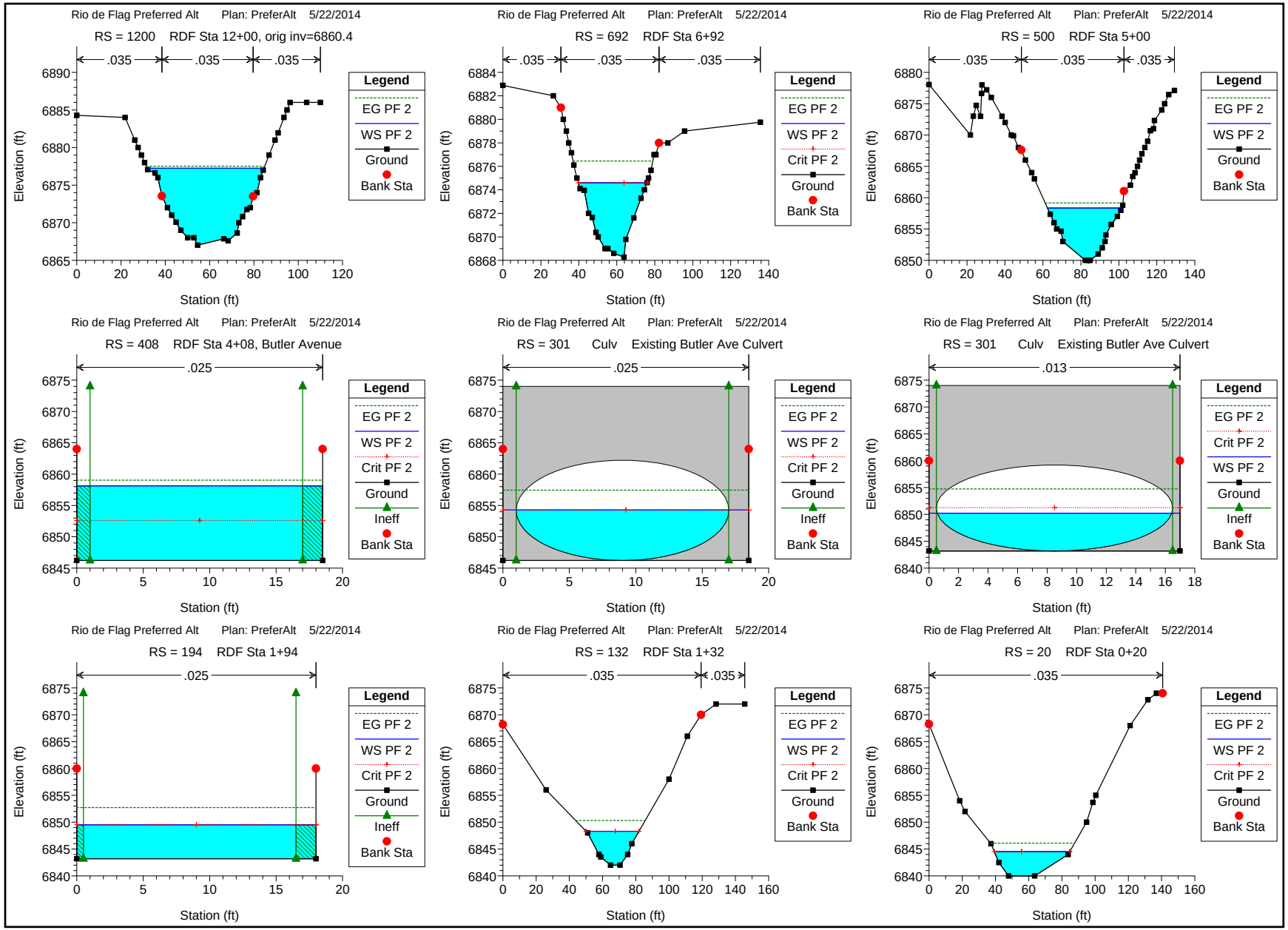

Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 11276
RS = 11262 U/S of Beal Road Culvert
RS = 11227 BR Beal Road - Proposed 2-24'-41/4" box culvert. Height of culvert
RS = 11195 D/S of Beal Road Culvert
RS = 11174
RS = 11058
RS = 10890
RS = 10780
.107
.038
.053
.043
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 10700
.107
.038
.053
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 10554
.107
.038
.053
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 10426
.107
.038
.053
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 10282
.107
.038
.053
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 10149 orig 0 elevation = 6936.70
.053
.038
.053
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 10053
.053
.038
.053
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 10039 U/S of Thorpe Road Culvert
.053
.038
.053
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 10006 Culv Thorp Road Thorpe Road - Existing 2-8x24 conarch culverts
.053
.038
.053
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 10006 Culv Thorp Road Thorpe Road - Existing 2-8x24 conarch culverts
.053
.038
.053
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta


Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 9971 D/S of Thorpe Road Culvert
.038
.053
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 9951
.107
.038
.053
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 9868
.107
.038
.053
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 9794
.107
.038
.053
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 9692
.107
.038
.053
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 9560
.107
.038
.053
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 8942 RDF Sta 89+42
.025
.025
.025
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 8761 RDF Sta 87+61
.025
.025
.025
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 8742 RDF Sta 87+42
.025
.025
.025
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)


Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 8470
.025
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 7392 Culv New 2 - 10 x 7 Culverts
.025
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 7392 Culv New 2 - 10 x 7 Culverts
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 5980
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 5960
.04
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 5445
.04
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 5440
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 5400 Culv
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 5400 Culv
.014
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta


Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 5375
.014
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 5346
.014
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 5304
.014
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 5284
.014
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 3500 Culv New 2 - 10 x 7 Culverts
.014
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 3500 Culv New 2 - 10 x 7 Culverts
.025
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 3310 RDF Sta 31+99, orig inv=6866.5, sta orig trap 32 and 48 (16' bot
.025
Legend
EG PF 2
WS PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 3090 orig inv=6866.2, 16' bot, 76' top
.025
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 1995 RDF Sta 19+95, orig inv=6862.8
.035
.035
.035
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)


Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 1200 RDF Sta 12+00, orig inv=6860.4
.035 .035 .035
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 692 RDF Sta 6+92
.035 .035 .035
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 500 RDF Sta 5+00
.035 .035 .035
Legend
EG PF 2
WS PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 408 RDF Sta 4+08, Butler Avenue
.025
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 301 Culv Existing Butler Ave Culvert
.025
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 301 Culv Existing Butler Ave Culvert
.013
Legend
EG PF 2
Crit PF 2
WS PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 194 RDF Sta 1+94
.025
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 132 RDF Sta 1+32
.035 .035
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)
Rio de Flag Preferred Alt Plan: PreferAlt 5/22/2014
RS = 20 RDF Sta 0+20
.035
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Bank Sta
Elevation (ft)
Station (ft)