

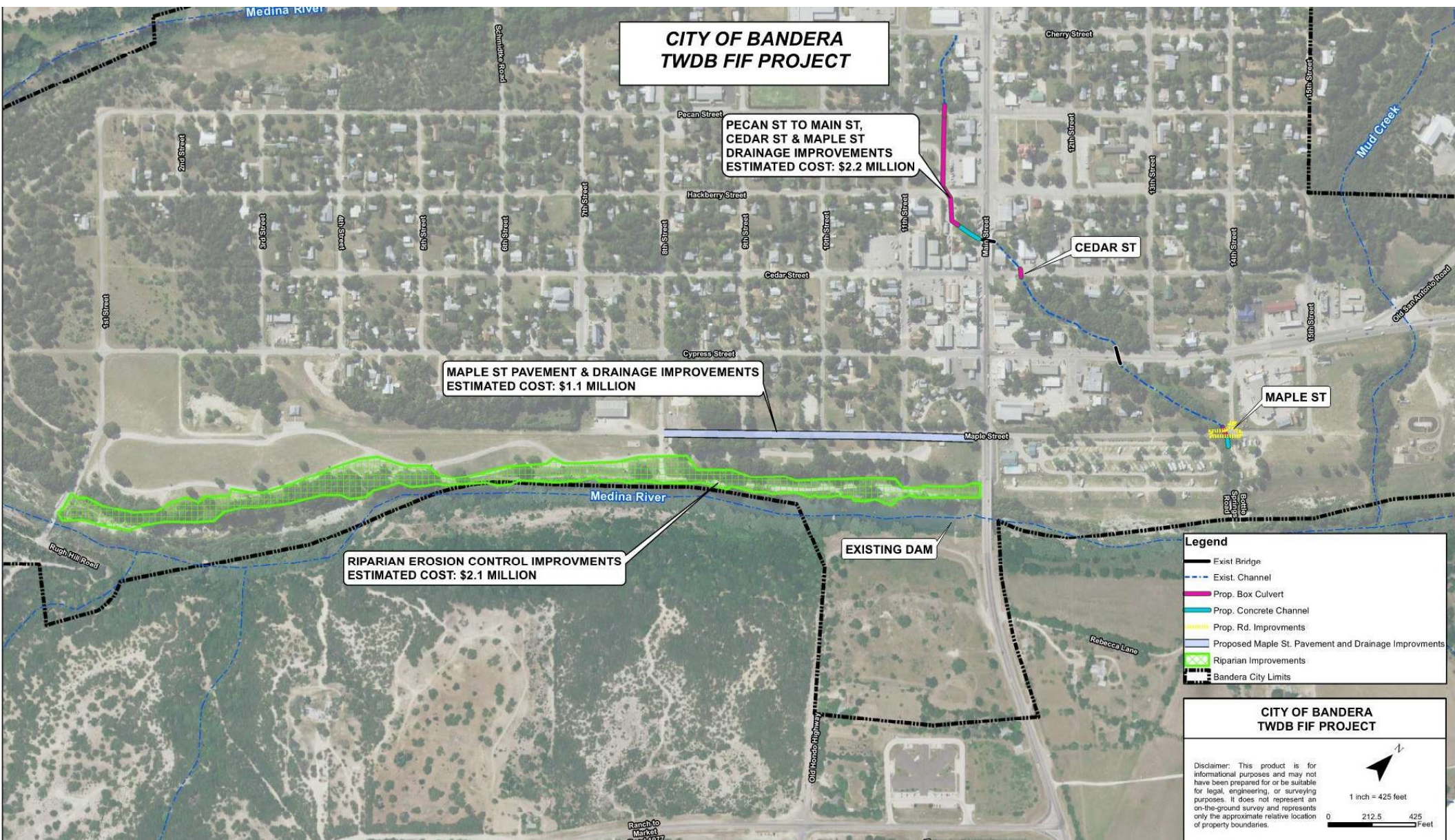
Bandera City Park

Stabilization :: Beautification :: Conservation

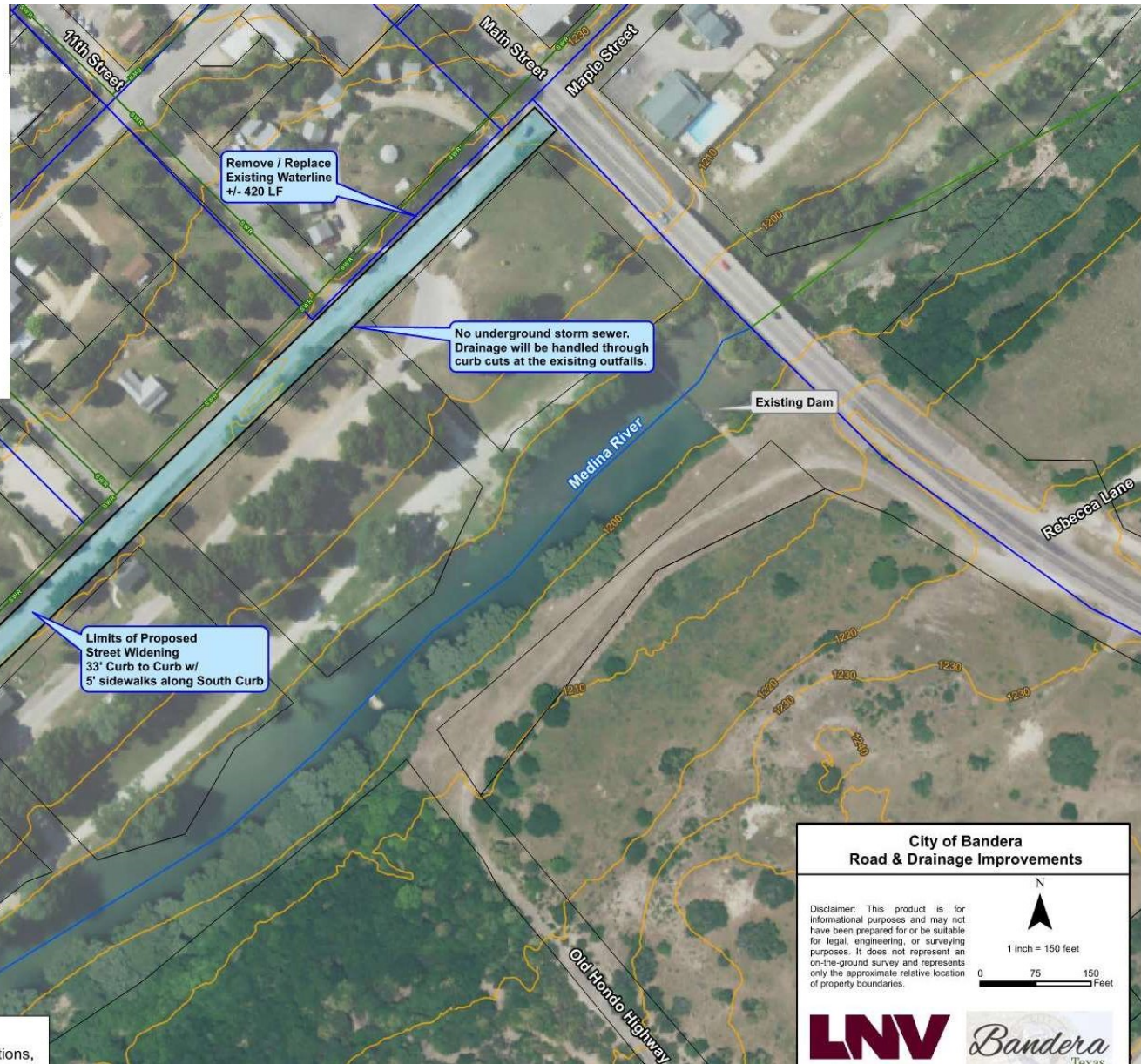
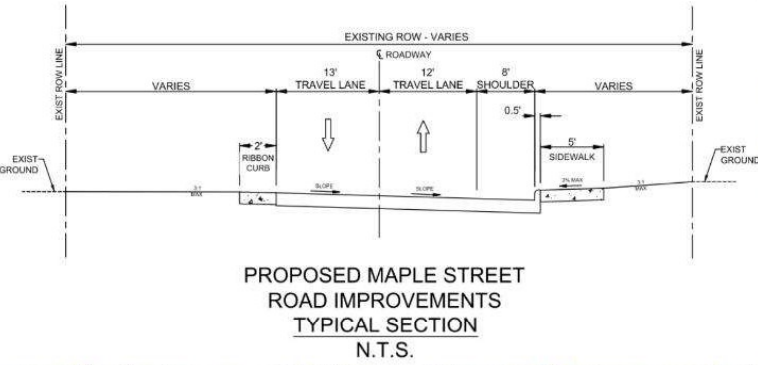


EFR Construction Budget

1. City-Wide Localized Flooding Drainage Improvements
 - Construction Cost = \$1.65 Mil
2. Maple Street Pavement and Drainage Improvements
 - Construction Cost = \$0.88 Mil
3. Bandera Park Improvements and Riparian Restoration
 - Construction Cost = \$1.75 Mil

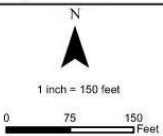


Maple Street Roadway and Drainage Improvements *Budget Cost Estimate = \$1.1 Million



City of Bandera Road & Drainage Improvements

Disclaimer: This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries.



*Budget Cost Estimate includes construction, a construction contingency, and design. This estimate does not include costs associated with easement acquisition, environmental investigations,

Recommendations for Riparian Management and Erosion Control at the Bandera City Park – Bandera, TX.

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Site Visit: March 11, 2020 with J. Horry (City of Bandera), Rebeca Gibson (City of Bandera), Levi Sparks (Bandera County River Authority and Groundwater District), Clint Carter (BCRAGD), Daniel Oppenheimer (HCA), and Ryan McGillicuddy (TPWD).

Background

The Bandera City Park is located along the Medina River in Bandera, Texas. The City manages the park based on the 2014 Bandera City Park Conceptual Park Master Plan. According to the Master Plan, the 77-acre park is situated mostly within the FEMA 100-year floodplain along approximately 1.5 miles of the Medina River. The park is a well-used asset, enjoyed by local residents as well as visitors to the Central Texas Hill Country.

On January 30, 2020, Rebeca Gibson, City of Bandera, Mayor Pro Tem, reached out to partners at the City, BCRAGD, and HCA to discuss opportunities for enhancing the park. During a conference call on February 18, 2020, local partners shared concerns with HCA related to erosion (e.g. cut-banks along the river, runoff from city streets, historic vehicle use, ongoing foot-traffic) as well as a shared interest in creating better river access for park visitors, and enhancing riparian health. The primary outcomes of this conference call were recruiting additional partners and scheduling the site visit hosted on March 11, 2020.

To date, local stakeholders have already installed fencing to keep vehicles off the river-side of the park road, installed rock features to slow down runoff, and controlled non-native, invasive *Arundo donax* (aka giant reed, river cane). The Medina River and park would benefit from additional measures, including: the creation of riparian grow zones, establishment of targeted river access areas, and storm water control measures that manage erosion by slowing and sinking runoff from the streets into the ground, rather than scouring down the hill.

Objective

Identify appropriate opportunities at the Bandera City Park to reduce erosion as well as enhance riparian and soil health, river bank stability, and public access. The following considerations include general recommendations as well as site-specific considerations discussed during the March 11, 2020 site visit.



Life's better outside.®



April 15, 2020 - ***DRAFT*** PLAN 1

Recommendations

1) Grow Zones

TPWD and HCA recommend that riparian buffers, commonly referred to as a “Grow Zones,” be established. Establishment of such riparian grow zones along the river’s edge, where disturbances (e.g. mowing, excessive foot traffic, etc.) are restricted and deep rooted native riparian plants can thrive, will provide enhanced stability, habitat, natural beauty, and ecological function. Healthy riparian zones are also more resilient than manicured landscapes and recover more quickly from disturbances and flooding. While a grow zone with a minimum width of 30 feet from the water’s edge begins to provide the optimum suite of functions, a width of even 5-10 feet will provide some degree of bank stabilization, wildlife habitat, and filtering of runoff for water quality. Dense grasses along the stream bank also protect the growth of young trees by sheltering them from wind and browsing, and also by trapping dew and water that can be delivered to the roots of young trees. Increased buffer width results in increased function, so establish as wide an area as you are comfortable with, given the stated goals and uses of the park. See Figure 1 for an example of a potential grow zone at the property.



Figure 1: Current site (left) and a mockup (right) of a riparian grow zone delineated with cedar posts. Note the targeted access point between the two grow zones in the mock-up.

Grow zones may be allowed to develop on their own simply by ceasing the source of disturbance (e.g. mowing, weed whacking, excessive foot traffic, etc.) and controlling invasive species. Alternatively, seed can be broadcast or transplants of native vegetation can be installed to jumpstart restoration, increase species diversity, or create a more manicured appearance if desired. The grow zone should be clearly marked by signage in order to inform patrons that the City is being proactive and intentional, and also to ensure that maintenance crews do not unintentionally intrude into the area. Signage with a message such as “Ecological restoration in progress” has been used in other similar areas to good effect. A low border could also be established at the edge of the grow zone using limestone, cedar logs, split rail fencing, or other natural looking material.

Please refer to the attached planting list from *Hill Country Design Guidelines* developed by the Lady Bird Johnson Wildflower Center and TPWD. The entire set of guidelines are also available at the link below in the “Additional Resources” section. Shade tolerant plants should be chosen for riparian zones with mature trees and a closed canopy. For shaded areas you can easily collect inland sea oats (*Chasmanthium latifolium*) and wild rye (*Elymus sp.*) seed from nearby and broadcast it in the late fall or early winter. Commercially available seed mixes are available from companies such as Native American Seed in Junction, TX. Their Riparian Recovery Mix is ideal for previously disturbed areas that receive partial to full sun, while the Shade Friendly Grass Mix can be used in areas that receive only shade to partial sun. Should City and local partners decide to conduct plantings or seedings

April 15, 2020 - ***DRAFT*** PLAN 2

of native vegetation, site preparation will be needed first to address compacted soils. Please refer to the “Site Preparation” chapter of the *Hill Country Design Guidelines* for more information.

2) Targeted Access

Use and enjoyment of the river is a primary function of the park. TPWD and HCA believe that recreational access to the water can continue to be supported at the current level while also reducing erosion and enhancing ecological function. This can be achieved using targeted access points that lead to the river that are interspersed with grow zones in between. The location of access points will be determined by a variety of considerations: existing infrastructure, compacted areas deemed appropriate “sacrifice” area for continued access, and places where the river-bank is not an overly steep cut-bank.

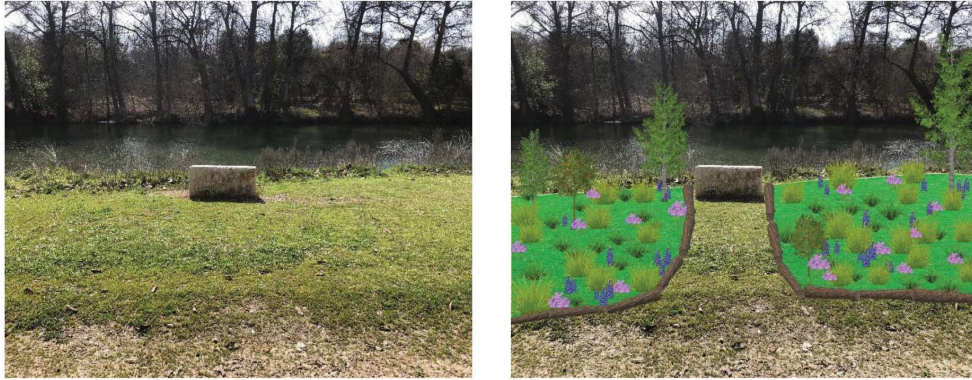


Figure 2: Current site (left) with a stone bench placed for recreation and a mockup (right) demonstrating the incorporation of riparian grow zones and a targeted access point for fishing. The width of access points will vary, depending on the use.

Ideally, each access point should not require more than 20 feet of length along the stream. The precise number, size, and location of access points and trails should be determined by the City based on the stated goals related to access, riparian health, and managing erosion. Blue Hole Regional Park in Wimberley is an excellent example of a high use area that provides access to the water’s edge while maintaining native riparian areas in between (see Figure 3).

Figure 3: Targeted access points interspersed with riparian buffers at Blue Hole Regional Park, Wimberley, TX. Most targeted access locations at Bandera City Park should not require hardscaping, which should be limited to areas with the most intensive use where bank stability is a concern. Photo courtesy of Design Workshop, Inc.



3) Woody Material

To the extent practicable, leave limbs and woody material in the creek and along the banks in the Grow Zones. These provide structure, trap sediment, and help to build the banks of streams that have previously widened from erosion. Wood within the channel also serves as fish habitat and refuge, and on the riverbank can act as a cage, protecting the growth of young trees from herbivory. This strategy may be especially well-suited for the far-western portion of the park that encompasses the Frisbee golf course.

4) Plantings along the Water’s Edge

While much of the riparian corridor in the park is a cut bank, there are periodic micro-sites that provide opportunities to plant along the water’s edge. Native plants could be installed where needed to promote stability and provide aesthetic appeal. Near the water’s edge where the soil stays relatively saturated, native plants such as Emory sedge (*Carex emoryi*), sawgrass (*Cladium mariscus*), white-top sedge (*Rhynchospora colorata*), spikerush (*Eleocharis montevidensis*), buttonbush (*Cephalanthus occidentalis*), and black willow (*Salix nigra*) could be transplanted to enhance stability. Care should be taken to only use plants sourced from the same watershed if possible. Most are easily transplanted if found nearby. The park has several sources of black willow that can provide dormant-season cuttings. See HCA’s enclosed *Riparian Planting Guide* for additional strategies and considerations.

If there are areas from which you wish to exclude people in a more passive manner, native plants such as sawgrass (*Cladium mariscus*) and dwarf palmetto (*Sabal minor*) are attractive yet abrasive enough to deter visitors from trampling the area. These can be planted along the border of a grow zone.

Transplant method: Some native plant material may be available as cuttings from onsite sources, or from other nearby landowners. Find a healthy stand and cut down into the soil with a sharpshooter shovel or sturdy gardening trowel to remove a plug from the edge of the plant. For smaller plants like spikerush and white-top sedge a 2”x 2” plug will do, and for Emory sedge about 4”x 4”. For sawgrass or switchgrass, a gallon sized cutting can be taken from a healthy stand, but smaller will work as well. Transplant these close to the water’s edge where they can keep their roots in moist soil. Water when first transplanted. For commercial stock, try calling a nearby nursery and ask what native sedges they might have available. See HCA’s enclosed *Riparian Planting Guide* for additional strategies and considerations.

5) Plantings in the Transitional Zone

Given the extensive cut-bank, opportunities for planting along the water’s edge will be limited. Should the City and local partners decide to conduct plantings or seedings to jumpstart recovery, greater opportunities exist to plant along the drier, upper terrace (i.e. where grow zones will be established), which is multiple feet above the river. When considering appropriate native species to plant on the cut banks, more facultative species (those that can tolerate both wet and non-wet conditions) should be considered. These could include facultative trees such as green ash (*Fraxinus ylvatica*), Texas ash (*Fraxinus albicans*), pecan (*Carya illinoensis*), Eve’s necklace (*Styphnolobium affine*), cedar elm (*Ulmus crassifolia*), and red mulberry (*Morus rubra*). Several additional species can be found in the *Your Remarkable Riparian* guide received during the site visit. Grasses may include Lindheimer muhly (*Muhlenbergia lindheimeri*) and switchgrass (*Panicum virgatum*). See HCA’s enclosed *Riparian Planting Guide* for additional strategies and considerations.

Given conversations about local Axis and white-tailed deer populations, as well as observed signs of browsing and deer scat in the park, City and local partners should consider installing protecting caging around trees that are planted in the grow zones.

6) Upland Management and Erosion Control

The health of rivers and streams is directly related to the management of upland areas within the watershed. Slowing water as it traverses the land and allowing it to sink into the soil has a number of benefits, including:

creating more stable streams by reducing the erosive force of water before it reaches the channel; reducing peak flow events and flooding; promoting the growth of grasses and the formation of healthy soils; increasing groundwater recharge; and potentially increasing base-flow and spring-flow in creeks. Vegetation is a primary means of slowing water on the landscape, but in certain circumstances additional physical structures may be needed. Features such as rock rows, woody debris, and swales and berms can be installed on contour (perpendicular to the slope of the land) to slow water, and also help to build the soil profile of hill sides. TPWD does not recommend the use of rip-rap, gabions, or other hard structures. The Hill Country Alliance has developed a useful guidance document titled “*Hill-side Stewardship: Reducing erosion, establishing vegetation, & enhancing water catchment*” that offers more detail on these structures. It is attached at the end of this report.



Figure 4: Current site (left) and a mockup (right) demonstrating how cedar logs can be placed along contour line to slow and sink water and trap sediment to build soil and enhance vegetation along hillsides.

The Bandera City Park is experiencing significant issues with stormwater runoff that originates from offsite sources (see Figure 5). Stormwater is conveyed as surface flow from several streets. Additionally, several culverts convey stormwater to the park where they then run into ditches that flow to the river. Erosion and scour along the ditches are evident.



Figure 5: Examples where stormwater runoff is causing erosion from the top of the park down to the river.

Solutions to this problem may include a mix of strategies sourced from “low impact development (LID)” and permaculture practices, which mimic natural process to allow for infiltration and evapotranspiration of stormwater (see links in the “Additional Resources” section below for more detailed information on LID and permaculture practices). On-site, a number of strategies may be assessed to slow and sink water. Potential tools may include

the use of: bioswales (aka rain gardens), vegetated berms, rock structures (e.g. one-rock dams, media lunas, zuni bowls rock run-down at the head cut), and Yeomans Keyline plow. The installation of bioengineered or LID features should be performed in consultation with an engineer, landscape architect, or other experienced stormwater professional. Additionally, the City should consult with the city and local floodplain administrator to determine what permits or authorizations are required to conduct such work.

9) Invasives

A number of non-native, invasive plants (e.g. *Arundo donax*, Brazilian vervain, and *Ligustrum*) were observed during the site visit. Priority should be given to continued monitoring of the *Arundo donax* to determine if any follow-up spot treatments are needed. Please refer to the invasives guide that was included in the *Your Remarkable Riparian* packet for additional information about non-native, invasive species.

10.) City Assistance

TPWD and HCA will continue to work with the City and BCRAGCD to identify potential resource experts and sources of funding to help offset the costs.

Should the City want greater support (e.g. formal planning, facilitation, and coordination), we recommend they contact the National Park Service’s River, Trails, and Conservation Assistance Program. Ericka Pilcher (RTCA_Apps_IMR@nps.gov) is the program manager for Texas. Both HCA and TPWD would be happy to write letters of support for a City application to the program for free NPS program support.

11.) Site-Specific Discussions

The following section outlines specific topics discussed at several sites within the park during the March 11, 2020 site visit.

- A. Moderate to severe erosion is evident at the large culvert site near the treated *Arundo donax*. Partners discussed establishing both a riparian grow-zone extending from the river’s edge to the main trail (i.e. paralleling the river), as well as a grow zone on either side of the gully and culvert (i.e. perpendicular to the river). Fencing may be added on either side of the gully to help establish a grow zone and keep people out of this potential safety hazard. Properly sized and situated rock structures (e.g. one-rock dams) may also be considered for addressing erosion within the gully;
- B. At the 7th Street Site, partners discussed making this an ADA-accessible ingress down the hill;
- C. At the bottom of the 9th Street Site towards the river, partners discussed the need for establishing a grow zone, adding rock structures to slow and sink water, raising the cutting height when mowing, and creation of switchbacks for public access. At the top of the site, partners discussed using rock-structures (e.g. one-rock dams, media lunas) to slow and sink water on both sides of the dumpster;
- D. At the bottom of the 10th Street Site, partners discussed re-directing foot traffic downstream and away from this area as part of an effort to establish soil and grasses; additional interventions for the gully (e.g. well designed and properly sited rock-structures, re-shaping) were also discussed. At the top of the site, partners discussed the existing rock structure and that this site provides more room than the 11th Street Culvert for creating rock-structures (e.g. one-rock dams, media lunas) to slow and sink water
- E. Downstream of the last picnic table, partners discussed maintaining a narrow path to be used both by RV Park users accessing the park as well as users visiting the memorial site, then changing mowing prescriptions around the trail by raising the cutting to at least 6 inches.
- F. Where the City decides to designate grow zones, there may be a need to relocate existing infrastructure (limestone benches, tables) to other areas.
- G. At the 11th Street site, partners discussed options for slowing and sinking water coming from the street down into the park, especially given the limited space; one option, with careful calculations of current and projected drainage, would be to create a bioswale/rain garden between Maple Street and the start of culvert in the park. This would require engineering expertise.

- H. Partners did not identify appropriate measure at two sites on the west-end of the park (e.g. Pebble Beach). Perhaps partners experiment with and adapt methods on the east-side of the park, then tailor those strategies to these sites applying lessons learned and adaptive management from work on the east-end of the park.

Additional Resources

- *Hill Country Design Guidelines*: Plant list (enclosed), full resource available online at https://tpwd.texas.gov/publications/nonpwdpubs/media/hill_country_design_guidelines.pdf
- *Your Remarkable Riparian*: <http://texasriparian.org/resources/your-remarkable-riparian/>
- Austin Grow Zones: <http://www.austintexas.gov/creekside>
- Native American Seed Company: <http://www.seedsource.com>
- *Rain Gardens for Stormwater Management*: <http://water.tamu.edu/files/2013/02/stormwater-management-rain-gardens.pdf>
- Low Impact Development (LID): <https://www.epa.gov/nps/urban-runoff-low-impact-development>
- HCA's Riparian Planting Guide (enclosed)
- HCA's Hillside Stewardship Guide (enclosed)



PLANNING PHASE CONCEPT PLAN



ZONE B

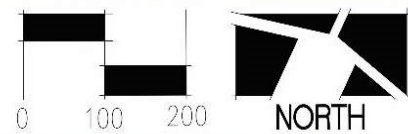
PASSIVE WATER BASED RECREATION

ZONE A

ACTIVE WATER BASED RECREATION



ZONE A





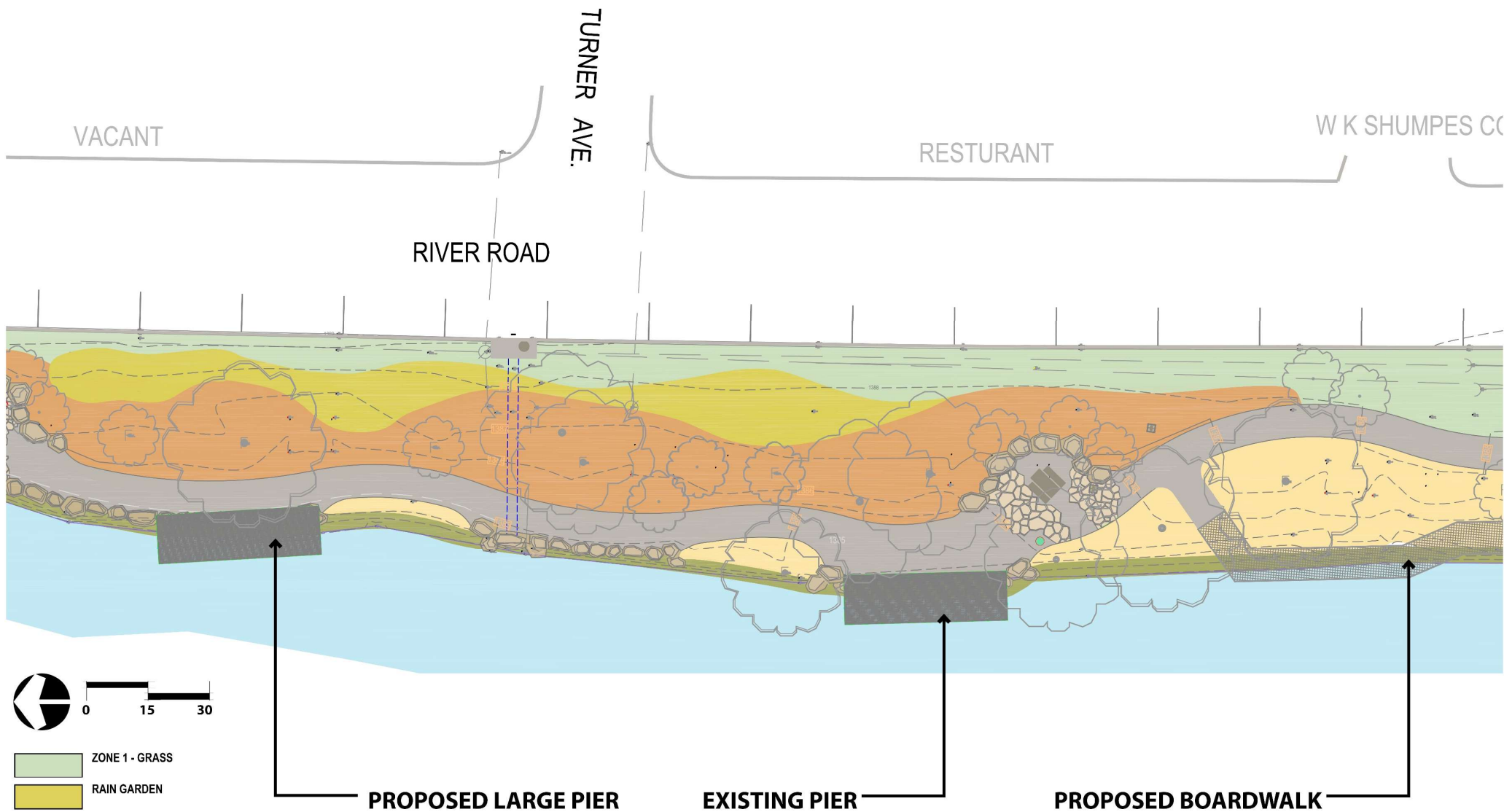






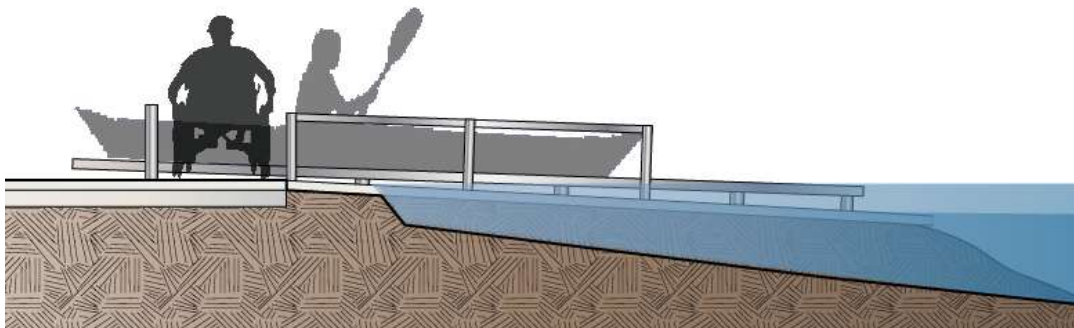
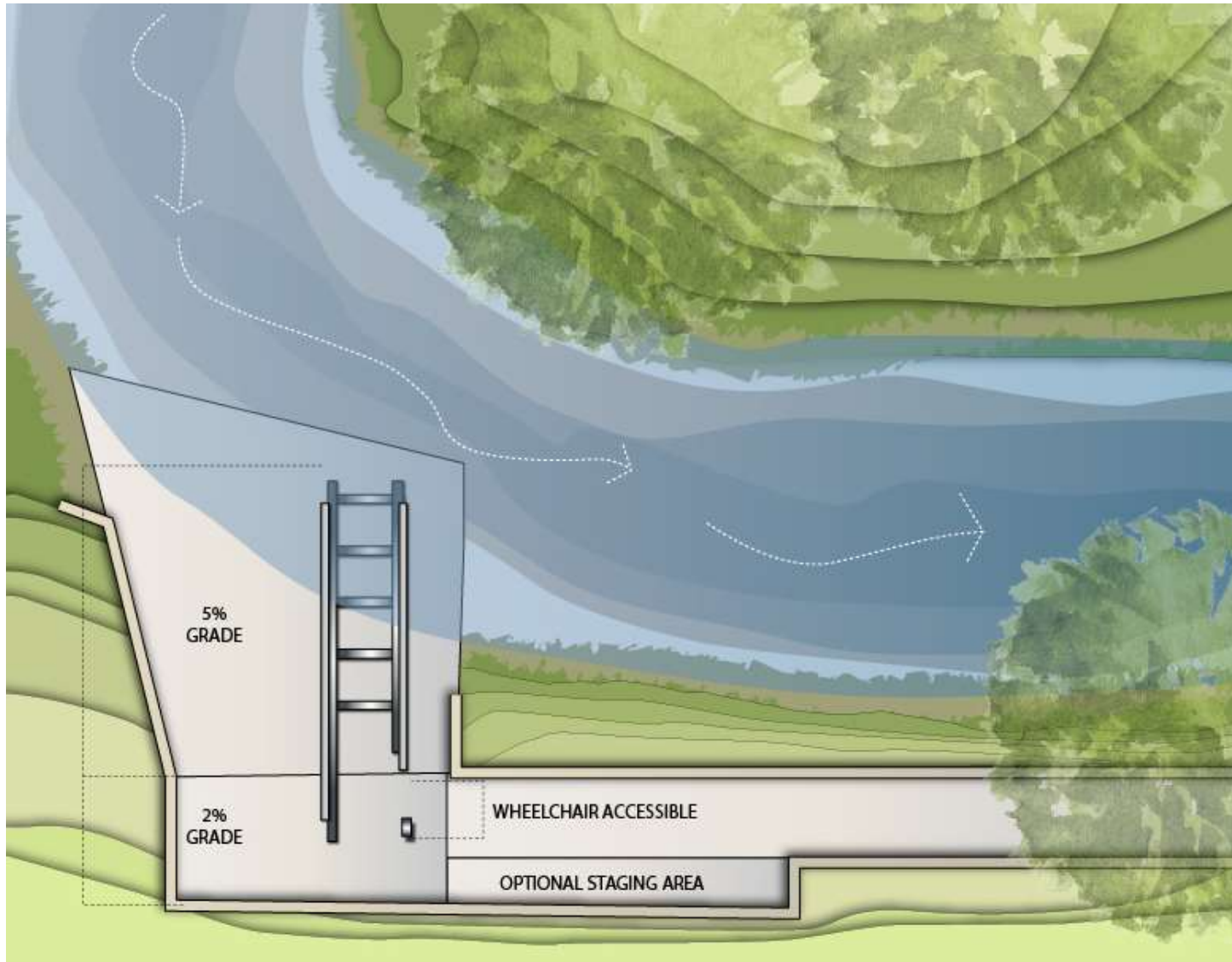






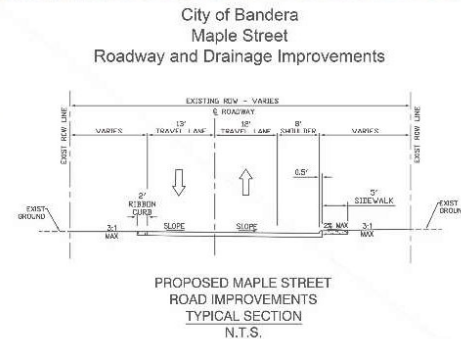
- ZONE 1 - GRASS
- RAIN GARDEN
- ZONE 2 - UPPER STREAM BANK
- ZONE 3 - LOWER STREAM BANK ABOVE HORIZONTAL
- ZONE 4 - LOWER STREAM BANK VERTICAL



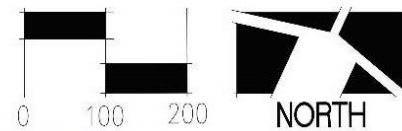


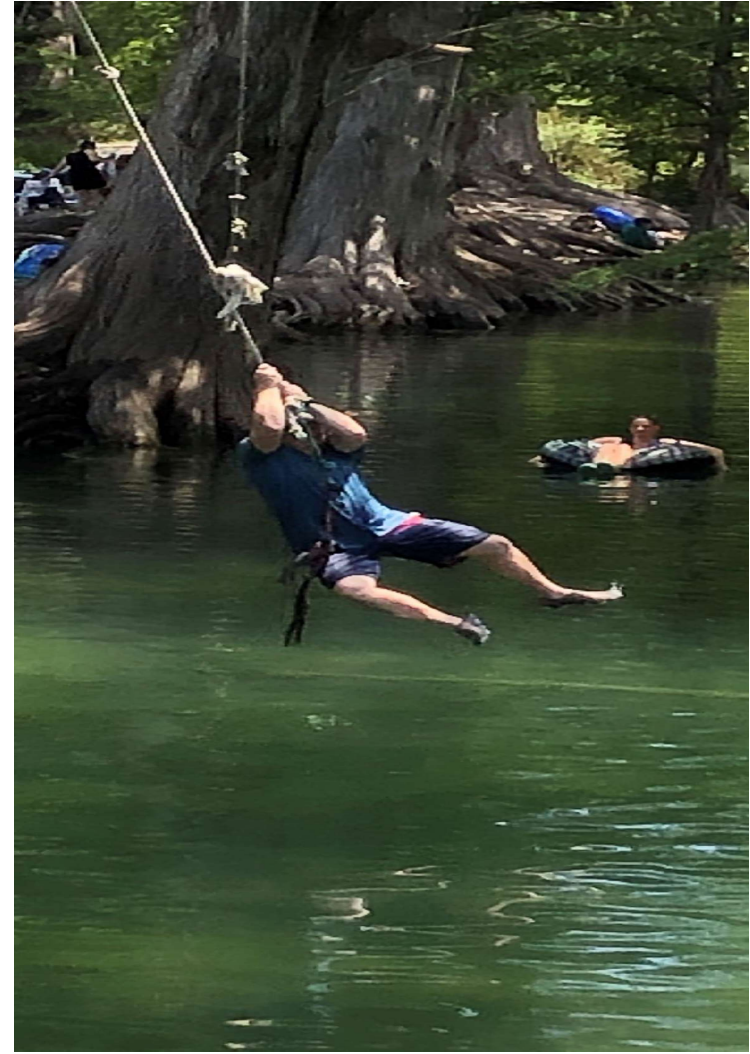
LEGEND

- (A) RIPARIAN RESTORATION
- (B) BIO-SWALES
- (C) CONCRETE TRAIL
- (D) ELEVATED WALK
- (E) WATER ACCESS POINTS
- (G) ENTRY DRIVE CANOE / KAYAK DROPOFF
- (H) LANDING FOR CANOE / KAYAK LAUNCH
- (I) IMPROVED PARKING



ZONE B

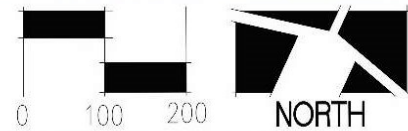








CITY PARK :: BANDERA, TEXAS





Rain Lily



Copper Iris



Eastern Goldeneye



Mexican Feather Grass



Inland Sea Oats



Seep Muhly



Zigzag Iris



Arapaho Muhly



Little Bluestem



Sideoats Grama



Creek Sedge



Lindheimer Muhly



Cedar Sedge



Texas Sacahuista

BANDERA CITY PARK RIVER BANK STABILIZATION GRASSES



Purple Trailing Lantana



New Gold Lantana



Pink Chintz Creeping



Straggler Daisy

BANDERA CITY PARK
RIVER BANK STABILIZATION
GROUND COVERS



Agarita



Dwarf Wax Myrtle



Turks Cap



Blackfoot Daisy



Plateau Goldeneye



Button Bush

BANDERA CITY PARK
RIVER BANK STABILIZATION
SHRUBS



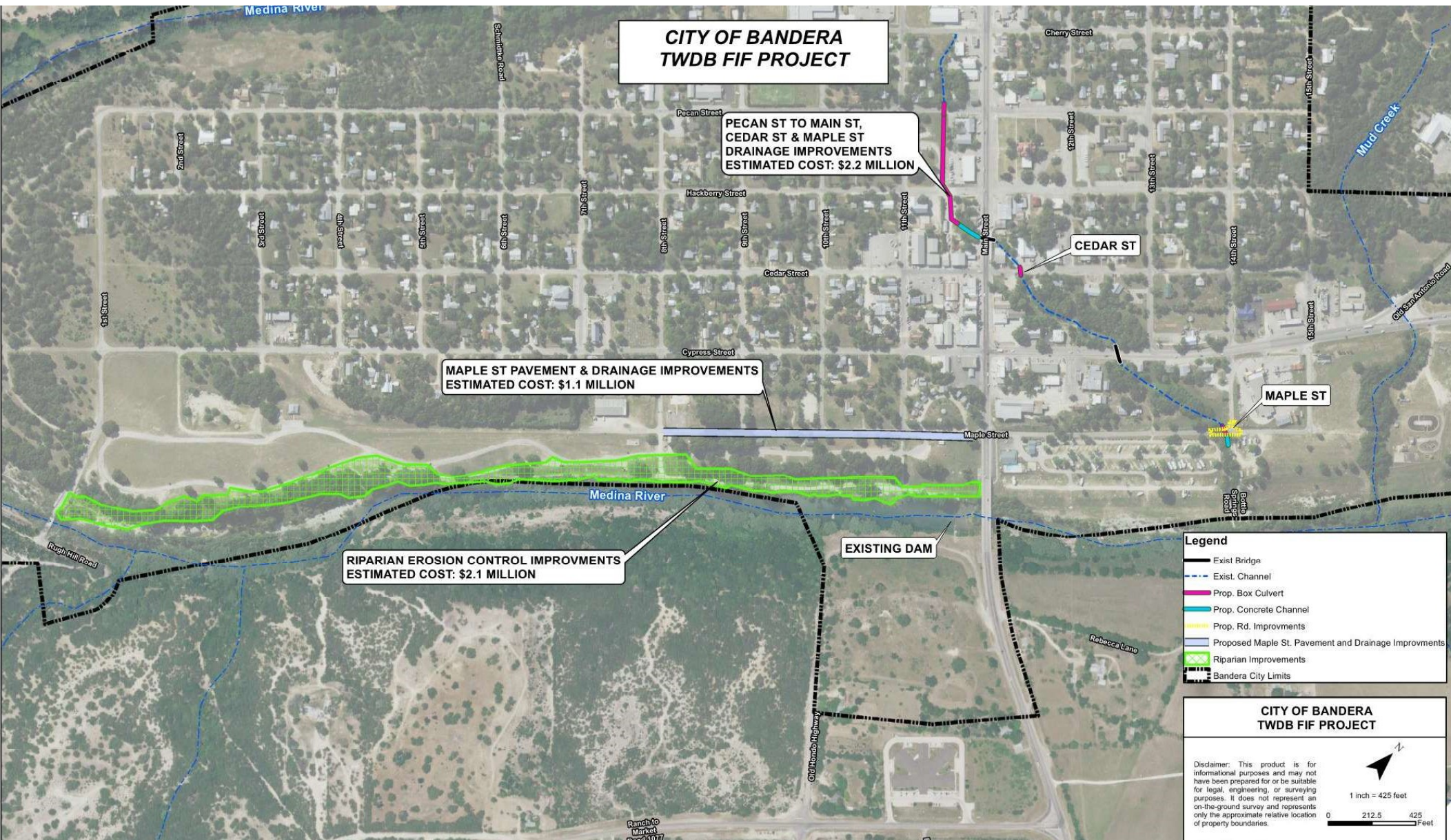
Red Yucca



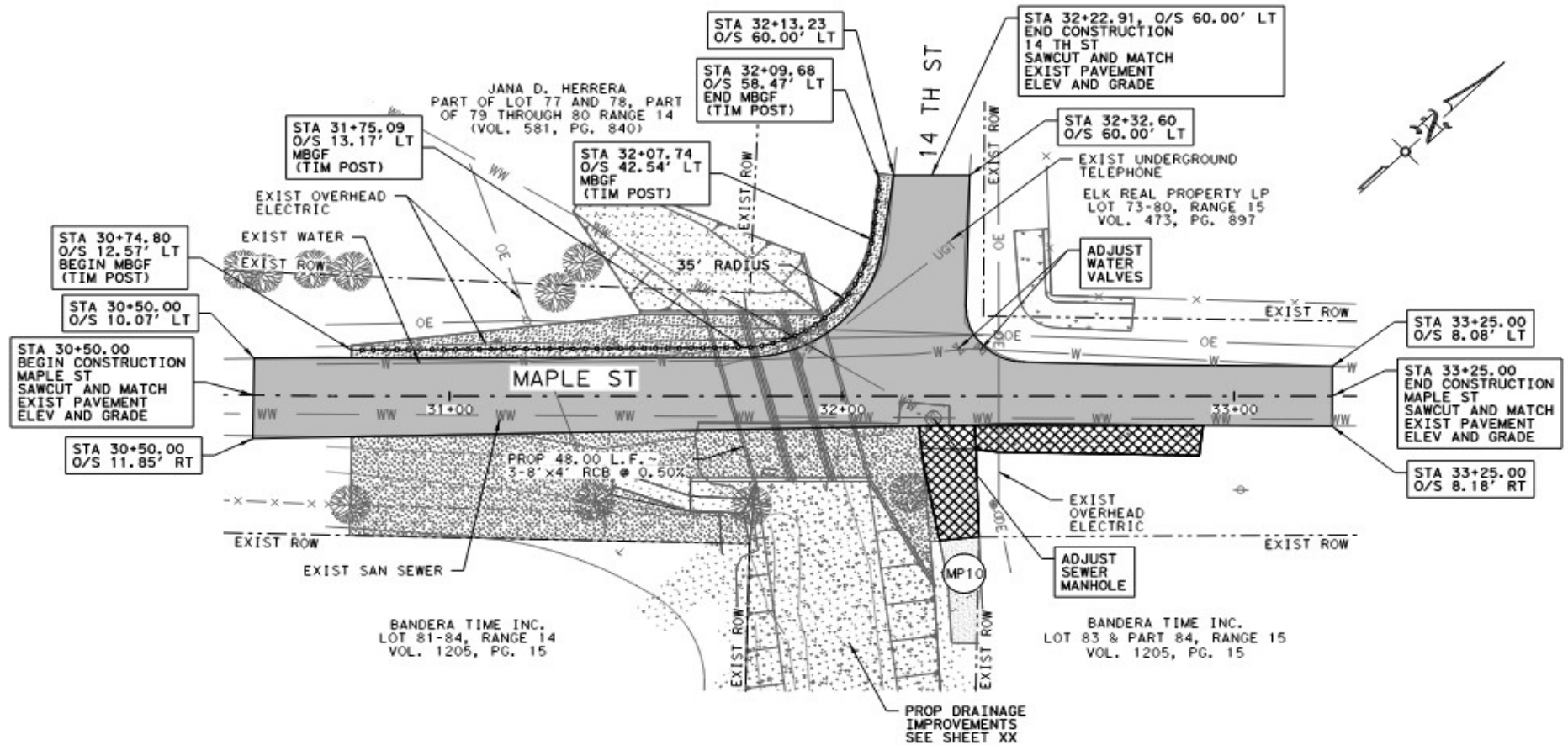
San Angelo Yucca

BANDERA CITY PARK
RIVER BANK STABILIZATION
SUCCULENT PLANTING

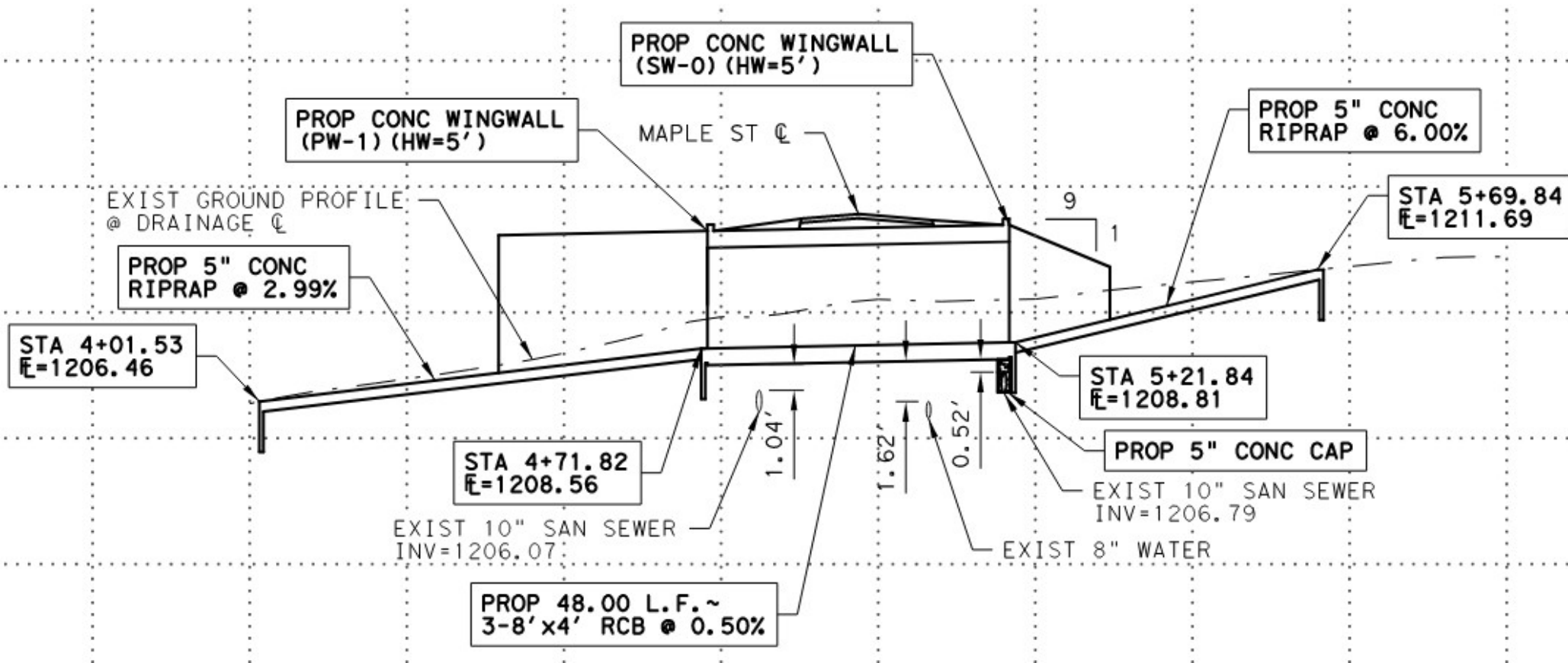
DESIGN PHASE



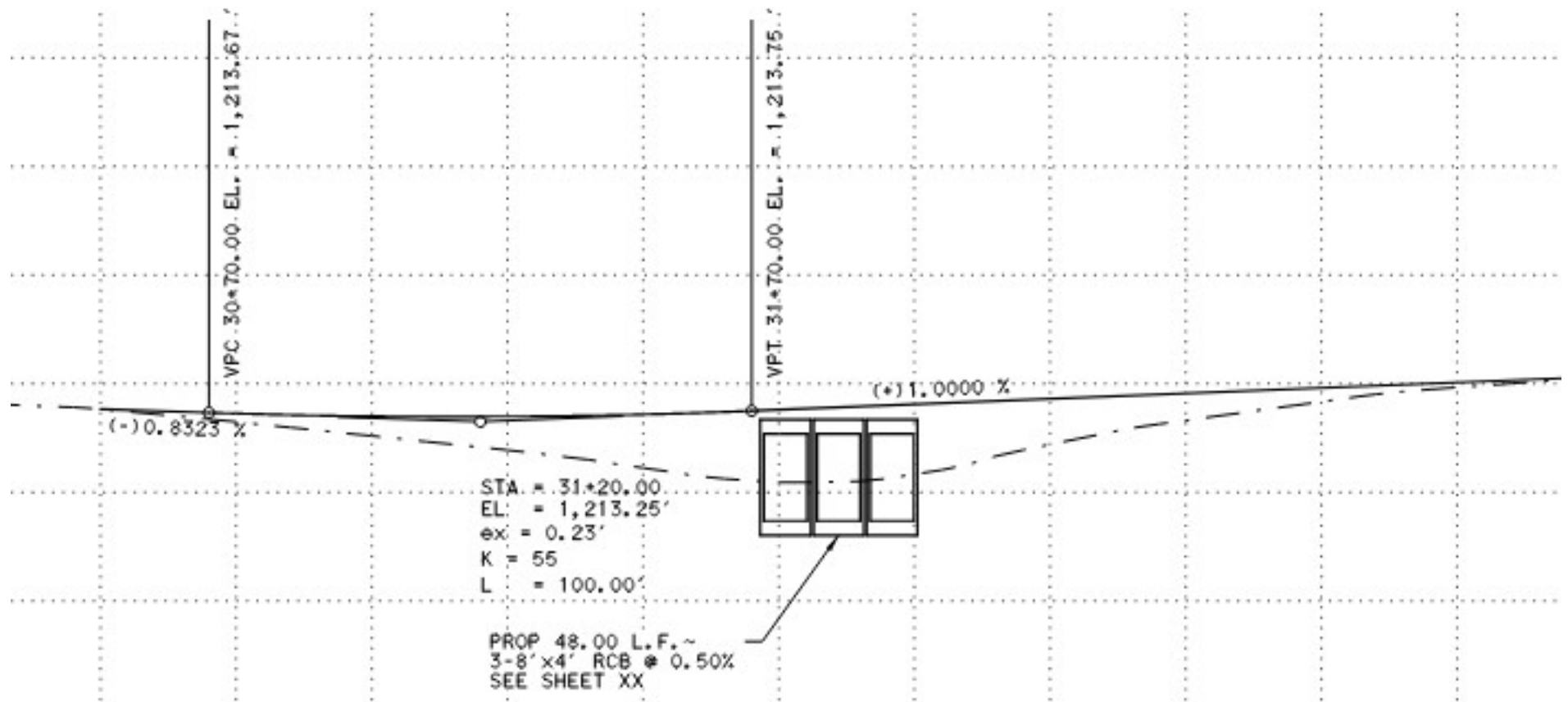
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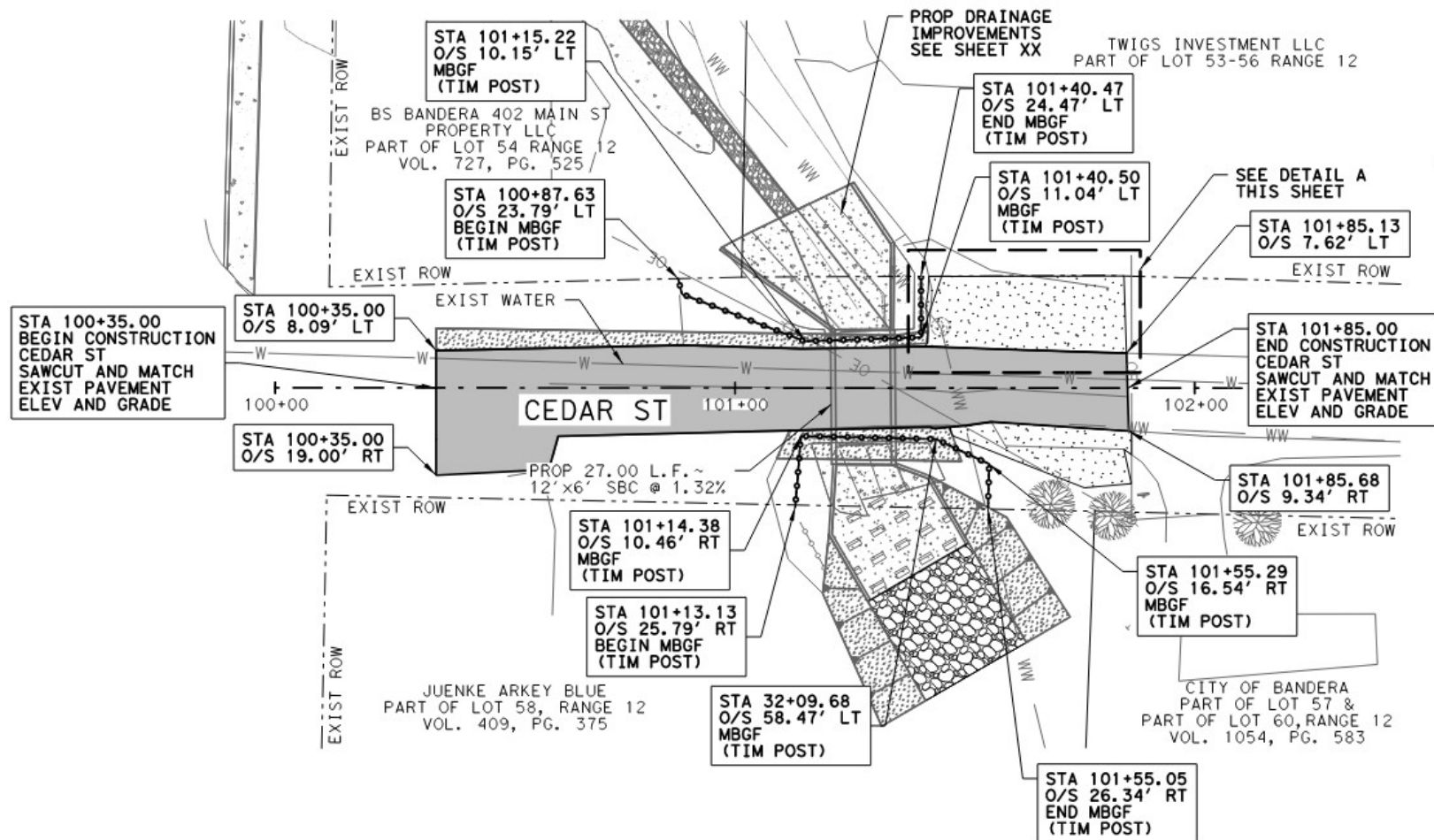
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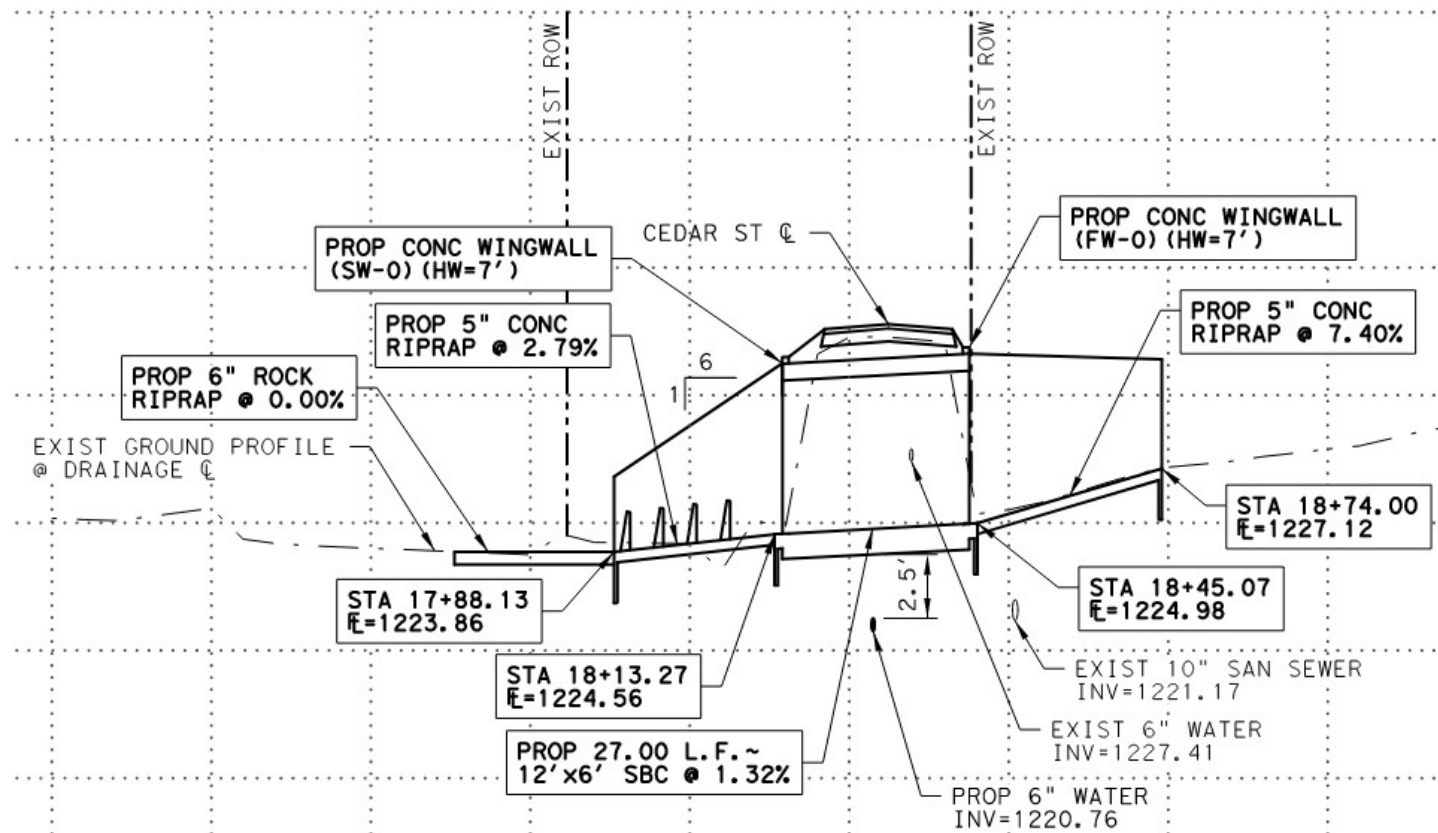
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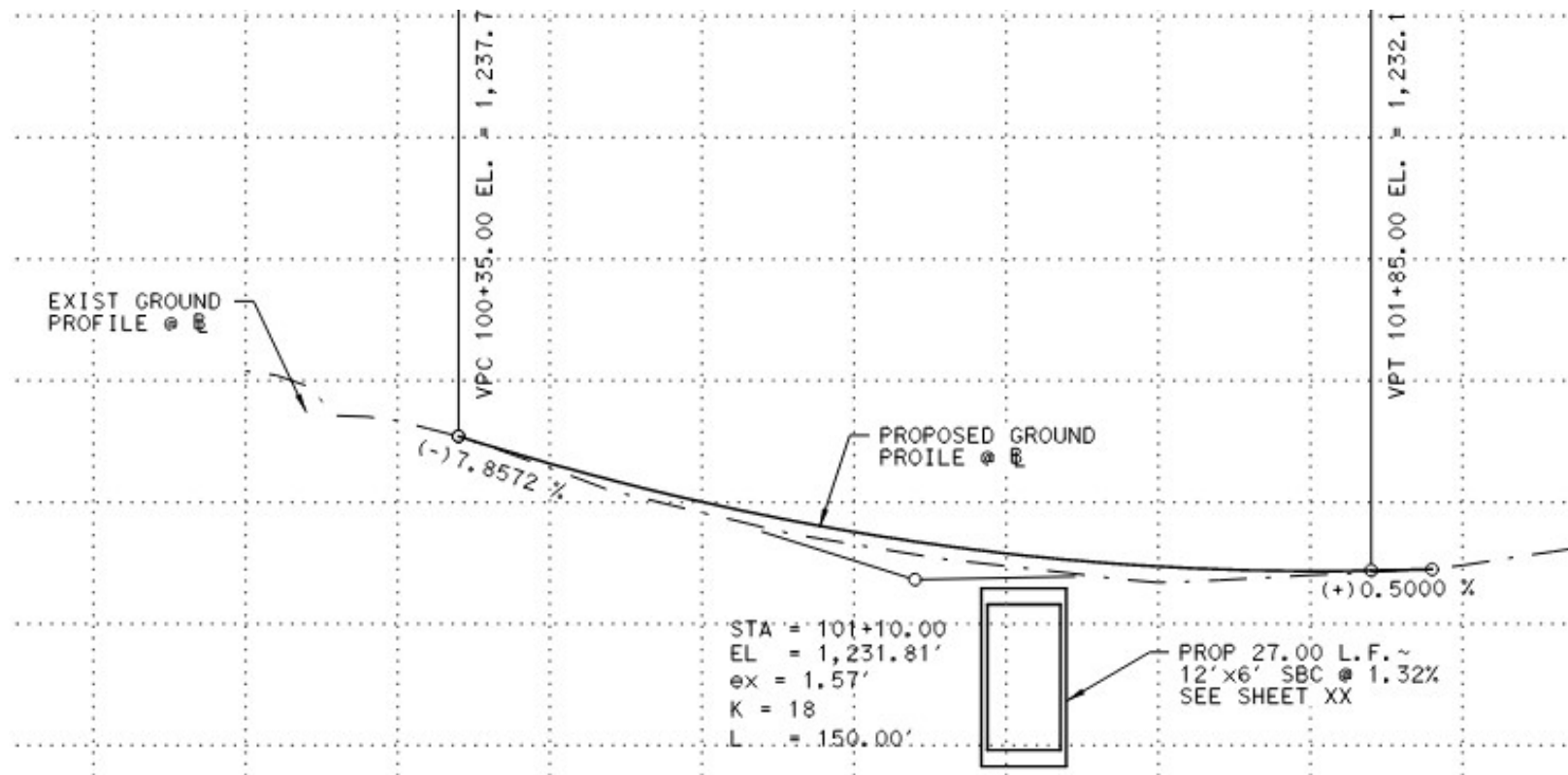
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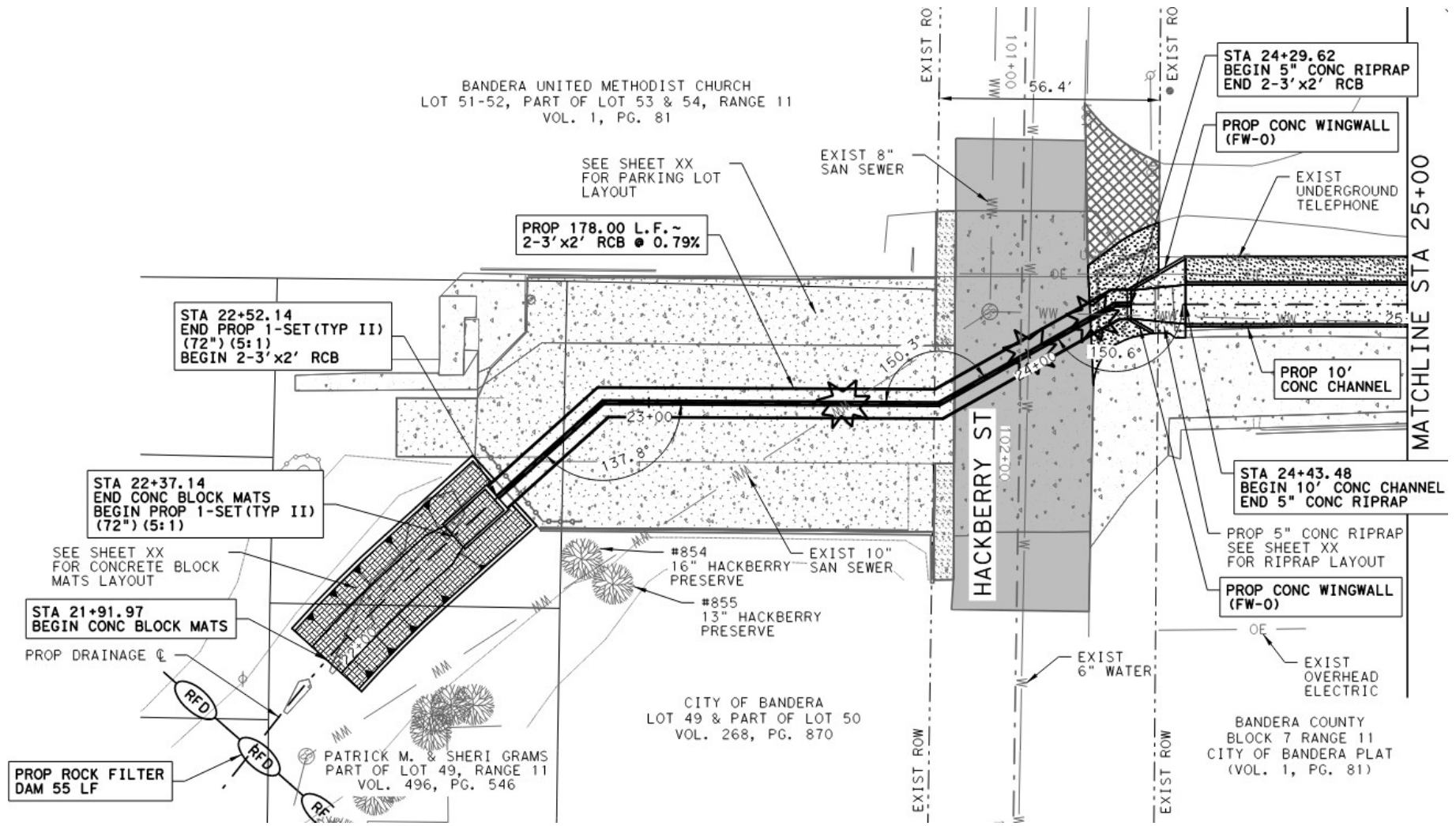
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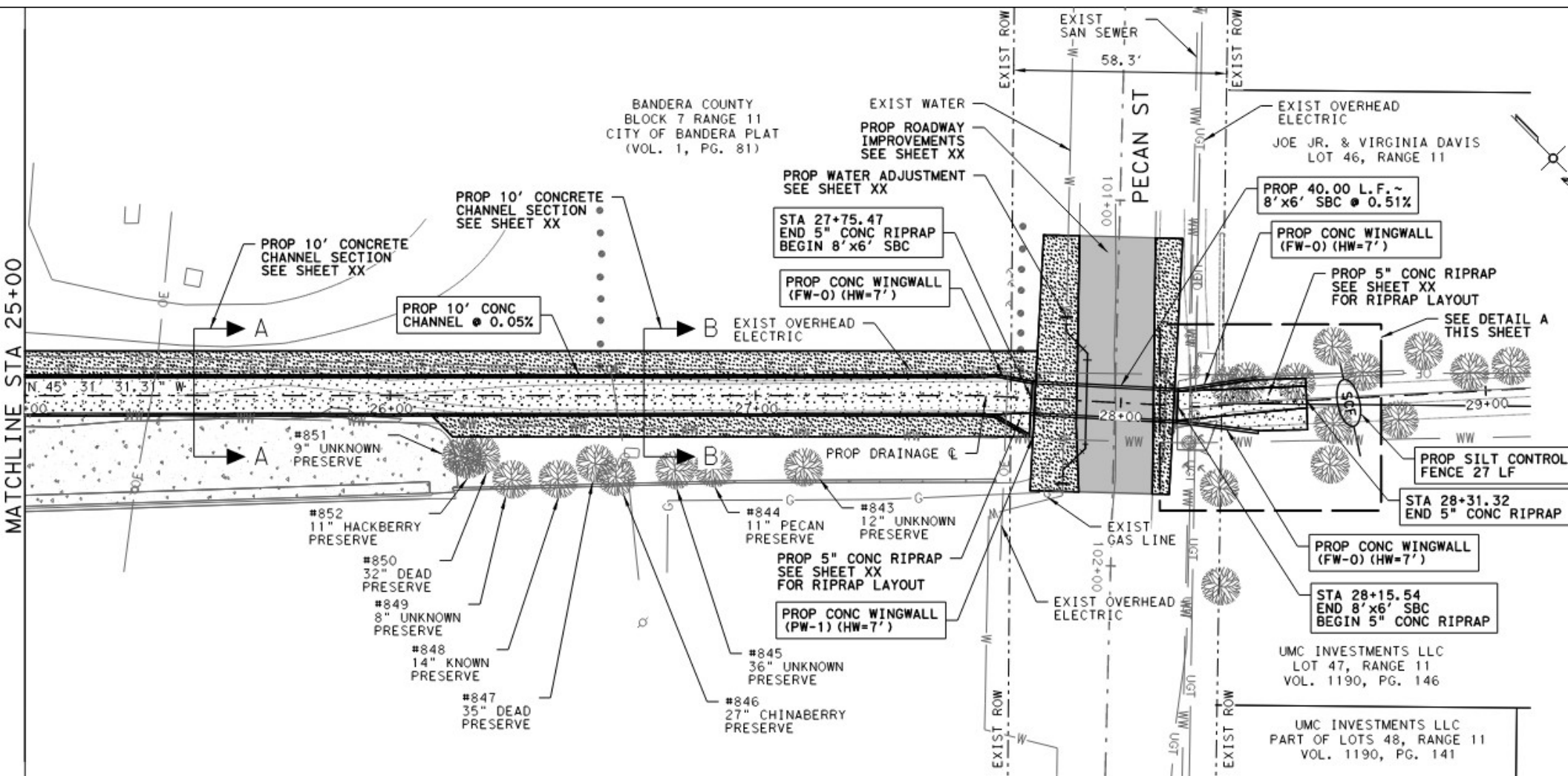
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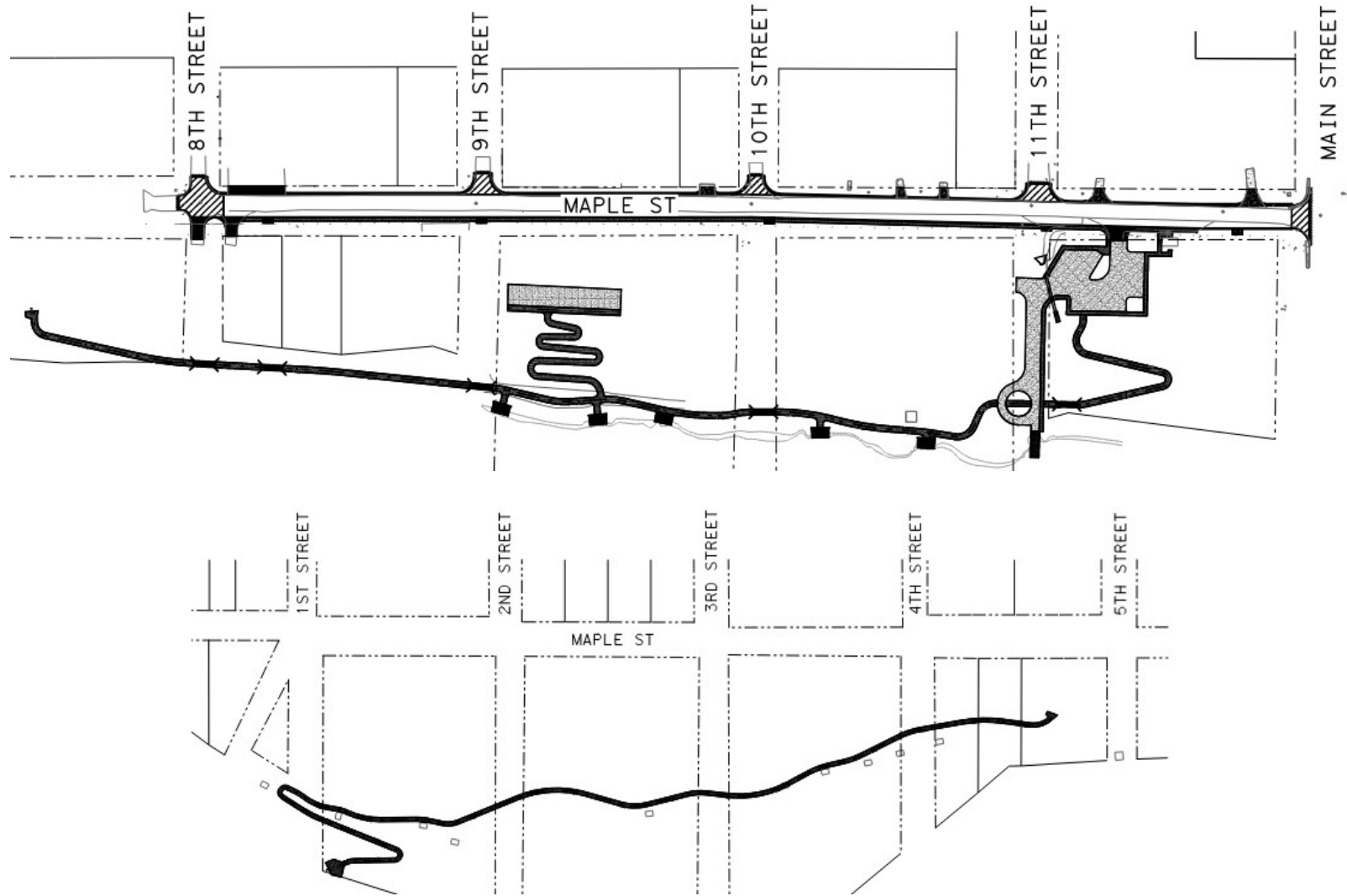
Main St. to Hackberry



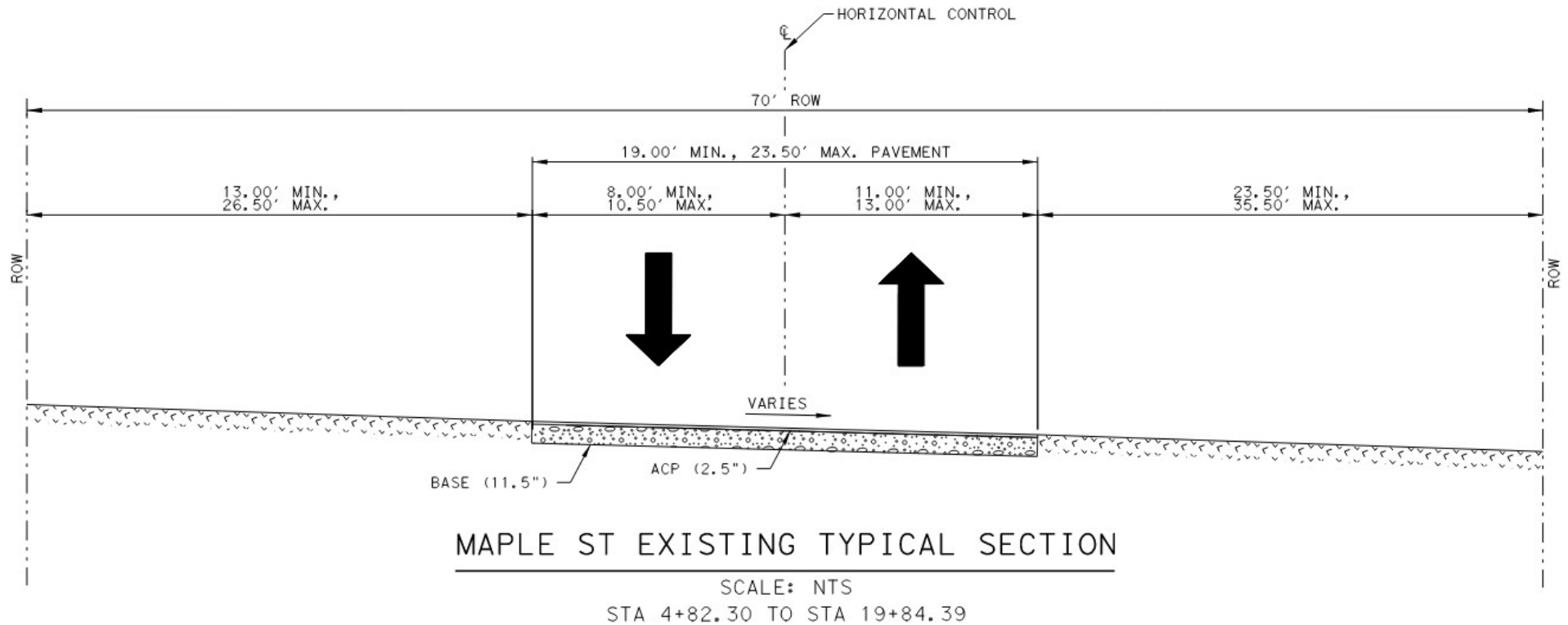
MATCHLINE STA 25+00



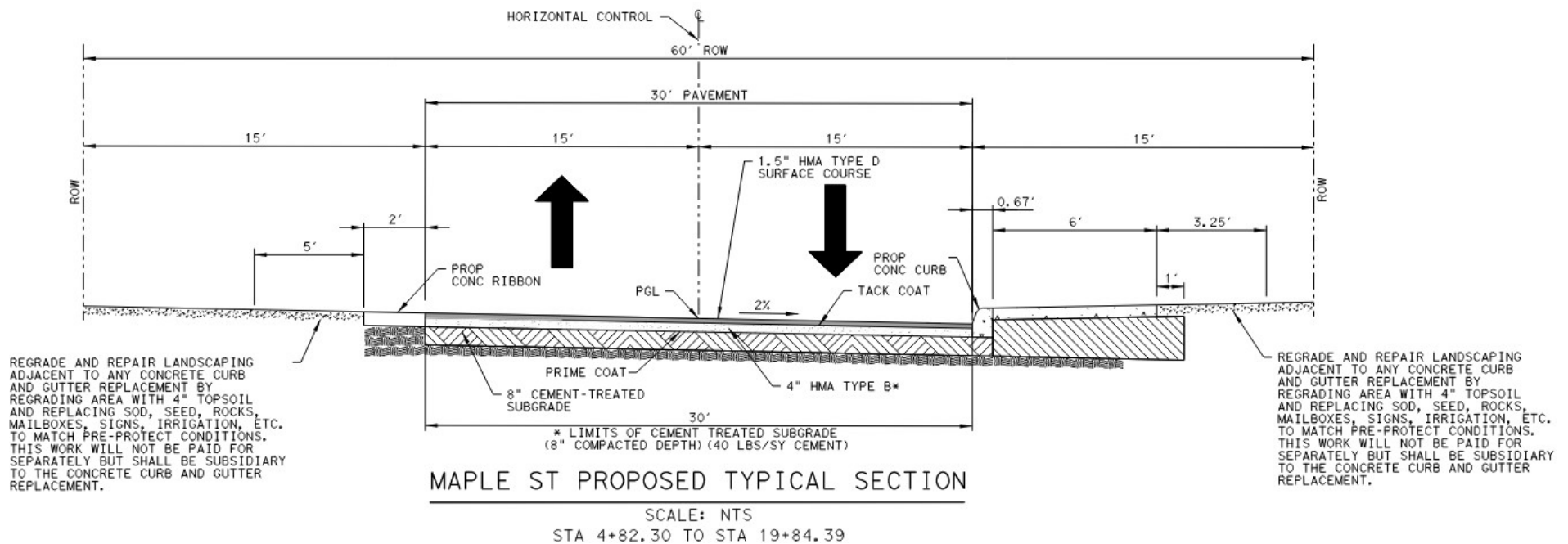
MAPLE ST. AND PARK IMPROVEMENTS



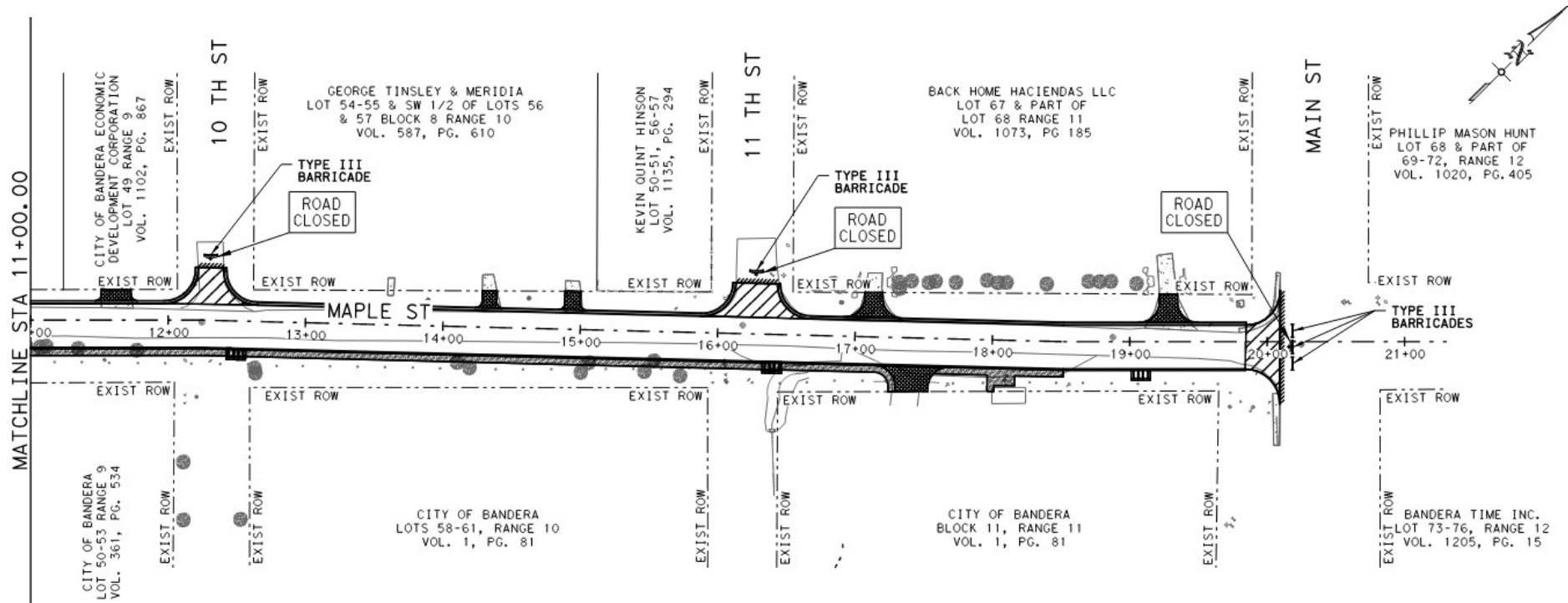
Maple St. Existing Typ.



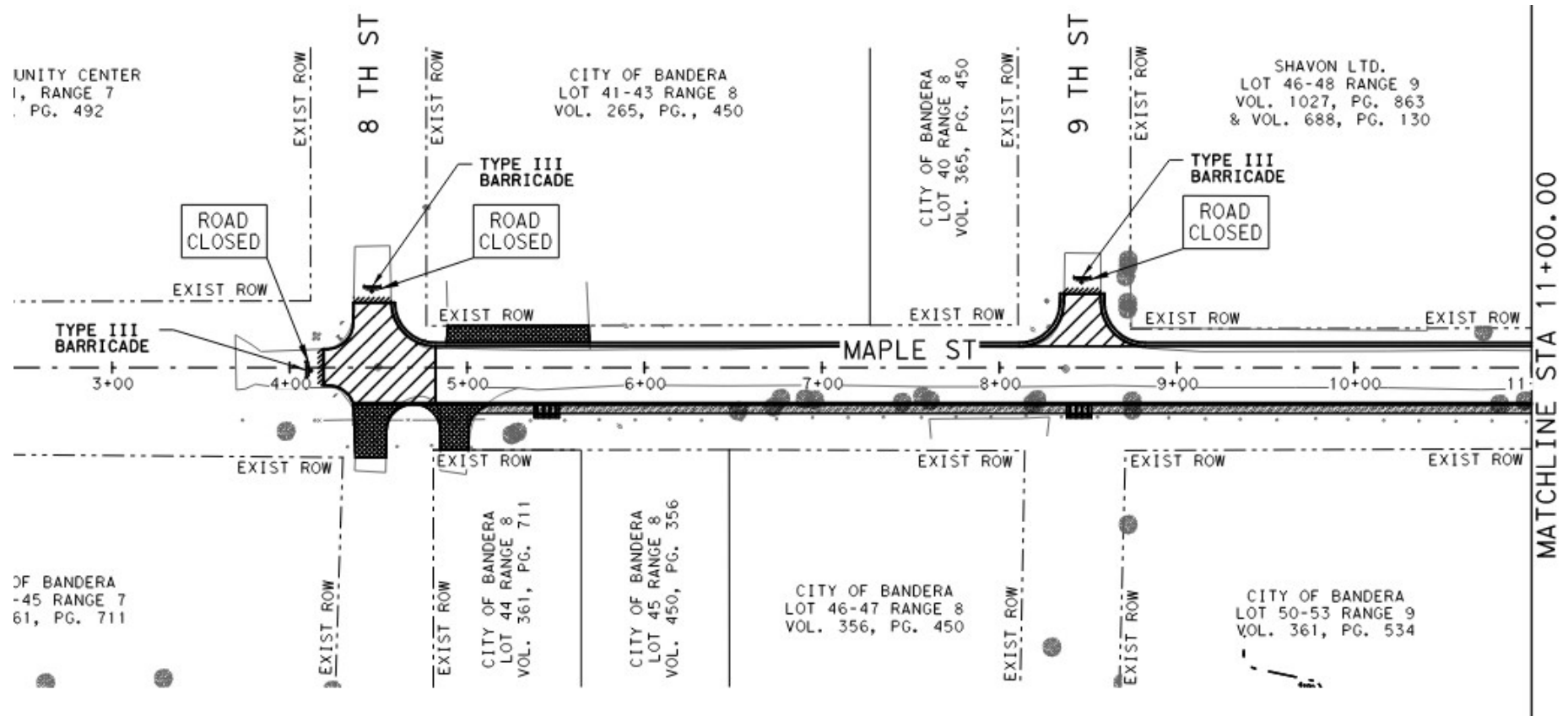
Maple St. Proposed Typ. Section



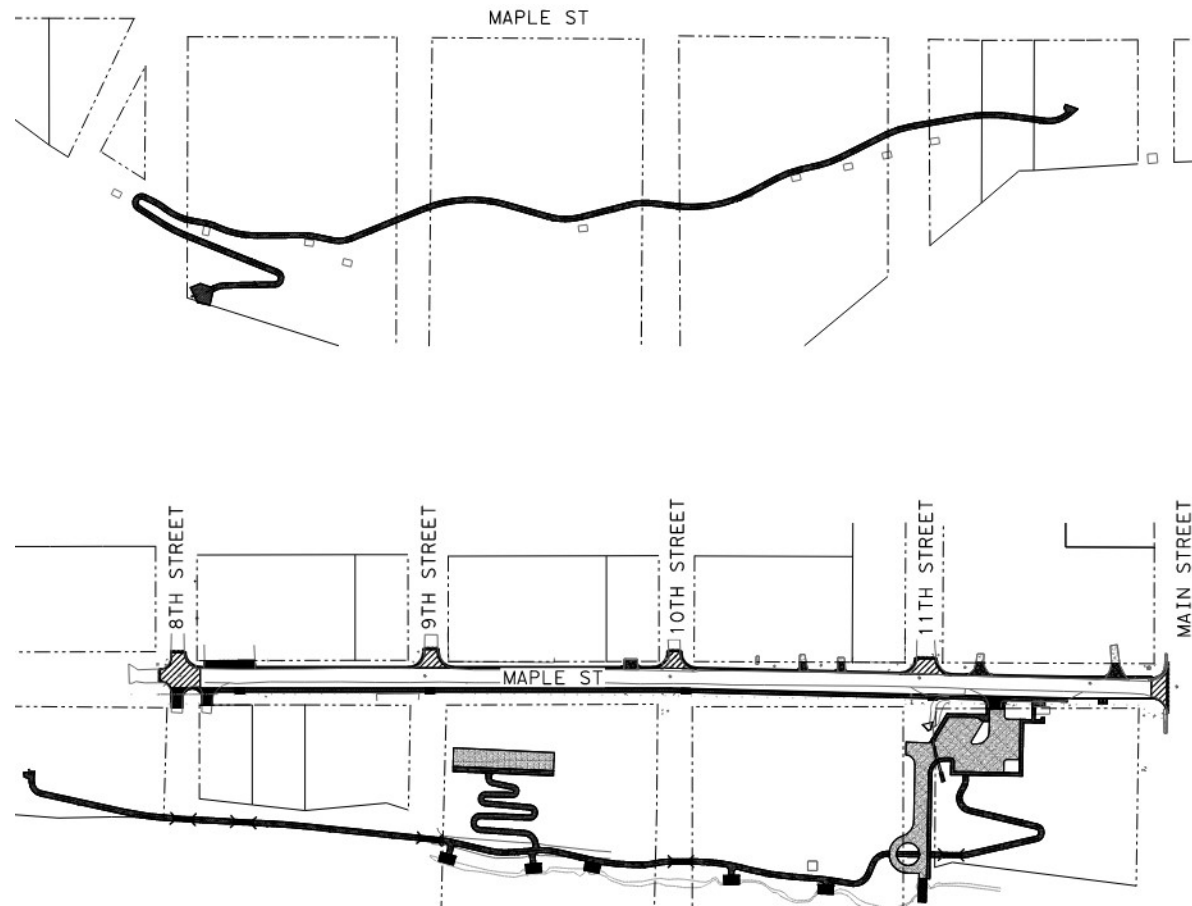
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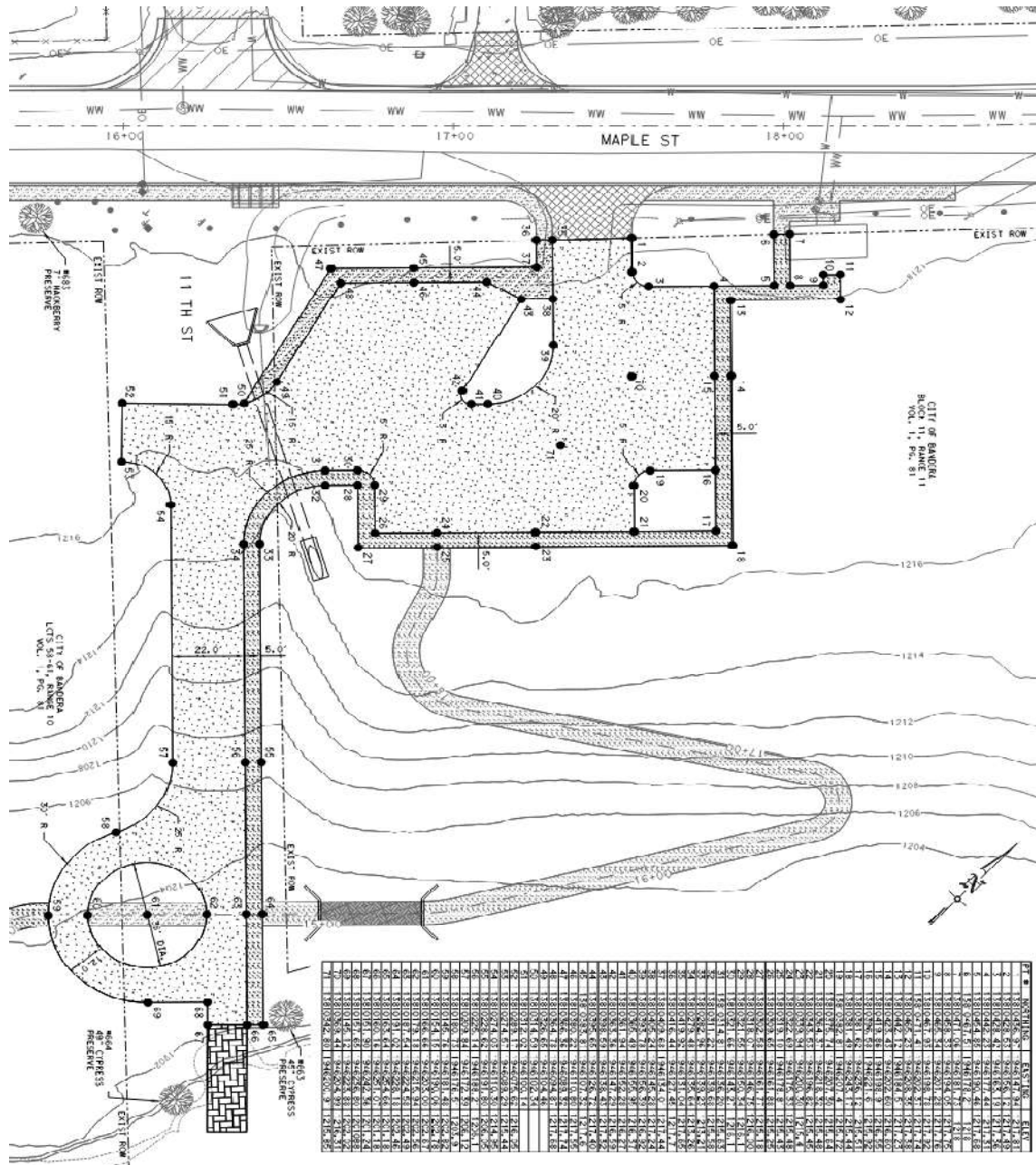


Maple St.

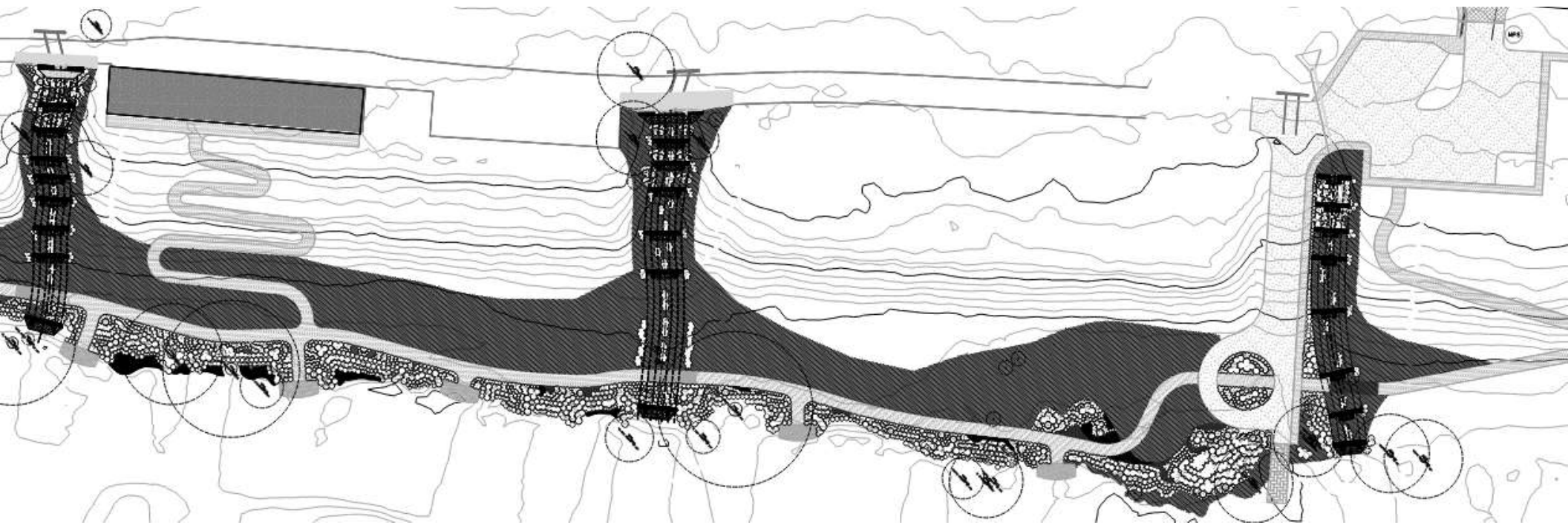


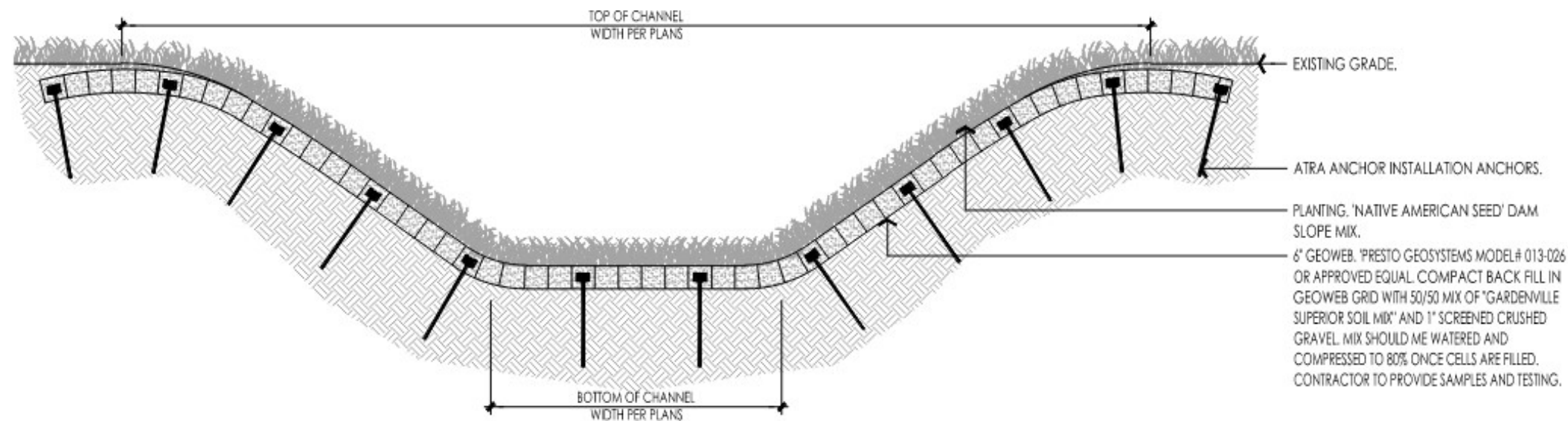
City Park Sidewalk and Parking





City Park Riparian Improvements



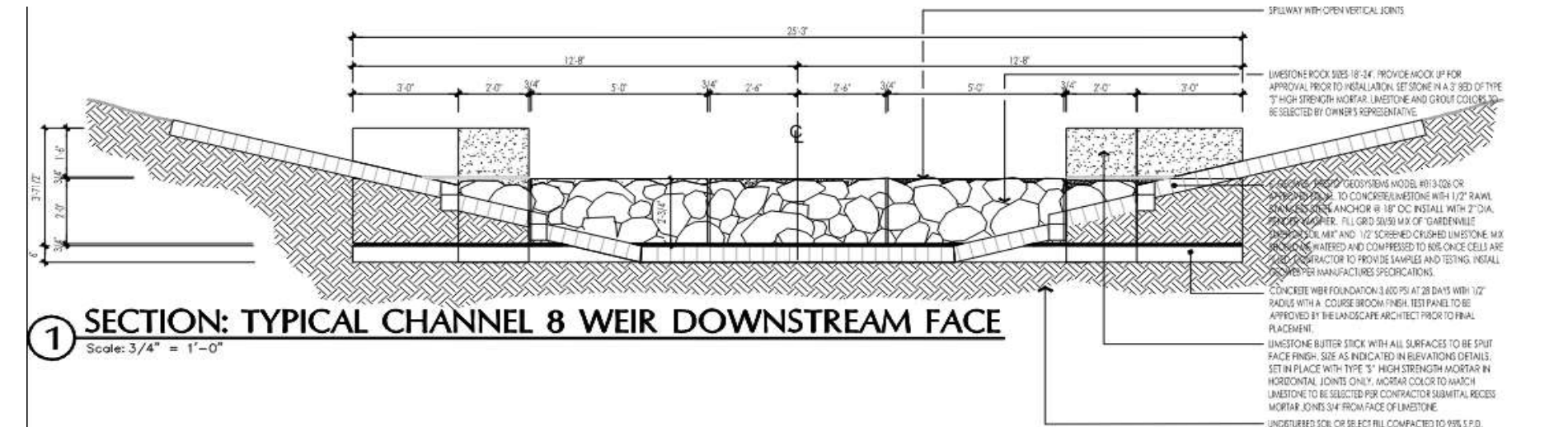
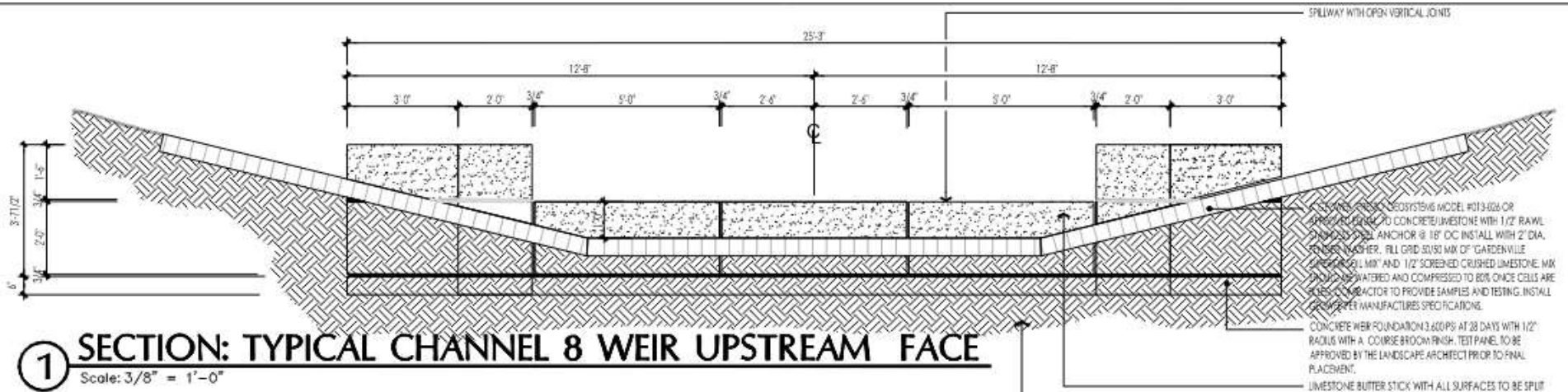


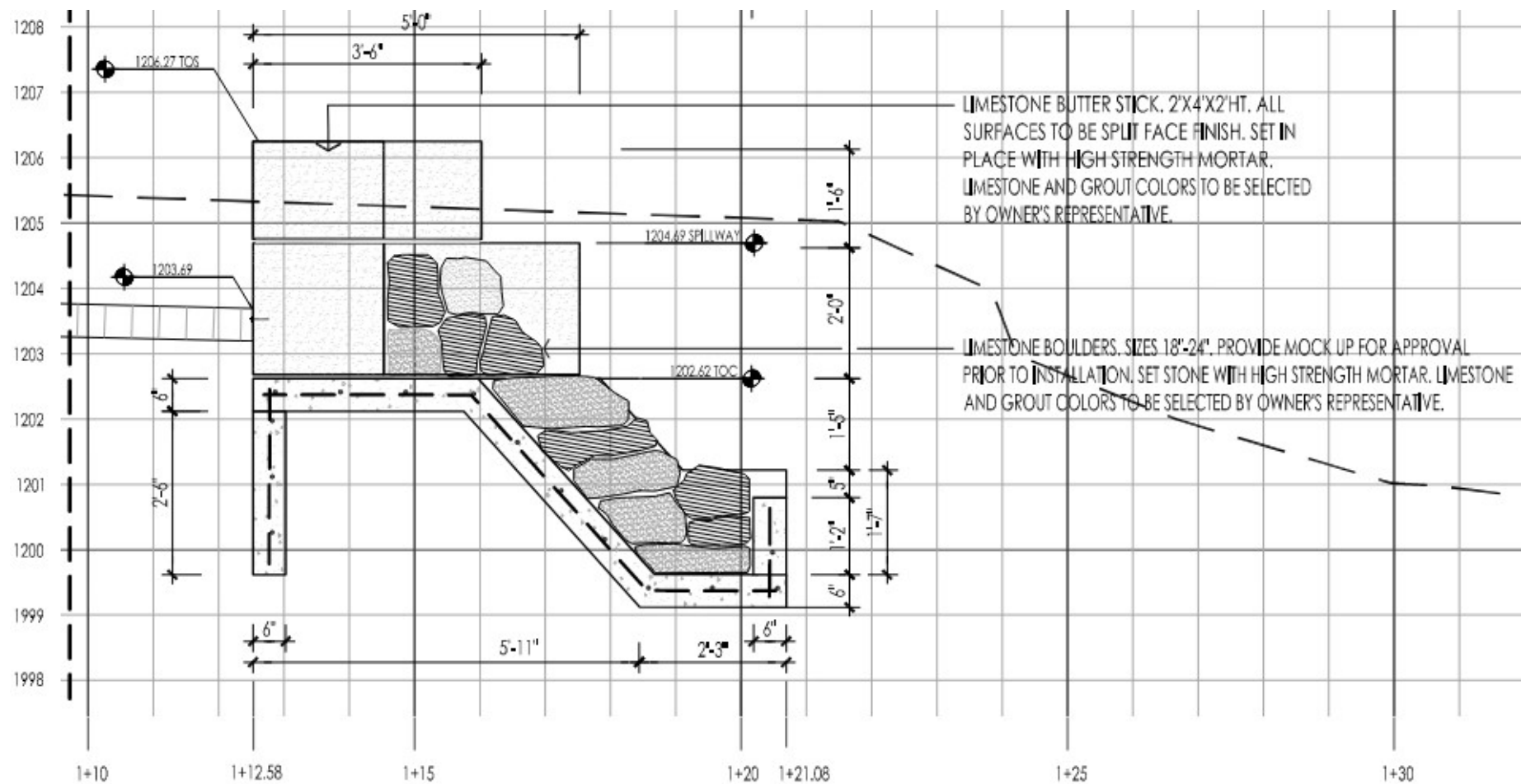
1 SECTION: CHANNEL PLANTING

Scale: N.T.S.



CONCRETE 3,600 PSI AT 28 DAYS WITH 1/2" RADIUS WITH A COURSE BROOM FINISH. TEST PANEL TO BE APPROVED BY THE LANDSCAPE ARCHITECT PRIOR TO FINAL PLACEMENT.
STRUCTURAL MATT. #4 REBAR AT MAX. 12" O.C.E.W., CENTER IN 6" STRUCTURE. PROVIDE AT LEAST 2" COVERAGE OF STRUCTURAL MATT ON ALL SIDES.
UNDISTURBED SOIL OR SELECT FILL COMPACTED TO 95% S.P.D.





6 SECTION: CHANNEL 8

Scale: 1/2" = 1'-0"