MEMORANDUM

Date: March 14, 2018

To: The Honorable Richard Elías, Chairman
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

Re: **Santa Cruz River Capacity Restoration**

The original Rio Nuevo Santa Cruz River flood control project, constructed by the City of Tucson before the Regional Flood Control District (RFCD) was formed, created a two-tier flood control channel for the Santa Cruz River in 1982. River flood capacity, through maintenance over the last 35 years, has not occurred. Hence, the originally constructed channel does not have the flood carrying capacity from its original design let alone the recalculated and reevaluated 100-year discharge in the Santa Cruz River based on the October 1983 flood. Compounding this problem with potential damage from future flood flows is the fact that the main bridges crossing the Santa Cruz River at Congress, St. Mary's, Speedway Boulevard and Grant Road, were constructed without the benefit of drilled caisson deep pour foundations. These bridges were mostly built in the range of 1951 to the 1970's and for discharge values of 15,000 to 30,000, as opposed to the present design standard of 60,000 cfs. Originally, these bridges were designed for significantly less flood discharges than what is now expected to occur in the 100-year return frequency, the standard for flood insurance and Federal Emergency Management Agency (FEMA) standards.

The RFCD has conceptualized a major capacity restoration project on the Santa Cruz River from Grant to Silverlake Roads. A number of alternatives have been examined, particularly related to how much excavation and vegetation removal would be necessary to provide a reasonable risk to minimize future flood damage. The aggradation and vegetation growth over the last 30 years caused an additional 173 structures to be potentially flooded adjacent to the Santa Cruz River; these structures have an assessed value of $84 million.

I have previously sent information regarding this matter to you on February 8, 2017 (Attachment 1) indicating the RFCD staff would begin with briefing members of the City of Tucson Mayor and Council since the proposed capacity restoration project lies exclusively within the City of Tucson. Before proceeding, Councilmember Regina Romero sought a recommendation from the Board prior to any discussion of this matter at a future Mayor and Council Study Session. To minimize time delay and allow certain low impact portions of this project to proceed, the project has been divided into three phases.

Phase I –Speedway Boulevard to Grant Road - Staff would like to proceed with this phase prior to the Summer monsoon season. This section of the Santa Cruz River is owned by the RFCD. After a vegetation survey, staff has identified certain desirable native vegetation to preserve with the goal of preserving as many of the established native trees as possible and restoring necessary flood conveyance capacity. In this phase of improvement, The Forbes Business Park near Grant Road is the most flood susceptible without this capacity restoration work. This phase of the project will also restore and fill an erosion meander that occurred in the flood of 1983, north of Grant Road on the west side of the Santa Cruz River. This work will create a park as the sediment will be deposited in this erosion scour and contoured to provide maximum multi-acre water harvesting. Our Native Plant Nursery will then plant a large volume of native plants on this property to restore it as a natural park with pathways and other low impact amenities. Phase I of this restoration site, Meander Bend Park, is Attachment 2.

Please note the extent of this project is 200 feet south of the Speedway Boulevard bridge and 100 feet south of the Grant Road bridge.

Phase II – 29th Street to Mission Lane - This phase was selected to proceed next, since it coincides with the location of the City proposed Heritage Water Project, to discharge reclaimed water into the Santa Cruz River no later than Memorial Day 2019. Given the proposal to discharge, it would be appropriate to remove non-native vegetation, restore channel capacity and coordinate the work after a vegetation survey has been completed with the proposed work of the City. A location to deposit this material will need to be coordinated with the City. Additional information about Phase II will be provided when available.

Phase III – Mission Lane to Speedway Boulevard – This phase will be the most difficult as significant sediment aggradation and vegetation removal will be required to restore the channel carrying capacity. This work will not occur until after Phases I and II are complete and after the monsoon season. I hope that the Phase I project can be used as a prototype to demonstrate how the project can proceed where the capacity restoration on the Santa Cruz River is balanced with retaining important stands of native vegetation that will not endanger the undersized bridges that cross the Santa Cruz River.

There has been no site selected for deposition of the excavated material from Phase III of this project; however, a potential property could be the site now owned by Rio Nuevo where the A-Mountain Landfill exists. With deposition of additional granular fill material contoured and shaped for large-scale water harvesting and replanting, the same natural desert park that is proposed north of Grant Road could also be developed on top of this site.

Attachment 3 is RFCD Director Suzanne Shield's March 8, 2018 report that includes maps and graphs for your information on this subject. RFCD is willing to participate with you and anyone else in neighborhood or public meeting to explain the project proposal.

Also in Attachment 1 is a February 8, 2017 memorandum from the Regional Flood Control District, which includes a draft report prepared by J.E. Fuller.

Attachment 4 shows the specific reach of the Phase I project with vegetation save areas shown as green polygons. This attachment also includes five pages of detailed vegetation surveys with specific trees to be preserved in place or removed.

Finally, the only potential issue that could delay implementation of the first phase of this project is consultation that is presently underway with the US Fish and Wildlife Service regarding the downstream Gila topminnow.

In summary, I would suggest the following actions:

1. Hold at least one public meeting with neighborhoods surrounding Phase I to explain the project and receive their feedback.

2. Hold at least one public meeting in vicinity of reclaimed Meander Bend Park in Supervisorial District 3, to receive feedback on development of Phase I the natural park.

3. Notify the City of Tucson of the RFCD moving ahead with Phase I and determine if the City would like the RFCD to brief Mayor and Council on the Study Session of the Phase I project and subsequent phases.

4. Proceed with and, complete, the Phase I project after the public meetings and before the start of the monsoon season on June 15.

5. After completion of Phase I determine how best to proceed with Phases II and III.

CHH/anc

Attachments

c: Carmine DeBonis, Jr., Deputy County Administrator for Public Works
Suzanne Shields, Director, Regional Flood Control District

ATTACHMENT 1

MEMORANDUM

Date: February 8, 2017

To: The Honorable Richard Elías, Vice Chair
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

Re: **Santa Cruz River Flood Control Options and Draft Report**

Please see the attached Draft Santa Cruz River Maintenance Report prepared by the Regional Flood Control District. The report highlights three alternatives for the maintenance of flood flow capacity in the Santa Cruz River. There are several options that would, if implemented, have varying impacts on the flood susceptibility of existing structures adjacent to the Santa Cruz River.

This report is also being forwarded to the Tucson City Manager for his review, as well as that of his staff. Please feel free to forward this report to those who may have an interest in or are adjacent to the Santa Cruz River and the proposed action.

CHH/anc

Attachment

c: Carmine DeBonis, Jr., Interim Deputy County Administrator for Public Works
Nanette Slusser, Assistant County Administrator for Public Works
Suzanne Shields, Director, Regional Flood Control District

PIMA COUNTY
FLOOD CONTROL

MEMORANDUM

DATE: February 7, 2017

TO: C. H. Huckelberry
County Administrator

FROM: Suzanne Shields, P.E.
Director

SUBJECT: **Draft JE Fuller Sedimentation and Capacity Analysis**

Please find attached a draft report, prepared by JE Fuller, evaluating the sedimentation and resulting loss of conveyance capacity of the Santa Cruz River channel from Starr Pass to Grant Road. This evaluation was completed in anticipation of the Pima County Regional Flood Control District (District) agreeing to be the entity responsible for the maintenance of the Santa Cruz River flood control infrastructure via an Intergovernmental Agreement.

The JE Fuller evaluation utilized 2015 Pima Association of Governments (PAG) topography developed from LiDAR, and revealed that excessive sedimentation has reduced the capacity of the Santa Cruz River resulting in increased overbank flows with an associated increased risk for flood damage of private property. The evaluation also revealed that the current Flood Insurance Rate Map (FIRM) for this portion of the City of Tucson (City) does not accurately describe the actual flood risk. The existing FIRM, adopted in 1986, does not reflect the changed floodplain conditions reducing the channel capacity, the placement of fill material on the west bank and the new improvements and infrastructure in the floodplain, specifically the relatively new Cushing Street Bridge.

As a result of the this evaluation, the District is proposing a maintenance project to remove excess sediment from this reach of the Santa Cruz River in order to restore conveyance capacity to the channel. This will necessarily result in the removal of vegetation that is growing on top of the sand bars. The District understands that the City is proposing a project, called Agua Dulce, to discharge treated effluent in the channel within this reach. In addition to the desired recharge of the effluent, the growth of riparian vegetation would be an expected result of the Tucson Water project.

Both of these projects are intended to benefit the downtown area, the recharge project would provide a running river through an area where economic development is desired, and the sediment removal project would reduce flood risk and the potential for flood damage to public and private property. In addition, there is considerable neighborhood interest in maintaining vegetation in the channel for aesthetic and habitat purposes.

However, these projects reflect competing priorities as well. The public safety project would result in a bare channel that restores the conveyance capacity to its original design conditions. The recharge project would create a more aesthetically pleasing environment, but also increase the risk of overbank flooding and damage to both public property, such as parks, roads, bridges, and landfills, and the private property that is adjacent to the river.

To evaluate the competing priorities and the flood risk associated with maintaining some vegetation in the channel and presence of the Agua Dulce project, the updated report evaluates existing conditions and three channel maintenance scenarios:

- Existing conditions using 2015 channel bed elevation information illustrating the reduction in channel capacity due to vegetation and sedimentation;
- Returning the channel to design conditions with full removal of vegetation and sediment and the Agua Dulce project does not happen;
- Big trees optimization to remove sediment and vegetation while preserving the larger trees in the river bottom with the Agua Dulce project in place; and
- Flood risk reduction optimization to remove vegetation and sediment in areas where overbank flooding most significantly impacts private property while preserving the vegetation in the channel in remaining areas and with the Agua Dulce project in place.

The District desires to communicate the various level of flood risks to the City through the transmittal of this report. Although the District remains an advocate for public safety, we also understand the competing priorities associated with the plans for downtown revitalization that are supported by City and Rio Nuevo. As such, the District would like this report to serve as a tool to identify to what extent, if any, channel maintenance should occur. It accomplishes this by considering a few scenarios that attempt to display the flood characteristics and flood damage potential when selectively removing vegetation from the channel.

The City understands that the current effective FIRM is inaccurate, and their own attempts to revise the FIRM through a Letter of Map Revision has revealed inadequacies in the flood control infrastructure. The minimum goal of the District, other than advocating to restore conveyance capacity to the maximum extent possible, is to ensure that the City's and Rio Nuevo's decisions are accurately reflected by updating the FIRM to show the true flood risk, based on the best available information.

Subsequent to delivery of the report to the City, the next steps would be to evaluate the level of flood risk for existing structures in the expanded floodplain footprint. This evaluation consists of a review of land use to determine if the use is commercial, public or residential, and the year the structure was constructed. Structures built after the effective date of the FIRM would have been subject to floodplain use regulations and should have an Elevation Certificate indicating finished floor elevation. Building permit files will be reviewed to determine whether floodwaters would enter the structure and, if so, what would be the depth of flooding by comparing the finished floor elevation to the water surface elevations under existing conditions and the three scenarios for channel maintenance.

If you have any questions or need additional information, please let me know.

SS/sm

Attachment

c: Carmine DeBonis, Interim Deputy County Administrator – Public Works
Nanette Slusser, Assistant County Administrator for Public Works Policy
Bill Zimmerman, Deputy Director – Regional Flood Control District
Eric Shepp, P.E., Deputy Director – Regional Flood Control District
Andy Dinauer, P.E., Division Manager – Regional Flood Control District

SANTA CRUZ RIVER MAINTENANCE PROJECT
GRANT ROAD TO STAR PASS BLVD
PIMA COUNTY, AZ
PIMA COUNTY CONTRACT # 16-32910

DRAFT

Prepared for:

Pima County Regional Flood Control District
201 N. Stone Avenue, 9th Floor
Tucson, AZ 85701

EXPIRES 12-31-2019

September 2016
Revised December 2016
Revised January 13, 2017
Revised January 30, 2017
Revised February 2, 2017

Prepared by:

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

40 E. Helen Street **520-623-3112 (voice)**
Tucson, Arizona 85705 **520-623-3130 (fax)**

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INTRODUCTION AND PURPOSE

This report was prepared to document the performance and findings of the Santa Cruz River Maintenance Project performed for the Pima County Regional Flood Control District (RFCD). The project reach for this project extends from Grant Road to the north to Starr Pass Blvd to the south[1]. The purpose of this project was to determine existing flooding conditions and to determine flooding conditions associated with proposed channel maintenance to restore the 1980's design capacity of the various channel segments. Figure 1 below shows the study reach (blue shading) of the Santa Cruz River for this project. The tasks for the project included;

1. Research and data collection
2. Prepare HEC-RAS floodplain model for existing (2015) and channel design conditions based on 1982-1991 plans.
3. Determine 100-year floodplain/WSELs for modeled conditions.
4. Generate design (1980's) surface and raster reflecting channel flowline per original 1980's design.
5. Determine quantities of aggradation/degradation based on comparison of original design vs existing condition.
6. Perform multiple HEC-RAS model runs with varying channel modifications to optimize flood reduction effects of maintenance plan.
7. Prepare 11" x 17" plan and section maps in AutoCAD Civil 3D for proposed maintenance.
8. Assist RFCD as needed to provide maintenance documentation for permitting purposes.
9. Prepare report documenting results of evaluation.
10. Public Involvement.
11. Project administration.
12. Structure Surveys – up to six bridges

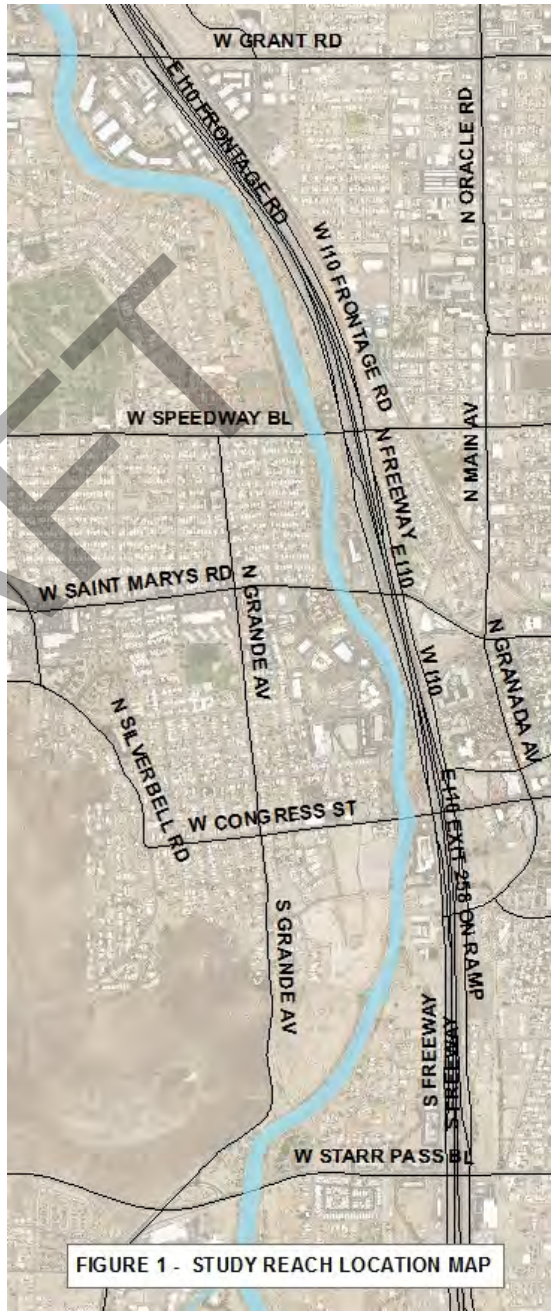

FIGURE 1 - STUDY REACH LOCATION MAP

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[1] It should be noted that prior to 1993, Starr Pass Blvd was known as 22nd Street and various plan documents reference this roadway as 22nd Street.

RESEARCH & DATA COLLECTION

Research and data collection for this project included obtaining and/or reviewing the following;

- FEMA flood insurance study data including the flood insurance report and GIS data for floodplain cross-section locations and base flood elevations.

- Design plans for the following structures and improvements on the Santa Cruz River;

Location/Type	Plans sealed	Plans as-built	Plan #	Notes
Grant Rd/Bridge	1965	1967	D-64-09	Rod Gomez Consulting Engineers. Plans note "Discharge Maximum = 30,000 cfs"
Grant Rd/ Emergency Repairs	1977	1979	D-77-14	COT plans for emergency repairs of flood damage to bridge
Grant Rd/Bridge mod.	1984	1986	E-84-10	COT plans for pier and abutment protection
Speedway WB/ Bridge	1953	1955	D-65-03	AZ Hwy Dept. Plans note "Assumed high water El 2321 for 15,000 cfs max. 40 year flood record."
Speedway EB/ Bridge	1973	1975	D-73-09	COT Plans. This design generally matches the WB bridge design.
St. Mary's Rd/Bridge	1949	1951	I-65-54A	AZ Hwy Dept. Plans note "Assumed high water for 15,000 cfs max. 40 year flood record."
St. Mary's Rd/Bridge mod.	1982	Not shown	D-81-06	COT plans for pier protection.
Congress Street/Bridge	1970	1972	T-981	McFarland-Johnson Consulting Engs. Plans note Q50 = 17,000 cfs.
Cushing Street/Bridge	2011	2013	I-2005-066	AMEC. Plans note Q100 = 60,000 cfs."
22nd Street/Bridge	1977	1977	D-77-04	Holben & Martin. Plans note "Q = 30,000 cfs EL 52.0'"

As noted in the table above, the Speedway Blvd. and St. Mary's Road bridges are the oldest (1950's) and appear to have been designed for a 15,000 cfs discharge. The Congress Street bridge appears to have been designed for a 17,000 cfs discharge. The Grant Road bridge, built in 1967, and the 22nd Street bridge, built in 1977, both appear to have been designed for a 30,000 cfs discharge. Only the Cushing Street bridge, built in 2013, was constructed to the current 100-year design discharge of 60,000 cfs.

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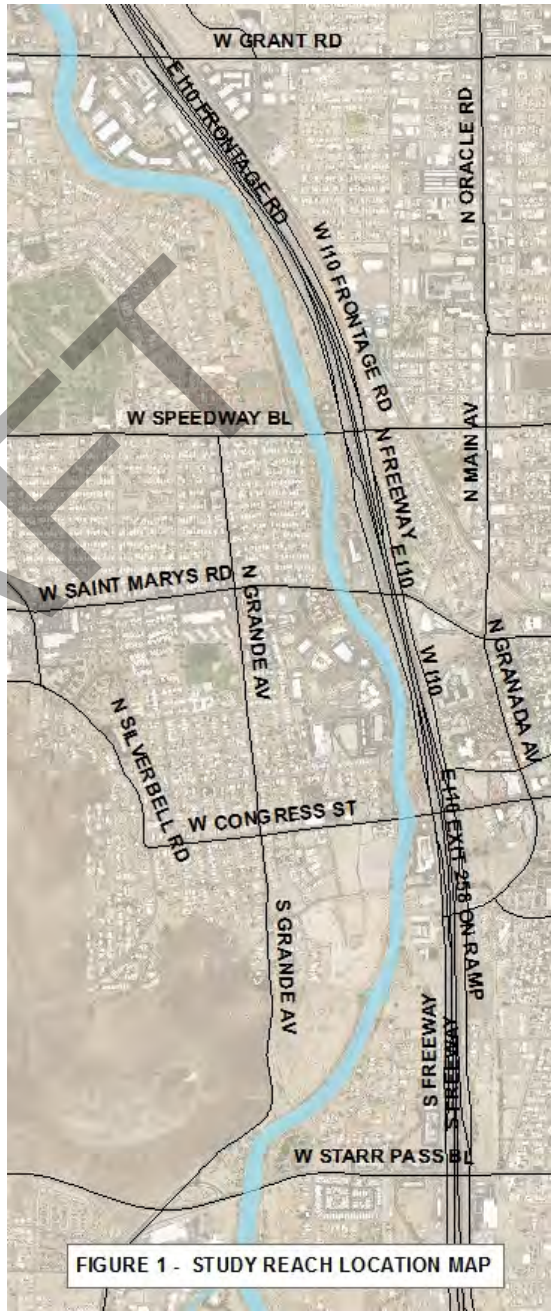

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- Bank protection plans as follows;

Reach	Plans sealed	Plans as-built	Plan #	Design Parameters		Notes
				Discharge	Bottom Width	
Grant Rd. to Speedway Blvd	1990	1991	4BSCSG	60,000 cfs	200’	PCDOT&FCD plans.
Speedway Blvd to St. Mary’s Rd.	1988	1989	4BBSTC	60,000 cfs	150’	PCDOT&FCD plans
St. Mary’s Rd. to Mission Lane	1981	1982	B121	Not indicated	150’	CBA, Rio Nuevo plans
Mission Lane to 22nd St.	1985/ 1987	1988	4BBSTB	70,000 cfs	150’	CBA plans sealed 1985. Revisions by flood control 1987

All of the bank protection plans called for excavation of a trapezoidal cross-section extending across the channel bottom from bank to bank. Figure 2 shows the longitudinal slopes along the project reach, including locations of grade control structures.

- 2015 DEM and aerial photography – This data was obtained from RFCD and was used as the basis for existing condition hydraulic modeling and as the basis for the existing condition ground level for preparation of plans, profiles and cross-sections. The DEM was processed in ArcGIS and AutoCAD Civil 3D to provide a working surface for modeling and plan development.

- As-Built Baseline of the Santa Cruz River – I-19 to Grant Road, URS, 2013 - This report and associated AutoCAD files were reviewed. The centerline from this study was adopted for use in establishing a centerline for modeling and plan development for this project.

- 2014 and 2016 Pictometery - These images were downloaded from the Pima County GIS website (http://gis.pima.gov/pictometry/) and were used to assess manning’s roughness and as a background for certain exhibits.

- Field investigation was performed on June 1, 2016 and on subsequent dates, to identify conditions associated with the channel and various bridges in the study reach.

- Survey - As a part of this project, each of the six bridges listed in the previous table were surveyed to provide pertinent hydraulic modeling data (high chord, low chord, pier dimensions, etc.). All survey was performed in NAVD88 datum to be consistent with the 2015 DEM data used for the modeling.

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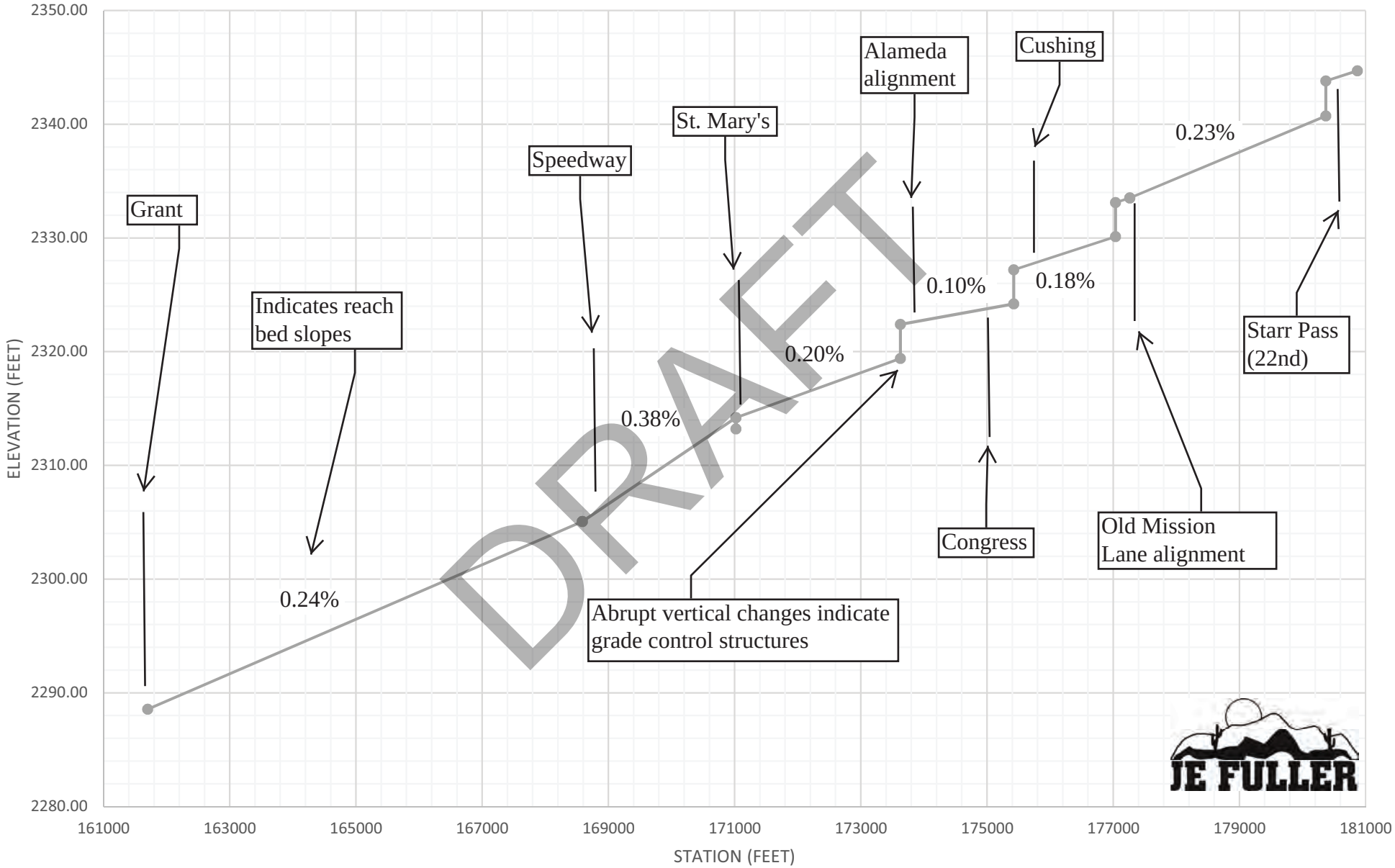
Figure 2 - Santa Cruz River Design Profile - Grant Road to Starr Pass Blvd (22nd St)



SURFACE MODELING

The 2015 DEM referenced in the previous section was utilized to create a digital surface of the existing channel and surrounding overbank areas. This surface was later utilized for hydraulic modeling of the floodplain. The 1980s era design plans and the 2013 URS as-built centerline referenced previously were used to create a digital surface of the channel condition associated with the design condition from that time. These two surfaces were compared digitally to assess the degree of ground change (aggradation and degradation) within the channel of the river. Figure 3 provides an illustration of the results of that effort. As shown in Figure 3, ground changes since the 1980's design varies from < -1 feet (degradation) to > 10 feet (aggradation). Most degradation occurred in the low flow channel, primarily on the outside of channel bends, while most aggradation occurred on the inside of bends. Of particular note is the aggradation at Congress Street where the 1980's design channel slope was only 0.1% (half the slope of most other segments). Another area of note for aggradation is just downstream of the Starr Pass Blvd bridge. Figure 4 provides a sampling of channel cross-sections showing the changes between the 1980's design condition and the 2015 condition.

The table below provides a summary of the collective amount of aggradation and degradation – relative to the 1980's plans - by reaches defined by the various roadway crossings. Review of the table below indicates a general pattern of higher aggradation and lower degradation along those reaches with a flatter design slope. It should be noted that the Grant to Speedway reach has a wider design bottom width (200' vs 150' for the others), and therefore might be expected to experience somewhat higher unit aggradation.

Reach	Reach Length (ft)	Aggradation Volume (cy)	Degradation Volume (cy)	Unit Aggradation (cy/ft)	Unit Degradation (cy/ft)	Design Slope (ft/ft)
Grant to Speedway	7150	152,400	18,800	21.31	2.63	0.24%
Speedway to St. Mary's	2200	28,500	8,800	12.95	4.00	0.38%
St Mary's to Congress	3500	57,100	2,900	16.31	0.83	0.20%
Congress to Cushing	1200	30,900	200	25.75	0.17	0.10%
Cushing to 22nd	4700	94,300	7,500	20.06	1.60	0.18-0.23%
TOTAL	18750	363,200	38,200	19.37	2.04	

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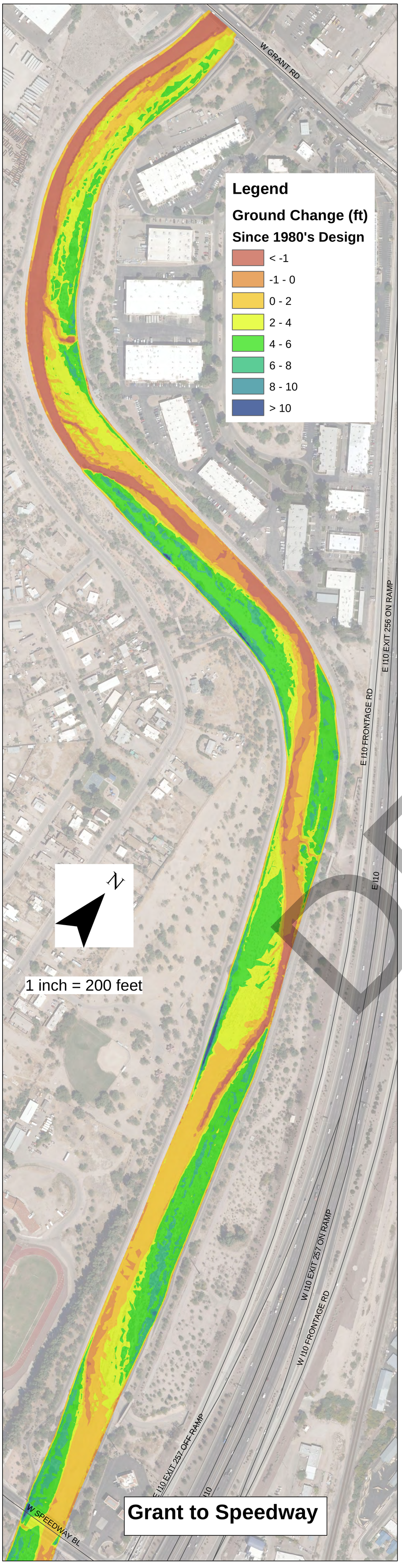
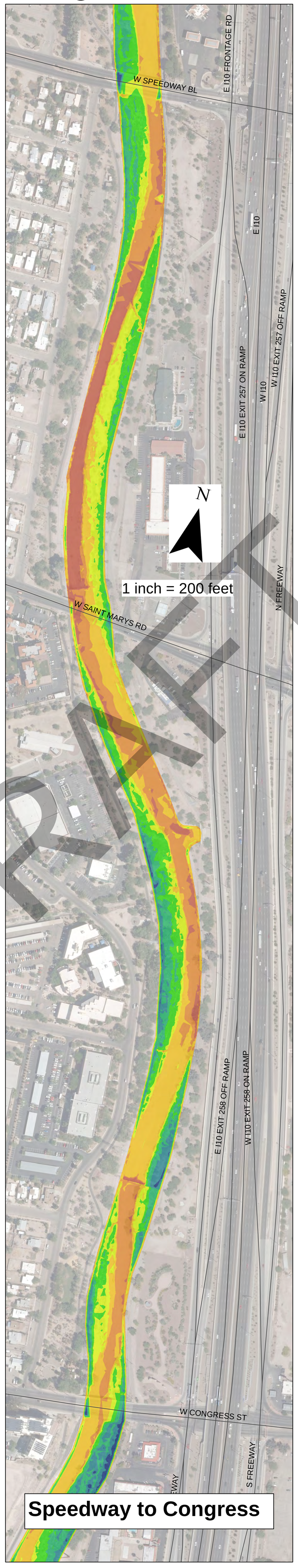
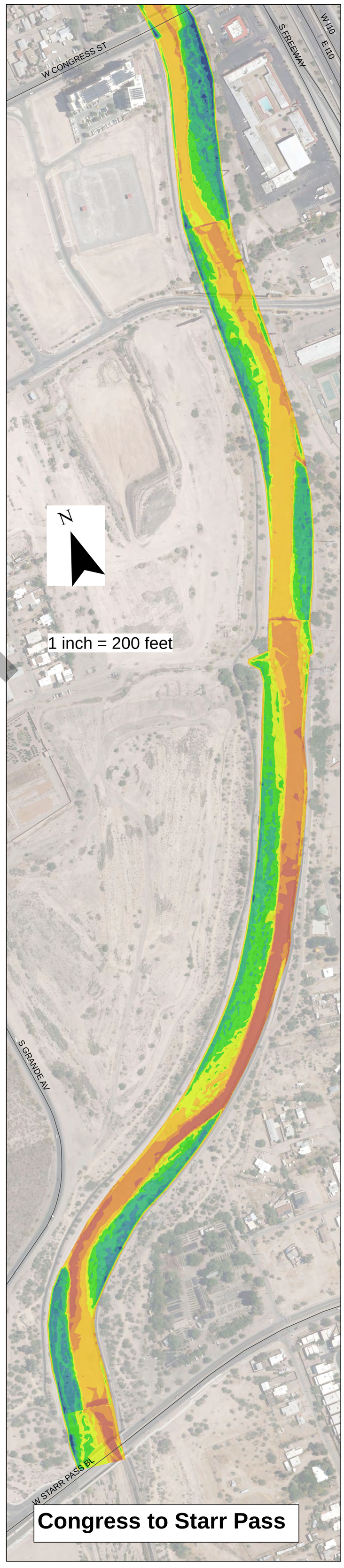
Figure 3 - Santa Cruz River - Grant Rd. to Star Pass Blvd.
Channel Ground Change Since 1980's Design



Grant to Speedway



Speedway to Congress



Congress to Starr Pass

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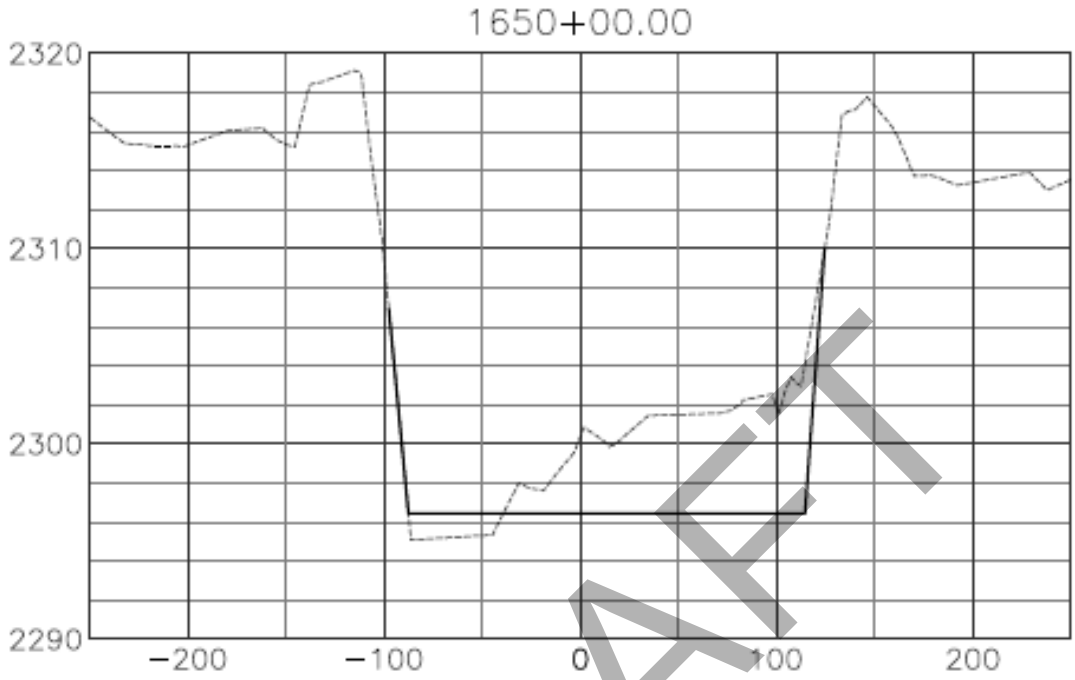
Figure 4 - Cross-Sections Showing Change from Design to 2015 Condition
(Solid line = Design, Dashed line = 2015, Sections are left to right looking upstream)

Midway between Grant Road and Speedway Blvd.



Just upstream of Speedway Blvd.

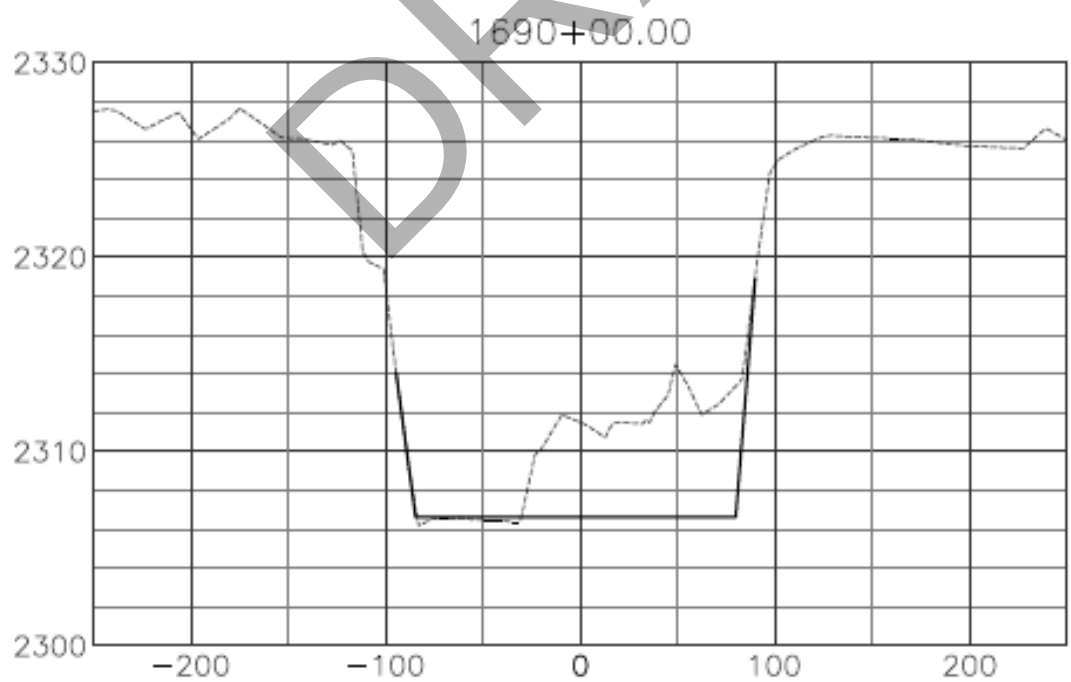


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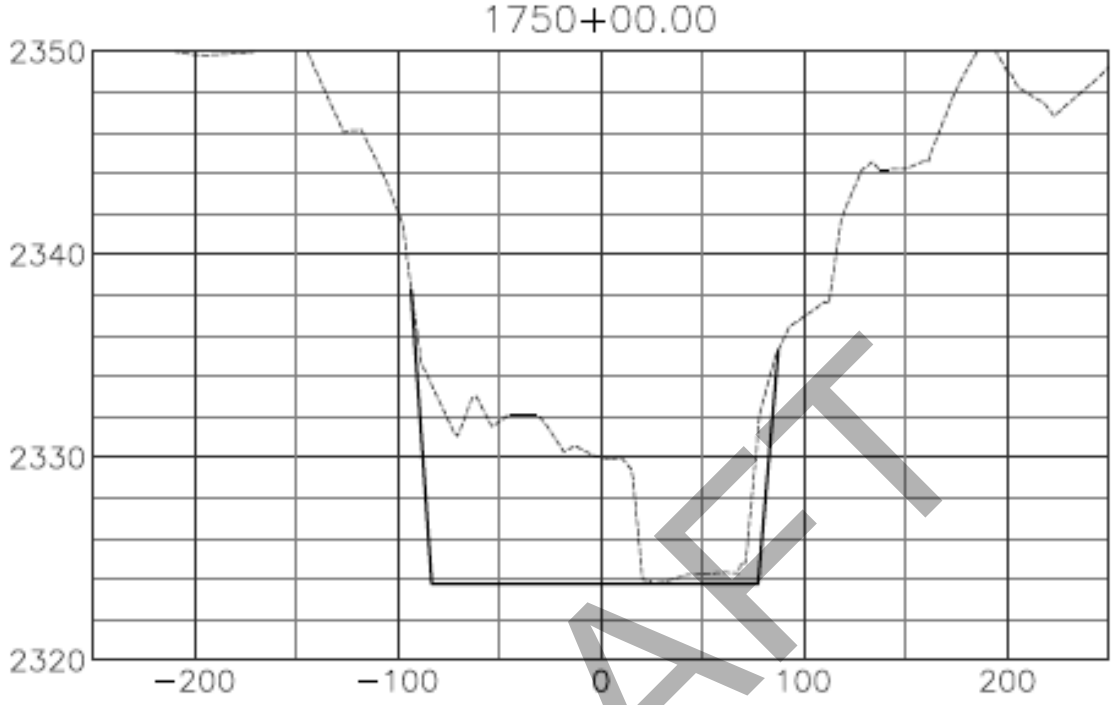
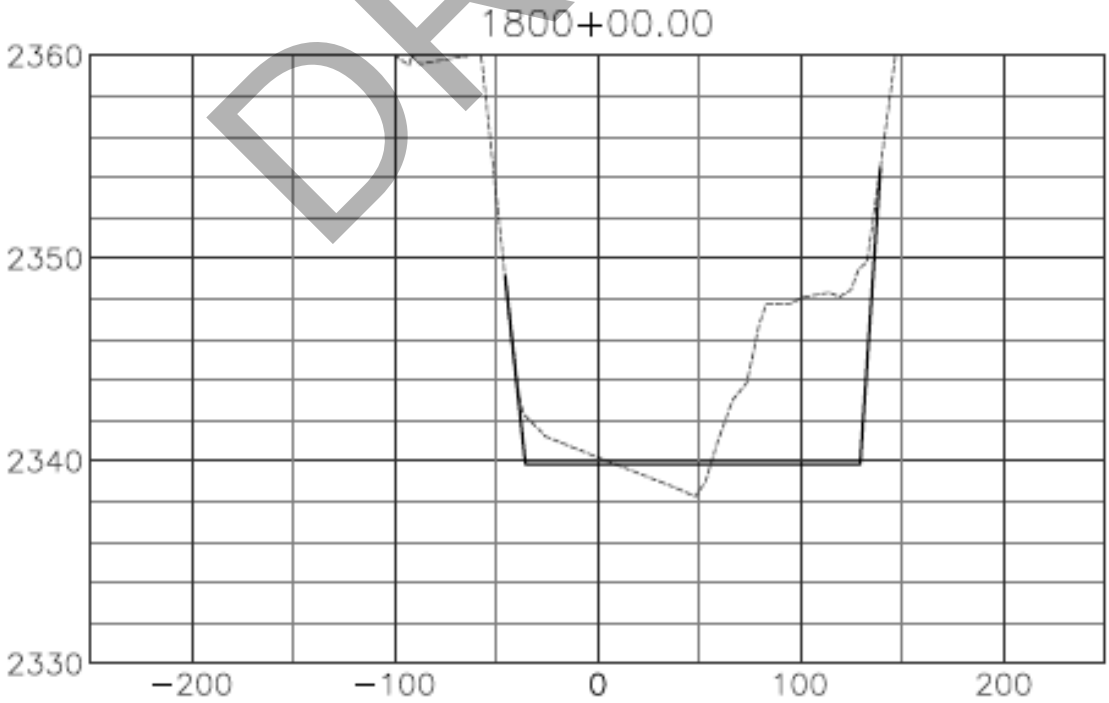
Figure 4 (cont) - Cross-Sections Showing Change from Design to 2015 Condition
(Solid line = Design, Dashed line = 2015, Sections are left to right looking upstream)

Just upstream of Congress Street



Just downstream of Starr Pass Blvd (22nd St)



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HYDRAULIC MODELING

The HEC-RAS program was used to develop a hydraulic model of the project reach of the Santa Cruz River for the 100-year event (60,000 cfs). The modeling included consideration for ineffective flow areas, levee conditions, grade controls and the six bridges at the locations noted in the previous section of this report. Manning's roughness coefficient were selected based on field investigation and review of 2014 pictometry of the study reach. Documentation of the channel roughness selections is included in Appendix A of this report. It should be noted that the development of vegetation and channel irregularities over the 25-year period since channel construction, has resulted in an increase in overall channel roughness for the river. Figure 5 provides photographs that illustrate the manner in which vegetation can increase debris accumulation and flooding potential.

The results of the existing condition HEC-RAS modeling are shown in Figure 6. As shown in Figure 6, the 100-year flow of 60,000 cfs overtops the channel banks at most locations along the project reach. This is particularly true at bridge crossings, most of which were not designed for 60,000 cfs. Of particular concern are the overbank flow areas between Congress and Speedway and between Speedway and Grant.

The HEC-RAS model was revised to reflect excavation of the channel bottom to match the design section shown on the bank protection plans listed in the previous section of this report. The channel invert and section were modified in the HEC-RAS model to reflect the design plans for this purpose. Figure 7 shows the resulting floodplain condition with channel excavation to create the design plan condition. As indicated in Figure 7, overbank flooding between Grant and Speedway is all but eliminated. Overbank flooding along the remaining reaches is substantially reduced.

Based on coordination with and direction from RFCD in November 2016, the HEC-RAS model was further revised to reflect two additional maintenance concepts described as follows;

- Big Trees Optimization – This concept focused on sediment and vegetation removal to attempt to optimize saving the larger trees in the river bottom. Figure 8 shows the results.
- Flood Risk Optimization – This concept focused on sediment and vegetation removal to optimize reduction of flood risk while still preserving some areas of vegetation. Figure 9 shows the results.

In both Figures 8 and 9, the proposed maintenance areas are shown in red.

A separate set of Figures (Figures 6A – 9A) follow Figures 6-9 showing just the outline of the floodplain for each condition rather than the flood depths. These maps also indicate levee freeboard where applicable. It should be noted that all modeling reflects berms/levees where they exist along the project. The modeling documented herein does not define specific amounts of freeboard that occur along leveed sections under the various modeled scenarios. Based on FEMA standards, if insufficient freeboard exists, additional areas may be place in the regulatory floodplain and that, as such, these maps should be considered best case scenarios.

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Figure 5 - Photographs from August 30, 2005 Flood Event Showing Effect of Vegetation

Upstream of Grant Road Bridge. Facing downstream (north) along right bank path. High water marks are observed as debris along the fence line.

Same date and location as above, facing the tree (west).

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Figure 6 - Santa Cruz River - Grant Rd. to Star Pass Blvd.
100-yr Floodplain - 2015 Conditions

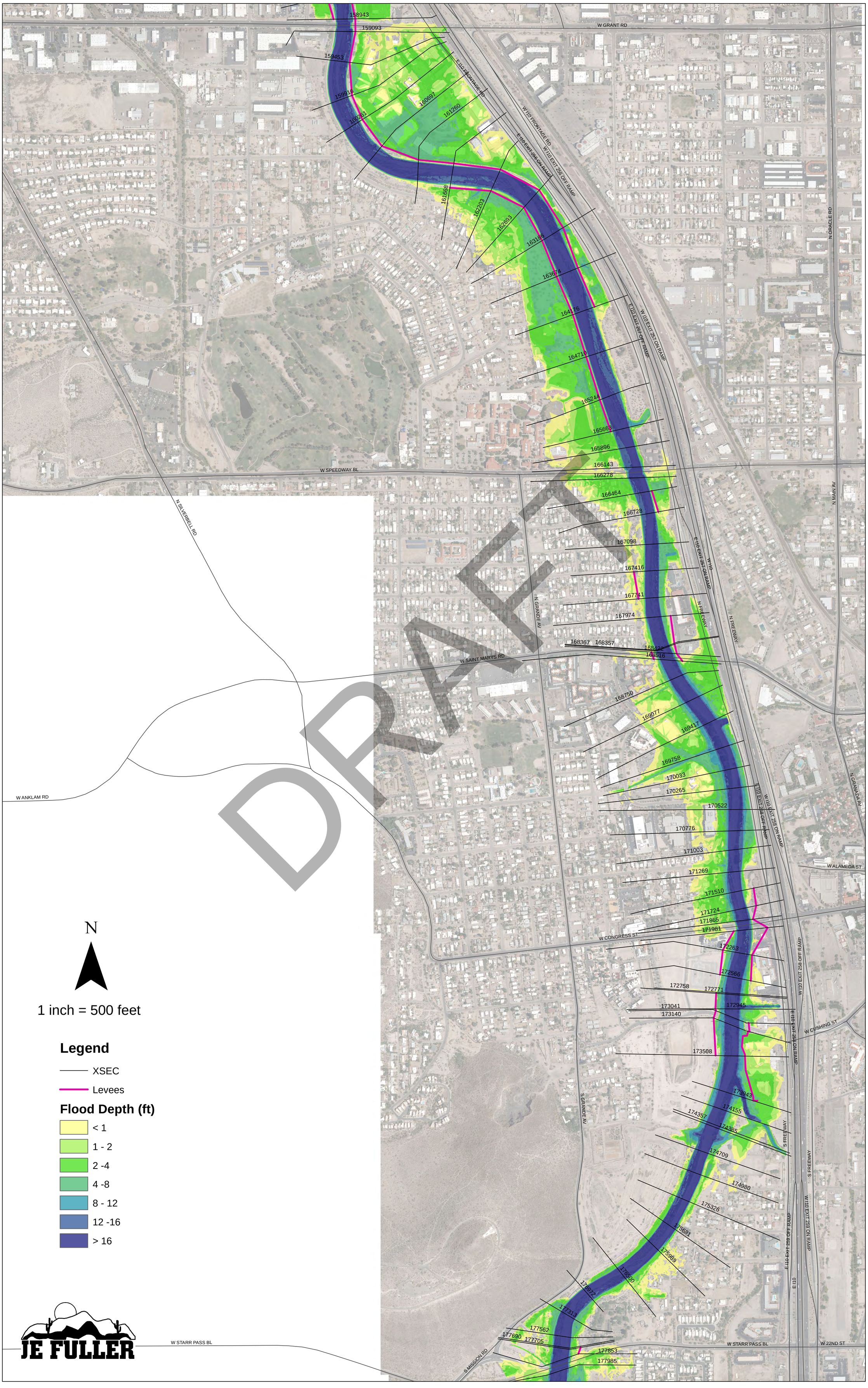


Figure 7 - Santa Cruz River - Grant Rd. to Star Pass Blvd.
100-yr Floodplain with Original (1980's) Channel Design

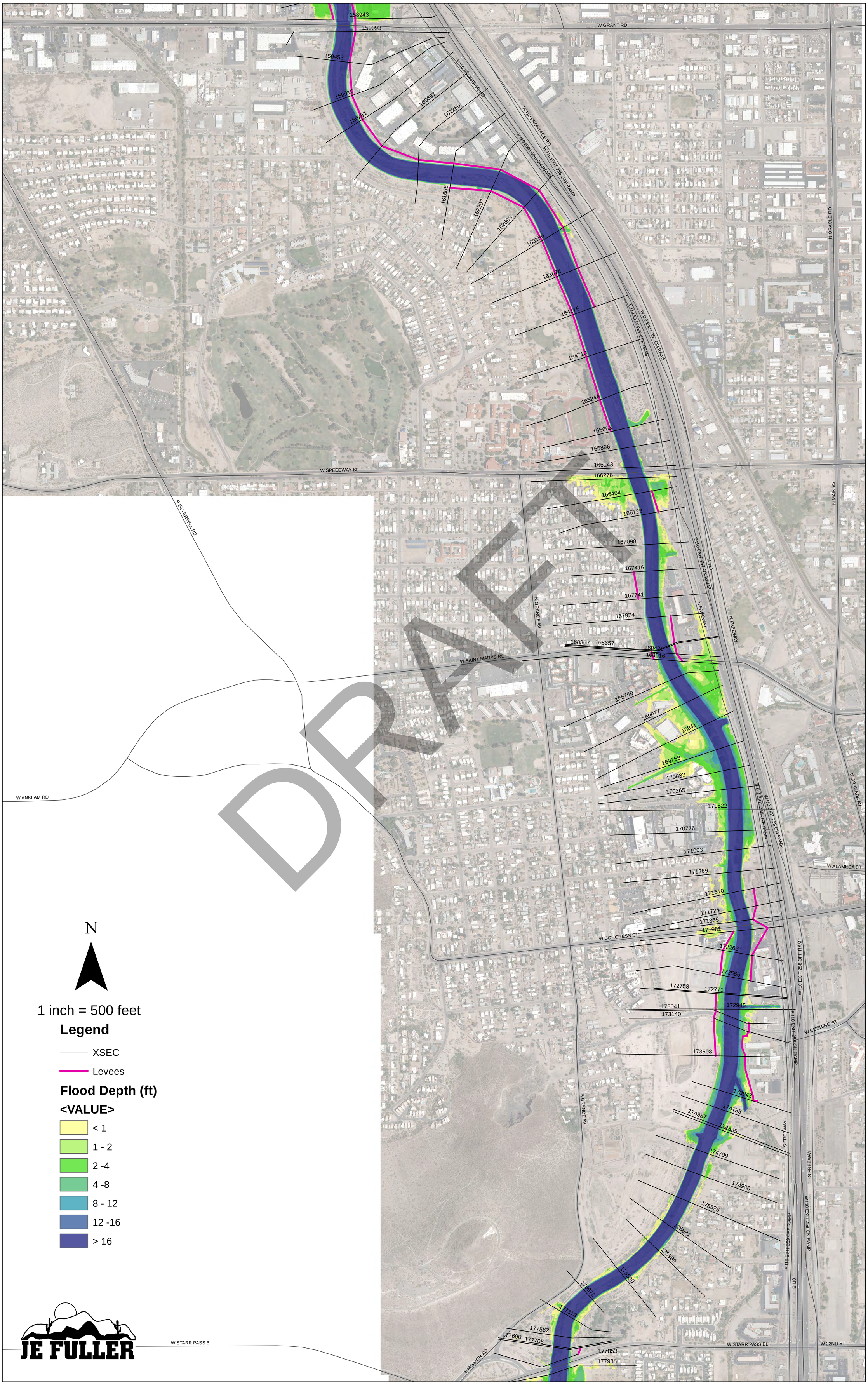


Figure 8 - Santa Cruz River - Grant Rd. to Star Pass Blvd
100-yr Floodplain for Big Trees Optimization Concept

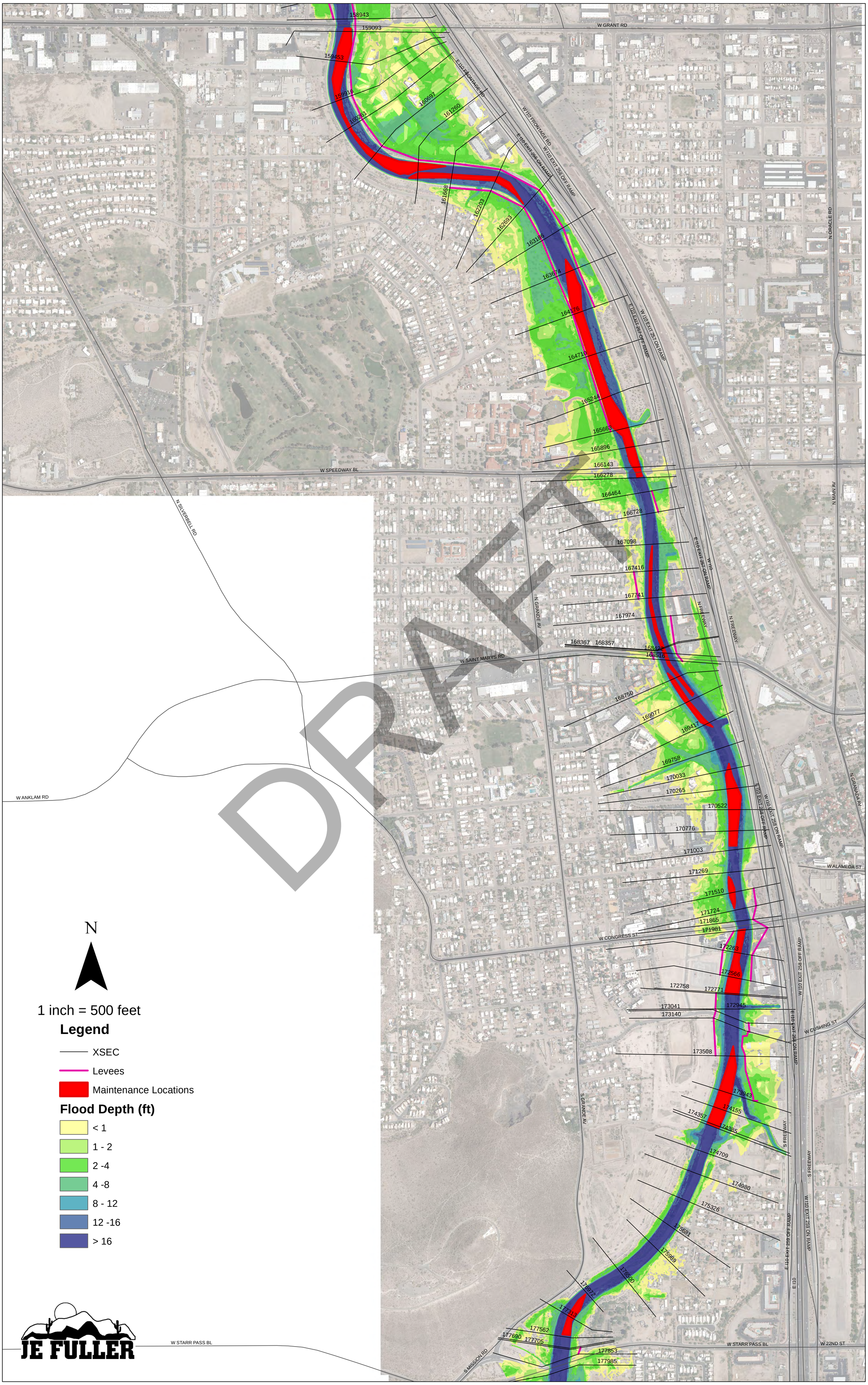


Figure 9 - Santa Cruz River - Grant Rd. to Star Pass Blvd
100-yr Floodplain for Flood Risk Optimization Concept

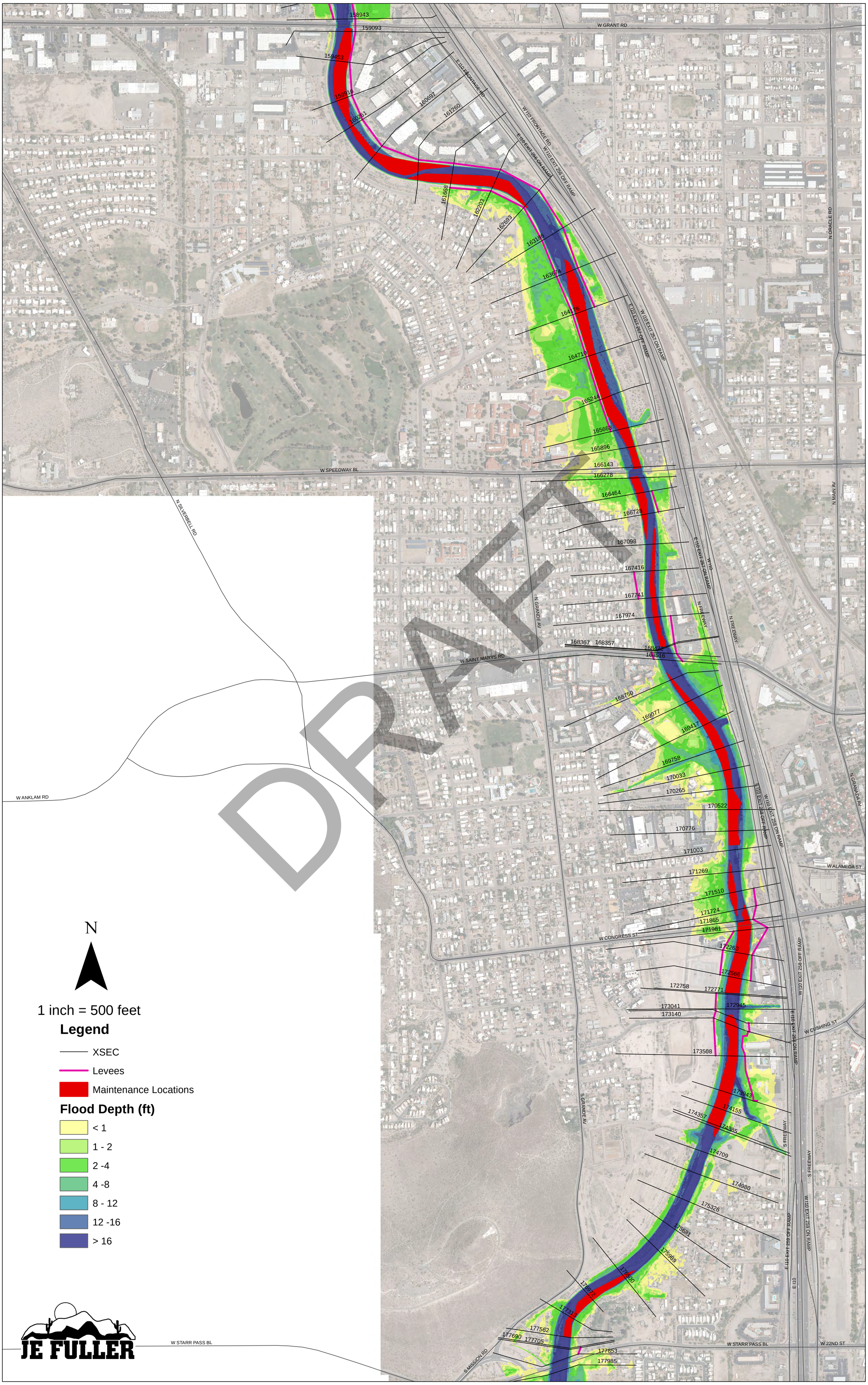


Figure 6A - Santa Cruz River - Grant Rd. to Star Pass Blvd.
100-yr Floodplain Outline - 2015 Conditions

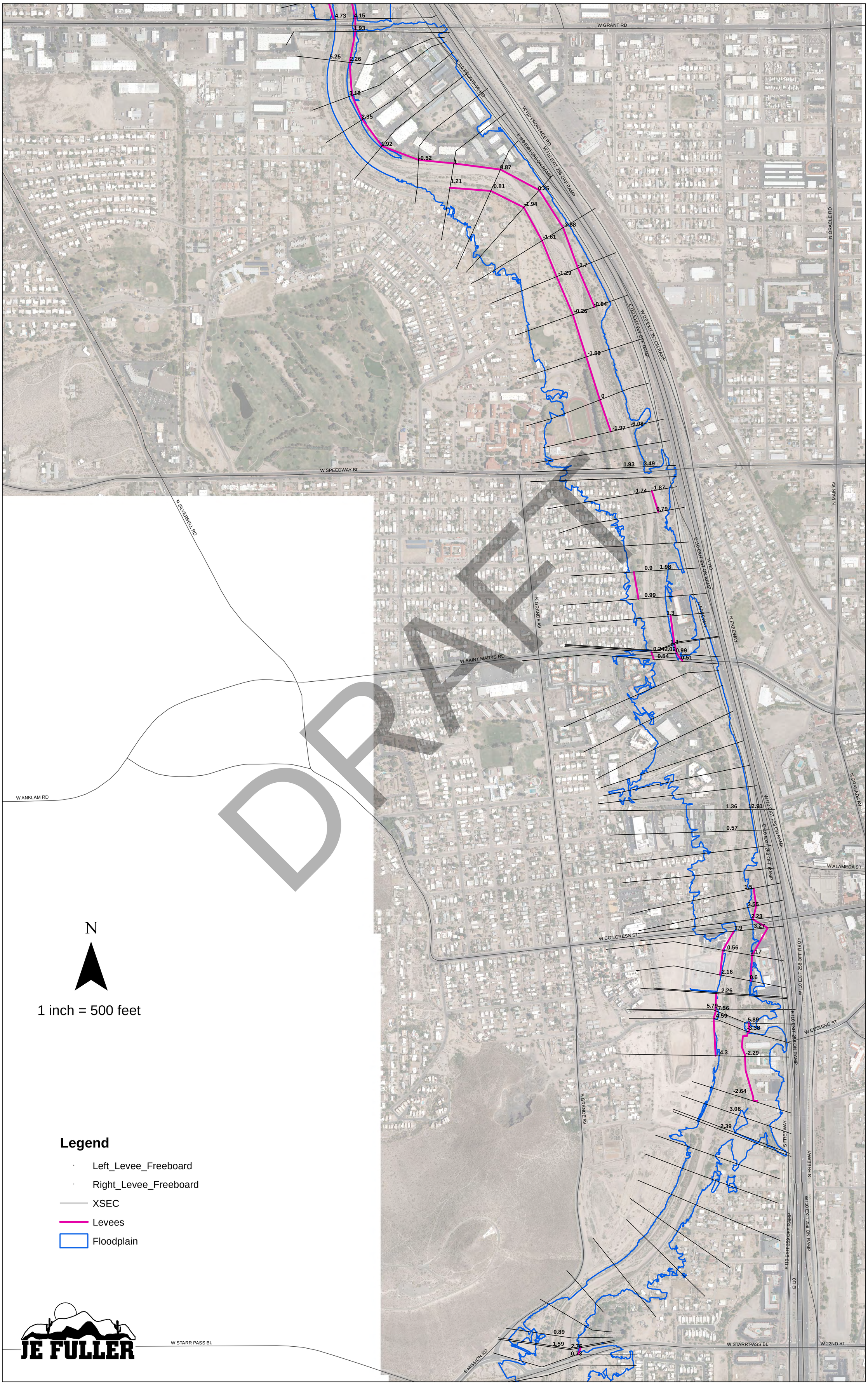


Figure 7A - Santa Cruz River - Grant Rd. to Star Pass Blvd.
100-yr Floodplain Outline with Original (1980's) Channel Design

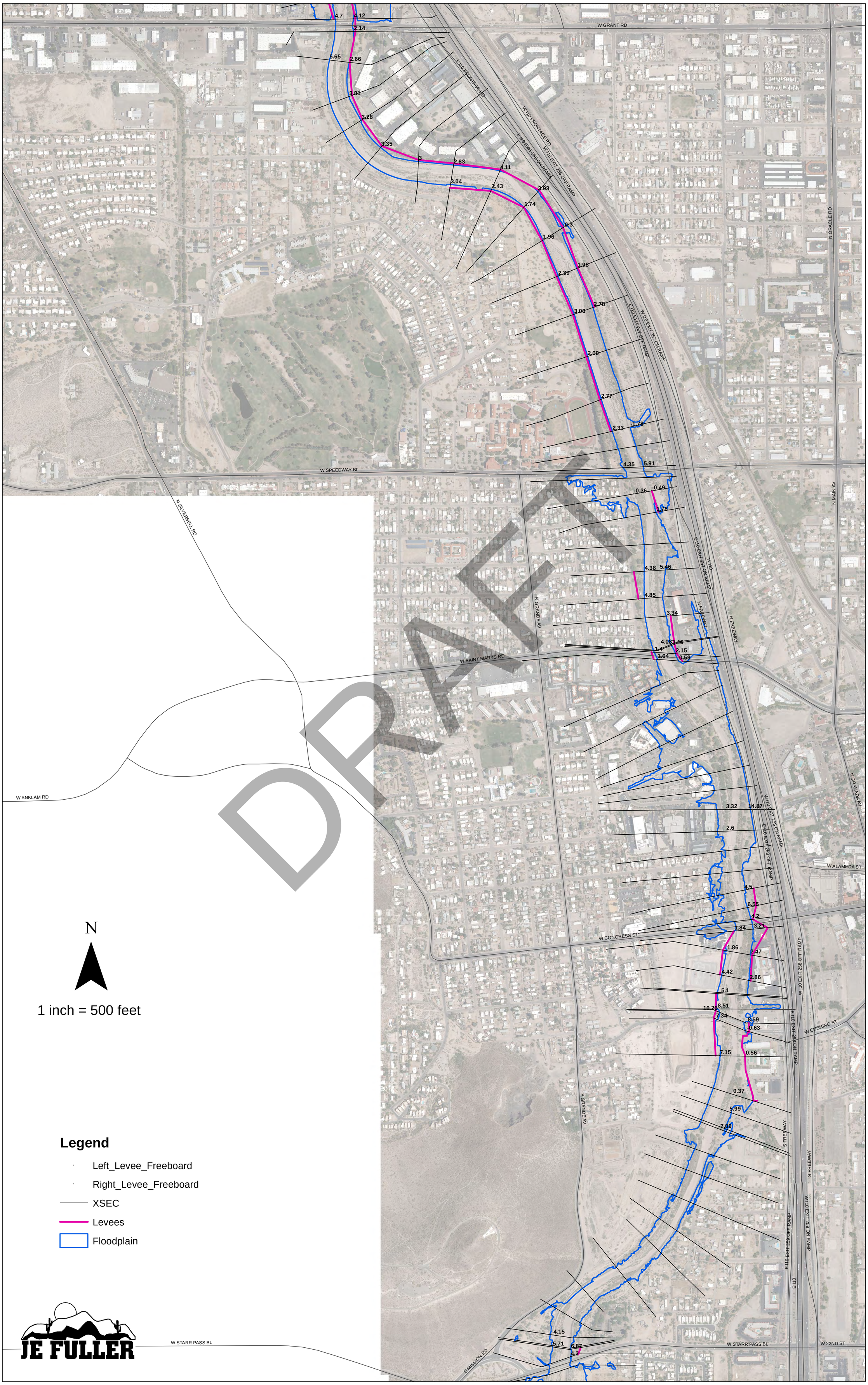


Figure 8A - Santa Cruz River - Grant Rd. to Star Pass Blvd
100-yr Floodplain Outline for Big Trees Optimization Concept

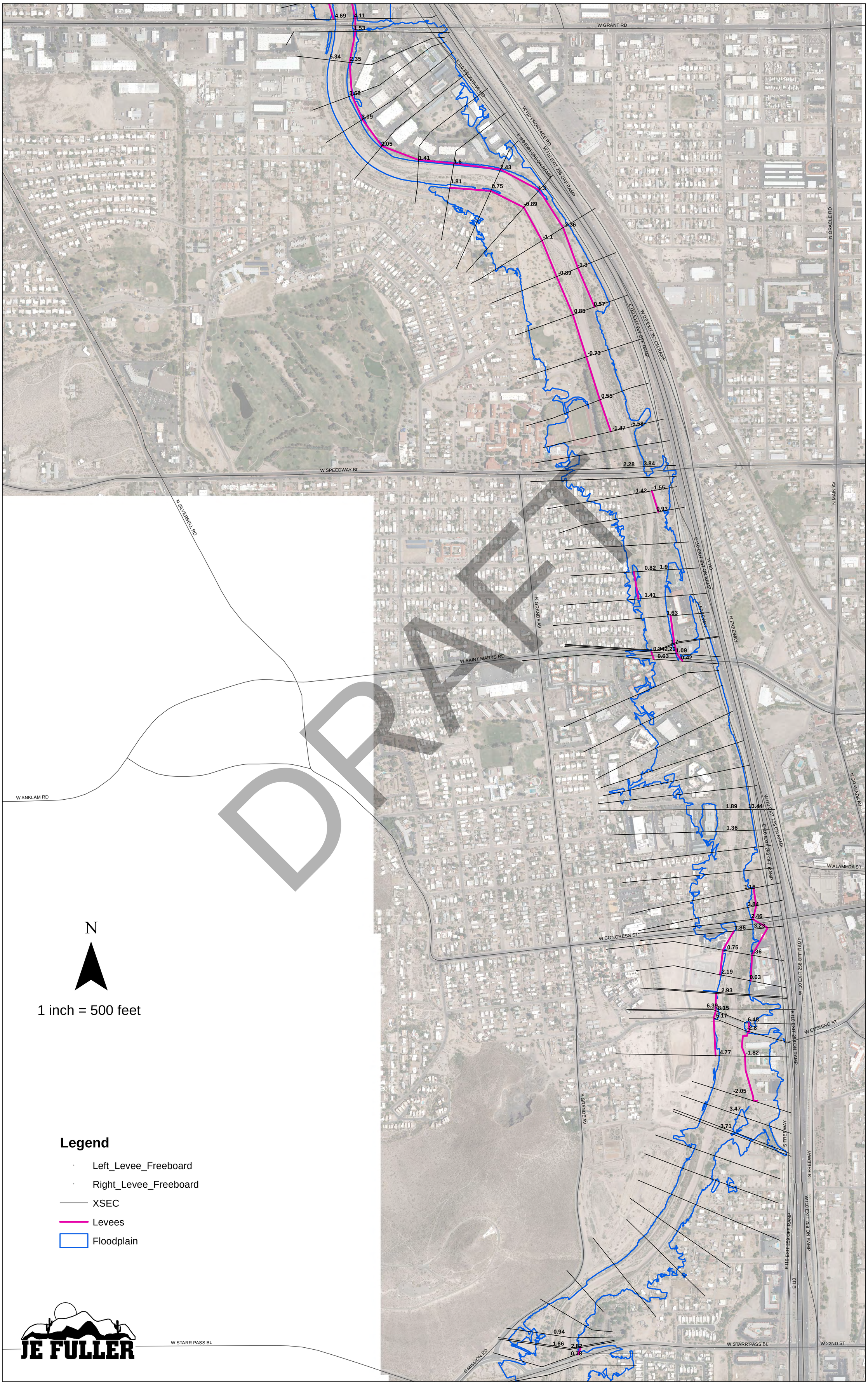
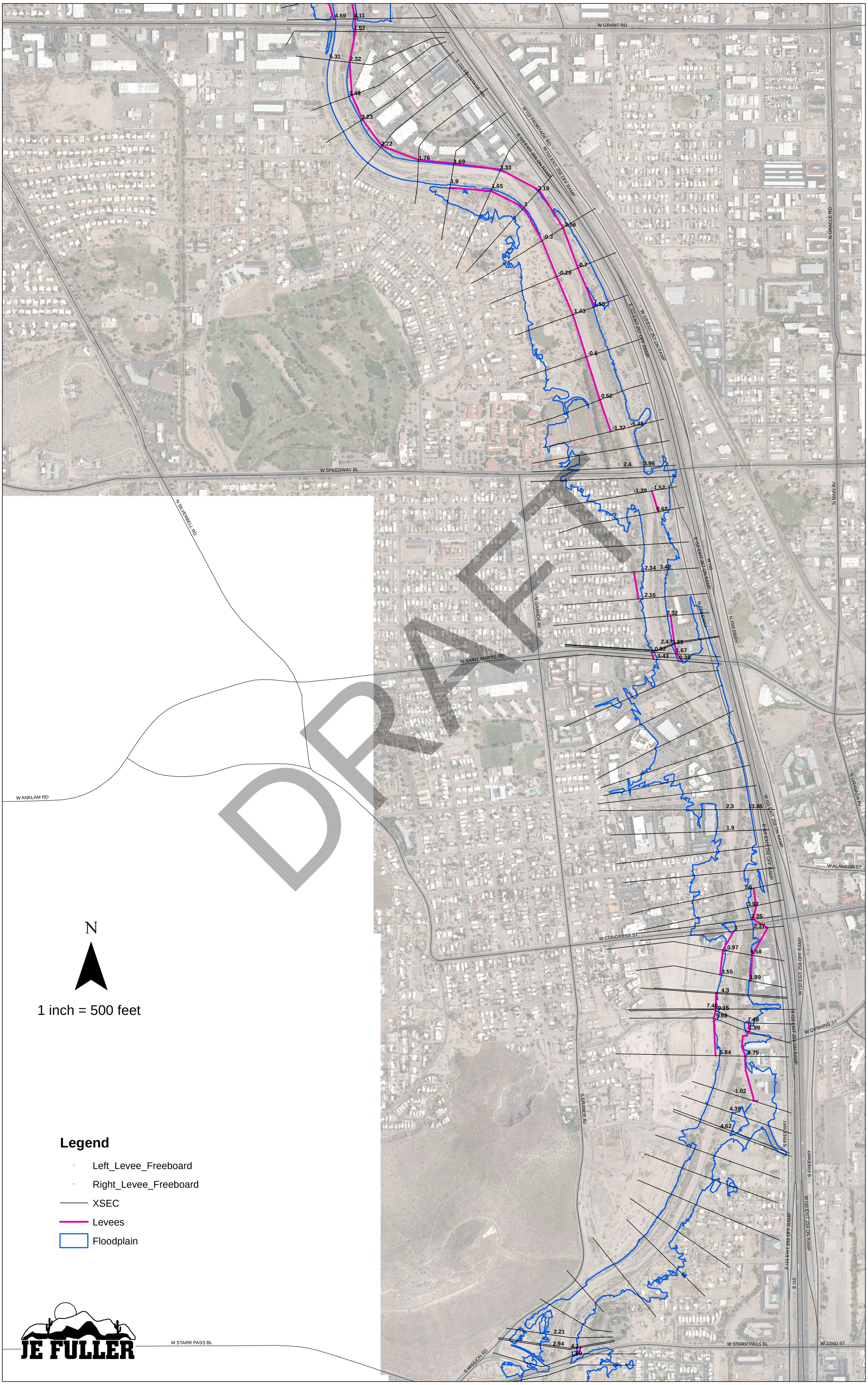


Figure 9A - Santa Cruz River - Grant Rd. to Star Pass Blvd
100-yr Floodplain Outline for Flood Risk Optimization Concept



PARCEL MAP OVERLAY

The floodplain mapping from each of the alternatives discussed in the preceding section was overlaid on county parcel mapping. Building counts and associated assessed valuations were derived by county staff. The table below summarizes the results of this effort.

Parcel Map Overlay Data Table

Mapping Condition	# of Buildings	Assessed Value[1]
Current Flood Insurance Maps	27	$15,207,953.80
Original 1980's Design Condition	39	$17,795,834.55
Floodrisk Optimization Concept	92	$36,555,149.15
Big Trees Optimization Concept	136	$56,644,105.05
2015 Condition	159	$59,344,289.55
[1] Assessed Value of structure assuming 0.65 of Total FCV		

PLAN & CROSS-SECTION MAPPING

Utilizing the 2015 and design plan surfaces discussed previously, plan, profile and cross-section mapping was prepared to guide maintenance activities by the RFCD toward the goal of restoring the subject channel reaches to their original design flood carrying capacities through excavation of aggraded material. The referenced maintenance plan set is provided under separate cover. AutoCAD Civil 3D files associated with the plan set are also available to the RFCD.

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SUMMARY & CONCLUSION

The Santa Cruz River through downtown Tucson (Grant to Starr Pass) was channelized during the late 1980's and early 1990's as a trapezoidal channel with soil cement stabilized banks. This work was done for flood control purposes to reduce flood and erosion damage potential to a heavily developed and high value area of town. Most of this channelization was constructed after the 1983 flood and the subsequent adoption of the current 60,000 cfs regulatory discharge for the Santa Cruz River. The older Rio Nuevo segment from St. Mary's Rd. to Mission Lane is the exception. In contrast, nearly all of the bridges along the same reach were constructed prior to the adoption of the 60,000 cfs regulatory discharge. The exception is the Cushing Street bridge which was constructed in 2013.

The results of the foregoing analysis indicate that the subject reach of the Santa Cruz River has experienced considerable aggradation since the original channelization work. This appears to be the result of unattended sedimentation and vegetation development over a period in excess of 25 years for most of the subject reach. This sedimentation and vegetation has resulted in reduced flood carrying capacity of the river and associated increases in flood risk to adjacent development. This evaluation provides guidance documents for the maintenance of the river toward the goal of restoring its design flood carrying capacity. It is recommended that maintenance be performed per this documentation to restore the original design capacity of the channel to protect the citizens of Pima County and their property.

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APPENDIX A

Manning's Roughness "n" Value Assessment

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DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS				
Project:	Santa Cruz River Maintenance			
Stream:	Santa Cruz River			
Location:	Starr Pass Blvd to Downstream of Grant Road			
Condition:	Existing Condition			
Channel Conditions		Manning's n Adjustment		Channel
Channel Material	Firm Earth	nb	.025-.032	
	Coarse Sand		.026-.035	0.026
	Gravel		.028-.035	
	Cobble		.030-.050	
	Boulder		.040-.070	
Degree of Channel Bank Irregularity	Smooth	n1	.000	0.000
	Minor		.001-.005	
	Moderate		.006-.010	
	Severe		.011-.020	
Variation in Channel Cross-Section	Gradual	n2	.000	0.000
	Alternating Occasionally		.001-.005	
	Alternating Frequently		.010-.015	
Effect of Obstructions in Channel	Neglible	n3	.000-.004	0.002
	Minor		.005-.015	
	Appreciable		.020-.030	
	Severe		.040-.060	
Amount of Vegetation in Channel	Neglible	n4	.000-.002	
	Small		.002-.010	0.007
	Medium		.010-.025	
	Large		.025-.050	
	Very Large		.050-.100	
	Extremely Large		.100-.200	
Degree of Meandering	Minor	m	1	1.000
	Appreciable		1.15	
	Severe		1.3	
n = (nb+n1+n2+n3+n4)*m				0.035

Reference - Selection of Manning's Roughness Coefficient for Natural and Constructed Vegetated and Non-Vegetated Channels, and Vegetation Maintenance Plan Guidelines for Vegetated Channels in Central Arizona, Jeff V. Phillips and Saeid Tadayon, Scientific Investigations Report 2006-5108, U.S. Department of the Interior, U.S. Geological Survey (SIR 2006-5108).

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DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS				
Project:	Santa Cruz River Maintenance			
Stream:	Santa Cruz River			
Location:	Starr Pass Blvd to Downstream of Grant Road			
Condition:	Original Design (1980's)			
Channel Conditions		Manning's n Adjustment		Channel
Channel Material	Firm Earth	nb	.025-.032	
	Coarse Sand		.026-.035	0.026
	Gravel		.028-.035	
	Cobble		.030-.050	
	Boulder		.040-.070	
Degree of Channel Bank Irregularity	Smooth	n1	.000	0.000
	Minor		.001-.005	
	Moderate		.006-.010	
	Severe		.011-.020	
Variation in Channel Cross-Section	Gradual	n2	.000	0.000
	Alternating Occasionally		.001-.005	
	Alternating Frequently		.010-.015	
Effect of Obstructions in Channel	Neglible	n3	.000-.004	0.001
	Minor		.005-.015	
	Appreciable		.020-.030	
	Severe		.040-.060	
Amount of Vegetation in Channel	Neglible	n4	.000-.002	
	Small		.002-.010	0.003
	Medium		.010-.025	
	Large		.025-.050	
	Very Large		.050-.100	
	Extremely Large		.100-.200	
Degree of Meandering	Minor	m	1	1.000
	Appreciable		1.15	
	Severe		1.3	
n = (nb+n1+n2+n3+n4)*m				0.030

Reference - Selection of Manning's Roughness Coefficient for Natural and Constructed Vegetated and Non-Vegetated Channels, and Vegetation Maintenance Plan Guidelines for Vegetated Channels in Central Arizona, Jeff V. Phillips and Saeid Tadayon, Scientific Investigations Report 2006-5108, U.S. Department of the Interior, U.S. Geological Survey (SIR 2006-5108).

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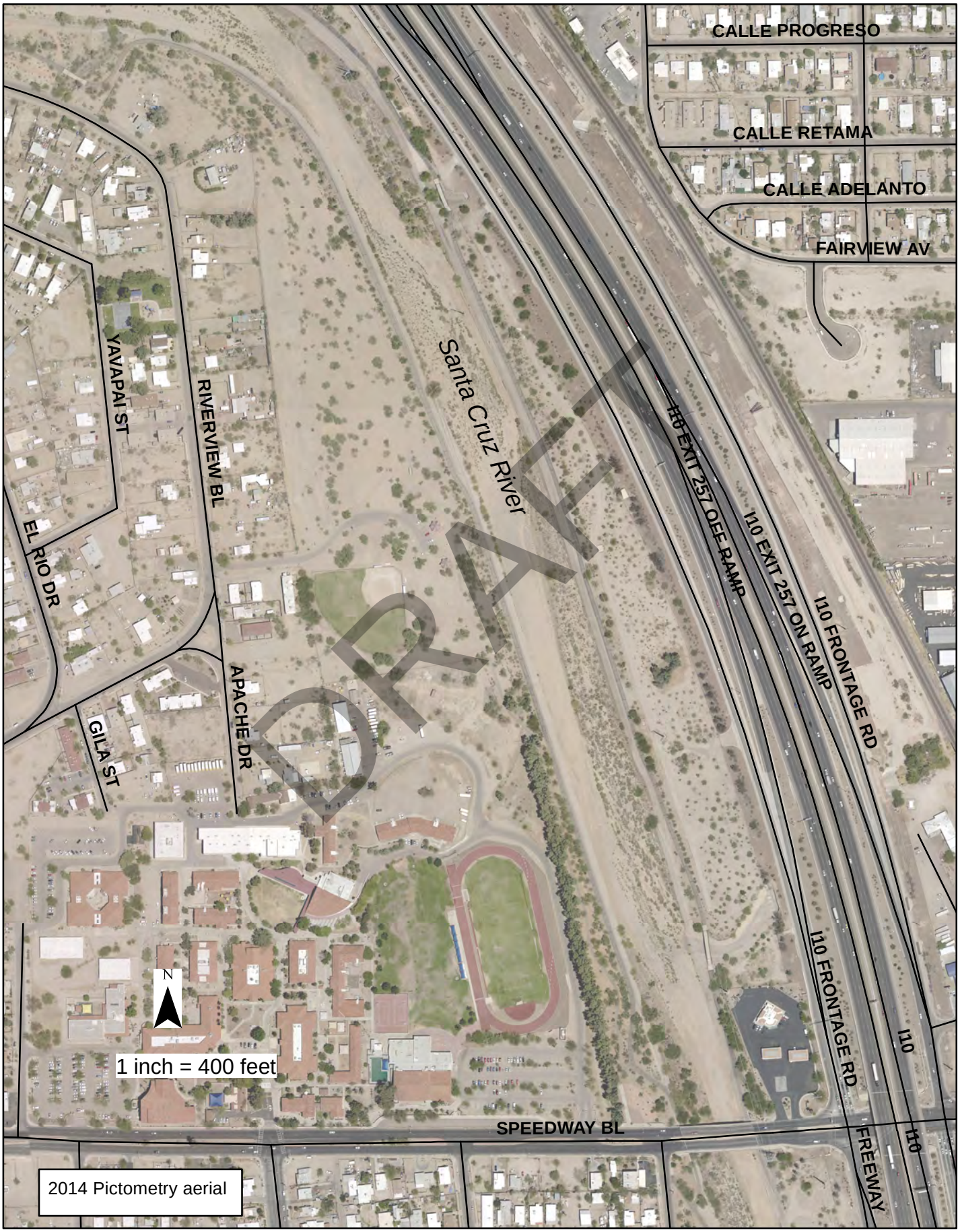
Santa Cruz River Maintenance Project - Manning's n
Starr Pass Blvd to Mission Lane

Santa Cruz River Maintenance Project - Manning's n
Mission Lane to Congress Street

Santa Cruz River Maintenance Project - Manning's n
Congress Street to Saint Mary's Road

Santa Cruz River Maintenance Project - Manning's n
Saint Mary's Road to Speedway Blvd

Santa Cruz River Maintenance Project - Manning's n
Speedway Blvd to Grant Road (South Portion)



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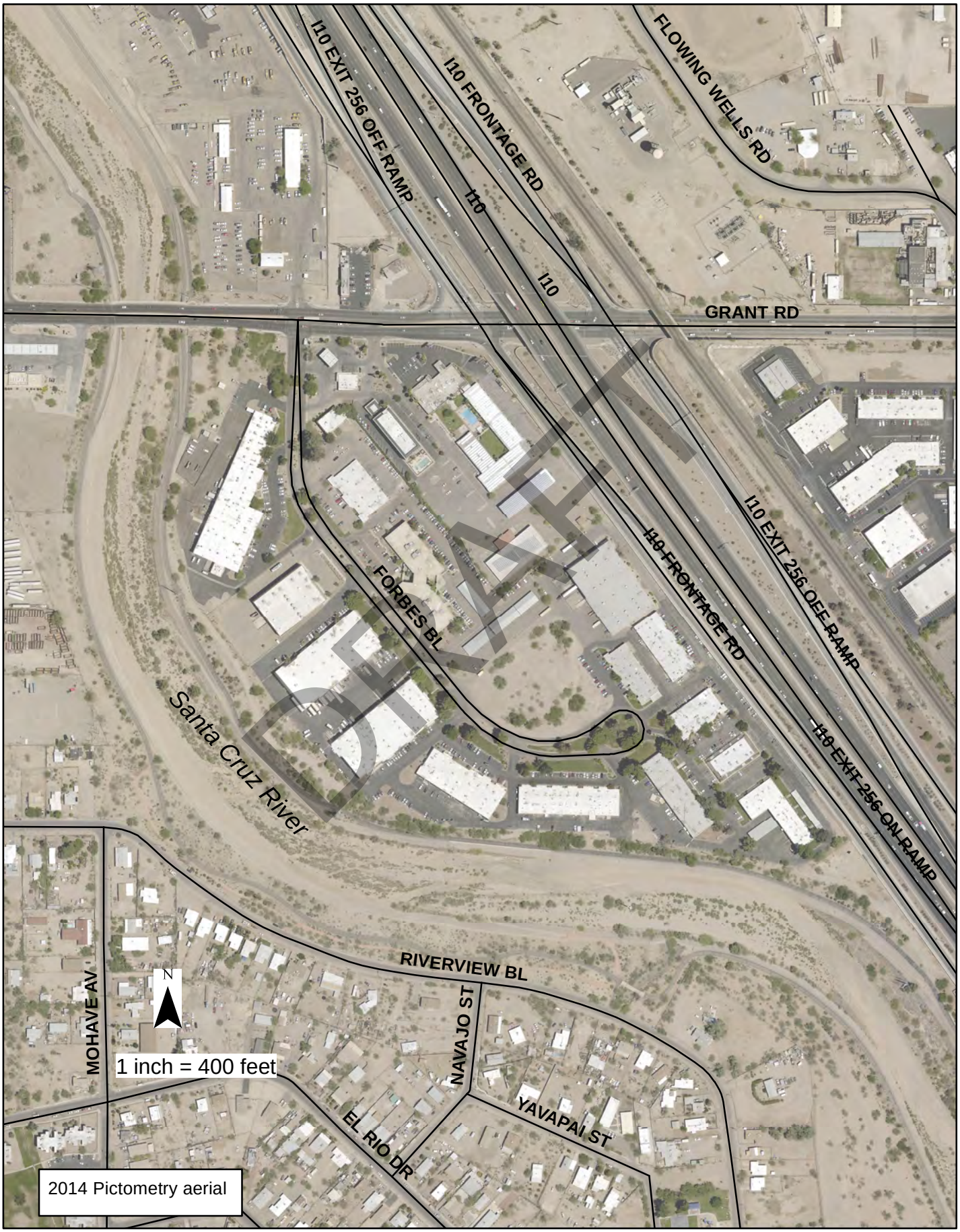
Speedway Blvd to Grant Road (North Portion)



APPENDIX B

Digital Files for HEC-RAS modeling & AutoCAD Civil 3D Plans

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ATTACHMENT 2

GI/LID TREES ASSESSMENT
PIMA COUNTY

Green Infrastructure Concept
Meander Bend Park

PLANT MATERIAL LEGEND

TREES

SYMBOL	BOTANICAL NAME COMMON NAME
	Celtis reticulata Western Hackberry
	Chilopsis linearis 'AZT' AZT Desert Willow
	Parkinsonia florida Blue Palo Verde
	Prosopis velutina Native Velvet Mesquite

NOTE:
Trees with SM notation refer to trees expected to germinate from seed mix. Location of trees is conceptual.

SHRUBS & CACTUS

SYMBOL	BOTANICAL NAME COMMON NAME
	Encelia farinosa Brittlebush
	Larrea tridentata Creosote
	Opuntia engelmannii Prickly Pear

NOTE:
Shrub and cactus symbols enlarged in legend for legibility.

150' 0 75' 150' 225' 300'

PIMA COUNTY
FLOOD CONTROL

WHEAT | DESIGN GROUP
LANDSCAPE ARCHITECTS

ATTACHMENT 3

PIMA COUNTY
FLOOD CONTROL

MEMORANDUM

DATE: March 8, 2018

TO: C. H. Huckelberry
County Administrator

FROM: Suzanne Shields, P.E.
Director

SUBJECT: **Santa Cruz River Capacity Restoration Phase I – Grant Road to Silverlake Road**

This memorandum is in response to your February 22, 2018 memorandum requesting information regarding the status of the Santa Cruz River Capacity Restoration project. As you know, the Intergovernmental Agreement (IGA) with the City of Tucson (City), which transferred maintenance responsibility of the Santa Cruz River to the Regional Flood Control District (District) was completed in 2014. At that time, the District evaluated the aggradation of the river from Silverlake Road to Grant Road and its impact on the channel's flood carrying capacity. The results of the evaluation revealed that the aggradation, which has occurred over 30 years, has the potential to flood an additional 173 structures and additional property with estimated assessed value of $84 million.

In order to identify the extent to which sediment removal activities must be performed, the District evaluated numerous scenarios in order to gain insight regarding the consequences of leaving otherwise desirable vegetation in the channel. Keeping vegetation means the sediment that is underneath the vegetation cannot be removed. The scenarios included full channel cleanout, leaving vegetation in place where flood damage potential is least severe, leaving the most desirable vegetation in place irrespective of flood damage potential, and maintenance near bridges to minimize bridge failure. As anticipated, there is a correlation to the removal of sediment and vegetation and the reduction in flood damage potential.

This information was provided to the Mayor and Council, individually, at their Ward offices. The purpose of the meetings was to provide an overview of the project in anticipation of a Study Session so that they could review and comment on the District's recommendation for maintenance. Among the councilmembers, there was a general understanding of the benefit of sediment removal with respect to the flood risk to existing structures, risk to the undersized bridges, and reduction in the cost of development and redevelopment along the river corridor. However, a request was made by Councilmember Romero to seek a recommendation by the Pima County Board of Supervisor's (Board) prior to a Mayor and Council Study Session, potentially delaying any maintenance activity. The proposed maintenance also covers a long reach of the Santa Cruz River; therefore, the District desires to break up the project into three phases. The three phases are shown on the attached map and are described more thoroughly below.

PHASE I – SPEEDWAY BOULEVARD TO GRANT ROAD

The IGA directs the District to seek review and approval of a maintenance plan from the City for those portions of the river owned by the City (Silverlake Road to Speedway Boulevard). However, the District is fee owner or has other property rights for maintenance for the portion of the river from Speedway Boulevard to Grant Road and desires to commence maintenance activities this April after outreach to adjacent neighborhoods, The Loop community and other stakeholders. Attached is the District's final recommendation for maintenance of this section of the river. In addition to the hydraulic evaluation, we utilized the results of a vegetation survey that identified the most desirable native plant species to preserve. The goal is to preserve as many of the native trees as possible while restoring the necessary capacity. The green polygons indicate areas to be preserved.

Forbes Business Park near Grant Road on the east bank is protected by a levee and the need to maximize river capacity is warranted. While significant sediment removal is proposed, numerous stands of trees have been preserved where levee freeboard requirements appear to be met. Where levee freeboard requirements have not been met, more sediment removal is necessary. In some cases, modification to the floodwall may also be necessary.

The presence of state land near Speedway Boulevard on the west bank provides some buffer that allows for overbank flow without risk to structures or property. The result is that much, but not all, of the desirable vegetation can be kept in the channel. Further, the recommended maintenance plan removes sediment and vegetation within 100 feet downstream and 200 feet upstream of the bridges in this reach.

It is anticipated that, upon completion of this sediment removal project, the 51 structures that are impacted by the floodplain in today's conditions (22 commercial, 20 residential, and 9 government structures) will be reduced to six or fewer structures that may be impacted. The District will conduct surveys of these remaining structures, which are owned by the State of Arizona, to determine if the actual finished floor elevations are high enough such that flood damage to the interior is not anticipated.

PHASE I- SEDIMENT RECEIVING AREA/RESTORATION SITE

It is also important to note that the receiving area for the sediment from the river, an old meander north of the Grant Road on the west bank that has been cut off from the river, is planned to become a restoration project after this phase of the sediment removal project is complete. This area, currently a sparsely vegetated hole, will be turned into a neighborhood scale water-harvesting project that will serve as an amenity to the adjacent Silver Creek II subdivision as well as a node on The Loop. The placement of the sediment from the river will occur in a way that results in a multi-acre water-harvesting basin with terraces that provide for a lush mesquite bosque in the lower areas with hardier desert species in the upper terraces. The diversion of flow from an adjacent small watershed will reduce the need for long-term irrigation, while containing the full flow volume of the 100-year flood (see attached concept plan for the restoration, tentatively called Meander Park). In addition, due to the benefits associated with restoration of this site, this project is being evaluated using AutoCASE as directed by the Board in their 2017 resolution regarding global climate change. The District anticipates that the Triple Bottom Line will show that social and environmental benefits will greatly outweigh the cost of restoration.

PHASE II – 29th STREET TO MISSION LANE

The proposed second phase of the Santa Cruz River sediment removal project will be from 29th Street to Mission Lane. This phase was selected for two reasons. First, this is the initial location for discharge of recycled water that is part of the City's Heritage Water Project. Performing maintenance in advance of that project, which the City anticipates will be Memorial Day 2019, would be prudent. The second reason is that, since there are relatively few structures in close proximity to the Santa Cruz River banks, there is an opportunity to preserve more vegetation in the channel. A vegetation survey will be performed and a grading plan that reflects the District's final recommendation will be prepared. Since this is property that is owned by City and is subject to the IGA, the Maintenance Plan

will be submitted to them for comment. It is anticipated that the sediment from this reach will be deposited at the A Mountain landfill or adjacent locations as the City desires. Once the final grading plan and receiving area have been determined, the District will prepare a memorandum for review by the Board. Then the District will provide the recommendation to City for its concurrence.

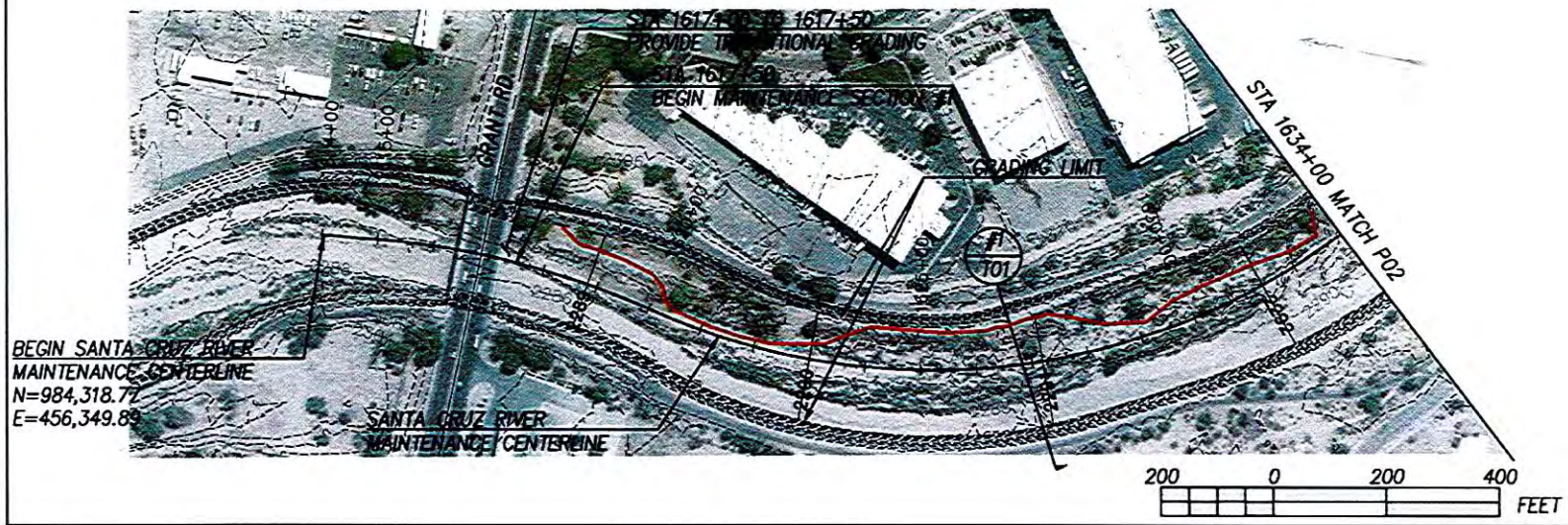
PHASE III – MISSION LANE TO SPEEDWAY BOULEVARD

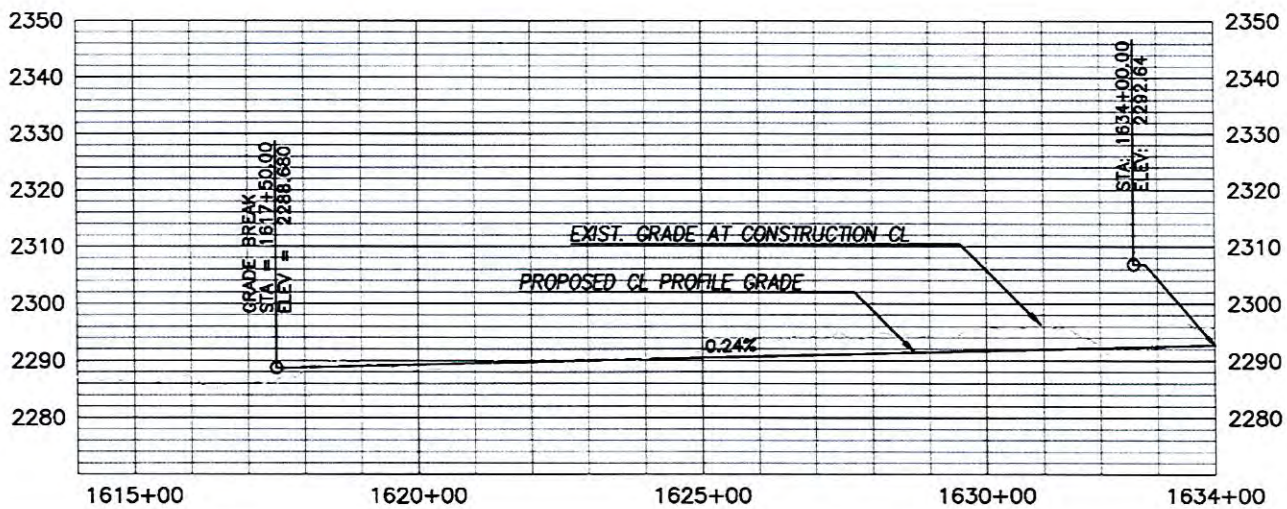
The remaining reach from Mission Lane to Speedway Boulevard is very complicated as it contains development that is very close to the channel, has old undersized bridges, has property rights issues, and contains improvements that appear to be non-compliant with FEMA standards. The District is preparing a separate document to describe these issues in more detail. More discussion will be necessary prior to any proposal on the extent of sediment removal.

SS/tj

Attachments

c: Carmine DeBonis, Deputy County Administrator – Public Works
Eric Shepp, P.E., Deputy Director – Regional Flood Control District





PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

NO	REVISION DESCRIPTION	ENGINEER	DATE

PRELIMINARY NOT FOR CONSTRUCTION

		DATE
DESIGNED	MW/PS	12/27
DRAWN	PS	12/27
CHECKED	MW	12/27
PROJ MGR	PS	12/27

PIMA COUNTY FLOOD CONTROL

SANTA CRUZ RIVER SEDIMENT REMOVAL
GRANT ROAD TO 29TH STREET
PLAN & PROFILE SHEET P01

1-800-STAKE-IT

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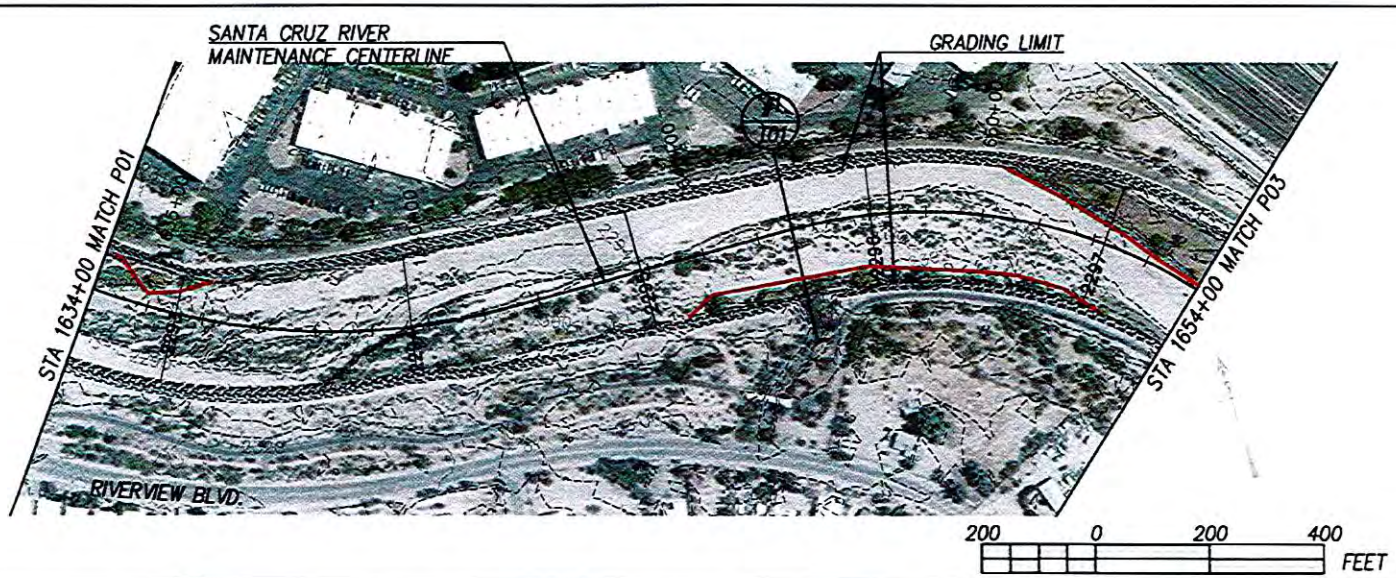

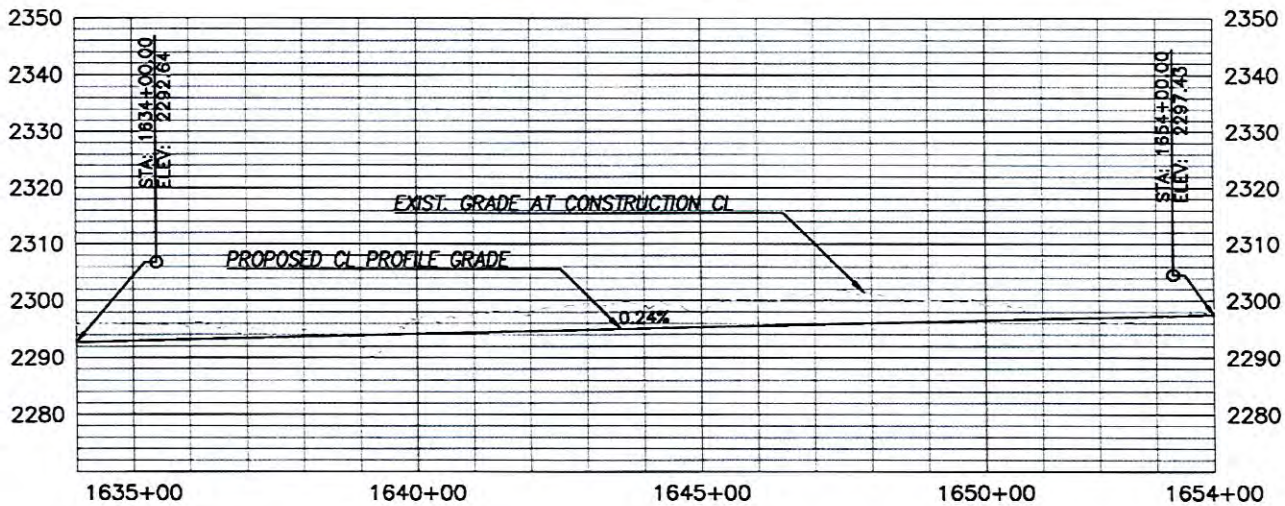

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PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

NO.	REVISION DESCRIPTION	ENGINEER	DATE

PRELIMINARY NOT FOR CONSTRUCTION

		DATE
DESIGNED	MJ/PS	12/17
DRAWN	PS	12/17
CHECKED	MJ	12/17
PROJ ENGR	PS	12/17

PIMA COUNTY FLOOD CONTROL

SANTA CRUZ RIVER SEDIMENT REMOVAL
GRANT ROAD TO 29TH STREET
PLAN & PROFILE SHEET P02

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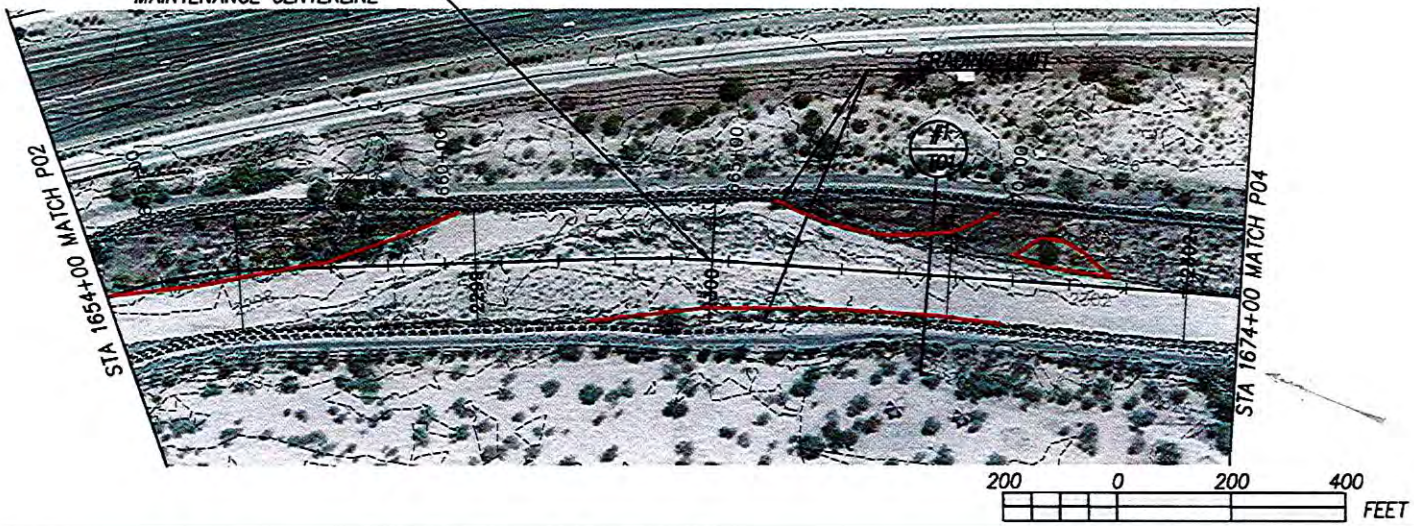

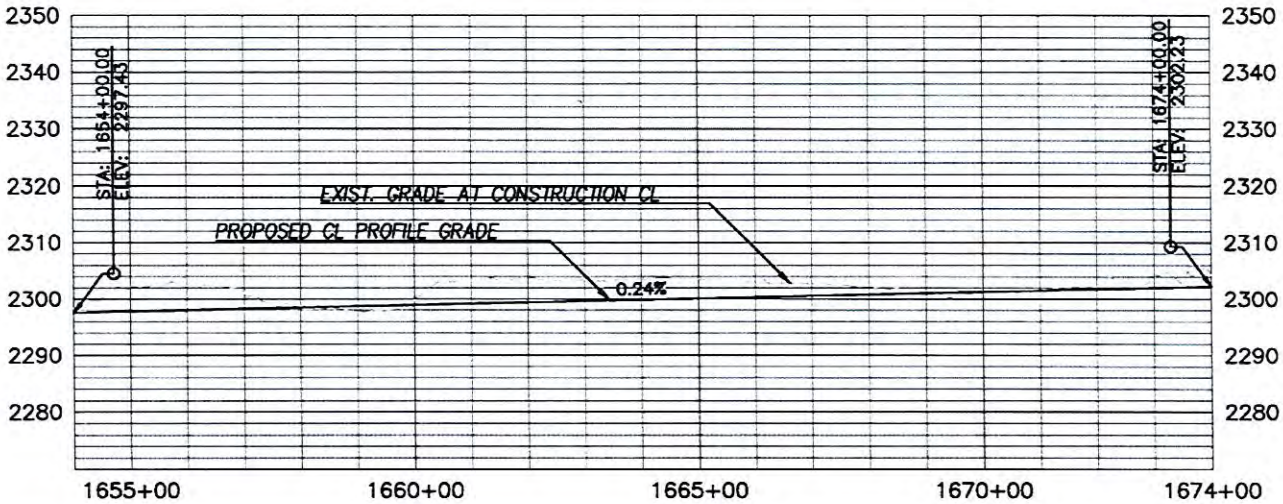

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PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

NO.	REVISION DESCRIPTION	ENGINEER	DATE

PRELIMINARY NOT FOR CONSTRUCTION

		DATE
DESIGNED	MW/PS	12/27
DRAWN	PS	12/27
CHECKED	MW	12/27
PROJ. MGR.	PS	12/27

PIMA COUNTY FLOOD CONTROL

SANTA CRUZ RIVER SEDIMENT REMOVAL
GRANT ROAD TO 29TH STREET
PLAN & PROFILE SHEET P03

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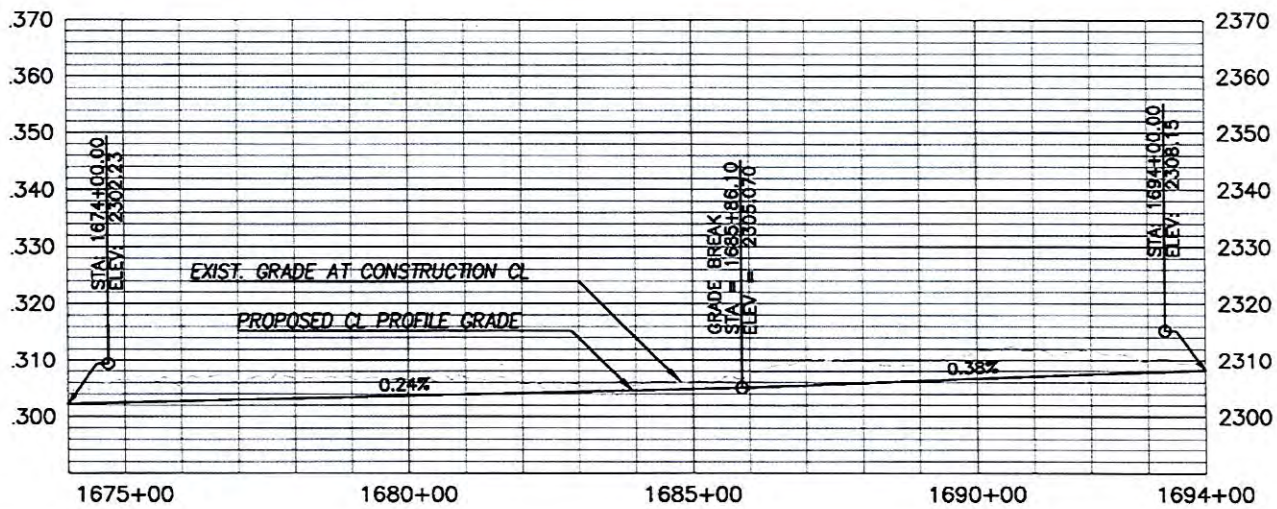

1-800-STAKE-IT

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

NO.	REVISION DESCRIPTION	ENGINEER	DATE

PRELIMINARY NOT FOR CONSTRUCTION

		DATE
DESIGNED	MW/PS	12/17
DRAWN	PS	12/17
CHECKED	MW	12/17
PROJ ENGR	PS	12/17

PIMA COUNTY FLOOD CONTROL

SANTA CRUZ RIVER SEDIMENT REMOVAL
GRANT ROAD TO 29TH STREET
PLAN & PROFILE SHEET P04

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SILVER CREEK DEPOSIT SITE

FILL PLAN

DESIGNED		
DRAWN		
CHECKED		
PROJ ENGR		

DATE	NO	REVISION DESCRIPTION	DIV/SECT ENGR	DATE

SHEET 2 OF 2

ATTACHMENT 4

PIMA COUNTY
FLOOD CONTROL

Pima County Regional Flood Control District
201 N. Stone Ave - 9th Floor
Tucson, Arizona 85701-1797
(520) 724-4600, FAX: (520)724-4621
http://www.rfcd.pima.gov

Santa Cruz Sediment Removal

Phase I Areas to be Preserved (207,895 sq ft)

Streams

0 80 160 320 480 640 Feet

1 inch = 210 feet

Date: 2/28/2018

The information depicted on this display is the result of digital analyses performed on a variety of databases provided and maintained by several governmental agencies. The accuracy of the information presented is limited to the collective accuracy of these databases on the date of the analysis. The Pima County Regional Flood Control District makes no claims regarding the accuracy of the information depicted herein.

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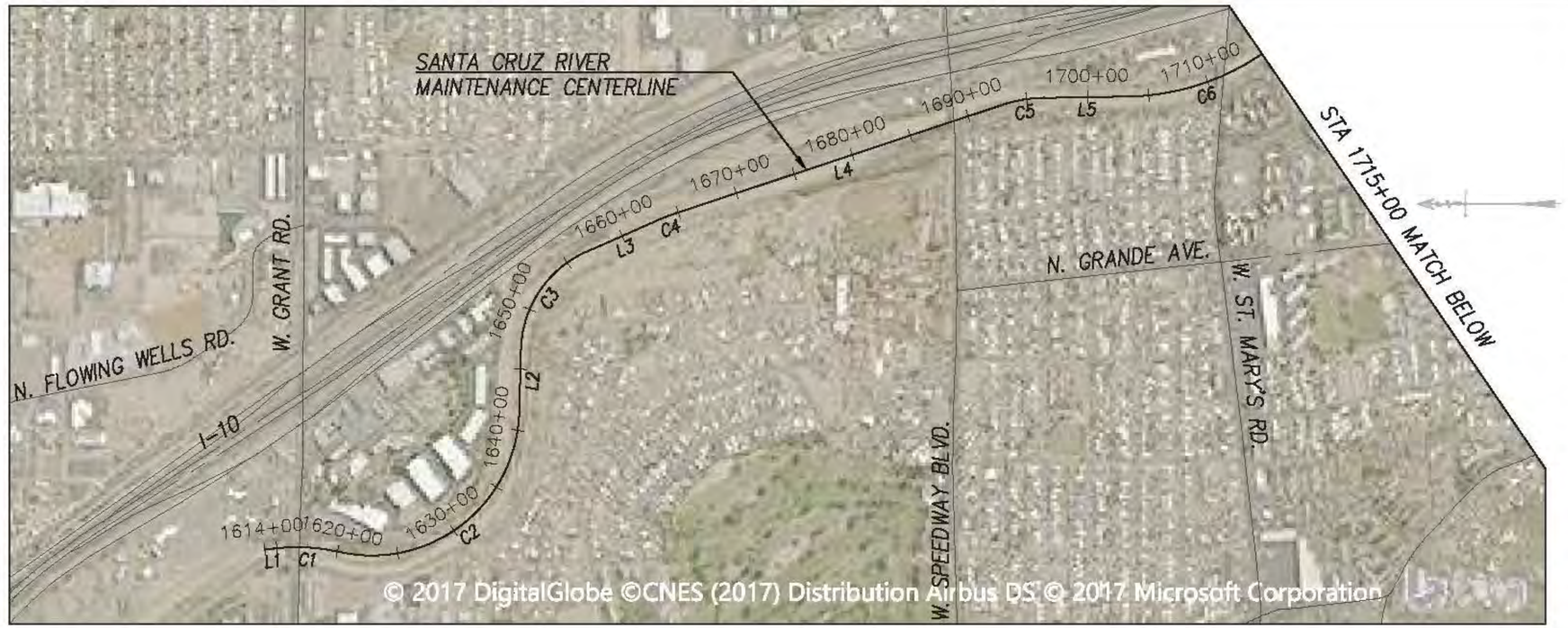
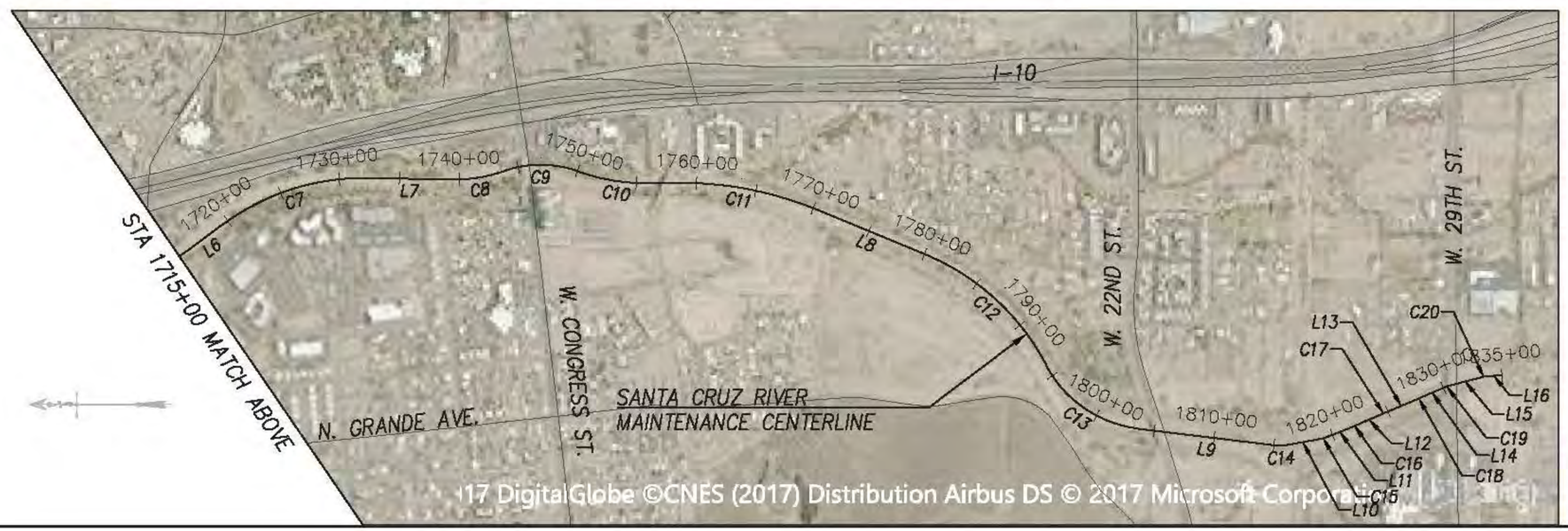


1,000 0 1,000 2,000 FEET



PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

SANTA CRUZ RIVER SEDIMENT REMOVAL
GRANT ROAD TO 29TH STREET
HORIZONTAL CONTROLSHEET H01

PIMA COUNTY FLOOD CONTROL

PRELIMINARY NOT FOR CONSTRUCTION

NO.	REVISION DESCRIPTION	ENGINEER	DATE

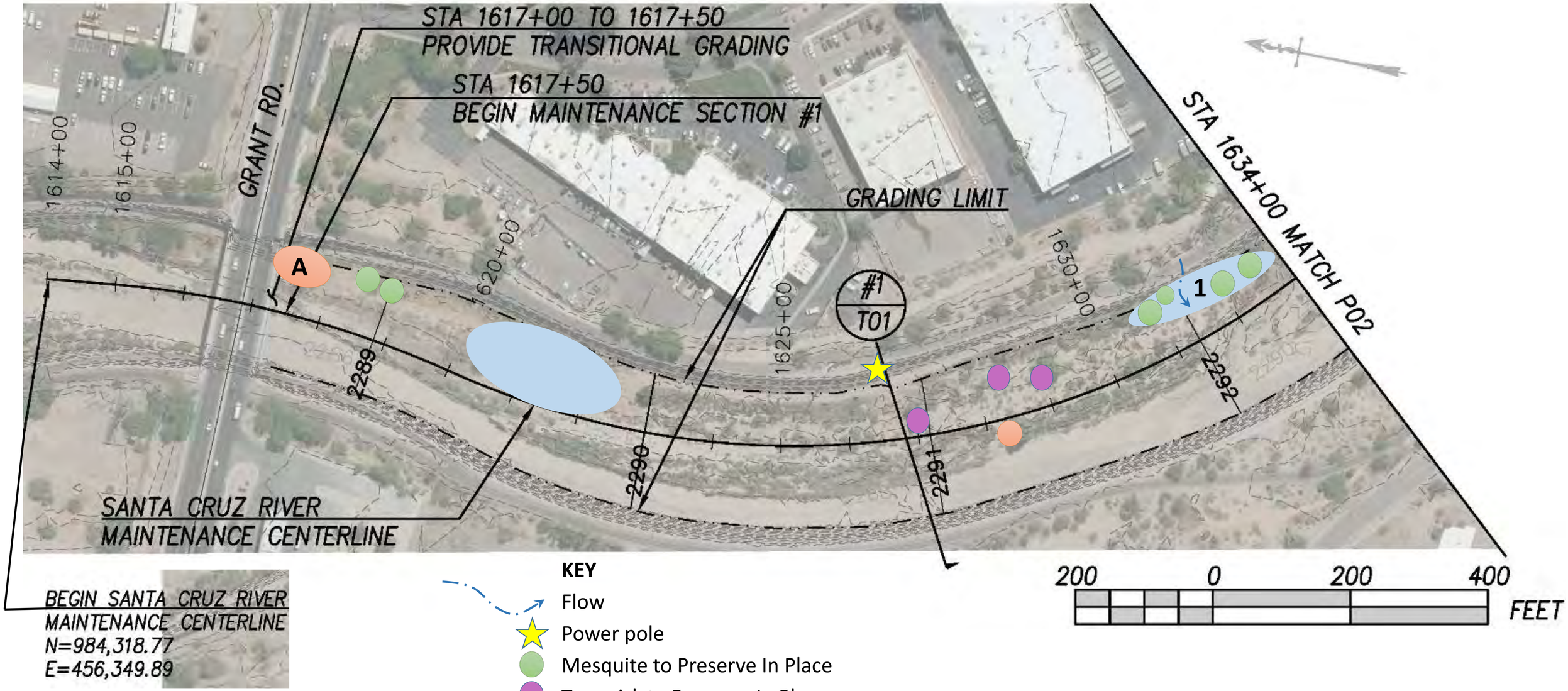
		DATE
DESIGNED	MJW/JPS	12/17
DRAWN	JPS	12/17
CHECKED	MJW	12/17
PROJ ENGR	JPS	12/17

1-800-STAKE-IT

Sheet 2 of 37

Overview Area of Vegetation Impacts

Santa Cruz Sediment Transport



KEY

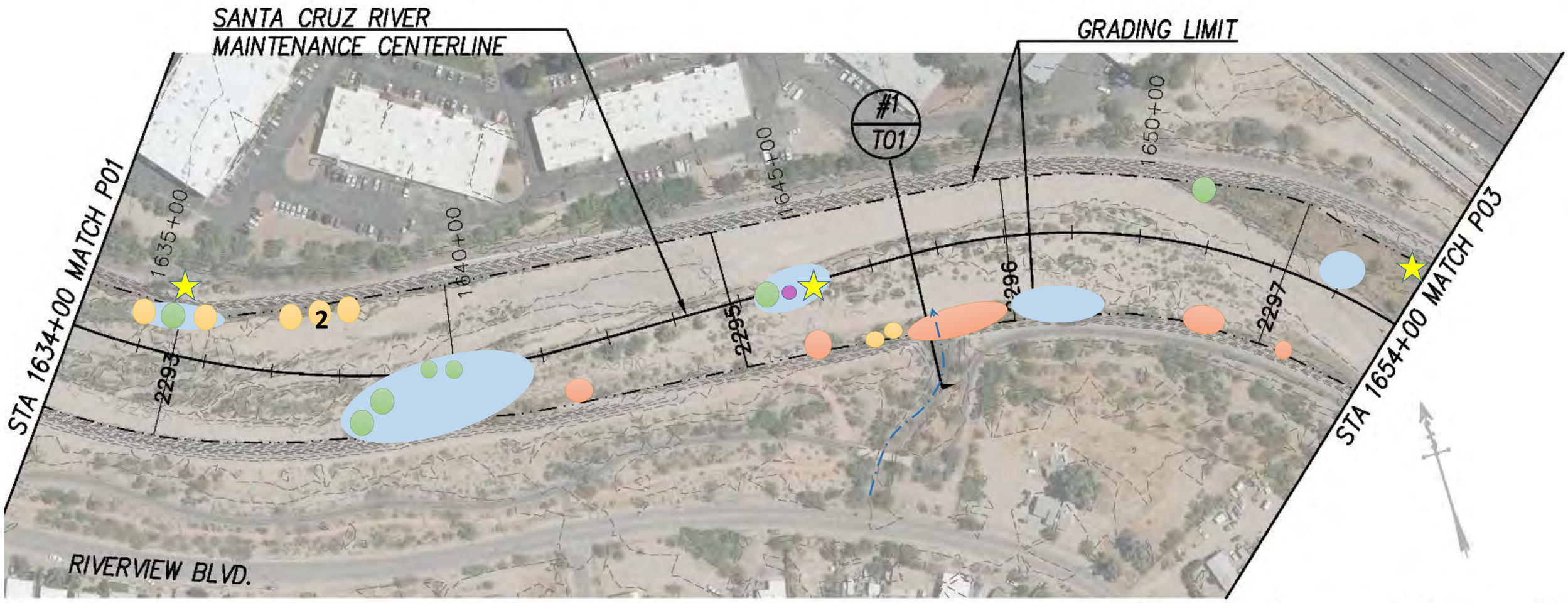
- Flow
- Power pole
- Mesquite to Preserve In Place
- Tamarisk to Preserve In Place
- Palo Verde to Preserve In Place
- Tree Grouping to Preserve In Place
- Remove (**A**=for safety)

1: If a portion of vegetation specifically blocks culvert flow, it may be removed

2: Not specimen Palo Verdes. If necessary, they can be removed.

Preserve In Place & Critical Vegetation Removals

Santa Cruz Sediment Transport



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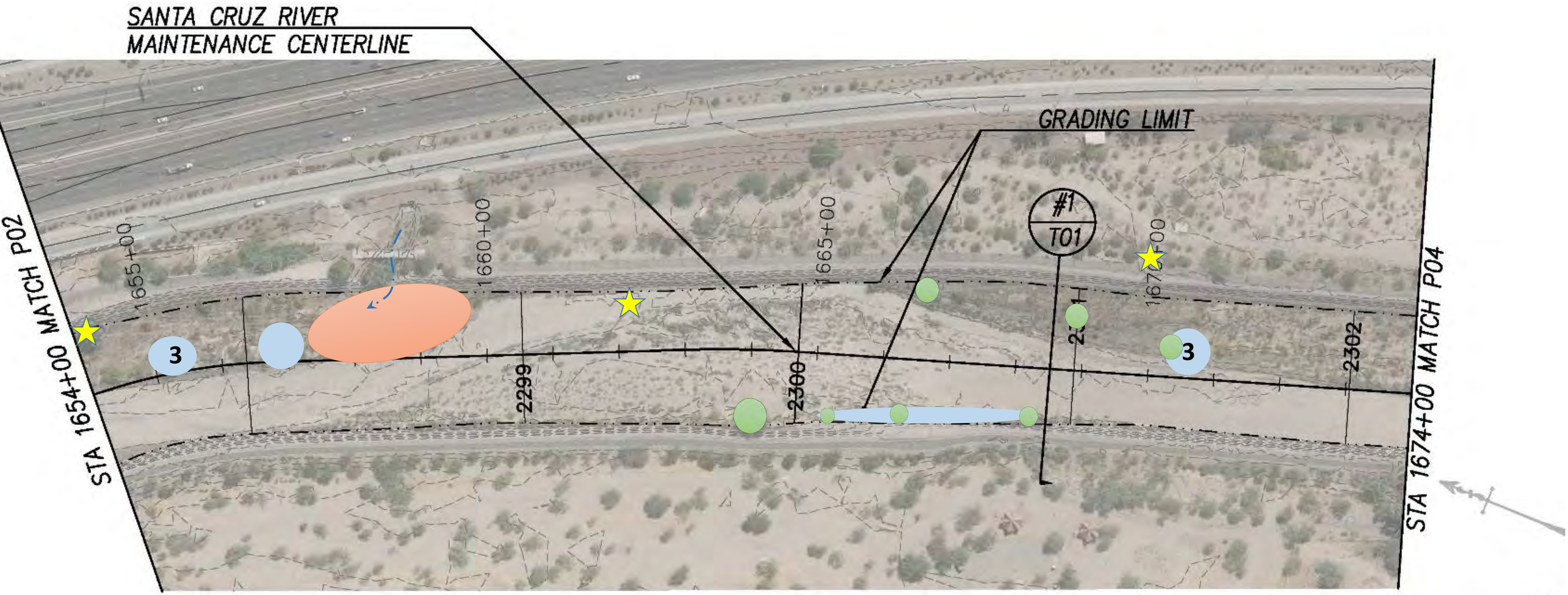
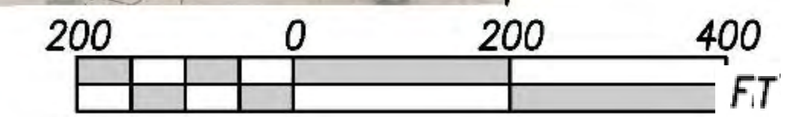
200 0 200 400

Preserve In Place & Critical Vegetation Removals

Santa Cruz Sediment Transport





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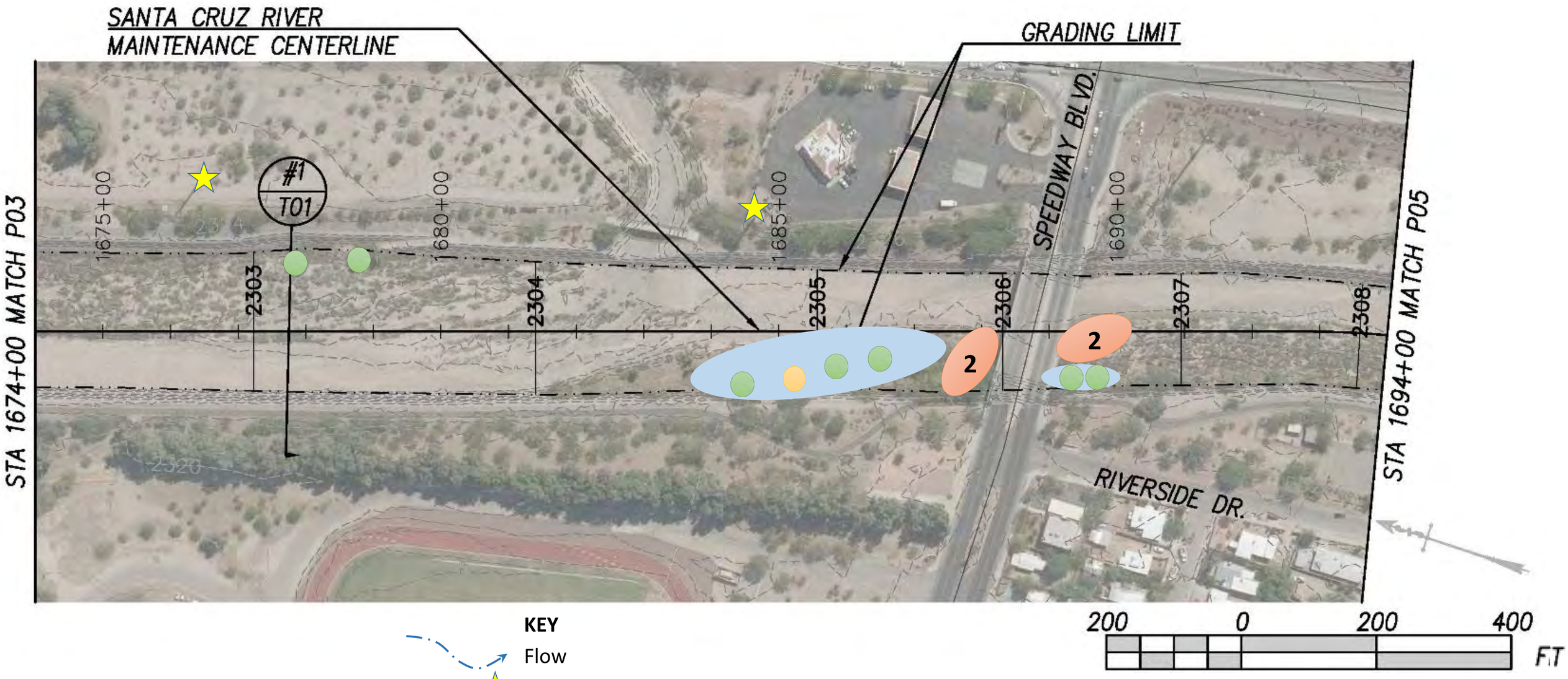
3: Nice Mesquite w/ Mexican PV. Keep if possible

Preserve In Place & Critical Vegetation Removals

Santa Cruz Sediment Transport



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