Westside Creeks Restoration Project

CONCEPTUAL PLAN

San Antonio's Westside Creeks run through the heart of the City's inner west side rich in culture and history. During each of the public workshops and meetings, local residents recalled using these creeks, **Alazán, Apache, Martínez and San Pedro**, for recreation and enjoyment, and shared stories of learning to swim and fish in the creeks, as well as picking plants for cooking.

History has also shown these creeks have been subject to some of the City's worst flooding. In 1921, flood waters (see map on page 3) claimed the lives of 51 people and left behind an estimated $3.7 million in property damage. Twenty-five years later in 1946, another flood claimed the lives of six people and an estimated $2.1 million in property damage.

Following the 1946 flood, the San Antonio River Authority (SARA) began working with the U.S. Army Corps of Engineers (USACE) and the Soil Conservation Service, now known as the Natural Resource Conservation Services (NRCS), to develop strategies to address flooding within the Westside Creeks and San Antonio River.

In 1954, the U.S. Congress authorized the USACE to construct the San Antonio Channel Improvements Projects (SACIP) which overlaps the Westside Creeks Concept Planning Area. The SACIP straightened and channelized approximately 31 miles of the San Antonio River and Westside Creeks.

Today, SARA has embarked upon efforts with the City of San Antonio, Bexar County and USACE to apply more modern, environmentally sensitive and aesthetic construction methodologies to enhance the flood carrying capacity of the eight miles of San Antonio River that were channelized. This project, also known as the Mission Reach, will restore much of the native habitat that once thrived along the River, as well as provide recreational amenities and environmental improvements to the San Antonio River.

The Westside Creeks Restoration Project, Conceptual Plan Phase, will build upon the successes and lessons learned from the on-going Mission Reach Project. As part of the next generation of restoration within our watershed, the Alazán, Apache, Martínez and San Pedro Creeks have opportunities for ecosystem restoration, enhanced flood control and to serve as a catalyst for revitalization of the surrounding community.

Introduction

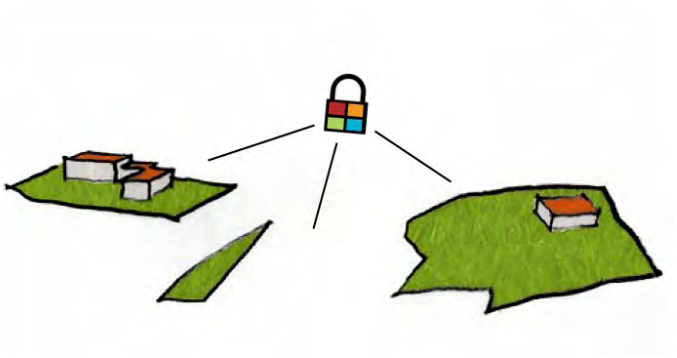
The Westside Creeks have attracted humans for over 10,000 years, from Native Americans, to Spaniards, to a variety of European settlers, to San Antonio's current residents. Once the impetus that made life possible, the creeks have been reduced in their community significance since they were channelized by the USACE in the 1960s and 70s to reduce flooding. SARA, working to sustain and enrich life in the San Antonio River Watershed, began restoration work with the San Antonio River Improvements Project, and has continued this process into the Westside Creeks, leading this project and ensuring extensive community involvement. This plan involved the community through three public workshops, a week-long stakeholders' charrette, and continual involvement by the Westside Creeks Restoration Oversight Committee as well as by individual Creek Advisory Subcommittees.

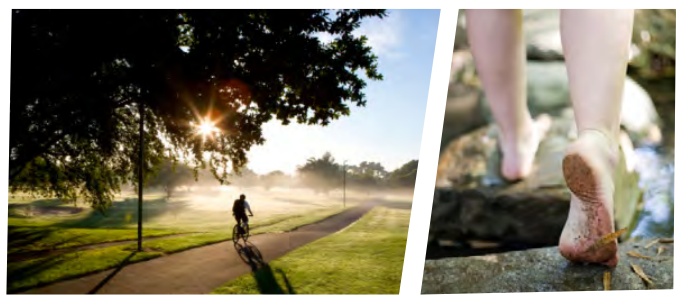
The vision is founded on four core philosophies – Water, Restoration, Connections and Security. The plan and its concepts are founded on the story of water. Watershed hydrology, existing flood hazards and structural constraints dictate the range of feasible restoration concepts. The restoration concepts are predicated on the fluvial geomorphology, native local ecosystem, what is possible and the desired final condition of each stream. Integrated with the restoration concepts are connections consisting of trails, crossings and wildlife corridors. Redevelopment nodes created along these connections capitalize on new and enhanced recreational amenities and on economic development opportunities that engage the water and land interface of the stream corridors. Completing the vision is the focus on public and neighborhood security though appropriate design elements, stewardship, patrols and maintenance.

These philosophies materialize in physical form through the restoration plan and catalyst sites. The restoration regimes include both project-wide and creek-specific concepts for flood hazard mitigation and stream restoration. Eleven neighborhood catalyst sites within the restoration framework describe multi-purpose projects that combine many of the vision elements to serve as the seeds of community revitalization. Within each catalyst site are typical design elements. These elements represent smaller areas where people interact with the creek and include key design features such as trails, crossings, plazas and stormwater best management practices.

Momentum for change is in the air. The implementation and action plan for the restoration **carry the vision forward**.

Security

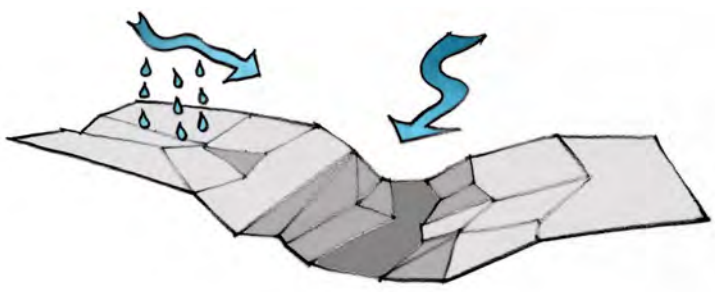




Connections

Restoration

Water



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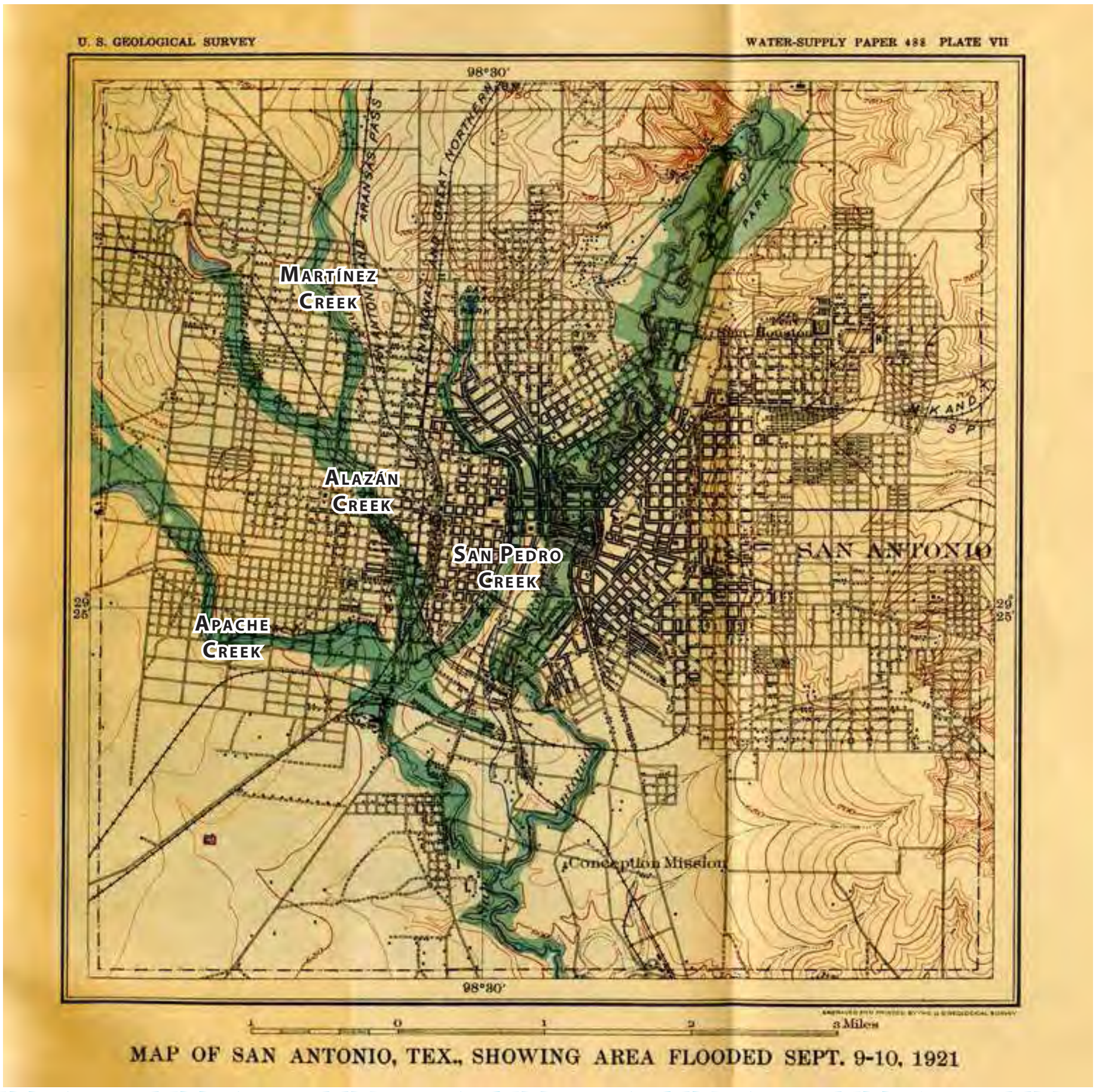


A map from C. E. Ellsworth's study of the 1921 flood. The report was prepared by the U.S. Geological Survey, a unit of the Department of the Interior, in cooperation with the state of Texas.

ABOUT SARA

In 1917, the voters of Texas, recognizing the necessity of developing and conserving the State's water resources and inspired by devastating floods of 1914 and 1915, passed a Constitutional amendment allowing the Legislature to create special purpose political subdivisions of the State to serve regional areas, generally coincidental with river basins and to be generally known as river authorities.

SARA, created in 1937, is one of many such active river authorities in the State of Texas. Its jurisdiction covers 3,658 square miles - all of Bexar, Wilson, Karnes and Goliad Counties.

Core Values

Stewardship

- We are passionately committed to the preservation, protection and sustainability of the San Antonio River Watershed.
- We are committed to making the river safe, healthy and enjoyable.
- We, working with our partners, pioneer innovative solutions that sustain and enrich the lives of the people in the Communities we serve.
- We are quick to respond, open to new ways of doing things and dedicated to delivering valued public service.
- We are not complacent, do not alter for our values, nor lose sight of our purpose and vision.

Integrity

- We are accountable to the Board of Directors, Citizens and Stakeholders of the communities we serve, and to our Partners and entrusted to efficiently use limited public resources.
- We are honest and reliable in our dealing with others.
- We base our decisions on prudent financial management and sound scientific/engineering principles and practices.
- We do not misrepresent facts, distort research, our capabilities, or expertise.

Excellence

- We are committed to collaborative, adaptive, and strategic actions that address watershed issues and priorities.
- We expect the best from ourselves, learn from our experiences and continuously strive to advance our capabilities.
- We do not make excuses or avoid responsibility for our actions.

Strategic Targets

- Generate lasting and recognized improvements to the health of the San Antonio River Watershed.
- Enhance community appreciation for and access to the San Antonio River and its tributaries.
- Strengthen and develop expertise at all levels.
- Diversify and leverage funding resources.

SARA's Vision: **Leaders in Watershed Solutions**

SARA's Mission: **Sustain and Enrich Life in the San Antonio River Watershed**


“We want the community to use the creeks, not have them be something that’s over the fence to be ignored.”
– Roberto Rodriguez, SARA Board Member

Plan Context

PLAN PURPOSE

The Westside Creeks Restoration Project is a community-based planning effort initiated in 2008 by SARA with support from the Board of Directors, and in particular, Director Roberto Rodriguez a lifelong resident of the west side who witnessed the 1946 flood and channelization of the creeks. The project's mission is to develop concepts for restoration of the Alazán, Apache, Martínez and San Pedro Creeks, maintain or enhance the current flood control components of these creeks, improve water quality, increase biological diversity, provide increased opportunities for people to enjoy these urban creeks and suggest the redevelopment potential along their margins. Through a lengthy public process, these goals were established for the Westside Creeks Restoration Project:

- Environmental enhancement
- Aquatic and riparian restoration
- Flood control enhancement
- Recreational uses for all ages
- Water quality enhancement
- Low maintenance and sustainable design
- Fluvial geomorphology concepts
- Continuous hike and bike trails
- Transportation connectivity
- Public gathering places
- Cultural/historical awareness
- Public art
- Economic development
- Neighborhood and business connections

PLAN CONTEXT

The Westside Creeks are heavily urbanized watersheds located predominantly west and northwest (with a segment to the south) of downtown San Antonio, Texas. San Antonio's west side has been built-out for several decades, with the creeks traversing many historic and active neighborhoods (Jefferson, Woodlawn Lake, King William, Avenida Guadalupe, Prospect Hill, Beacon Hill, Los Angeles Heights). The Westside Creek Restoration Project is targeted to specific portions of the four Westside Creeks (tributaries to the San Antonio River) which were channelized by the USACE during the 1960s. The targeted portions include:

Alazán Creek. This segment begins downstream of the Woodlawn Lake outfall and flows approximately 3.3 miles south southeast, ending at its confluence with Apache Creek[1].

Apache Creek. This segment begins at the bridge of General McMullen Road over Elmendorf Lake[2] and flows approximately 4.2 miles southeast, ending at its confluence with San Pedro Creek.

Martínez Creek. This segment begins at Hildebrand Avenue and flows approximately 2.8 miles south southwest, ending at its confluence with Alazán Creek.

San Pedro Creek. Approximately 3.8 miles long within the project area, the study segment begins immediately downstream of the San Pedro tunnel inlet structure (between the I-35 frontage and North Santa Rosa) and flows south to its connection with the San Antonio River.

[1] The stream reach identified in this report as Apache Creek, between the confluences with Alazán and San Pedro Creeks is referred to as Alazán Creek by some residents and historic maps. However, this report follows the naming convention used in the FEMA Flood Insurance Study (Sep 2010).

[2] The stream reach between General McMullen Road and the confluence with Apache Creek approximately 2,000 feet downstream is actually Zarzamora Creek.

PLAN PROCESS

The concept plan was developed over a two year period and included the following six phases:

Phase I, Inventory + Analysis

The existing conditions and planning context were analyzed. Issues were identified through committee meetings, document reviews, field studies, hydraulic modeling, stakeholder interviews and public workshops. Key analysis factors included creek conditions, adjacent land uses, redevelopment potential, restoration potential, flooding issues, connections, environmental hazards, cultural resources, wildlife habitat and public and private security. This phase included applying appropriate fluvial geomorphology considerations and the latest hydrologic and hydraulic modeling to each creek in order to determine options for restoration and flood control. Opportunity areas for enhanced recreation and community re-development were also identified during this phase.

Phase II, Vision

The overall vision for the Westside Creeks was developed through community workshops. Community workshops and design team work sessions were held at the Woodlawn Lake Gymnasium on April 18, 2009, at the Guadalupe Cultural Arts Center during the week of August 31, 2009, at the El Progresso Community Center on October 24, 2009, and at VIA Metro Center Community Room on February 27, 2010. Individual framework plans for each creek were developed from this important vision. The team and committees then continued to meet periodically, refining the concepts to achieve a feasible plan.

Phase III, Restoration Concepts

Restoration concepts for each creek were developed according to the principles of fluvial geomorphology. These concepts are intended to return the streams to a more natural state, with the additional goal of achieving a long-term sustainable condition that minimizes maintenance requirements while continuing or enhancing the existing flood control benefits of the original channel improvements. Coordination with other projects and teams (e.g. Watershed Master Plan, Linear Creek Greenways Program, etc.) was a key component to ensure effective plan development.

Phase IV, Catalyst Sites

On each creek, catalyst sites were identified and programmed by the community for further development by the planning team. These neighborhood-scale areas represent areas which have opportunities for future multi-purpose projects that combine flood mitigation, stream restoration, neighborhood redevelopment and recreation enhancement and which will serve as catalysts for the revitalization of the community. Key considerations include allowing efficient and effective stream restoration and flood mitigation; the enhancement and beautification of the creeks, trails, parks and open spaces; providing and supporting transportation connectivity, ADA compliance, and historical context; and adjacent land uses. Catalyst sites represent the possibility for immediate change within each community.

Phase V, Design Elements

Within each catalyst site are typical design elements. These elements represent smaller areas where people interact with the creek and include key design features such as trails, crossing, plazas and rain gardens. Best management practices were also developed in this phase which would be universally applied to the development of future projects.

Phase VI, Implementation

The development of an implementation plan identifies opportunities for the Westside Creeks Restoration Project to be coordinated with other community development initiatives (flood mitigation, trails and parks, transportation, economic development), providing for a more integrated concept for the future of the Westside Creeks area. This phase also addressed the multiple organizational partnerships and potential funding opportunities which are to be explored by SARA as the project moves forward.

General aerial view of the four creeks and their relationship to downtown San Antonio

"This is not the River Authority's plan or the consultant's plan, it's the **public's plan**."

- Rudy Farias, SARA Project Manager

HISTORICAL CONTEXT

Since pre-historic times, the San Antonio River and its associated waterways such as the Westside Creeks have attracted human habitation. Archaeological excavations have produced evidence that settlement in the area occurred as long as 10,000 years ago. In 1691, an expedition of Spaniards from Mexico ventured into Texas as far north as San Pedro Springs, now located in the northern portion of San Antonio's central business district. In an often quoted report to the viceroy, explorer Domingo Terán de los Ríos describes the territory. "We marched five leagues over a fine country with broad plains - the most beautiful in New Spain. We camped on the banks of an arroyo, adorned by a great number of trees, cedars, willows, cypresses, osiers, oaks and many other kinds. This I called San Antonio de Padua, because we reached it on his day." Similar undisturbed natural environments existed on all the Westside Creeks.

"We marched five leagues over a fine country with broad plains - the most beautiful in New Spain. We camped on the banks of an arroyo, adorned by a great number of trees, cedars, willows, cypresses, osiers, oaks and many other kinds. This I called **San Antonio de Padua**, because we reached it on his day."

-Domingo Terán de los Ríos, explorer

Some Spanish families had permanently settled in the vicinity of San Antonio by 1715, and by 1718 the Spanish officially established the first settlement north of the Rio Grande near San Pedro Park. Called San Antonio de Padua, it consisted of a mission and a presidio based on agriculture employing Indian labor and irrigation. The Spanish soon expanded their colony southward along San Pedro Creek and the San Antonio River, and by 1726, citizens of the Spanish crown numbered about 200 in the San Antonio area. As San Antonio grew, engineering the river to protect the community from flooding became inevitable. Flooding was a recognized hazard as early as the flood of 1724, which resulted in relocation of Mission San Antonio de Valero (The Alamo) to a safer site.

After Texas entered the Union, growth became rapid, as the city became a servicing and distribution center for the western movement of the United States. With the coming of the Galveston, Harrisburg and San Antonio Railway in 1877, San Antonio, formerly without a transportation system, entered a new era of economic growth. San Antonio was once again the largest city in the state in 1900 with a population of 53,321. It remained the largest city in 1910 with 96,614 inhabitants, and in 1920 with a population of 161,379. After 1910, Mexican immigration greatly increased due to the Mexican Revolution and the development of local service industries.

The San Antonio Conservation Society, founded in 1924, was instrumental in saving the beautiful San Antonio River from being paved over for a stormwater drain. The society has since become a popular and powerful organization devoted to preserving the city's unique features. After a period of slow growth during the 1930s, San Antonio's population increased by 61 percent during the wartime boom of the 1940s to reach 408,442 in 1950.

From 1939 through 1941, the pilot channel for the San Antonio River was deepened, three dams were constructed, underground drains built and flood gates installed at both ends of the river loop. Aesthetic features included stone walkways and stairwells and graceful footbridges. Also added was the outdoor Arneson River Theater, preservation of indigenous trees and plants and River Walk architect Robert Hugman's northern flood gate, adorned with arches and an arbor that lend an Old World Spanish flair. The result was San Antonio's River Walk.

Although the San Antonio River Walk improvements addressed flooding in the City, flooding was still an issue in the Westside neighborhood areas. The Westside Creeks were channelized by the USACE during this period as part of the San Antonio Channel Improvements federal flood control project beginning in 1954. Unlike the improvements along the San Antonio River, these Westside Creeks improvements served only to protect the residents from flooding. Much of the housing in the Westside Creeks area was constructed in the early 1900s and later restored or replaced through urban renewal, redevelopment, and infill housing.

More recently on the San Antonio River, the Museum Reach – Urban Segment doubled the length of the San Antonio River Walk when it was completed in 2009. The Museum Reach – Urban Segment includes a lock and dam near Brooklyn Avenue and plays host to public art along the meandering river. In addition to the Museum Reach – Urban Segment, which was developed to fit the character of its dense urban setting, the Mission Reach Ecosystem Restoration Project is currently underway. Also addressing the uniqueness of its location, the Mission Reach project is focused on ecosystem restoration to transform an eight mile stretch of the San Antonio River into a quality riparian woodland ecosystem.

The Westside neighborhoods associated with this project also contain their own unique, rich history, which will affect the character of this restoration project. Four historic resources are potentially eligible for the honor of listing in the National Register of Historic Places: the San Fernando Cemetery No. 1 on Apache Creek; the Battle of Alazán site (near Alazán Creek, near Smith and Buena Vista Streets); the Alameda Theater, located at Houston and Cameron Streets on San Pedro Creek; and a portion of the San Pedro Acequia as it is found at the San Pedro Creek. A number of historic resources, properties and a district already listed in the National Register are found along San Pedro Creek, principally in the downtown, as well as some historic markers. The two most important National Register properties that back up to the San Pedro Creek in this area are the Spanish Governor's Palace, which is also a National Historic Landmark, found on Commerce Street, and Casa Navarro, both of which are popular tourist destinations.

More information on the historic nature of the Westside Creeks is available in Appendix A - Historic Resources Survey.

Historic flood damage along Alazán Creek in the early 20th century

Channel construction for San Pedro Creek in the early 20th century

Corps channelization of Alazán Creek in the early 20th century

Community Vision

OVERVIEW

Given the importance of the Westside Creeks Restoration Project, the public involvement activities identified for this effort sought to involve the community that lives, works and plays near the creeks. SARA and the consultant team further sought to communicate early on and continuously with stakeholder groups during the development of the Conceptual Plan to ensure it reflects the local community ideas. For this reason, a primary goal was to implement a proactive public involvement program that offered the public a variety of opportunities to participate.

Specific public involvement objectives for the effort included:

- Disseminating information about the project to the neighborhoods around the creeks and the public;
- identifying stakeholder groups most affected by and interested in the project and actively soliciting their input;
- ensuring adequate community understanding and maximum input through bilingual communications;
- adequately addressing and documenting the issues raised by the project's multiple stakeholders;
- developing, distributing and displaying high quality, user-friendly and community-appropriate information;
- building on existing community partnerships and communication networks;
- coordinating closely with local jurisdictions, community organizations and neighborhood groups; and
- responding in a timely manner to questions and concerns throughout the process.

The consultant team worked closely with SARA's Intergovernmental and Community Relations Department to execute a public involvement plan that consisted of information gathering through extensive community outreach.

Public Workshop #3; Plan Frameworks

"We want a **rebirth** of the waterways on the Westside so they become a **center of community activity**."

-Paul Elizondo, Bexar County Commissioner

BRANDING

In order to differentiate and define a brand for the Westside Creeks Restoration Project, it was important to determine the project's core values, which would resonate as themes throughout key messages and graphic designs. To accomplish this, a Branding & Key Messaging Workshop was conducted on November 18, 2008. The Westside Creeks Restoration Oversight Committee (WCROC) was led through a guided discussion aimed at identifying the core values; findings of that discussion were utilized in the development of the branding concepts.

Historic Theme. The WCROC wanted to reflect the roots and the history of the creeks. Committee members felt that the historical significance of the creeks' function, of the local community (Little Flower Basilica, Our Lady of the Lake, etc.) and of the wildlife that was once abundant along the creeks (e.g. crawfish, cranes, bullfrogs, plant life) were important themes. Committee comments supporting this theme include:

- "There is some real history along those creeks that we would like to remember"
- "Good command of the historical value of that particular community"
- "I also think there are incredible architectural resources in these areas that could somehow be incorporated"
- "Making connections throughout to architecture, culture, etc."
- "The historical significance"
- "Overcoming the fear and anxiety people have regarding the creeks – it is as wild and dangerous as a teenager"

Cradle to Grave Theme. This theme reflects the core value that the creeks should be accessible and usable for all members of society, regardless of age or other demographic factors. It addresses making the creeks safe and accessible with activities for people in all stages of life. Committee comments supporting this theme include:

- "I would like to see that something for every age group is incorporated into the design"
- "Has to be completely people friendly"
- "To have youth involvement – that the youth had a say in the project too"

Public Workshop #2; Catalyst Site Development

"We've been doing creek cleanups for years. We need something like a major restoration to make the area better. Whatever is done, people need to pick up and maintain it. **We're behind it one hundred percent.**"

- Jason Mata, President of the Prospect Hill Neighborhood Association

- "It is only great if community uses it"
- "We are having a big party by a creek and we look at each other and it is unique – becomes a point of envy to other communities – you can see there are generations at the party"

Rebirth Theme. This theme was raised by several WCROC members. This process will essentially give new life to the creeks, effectively generating a new perception of the Westside Community. This project also presents an opportunity to reintroduce the Westside of San Antonio to the rest of the City as a place that is ecologically-sound, safe and inviting. Committee comments supporting this theme include:

- "Recognition, understanding of the Westside. Bringing back the community and reintroducing it. So the community is reintroduced as a result of the process"
- "An ownership by people; sense of pride so that they actually do want to be a part of helping to maintain that"
- "How do you convince them to take part in an active urban community? Need to believe in their community again"
- "Changing the negative and definition and culture of the Westside – if I told my friends we were doing this they would be surprised that the Westside would be considered for this"
- "You have to make people want to face in rather than face out – right now it is something you don't want to face"
- "This is an opportunity to convert what is already there into something better – this is the best opportunity to do that"
- "A creek that looks like nothing else in the city – this is the rebirth of the community"

Bringing Nature Back Theme. This theme symbolizes a return to the natural beauty that once was, focused on the importance of bringing plants and animals back to the creeks. It also voices the need to create a biologically sound and environmentally sustainable vision. Committee comments supporting this theme include:

- "Want to make sure that the creeks themselves are biologically sound and that we make it environmentally sustainable"
- "Eco-friendly"
- "There was wildlife in those creeks that didn't exist anywhere else and now it is all gone – perhaps we can bring some of that back"
- "Personally would like to see beauty brought out not only in the culture but also in the environment"
- "Changing human habits – I live on a section of Martínez Creek that is used as a dump site – dead and live animals, residual trash during flooding from I-10 and beyond."
- "Educate the public on ecological impact – the birds will come back if you restore the creek – they are already coming back and I look at them with sadness when I see them pecking at concrete, not at the crawdads that used to be there"
- "They need to know that we appreciate the diversity – or restoring the diversity to the creek"

Connections Theme. The core value here is the importance of the creeks as a way of connecting points of interests, transportation networks, and the Westside to the rest of San Antonio. The general feeling was that even though the creeks are on the Westside, they will be used by people from all parts of the city and county. Committee comments supporting this theme include:

- "Communication – we have to consistently communicate what we are doing"
- "It can't be an us / them kind of thing – we have to be working together"
- "That goes back to providing linkages to facilities that are in close proximity like Our Lady of the Lake University"
- "Make connections to transportation networks"

Ultimately, the oversight committee voted on and approved a logo concept which allowed each creek included in the project its own identity within the logo. The four square, four creeks logo drew on many of these themes for inspiration. Once created, it served as the basis for a project website and a series of project templates.

"A creek that looks like nothing else in the city – this is the **rebirth of the community**"

"There was wildlife in those creeks that didn't exist anywhere else and now it is all gone – perhaps we can bring some of that back"

"It can't be an us / them kind of thing – we have to be **working together**"

"There is some real history along those creeks that we would like to remember"

- Members of the WCROC on branding

COMMITTEES

One of the primary mechanisms for community involvement was the WCROC. Modeled after the San Antonio River Oversight Committee involved in the development of the San Antonio River Improvements Projects, the WCROC consists of two co-chairs and representatives of 20 local community organizations approved by the SARA Board of Directors. The WCROC facilitated the gathering of ideas, existing plans and community input into the Westside Creeks Restoration Project. Its members represented established organizations with an interest in the history, preservation, restoration, improvement, enjoyment, education, development and integration of these creeks with community projects.

The WCROC met monthly during the conceptual design phase and was led by two co-chairs, Robert Ramirez and Olga Lizcano, who were appointed to lead by the SARA Board of Directors. Minutes from those meetings can be viewed in Appendix B. Organizations represented on the WCROC included:

- Avenida Guadalupe Association
- Beacon Hill Neighborhood Association
- Bexar Audubon Society
- Donaldson Terrace Neighborhood Association
- Downtown Residents Association
- Los Bexareños Genealogical Society
- Mid-town Neighborhood Association
- Our Lady of the Lake University
- Prospect Hill Neighborhood Association
- San Antonio Alternative Housing
- San Antonio Conservation Society
- San Antonio Independent School District
- San Antonio Wheelmen
- St. Mary's University
- Student Representative
- United San Antonio Pow Wow, Inc.
- University of Texas at San Antonio
- West San Antonio Chamber of Commerce
- Westside Development Corporation
- Woodlawn Lake Neighborhood Association

From the beginning, the WCROC recognized that each creek had its own unique character. Therefore, four sub-committees were established. The sub-committees were designed to be open membership, meaning anyone choosing to participate could attend as a sub-committee member. During the course of the project, 119 people participated on the sub-committees, which met a total of 10 times over the approximately 12-month process. Some of the participating organizations included:

- American GI Forum
- Avenida Guadalupe Association
- Beacon Hill Neighborhood Association
- Bihl Haus Arts
- Bexar County
- Camino Real Christian Fellowship
- Casa Navarro
- League of United Latin American Citizens (LULAC)
- City of San Antonio
- Donaldson Terrace Neighborhood Association
- Downtown Residents Association
- Esperanza Peace and Justice Center
- Gardendale Homeowners Association
- Inner City Development
- Jazz Poet Society
- Jefferson Neighborhood Association
- La Luz Del Mundo Church
- Nogalitos Zarzamora Coalition
- Old Spanish Trail Centennial
- Our Lady of the Lake University
- Preservation Matters
- Prospect Hill Neighborhood Association
- San Antonio Alternative Housing
- San Antonio Conservation Society
- San Antonio Independent School District
- San Antonio Wheelmen
- St. Mary's University
- Sunshine Estates Neighborhood Organization
- Tobin Hill Neighborhood Association
- University of Texas at San Antonio
- Urban Connection – San Antonio
- West San Antonio Chamber of Commerce
- Woodlawn Lake Community Association

STAKEHOLDERS

As part of the public involvement and site analysis process, various key stakeholders were interviewed about opportunities and challenges for this project. The stakeholders selected were in addition to the various groups identified to participate on the WCROC. The stakeholder meetings and interviews were used to compile a range of concerns, gather data and information and gain a closer understanding of project opportunities and challenges in developing goals and objectives for the project. The following summarizes some of the stakeholders involved throughout the process and issues or concerns expressed.

Residents + Neighborhood Groups. Property owners and residents adjacent to the Westside Creeks Concept Planning Area were most concerned about what was planned for their area. While some expressed concerns about street and neighborhood flooding, many did not see it as a threat to them personally. Some hoped to stay at their current location while others expressed an interest in selling. This stakeholder group also expressed significant concerns related to safety and security.

Business Owners + Business Groups. Business owners expressed an interest and curiosity in the project, specifically related to potential opportunities for redevelopment.

Elected Officials. Elected officials in San Antonio and Bexar County were very supportive of the overall effort and are most concerned with the costs and funding mechanisms for the project.

Technical Officials. Officials from Bexar County, City of San Antonio, the USACE and SARA reviewed and commented on their interests for the plan. These groups were most concerned about enhancing flood conveyance, improving water quality, ecosystem restoration, recreational opportunities and improving neighborhood quality.

Media. Members of the media were generally supportive of the effort and reported on the positive aspects of increasing green space and opportunities for walking and cycling in San Antonio.

Westside Service Organizations. As an area with a significant population of low-income and minority groups, service organizations played a critical role throughout the planning process. These groups provided input with the goal of positive impacts from the project on the existing community.

Schools/Universities. Our Lady of the Lake and St. Mary's Universities are both in the middle of their own planning efforts and coordinated with the planning team for Westside Creeks. These universities served on the WCROC alongside the University of Texas at San Antonio and the San Antonio Independent School District (SAISD).

General Public. The public was very supportive of a plan to restore the creeks and bring more recreational amenities to the Westside of San Antonio. Public Workshops were a key component of the development of the vision for the Westside Creeks Restoration Project.

VISION

Public Workshop #1, April 2009 - Prioritization

The Imagination Station was the first public workshop held for the project and served as the community's introduction to the planning process. This key milestone workshop's purpose was to educate the public about project goals and explain public involvement in the planning process. The unique event was conducted in conjunction with the Fiesta Earth Day celebration at Woodlawn Lake on Saturday, April 18, 2009. A total of 158 individuals registered at the Imagination Station public workshop. Since the event attracted many families and children that signed in as one, it is difficult to estimate the exact number of participants. The feedback collected was used to craft a statement of needs and goals that served as a guide for the refinement of the vision statement.

Public Workshop #1; Vision

Change Priority Analysis. Public comments often reveal a neighborhood's most challenging issues and promising opportunities, especially when tied to specific locations on a map. Participants indicated places that would lend themselves to improvement projects on large, table-sized maps, as shown above. Markers were placed throughout the four creeks - Apache, Alazán, Martínez and San Pedro - however, certain stretches emerged as targeted areas of interest among community members. Many of these "targeted areas" later developed into Catalyst sites. (See pages 52 - 55).

The Change Priority Analysis, shown on the facing page, summarizes results of that exercise through two levels. First, each half- to one-mile creek segment is categorized as a "High", "Medium" or "Low" Change Priority based upon public input. The categories were assigned based on the amount of comments that stretch of creek received, indicating the general level of interest. For example, both sections of San Pedro Creek received a large number of comments, indicating their high or moderate potential for change in the eyes of the community. Interest levels may be a reflection of where meeting participants reside or a reflection of local insight about existing conditions of a particular creek.

The second level of analysis explains the comments received for each creek segment. Each segment was represented by a pie chart indicating the breakdown of comments by percentage. Comments fell under five categories: Natural, Redevelopment/Transit Oriented Design (TOD)/Centers, Gateway, Park/Civic and Security. For example, the westernmost stretch of Alazán Creek that flows out of Woodlawn Lake received a great deal of interest in expanding upon the existing park and civic amenities.

Nearly half of the comments received for this stretch pertained to Park/Civic improvements. Alternatively, a middle stretch of the Apache Creek is widely regarded amongst residents of a place that should focus on restoration, with 75% of the comments pertaining to Natural.

Combined, the information helped to prioritize creek segments and understand what the public sees as the most promising opportunities. Those segments that are "High" priority and have a large percentage of comments falling into one category, such as "Redevelopment" or "Park", will be the most straightforward in designing. Other segments that received a wide range of comments will have to be investigated more closely to reveal what the best opportunities for the future may be.

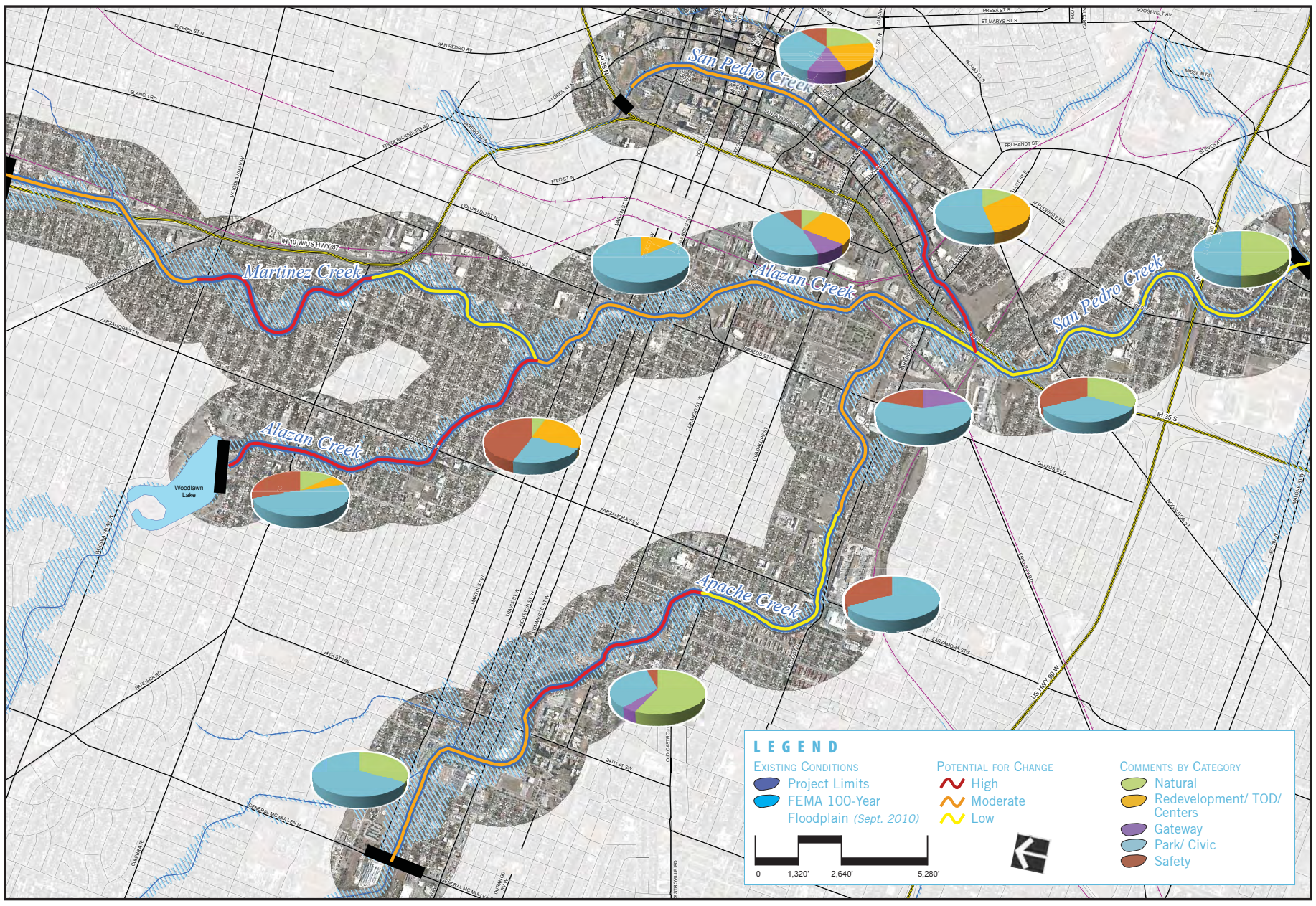
Stakeholders' Workshop, September 2009 - Catalyst Site Identification

Based on the Change Priority Analysis, a week-long design charrette was held with the project committees at the historic Guadalupe Theater to identify and design catalyst sites. Meetings were also held with large property owners and area public agency technical staff to elicit their concerns and comments. A final public workshop was used to describe the results of the work session to the public.

Public Workshop #2, October 2009 - Catalyst Site Development

The second public workshop was held on October 24, 2009 at El Progreso Hall. The purpose of the workshop was to educate the public regarding the vision development, present the proposed catalyst sites and discuss concept alternatives. The workshop was scheduled on a Saturday in order to provide an adequate amount of time for participants to view the exhibits. The project team further accommodated participants by having two identical sessions, one in the morning and one in the afternoon. Each session of the workshop began with a brief presentation by the project team followed by an open house to allow participants to visit exhibits relating to different project components. A member of the consultant team was present at each of the stations to answer questions and solicit feedback. SARA staff members and the consultant team assisted participants at the stations to help participants with the various activities and to record comments and concerns. A total of 75 individuals attended the October Workshop.

The feedback collected was used to refine the overall vision plan and the creek-specific catalyst sites.



Public Workshop #1: Change Priority Analysis

"Still provide flood protection, restore the creeks, provide recreational benefits and water quality enhancements, to make those creeks be **what the community wants them to be.**"

- Suzanne Scott, San Antonio River Authority

Public Workshop #3, February 2010 - Plan Frameworks

The third and final workshop for the Conceptual Design Phase was held on Saturday, February 27, 2010 at VIA Metropolitan's Community Room. The workshop offered the public, WCROC and various subcommittees an opportunity to comment on the conceptual designs developed for the Alazán, Apache, Martínez and San Pedro Creeks, including the catalyst sites with potential for development. The workshop consisted of a formal presentation summarizing the project process and public involvement, identifying possibilities for stream restoration and explaining engineering factors such as hydrology and sediment transport, hydraulic design and restoration options. The presentation ended with a brief overview of each catalyst site developed at Public Workshop #2. Following the presentation, attendees were invited to visit stations for each of these catalysts sites, as well as a station on the engineering behind restoration of the creeks. A total of 101 participants attended the meeting. Feedback collected at this workshop was utilized to make final refinements to the Draft Conceptual Design prior to presentation to SARA.

Stakeholders' Workshop; Catalyst Site Identification

Resulting Vision

The vision for the Westside Creeks is to restore ecological functions of the creeks while providing safety from floods, security from crime, connected communities and celebration of unique identities, ultimately leading to restored and vibrant creek corridors.

A consistent message from the public, stakeholders and the steering committees was a desire that the four different creeks maintain a unique character in the design details. This interest was expressed clearly in the first project element to be designed, the Westside Creeks Restoration Project logo. Exploring these themes in detail will be a major effort to be fully explored in future phases of the project and its implementation. Towards that end, it also presents an opportunity for the community art program, as well as architectural competitions for the shelters and gateways.

The vision materialized in the development of four frameworks - **water, restoration, connections and security** - that apply to each creek and serve as guiding principles from which all other design decisions are made. Each framework builds upon the preceding.

Water. A return to more natural conditions with a more natural low flow channel and enough flood capacity to maintain or improve the flood control benefits from the channelization. Opportunities for restoring or enhancing base flow should also be considered, primarily in San Pedro Creek. Additional land might be necessary to accommodate the wider channel and contain the floodplain.

Restoration. A treatment that restores natural processes through stable channel design incorporating meanders, wetlands, pools, riffles and drop structures. The restoration procedure would create channels that are in equilibrium with sediment transport. This restoration should also enhance the ecological functions of the stream, with vegetation and wildlife habitat that resembles the pre-channelized state.

Connections. The creation of a continuous multi-use paved trail with neighborhood connections, creek crossings and pedestrian bridges. Connections from the community into this trail system will range from simple gravel connectors, up to trails of the same configuration and materials as the main trail. These connections should incorporate all of the transportation modes in use locally.

Security. Utilization of physical design, increased police patrols and increased public use of the creek corridor to improve creeks' safety. Specific locations will begin with simple features such as uniform lighting, signage, emergency call boxes, increased visibility and reduced understory growth. Basic design elements include clear lines of sight, uniform lighting using a white light source, clear delineation between public and private spaces, public "ownership" and access control.

Prior Plans and Visions

The resulting Westside Creeks concepts aligns with current and prior City plans and visions. The recently adopted 2011 SA2020 identified increasing the growth of green spaces (sidewalks, parks, etc.), providing opportunities for families to improve their health and well-being, and reducing the number of vehicle miles which are all supported by the proposed development of 14 miles of linear creekway trails and ecosystem restoration. The vision also called for increasing the economic impact of the arts which is also supported by the recommended percent for the arts.

Other plans such as the 2011 West/Southwest Sector Plan call for the support of the Westside Creeks Restoration Plan as does the 2009 Westside Reinvestment Plan. The 2007 Guadalupe Westside Community Plan identified the objectives of developing a linear park system along Apache and Alazán Creeks, requesting more visible security at area parks, and improving drainage infrastructure which are recommended within the Westside Creeks Restoration Concept Plan.

The 2005 Avenida Guadalupe, San Antonio, Texas Redevelopment Plan strongly acknowledged the importance of open space and linkages within communities. It also identified the Alazán and Apache Creeks as both a constraint because they separate neighborhoods and as an opportunity because of their potential to serve as connections and linkages to neighborhoods, parks, schools, and other community destinations.

The 2004 Nogalitos/South Zarzamora Community Plan embraced the concept of linking parks and green spaces with trails along the San Antonio River and up San Pedro Creek. The 1999 Downtown Neighborhood Plan – Westside, identified as a strategy enhancing San Pedro and Alazán Creeks as green belts for pedestrians, bicyclists and for active recreational uses.

Lastly, the 1993 Historic Civic Center Master Plan identified San Pedro Creek as having the potential to become a linear park connecting existing neighborhoods to the north and south of the Historic Civic Center and envisioned the creekway lined with native trees and vegetation. These plans and visions all contain elements recommended in the Westside Creeks Restoration Plan which supports integrating creek improvements for flood control, greenways, hike and bike trails, and recreation.

Typical desired natural condition with development & trail amenities (Underlying aerial from the 1960s following Corps channelization of Alazán Creek)

Existing Conditions

OVERVIEW

The Westside Creeks are located just west of downtown San Antonio in an area at the northern part of the Rio Grande Plain and the adjacent Edwards Plateau. Elevations in the project area range from approximately 720 feet along Fredericksburg Road to approximately 570 feet at the confluence of San Pedro Creek with the San Antonio River. Martínez Creek flows in to Alazán Creek, which flows into Apache Creek, which in turn flows into San Pedro Creek.

Bexar County has a modified subtropical climate, predominately continental in winter and marine in summer. Mean annual rainfall is slightly less than 29 inches with a range of 16 to 40 inches. January is typically the driest month with an average of 1.66 inches of precipitation, and May is the wettest month with an average of 4.72 inches of precipitation (RSS 2010). The mean annual temperature is 68°F, with normal temperatures ranging from an average daily high of 94°F in July and August to an average daily low of 38° F in January. An average of 20 days per year is below freezing and an average of 111 days is above 90°F. The normal freeze-free period of 279 days extends from February 24 to November 30 (NRCS 2009).

The Westside Creeks lie in the gulf coastal plains physiographic region of Texas, south of the Balcones escarpment. The gulf coastal plains include three sub-provinces named the coastal prairies, the interior coastal plains and the blackland prairies. The upper reaches of Westside Creeks fall in the blackland prairies region, where the downstream regions fall in the interior coastal plains. The blackland prairies region is characterized by low rolling terrain with marlstone (lime-rich mudstone with variable amounts of clays and aragonite) underline with limestone chalk. Over time, limestone chalks and marlstone weather to deep, black, fertile clay soils. The bedrock in this region is typically shale and sandstone. The interior coastal plains are characterized by tan sandy and clay soils among shales that erode into long, sandy ridges. Chaparral brush and grasses dominate between San Antonio and Laredo.

The evolution of the Westside Creeks over the last half-century is largely due to shifts in urbanization and in flood control and maintenance practices. Earlier cross sections depict a more natural stream, consisting of a baseflow channel, a wider channel and a large floodplain. Straightening and channelization of the creeks yielded grass-lined trapezoidal channels (that delineate most of the creeks), dramatic concrete banks and underground bypass tunnels (San Pedro Creek). The channel substrate consists of unfractured Cretaceous limestone that covers the Edwards Group limestone and is overlaid by a thin soil cap. The high intensity precipitation coupled with urbanized, rocky terrain, makes the Westside Creeks prone to flash floods which rise and fall in rapid response to storms.

While long-time area residents recall base flow that was perennial (continual), site inspections and anecdotal reports indicate that base flow for most of the Westside Creeks has been reduced to either intermittent (during wet periods of the year only) or ephemeral (only immediately following storm events). There is no gauge data available to accurately determine the current base flow category for the Westside Creeks.

FLOOD HAZARDS

As the result of the community's efforts to mitigate frequent flooding conditions and to provide improved stormwater management practices for the area, a significant transformation was accomplished in the 1960s and '70s, changing the channels from natural to widened and rectified drainage systems. Through a comprehensive channelization project, the USACE transformed the natural creeks into efficient drainage channels for the purposes of conveying flood waters out of the neighborhoods as quickly as possible. The project was based on the volume of water that occurred in the 1946 flood. The channelization was effective and for many years provided adequate protection for the area. In many areas, the floodplain was subsequently filled to allow for additional urban development. These changes resulted in creeks that are far from their natural state.

The flooding that had impacted residents and businesses along the Westside Creeks was reduced as a result of the channelization and other modifications that were constructed in the 1960s and '70s; however, additional development in the area adjacent to the creeks as well as within the upstream portions of the contributing watershed has increased impervious cover resulting in greater volumes of storm water runoff. In addition, improved technology to better capture topography and land use to simulate the effects of rain events on the creeks have led to the creation of updated engineering models. These updated models indicate that the existing channelized creeks no longer have the capacity to contain the increased amount of water that would result if another major flood occurred in the area. The channelized creeks no longer provide the same level of flood protection they originally provided.

Concrete channel at Apache Creek

Concrete retaining walls at Alazán Creek

Trapezoidal channel at Alazán Creek

Retaining walls at Martínez Creek

Confluence of Martínez and Alazán Creeks

Trapezoidal channel at San Pedro Creek

From 2004 -2010, SARA partnered with FEMA to update the Flood Insurance Rate Maps in Bexar County and the downstream counties, which included updating the engineering models[3] to reflect current conditions. These updated models and maps enlarged the regulatory floodplains in portions of the Westside Creeks, resulting in the identification of many more homes and businesses in the floodplain. The areas which appear to be most affected by flooding are in the middle portion of Martínez Creek and along Apache Creek, northeast of Elmendorf Lake, both of which have numerous structures which are affected by flooding as frequently as the 10% (10-year) storm event.

Figure 1 illustrates the extent of flooding along the Westside creeks. Exhibits EC-1 through 11 (pages 27 - 37) illustrate the impacts of flooding on this area. Mapping of the floodplain limits from storms with a 4% chance of annual occurrence (commonly referred to as a 25 year storm) and a 1% chance or annual occurrence (commonly referred to as a 100 year storm) shows the locations where the existing stream channels cannot contain the predicted stream flows (see Figure 1). In addition, structures which may be impacted by these flood events are color coded on these maps based on the frequency of flood events which impact them. There is also color coding on these maps applied to the property parcels, for use in identifying publicly owned properties[4].

In 2003, Bexar County, the City of San Antonio and SARA joined forces with 20 suburban communities to establish the Bexar Regional Watershed Management Program (BRWM), in an effort to develop consistent standards and regional solutions to drainage issues. Under this program, projects to mitigate flood issues such as those in the Westside Creeks are jointly undertaken, with SARA developing proposed plans and engineering models and Bexar County constructing the projects with Capital Improvement Project (CIP) funds, according to priorities established by the BRWM.

As part of this coordinated approach, SARA has initiated a San Antonio River Watershed Master Plan that is exploring projects to mitigate the increased flood risk in the neighborhoods adjacent to the creeks. The concepts under investigation in the master plan were coordinated with the restoration concepts being developed for the creeks. The opportunity to explore ecosystem restoration improvements to the creeks while providing additional flood conveyance capacity allows the improvements proposed to the creeks to meet multiple objectives to improve both the ecosystem habitat and sustainability of the creeks while also reducing flooding risk to the adjacent neighborhoods.

GEOMORPHOLOGY

Geomorphology evaluates the shape of a river (dimension, pattern and profile) and how and why it changes over time. The morphology of a river channel is a function of in-stream processes and environmental conditions, including storm flows, sediment transport, bed and bank composition, bed and bank erodibility, vegetation and floodplain characteristics. Figures 2, 3 and 4 illustrate a typical natural stream's morphology in cross section, pattern and profile views and illustrate natural stream features which likely existed in the Westside Creeks prior to their channelization.

Natural channel design aims to restore unstable or altered streams to a state of dynamic equilibrium, where natural function is restored providing a biologically diverse system that reconnects riparian areas, sufficiently transports sediment and conveys storm flows. In urban watersheds, such as the Westside Creeks, sources of instability are a result of increased development (resulting in increased impervious surfaces and increased storm flows), channel alteration, disconnected or modified riparian areas and changes in sediment supply. These anthropogenic (manmade) changes create a state of disequilibrium, characterized by the creek's inability to transport its sediment, adequately convey storm flows or provide suitable aquatic diversity and riparian habitat. Typically, if given the opportunity, channels in this state are in the process of re-establishing their equilibrium. This process modifies the morphological features of the channel to accommodate the changes to the watershed. Martínez, Alazán and San Pedro Creeks are examples of streams which are undergoing natural modification to their morphological features; however, due to flood maintenance activities that have been required over the past 50 years (e.g. dredging) these creeks have made little progress in re-establishing equilibrium. Similarly, the base flow channel of Apache is predominantly concrete lined and cannot adjust to the natural and man-made changes that have occurred in the watershed and in the creek over the past 50 years.

Performing a geomorphic classification provides a useful framework to assess the morphology of the stream system by establishing its fundamental components: dimension, pattern and profile. Morphological parameters can be calculated

[3] *Bexar County Flood Insurance Study, September 2010.*
[4] *Bexar County Appraisal District, 2008.*

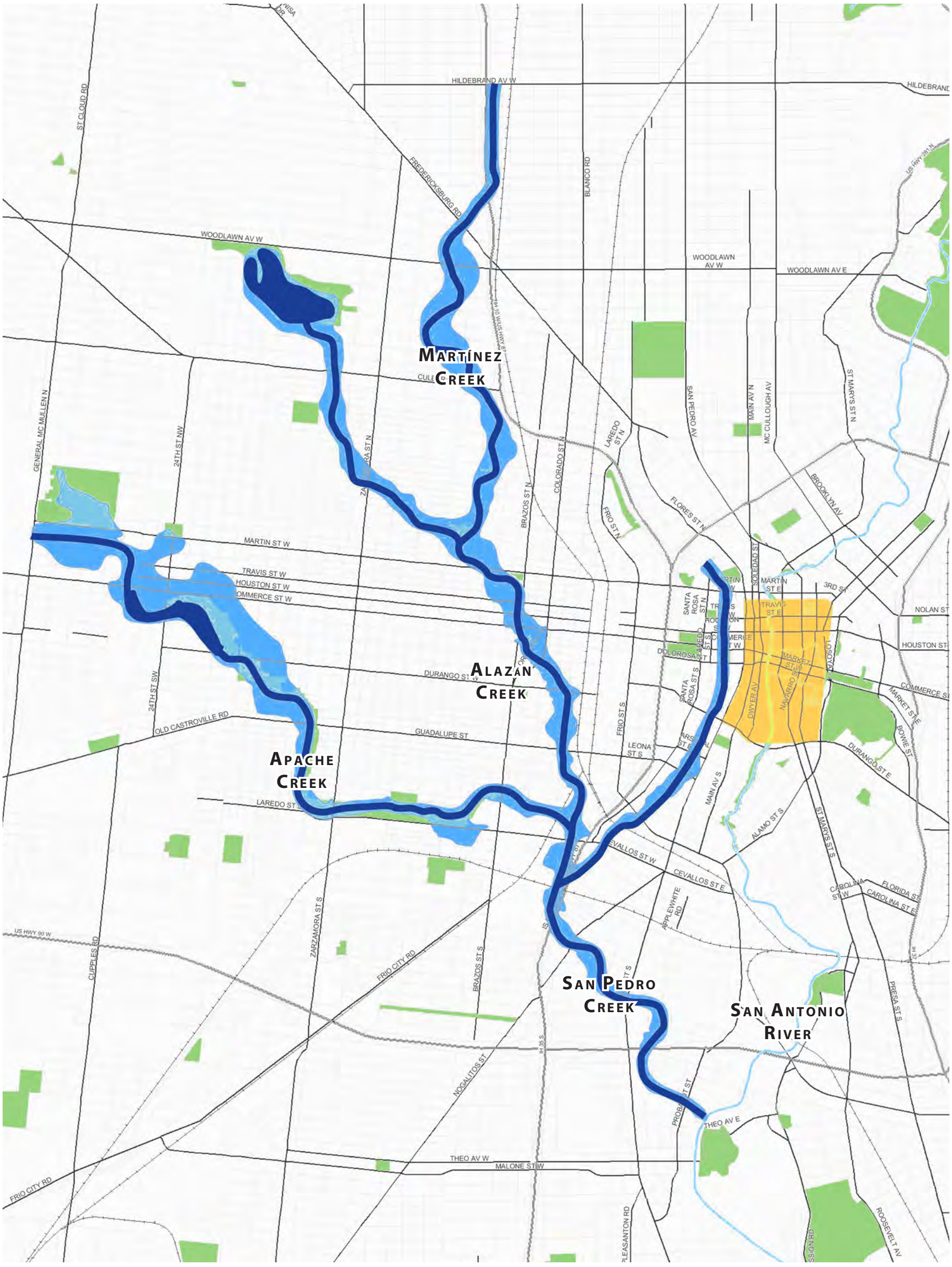


FIGURE 1. FEMA 100-YEAR FLOODPLAIN MAP

Existing Parks
FEMA 100-Year Floodplain
(September 2010)

Creek Extents
Central Business District

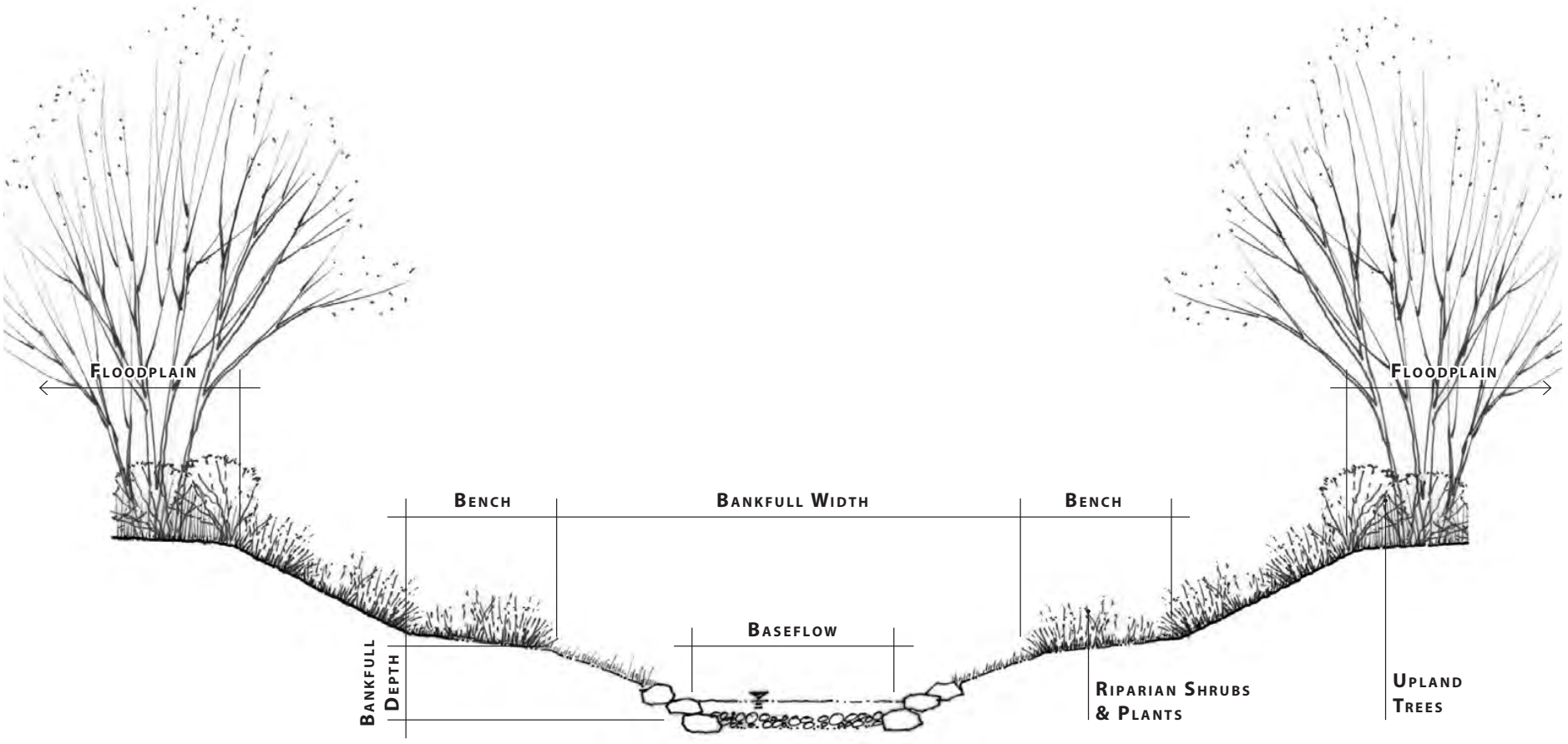


Figure 2. Typical Natural Channel Cross Section

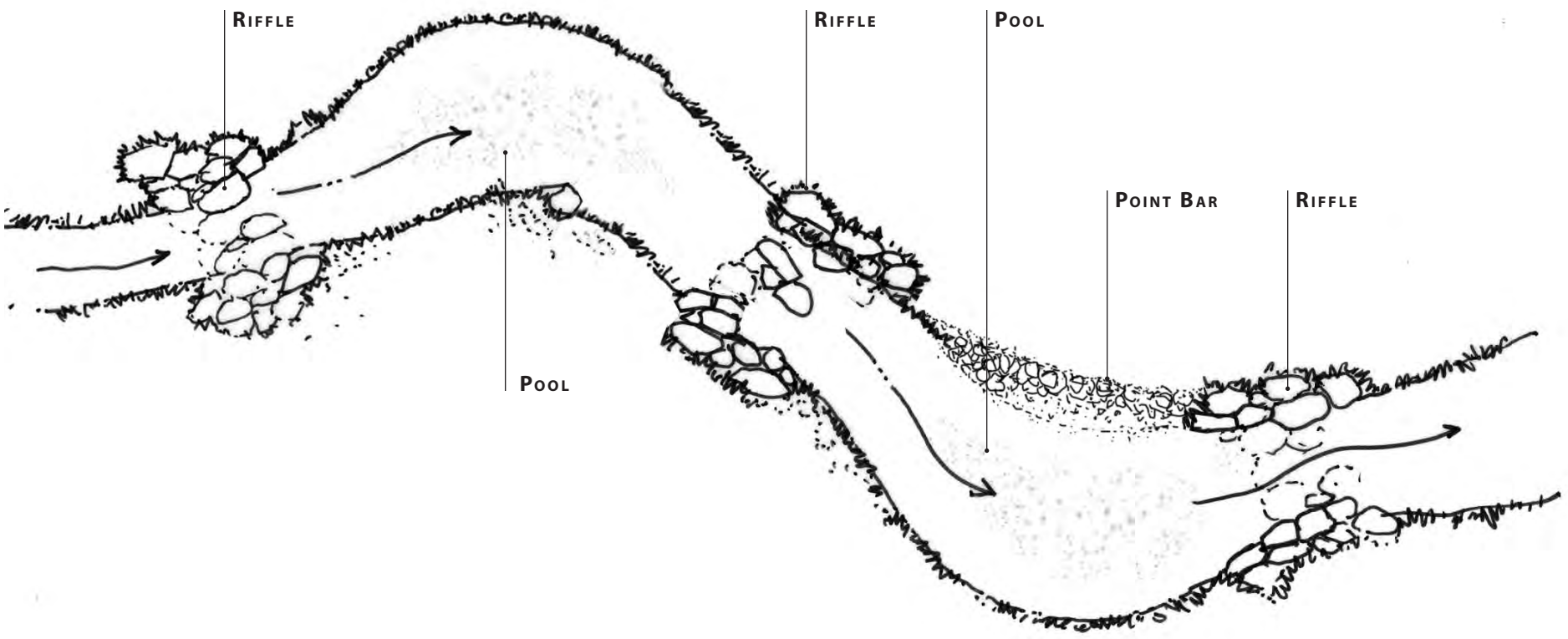


Figure 3. Pattern of a Natural Channel with Typical Riffle, Pool Morphology

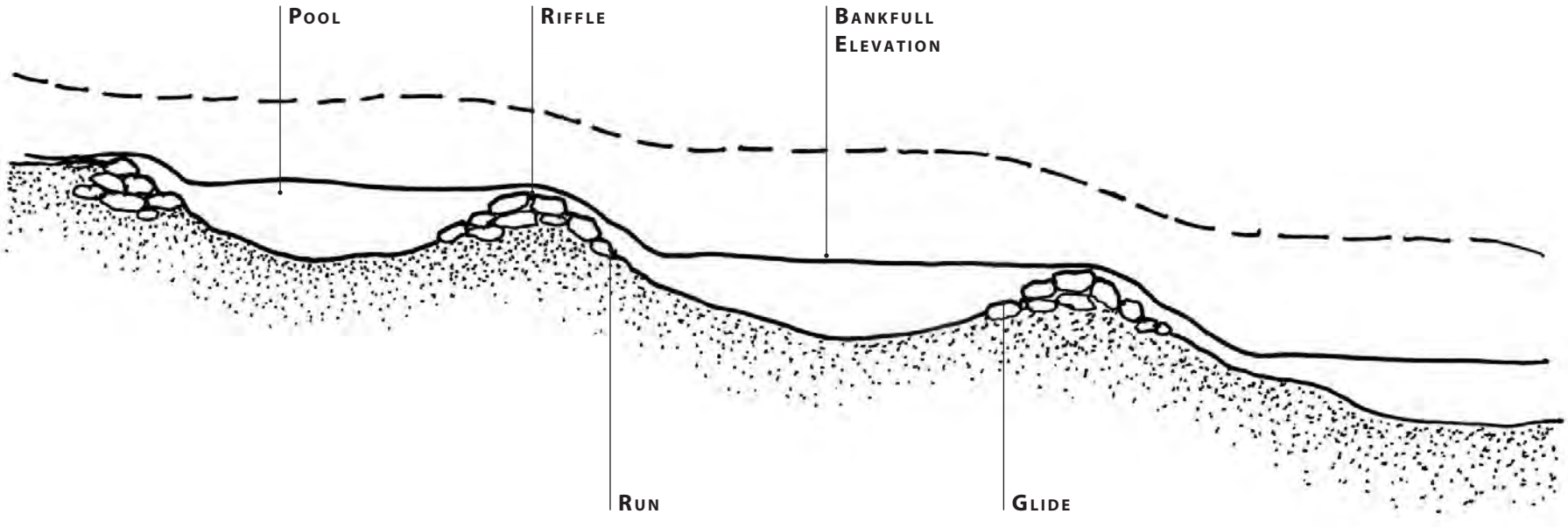


Figure 4. Profile of a Natural Channel with Typical Riffle, Pool Morphology

from these fundamental components to provide insight into how the system has responded to changes. Since the study streams have been highly modified from their natural state, a conceptual level stream classification of existing conditions was not conducted. However, it is still helpful to understand the streams existing and historical morphological characteristics as these provide insight to the desired equilibrium state. Many morphological variables are a function of the bankfull discharge (or streamflow), sometimes referred to as the effective or dominant discharge of the channel. The bankfull discharge is the most critical parameter in natural channel design and defines the channel shape due its frequency, magnitude and efficiency in moving sediment. It is also the stream flow condition where flood waters begin to access the natural floodplain, or the point of "incipient flooding." The most commonly accepted definition of the bankfull stage was provided by Dunne and Leopold (1978): "The bankfull stage corresponds to the discharge at which channel maintenance is the most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work results in the average morphologic characteristics of channels." The storm event which creates this bankfull discharge is typically between the 1- and 2- year recurrence interval. The glossary in the back of this report provides definitions of other morphological variables used in performing a geomorphic assessment of the stream channel.

The natural, unaltered, pre-developed state of the Westside Creeks channels were likely characterized by riffle, pool morphology with moderate slopes and sinuosity and broad, open floodplains. However, as development increased, impervious areas increased which correspondingly increased runoff. This led to accelerated bank erosion rates, aggradation, degradation and incision as the streams worked towards a new state of equilibrium. Compounding the situation for the Westside Creeks was the alteration of their fundamental components of dimension, pattern and profile. When approaching natural design it is helpful to understand the evolutionary process a stream would undertake naturally to re-achieve equilibrium. A model defining the six stages of channel evolution model was first developed by Simon and Hupp in 1986. It is common in confined urban systems to see succession from a natural, stable channel with riffle, pool morphology and wide, open floodplains to channels where the floodplain has been encroached due to development. Additionally, altered streams which have been straightened experience an increase in the slope of the channel which results in increased velocities and shear stress. This change can result in near bank erosion and channel incision as the channel evolves to a new state of equilibrium and is often characterized by a more confined channel, with greater sinuosity than its pre-developed, unaltered condition.

SOILS

The geology of the Westside Creeks was developed during the Early Cretaceous period (130 to 90 million years ago) when central Texas was part of the Gulf of Mexico (Wrede 2005). Marine organism deposition developed into a hard layer of limestone, called caliche, which is found just below the soil surface in the Westside Creeks area and in some cases is exposed to the surface. Caliche is composed of limestone material with some gravel and cobble aggregate, which is the parent material from which the soil was derived. The channel substrate generally consists of unfractured Cretaceous limestone that covers the Edwards Group limestone and is overlaid by a thin soil cap.

Soil is another of the foundations upon which stream restoration must be established. It is important to provide plant species for restoration that will thrive and reproduce within the available soil foundation and its characteristics. There are 12 soil types within a quarter mile of the four creeks, which can be categorized in to seven soil series (NRCS 2010). These soils influence the nature of the soil, through sediment transport and urban grading, that is located within each of the Westside Creeks' drainage systems. The soil types are listed below in Table 1.

Soil sample at Martínez Creek

Black crowned night heron at Martínez Creek

TABLE 1. SOIL TYPES WITHIN A QUARTER MILE OF THE CREEKS

Soil Type	San Pedro	Martínez	Alazán	Apache
Austin silty clay, 3 to 5 percent slopes		*		
Branyon clay, 0 to 1 percent slopes	*		*	*
Branyon clay, 1 to 3 percent slopes	*	*	*	*
Houston Black clay, 1 to 3 percent slopes		*		*
Houston Black gravelly clay, 1 to 3 percent slopes			*	*
Houston Black gravelly clay, 3 to 5 percent slopes			*	
Lewisville silty clay, 0 to 1 percent slopes	*	*	*	*
Lewisville silty clay, 1 to 3 percent slopes	*			
Patrick soils, 0 to 1 percent slopes, rarely flooded	*			
Patrick soils, 1 to 3 percent slopes, rarely flooded	*			
Sunev clay loam, 1 to 3 percent slopes	*			
Tinn and Frio soils, 0 to 1 percent slopes, frequently flooded	*	*	*	*

Natural Resources Conservation Service (NRCS). 2009. Soil Survey Geographic (SSURGO) database for Bexar County, Texas. October 26, 2009.

As a part of this study, agricultural suitability tests were performed on limited soil samples from each of the Westside Creeks to determine the characteristics for prescribing restoration. Soil textures included clay, loamy clay, gravelly sandy clay loam, gravelly loam and gravelly clay. Based on these limited samples, the soil is generally alkaline with an average pH of 7.62 with a range 7.52 to 7.68. The limestone from the caliche parent material is present throughout the soil, which can induce iron deficiencies or "chlorosis" in acid-loving plants. Generally, soil salinity is not excessive, and nitrogen, phosphorous and boron concentrations are low. Likewise, sulfur is low for Alazán, Apache and Martínez Creeks.

Lead was determined from the samples to be elevated, but still within acceptable limits (perhaps due to past agricultural activities) in San Pedro and Martínez Creeks. Woody species are the most sensitive to lead, with herbaceous species being less sensitive and grasses being the most tolerant to heavy metals. San Pedro samples showed excessive zinc and manganese. Excessive zinc causes stunting, dieback and discoloration of many natural vegetation species, and excessive manganese interferes with the assimilation of iron.

VEGETATION

Some landscape trees exist at the top of some of the channel banks and include oak (Quercus spp.), sycamore (Platnus occidentalis), huisache (Acacia farnesiana), Mexican ash (Fraxinus berlandieri), Texas mulberry (Morus microphylla), pecan (Carya illinoinensis), black walnut (Juglans nigra) and American black elderberry (Sambucus Canadensis). A few wetland species occur at small isolated seeps or along the margins of the baseflow channel and include cattail (Typha domingensis), sedges (Carex spp.) and rushes (Juncus spp.).

Although most of the species present are relatively weedy in nature, only one species, giant reed (Arundo donax), found at a tributary along Apache Creek, is considered to be highly invasive. More information on the existing vegetation can be found in the Appendix of this report.

WILDLIFE

A number of common wildlife species are typically present along the Westside Creeks. Some of these species were observed during the brief field visit in 2010 and are listed in Table 2. These creeks provide both core habitats as well as migration linkages. The vegetation in the Westside Creek channels primarily consists of grasses and forbs providing limited habitat value. Most of the core habitat is associated with the in-creek reservoirs such as Elmendorf Lake, Woodlawn Lake and portions of San Pedro where perennial water occurs.

WATER QUALITY

The Texas Commission on Environmental Quality (TCEQ)'s Draft 2010 Water Quality Inventory (also known as the "303(d) List") identifies numerous tributaries of the Upper San Antonio River as not meeting the contact recreation use designation because of bacteria. The tributaries include three of the Westside Creeks: Apache Creek (Segment 1911B), Alazán Creek (Segment 1911C) and San Pedro Creek (Segment 1911D). Primary contact recreation use is defined by the TCEQ as "activities that are presumed to involve a significant risk of ingestion of water (e.g., wading by children, swimming, water skiing, diving, tubing, surfing and the following whitewater activities: kayaking, canoeing and rafting)."

Nutrient concerns were also identified for this area in SARA's 2010 San Antonio River Basin Highlights Report including nitrate, orthophosphorus, and total phosphorus. Nutrients increase plant and algae growth. When plants and algae die, the bacteria that decompose them use oxygen, and this in turn, reduces the dissolved oxygen in the water. High levels of nitrates and nitrites can produce nitrite toxicity, or "brown blood disease," in fish. This disease reduces the ability of blood to transport oxygen throughout the body. Finally, San Pedro and Apache Creeks were identified as having concerns for dissolved oxygen, based upon grab-sample screening levels in the highlights report.

TABLE 2. LIST OF SPECIES OBSERVED DURING 2010 SITE VISIT

Species	Common Name
Reptiles	
Apalone spinifera guadalupensis	Guadalupe spiny softshell turtles
Trachemys scripta elegans	red eared slider
Fish	
Ctenopharyngodon idella	grass carp
Invertebrates	
Fallicambarus sp.	crayfish
Birds	
Ardea herodias	Great blue heron
Nycticorax nycticorax	Black crowned night heron
Egretta thula	Snowy egret
Ardea alba	Great egret
Quiscalus mexicanus	Great-tailed grackle
Phalacrocorax brasilianus	Neotropical cormorant
Charadrius vociferus	Kildeer
Zenaida macroura	Mourning dove
Petrochelidon pyrrhonota	Cliff swallow
Zenaida asiatica	White wing dove
Passer domesticus	House sparrow
Mammals	
Canis lupus familiaris	feral dog
Felis catus	feral cat

SOCIO-ECONOMIC

The U.S. Census data (2000) provides an opportunity to examine the socioeconomic character of the census tracts comprising the Westside Creeks communities. According to the census data, approximately 89 percent of the population in the communities identified themselves as Hispanic. Approximately 7 percent identified themselves as white and 2.5 percent identified themselves as African American. Smaller percentages of American Indian/ Alaska Native, Asian and Native Hawaiian/Pacific Islanders were also identified in the area. These numbers demonstrate, what those living in the Westside Creeks generally already know about their neighborhoods—a higher percentage of individuals considering themselves Hispanic as compared to the total population of San Antonio, which is approximately 59 percent Hispanic, 32 percent white, 6.5 percent African American and several other ethnicities comprising the remainder.

Language also varies in the neighborhoods from the overall City of San Antonio population. For adults aged 18 to 64 years, approximately 20 percent of residents of the Westside Creeks neighborhoods speak only English compared to 79 percent speaking Spanish; of those who speak Spanish, 47 percent reported the ability to speak English "very well." In the City of San Antonio

TABLE 3. STREAM REACH DEFINITION PARAMETERS

Reach	Reach Limits	General Conditions	ROW Constraints	Flood Hazards	Vegetation	Socio-Economic
AL-1	S. Josephine Tobin Dr. culvert to Lombrano St. bridge	trapezoidal grass lined channel	limited	moderate (some 50 yr)	grasses	residential
AL-2	Lombrano St. bridge to W. Poplar St. bridge	rectangular channel with concrete retaining walls	very limited in public housing	moderate (some 50 yr)	grasses	adjacent public housing project
AL-3	W. Poplar St. bridge to near Leal St.	trapezoidal grass lined channel	limited	moderate (some 50 yr)	grasses	residential
AL-4	near Leal St. to Martínez Creek confluence	trapezoidal grass lined channel	limited, public land at Farias Park	major (some 10 yr)	grasses	residential
AL-5	Martínez Creek confluence to S. Colorado St. bridge	trapezoidal grass lined channel	limited	major (some 10 yr)	grasses	residential and retail
AL-6	S. Colorado St. bridge to Missouri Pacific Railroad bridge	trapezoidal grass lined channel	limited, very restricted near San Luis	moderate (some 50 yr)	grasses	adjacent public housing project, residential and industrial
AL-7	Missouri Pacific Railroad bridge to Apache Creek confluence	trapezoidal grass lined channel	limited, public land near confluence	minor (some 100 yr)	grasses	residential and industrial
AP-1	N. General McMullen Dr. bridge to SW 19th St. bridge	Elmendorf Lake	limited above Commerce, public park on north shore between 24th and 19th Streets	extreme (extensive 10 yr) above Commerce	woody riparian zone in upper end, grasses in lower end	residential, public housing, retail, adjacent to Our Lady of the Lake University
AP-2	SW 19th St. bridge to Chihuahua St. footbridge	trapezoidal grass lined channel with concrete pilot and riprap on outer bends	publc parkland in upper end, limited below	moderate (some 50 yr)	limited grasses	residential
AP-3	Chihuahua St. footbridge to S. Trinity St. bridge	trapezoidal grass lined channel with concrete pilot and riprap on outer bends	extensive public lands	minor (limited 50 yr)	limited grasses in channel, woody plants in parks	adjacent public housing, residential and industrial
AP-4	S. Trinity St. bridge to Missouri Pacific Railroad bridge	trapezoidal grass lined channel with concrete pilot and riprap on outer bend (at upper end)	limited	moderate (some 50 yr)	concrete pilot in upper end, then grasses	adjacent public housing, residential and industrial
AP-5	Missouri Pacific Railroad bridge to San Pedro Creek confluence	trapezoidal grass lined channel	limited	minor (some 100 yr)	grasses	industrial

as a whole for adults of the same age, 50 percent speak only English, 47 percent speak Spanish and 32 percent of those who speak Spanish reported the ability to speak English "very well."

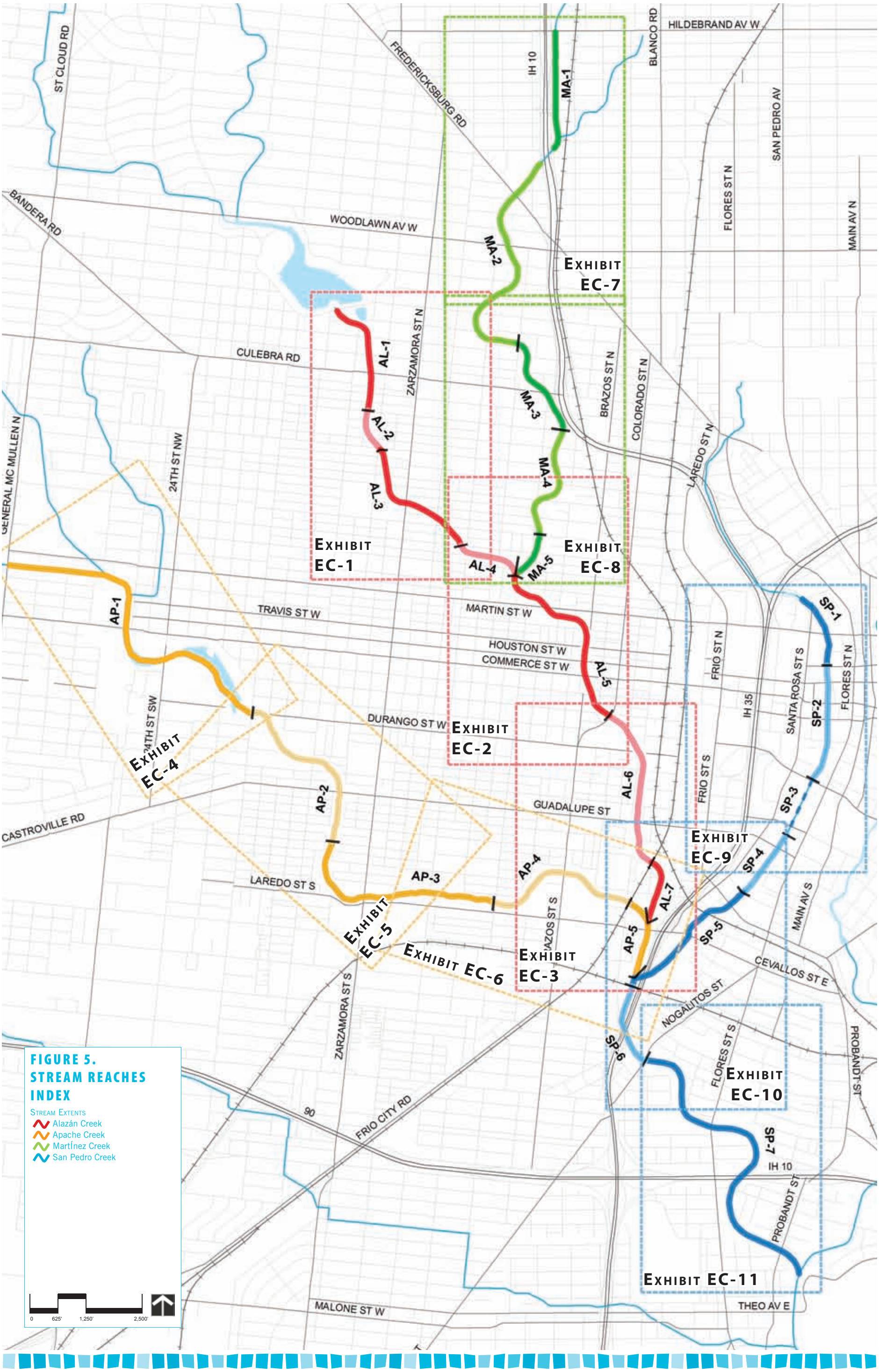
Median household incomes varied within the Westside Creeks census tracts from $10,871 to $32,556 as compared to a City of San Antonio median income of $36,214 for the same time period. While many factors affect median household incomes, the median household incomes of tracts in the Westside Creeks area tend to be lower than that of the entire City.

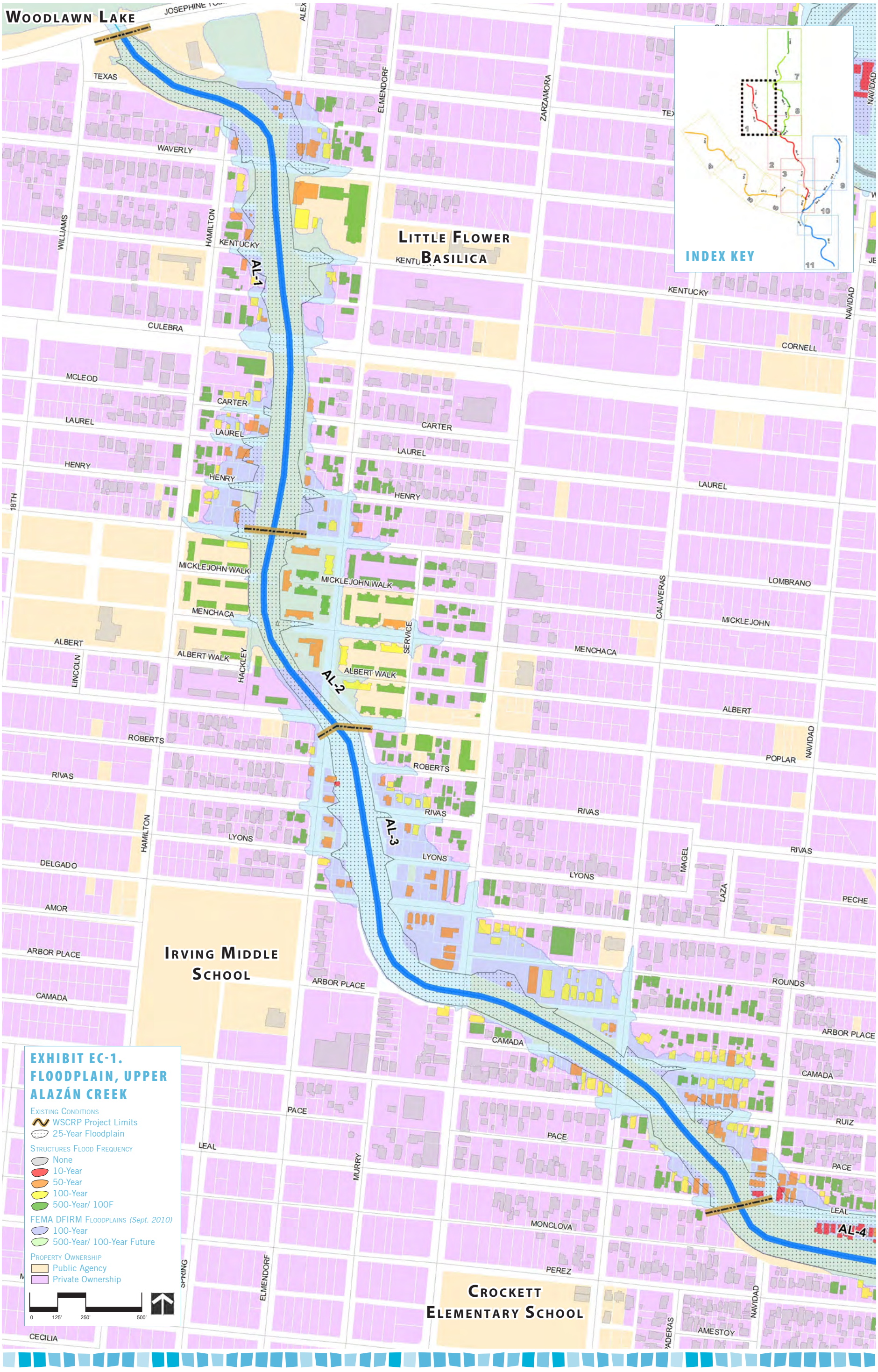
REACH DESIGNATION

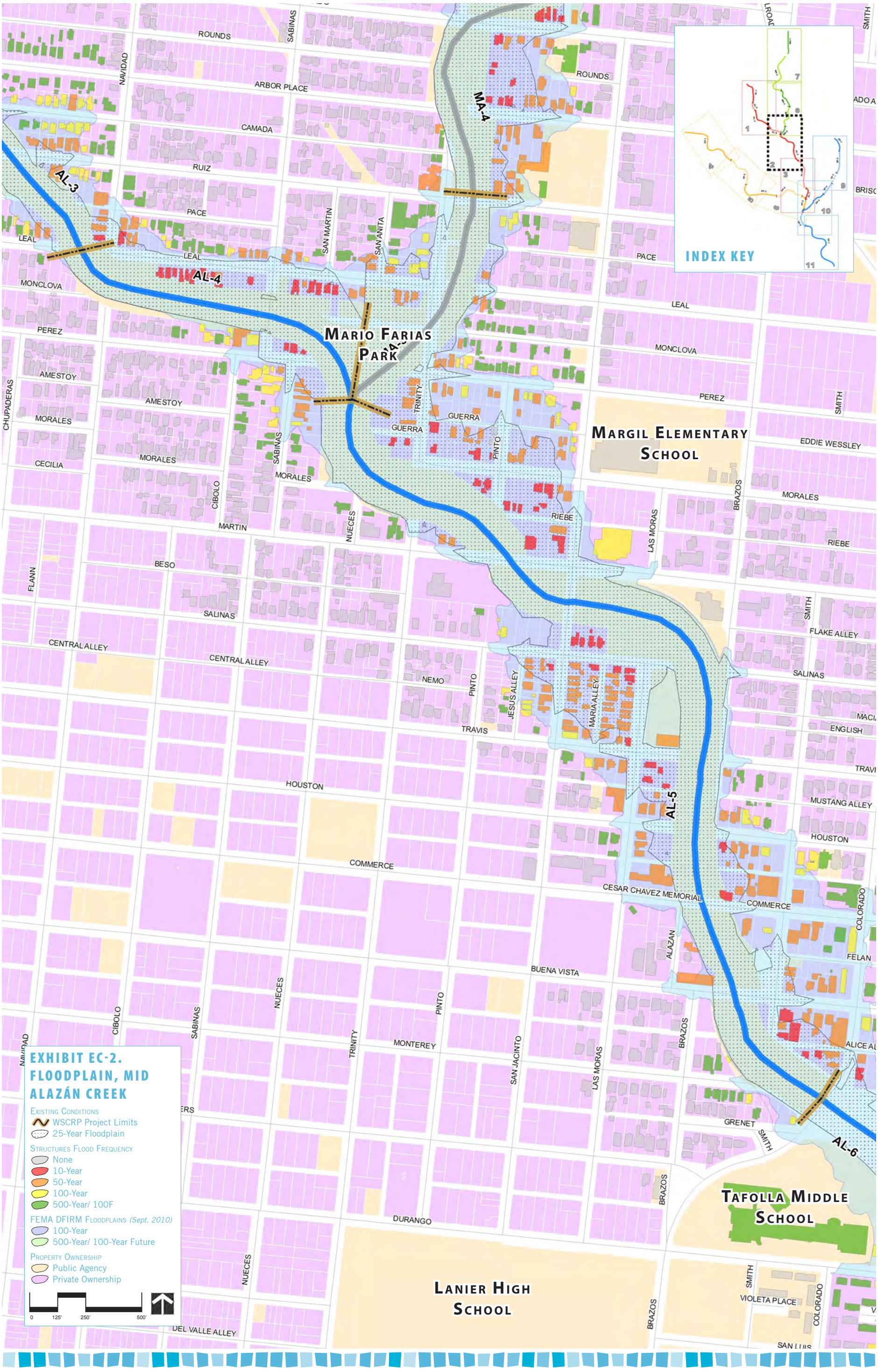
For the purposes of further discussion and characterization in this report, each of the Westside Creeks was divided into multiple individual reaches which are relatively uniform in character (flood hazard, ROW constraints, existing design, etc). These reaches are shown in large scale within the overall Westside Creeks map provided in Figure 5 and are also highlighted in more detail on the existing conditions maps shown in Exhibits EC-1 through EC-11. The reach limits and some of the defining characteristics of each reach are summarized in Table 3. In this report, the stream reaches and various features are identified by stream with the following acronyms: Alazán Creek (AL-_), Apache Creek (AP-_), Martínez Creek (MA-_) and San Pedro (SP-_).

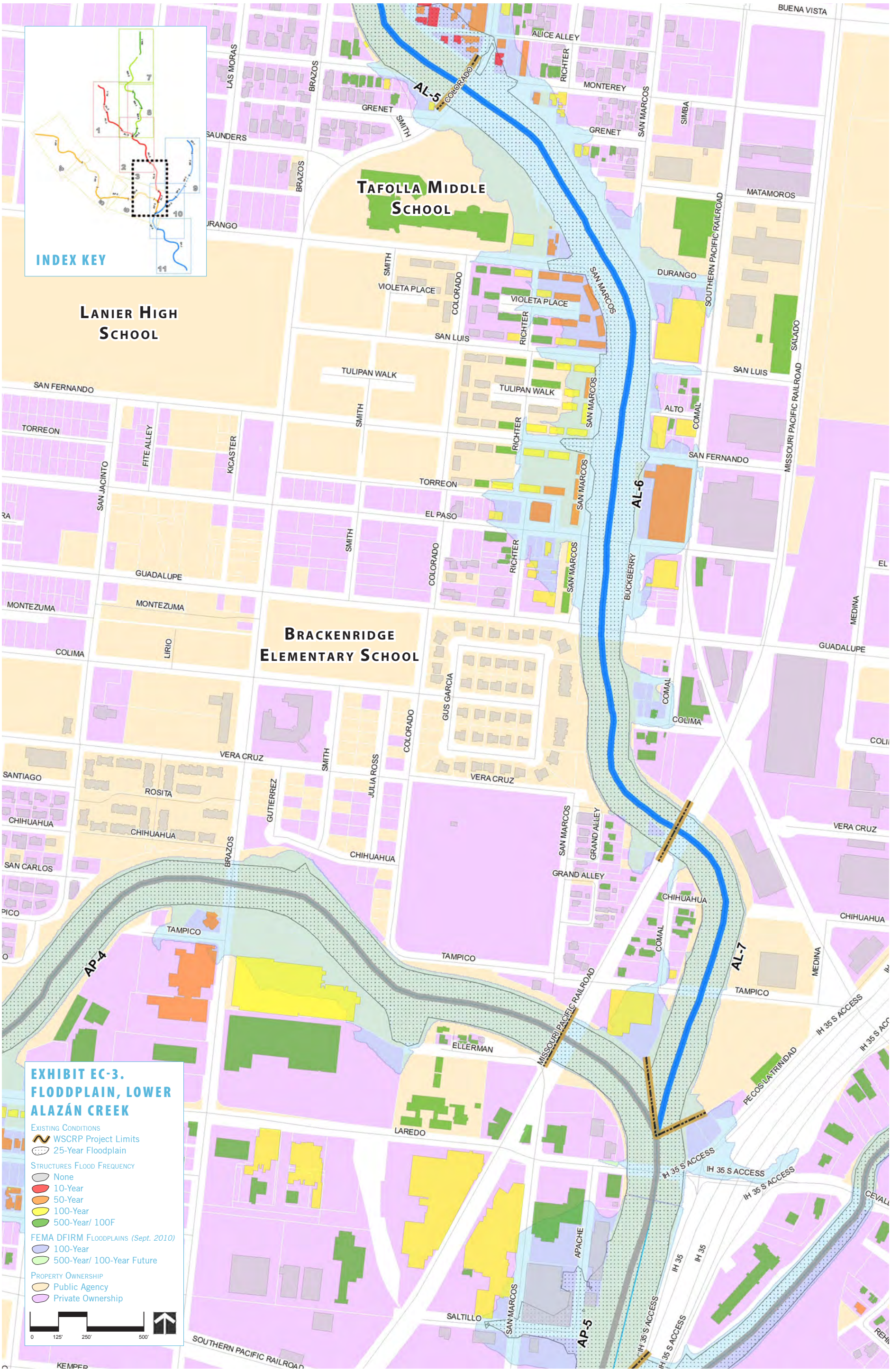
TABLE 3. STREAM REACH DEFINITION PARAMETERS

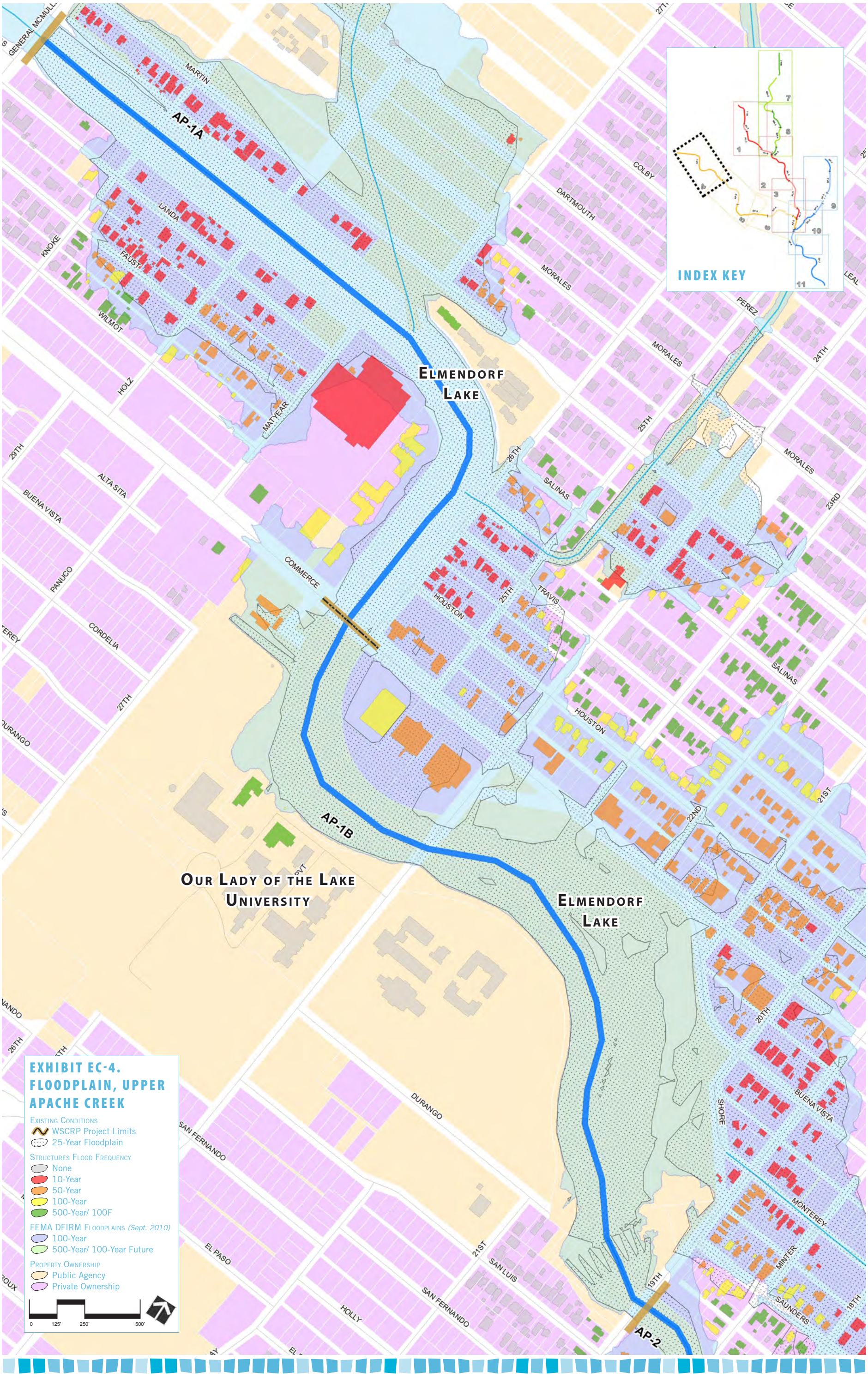
Reach	Reach Limits	General Conditions	ROW Constraints	Flood Hazards	Vegetation	Socio-Economic
MA-1	Hildebrand Ave. bridge to IH-10 culvert	trapezoidal grass lined channel	frontage road hard limit	moderate (some 50 yr)	grasses	adjacent to IH-10 and industrial
MA-1x	IH-10 culvert	box culvert without overland access, trails must utilize culvert or divert to street level	public ROW under IH-10	none	none	n/a
MA-2	IH-10 culvert to N. Sabinas St. bridge	shallow trapezoidal grass lined channel	limited above Fredericksburg, some public land from previous flood buyouts below	extreme (extensive 10 yr)	grasses in channel, some woody plants in overbanks	residential and industrial
MA-3	N. Sabinas St. bridge to near Lombrano St.	trapezoidal grass lined channel	limited, some public land at lower end	major (some 10 yr)	grasses and woody plants in overbanks	residential and retail
MA-4	near Lombrano St. to Ruiz St. bridge	trapezoidal grass lined channel	limited	extreme (extensive 10 yr)	grasses	industrial and residential
MA-5	Ruiz St. bridge to Alazán Creek confluence	trapezoidal grass lined channel	limited, public land at Farias Park	moderate (some 50 yr)	grasses	residential
SP-1	tunnel inlet to W. Travis St. bridge	rectangular concrete / masonry lined channel with grassy overbanks (at upper end)	limited by roadway	minor (no structural flooding, roadway only)	limited grasses and woody plants	urbanized residential
SP-2	W. Travis St. bridge to W. Durango Blvd. culvert	rectangular concrete / masonry lined channel	extremely constrained by commercial structures	moderate (limited 10 yr)	little to none	urbanized commercial and governmental facilities
SP-3	W. Durango Blvd. to south of El Paso St.	extended box culvert with potential for overland trails	no existing ROW (drainage easement likely)	none	n/a, no restoration in this reach, trails opportunity only	hotels and industrial
SP-4	culvert outfall south of El Paso St. to Camp St. culvert	rectangular concrete / masonry lined channel	very constrained by industrial structures	extreme (extensive 10 yr)	little to none	industrial
SP-5	Camp St. culvert to Southern Pacific Railroad bridge	trapezoidal grass lined channel	limited at upper end, extensive private land at lower end	minor (limited 50 yr)	grasses and limited woody plants	Industrial, urban residential and governmental facilities
SP-6	Southern Pacific Railroad bridge to Nogalitos St. bridge	trapezoidal grass lined channel	limited	moderate (some 50 yr)	grasses	industrial and residential
SP-7	Nogalitos St. bridge to San Antonio River confluence	trapezoidal grass lined channel	limited	moderate (extensive 50 yr)	grasses	residential

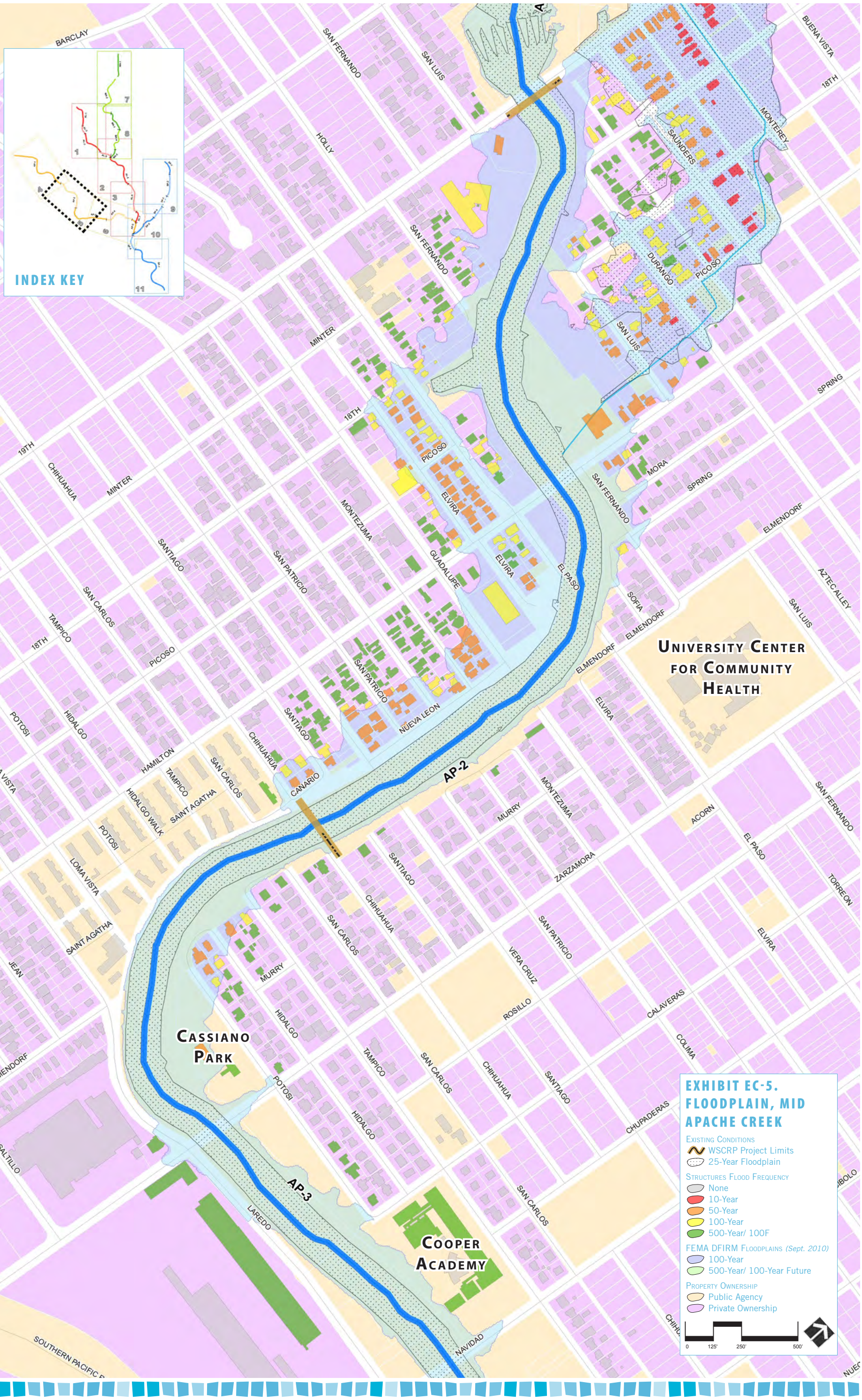

ST CLOUD RD
FREDERICKSBURG RD
IH 10
BLANCO RD
HILDEBRAND AV W
SAN PEDRO AV
FLORES ST N
MAIN AV N
BANDERA RD
WOODLAWN AV W
MA-1
MA-2
MA-3
MA-4
MA-5
AL-1
AL-2
AL-3
AL-4
AL-5
AL-6
AL-7
ZARZAMORA ST N
BRAZOS ST N
COLORADO ST N
LAREDO ST N
CULEBRA RD
24TH ST NW
GENERAL MC MULLEN N
EXHIBIT EC-7
EXHIBIT EC-1
EXHIBIT EC-8
EXHIBIT EC-2
EXHIBIT EC-4
EXHIBIT EC-5
EXHIBIT EC-6
EXHIBIT EC-3
EXHIBIT EC-9
EXHIBIT EC-10
EXHIBIT EC-11
AP-1
AP-2
AP-3
AP-4
AP-5
SP-1
SP-2
SP-3
SP-4
SP-5
SP-6
SP-7
TRAVIS ST W
MARTIN ST W
HOUSTON ST W
COMMERCE ST W
DURANGO ST W
GUADALUPE ST
LAREDO ST S
CASTROVILLE RD
24TH ST SW
ZARZAMORA ST S
BRAZOS ST S
FRIO ST N
FRIO ST S
IH 35
SANTA ROSA ST S
FLORES ST N
MAIN AV S
CEVALLOS ST E
NOGALITOS ST
FLORES ST S
PROBANDT ST
IH 10
FRIO CITY RD
90
MALONE ST W
THEO AV E
FIGURE 5.
STREAM REACHES INDEX
STREAM EXTENTS
Alazán Creek
Apache Creek
MartÍnez Creek
San Pedro Creek
0
625'
1,250'
2,500'


WOODLAWN LAKE
JOSEPHINE TU
ALEX
TEXAS
ELMENDORF
ZARZAMORA
TEX
NAVIDAD
WAVERLY
WILLIAMS
HAMILTON
KENTUCKY
AL-1
LITTLE FLOWER BASILICA
KENTU
CULEBRA
MCLEOD
CARTER
LAUREL
HENRY
18TH
MICKLEJOHN WALK
MENCHACA
ALBERT
ALBERT WALK
LINCOLN
HACKLEY
SERVICE
AL-2
ROBERTS
RIVAS
LYONS
HAMILTON
AL-3
DELGADO
AMOR
ARBOR PLACE
CAMADA
IRVING MIDDLE SCHOOL
CALAVERAS
LOMBRANO
MICKLEJOHN
POPLAR
CORNELL
MAGEL
LAZA
PECHE
ROUNDS
RUIZ
PACE
LEAL
MURRY
MONCLOVA
PEREZ
AMESTOY
CROCKETT ELEMENTARY SCHOOL
CECILIA
SPRING
INDEX KEY
1
2
3
4
5
6
7
8
9
10
11
EXHIBIT EC-1.
FLOODPLAIN, UPPER ALAZÁN CREEK
EXISTING CONDITIONS
WSCRP Project Limits
25-Year Floodplain
STRUCTURES FLOOD FREQUENCY
None
10-Year
50-Year
100-Year
500-Year/ 100F
FEMA DFIRM FLOODPLAINS (Sept. 2010)
100-Year
500-Year/ 100-Year Future
PROPERTY OWNERSHIP
Public Agency
Private Ownership
0
125'
250'
500'


INDEX KEY
ROUNDS
SABINAS
NAVIDAD
ARBOR PLACE
CAMADA
RUIZ
PACE
LEAL
MONCLOVA
PEREZ
AMESTOY
MORALES
CECILIA
CHUPADERAS
CIBOLO
MARTIN
BESO
FLANN
SALINAS
CENTRAL ALLEY
HOUSTON
COMMERCE
BUENA VISTA
NUECES
TRINITY
PINTO
SAN MARTIN
SAN ANITA
SAN JACINTO
LAS MORAS
BRAZOS
ALAZAN
NEMO
JESUS ALLEY
MARIA ALLEY
TRAVIS
RIEBE
GUERRA
MONTEREY
DURANGO
DEL VALLE ALLEY
SMITH
EDDIE WESSLEY
FLAKE ALLEY
ENGLISH
MUSTANG ALLEY
CESAR CHAVEZ MEMORIAL
COLORADO
VIOLETA PLACE
GRENET
FELAN
ALICE
MACIAS
AL-3
AL-4
AL-5
AL-6
MA-4
Mario Farias Park
Margil Elementary School
Tafolla Middle School
Lanier High School
EXHIBIT EC-2.
FLOODPLAIN, MID
ALAZÁN CREEK
Existing Conditions
WSCRP Project Limits
25-Year Floodplain
Structures Flood Frequency
None
10-Year
50-Year
100-Year
500-Year/ 100F
FEMA DFIRM Floodplains (Sept. 2010)
100-Year
500-Year/ 100-Year Future
Property Ownership
Public Agency
Private Ownership
0
125'
250'
500'

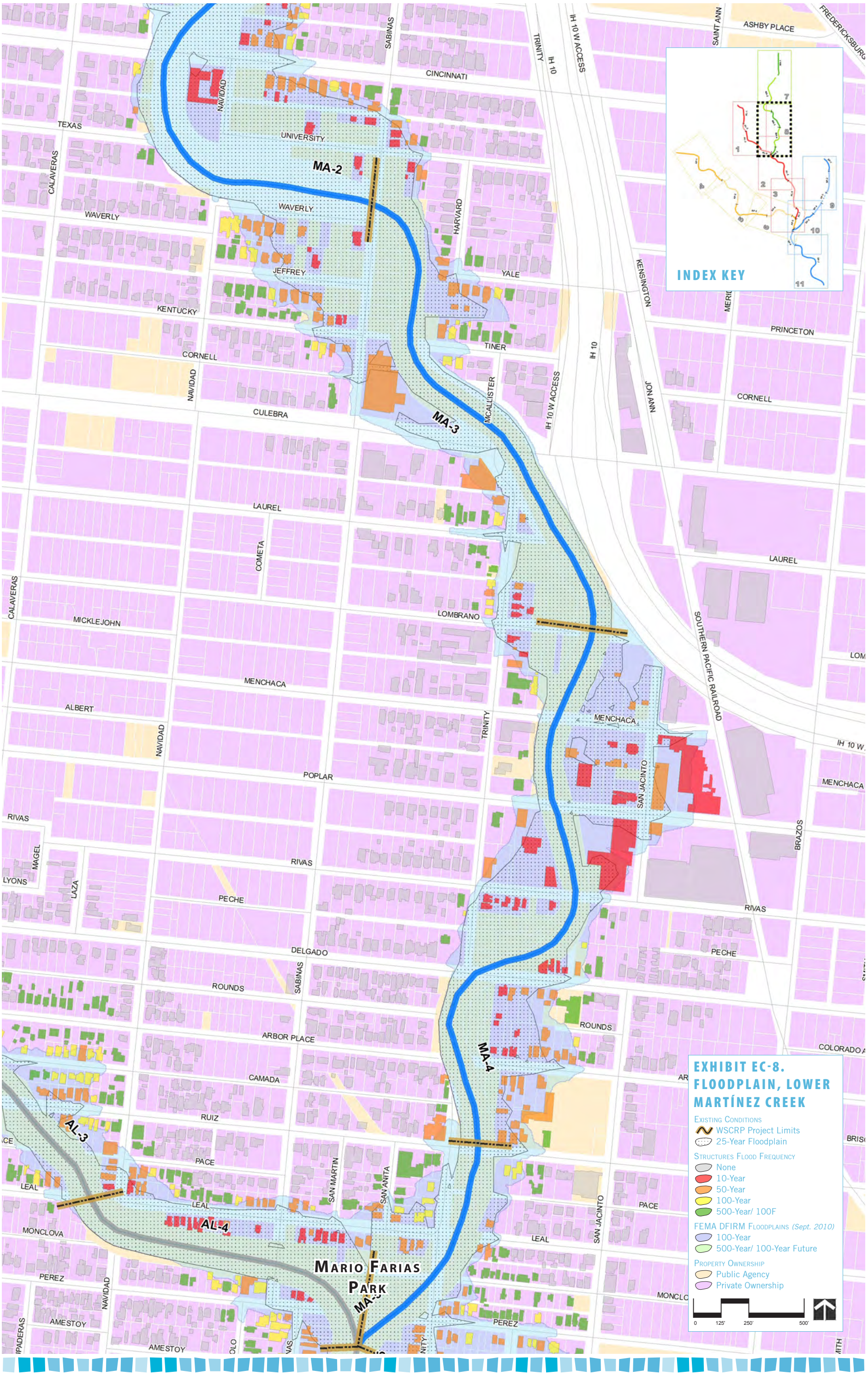

INDEX KEY
LANIER HIGH SCHOOL
TAFOLLA MIDDLE SCHOOL
BRACKENRIDGE ELEMENTARY SCHOOL
BUENA VISTA
ALICE ALLEY
LAS MORAS
BRAZOS
AL-5
COLORADO
RICHTER
MONTEREY
GRENET
SMITH
SAUNDERS
SAN MARCOS
SIMBA
MATAMOROS
SOUTHERN PACIFIC RAILROAD
DURANGO
VIOLETA PLACE
SAN LUIS
SALADO
TULIPAN WALK
SAN FERNANDO
TORREON
FITE ALLEY
KICASTER
SAN JACINTO
ALTO
COMAL
MISSOURI PACIFIC RAILROAD
EL PASO
AL-6
GUADALUPE
MONTEZUMA
COLIMA
LIRIO
BUCKBERRY
MEDINA
GUS GARCIA
VERA CRUZ
SANTIAGO
ROSITA
GUTIERREZ
JULIA ROSS
CHIHUAHUA
SAN CARLOS
GRAND ALLEY
AP-4
TAMPICO
AL-7
ELLERMAN
IH 35 S ACCESS
PECOS LATRINIDAD
LAREDO
APACHE
IH 35
SALTILLO
AP-5
KEMPER
EXHIBIT EC-3. FLOODPLAIN, LOWER ALAZÁN CREEK
EXISTING CONDITIONS
WSCRP Project Limits
25-Year Floodplain
STRUCTURES FLOOD FREQUENCY
None
10-Year
50-Year
100-Year
500-Year/ 100F
FEMA DFIRM FLOODPLAINS (Sept. 2010)
100-Year
500-Year/ 100-Year Future
PROPERTY OWNERSHIP
Public Agency
Private Ownership
0
125'
250'
500'

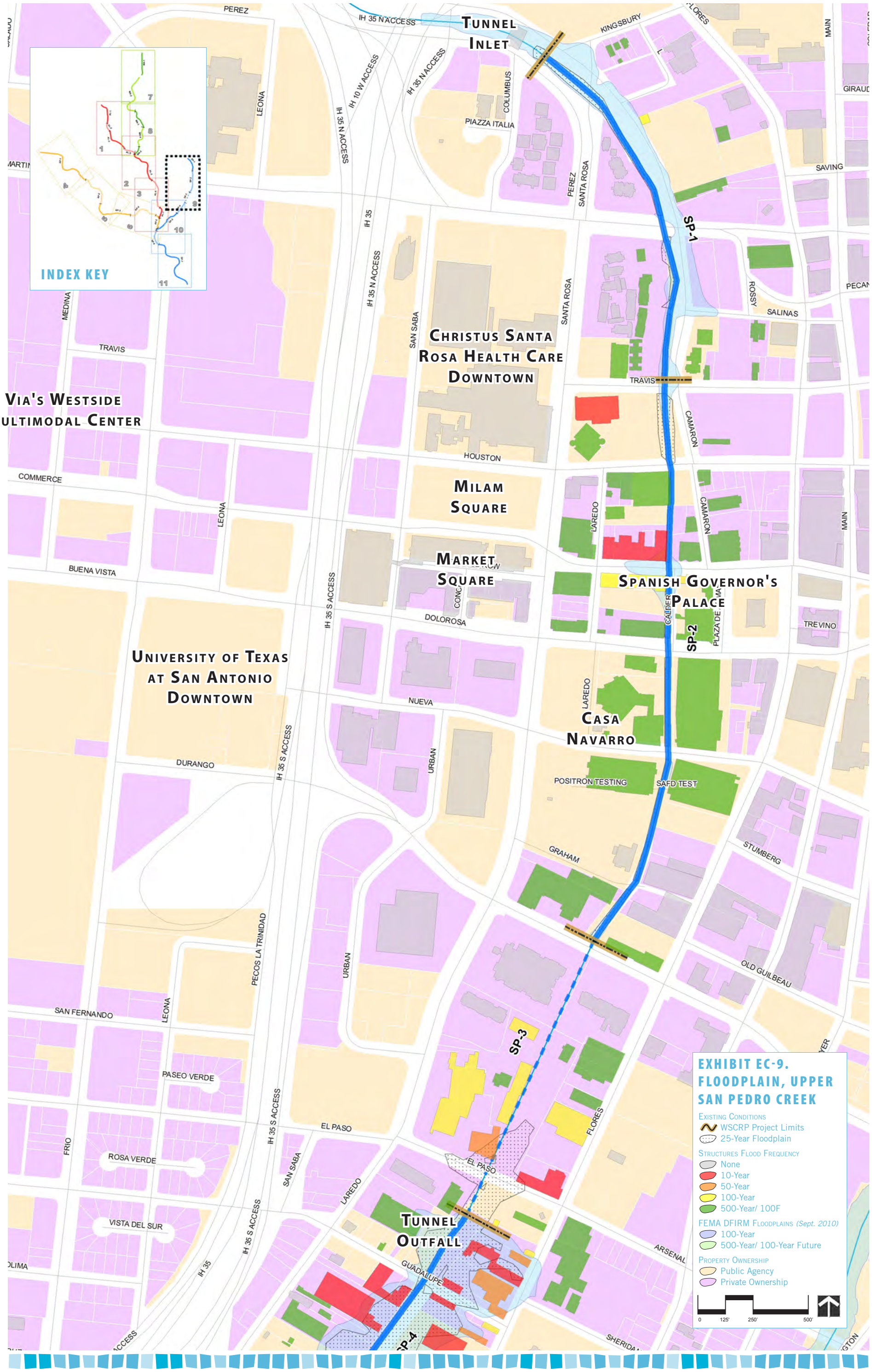

INDEX KEY
1
2
3
4
5
6
7
8
9
10
11
GENERAL MCMULLEN
MARTIN
AP-1A
LANDA
FAUST
KNOKE
WILMOT
HOLZ
MATYEAR
ELMENDORF LAKE
COLBY
DARTMOUTH
MORALES
PEREZ
LEAL
24TH
25TH
26TH
MORALES
SALINAS
23RD
29TH
ALTA SITA
BUENA VISTA
PANUCO
CORDELIA
27TH
COMMERCE
HOUSTON
25TH
TRAVIS
SALINAS
HOUSTON
21ST
22ND
AP-1B
OUR LADY OF THE LAKE UNIVERSITY
ELMENDORF LAKE
20TH
SHORE
BUENA VISTA
MONTEREY
MINTER
SAUNDERS
19TH
18TH
AP-2
DURANGO
SAN FERNANDO
EL PASO
HOLLY
SAN LUIS
EXHIBIT EC-4.
FLOODPLAIN, UPPER
APACHE CREEK
EXISTING CONDITIONS
WSCRP Project Limits
25-Year Floodplain
STRUCTURES FLOOD FREQUENCY
None
10-Year
50-Year
100-Year
500-Year/ 100F
FEMA DFIRM FLOODPLAINS (Sept. 2010)
100-Year
500-Year/ 100-Year Future
PROPERTY OWNERSHIP
Public Agency
Private Ownership
0
125'
250'
500'

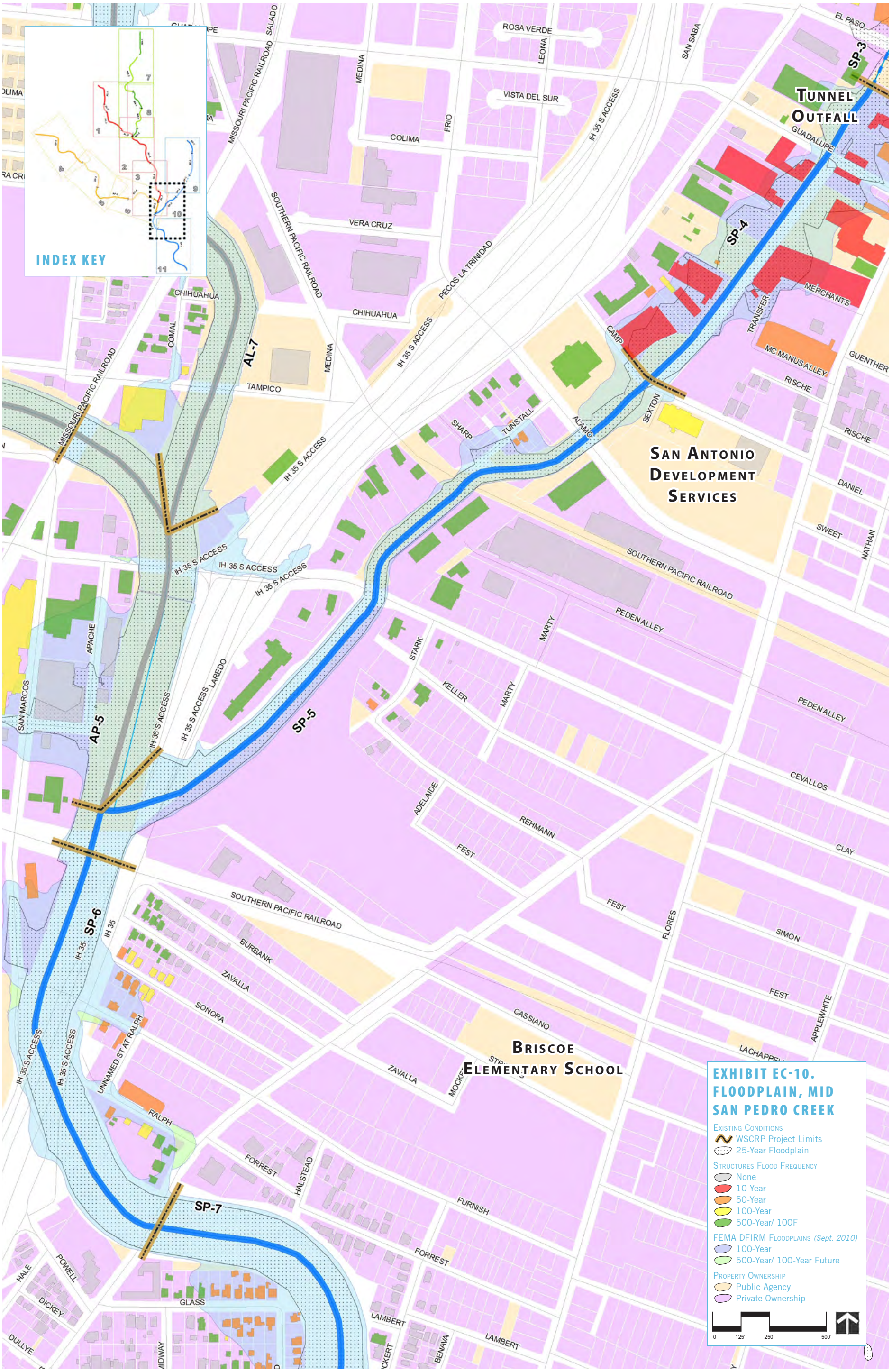

INDEX KEY
BARCLAY
SAN FERNANDO
SAN LUIS
HOLLY
BUENA VISTA
18TH
MONTEREY
SAUNDERS
21ST
MINTER
DURANGO
PICOSO
SPRING
19TH
CHIHUAHUA
MONTEZUMA
ELVIRA
MORA
ELMENDORF
SANTIAGO
SAN PATRICIO
GUADALUPE
EL PASO
SOFIA
AZTEC ALLEY
TAMPICO
SAN CARLOS
NUEVA LEON
HIDALGO
POTOSI
HAMILTON
CANARIO
LOMA VISTA
HIDALGO WALK
SAINT AGATHA
MURRY
ACORN
ZARZAMORA
TORREON
JEAN
VERA CRUZ
ROSILLO
CALAVERAS
COLIMA
CHUPADERAS
SALTILLO
LAREDO
NAVIDAD
AP-2
AP-3
UNIVERSITY CENTER FOR COMMUNITY HEALTH
CASSIANO PARK
COOPER ACADEMY
SOUTHERN PACIFIC
EXHIBIT EC-5. FLOODPLAIN, MID APACHE CREEK
EXISTING CONDITIONS
WSCRP Project Limits
25-Year Floodplain
STRUCTURES FLOOD FREQUENCY
None
10-Year
50-Year
100-Year
500-Year/ 100F
FEMA DFIRM FLOODPLAINS (Sept. 2010)
100-Year
500-Year/ 100-Year Future
PROPERTY OWNERSHIP
Public Agency
Private Ownership
0
125'
250'
500'

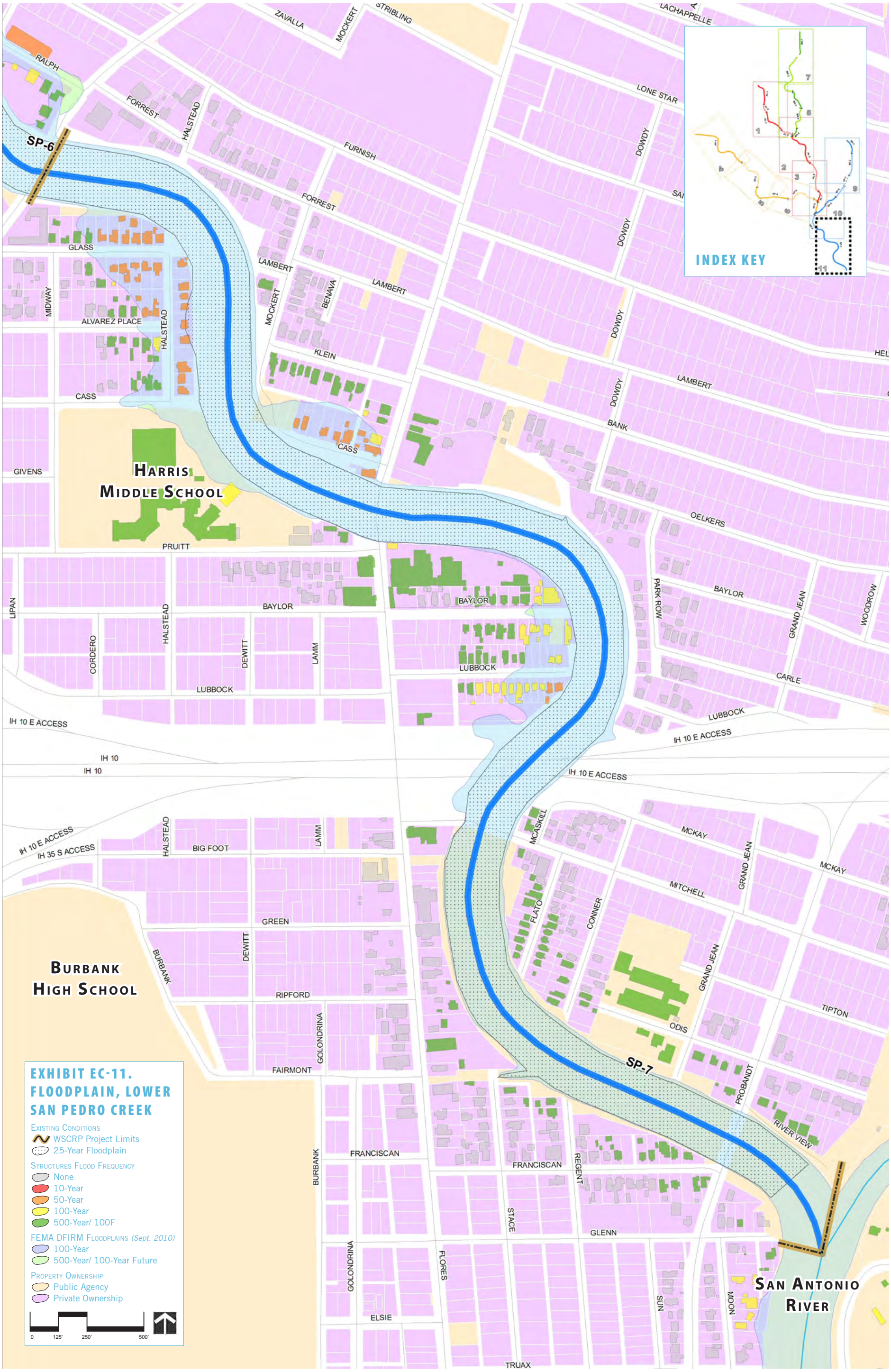

COOPER ACADEMY
AMISTAD PARK
MARTINEZ PARK
ESTRADA ACHIEVEMENT CENTER
AP-3
AP-4
AP-5
AL-7
SP-5
INDEX KEY
NAVIDAD
CIBOLO
SALTILLO
KEMPER
SABINAS
ANGELA
ALTA VISTA
JEAN
LAREDO
HIDALGO
TAMPICO
CHIHUAHUA
VERA CRUZ
SAN CARLOS
SAN PATRICIO
ELVIRA
NUECES
MONTEZUMA
TRINITY
PINTO
SANTIAGO
SAN JACINTO
MERIDA
ORLEANS
ARLENE
PASO CHICO
ROSITA
LIRIO
BRAZOS
GUTIERREZ
SMITH
COLIMA
JULIA ROSS
COLORADO
GUS GARCIA
FLERMAN
SAN MARCOS
GRAND ALLEY
MISSOURI PACIFIC RAILROAD
SOUTHERN PACIFIC RAILROAD
APACHE
COMAL
MEDINA
IH 35 S ACCESS
CEVA
EXHIBIT EC-6.
FLOODPLAIN, LOWER
APACHE CREEK
Existing Conditions
WSCRP Project Limits
25-Year Floodplain
Structures Flood Frequency
None
10-Year
50-Year
100-Year
500-Year/ 100F
FEMA DFIRM Floodplains (Sept. 2010)
100-Year
500-Year/ 100-Year Future
Property Ownership
Public Agency
Private Ownership
0
125'
250'
500'


INDEX KEY
LULLWOOD
IH 10
MA-1
HOLLYWOOD
ROSEWOOD
JERRY
LYNWOOD
NEER
ELSMERE PLACE
BEAL
FULTON
WARNER
GRAMERCY PLACE
KINGS HWY
SUMMIT
LOUISE
KEY
AGARITA
FREDERICKSBURG
MULBERRY
HUISACHE
MAGNOLIA
MISTLETOE
WOODLAWN
CRAIG PLACE
FRENCH PLACE
ASHBY PLACE
CALAVERAS
NAVIDAD
WEST
EAST
MA-2
MA-1x
SOUTHERN PACIFIC RAILROAD
MICHIGAN
CAPITOL
TRINITY
SABINAS
IH 10 W ACCESS
BEACON HILL LINEAR PARK
BEACON HILL COMMUNITY GARDEN
BEACON HILL ELEMENTARY SCHOOL
EXHIBIT RC-7. FLOODPLAIN, UPPER MARTÍNEZ CREEK
EXISTING CONDITIONS
WSCRP Project Limits
25-Year Floodplain
STRUCTURES FLOOD FREQUENCY
None
10-Year
50-Year
100-Year
500-Year/ 100F
FEMA DFIRM FLOODPLAINS (Sept. 2010)
100-Year
500-Year/ 100-Year Future
PROPERTY OWNERSHIP
Public Agency
Private Ownership
0
125'
250'
500'


INDEX KEY
EXHIBIT EC-8.
FLOODPLAIN, LOWER
MARTÍNEZ CREEK
Existing Conditions
WSCRP Project Limits
25-Year Floodplain
Structures Flood Frequency
None
10-Year
50-Year
100-Year
500-Year/ 100F
FEMA DFIRM Floodplains (Sept. 2010)
100-Year
500-Year/ 100-Year Future
Property Ownership
Public Agency
Private Ownership
0
125'
250'
500'
MA-2
MA-3
MA-4
AL-3
AL-4
Mario Farias
Park
TEXAS
WAVERLY
UNIVERSITY
CINCINNATI
JEFFREY
YALE
KENTUCKY
CORNELL
TINER
CULEBRA
LAUREL
LOMBRANO
MICKLEJOHN
MENCHACA
ALBERT
POPLAR
RIVAS
PECHE
DELGADO
ROUNDS
ARBOR PLACE
CAMADA
RUIZ
PACE
LEAL
MONCLOVA
PEREZ
AMESTOY
LYONS
PRINCETON
ASHBY PLACE
SABINAS
NAVIDAD
CALAVERAS
TRINITY
HARVARD
MCALLISTER
KENSINGTON
JON ANN
SAINT ANN
IH 10
IH 10 W ACCESS
SOUTHERN PACIFIC RAILROAD
SAN JACINTO
SAN MARTIN
SAN ANITA
COMETA
MAGEL
LAZA
BRAZOS


INDEX KEY
TUNNEL INLET
IH 35 N ACCESS
IH 10 W ACCESS
PEREZ
KINGSBURY
COLUMBUS
PIAZZA ITALIA
LEONA
SANTA ROSA
SAVING
SP-1
IH 35
IH 35 N ACCESS
SAN SABA
CHRISTUS SANTA ROSA HEALTH CARE DOWNTOWN
ROSSY
SALINAS
PECAN
MEDINA
TRAVIS
VIA'S WESTSIDE MULTIMODAL CENTER
CAMARON
HOUSTON
COMMERCE
MILAM SQUARE
LAREDO
MAIN
BUENA VISTA
MARKET SQUARE
IH 35 S ACCESS
SPANISH GOVERNOR'S PALACE
CALDERA
PLAZA DE ARMAS
SP-2
TREVINO
DOLOROSA
UNIVERSITY OF TEXAS AT SAN ANTONIO DOWNTOWN
NUEVA
CASA NAVARRO
URBAN
DURANGO
POSITRON TESTING
SAFD TEST
GRAHAM
STUMBERG
PECOS LA TRINIDAD
OLD GUILBEAU
SAN FERNANDO
SP-3
PASEO VERDE
EL PASO
FLORES
FRIO
ROSA VERDE
VISTA DEL SUR
TUNNEL OUTFALL
GUADALUPE
ARSENAL
SHERIDAN
SP-4
EXHIBIT EC-9. FLOODPLAIN, UPPER SAN PEDRO CREEK
EXISTING CONDITIONS
WSCRP Project Limits
25-Year Floodplain
STRUCTURES FLOOD FREQUENCY
None
10-Year
50-Year
100-Year
500-Year/ 100F
FEMA DFIRM FLOODPLAINS (Sept. 2010)
100-Year
500-Year/ 100-Year Future
PROPERTY OWNERSHIP
Public Agency
Private Ownership
0
125'
250'
500'


INDEX KEY
1
2
3
5
6
7
8
9
10
11
ROSA VERDE
LEONA
SAN SABA
EL PASO
SP-3
TUNNEL OUTFALL
GUADALUPE
MISSOURI PACIFIC RAILROAD
SALADO
MEDINA
VISTA DEL SUR
COLIMA
FRIO
IH 35 S ACCESS
SOUTHERN PACIFIC RAILROAD
VERA CRUZ
PECOS LA TRINIDAD
SP-4
MERCHANTS
TRANSFER
CAMP
MC MANUS ALLEY
GUENTHER
RISCHE
CHIHUAHUA
COMAL
AL-7
TAMPICO
SHARP
TUNSTALL
ALAMO
SEXTON
SAN ANTONIO DEVELOPMENT SERVICES
DANIEL
SWEET
NATHAN
IH 35 S ACCESS LAREDO
SAN MARCOS
APACHE
AP-5
SP-5
PEDEN ALLEY
MARTY
STARK
KELLER
ADELAIDE
REHMANN
FEST
CEVALLOS
CLAY
FLORES
SIMON
APPLEWHITE
SOUTHERN PACIFIC RAILROAD
IH 35
SP-6
BURBANK
ZAVALLA
SONORA
UNNAMED ST AT RALPH
RALPH
CASSIANO
BRISCOE ELEMENTARY SCHOOL
FORREST
HALSTEAD
FURNISH
SP-7
HALE
POWELL
DICKEY
DULLYE
GLASS
MIDWAY
LAMBERT
BENAVA
EXHIBIT EC-10.
FLOODPLAIN, MID SAN PEDRO CREEK
Existing Conditions
WSCRP Project Limits
25-Year Floodplain
Structures Flood Frequency
None
10-Year
50-Year
100-Year
500-Year/ 100F
FEMA DFIRM Floodplains (Sept. 2010)
100-Year
500-Year/ 100-Year Future
Property Ownership
Public Agency
Private Ownership
0
125'
250'
500'


INDEX KEY
1
2
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10
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ZAVALLA
MOCKERT
STRIBLING
LACHAPPELLE
RALPH
FORREST
HALSTEAD
SP-6
FURNISH
LONE STAR
DOWDY
GLASS
LAMBERT
MIDWAY
ALVAREZ PLACE
BENAVA
KLEIN
CASS
GIVENS
HARRIS MIDDLE SCHOOL
PRUITT
BANK
OELKERS
LIPAN
CORDERO
DEWITT
LAMM
BAYLOR
LUBBOCK
PARK ROW
GRAND JEAN
WOODROW
CARLE
IH 10 E ACCESS
IH 10
IH 35 S ACCESS
BIG FOOT
GREEN
MCASKILL
MCKAY
MITCHELL
CONNER
FLATO
BURBANK HIGH SCHOOL
BURBANK
RIPFORD
GOLONDRINA
FAIRMONT
ODIS
TIPTON
PROBANDT
RIVER VIEW
SP-7
FRANCISCAN
REGENT
STACE
GLENN
FLORES
SUN
MOON
ELSIE
TRUAX
SAN ANTONIO RIVER
EXHIBIT EC-11.
FLOODPLAIN, LOWER
SAN PEDRO CREEK
EXISTING CONDITIONS
WSCRP Project Limits
25-Year Floodplain
STRUCTURES FLOOD FREQUENCY
None
10-Year
50-Year
100-Year
500-Year/ 100F
FEMA DFIRM FLOODPLAINS (Sept. 2010)
100-Year
500-Year/ 100-Year Future
PROPERTY OWNERSHIP
Public Agency
Private Ownership
0
125'
250'
500'

Stream Restoration Approach

OVERVIEW

The vision of the Westside Creeks Restoration Project is to improve the four channelized creek systems to restore their ecological functions, maintain or improve flood safety and increase connectivity in a secure manner. With these objectives in mind, design elements were developed based on the hydrology and hydraulics, ecology and community context of each creek. Hydrologic analysis was performed to determine the existing flow rates which create bankfull conditions (see Figure 2, Typical Natural Channel Cross Section on page 21), which in turn, were used to develop the conceptual restoration characteristics for each creek. Soil properties, native vegetation and wildlife were considered as a part of the conceptual ecological restoration elements to be included in the design. Specific design features related to public use and neighborhood integration were also developed to enhance the public's use and appreciation for the creeks and to restore the creek's social connectivity potential. The resulting Stream Restoration Approach ties these elements together around the four frameworks of water, restoration, connectivity and security.

DESIGN APPROACH

Natural channel design in its most basic sense seeks to restore the channel to an "unspoiled" condition that can accommodate changes in sediment and hydrologic variability of flows per the stream evolution model. In urban environments, where the channel is confined by densely competing land uses and the presence of hydraulic structures and adjoining utilities, natural channel design must accommodate these constraints and limitations. Urbanized areas such as the Westside Creeks often experience increased levels of stormwater run-off due to the introduction of impervious surfaces (e.g. streets, driveways and rooftops) and are not able to achieve a suitable equilibrium state without impacting property or compromising the integrity of underground utilities and hydraulic structures (e.g. bridges and culverts). Therefore, restoring the channel to a completely natural, unspoiled condition is not possible; however, through natural design, the flow characteristics and sediment transport will function in a more natural manner. In cases of lateral containment, where the stream does not have the ability to adjust to changes horizontally, the stream often begins to down-grade or incise. In this urban environment, the design goal is to restore natural channel function, stability and biological diversity to the maximum extent practical. The design approach for incised channels such as the Westside Creeks can also be discussed using Rosgen's priority levels for incised channels (1997). Table 4, Rosgen's Priority Levels for Restoration of Incised Channels, shows the 4 priority levels of incised channels, methods for restoration, advantages and disadvantages. (For definitions of technical terms that are included in this report, please refer to the Glossary.)

The main constraints for the Westside Creeks Restoration Project are the limited availability of land and the requirement to not increase flood elevations. Priority levels 1 and 2 are not appropriate for this project because they would require raising the channel bed elevation which would cause an undesired increase in the floodplain elevations. Alternately, the priority 3 approach is appropriate because it limits the amount of land required and does not adversely impact the floodplain elevations. Priority 3 also meets the goals of this project of restoring the natural channel function, stability and biological diversity of the stream channels. Priority 3 restoration is implemented by excavation and bank stabilization. Its advantages include reduction in the amount of land needed while maintaining or decreasing flood elevations and improving aquatic habitat. Often, this approach results in a stable step/pool morphology rather than riffle/pool morphology. Due to the lateral containment of the channel, profile slopes are

TABLE 4. ROSGEN'S PRIORITY LEVELS FOR RESTORATION OF INCISED CHANNELS

Description	Methods	Advantages	Disadvantages
Priority 1	Re-establish channel on previous floodplain using relic channel or construction of new bankfull discharge channel. Design new channel for dimension, pattern, and profile characteristic of stable form. Fill in existing incised channel or with discontinuous oxbow lakes level with new floodplain elevation.	Re-establishment of floodplain and stable channel: 1) Reduced banks height and stream bank erosion; 2) Reduces land loss; 3) Raises water table; 4) Decreases sediment; 5) Improves aquatic habitats; 6) Improves land productivity; 7) Improves aesthetics	1) Floodplain re-establishment could cause flood damage to urban agricultural and industrial development; 2) Downstream end of project could require grade control from new to previous channel to prevent head cutting.
Priority 2	If belt width provides for the minimum meander ratio, construct channel in bed of existing bed to new floodplain. If belt width is too narrow, excavate stream bank walls. End-haul material or place in streambed to raise streambed elevation and create new floodplain in the deposition.	1) Decreases bank height and stream bank erosion; 2) Allows for riparian vegetation to help stabilize the banks; 3) Establishes floodplain to help reduce stress on the channel during flood events; 4) Improves aquatic habitat 5) Prevents wide-scale flooding of original land surface ; 6) Reduces sediment ; 7) Downstream grade control is easier	1) Does not raise water table back to previous elevation; 2) Shear stress and velocity higher during flood due to narrow floodplain ; 3) Upper banks need to be sloped and stabilized to reduce erosion during flooding
Priority 3	Excavation of channel to change stream type involves establishing proper dimension, pattern and profile. This often involves either an increase or decrease in width/depth ratio and entrenchment ratio. Shaping upper slopes and stabilizing both bed and banks.	1) Reduces the amount of land needed to return the creek to a stable form; 2) Developments next to creek need not be relocated; 3) Can be designed to have no impact on the flood stage elevation; 4) Improves aquatic habitat	1) High cost of materials for bed and bank stabilization; 2) Does not create diversity of habitat; 3) Does not raise water table to previous levels
Priority 4	A long list of stabilization materials and methods have been used to decreased streambed and stream bank erosion including concrete, gabions, boulders and bio-engineering methods.	1) Excavation volumes are reduced; 2) Land needed for restoration is minimal	1) High cost for stabilization; 2) High risk due to excessive shear stress and velocity; 3) Limited aquatic habitat depending on nature of stabilization methods used.

decreased to accomplish lower velocities and shear stress. In some reaches it may be necessary to implement components of priority 4 restoration, and the presence of underground utilities or right-of-way (ROW) constraints may dictate structural stabilization measures. When needed, these measures should be designed using natural, native materials to achieve a natural looking channel.

The approach taken to provide stable channels for all four streams in the Westside Creeks project was an iterative approach that balanced the design of a stable stream cross section within the constraints of the horizontal alignments and the appropriate longitudinal slope to attain a sediment balance to reduce aggradation (sediment deposition) and degradation (erosion). Typical cross sections for each channel were determined to accommodate the 1.5-year design bankfull stream flow (please refer to appendices for a detailed hydrological discussion). The design bankfull stream flow rate was used in conjunction with existing stream flow mathematical models to develop the appropriate width, depth, cross-sectional area and channel slope for each stream. Further design criteria included choosing channel configurations that yielded acceptable velocities of around 6 feet per second and shear stresses of around 1.0 lbs/ft^2, which should yield a stable configuration without excessive erosion or sedimentation. The calculations for bankfull discharge, sinuosity and slope are discussed in more detail within Appendix D, Stable Channel Design. Typical design elements are shown below and on the pages that follow. Stream-specific design elements are also included in the Appendices and generally described below.

Plan View Characteristics

Typically, the horizontal alignment or "pattern" of the stream configuration follows a meandering layout across a floodplain. Meanders result in longer channel length and lower slopes and are often discussed in terms of meander wavelength and channel sinuosity (channel centerline length divided by centerline of the valley length). Meander wavelength is illustrated in Figure 6, Plan View Characteristics. Sinuosity is generally related to the product of discharge and gradient and assists the stream in dissipating its energy. In the case of the Westside Creeks, these urbanized streams have been modified and their natural sinuosity has been reduced by straightening the channel, which tends to result in channel down-cutting and erosion.

The horizontal alignments imposed on each stream during the flood mitigation improvements in the 1960s were generally controlled by the horizontal constraints of the already urbanized project area. Due to these continuing land use constraints, the desired meander wavelength for a stable stream could not be attained under this proposed conceptual design, and therefore, the resulting recommended sinuosity is similar to the existing channel sinuosity. While the proposed centerline of the channel necessarily remains within the existing right-of-way, the channel thalweg (deepest part of the channel) is recommended to meander within the bankfull channel, producing a more locally sinuous channel with defined pools and riffles.

Cross Section Characteristics

One typical "riffle" cross section and two "pool" alternative cross sections were conceptually developed for the Westside Creeks project. Additionally, depending on the horizontal constraints, various-sized benches were incorporated into the proposed riffle cross sections to allow occasional access to the overbank floodplain area, as shown in Figure 7, Typical Riffle Cross Section. Connecting the floodplain area to the channel allows for frequent inundation of stormwater into the floodplain, which helps release energy and allows sediment and suspended solids to deposit along the bankfull channel. Benches also provide opportunities to ecologically restore the important riparian area along the channel with appropriate native vegetation. Bioengineering techniques are also expected to be incorporated into the riffle cross sections. The roots and cuttings used in bioengineering techniques help stabilize the banks and protect against erosion, while providing a natural, aesthetic solution. Due to the high bank shear stress, it is also anticipated that toe protection will be provided at critical areas as an added stabilization measure, consisting of approximately two vertical boulders (or their equivalent) placed at the toe of the bank. The two different pool cross sections represent options for differing widths of the stream channel. For constrained areas, one cross section uses a mechanically stabilized earth (MSE) wall on the outside bend (Figure 8, Typical Pool Cross Section with MSE Wall). For less constrained channels, the second pool cross section shows a flatter side slope on the outside bend (Figure 9, Typical Pool Cross Section). Both pool cross sections show protection is needed at the toe of the outside bank.

Profile Characteristics

The stream profile was established through hydraulic modeling to determine the desired energy grade for a stable channel. Generally, to achieve a sediment balance, the design slopes were determined to be flatter than the existing slopes. In order to accommodate these flatter slopes without changing the alignment too drastically, various drop structures must be used to achieve the required vertical drop over the given stream length. Step pools and constructed riffles are the types of drop structures that are recommended in this design.

Once stable designs were determined for the bankfull portion of the channel, the hydraulic models were further modified to determine the minimum bench widths that would be required to prevent any increases in the damages from the 100-year flood. The projected width estimated by these models identifies the minimum cross sectional area required to conduct stream restoration. In locations where there is additional area identified as potentially available for the project, the opportunity exists either to further enhance the level of restoration or to reduce the level of flood hazard. These models were based upon the 100-year flows published in the officially adopted Federal Emergency Management Agency (FEMA) digital flood insurance rate maps (DFIRM) studies.

In-Stream Structures

In urban systems, since it is difficult to modify the basic geomorphic parameters of the stream to achieve equilibrium, designs must rely on additional structural elements to yield a stable, functioning system. Several different types of structures have been incorporated into the Westside Creek's channel design to accomplish this objective, including rock cross vanes, j-hook vanes, rock vanes, step pools and constructed riffles.

Rock cross-vanes function to bring the flow into the center of the channel and to provide grade control for the designed channel slope (Figure 10, Use of Rock Vanes to Protect Outside Meander Bends, Figure 11, Use of Rock Cross Vanes to Provide Grade Control and Center Flow and Figure 12, Example of a Constructed Cross Vane). This measure also aids in preventing head cut erosion. J-hook vanes (Figure 13, Use of J-Hook Vanes to Redirect High Velocity Flow Away from Outside Meander Bands and Create Scour Pools for Habitat) and rock vanes are typical stone structures that protect meander bends from erosive velocities. They are placed on the outside of bends and direct the flow away from stream banks, protecting the banks from erosion and dissipating energy in the downstream direction in scour pools. These scour pools can also function to provide enhanced in-stream habitat for aquatic plants and animals.

Step pools and constructed riffles (Figure 3, Pattern of a Natural Channel with Typical Riffle, Pool Morphology and Figure 4, Profile of a Natural Channel with Typical) are examples of in-stream structures classified as grade control structures, which are used to help flatten the stream profile and restore the natural pool-riffle sequence. Grade control structures allow the profile of the stream to drop in elevation over a short longitudinal distance. This drop in elevation makes it possible for streams to attain the necessary slope to accommodate the recommended design.

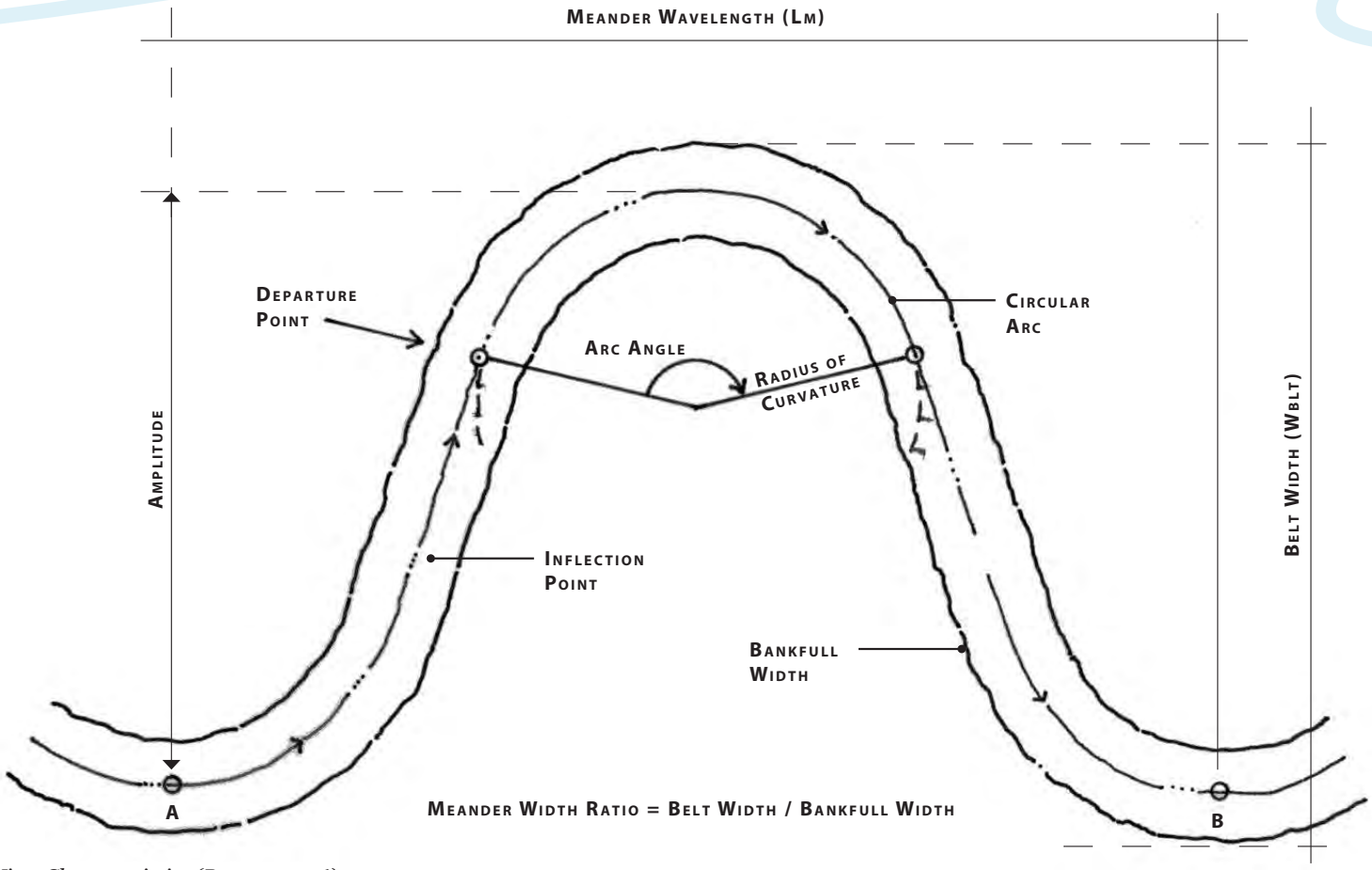


Figure 6. Plan View Characteristics (Rosgen, 1996)

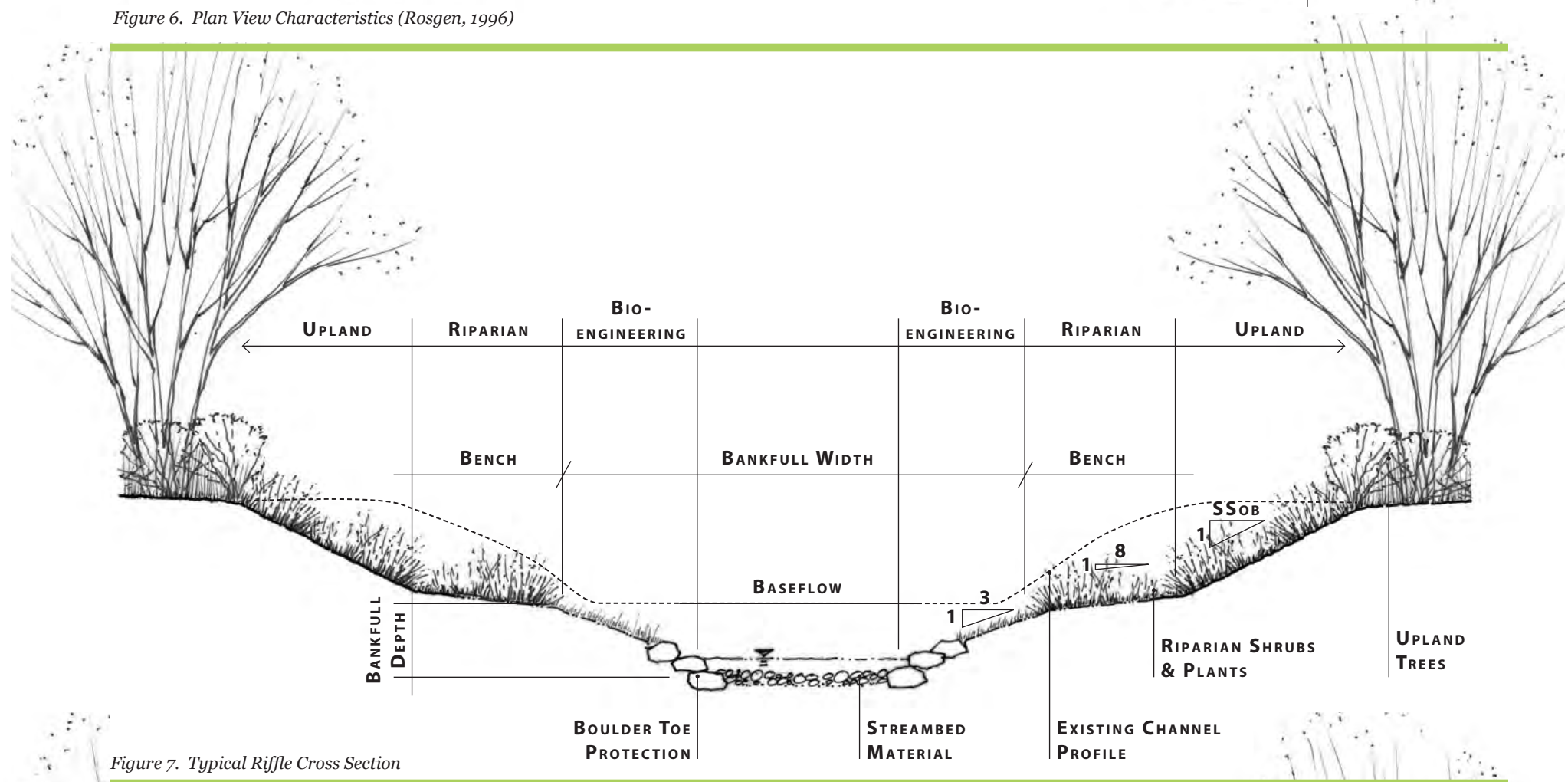


Figure 7. Typical Riffle Cross Section

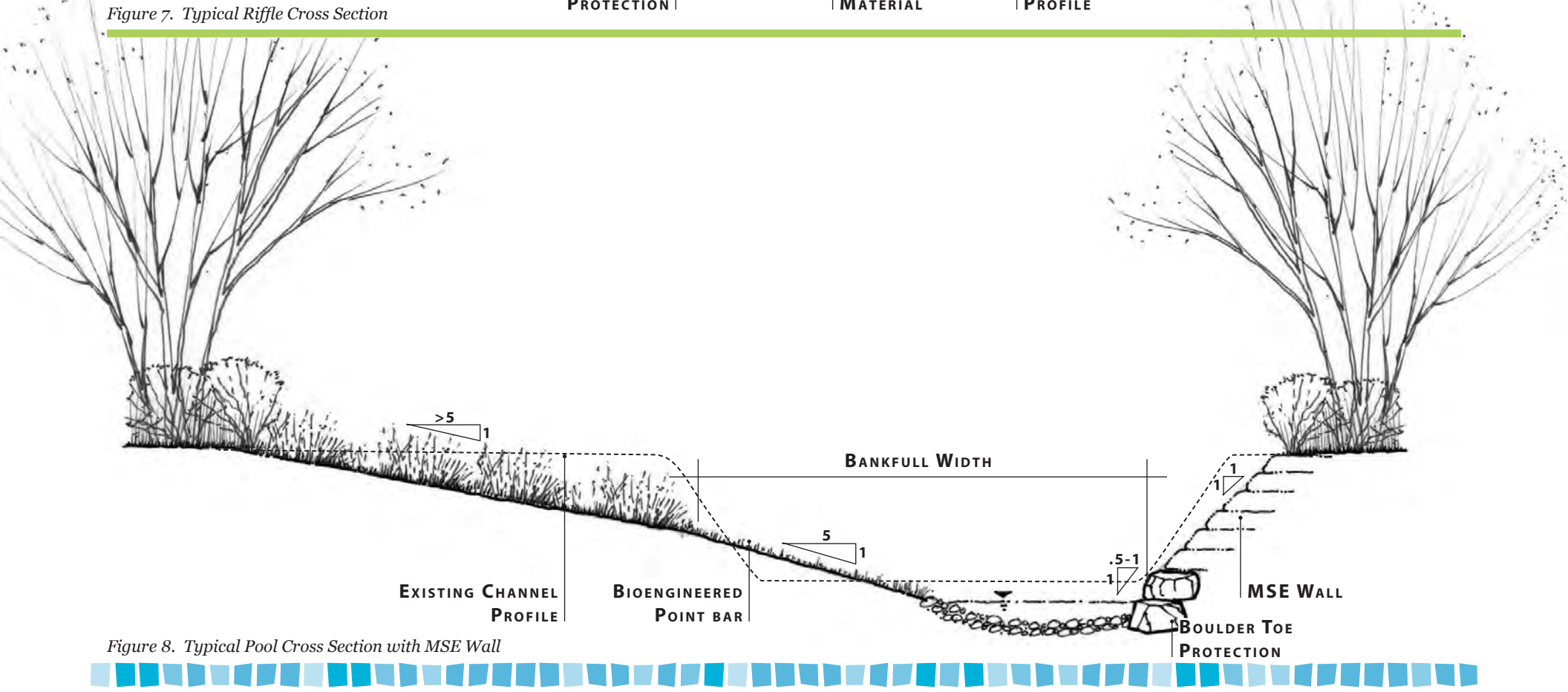


Figure 8. Typical Pool Cross Section with MSE Wall

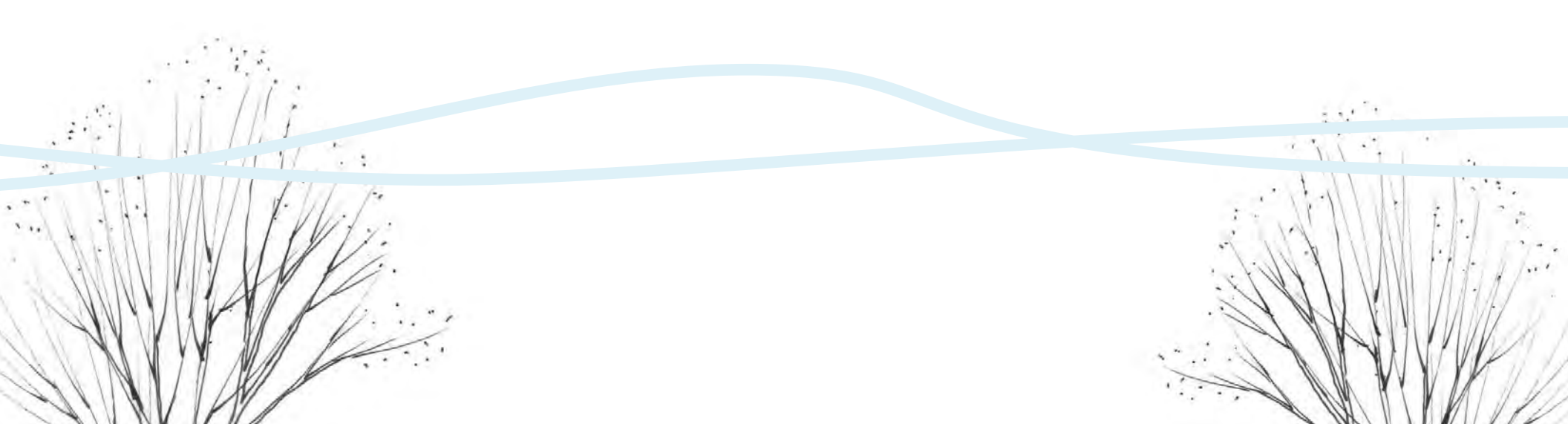


Figure 9. Typical Pool Cross Section

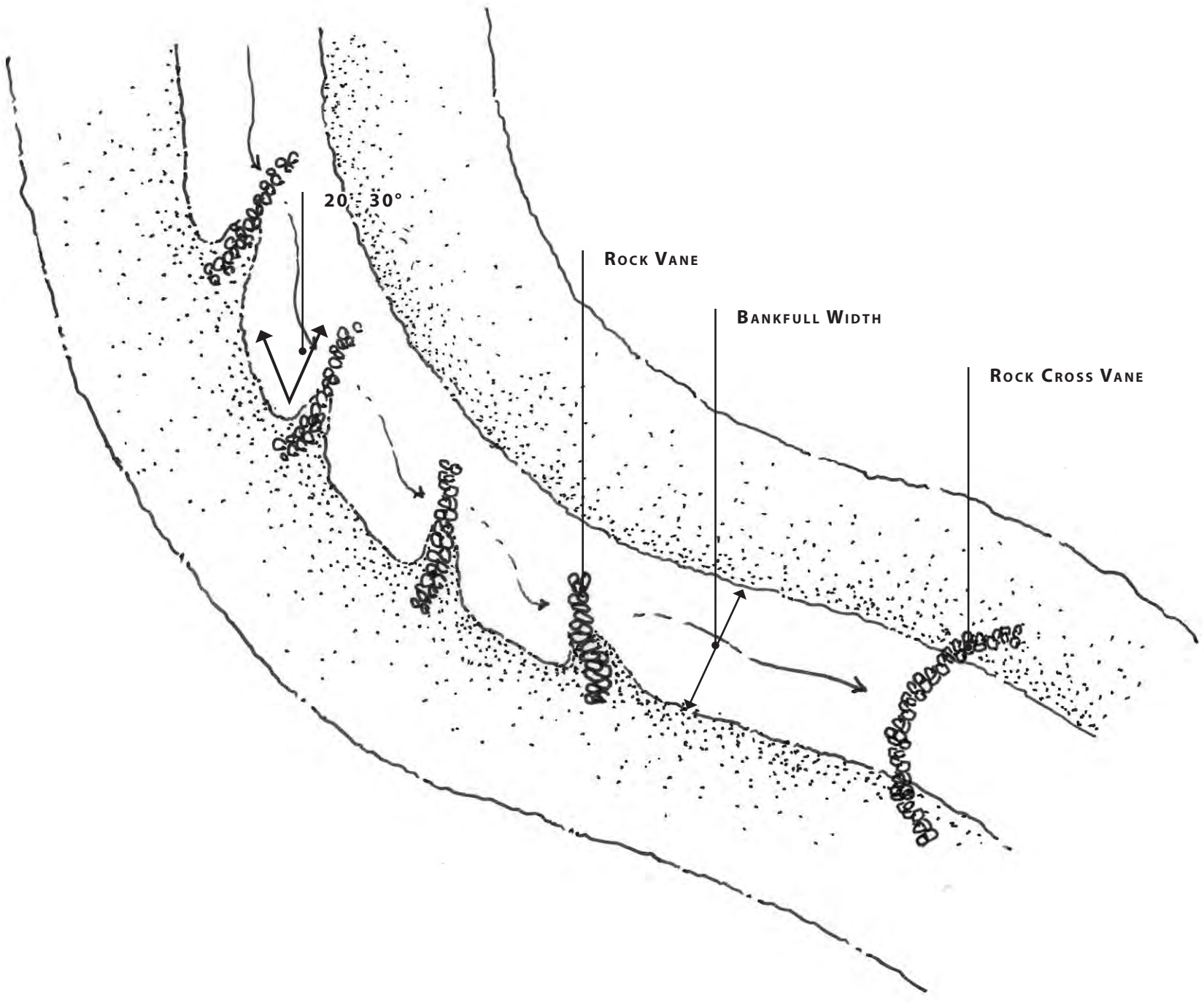


Figure 10. Use of Rock Vanes to Protect Outside Meander Bends

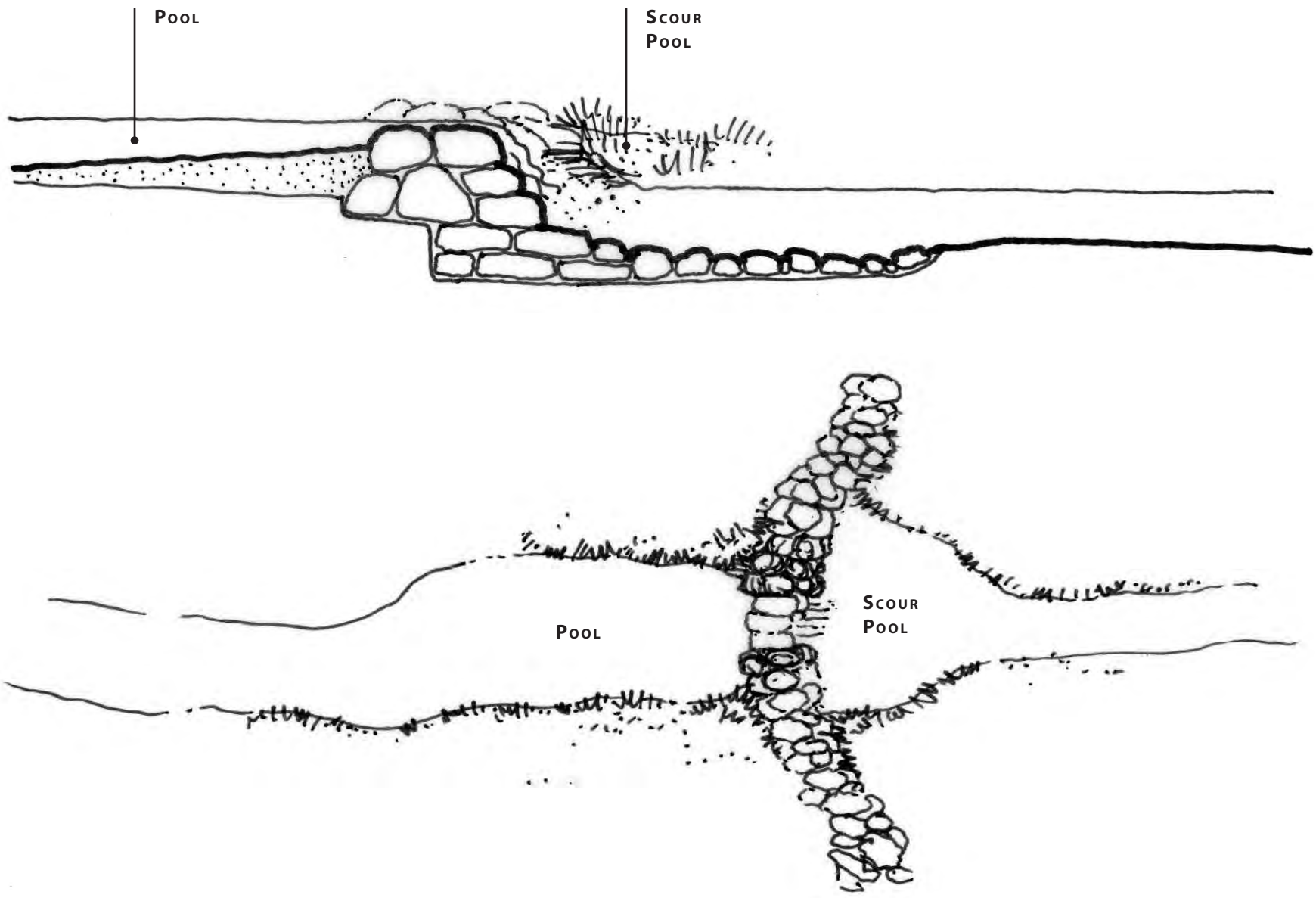


Figure 11. Use of Rock Cross Vanes to Provide Grade Control and Center Flow

Figure 12. Example of a Constructed Rock Cross Vane

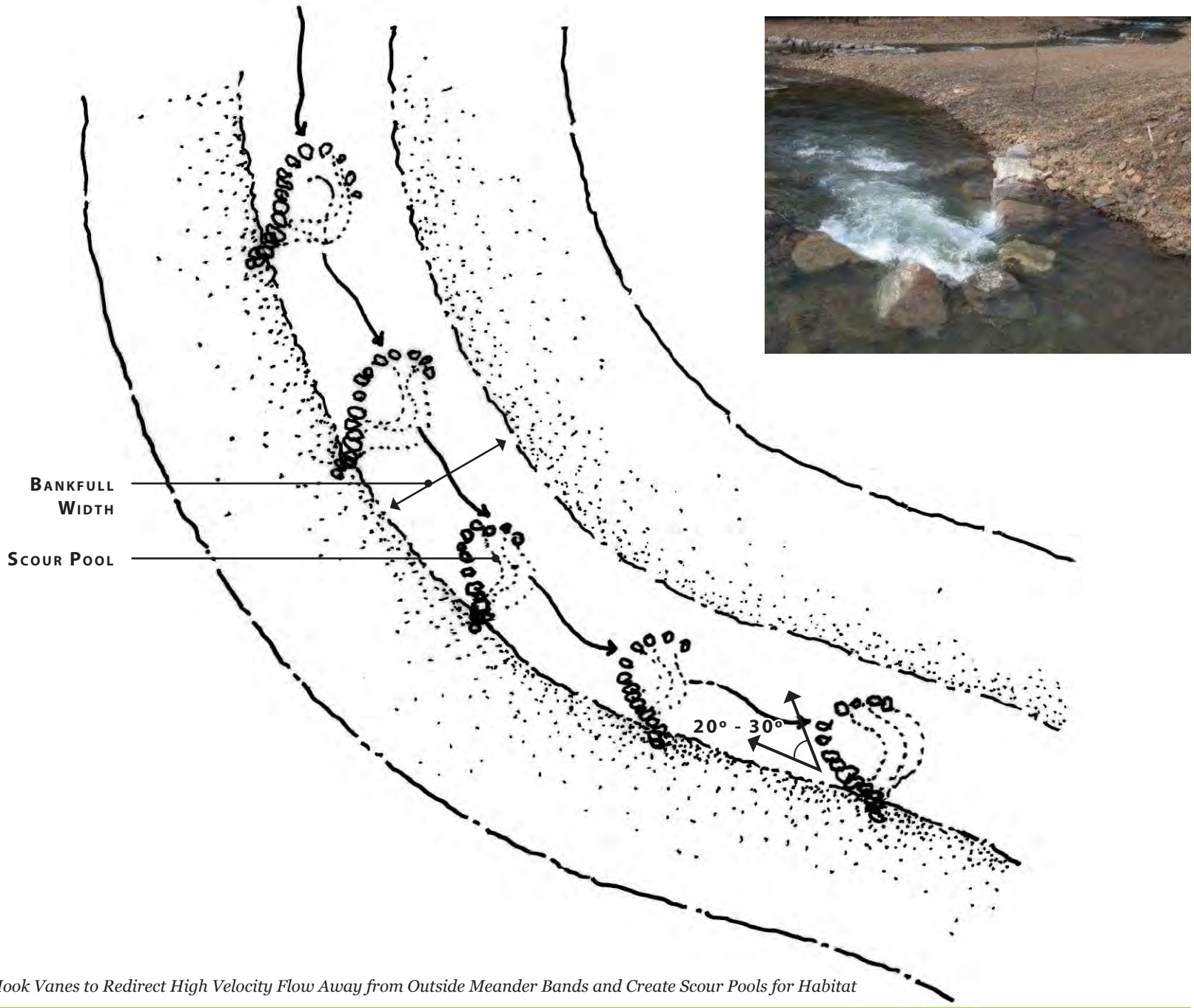


Figure 13. Use of J-Hook Vanes to Redirect High Velocity Flow Away from Outside Meander Bands and Create Scour Pools for Habitat

Figure 14. Example of Constructed Step Pools Using Native Central Texas Material (Limestone Blocks) at a Storm Sewer Outfall

ECOLOGICAL RESTORATION

Two fundamental restoration regimes are proposed for the restoration of the Westside Creeks: upland and riparian. These restoration regimes were developed based on the existing site conditions and the suitability of the area for various alternative habitats. The use of sustainable ecological restoration principles provides the ability to establish and sustain native biological communities in perpetuity. Since these communities must exist along the creeks, they must be able to endure or reestablish themselves following the natural flood/scour events that will regularly occur. The restoration concepts for the upland and riparian communities are described below. Once established, restored native communities are not expected to require significant maintenance with the exception of dealing with threats from outside influences such as manmade disturbances, trash accumulation and invasion by nonnative weed species.

Upland Restoration

This area of restoration includes the bench above the 1.5-year bankfull channel and the side slopes of the flood channel. In some of the stream reaches, these areas will be greatly expanded due to the increased area created by the recommended stream meanders. The shallow soil, alkalinity and occasionally excessive heavy metals create some limitations on the plant species which can thrive under these conditions. The existing weedy vegetation provides competition for native species and will need to be removed. Native species prescribed within the design will need to tolerate periodic inundation, thin clay soils and low water availability.

Species diversity (heterogeneity) will create a large variety of tolerances both with the soil and the extremes of hydrological conditions (ephemeral or intermittent wet / dry cycles). Heterogeneity will create the greatest opportunity for success, as measured by vegetative cover, lack of erosion and regeneration of species in scour prone areas. In order to address some of the soil nutrient deficiencies, nitrogen fixing species such as legumes should be used to encourage accelerated nitrogen fixing. Mycorrhizal inoculums (Figure 15, Mycorrhizal Fungi Attached to Several Symbiotic Host Species) should also be used along with symbiotic native host plant species to improve the uptake of available phosphorous in phosphorous poor soil conditions. The hyphae from mycorrhizae fungi connect roots from different individual plant species, which also help improve plants' resilience to drought and disease. Recommended upland species are provided in the Appendix.

Riparian Restoration

A key determinant in the success of vegetation and wildlife in the riparian zone is the presence of base flow in the creek bed or groundwater near the surface. Visual estimates indicate that there is little to no base flow during most of the year, which is supported by input from the resident community. It is possible that the water table (top surface of the groundwater) may be close enough that the excavation required to deepen and widen the creeks could expose this water, providing a natural source of base flow (Figure 16, Riparian Community Restoration). Further discussion on Base Flow Enhancement follows later in this section.

The soil characteristics and lack of alluvial groundwater are the primary limiting factors in supporting riparian and wetland communities. In order to sustain riparian communities, consistent sources of water must be developed and the limitations of the soil need to be overcome. The greatest opportunity to achieve these goals is on the inside curve of a stream meander adjacent to a point bar feature. Point bars are where water velocity slows and soil deposition occurs.

Because the existing substrate caliche material provides a potential barrier preventing roots from reaching groundwater and because the thin clayey soils provide limited opportunities for extensive root development, expanded subsurface water storage through either fracturing or over-excavating caliche rock is recommended for the Westside Creeks conceptual design. These areas can serve as subsurface reservoirs or cisterns, creating additional opportunities for water to percolate and be stored below ground in soil or rock crevices. Ideal locations would include point bars and where floodplain capacity is expanded. Subsurface depressions within the bench which are subsequently backfilled with soil will create greater rooting depth for plants and expand the water-holding capacity of the soil. Expanded rooting capacity should range from 6 to 48 inches and will serve to create a variety of opportunities for a diverse set of riparian plant species with different hydrology requirements and rooting depths. The excavated reservoirs should be graded so that the subsurface bedrock slopes away from the creek. The underground reservoir should be distinct and separate

Figure 15. Mycorrhizal fungi attached to several symbiotic host species.

from the 1.5-year bank full channel, but caliche that separates the bankfull channel from the underground reservoir should be slightly lowered to less than the 1-year storm elevation. This will allow some recharge from the creek even during low rain periods. The reservoir areas should be backfilled with large boulders and then with sediment and soil. The boulders will help prevent the soil and sediment from becoming eroded during high storm events, but also create seams along which water can infiltrate. Boulders also naturally store moisture underneath them while preventing evaporation. An example where this technique has been successfully implemented is along Guadalupe Creek in Croydon, California (see Figure 17).

The underground reservoirs will have two opportunities to recharge. First, recharge will occur when the creek levels rise high enough to flow through these areas and when runoff occurs from the adjacent slopes. Additionally, urban stormwater from the secondary storm drainage system can also be directed toward these features. These underground reservoir areas will be planted with riparian species such as black willow and false willow cuttings and seeded with a variety of native grass and shrub species. Some of these species are known to be tolerant of agriculturally high concentrations of heavy metals such as lead. The vegetation and the slower stream velocity on the inside meander are expected to build the deposition of sediment, creating a larger potential root zone and larger capacity for water storage. Recommended riparian species are provided in the Appendix. These constructed underground reservoirs can also benefit the alluvial aquifer recharge, which can improve base flow in the creeks.

Other Restoration Activities

Ecological restoration principles are incorporated into all aspects of the native landscaping where it interfaces with the urban environment. Controlling the flow of the creek to protect adjacent property is an important aspect of restoration in an urban environment including infrastructure and buildings. Waterways can generally damage property through flooding or scouring. Rock cross vanes are proposed to help control the thalweg from meandering and damaging property. Cross vanes and J-hooks are proposed to help dissipate the scouring energy on the outside of creek meanders. In areas that are highly constrained by development, cross vanes and J-hooks will not have enough room to be effective. In those areas, MSE walls will be used where hard scour protection is necessary (Figure 18, Riparian Restoration with complementary bank protection in confined space). Products such as loeffel block walls can be planted with native vegetation with low water requirements to help soften the views of the hardscape. In areas with more space, terracing and bio-infiltration zones (Figure 19, Terracing provides opportunity for soil infiltration and providing greater opportunity for use by down slope plants and Figure 20 Bio-Filtration allows for natural processes to clean runoff) before entering the streams can provide greater opportunity to clean water before it enters the creek system and riparian zone. Water quality can be enhanced by flowing through vegetation to filter out floatables and other pollutants. This also allows the surface water to infiltrate through the soil and slowly release into the channel, thereby creating additional opportunity for the downhill vegetation to take advantage of the water before it flows into the bankfull channel.

Erosion Control

Erosion and lateral migration is a part of any natural creek system; however, in an urban environment, erosion and channel movement should be minimized to the extent practical. Rock vanes, J-hook vanes and toe protection will be the primary source for stability control along the creeks. However, surficial erosion can be further minimized through the use of erosion control blankets that use coconut or oak shavings for short-term control until the seeded species germinate and become established. The germinated species' fibrous and tap roots will help secure the soil and above-ground vegetation will help trap additional sediment. Coconut or straw wattles laid with slope contours will help slow sheet flow velocities, trap sediment and provide moisture for additional seed germination. Live fascines (Figure 21) composed of living material, such as black willow or prairie false willow, will perform a similar function, and the live material will root in place providing a much more substantial capability for trapping sediment and retaining moisture.

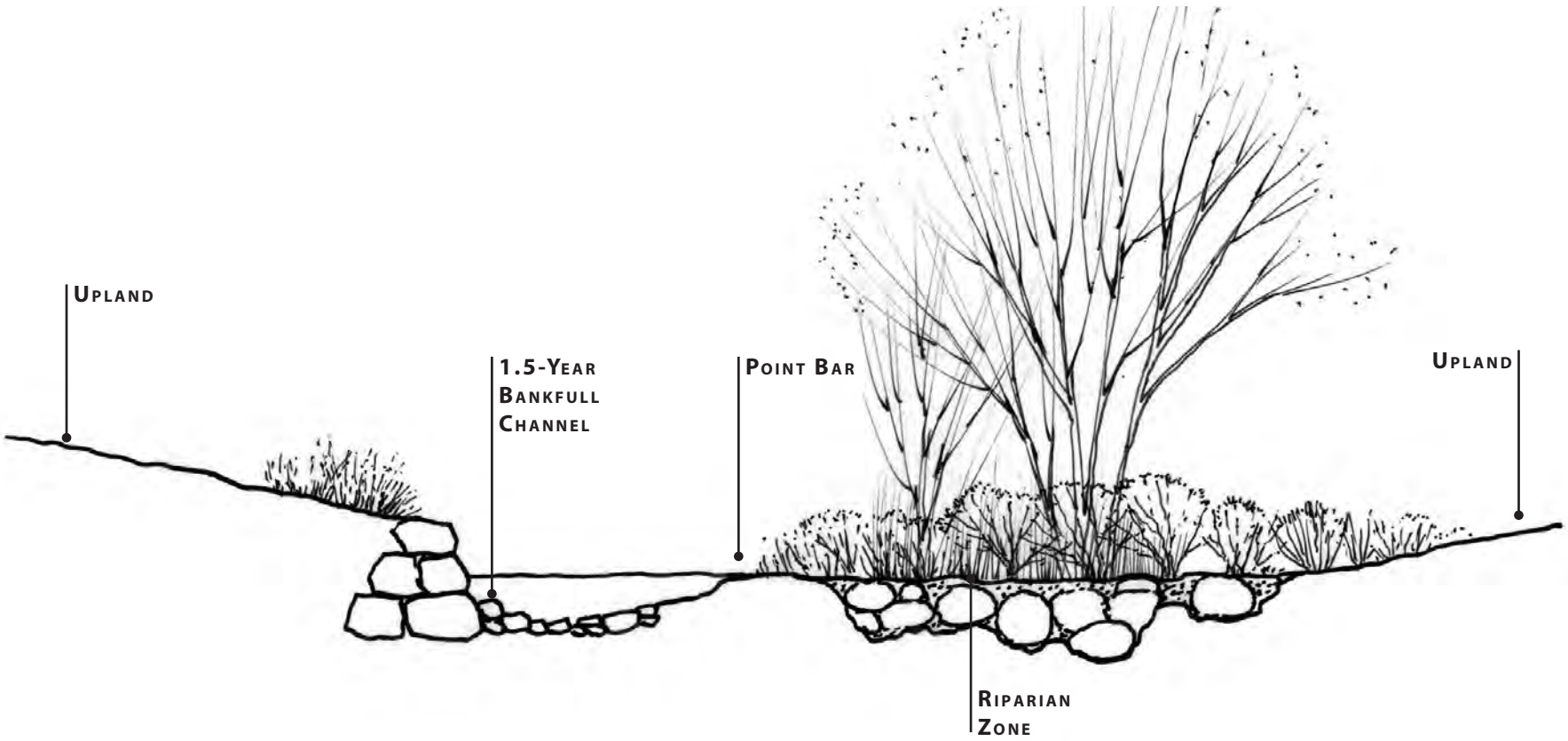


Figure 16. Riparian Community Restoration

Figure 17. Example of Overexcavation on Guadalupe Creek to Enhance Subsurface Water Storage (top photo, before; bottom photo, after)

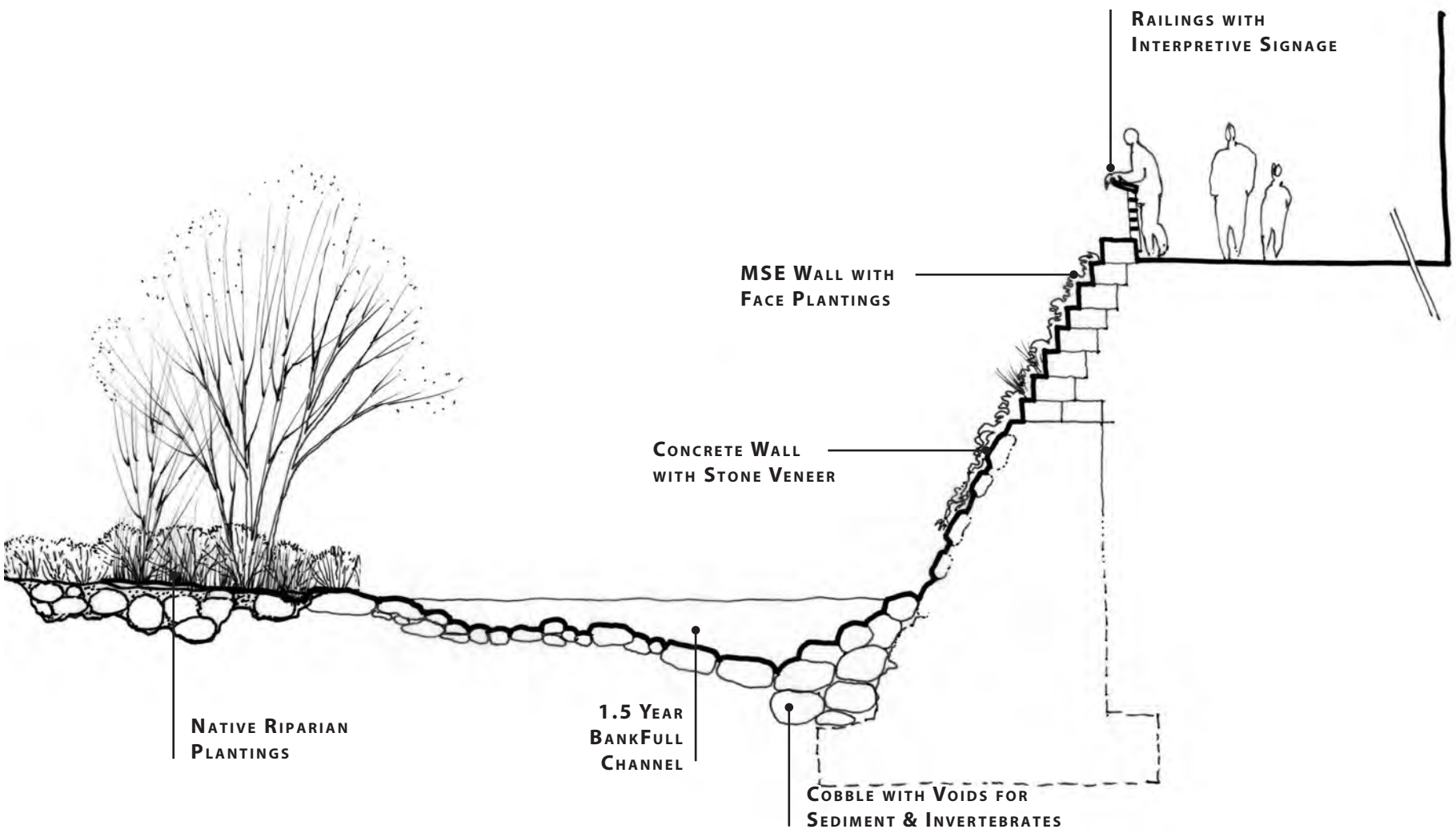


Figure 18. Riparian Restoration with complementary bank protection in confined space.

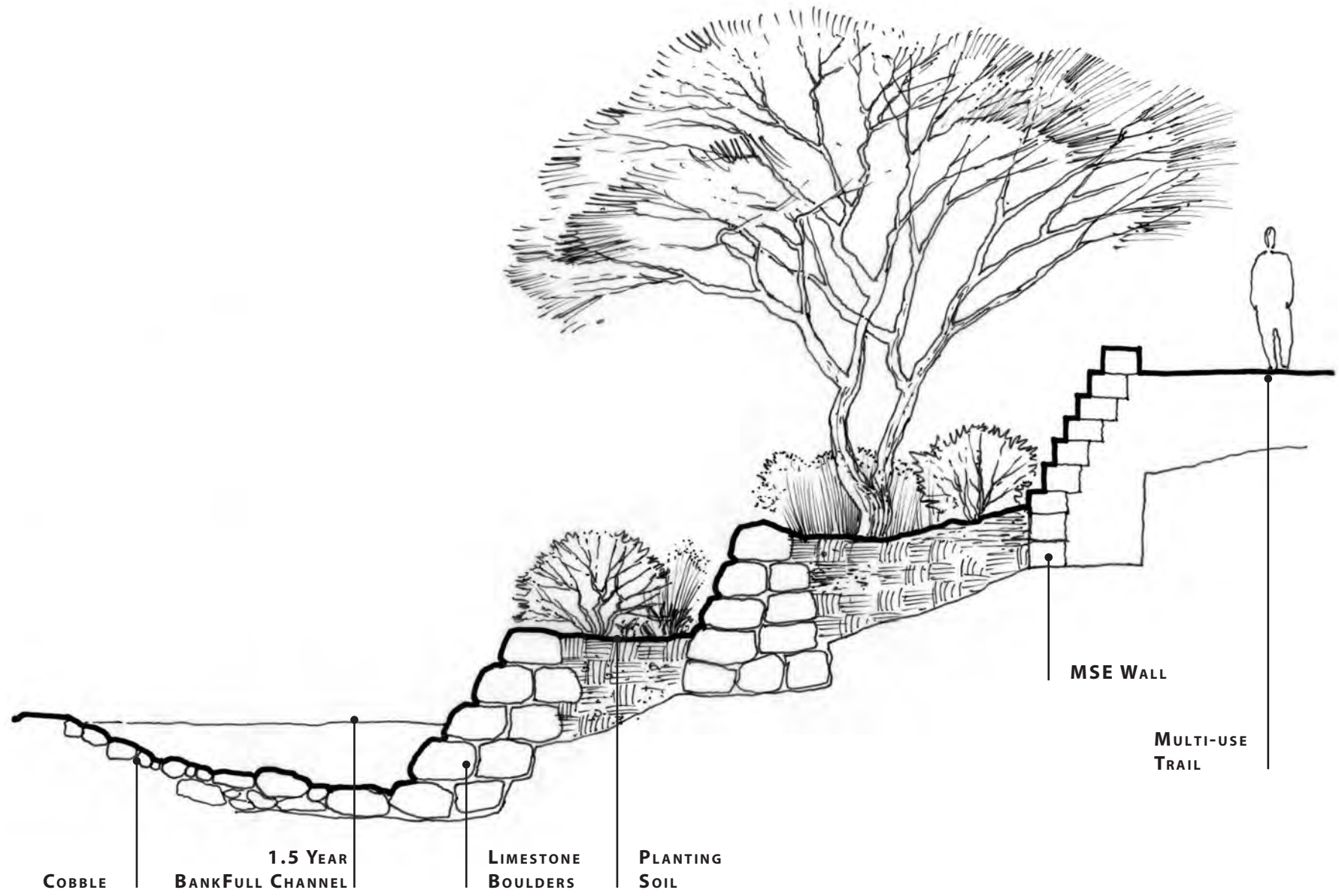


Figure 19. Terracing provides opportunity for soil infiltration and providing greater opportunity for use by down slope plants.

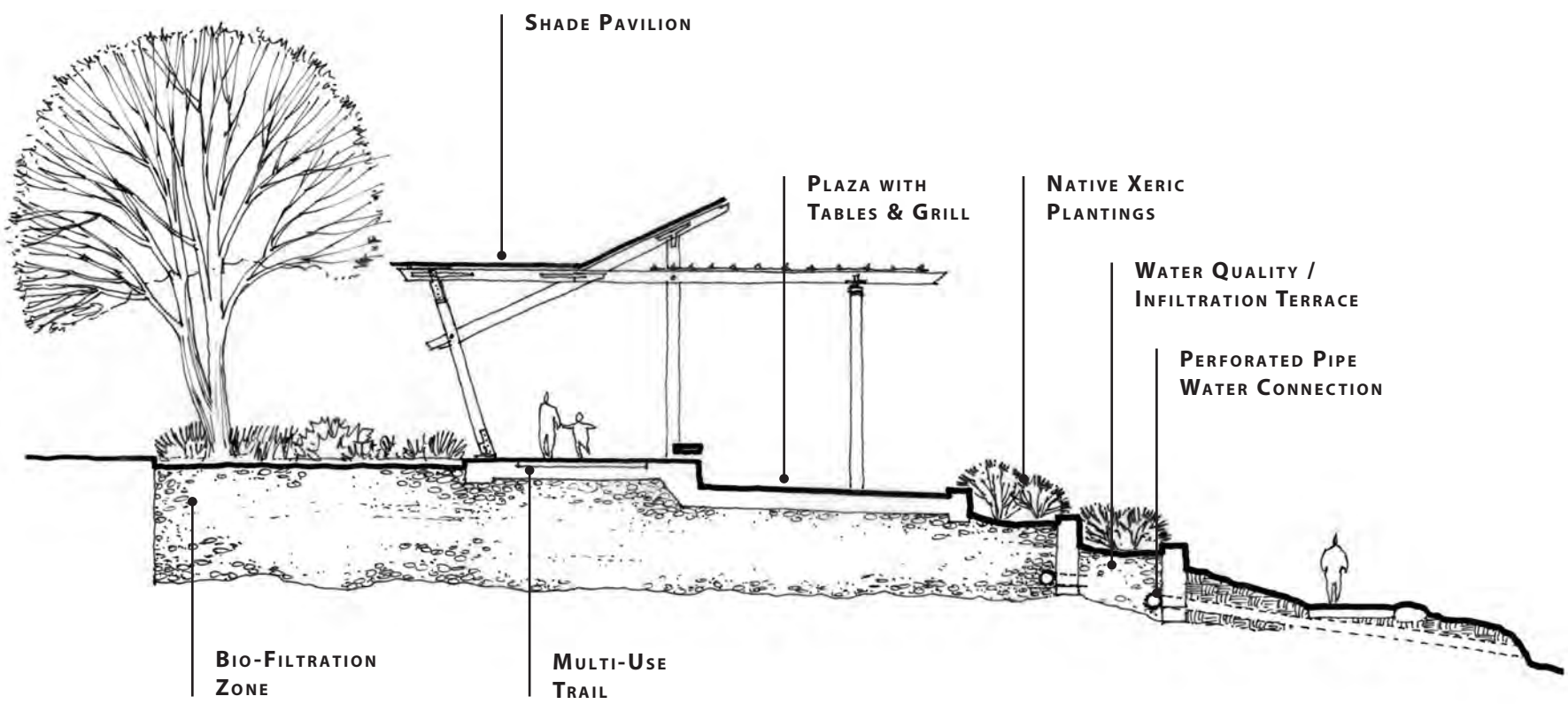


Figure 20. Bio-Filtration allows for natural processes to clean runoff before entering the streams.

INTEGRATION OF RESTORATION WITH OTHER OBJECTIVES

Major stream restoration, such as is envisioned for the Westside Creeks, requires significant public investment and temporary neighborhood disruption during construction. Therefore, it is appropriate to also consider other public needs and opportunities which can be accomplished concurrently during the stream restoration process and which can eventually allow the creeks to better serve the broader community needs which exist in this area. The foremost opportunity is in the area of flood damage reduction. If additional channel improvements can be implemented to **reduce future flood risk** within any of these creeks, these improvements are being considered as a part of the stream restoration program in order to reduce the total costs and neighborhood impacts and to enhance the effectiveness of the joint projects. Another important secondary objective identified for this program is the **incorporation of a system of linear parks and trails** to bring members of the community back to enjoy the creeks. The creation of this trail system along the restored creeks can provide additional community benefits to the neighborhoods in the form of improved connectivity and increased opportunities for recreation, fitness wildlife habitat, water quality enhancement and aesthetically desirable open space within an urban setting. It is also anticipated that the improvements proposed in this project will **serve as a catalyst for economic revitalization** of the adjoining neighborhoods and the Westside area. The conceptual design approach for the Westside Creek's stream restoration has included provisions for these expanded opportunities in the planning process which are outlined further below and in the next section of this report.

Reduction of Flood Damages

The stream restoration conceptual design for the Westside Creeks involves the addition of vegetation, bank full meanders and variability in the cross section geometries, and these changes have the effect of increasing surface roughness within the floodplain. If this increased roughness is not appropriately mitigated, it can result in increased water surface elevations (i.e. increased flood hazards) during flood events. The potential for flood damage that currently exists along the majority of the Westside Creeks does not allow for increasing flood levels. Therefore, the restoration design concept must, at a minimum, include additional stream modifications to offset (i.e. mitigate) the increased flood levels created by the increased roughness in the stream channel.

Various modifications are possible for mitigating increased flood levels including, 1) floodwater detention to reduce peak flows and/or 2) increased flood channel conveyance. These types of modifications must be integrated into the broader community objective to eliminate or reduce to the maximum extent practical, the continuing threat of flood damages within the Westside Creeks community. SARA is currently in the early stages of a separate study (the San Antonio River Watershed Master Plan), which is evaluating both detention and increased channel conveyance, among other options, including property buyouts and source runoff reduction, for reducing the level of flood damages within the Westside Creeks. All planning level activities relating to flood mitigation were coordinated between the Westside Creeks Restoration team and the San Antonio River Watershed Master Plan team to help ensure that both plans proceed in a coordinated manner, potentially providing greater benefits at a lower cost than if these projects were independent of each other. For those reaches of the Westside Creeks which may potentially be included in a future major flood reduction project, there is a potential for direct integration with the restoration activities of this project. The degree of restoration intensity that can be realized is site specific, with many factors affecting the outcome. Two alternatives were considered, as shown below, based on whether or not additional major channel improvements may be ultimately incorporated into the project. In most cases, additional property ROW must be acquired if the objective of major channel improvements to achieve substantial flood damage reductions is to be accomplished.

Type A. This restoration alternative defines locations where the extents of stream modifications are expected to remain essentially within existing ROW limits and publicly owned property.

Type B. In locations where additional property may be required to meet flood mitigation needs, the restoration alternative is shown with expanded ROW into existing privately owned properties. This additional property for flood mitigation has the added benefit of potentially enhancing the ecological restoration and providing additional recreational facilities. It was assumed that this alternative should incorporate a mix of buyouts of the most flood hazard-influenced properties, along with channel widening and deepening to take advantage of flood buyout properties and reduce the flood hazards for other remaining properties. It was also assumed that while flood detention may technically be one of the solutions, its cost could prevent it from becoming a viable alternative.

These restoration alternatives are presented in the following sections, relating the feasibility and impacts of the restoration intensity on the project effectiveness and cost.

Base Flow Enhancement

The conceptual planning approach for the Westside Creek's stream restoration also includes provisions which should provide enhancement of intermittent base flows in the creeks. Multiple stakeholders have noted an observed reduction in base flow within the Westside Creeks that has been attributed to the historic stream channelization modifications. This observation could be due to factors beyond the channelization, such as increased impervious cover in the areas surrounding the creeks. However, an integral part of the stream restoration concept is the goal of returning the creeks to a more "natural" condition, which in this area typically included multiple spring fed tributaries and other groundwater contributions to the base flow condition. Clearly, to achieve the desired aquatic habitat and maintain the appropriate mix of aquatic and riparian vegetation within the creeks, a stronger component of base flow is necessary. Many of the design approaches described in the preceding Riparian Restoration section involved creation and enhancement of additional groundwater storage areas within the riparian zone. These concepts, in combination with lowering the stream thalwegs, may expose alluvial groundwater to the channel and partially accomplish this enhanced base flow objective. The delayed release of flows from stormwater detention or retention facilities could also offset the impacts of increased impervious cover and improve base flow conditions, although these benefits would still likely be limited. Implementing Low Impact Development (LID) designs for future redevelopment in the area could reduce impervious cover and provide increased recharge to the soils, which would benefit the base flow in the streams, but these benefits could take many years to be realized.

In many urban areas, the most reliable method to address the goal of increased base flows is with introduction of new sources of flow which rely on urban infrastructure, such as shallow alluvial groundwater pumps, municipal reclaimed (treated) water, or other gray water sources in the community. Obviously, these sources are less desirable in that they require physical infrastructure and an associated capital and operation and maintenance cost; however, in certain areas the cost may be acceptable to achieve the desired reliability and volume of base flow. One promising opportunity is the existing recirculation pump in the San Pedro storm diversion tunnel which may be available to enhance base flow in the urban portion of San Pedro Creek. The San Antonio Water System (SAWS) already maintains an extensive network of pipelines which convey reclaimed water to many areas of San Antonio from SAWS' wastewater treatment plants. The feasibility of using such options in the restoration program should be investigated in the next phases of this study.

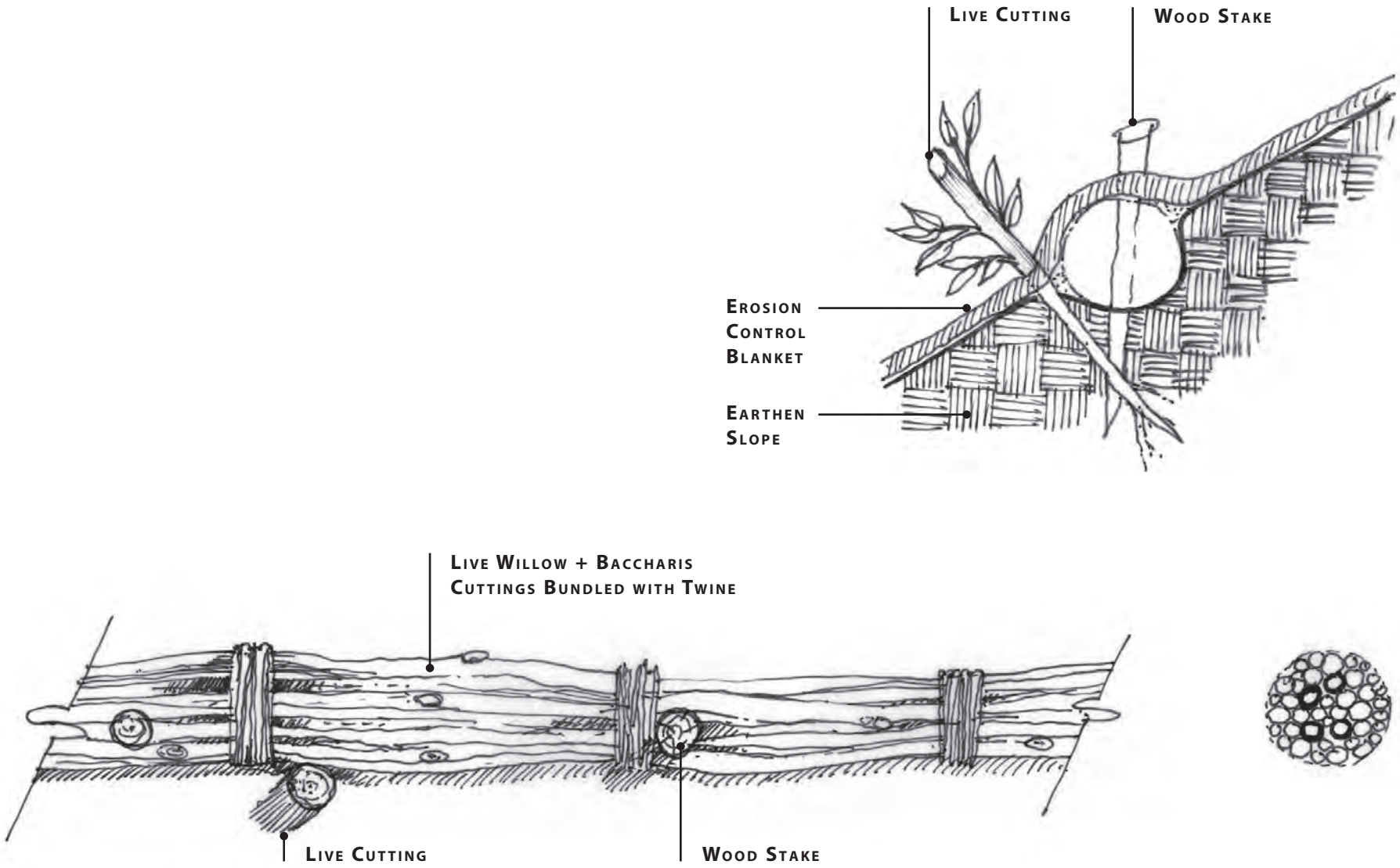


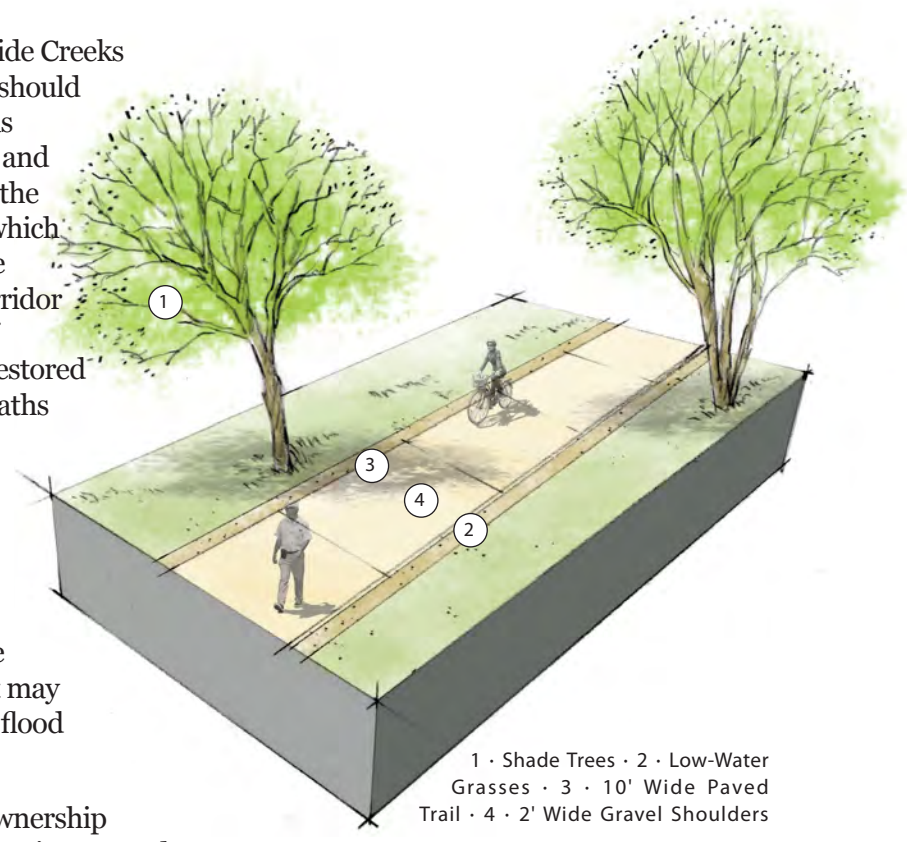
Figure 21. Live Fascines

"Restore the creeks so they may be used by all generations from the youngest to the oldest members of the community."

- Member of the WCROC

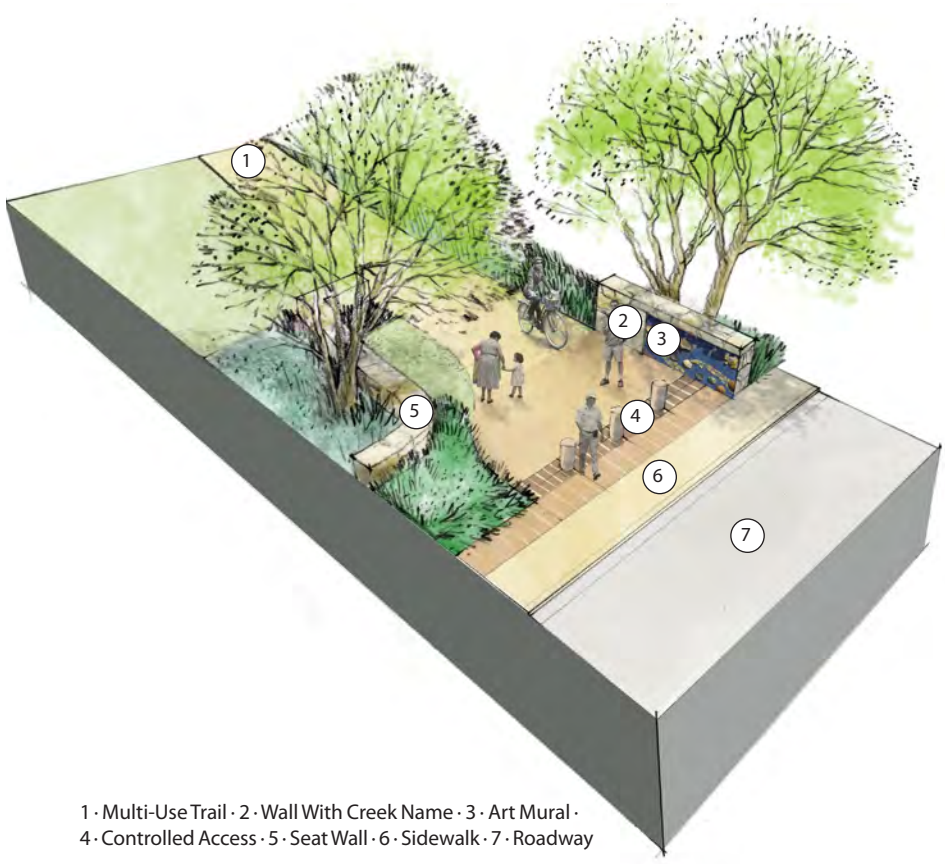
Trails and Recreation

The incorporation of an interconnected trail network is a key component of the Westside Creeks Restoration Project Conceptual Plan. The trails system proposed for Westside Creeks should be coordinated with other similar projects, such as the recently completed trail that was constructed by the San Antonio Alternative Housing Authority along Elmendorf Lake, and the ongoing Linear Creekways Initiative, whose advisory board has authorized adding the Westside Creeks into their funding plan. Voters also recently approved Proposition 2 which includes funding for trails along the Westside Creeks. With a suitable trail network, the Westside Creeks can function as a linear park, a pedestrian-friendly transportation corridor and a source of recreational opportunity throughout the community. A dual system of primary and secondary trails is envisioned to give residents and visitors access to the restored creeks, providing additional mobility for the community, through safe walk and bike paths that will connect the Westside to the San Antonio River and to other trail networks. The backbone of this trail system is a continuous primary trail, which is capable of supporting pedestrians and bicyclists in improving their options for recreation, fitness and alternative transportation. This primary trail should be, at a minimum, a ten foot wide concrete trail with two foot wide crushed stone shoulders. A series of secondary trails will also be utilized in limited areas, allowing more intimate access to the creeks, dipping down into the channel, traversing the side slopes and occasionally crossing the streams near the water's edge. These secondary trails will utilize similar materials, but may be narrower and steeper than the primary trails and will need to be left unused during flood events.



1 · Shade Trees · 2 · Low-Water Grasses · 3 · 10' Wide Paved Trail · 4 · 2' Wide Gravel Shoulders

There will be locations where creekside trails may not prove feasible due to property ownership constraints, and in those areas, the trail system can divert through local streets, utilizing signage and pavement markings to clearly identify the trail. At roadway crossings over the streams, the primary trails will typically connect with the roadways, with ramps and identifying signage. High traffic areas may also utilize enhanced gateways, providing an invitation to visit the creeks.



1 · Multi-Use Trail · 2 · Wall With Creek Name · 3 · Art Mural · 4 · Controlled Access · 5 · Seat Wall · 6 · Sidewalk · 7 · Roadway

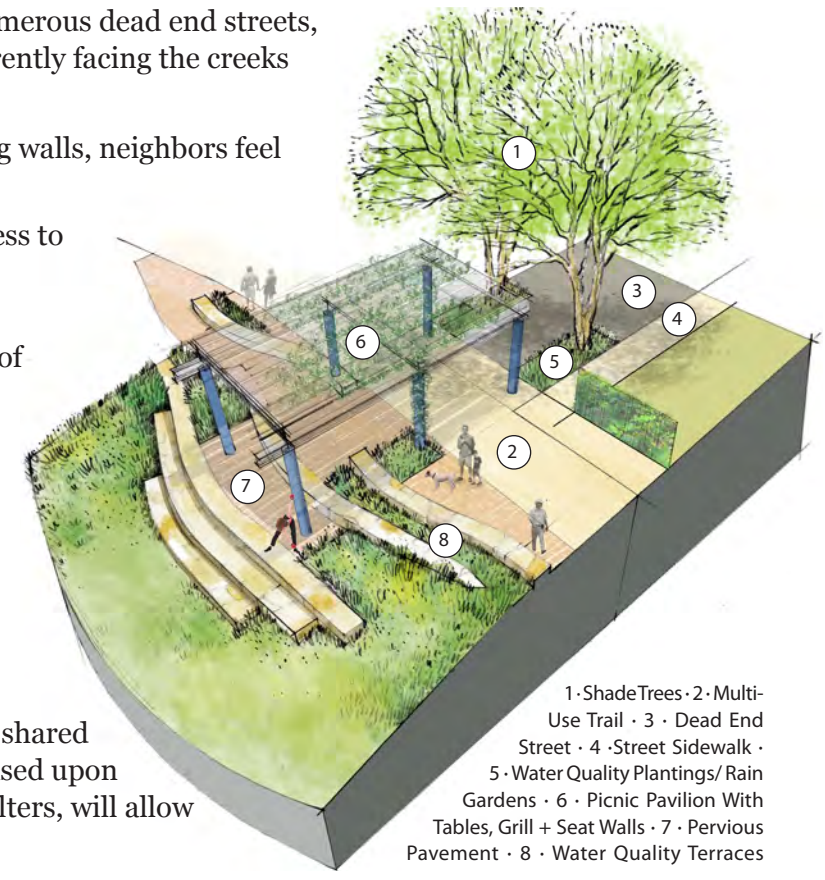
Gateways. At the creek's intersections with City streets, small plazas serve as the front doors to the corridors, announcing the trails that follow. While being kept simple and inviting, the plazas highlight the key elements that are at play in the Westside Creeks. These include:

- restoration with integrated rain gardens and native and drought-tolerant plants;
- a continuous multi-use trail for transportation connections;
- a sense of permanence and history, using solid, durable local materials;
- art opportunities which celebrate each creeks identity and local talent;
- security, increasing use by making the plazas and trails visible and accessible from the streets; and
- low maintenance.

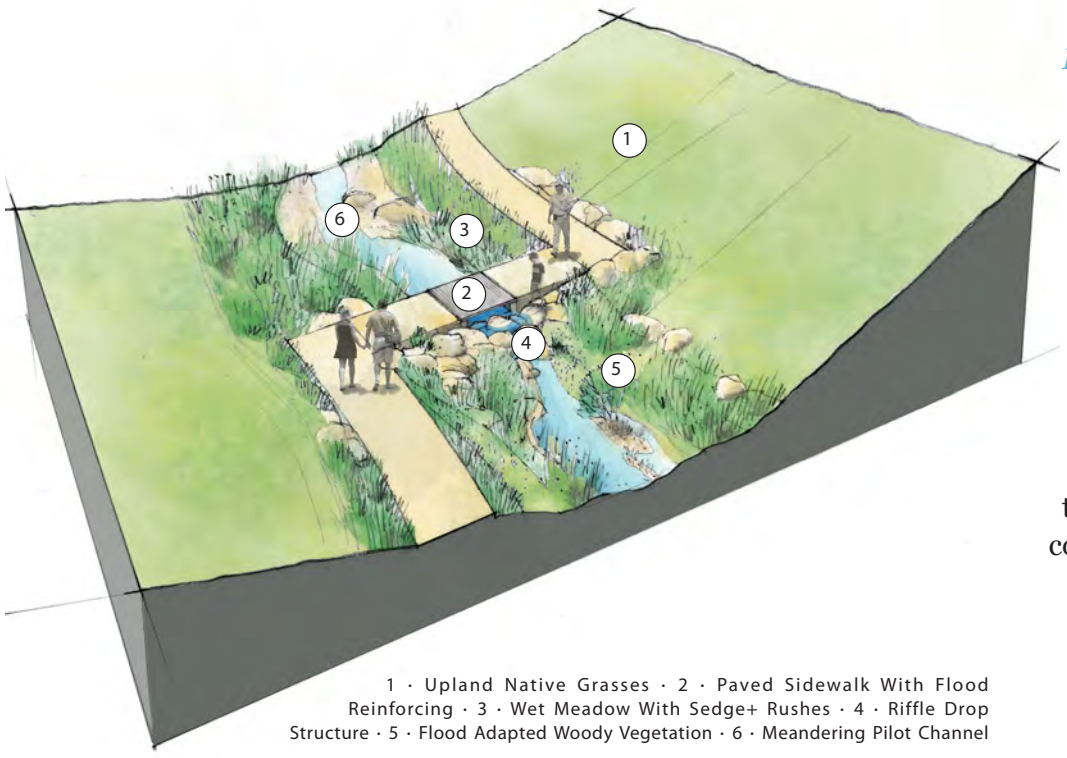
Street-End Plazas. Street-end plazas are designed to take advantage of the numerous dead end streets, many resulting from bridge removal during previous channelization, that are currently facing the creeks and provide four fundamental purposes:

- It makes a better place for people. By adding a canopy, a grill, tables and seating walls, neighbors feel welcome to come together and energize the creeks.
- It helps address Parks Department stated goals of increasing neighborhood access to recreation and open space in these underserved neighborhoods.
- It provides multiple connections onto the trails and gives the surrounding neighborhoods a sense of ownership of the public trails and creeks. This is one of the fundamental tools toward bringing a sense of security on the creeks.
- It acts as a bio-filter for urban stormwater. Currently the stormwater runs directly from the streets down into the creeks. By implementing rain gardens, bioswales and improved outfalls, run-off is slowed down, increasing groundwater recharge and improving water quality while sustaining additional planting. This in turn improves shade and sustains attractive landscape at the plazas.

Shade Shelters offer the opportunity for greater comfort while providing a perfect point of engagement for the broader design community. These could also serve a shared shelter function in locations along VIA routes. Promoting design competitions based upon the Westside Creeks logo for each of the creeks, or even each of the individual shelters, will allow a truly great infrastructure to develop.



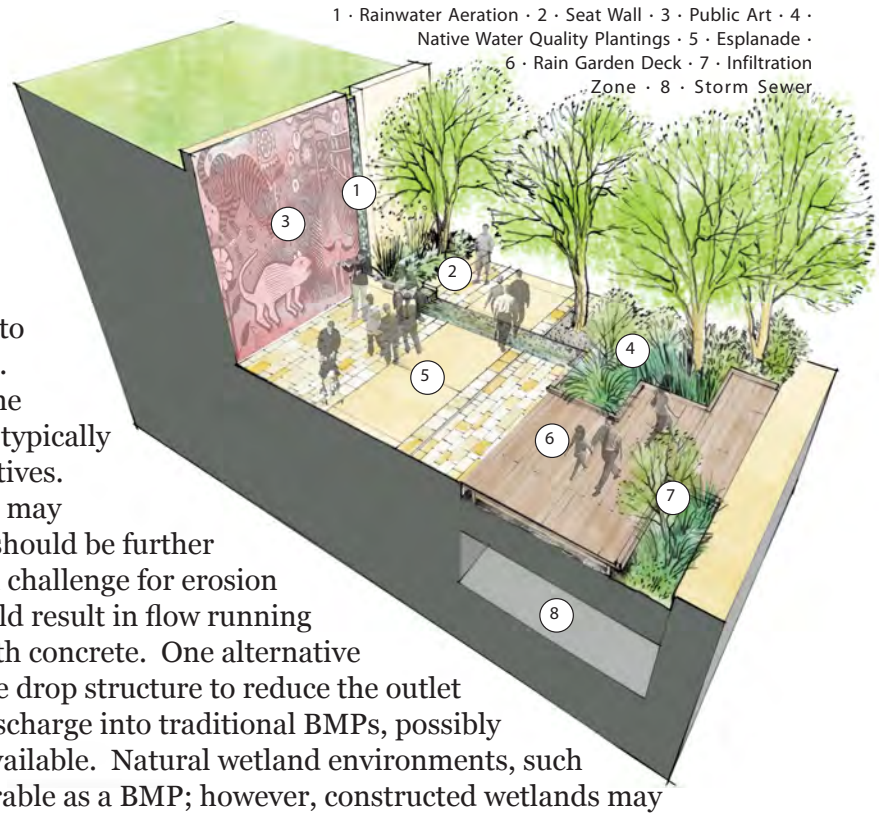
1 · Shade Trees · 2 · Multi-Use Trail · 3 · Dead End Street · 4 · Street Sidewalk · 5 · Water Quality Plantings/ Rain Gardens · 6 · Picnic Pavilion With Tables, Grill + Seat Walls · 7 · Pervious Pavement · 8 · Water Quality Terraces



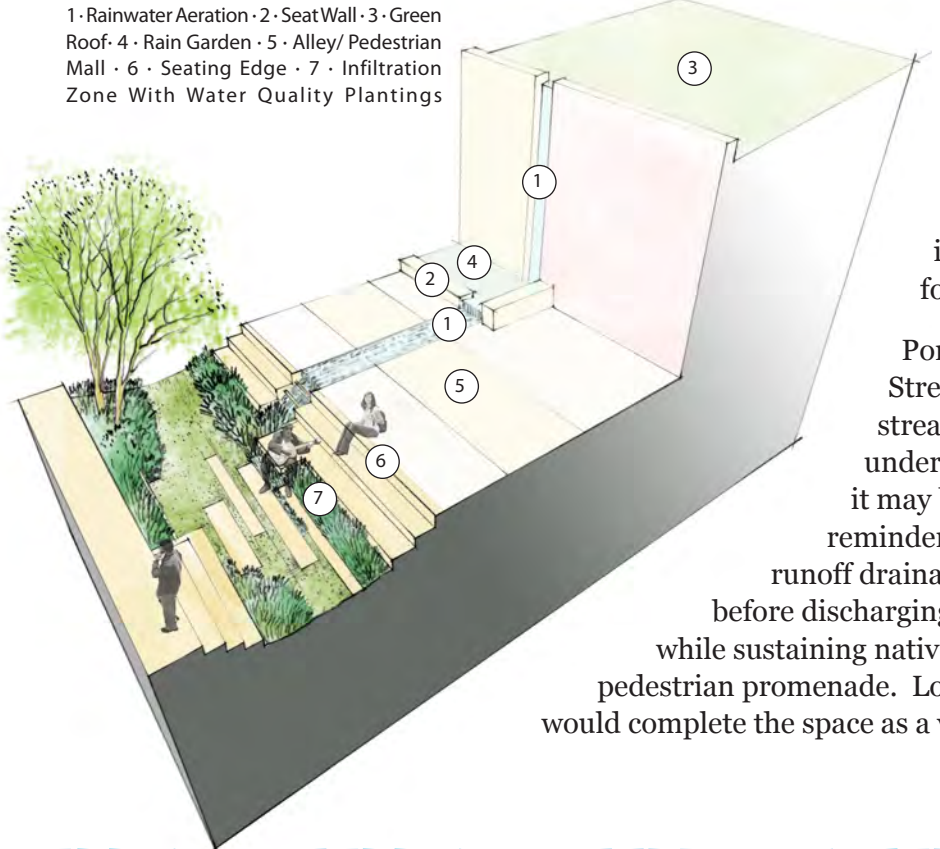
1 · Upland Native Grasses · 2 · Paved Sidewalk With Flood Reinforcing · 3 · Wet Meadow With Sedge+ Rushes · 4 · Riffle Drop Structure · 5 · Flood Adapted Woody Vegetation · 6 · Meandering Pilot Channel

Low Water Crossings. Today, most creek crossings are bridges designed for vehicular traffic, with several pedestrian bridges. As the creeks are restored via a series of small drop structures, slowing the water and improving water quality through aeration, there is an opportunity to combine these creek structures with pedestrian crossings as a part of the secondary trails. These improvements can help to restore the connectivity lost within the communities when the flood improvements were constructed in the 1960s. All structures within the stream channel will need to be designed to withstand flooding with minimal maintenance; low water crossings and their approaches should be have hardened surfaces (stone or concrete).

Storm Drain Outfalls. The conceptual planning approach for the Westside Creek's stream restoration also includes provisions which should provide enhancement of water quality in the creeks. Restoration processes inherently create better conditions for sustaining desirable water quality with increased aquatic vegetation, natural biofiltering and pools for sediment deposition. As part of an urban drainage network, the Westside Creeks serve as receiving bodies for stormwater runoff from multiple enclosed stormwater drainage systems. Most of these systems currently use traditional concrete or corrugated pipe outfall structures and discharge stormwater runoff directly into the streams, potentially impacting water quality and causing localized erosion. There are alternative types of storm drain outfalls designed to accomplish some removal of sediment and floatable materials. These alternative structures are typically characterized as "Best Management Practices" (BMPs) for water quality objectives. The channel depths and limited space constraints in the Westside Creek areas may negatively impact the use of these BMP outfall structures but this alternative should be further investigated in future phases of the project. The channel depths can present a challenge for erosion protection, since allowing outfalls to discharge at their current elevations would result in flow running down the relatively steep side slopes, some of which are currently armored with concrete. One alternative may be to use an inlet box screen for debris removal combined with a manhole drop structure to reduce the outlet velocities (including energy dissipation features, as necessary), followed by discharge into traditional BMPs, possibly including naturally vegetated grassy swales in areas where sufficient land is available. Natural wetland environments, such as proposed for the restoration conceptual design, are also aesthetically desirable as a BMP; however, constructed wetlands may be a challenge for reaches of the Westside Creeks where perennial flow may not be available to sustain typical wetland vegetation.



1 · Rainwater Aeration · 2 · Seat Wall · 3 · Public Art · 4 · Native Water Quality Plantings · 5 · Esplanade · 6 · Rain Garden Deck · 7 · Infiltration Zone · 8 · Storm Sewer



1 · Rainwater Aeration · 2 · Seat Wall · 3 · Green Roof · 4 · Rain Garden · 5 · Alley/ Pedestrian Mall · 6 · Seating Edge · 7 · Infiltration Zone With Water Quality Plantings

Urban Conditions - San Pedro Creek. San Pedro Creek offers many restoration challenges in its current condition, especially in the upper portion of the study area, regarding water quality and attractiveness as an amenity. This plan strives to better integrate this forgotten and neglected creek as a positive place within San Antonio. When possible, widening the creek and reducing the amount of paving is proposed. Integrating a series of small rain gardens is proposed to take advantage of adjacent roof run-off and provide places for planting, thus improving environmental qualities within the corridor.

Portions of San Pedro Creek, such as between Houston and Dolorosa Streets, are so intensely urbanized that the best alternative is not to attempt stream restoration at all, but instead to divert all storm runoff to an enclosed underground conveyance and expand the pedestrian corridor. However, it may be beneficial to construct a small water course on top, as an aesthetic reminder of the importance of San Pedro Creek to San Antonio. Local storm runoff drainage in this area is proposed to be routed through large planted bioswales before discharging into the underground conveyance, further improving water quality while sustaining native planting and transforming the corridor into a wonderfully inviting pedestrian promenade. Local artists could develop a series of art installations and murals which would complete the space as a vibrant cultural center within San Antonio.

Economic Development

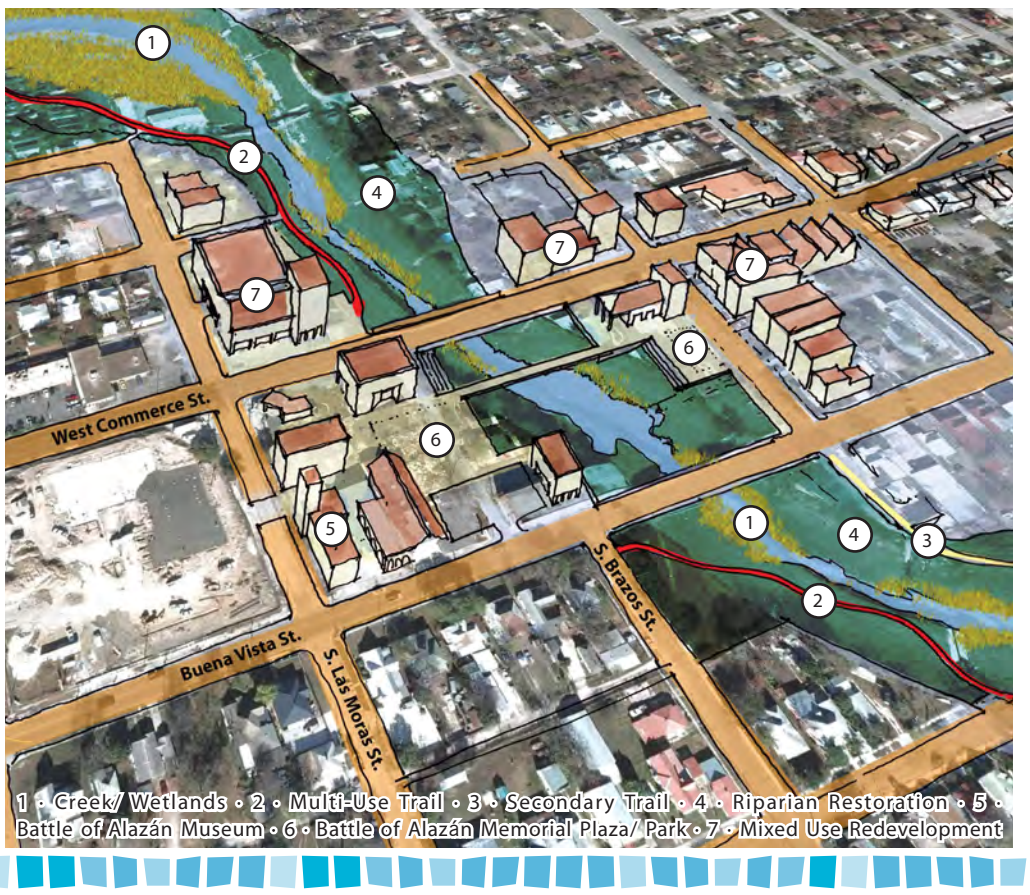
IRVING MIDDLE SCHOOL

1 · Creek/Wetlands · 2 · Multi-Use Trail · 3 · Secondary Trail · 4 · Riparian Restoration · 5 · Parkland · 6 · Pedestrian Bridge · 7 · Park Shelter + Parking · 8 · Irving Middle School · 9 · Sports Field · 10 · Mixed Use Redevelopment · 11 · Low Water Crossing

FARIAS/CROCKETT

1 · Creek/ Wetlands · 2 · Multi-Use Trail · 3 · Secondary Trail · 4 · Riparian Restoration · 5 · Parkland · 6 · Community Gardens · 7 · Mario Farias Park · 8 · Pedestrian Bridge · 9 · Police Station/ Garden Storage · 10 · Margil Elementary School

ALAZÁN PLAZA



1 · Creek/ Wetlands · 2 · Multi-Use Trail · 3 · Secondary Trail · 4 · Riparian Restoration · 5 · Battle of Alazán Museum · 6 · Battle of Alazán Memorial Plaza/ Park · 7 · Mixed Use Redevelopment

While the primary focus of this project is on the ecological restoration of the streams, mitigation of existing flood hazards and access along and across the streams, the surrounding land uses stand to benefit from these improvements through revitalization, community and economic development opportunities. Considerable effort was expended by community members in the long range planning of economic opportunities that should be available from this project. A number of long-term design elements based on land use were developed to address connectivity and security. These elements were designed to increase access and usage by the public while maintaining the flood hazard reduction and ecologically restored functions of the restored creeks. As described below, the social restoration design included the development of catalyst sites based on public workshops and stakeholder input.

ALAZÁN CREEK CATALYST SITES

History · Community Connections · Economic Development

The **Irving Middle School Catalyst Site** is located west of the intersection of Delgado and Zarzamora Streets, and lies within easy walking distance (1/4-mile) of six churches and is adjacent to/east of Irving Middle School.

This proposal expands Irving Middle School grounds east and connects it with the creek, providing an additional soccer field, open space and a pedestrian bridge while providing community connections to this restored segment. Community gardens offer the potential for both edible rewards and as a teaching opportunity for the adjacent school and community.

Farias/ Crockett Catalyst Site is located south of Ruiz Street at the confluence of Alazán Creek and Martínez Creek, expanding Mario Farias Park to the three sides of the confluence. The proposal for this site takes advantage of the extensive open area at the confluence of Alazán and Martínez Creeks, expands Mario Farias Park and adds community gardens and a police patrol office, while adding pedestrian bridges (or modifying existing pedestrian bridges) and low water type crossings to connect the neighborhoods together. Access to public parks and open space has been in short supply in Westside neighborhoods for many years. This location offers the chance to improve the quality of life for those living here. Increased usage has the potential to stimulate retail activity associated with recreation/leisure settings such as bike shops, convenience stores or coffee shops.

Alazán Plaza Catalyst Site has many features attractive for redevelopment, including the nexus of Commerce Street and the creek, a planned streetcar line along Commerce Street with a direct connection to downtown, the Battle of Alazán dedication marker, new development in the form of a bank building, and undervalued vacant properties. This design proposes increasing the density of residential units in a vertical mixed use development adjacent to the streetcar line should be an attractive incentive for investors. The potential exists for a Battle of Alazán Creek plaza and history museum.

APACHE CREEK CATALYST SITES

Culture·Arts·Market

The **Elmendorf Catalyst Site** is designed to provide many services to the community in this area. Our Lady of the Lake University has a shortage of quality higher density, mixed income housing options as well as attractive retail and commercial services suited to the student population. This area would benefit from increased density allowances and placement of a streetcar station near the intersection of Commerce Street and 24th Street. Upstream of the Commerce Street bridge over Apache Creek is the most natural looking area in the Westside Creeks project area, with relatively dense riparian vegetation, and which was recently enhanced with a trails project sponsored by the San Antonio Alternative Housing Authority. This, combined with the extensive flood plain and close proximity to Rosedale Park, present a good opportunity to excavate a large volume of earth east and north of the existing alignment to create greater stormwater capacity and an asset for the community and the existing, highly utilized park.

ELMENDORF

1 · Creek/Wetlands · 2 · Multi-Use Trail · 3 · Secondary Trail · 4 · Riparian Restoration · 5 · Parkland · 6 · Existing Lake · 7 · Enhanced Bridge for Pedestrian + Bicycle Use · 8 · Retail/ Mixed Use · 9 · Mixed Use/ Student Housing · 10 · Future BRT Station · 11 · Pedestrian Bridge · 12 · Lake Expansion into Rosedale Park · 13 · Veterans' Memorial

The **Produce Center Catalyst Site** is one of the Westside catalyst sites most heavily programmed, with a variety of community activities designed to engage a wide range of ages. Located near the City's main wholesale produce market, this vibrant area should celebrate local food supply, arts and crafts with a permanent market where vendors, growers and artists can set up and sell to the public. Public restrooms, skate park, play grounds, climbing wall, amphitheater and community center are all illustrated options suggested for this area. Coordination with the Mission Verde Center at old Cooper Middle School will be an integral component of this catalyst.

The City's successful food assistance programs benefitting both the public and the local producers can make special allowances for food stamps to be used at a discount for locally produced foods at areas such as this.

PRODUCE CENTER

1 · Creek/Wetlands · 2 · Multi-Use Trail · 3 · Secondary Trail · 4 · Riparian Restoration · 5 · Parkland · 6 · Amphitheater/ Stormwater Detention · 7 · Open Air Public Market · 8 · Adaptive Reuse of Existing School · 9 · Produce Center · 10 · Dance Hall/ Senior Center · 11 · Additional Parking · 12 · Public Restrooms · 13 · Skate Park · 14 · Climbing Walls

The **Memorial Avenue Catalyst Site**, the Community Activists' Memorial Avenue and community gardens is yet another example of building upon the local history and culture to celebrate and instill pride, investing the community in the success of the civic improvements. Starting at the Guadalupe Cultural Arts Center and continuing south along Brazos to Apache Creek, this proposed memorial avenue will create a walk of commemorative plaques and sculpture telling the proud history of passionate citizens working hard to affect positive change for all. This self guided tour could lead from Guadalupe Street to the Apache Creek, through the garden rental shelter, the community gardens and to the historic San Fernando Cemetery Number 1 and the grave sites of select activists. This site could also be incorporated into existing bike tours that visit community murals.

MEMORIAL AVENUE

1 · Creek/Wetlands · 2 · Multi-Use Trail · 3 · Secondary Trail · 4 · Riparian Restoration · 5 · Parkland · 6 · Pedestrian Bridge · 7 · Low Water Crossing · 8 · Community Gardens · 9 · Enhanced Bridge for Pedestrian + Bicycle Use · 10 · Upland restoration · 11 · Cultural Center · 12 · Horticulture Pavilion · 13 · Historic Cemetery · 14 · Community Activist Promenade

FREDERICKSBURG TOD/OST

CINCINNATI GARDENS

FARIAS/CROCKETT

MARTÍNEZ CREEK CATALYST SITES

Neighborhood• Community • Environment

The **Fredericksburg Transit Oriented Development/ Old Spanish Trail Catalyst Site** along Martínez Creek is located between Fredericksburg Road and French Place, a six block focus area with some property already acquired and cleared by the City of San Antonio due to the flooding probability of this area. Set in a predominantly single family residential area, with commercial land uses along Fredericksburg Road, the community vision for this segment of the creek is for passive and smaller scale active recreation along a restored creek. Also of interest to the public participants in the development of this area are community gardens, playgrounds, dog parks and fishing.

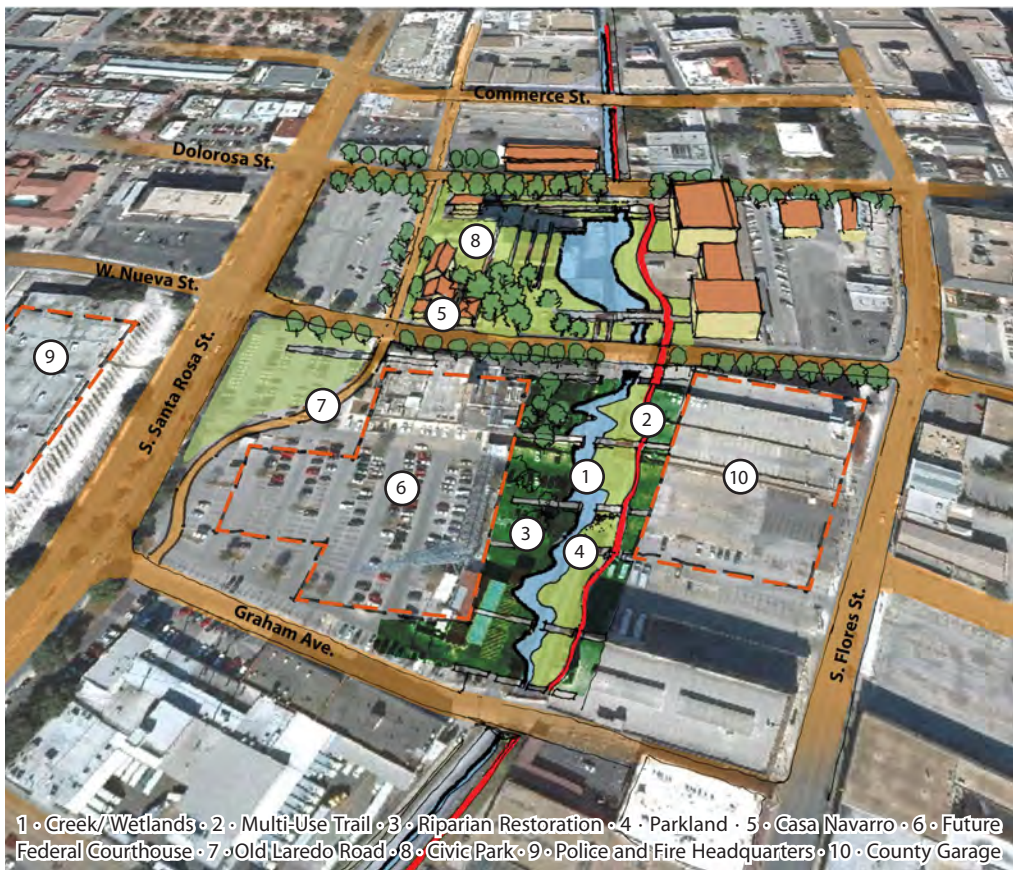
Along with regular trail connections along the ends of severed streets, access plazas/gateways are proposed for the trail connection from Woodlawn Avenue and Fredericksburg Road. These will serve as highly visible wayfinding amenities announcing the trails' location to potential users. Trail amenities such as interpretive signage, orientation "You Are Here" maps, gateway architecture, public art, seating, shade structures, trash receptacles, drinking fountains and safety features may be incorporated.

A significant transit connection and transit oriented development opportunity exists just east of the creek along Fredericksburg Road at Huisache, where a proposed Bus Rapid Transit station will be built, greatly enhancing the transportation options for trail users. Currently the Fredericksburg Road corridor carries over 10,000 transit passengers daily, VIA's highest travelled corridor in the system. The Primo Bus Rapid Transit project anticipates attracting additional patrons as service and amenities will be enhanced. Primo is scheduled to begin operation on Fredericksburg Road in late 2012.

The **Cincinnati Gardens Catalyst Site** was selected as an opportunity to reduce flooding at a major creek constriction point while creating open space land in this moderately dense residential neighborhood. Undeveloped properties line portions of this area providing good opportunity to widen and naturalize the creek's character. Proposed features include community gardens, a pocket park and preservation of the existing church. Creek and trail access will primarily focus on the east side of the creek from Cincinnati Avenue. An at-grade crossing of Cincinnati Avenue will allow for gateway features to alert patrons to the presence of the trail system. In addition, the existing bike lane along Cincinnati provides an on-street connection for cyclists to travel to Woodlawn Lake, St. Mary's University and downtown.

Farias/ Crockett Catalyst Site is located south of Ruiz Street at the confluence of Alazán Creek and Martínez Creek, expanding Mario Farias Park to the three sides of the confluence. The proposal for this site takes advantage of the extensive open area at the confluence of Alazán and Martínez Creeks, expands Mario Farias Park and adds community gardens and a police patrol office, while adding pedestrian bridges (or modifying existing pedestrian bridges) and low water type crossings to connect the neighborhoods together. Access to public parks and open space has been in short supply in Westside neighborhoods for many years. This location offers the chance to improve the quality of life for those living here. Increased usage has the potential to stimulate retail activity associated with recreation/leisure settings such as bike shops, convenience stores or coffee shops.

CIVIC CENTER



ARTS DISTRICT

SOUTHGATE

SAN PEDRO CREEK (EL ARROYO SAN PEDRO) CATALYST SITES

Complement • Downtown Arts • Urban Living

The **Civic Center Catalyst Site** lies at the heart of historic old San Antonio, along San Pedro Creek (or El Arroyo San Pedro, the historical name which the San Pedro Subcommittee would like considered). The location coincides with Casa Navarro and presents the best opportunity for celebrating the early days of the City. Located between Dolorosa Street and Graham Street, Santa Rosa and Flores Street, this site contains a county jail facility, the Casa Navarro State Historical Site celebrating the life of Texas patriot Jose Antonio Navarro, and the future site of a new federal courthouse, and is adjacent to a proposed streetcar line along Nueva Street and the highly pedestrian tourist zone immediately to the north which includes the Governor's Palace, City Hall and numerous historic structures. Within this context and the long term vision, great opportunities exist to create a true civic green within the heart of the City. By removing some of the large amounts of pavement that are currently narrowing the San Pedro Creek, some areas could be returned to a more historic landscape, revealing the historical character of the creeks within San Antonio. This powerful gesture would contribute to improving the environmental qualities within downtown such as stormwater quality, air quality, and urban heat island effect, while creating a new vibrant destination for visitors and the larger community as well.

The proposed improvements include: restored flowing water for the surface channel with stormwater enclosed below (Travis to Dolorosa), a civic park, a linear park connecting El Mercado with the Riverwalk District, major landscape and arts enhancements to the densely urbanized creek area and shaded walkways and rest areas to entice patrons during festivals and events. The removal of existing buildings is in current Bexar County plans, but may be considered as long-term opportunities.

The **Arts District Catalyst Site** lies north of Camp Street and is at the center of plans for a new grassroots arts area, with studios, galleries and museums within a mixed-use high density residential neighborhood. Plazas are to demonstrate water quality improvements as aesthetic features of the sculpture filled plazas and linear art walk along the San Pedro Creek. An enhanced boulevard emphasizing bicycle and pedestrian use will create a connection along Guenther between the San Antonio River trail and the San Pedro trail. When combined with the linear park cross connection from the Civic Center Catalyst Site, these two cross connections between waterways will allow visitors and residents alike to enjoy a complete 2.3-mile downtown loop.

The **Southgate Catalyst Site** takes advantage of the largest parcel of undeveloped land in close proximity to downtown, located between Cevallos Street, Nogalitos Street and I-35 along the east side of San Pedro Creek. It is envisioned to create a large active, multi-use complex within hiking & biking distance of Downtown. The proposed improvements include creek restoration, recreational facilities and medium and high density residential towers as a means of bringing activities and security within the area. The restoration includes opening the width of the creek in order to slow the water, restore plants and create new wildlife habitats. Taking advantage of this new amenity, an amphitheater and sports fields would welcome activities and social events. This site is also adjacent to a possible east-west portion of a fixed rail transportation system. As a whole, the proposed improvements would allow restoration while creating a safe destination within the surrounding neighborhoods; an opportunity for families and children to rediscover the creeks as a positive place within San Antonio.

Restoration Concept

A conceptual plan has been developed to address the four frameworks - **water, restoration, connections and security** - which apply to each creek as adopted by the WCROC. The accompanying aerial plan views and cross sections illustrate this recommended plan as further discussed below.

Water. The conceptual plan provides a return to earlier conditions with a more natural low flow channel and enough flood capacity to maintain or improve the flood control benefits from the channelization. Opportunities for restoring or enhancing base flow were also considered. Additional land will be necessary to accommodate the wider channel and contain the floodplain in selected areas.

Restoration. The conceptual plan provides for improvements that restore natural processes through stable channel design incorporating meanders, wetlands, pools, riffles and drop structures. The restoration plan creates channels that are in equilibrium with sediment transport. This restoration should also enhance the ecological functions of the stream, with vegetation and wildlife habitat that more closely approaches the pre-channelized state.

Connections. The conceptual plan provides for continuous multi-use paved trails with neighborhood connections, low water creek crossings and pedestrian bridges. Connections from the community into this trail system range from simple gravel connectors, up to trails of the same configuration and materials as the main trail. These connections will incorporate all of the transportation modes in use locally.

Security. The conceptual plan provides for physical design features, increased police patrols and increased public use of the creek corridor, all of which will improve the creeks' safety. Specific locations will begin with simple features such as uniform lighting, signage, emergency call boxes, increased visibility and reduced understory growth. Basic design elements include clear lines of sight, uniform lighting using a white light source, clear delineation between public and private spaces, public "ownership" and access control.

ALTERNATIVE COST AND SELECTION

As outlined in the Stream Restoration Approach, two conceptual restoration plans were developed for each identified reach of the Westside Creeks using appropriate assumptions for each of the alternative restoration levels:

Type A - basic low-intensity stream restoration primarily contained within existing available ROW with no flood reduction enhancement.

Type B – includes a higher level of stream restoration and significant flood reduction benefits by expanding the project ROW limits and providing additional channel capacity to contain the 100-year floodplain.

All reaches of the Westside Creeks were evaluated as to their potential cost and benefits for each type of restoration. Conceptual cost estimates for both types within each reach were developed for comparison purposes and details regarding these cost estimates are provided in the Appendix. Some of the major assumptions related to cost were:

General

Unit prices for construction costs are based on local work adjusted to 2010 prices. In stream structure quantities were estimated based on general dimension criteria or details from other San Antonio stream restoration projects. Utility adjustments are assumed as 20% of the total restoration costs but no bridge modification costs are assumed within this estimate.

Type A

- Primary trails are to be located only on one side of the channel where existing publicly-owned land is available or on adjacent streets where public lands are not available. In locations where the restricted project width prevents wide flood bench areas, some secondary trails may need to be incised into the channel side slopes.
- Retaining walls are to be used inside the channel when available channel width is not adequate to achieve required cross-section area for maintaining flow levels.
- Turf reinforcement mats were assumed where channel velocities exceeded 6 feet per second in the 100 year event.

Type B

- Land acquisition costs were taken from 2009 Bexar County Appraisal District (BCAD) value and whole lot purchase with a 3.0 multiplier on residential lots and a 2.0 multiplier on non-residential lots, incorporating the typical full cost of acquisition, along with the impact of parcel size on the cost. Publicly owned parcels were not included in ROW acquisition cost.
- Excavation volumes are conceptual level estimates only. Earthwork quantities were taken from HEC-RAS and increased by 20% to account for shrinkage/swell and spoil.
- Two trails – one primary and one secondary.

"For a long time I felt that the beauty of the creeks was gone forever. There was a lot of life on those creeks. It was a happy deal. And now we need to bring that back."

- Roberto Rodriguez, SARA Board Member

The type of restoration approach recommended for each reach is shown in Table 5. Within those reaches in which there are limited flood hazards for properties, stream restoration using Type A assumptions was selected as the most appropriate choice. Within those reaches shown to have significant properties located within the floodplain, the potential for implementing future additional channel improvements is expected to be warranted and the combined restoration and flood mitigation approach provided by Type B restoration was selected for the recommended plan. The aerial plan views and cross sections which follow reflect these recommendations within each reach. For two of the reaches of San Pedro Creek, no practical restoration potential could be identified due to the intense urban development surrounding the creek; therefore, only aesthetic improvements are recommended for one reach and only "urban" trails are recommended for the other reach.

Based upon these selected restoration concepts for each reach, the estimated construction cost for the total project would exceed $500 million if all reaches were included in the recommended conceptual plan. A significant portion of the estimated construction cost for the recommended conceptual plan can be attributed to the need for additional flood mitigation within seven of the reaches. SARA is also conducting more detailed flood reduction analyses under a Watershed Master Plan for the San Antonio River Watershed which will incorporate these Westside Creeks recommendations into its analysis of the final flood mitigation recommendations for the entire watershed. This ongoing Watershed Master Plan and the subsequent detailed planning phase of the Westside Creeks Restoration will develop additional cost estimates to a higher degree of accuracy than has been developed for this conceptual plan. Please see the Appendix for further details and for tabulations for each reach within the Westside Creeks Restoration Project.

EXAMPLE CROSS SECTIONS

Figures 22-25 provide examples of the restoration plan at representative locations within each of the creeks as follows.

Figure 22 shows a traditional stream restoration cross section upstream of the Culebra Road bridge crossing of Alazán Creek located in the fairly narrow upper reaches of the creek below Woodlawn Lake. This reach does not require any additional flood mitigation improvements other than some limited low-flow channel modifications to accommodate the main channel restoration activities of added riffle pools, added sinuosity, and enhanced vegetation for the entire floodplain area. Through use of limited landscape retaining walls, new pedestrian trails are envisioned to be located along the channel banks with space to cross under the existing bridge structure so as to avoid a busy street grade crossing.

Figure 23 shows a very shallow and broad section of Apache Creek downstream of General McMullen Drive where there are significant existing flood hazards and major improvements are proposed to reduce these hazards. A single row of residential lots and homes which are exposed to frequent flooding along West Martin Street are proposed to be acquired to allow expansion of the carrying capacity of the channel and restoration of the broad riparian area with native vegetation and trails suitable to complement the existing nearby parks and trails already provided in this area adjacent to Elmendorf Lake.

Figure 24 likewise demonstrates an upstream area of Martínez Creek which is recommended for major channel improvements and requiring acquisition of property located deep within the floodplain. The example cross section is located in a broad bend of the creek downstream of Cincinnati Avenue and shows the significantly enlarged channel required to contain the predicted flood flows in this area. This section of the creek will utilize the typical design features for a pool section, with a shallow inner bank and point bar, and a steeper outer bank, with stability protection such as rock vanes to help direct flow away from the outer bank. The expansion of the channel also allows additional recreational trails to be located within the floodplain area and low-flow channel crossings to be provided at selected areas further enhancing the linear park-like atmosphere of the creek.

Figure 25 illustrates an extremely narrow and constrained location between two buildings where the majority of the upstream flood discharges in San Pedro Creek were relocated to an underground tunnel as a part of earlier flood mitigation project and the remaining local surface drainage is currently handled within the existing concrete-lined vertical-walled channel. The restoration concept selected for this section is to remove the vertical walls and provide more traditional sloped banks, stream-side trails and native vegetation to create an appropriate riparian environment within this highly urbanized reach of San Pedro Creek. This location is immediately adjacent to the new Federal Courthouse, which is also currently in the planning phase.

TABLE 5. RECOMMENDED RESTORATION APPROACH

Reach No. *(see Figure 5, page 26)*	**Alazán**	**Apache**	**Martínez**	**San Pedro**
1	A	B	A	A
2	A	A	B	A*
3	A	B	A	trails only
4	B	A	B	B
5	B	A	A	A
6	A			A
7	A			A

* *A portion of San Pedro Reach 2 is intended for urban restoration only*

Alazán Creek

- Concept divided into 7 stream reaches, including 2 with expanded design to incorporate flood mitigation benefits
- Add flood capacity to remove structures from the 100-year floodplain through expanded channel conveyance, coordinated with CIP bridge improvements
- Removal of existing concrete (primarily at bridges and storm outfalls)
- Lengthen and create meanders in channel
- Regrade bankfull channel
- Excavate riparian planting zones
- Install rock cross vanes, riffle drops, rock vanes, and J-hook vanes
- Seed upland plant communities along bench and side slopes
- Install erosion blankets, wattles and live facines
- Trail system that connects Woodlawn Lake with downstream neighborhoods, parks, catalyst sites, and the remainder of the Westside Creeks and the San Antonio River
- Theme Alazán Creek entry plazas, shelters, public art and signage to celebrate its history, community connections and enhance economic development
- Encourage the development of catalyst sites which build off the stream restoration, landscaping and enhanced connectivity to create social restoration

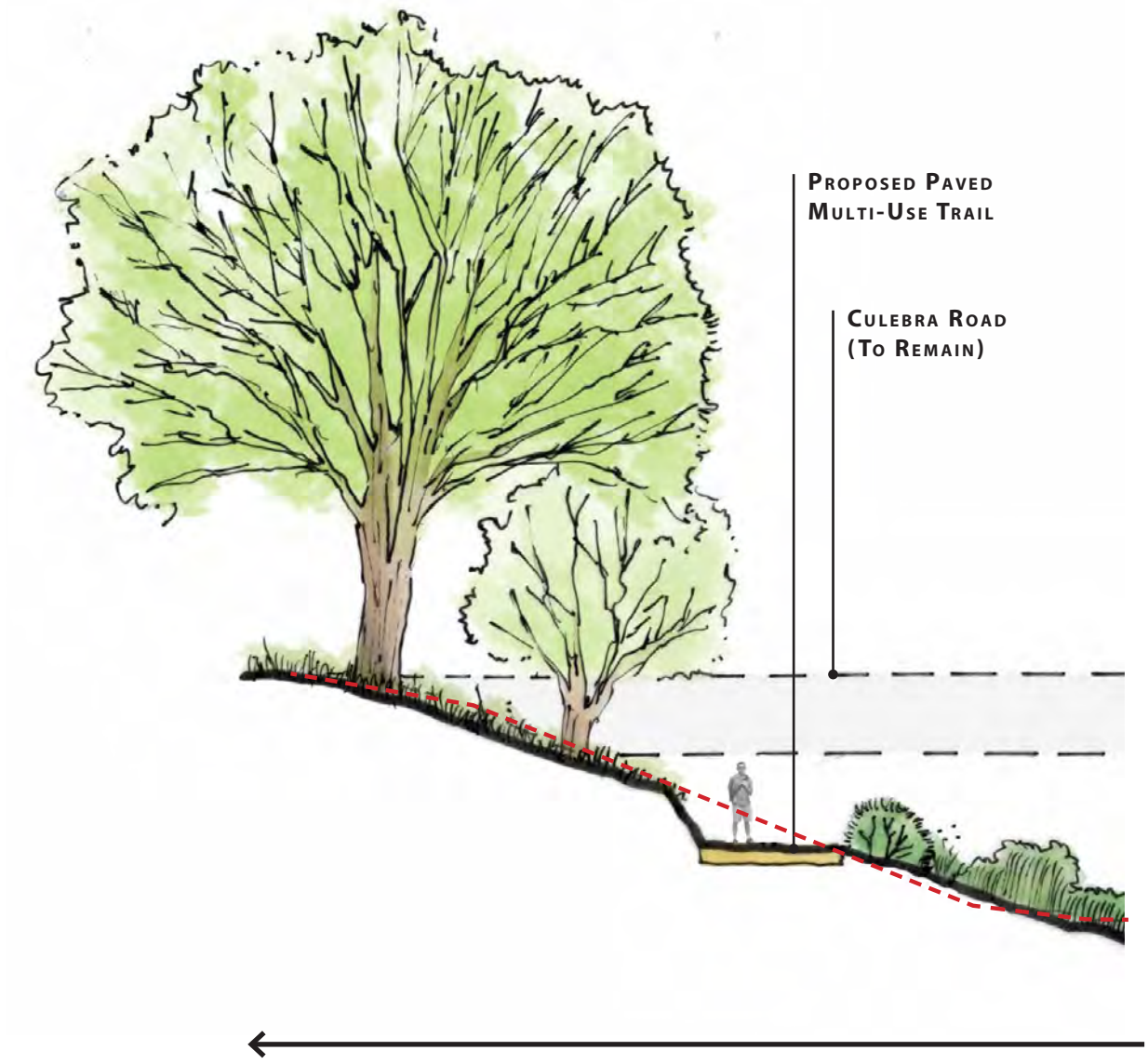


Figure 22. Alazán Creek Proposed Cross Section, Upstream of Culebra Road

Apache Creek

- Concept divided into 5 stream reaches, including 2 with expanded design to incorporate flood mitigation benefits
- Add flood capacity to remove a significant number of structures from the 100-year floodplain through expanded channel conveyance, coordinated with regional stormwater detention projects
- Removal of existing concrete
- Lengthen and create meanders in channel
- Regrade bankfull channel
- Excavate riparian planting zones
- Install rock cross vanes, riffle drops, rock vanes and J-hook vanes
- Seed upland plant communities along bench and side slopes
- Install erosion blankets, wattles and live facines
- Trail system that connects Elmendorf Lake with downstream neighborhoods, parks, catalyst sites, and the remainder of the Westside Creeks and the San Antonio River
- Theme Apache Creek entry plazas, shelters, public art and signage to celebrate Westside's culture, arts and market heritage

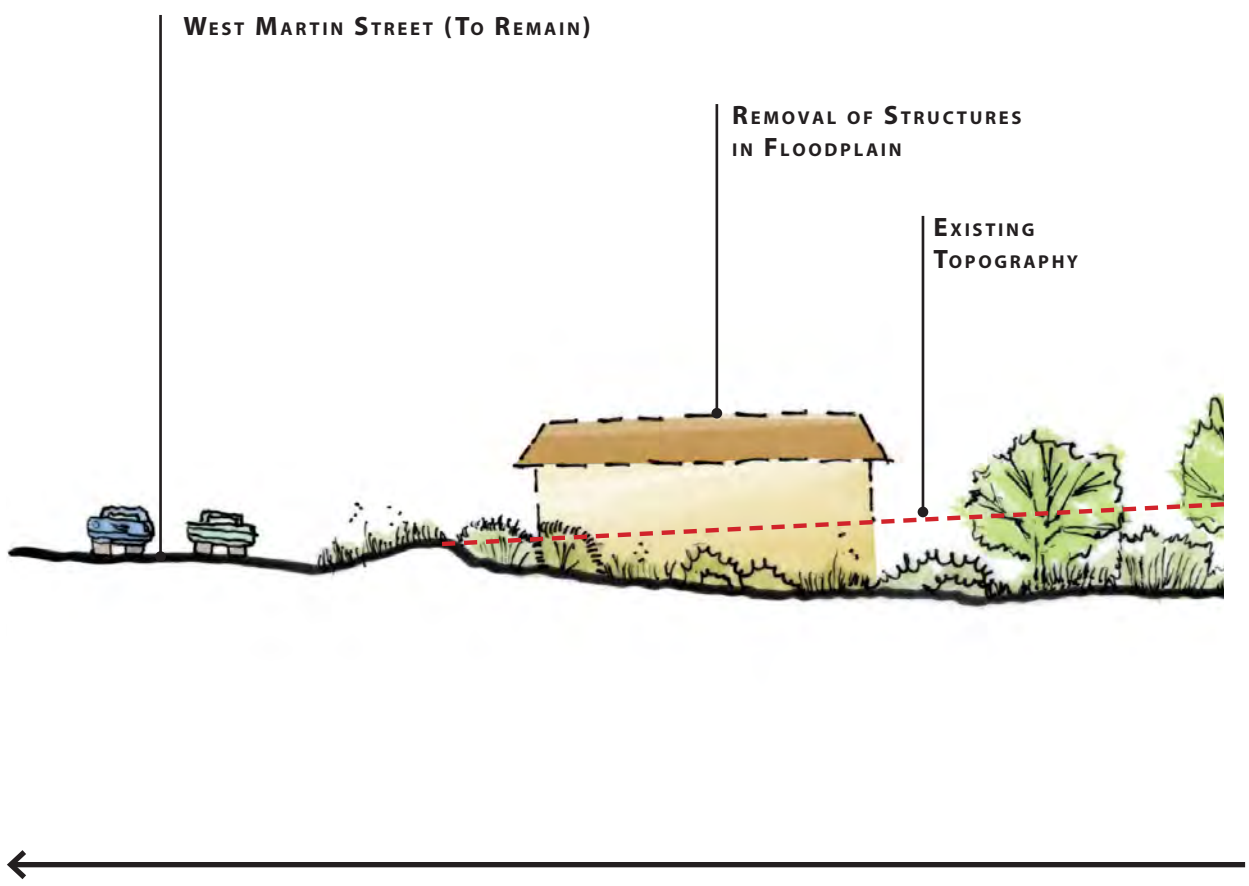
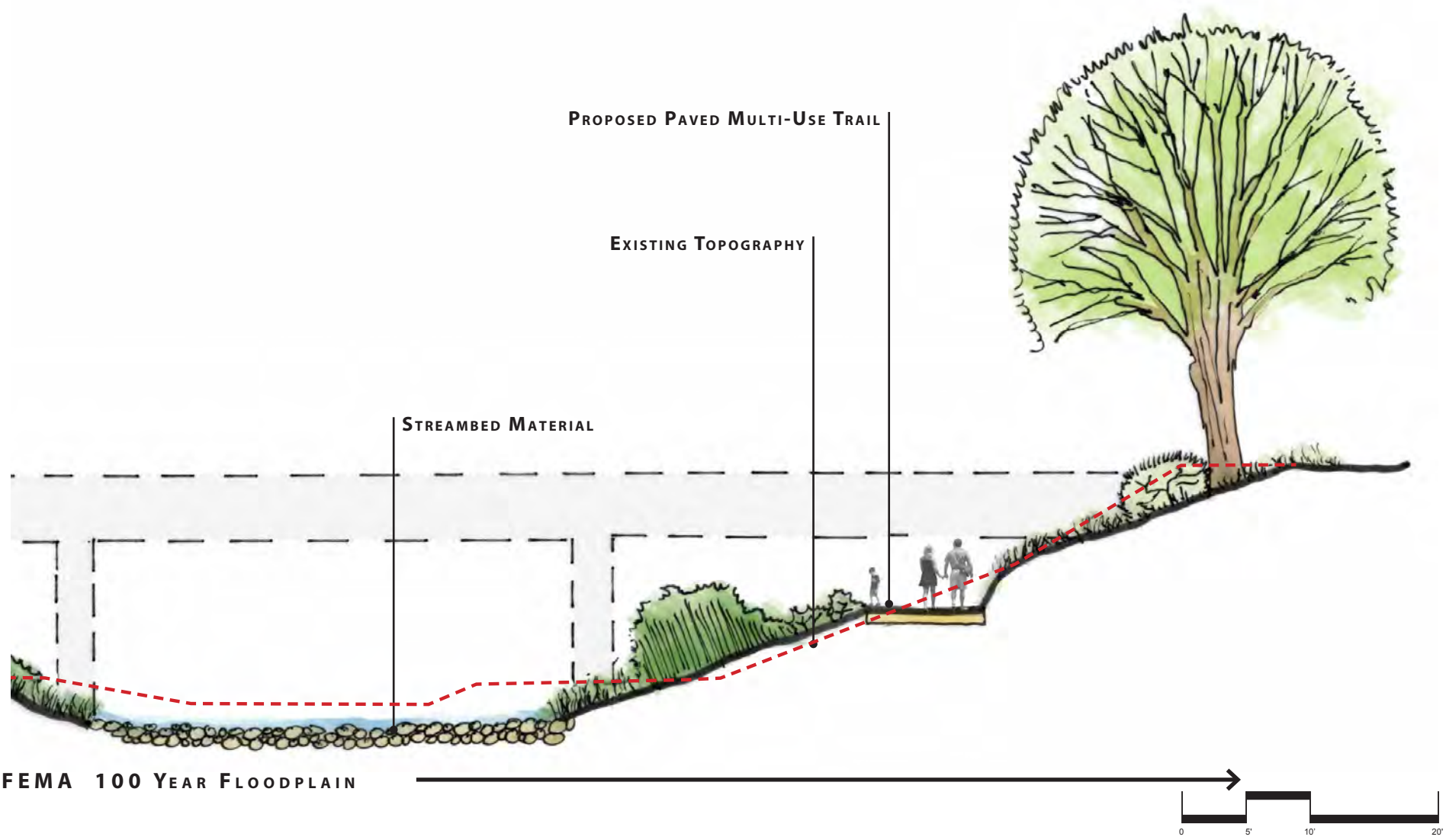
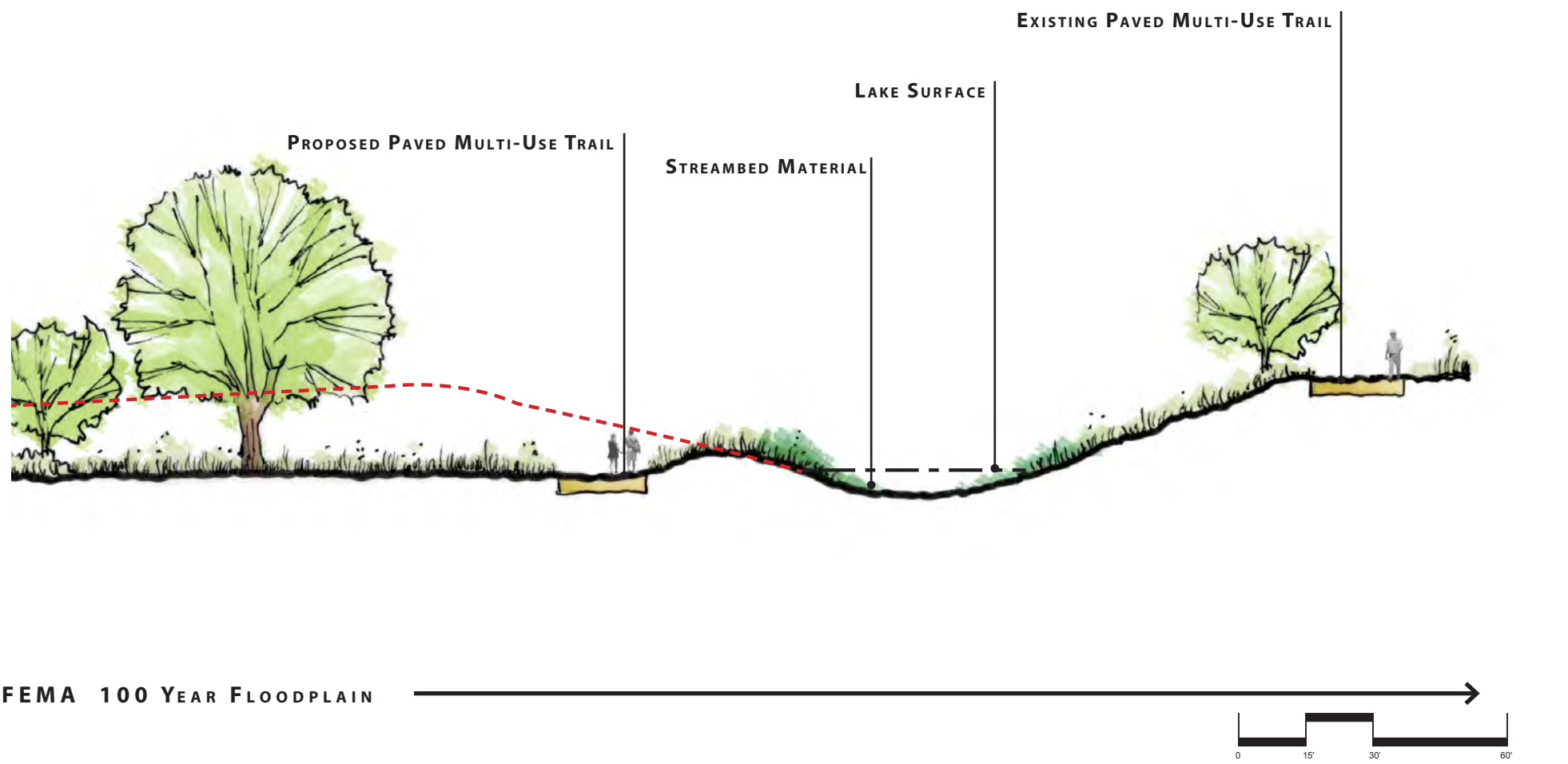


Figure 23. Apache Creek Proposed Cross Section, Downstream of General McMullen Drive


Proposed Paved Multi-Use Trail
Existing Topography
Streambed Material
FEMA 100 Year Floodplain
0
5'
10'
20'


Existing Paved Multi-Use Trail
Lake Surface
Proposed Paved Multi-Use Trail
Streambed Material
FEMA 100 Year Floodplain
0
15'
30'
60'

Martínez Creek

- Concept divided into 5 stream reaches, including 2 with expanded design to incorporate flood mitigation benefits
- Add flood capacity to remove a significant number of structures from the 100-year floodplain through expanded channel conveyance, coordinated with regional stormwater detention and CIP bridge improvements
- Removal of existing concrete (primarily at bridges and storm outfalls)
- Lengthen and create meanders in channel
- Regrade bankfull channel
- Excavate riparian planting zones
- Install rock cross vanes, riffle drops, rock vanes, and J-hook vanes
- Seed upland plant communities along bench and side slopes
- Install erosion blankets, wattles, and live facines
- Trail system that connects upper Martínez Creek with downstream neighborhoods, parks, catalyst sites, and the remainder of the Westside Creeks and the San Antonio River
- Theme entry plazas, shelters, public art and signage to enhance the historic residential community and the natural environment of the restored Martínez Creek

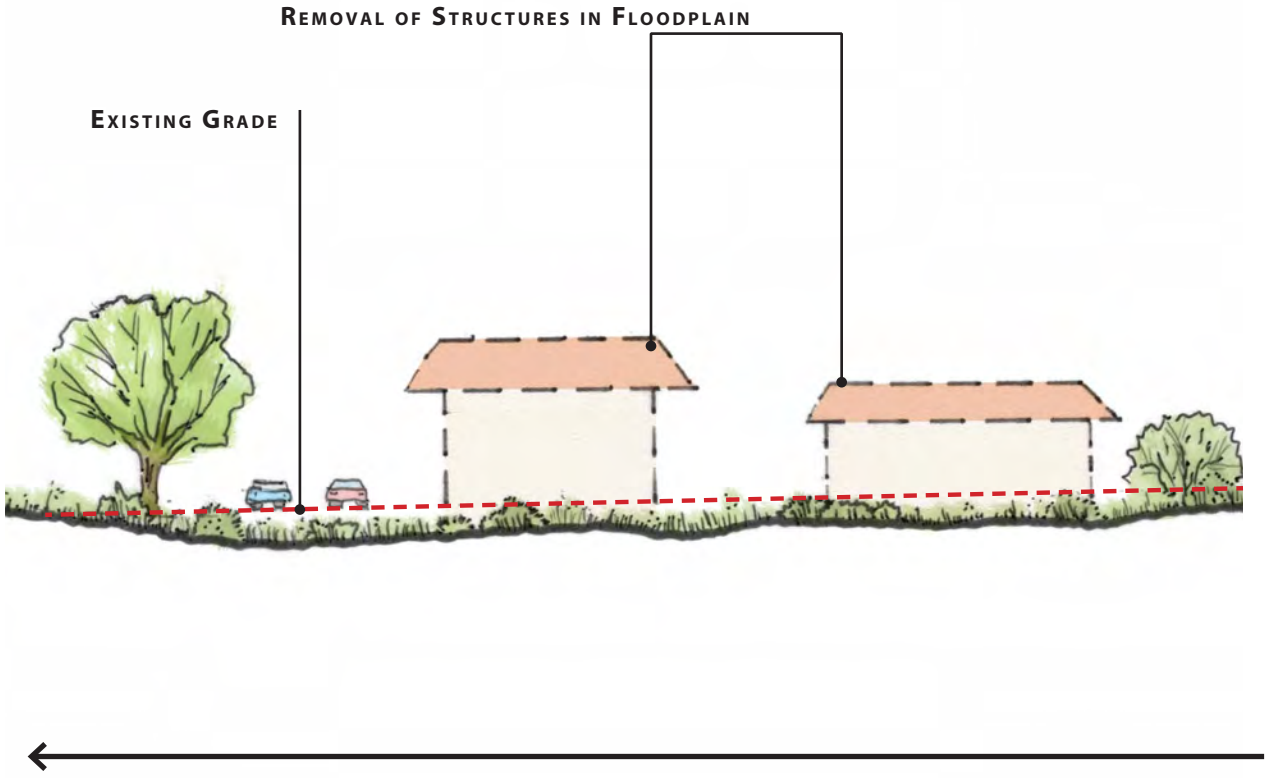


Figure 24. Martínez Creek Proposed Cross Section, Downstream of Cincinnati Avenue

San Pedro Creek

- Concept divided into 7 stream reaches, including 1 with expanded design to incorporate flood mitigation benefits
- Add flood capacity to remove structures from the 100-year floodplain through expanded channel conveyance, coordinated with CIP bridge improvements
- Removal of existing concrete
- Lengthen and create meanders in channel
- Regrade bankfull channel
- Excavate riparian planting zones
- Install rock cross vanes, riffle drops, rock vanes, and J-hook vanes
- Seed upland plant communities along bench and side slopes
- Install erosion blankets, wattles, and live facines
- Trail system that connects upper the downtown area with downstream neighborhoods, parks, catalyst sites, and the remainder of the Westside Creeks and the San Antonio River
- Complement the urban lifestyle and urban arts community of San Pedro Creek with custom entry plazas, shelters, art installations and signage
- Strategic urban creek segments will not be restored, but instead will be enclosed or remain enclosed in culverts

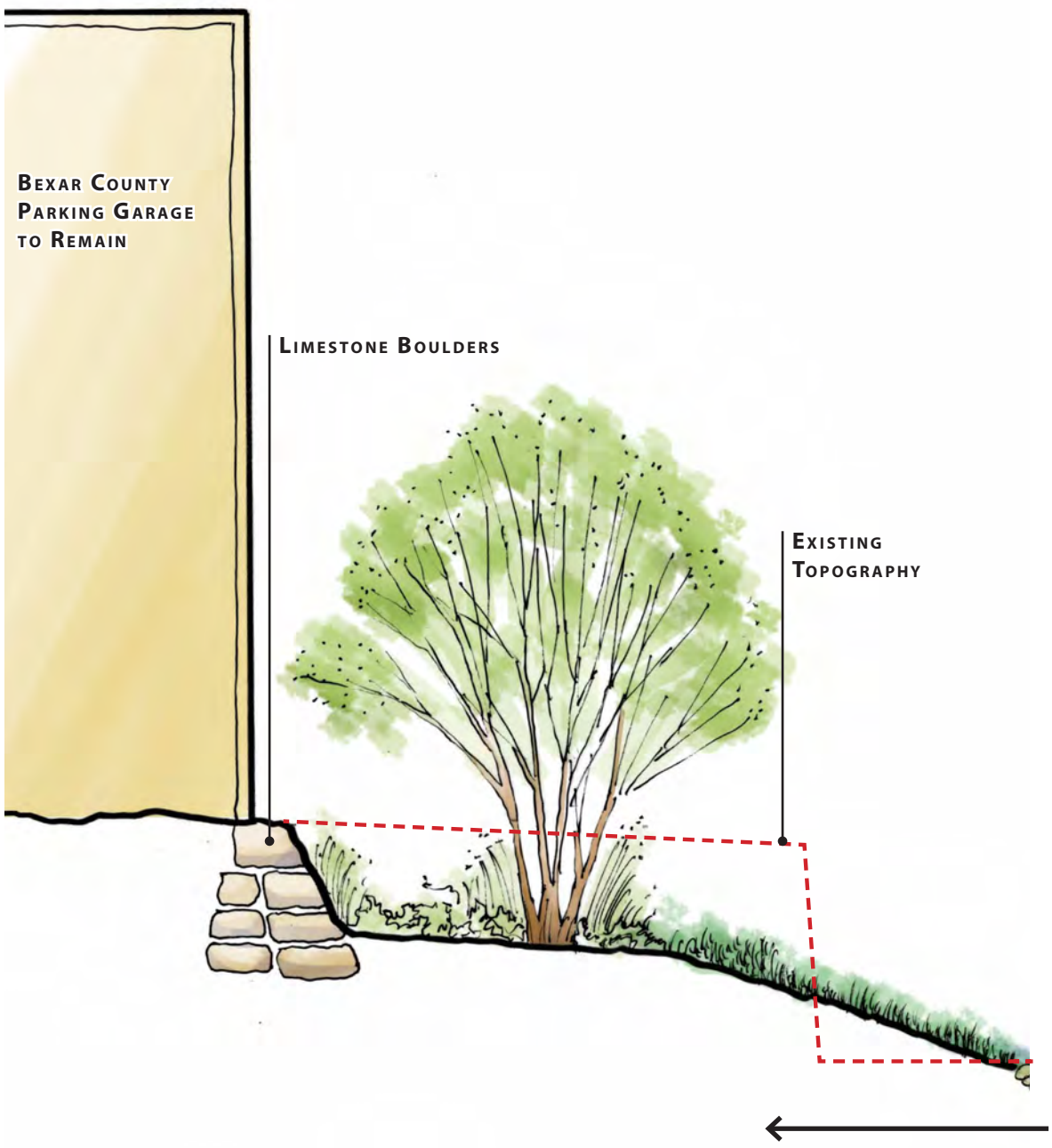
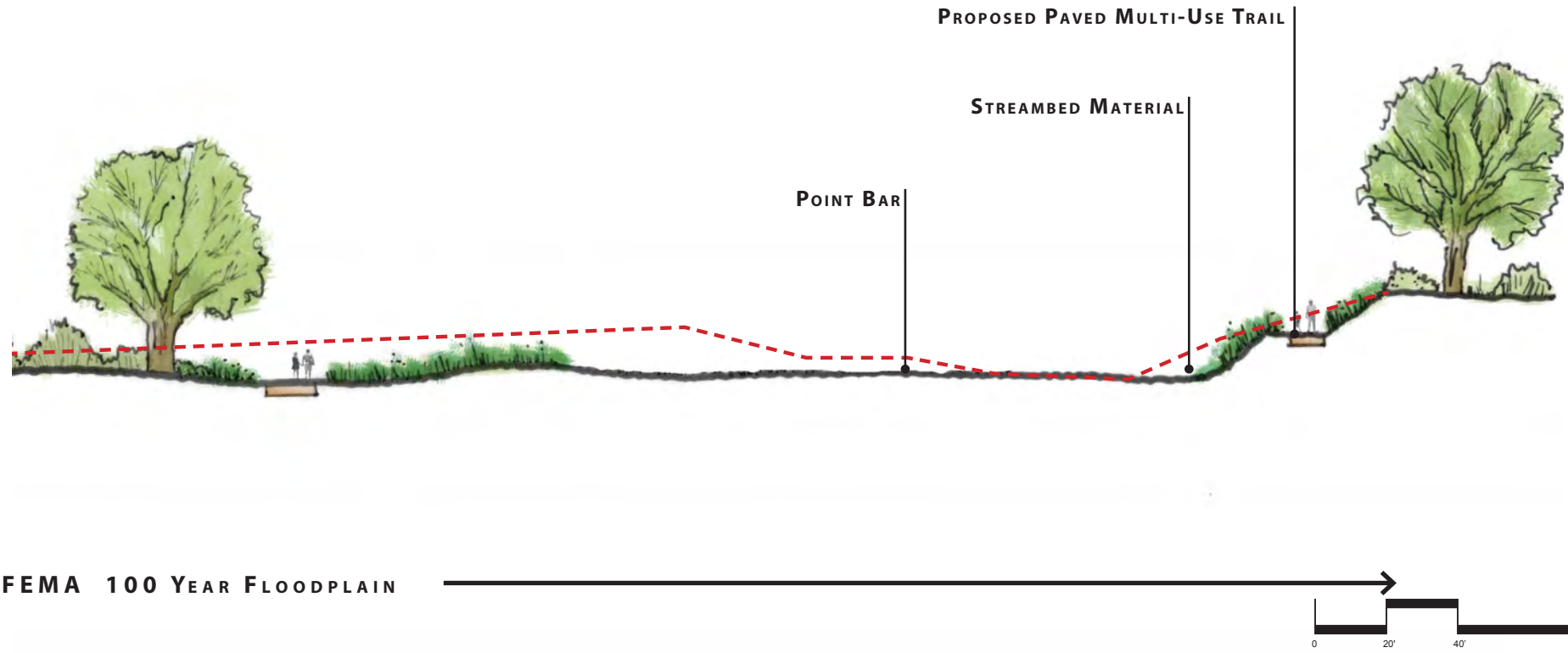
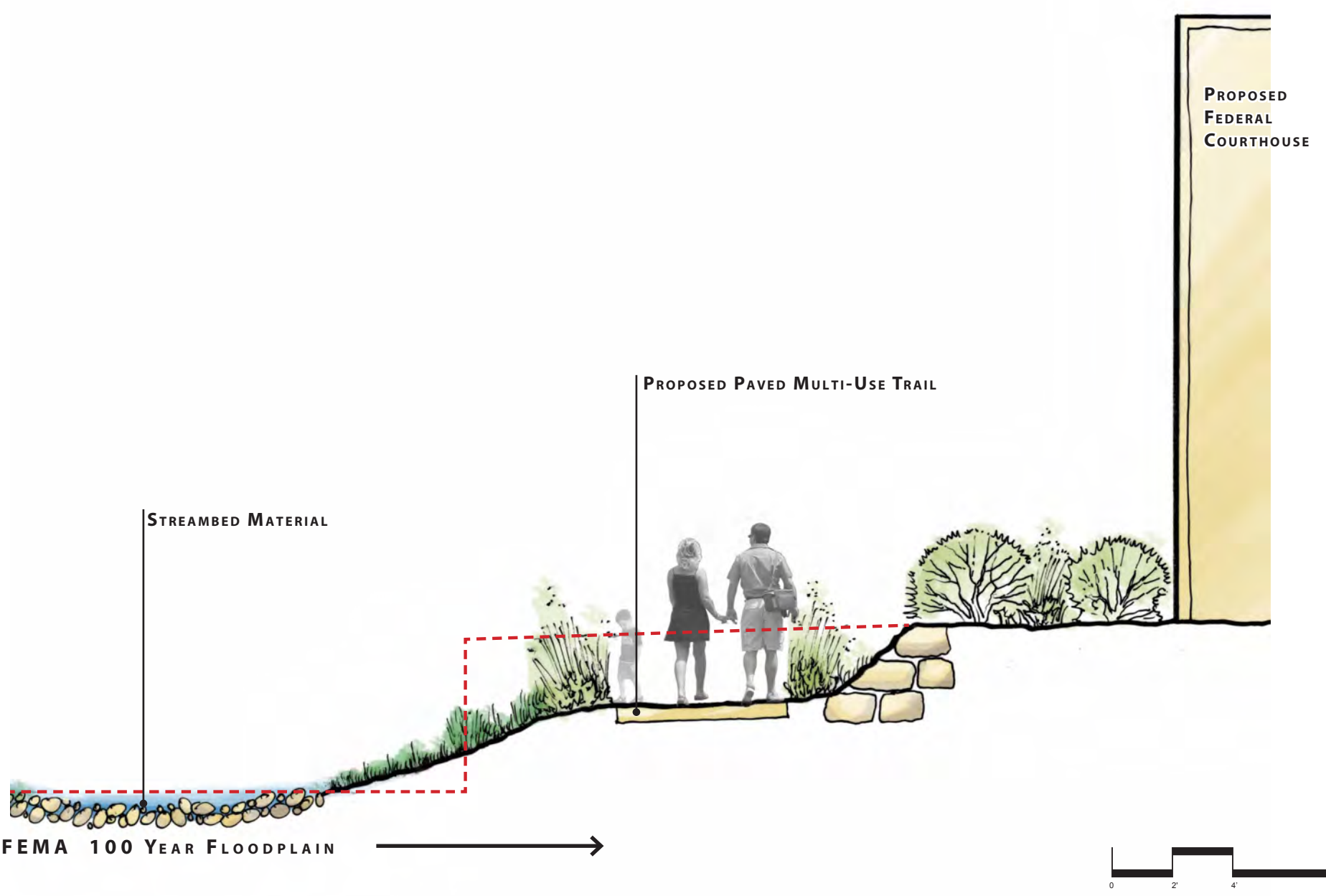


Figure 25. San Pedro Creek Proposed Cross Section, Downstream of Nueva Street


Proposed Paved Multi-Use Trail
Streambed Material
Point Bar
FEMA 100 Year Floodplain
0
20'
40'
80'


Proposed
Federal
Courthouse
Proposed Paved Multi-Use Trail
Streambed Material
FEMA 100 Year Floodplain
0
2'
4'
8'

REACH SEQUENCING

Obviously, the Westside Creeks Project represents an ambitious program that will require major infrastructure development funding over multiple years. For these reasons, it is appropriate that the construction of the project be staged in sequences to allow a logical progression to be implemented using the available funding and following the priority determinations agreed to by the community and stakeholders. The degree of restoration that will ultimately be implemented will be proportional to the amount of funding which becomes available. For these reasons, higher priority reaches have been identified based on a combination of the following criteria:

- The need for significant flood mitigation along the reach
- Presence of multiple catalysts sites in the neighborhood for this reach
- Potential for funding opportunities with other partners already identified for the reach, such as the Linear Creek Greenways Initiative
- Presence of large publicly-owned tracts adjoining the creek
- Large residential neighborhoods located along the reach that can benefit from the addition of trails and connectivity improvements

Conversely, lower priority sites were identified based on related and opposing criteria:

- Minimal neighborhood access available along the reach
- Significant cost for property acquisition required to accomplish restoration or flood mitigation for the reach
- Predominance of industrial or commercial land-use along reach
- Immediately adjoining a major freeway or railroad corridor

The recommended prioritization of the stream reaches is shown in Table 6. For each of the four streams, the individual reaches were characterized according to the technical criteria mentioned above, and were rated according to the four core philosophies for the Westside Creeks Restoration and project readiness as follows:.

- The Restoration column rates each reach according to its potential for ecosystem restoration (native flora & fauna, natural geomorphologic processes), which often reflects the feasibility of expanding the channel into a wider configuration.
- The Water column is used to identify reaches by their potential (or need) for flood mitigation, which could result in reduced injuries or property loss from flooding.
- The Connections column rates each stream reach by its potential for neighborhood connectivity, which is a hybrid of trails,

TABLE 6. PHASING MATRIX

		Restoration Potential for Ecosystem Restoration	Water Potential for Flood Hazard Reduction	Connections Potential for Connecting Neighborhoods and Destinations	Security Potential for Enhanced Safety in High Traffic Areas	Readiness Potential for Cooperative Venture or Rapid Implementation
Alazán Creek						
AL-1	0.49 mi.					✓✓
AL-4	0.28 mi.					✓
AL-5	0.81 mi.					✓
AL-2	0.19 mi.					
AL-3	0.58 mi.					
AL-6	0.70 mi.					
AL-7	0.28 mi.					
Apache Creek						
AP-1	1.44 mi.					✓✓✓
AP-3	0.92 mi.					✓
AP-2	0.76 mi.					
AP-4	0.67 mi.					
AP-5	0.36 mi.					
Martínez Creek						
MA-5	0.21 mi.					✓✓
MA-2	1.05 mi.					✓
MA-4	0.51 mi.					
MA-3	0.44 mi.					
MA-1	0.50 mi.					
San Pedro Creek						
SP-2	0.50 mi.					✓✓
SP-3	0.26 mi.					✓
SP-5	0.65 mi.					✓
SP-4	0.31 mi.					
SP-1	0.32 mi.					
SP-6	0.36 mi.					
SP-7	1.41 mi.					✓✓✓

adjacent catalyst sites, and other related mobility features like BRT.

- The Security column is used to show how reaches may benefit from the expected traffic volumes along the creeks, with resultant decreases in crime.
- The last column, labeled Project Readiness is not one of the core philosophies, but offers a means of capturing the critical interaction of other programs, projects and partnerships that can mutually benefit from implementation of the individual stream reach restorations, along with the potential for delays which may be encountered for some of the more complex reaches.

Using these criteria, nine reaches shown in Table 7 were selected for an initial Phase 1 restoration program. The remaining fifteen reaches are recommended to have construction of initial trails only in order to provide for neighborhood connectivity during this initial phase of the program. Some of these trails may require relocation or reconstruction when full restoration of the reach occurs in the future Phase 2; however, it may be possible to locate the trails along one side of the reach in an area which would not be subject to future major construction. As shown in Table 7, the total estimated construction cost for this Phase 1 program is about 60% of the estimated full project cost of $500 million, or slightly under $300 million. Therefore, this Phase 1 program will still require a significant infrastructure development program and major funding and commitment by both the public and private community in order to move forward successfully.

Some of the advantages created for the initial program by these Phase 1 reach selections are as follows:

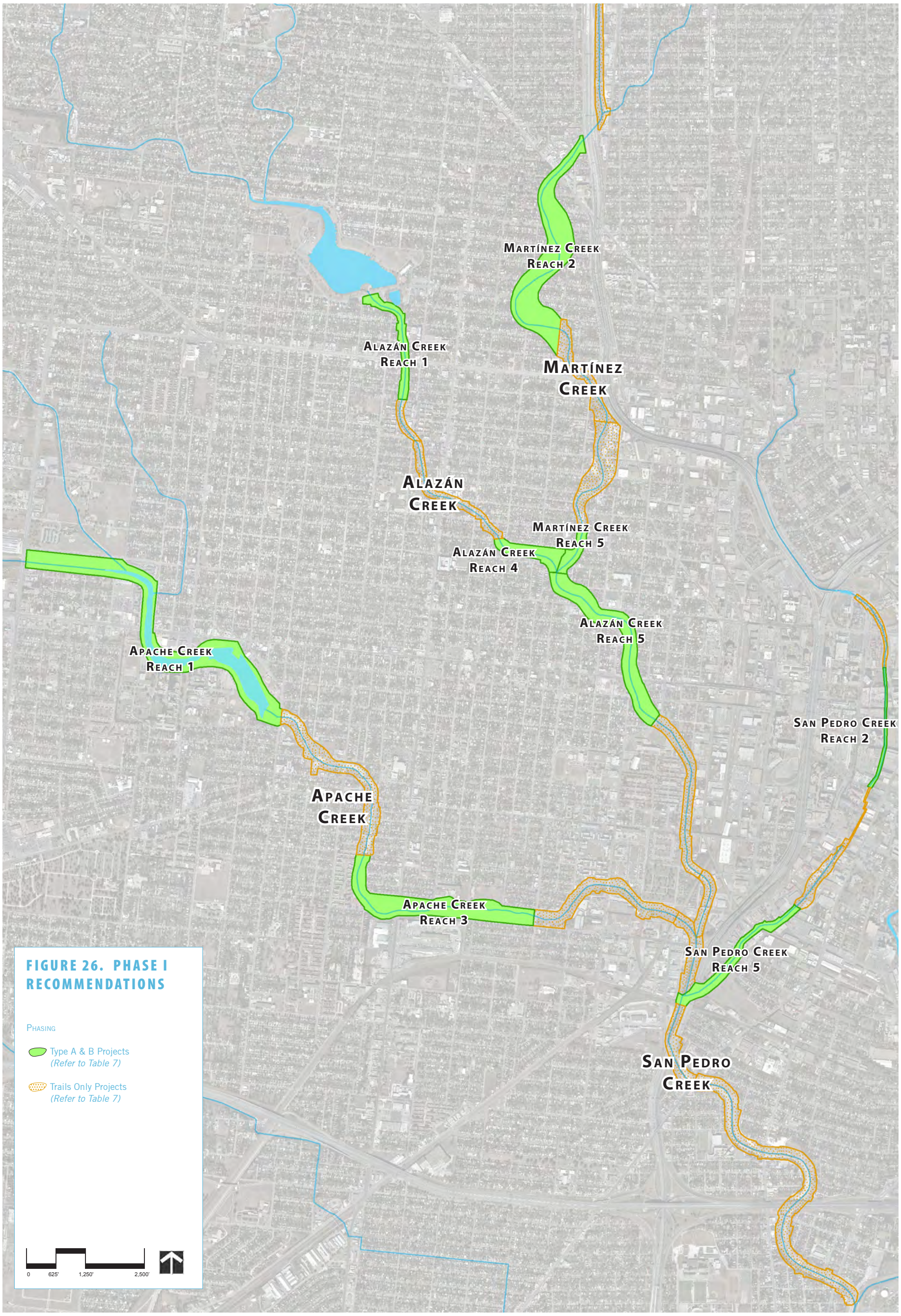
- Includes five reaches which are predicted to be vulnerable to major flood damages
- Provides stream restoration for approximately 45% by length of the creeks, including multiple reaches for each creek
- Provides restoration and/or flood reductions near most of catalyst sites identified for economic redevelopment and neighborhood revitalization
- Distributes the restoration work generally throughout the full linear expanse of the creeks and does not focus the work in any one area

Further review and evaluation of the Phase 1 selection by the WCROC will be warranted during subsequent planning and evaluation of the Westside Restoration Project. More detailed planning and design may reveal reasons for adjustment of the individual reaches selected for Phase 1 as well as for the type of restoration selected, especially as funding partners and stakeholders consider the cost and implementation aspects of the program further.

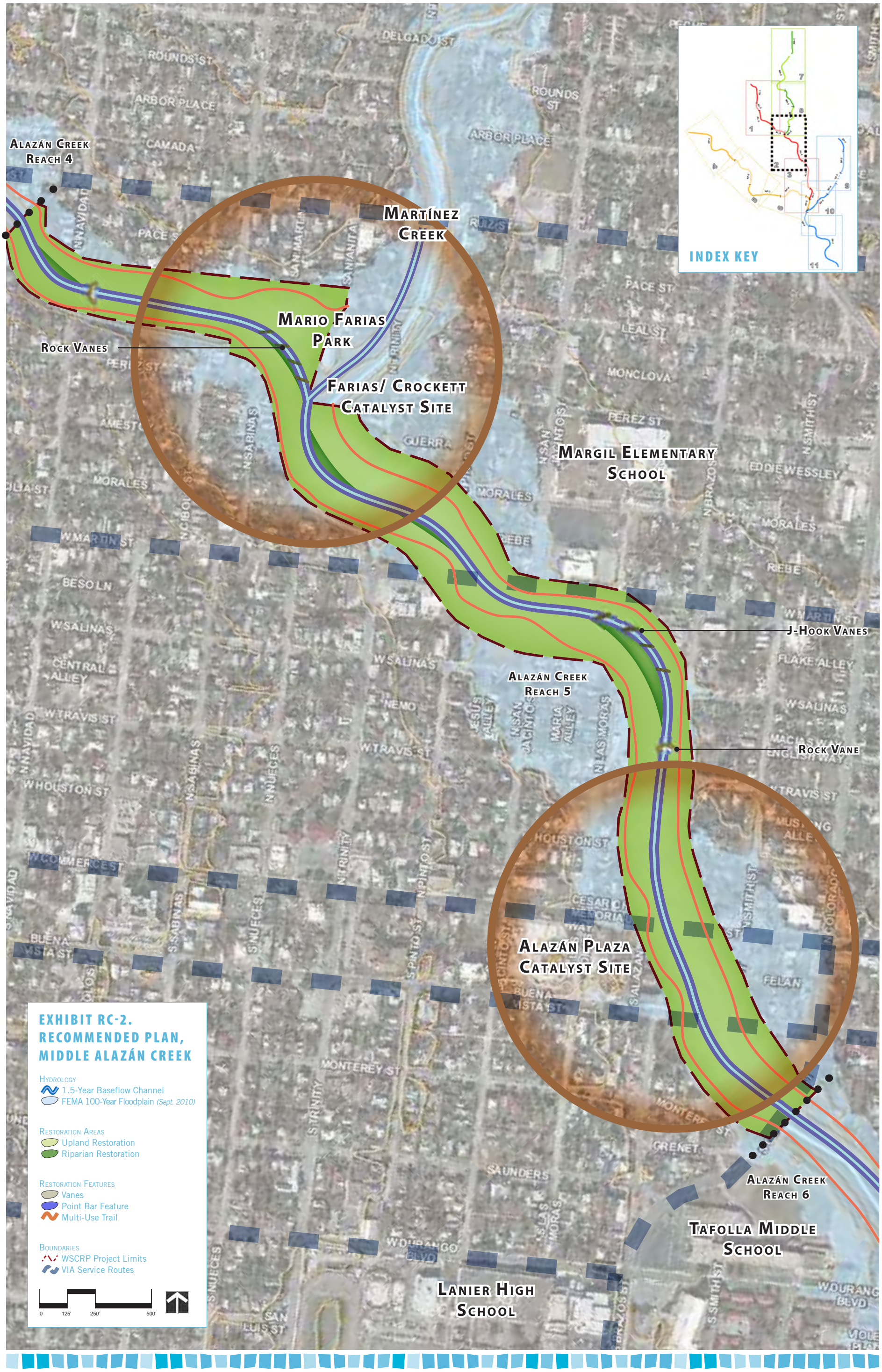
TABLE 7. PHASE 1 RECOMMENDATION + COST

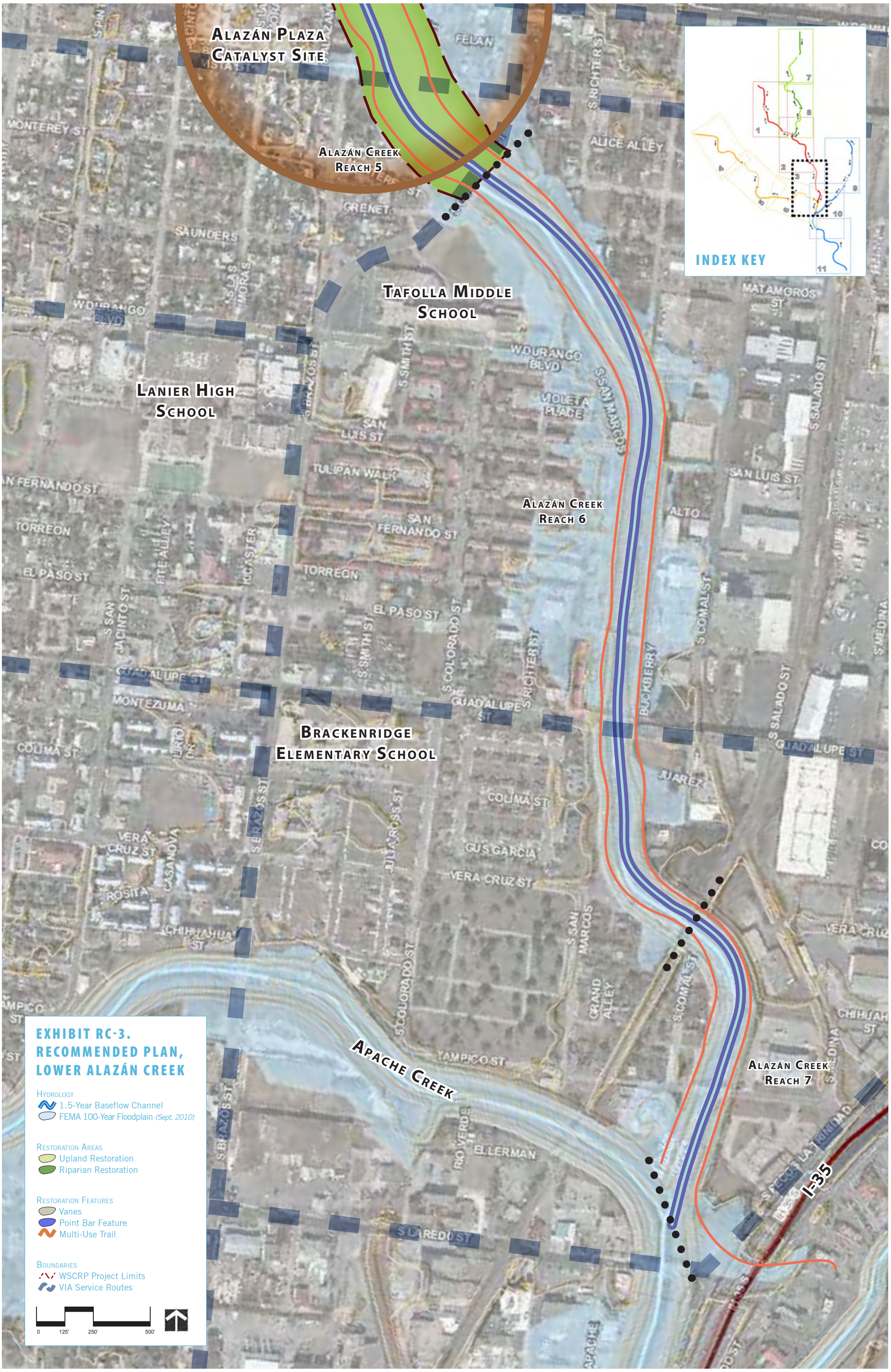
Description	Phase 1 Recommendation	Phase 1 Cost	Phase 1a Restoration	Phase 1a Trails Only
Alazán Creek		**$ 79,600,000**		
Reach 1 - Josephine Tobin Dr. to Lombrano	Type A (restricted ROW)	$ 8,950,000	$ 8,950,000	
Reach 2 - Lombrano to Poplar	Trails only	$ 235,000		$ 235,000
Reach 3 - Poplar to Leal	Trails only	$ 731,000		$ 731,000
Reach 4 - Leal to Confluence with Martínez Creek	Type B (expanded ROW)	$ 10,200,000		$ 269,000
Reach 5 - Confluence with Martínez Creek to Colorado	Type B (expanded ROW)	$ 58,200,000		$ 773,000
Reach 6 - Colorado to Missouri Pacific RR	Trails only	$ 889,000		$ 889,000
Reach 7 - Missouri Pacific RR to Confluence with San Pedro Creek	Trails only	$ 354,000		$ 354,000
Apache Creek		**$ 85,500,000**		
Reach 1 - General McMullen to 19th Street	Type B (expanded ROW)	$ 27,800,000	$ 27,800,000	
Reach 2 - 19th Street to Chihuahua	Trails only	$ 969,000		$ 969,000
Reach 3 - Chihuahua to Trinity	Type B (expanded ROW)	$ 55,400,000		$ 870,000
Reach 4 - Trinity to Missouri Pacific RR	Trails only	$ 853,000		$ 853,000
Reach 5 - Missouri Pacific RR to Confluence with San Pedro Creek	Trails only	$ 452,000		$ 452,000
Martínez Creek		**$ 86,400,000**		
Reach 1 - Hildebrand to IH-10 (Upstream)	Trails only	$ 628,000		$ 628,000
Reach 2 - IH-10 (Downstream) to Sabinas	Type B (expanded ROW)	$ 73,000,000		$ 1,000,000
Reach 3 - Sabinas to Lombrano	Trails only	$ 555,000		$ 555,000
Reach 4 - Lombrano to Ruiz	Trails only	$ 648,000		$ 648,000
Reach 5 - Ruiz to Confluence with Alazán Creek	Type A (restricted ROW)	$ 11,500,000	$ 11,500,000	
San Pedro Creek		**$ 43,300,000**		
Reach 1 - Tunnel Inlet to Travis	Trails only	$ 402,000		$ 402,000
Reach 2 - Travis to Durango	*Type A (restricted ROW)	$ 15,900,000	$ 100,000	
Reach 3 - Durango to Tunnel Outfall (South of El Paso St.)	Trails only	$ 328,000		$ 328,000
Reach 4 - Tunnel Outfall (South of El Paso St.) to Camp	Trails only	$ 388,000		$ 388,000
Reach 5 - Camp to Southern Pacific RR (Downstream of IH-35)	Type A (restricted ROW)	$ 24,000,000		$ 614,000
Reach 6 - Southern Pacific RR (Downstream of IH-35) to Nogalitos	Trails only	$ 450,000		$ 450,000
Reach 7 - Nogalitos to Confluence with San Antonio River	Trails only	$ 1,780,000		$ 1,780,000
Westside Creeks Total		**$ 295,000,000**	**$ 48,400,000**	**$ 13,200,000**
Cost Contingency Range:	-5%	$280,000,000	$ 61,600,000	
	+15%	$339,000,000		

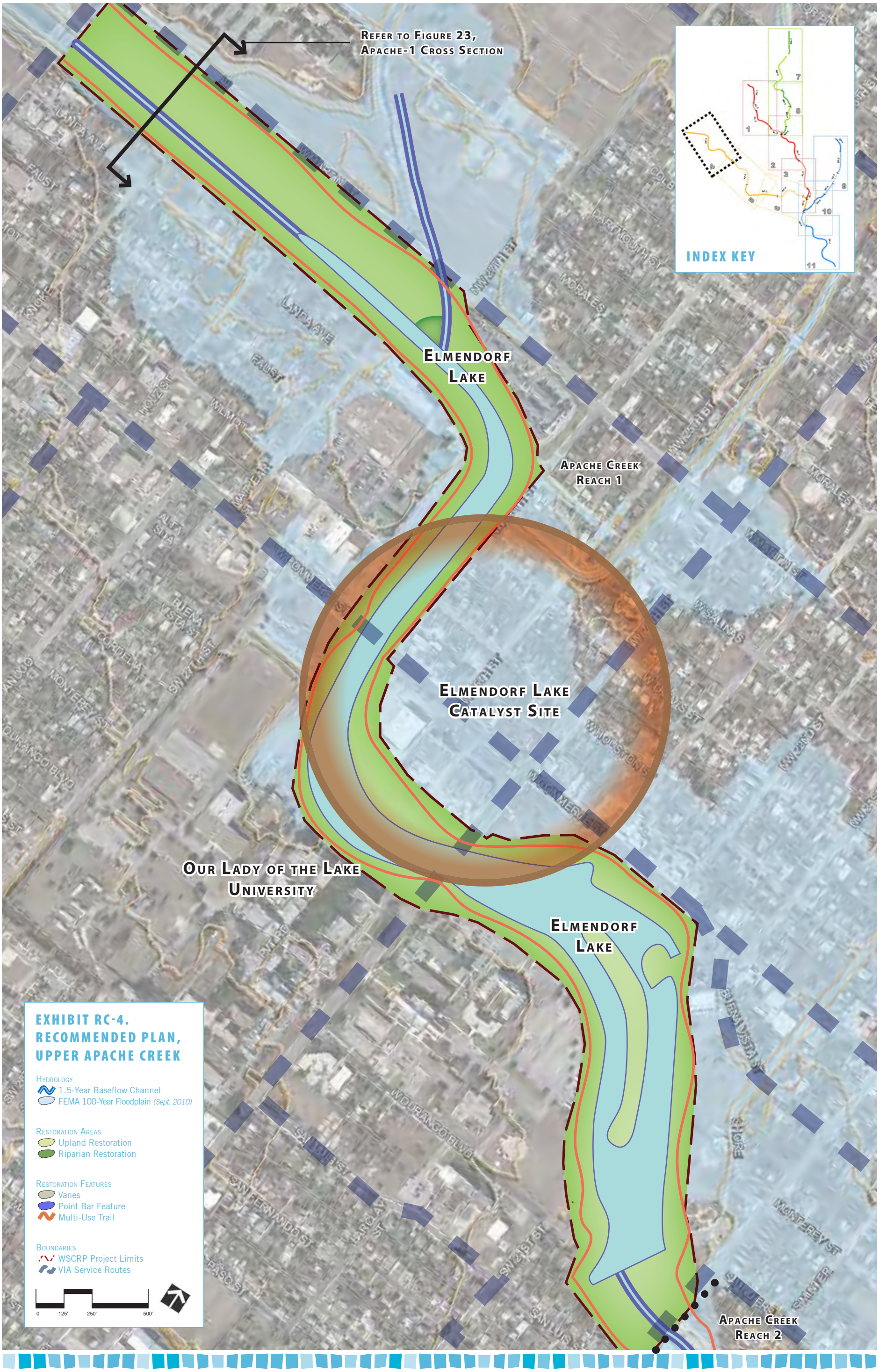
** a portion of San Pedro Reach 2 is intended for urban restoration only*

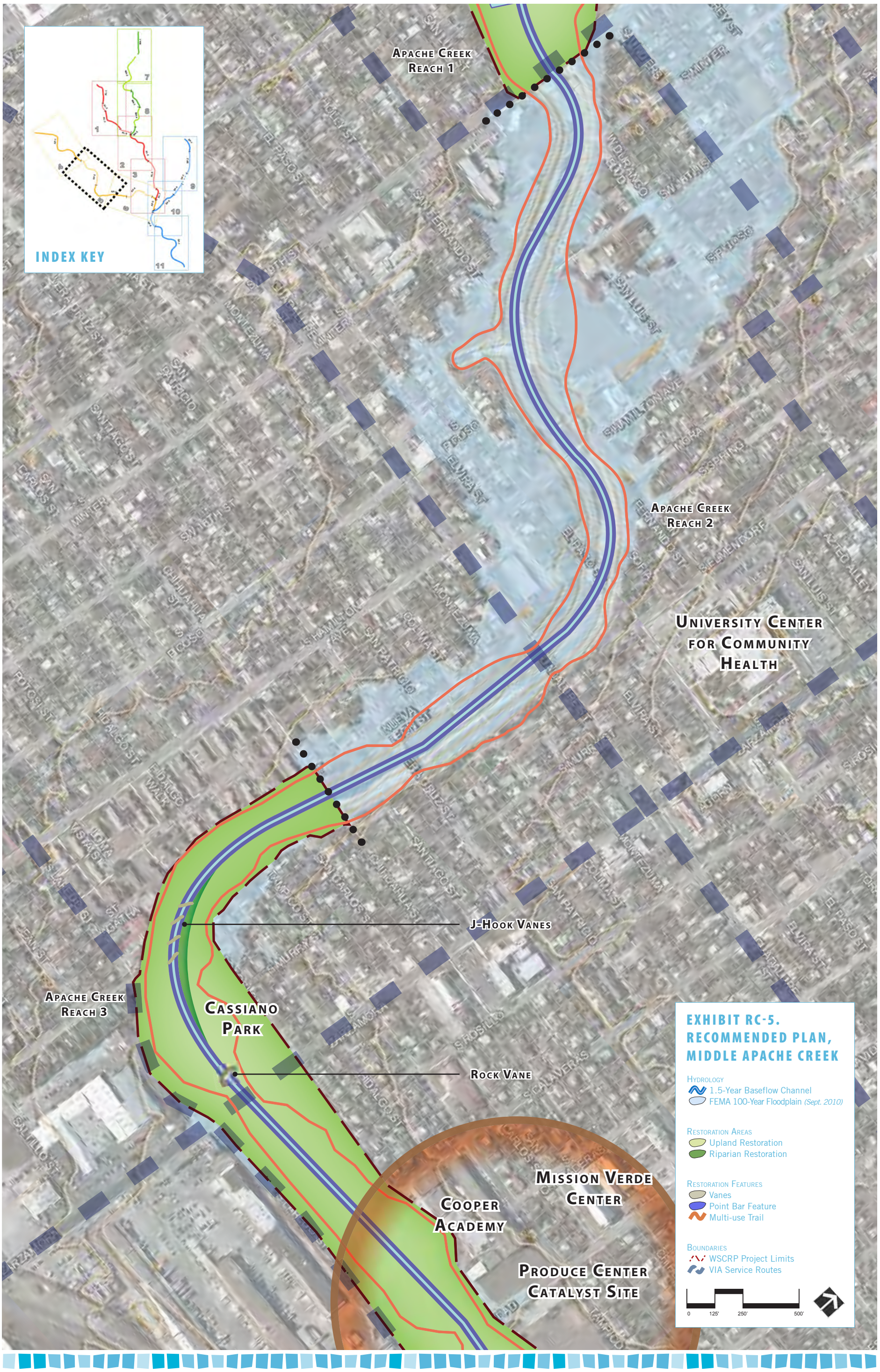

Martínez Creek
Reach 2
Alazán Creek
Reach 1
Martínez
Creek
Alazán
Creek
Martínez Creek
Reach 5
Alazán Creek
Reach 4
Alazán Creek
Reach 5
Apache Creek
Reach 1
San Pedro Creek
Reach 2
Apache
Creek
Apache Creek
Reach 3
San Pedro Creek
Reach 5
San Pedro
Creek
FIGURE 26. PHASE I
RECOMMENDATIONS
Phasing
Type A & B Projects
(Refer to Table 7)
Trails Only Projects
(Refer to Table 7)
0
625'
1,250'
2,500'


Woodlawn Lake
Cross Vanes
Alazán Creek Reach 1
Little Flower Basilica
Refer to Figure 22, Alazán-1 Cross Section
Alazán Creek Reach 2
Irving Middle School
Alazán Creek Reach 3
Alazán Creek Reach 4
Rock Vane
Crockett Elementary School
INDEX KEY
EXHIBIT RC-1. RECOMMENDED PLAN, UPPER ALAZÁN CREEK
Hydrology
1.5-Year Baseflow Channel
FEMA 100-Year Floodplain (Sept. 2010)
Restoration Areas
Upland Restoration
Riparian Restoration
Restoration Features
Vanes
Point Bar Feature
Multi-Use Trail
Boundaries
WSCRP Project Limits
VIA Service Routes
0
125'
250'
500'


Alazán Creek Reach 4
Martínez Creek
Mario Farias Park
Rock Vanes
Farias/ Crockett Catalyst Site
Margil Elementary School
J-Hook Vanes
Alazán Creek Reach 5
Rock Vane
Alazán Plaza Catalyst Site
Alazán Creek Reach 6
Tafolla Middle School
Lanier High School
INDEX KEY
EXHIBIT RC-2.
RECOMMENDED PLAN,
MIDDLE ALAZÁN CREEK
Hydrology
1.5-Year Baseflow Channel
FEMA 100-Year Floodplain (Sept. 2010)
Restoration Areas
Upland Restoration
Riparian Restoration
Restoration Features
Vanes
Point Bar Feature
Multi-Use Trail
Boundaries
WSCRP Project Limits
VIA Service Routes
0
125'
250'
500'


Alazán Plaza Catalyst Site
Alazán Creek Reach 5
Tafolla Middle School
Lanier High School
Alazán Creek Reach 6
Brackenridge Elementary School
Apache Creek
Alazán Creek Reach 7
I-35
INDEX KEY
MONTEREY ST
ALICE ALLEY
SAUNDERS
W DURANGO BLVD
S SMITH ST
S SAN MARCOS
VIOLETA PLACE
SAN LUIS ST
TULIPAN WALK
SAN FERNANDO ST
TORREON
EL PASO ST
S SAN JACINTO ST
S COLORADO ST
S RICHTER ST
GUADALUPE ST
MONTEZUMA
COLIMA ST
VERA CRUZ ST
GUS GARCIA
JUAREZ
S COMAL ST
S SALADO ST
BUCKBERRY
TAMPICO ST
S LAREDO ST
RIO VERDE
ELLERMAN
MATAMOROS ST
ALTO
CHIHUAHUA ST
EXHIBIT RC-3.
RECOMMENDED PLAN,
LOWER ALAZÁN CREEK
Hydrology
1.5-Year Baseflow Channel
FEMA 100-Year Floodplain (Sept. 2010)
Restoration Areas
Upland Restoration
Riparian Restoration
Restoration Features
Vanes
Point Bar Feature
Multi-Use Trail
Boundaries
WSCRP Project Limits
VIA Service Routes
0
125'
250'
500'


Refer to Figure 23,
Apache-1 Cross Section
INDEX KEY
Elmendorf
Lake
Apache Creek
Reach 1
Elmendorf Lake
Catalyst Site
Our Lady of the Lake
University
Elmendorf
Lake
Apache Creek
Reach 2
EXHIBIT RC-4.
RECOMMENDED PLAN,
UPPER APACHE CREEK
Hydrology
1.5-Year Baseflow Channel
FEMA 100-Year Floodplain (Sept. 2010)
Restoration Areas
Upland Restoration
Riparian Restoration
Restoration Features
Vanes
Point Bar Feature
Multi-Use Trail
Boundaries
WSCRP Project Limits
VIA Service Routes
0
125'
250'
500'


INDEX KEY
Apache Creek Reach 1
Apache Creek Reach 2
University Center for Community Health
J-Hook Vanes
Apache Creek Reach 3
Cassiano Park
Rock Vane
Cooper Academy
Mission Verde Center
Produce Center Catalyst Site
EXHIBIT RC-5. RECOMMENDED PLAN, MIDDLE APACHE CREEK
Hydrology
1.5-Year Baseflow Channel
FEMA 100-Year Floodplain (Sept. 2010)
Restoration Areas
Upland Restoration
Riparian Restoration
Restoration Features
Vanes
Point Bar Feature
Multi-use Trail
Boundaries
WSCRP Project Limits
VIA Service Routes
0
125'
250'
500'

Cooper Academy

Produce Center Catalyst Site

Amistad Park

Apache Creek Reach 3

Martinez Park

Memorial Avenue Catalyst Site

Apache Creek Reach 4

Estrada Achievement Center

Apache Creek Reach 5

San Pedro Creek

Alazán Creek

INDEX KEY

EXHIBIT RC-6. RECOMMENDED PLAN, LOWER APACHE CREEK

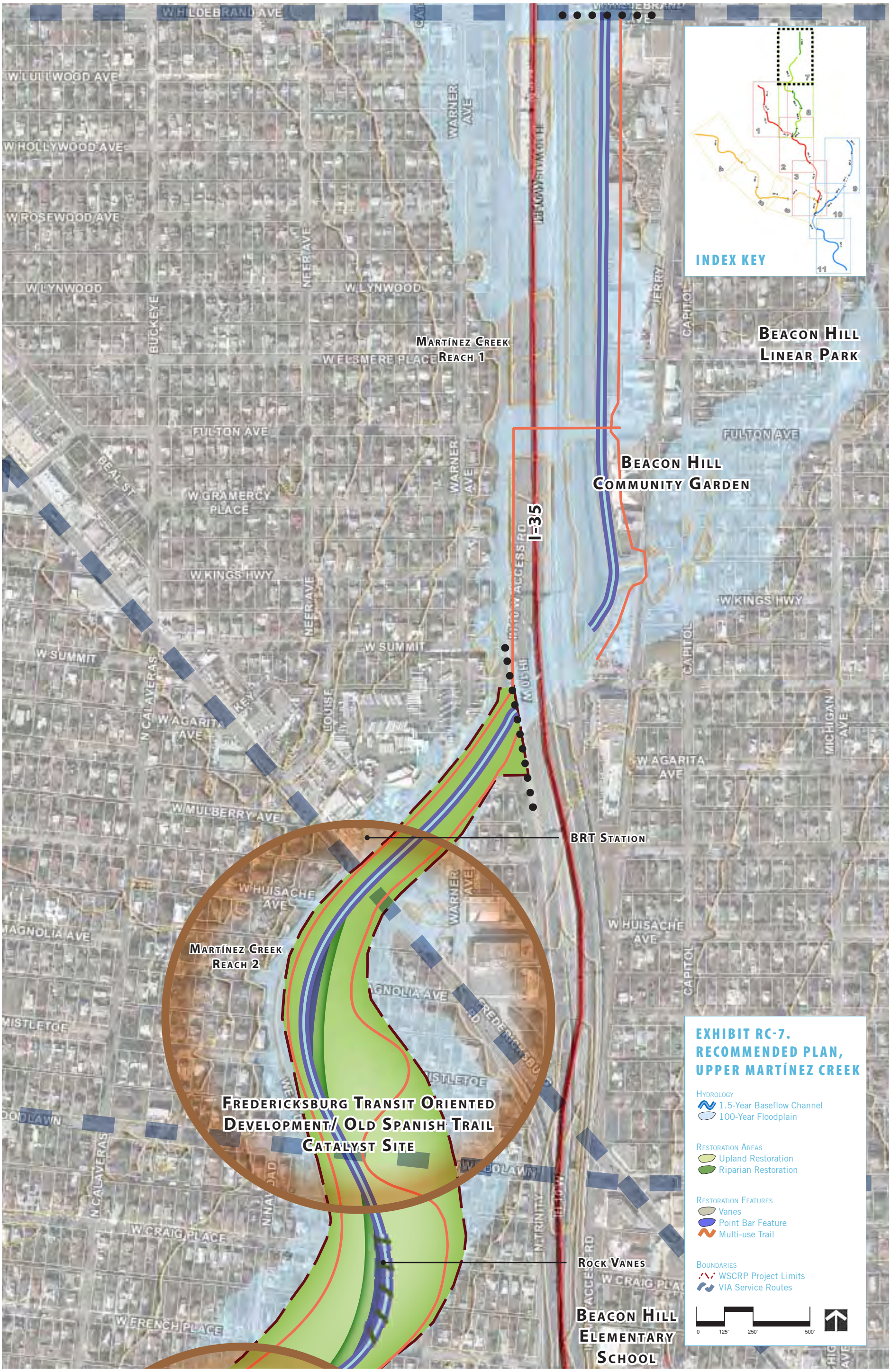
Hydrology
- 1.5-Year Baseflow Channel
- FEMA 100-Year Floodplain *(Sept. 2010)*

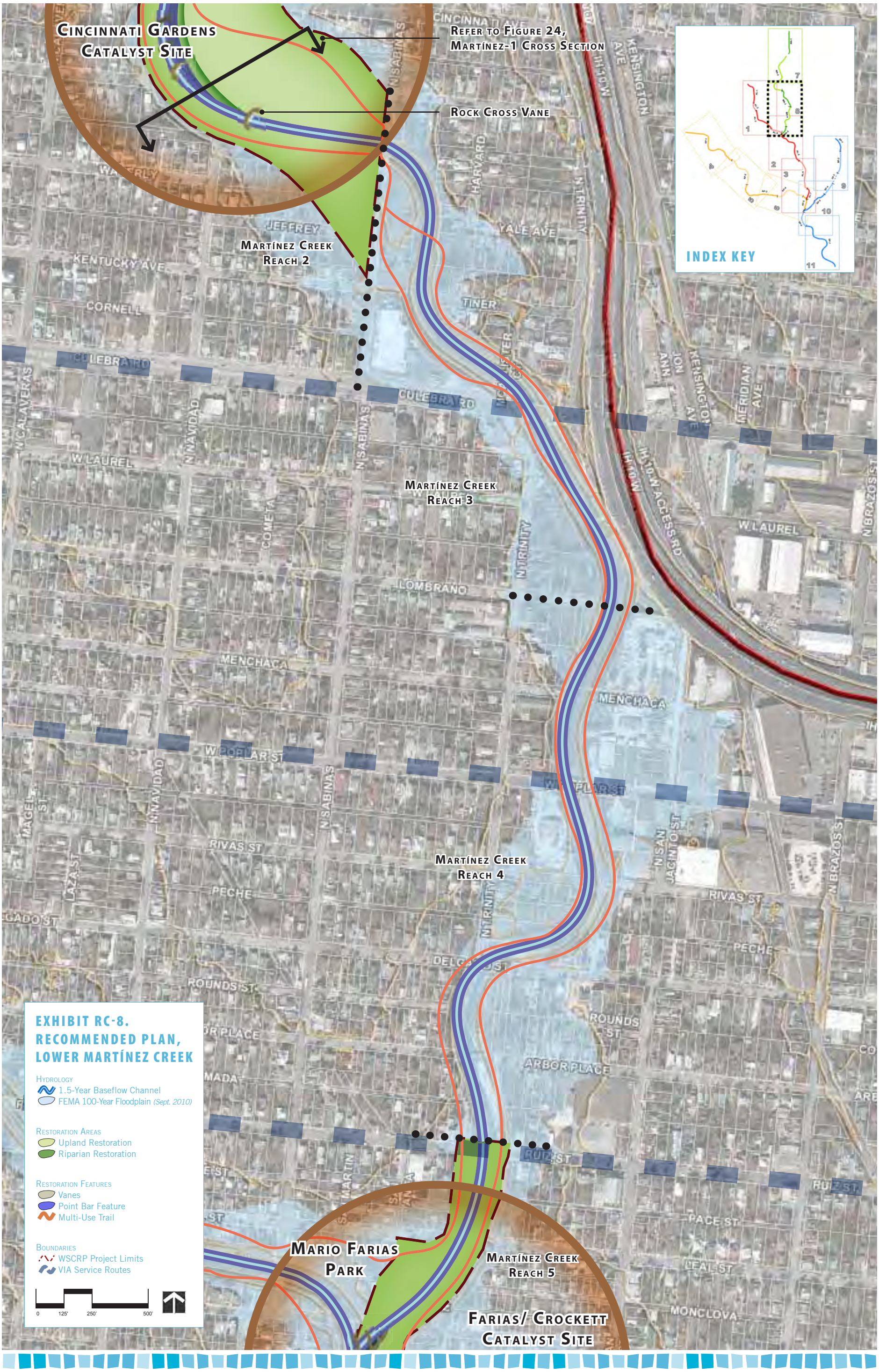
Restoration Areas
- Upland Restoration
- Riparian Restoration

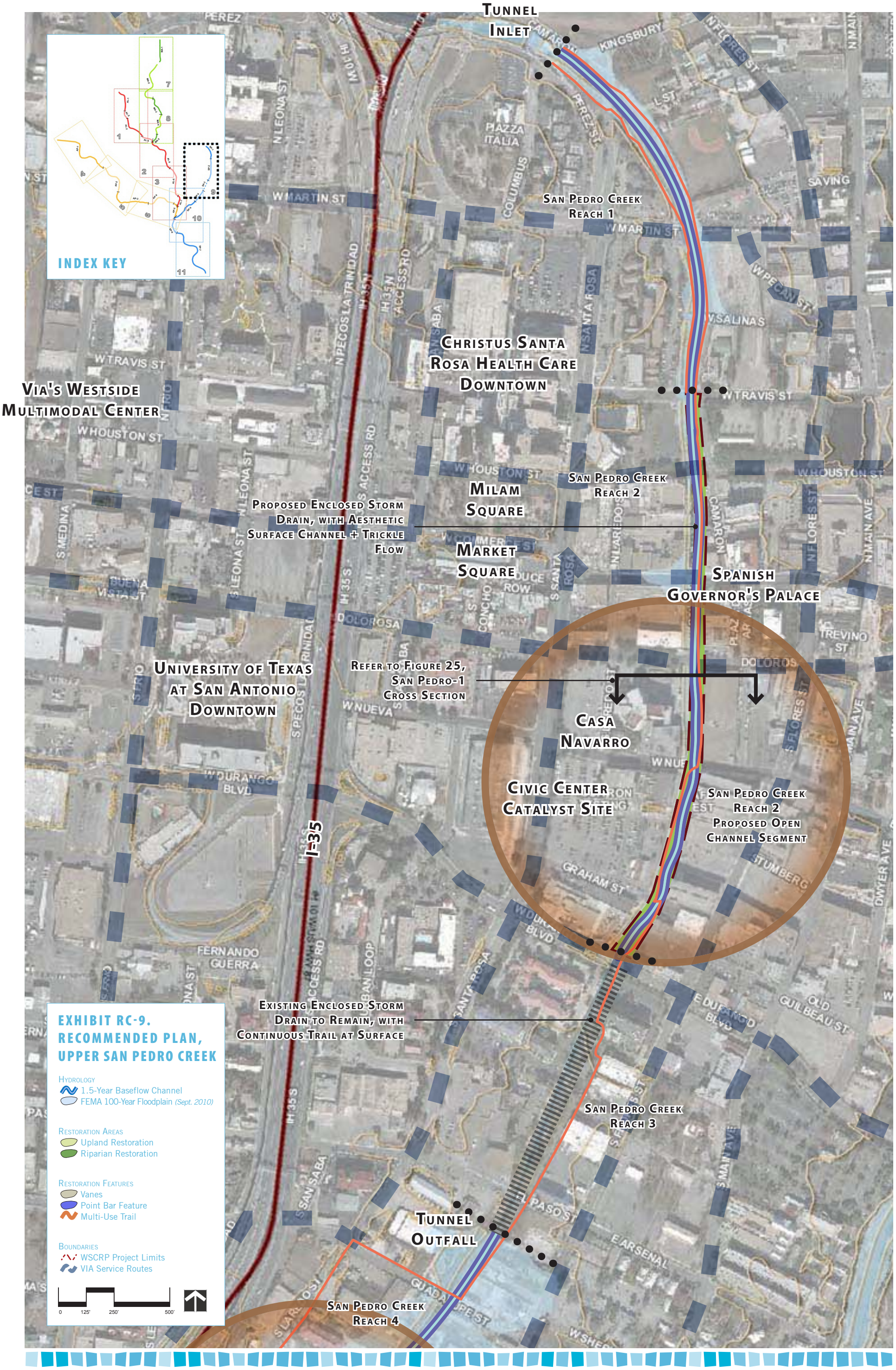
Restoration Features
- Vanes
- Point Bar Feature
- Multi-Use Trail

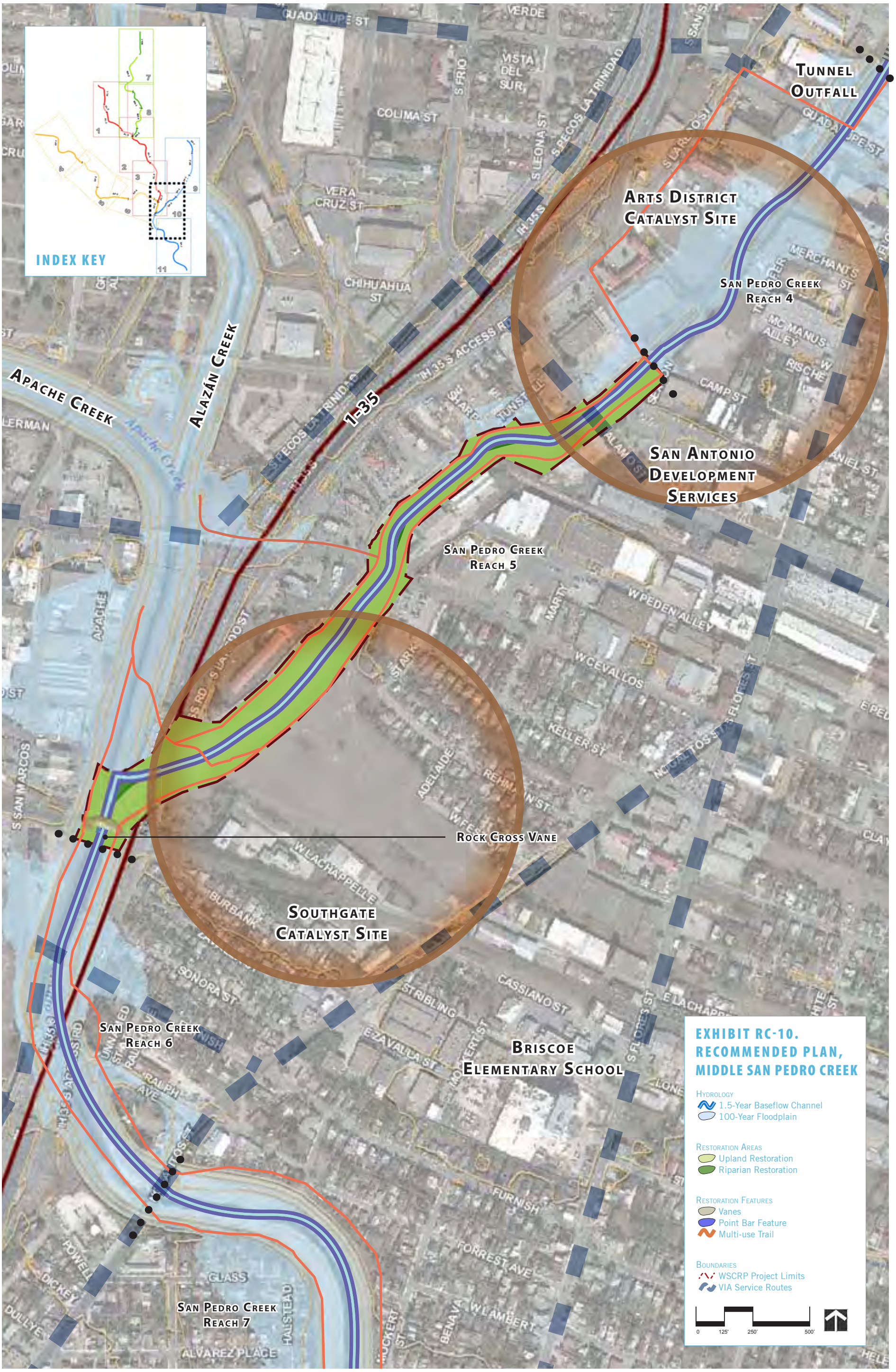
Boundaries
- WSCRP Project Limits
- VIA Service Routes

0 125' 250' 500'


W HILDEBRAND AVE
W HOLLYWOOD AVE
W ROSEWOOD AVE
W LYNWOOD
W LYNWOOD
WARNER AVE
NEER AVE
BUCKEYE
JERRY
CAPITOL
FULTON AVE
FULTON AVE
BEAL ST
W GRAMERCY PLACE
W KINGS HWY
W KINGS HWY
W SUMMIT
W SUMMIT
N CALAVERAS
LOUISE
W AGARITA AVE
W AGARITA AVE
MICHIGAN AVE
W MULBERRY AVE
W HUISACHE AVE
W HUISACHE AVE
MAGNOLIA AVE
MISTLETOE
DOWNTOWN ACCESS RD
I-35
W CRAIG PLACE
W FRENCH PLACE
INDEX KEY
Martínez Creek Reach 1
Beacon Hill Linear Park
Beacon Hill Community Garden
BRT Station
Martínez Creek Reach 2
Fredericksburg Transit Oriented Development/ Old Spanish Trail Catalyst Site
Rock Vanes
Beacon Hill Elementary School
EXHIBIT RC-7. RECOMMENDED PLAN, UPPER MARTÍNEZ CREEK
Hydrology
1.5-Year Baseflow Channel
100-Year Floodplain
Restoration Areas
Upland Restoration
Riparian Restoration
Restoration Features
Vanes
Point Bar Feature
Multi-use Trail
Boundaries
WSCRP Project Limits
VIA Service Routes
0
125'
250'
500'


Cincinnati Gardens
Catalyst Site
Refer to Figure 24,
Martínez-1 Cross Section
Rock Cross Vane
Martínez Creek
Reach 2
Martínez Creek
Reach 3
Martínez Creek
Reach 4
Mario Farias
Park
Martínez Creek
Reach 5
Farias/ Crockett
Catalyst Site
INDEX KEY
EXHIBIT RC-8.
RECOMMENDED PLAN,
LOWER MARTÍNEZ CREEK
Hydrology
1.5-Year Baseflow Channel
FEMA 100-Year Floodplain (Sept. 2010)
Restoration Areas
Upland Restoration
Riparian Restoration
Restoration Features
Vanes
Point Bar Feature
Multi-Use Trail
Boundaries
WSCRP Project Limits
VIA Service Routes
0
125'
250'
500'
CINCINNATI AVE
KENSINGTON AVE
HARVARD
N TRINITY
YALE AVE
JEFFREY
KENTUCKY AVE
CORNELL
TINER
CULEBRA RD
N CALAVERAS
N NAVIDAD
N SABINAS
W LAUREL
COMETA
LOMBRANO
MENCHACA
W POPLAR ST
RIVAS ST
PECHE
ROUNDS ST
ARBOR PLACE
PACE ST
LEAL ST
MONCLOVA
MERIDIAN AVE
ION ANN
N SAN JACINTO ST
N BRAZOS ST
IH-10 W
IH-10 W ACCESS RD


INDEX KEY
Tunnel Inlet
San Pedro Creek Reach 1
Christus Santa Rosa Health Care Downtown
Via's Westside Multimodal Center
Milam Square
San Pedro Creek Reach 2
Proposed Enclosed Storm Drain, with Aesthetic Surface Channel + Trickle Flow
Market Square
Spanish Governor's Palace
University of Texas at San Antonio Downtown
Refer to Figure 25, San Pedro-1 Cross Section
Casa Navarro
Civic Center Catalyst Site
San Pedro Creek Reach 2 Proposed Open Channel Segment
I-35
Existing Enclosed Storm Drain to Remain, with Continuous Trail at Surface
San Pedro Creek Reach 3
Tunnel Outfall
San Pedro Creek Reach 4
EXHIBIT RC-9. RECOMMENDED PLAN, UPPER SAN PEDRO CREEK
Hydrology
1.5-Year Baseflow Channel
FEMA 100-Year Floodplain (Sept. 2010)
Restoration Areas
Upland Restoration
Riparian Restoration
Restoration Features
Vanes
Point Bar Feature
Multi-Use Trail
Boundaries
WSCRP Project Limits
VIA Service Routes
0
125'
250'
500'


INDEX KEY
Tunnel Outfall
Arts District Catalyst Site
San Pedro Creek Reach 4
San Antonio Development Services
San Pedro Creek Reach 5
Rock Cross Vane
Southgate Catalyst Site
San Pedro Creek Reach 6
Briscoe Elementary School
San Pedro Creek Reach 7
Apache Creek
Alazán Creek
I-35
COLIMA ST
VERA CRUZ ST
CHIHUAHUA ST
MERCHANTS ST
MC MANUS ALLEY
RISCHE
CAMP ST
W PEDEN ALLEY
W CEVALLOS
KELLER ST
W LACHAPPELLE
BURBANK
SONORA ST
STRIBLING
CASSIANO ST
E ZAVALLA ST
FURNISH
FORREST AVE
W LAMBERT
GLASS
ALVAREZ PLACE
EXHIBIT RC-10.
RECOMMENDED PLAN,
MIDDLE SAN PEDRO CREEK
Hydrology
1.5-Year Baseflow Channel
100-Year Floodplain
Restoration Areas
Upland Restoration
Riparian Restoration
Restoration Features
Vanes
Point Bar Feature
Multi-use Trail
Boundaries
WSCRP Project Limits
VIA Service Routes
0
125'
250'
500'

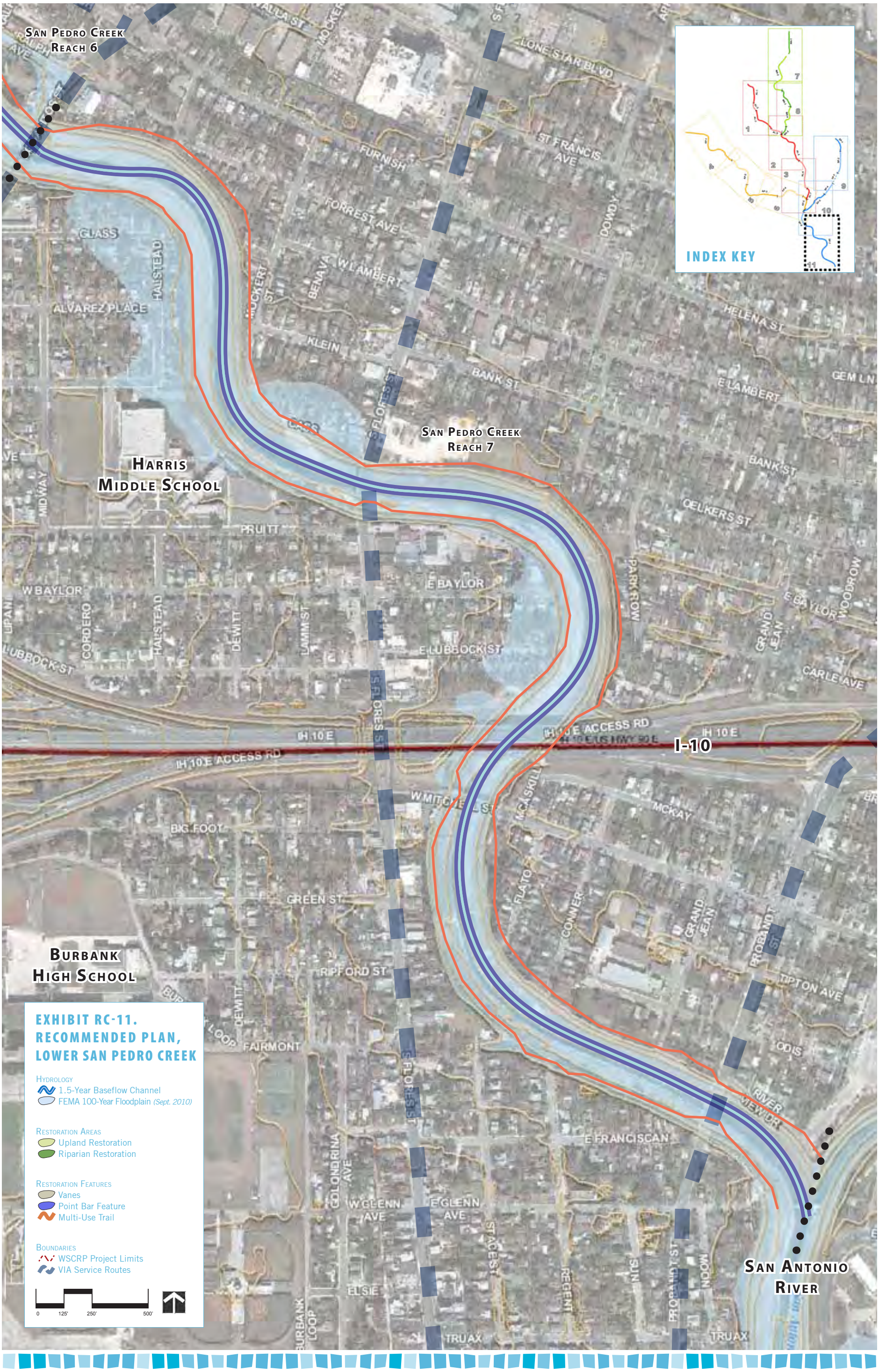


EXHIBIT RC-11. RECOMMENDED PLAN, LOWER SAN PEDRO CREEK

Hydrology
- 1.5-Year Baseflow Channel
- FEMA 100-Year Floodplain *(Sept. 2010)*

Restoration Areas
- Upland Restoration
- Riparian Restoration

Restoration Features
- Vanes
- Point Bar Feature
- Multi-Use Trail

Boundaries
- WSCRP Project Limits
- VIA Service Routes

Implementation

IMPLEMENTATION CONSIDERATIONS

Through investment in planning, SARA continues to lead the San Antonio community in the enhancement of unique urban places through stream restoration and flood mitigation. SARA, through development of this conceptual planning report, has initiated the first step in creating the distinctive Westside Creeks Restoration Project. This conceptual plan for the project includes two distinct project concepts: 1) stream restoration, flood hazard mitigation, public trails, parks and community facilities; and 2) multi-purpose facilities that recognize potential opportunities for community economic revitalization through private development. In many cases, these two distinct project activities will develop simultaneously and include multiple public and private partners. To sustain and implement this long-term Creeks restoration vision and realize the neighborhood and community revitalization opportunities, many important milestones must be achieved:

- The public and stakeholders have embraced this vision as a worthy and reasonable public project.
- Local agency support and participation is necessary in the implementation process and in the ultimate operation and maintenance of the project.
- Adequate funding must be identified and committed to the project through its completion.
- Inter-governmental policy agreements must be worked out among all the agency participants.
- Private development investment groups must be encouraged to engage and coordinate with the project.

This section of the report outlines considerations related to implementation of the Phase 1 restoration and flood hazard mitigation elements of the Project. It is expected and desired that the community revitalization and neighborhood re-development activities will be stimulated by the Project and will proceed appropriately.

The current oversight committee and creek subcommittees should remain in place and continue to meet as the project moves forward. The committees will be supported and administered by SARA staff and the objectives for the continuation include assistance with:

- Maintenance of the grass-roots momentum and community support for the project.
- Identification of and contact with potential partners to elicit their support for the project.
- Monitoring and participation in other nearby efforts such as VIA streetcar projects, ongoing University Health System improvements, UTSA and Our Lady of the Lake University construction/planning, City of San Antonio and Bexar County Capitol Improvement Project (CIP) bond drainage improvements, Mission Verde Center at Cooper efforts, Bicycle Mobility Advisory Committee of the Metropolitan Planning Organization (MPO), Bicycle Master Plan, Mayor's Vision 2020, Linear Creek Greenways Program, and similar related programs.
- Coordination with SARA during the Final Planning and Design Phase of each individual reach of the Project
- Collaboration with local stakeholders throughout the process such as downtown associations, the Westside Development Corporation, community development corporations and neighborhood and civic groups.

TABLE 8. PARTNERSHIP OPPORTUNITIES

Projects	USACE	Texas P&W	Bexar County	COSA	VIA Transit	SAWS	CPS Energy	SAISD	OLLU	UTSA	Univ. Health	Texas Diabetes	SAHA	CDC	Private Developers/ Other	Linear Creek Greenways
Overall Stream Restoration	*	*	*	*		*	*									*
Alazán Creek																*
Irving Middle School Catalyst Site	*	*	*	*	*	*	*	*					*	*	*	*
Alazán Plaza Catalyst Site	*	*	*	*	*	*	*	*						*		*
Farias/Crockett Catalyst Site	*	*	*	*	*	*	*			*	*		*	*	*	*
Apache Creek																*
Elmendorf Catalyst Site	*	*	*	*	*	*	*		*				*	*	*	*
Produce Center Catalyst Site	*	*	*	*		*	*	*			*	*		*		*
Memorial Avenue Catalyst Site	*	*	*	*		*	*							*		*
Martínez Creek																*
Fredericksburg TOD / Old Spanish Trail	*	*	*	*	*	*	*						*	*	*	*
Cincinnati Gardens Catalyst Site	*	*	*	*		*	*						*	*	*	*
San Pedro Creek																*
Civic Center Catalyst Site	*	*	*	*	*	*	*			*	*				*	*
Arts District Catalyst Site	*	*	*	*	*	*	*						*		*	*
Southgate Catalyst Site	*	*	*	*		*	*						*		*	*

FUNDING + PARTNERSHIP OPPORTUNITIES

As part of the implementation process, various components and catalyst projects will require multiple layers of partnership and financing mechanisms. SARA and the WCROC need to coordinate and select different funding options for each of the components of the vision plan. Some of the funding options which can be considered for the long-term implementation of the plan include:

- Federal and state programs to restore stream environments and revitalize urban communities.
- City and County annual CIP budgets financed through existing tax and revenue bond programs and/or future city and county bond issuances.
- Potential sales tax dedication programs or future tax increment financing districts.
- Creation of a Public Improvement District or other special entity with a dedicated revenue source.
- Financial institutions with target programs for investment in the geographic area of the four creeks.
- Private investment groups and developers with private funding for local projects along the creeks or in the catalyst site areas.

In support of the City of San Antonio's Linear Creek Greenways Program, a sales tax extension was recently approved by voters which specifically included each of the Westside Creeks as eligible for funding. This sales tax program can fund those proposed trails which would not need to be demolished and rebuilt once the Westside Creeks Restoration begins.

Significant opportunities exist for enhanced project implementation and funding due to the abundance of potential participating entities, including multiple state and federal resource agencies, other local governmental agencies, local universities, medical and educational institutes, community non-profit groups, neighborhood associations and private businesses. However, partnerships are not created overnight. The successful restoration of the Westside Creeks and subsequent development of the catalyst sites and economic stimulation of the surrounding neighborhoods depend on a comprehensive approach to public-private partnerships. Some of the potential identified partners include, but are not limited to the following:

- USACE
- US Department of Housing and Urban Development (HUD)
- Texas Parks & Wildlife (TPWD)
- Bexar County
- City of San Antonio (COSA)
- VIA Metropolitan Transit (VIA)
- San Antonio Water Systems (SAWS)
- CPS Energy
- San Antonio Independent School District (SAISD)
- Our Lady of the Lake University (OLLU)
- University of Texas at San Antonio (UTSA)
- University Health System
- Texas Diabetes Center
- San Antonio River Foundation (SARF)
- San Antonio Housing Authority (SAHA)
- Community Development Council (CDC)
- St. Mary's University
- Metropolitan Planning Organization (MPO)
- Haven for Hope
- Westside Development Corporation
- Mission Verde Center
- Avenida Guadalupe Association
- Jefferson/Woodlawn Community Development Corporation
- Downtown Alliance
- West San Antonio Chamber of Commerce
- San Antonio Hispanic Chamber of Commerce
- Green Spaces Alliance
- Neighborhood and Civic Organizations
- Texas Historical Commission
- Federal Courthouse Complex
- Produce Market
- Greater San Antonio Chamber of Commerce

These agencies and organizations all represent local interests and have an ability to bring valuable resources to the effort to implement the Westside Creek Restoration Project since they all have a legitimate stake in its success. Of these potential partners, the USACE has historically been a key participant for this type of program, especially where it involves a previous federal flood mitigation program. Not only was the USACE responsible for the current design and constructed condition of the Westside Creeks, but they are the principal federal agency charged with the responsibility to assist with the funding, permitting, design and construction of both stream restoration and flood mitigation projects. The existing federal authorization for the ecosystem restoration of the San Antonio River specifically includes authorization for the Westside Creeks; however, a determination of a federal interest in this specific restoration project is now needed in order to move forward with USACE support under various federal programs. Initial communications have already begun with the USACE, helping to guide the planning process towards a higher probability of federal interest. However, experience with the Mission Reach restoration and the current economic condition related to the availability of federal funding suggest this source should not be expected to be available for many years or perhaps decades into the future.

Once the federal interest and near-term funding availability have been determined, other potential partners and their specific roles can be identified to further enhance the successful implementation of the Westside Creeks Restoration Project. Some partners may bring immediate funding to the project, others technical/administrative support, but all local partnerships should be encouraged to find an appropriate role in the project so that community support and grass-roots momentum for this project can continue throughout its implementation. Already, the City of San Antonio and Bexar County have shown interest in the future evaluation of opportunities to integrate the Westside Creeks Restoration Project with their own individual CIP bond programs for improving drainage and providing flood mitigation throughout their service areas. These two local governments' continued participation will be essential to the success of this project.

FUTURE DEVELOPMENT ACTIVITIES

Several activities are critical in order to maintain the project momentum and realize the vision of the Westside Creeks Restoration Project. Because this vision includes the multiple elements of creek restoration, flood mitigation and recreational trails, and affords opportunities to also serve as a catalyst for private development, the approach to implementation becomes even more critical. A parallel path is required to encompass design development, marketing, organizational and community involvement and catalyst development. All of this must be accomplished within the available overall project funding. The following six action items have been identified as the core activities to be completed in order to address the initial Phase 1 program. A realistic target schedule for each of these activities is outlined in the bar chart below.

Action Item 1. Maintain Community Support for the Project - SARA, the WCROC and community leaders will continue to meet with potential public and private partners to elicit their buy-in and support for the project and to begin exploration of partnership interest level and possible activities of involvement. This activity must continue throughout the entire planning and development process to ensure continued support at all appropriate political and community levels. In addition to seeking approval of the Conceptual Plan by the SARA Board, this action item may also include formal adoption of the Plan by other key local governments and/or agencies and execution of memorandums of understanding and of resolutions supporting or adopting all or components of the Plan. The WCROC will also continue to hold additional meetings which will be open to the public in order to solicit public and interest group feedback throughout the process.

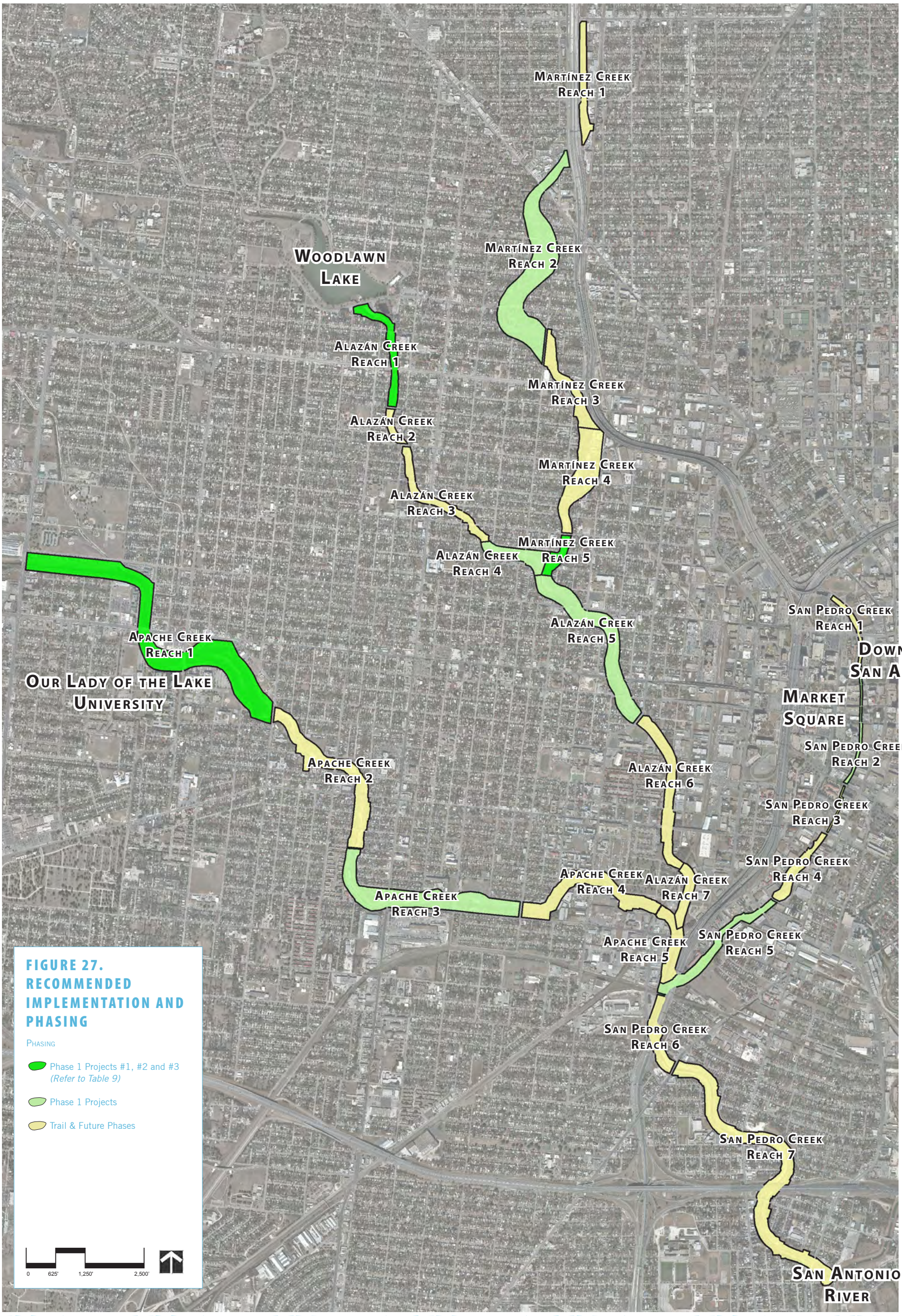
Action Item 2. Develop Public Agency Funding and Partnership Agreements - SARA will also proceed to evaluate all funding and partnering options and develop a coalition of governments, agencies and private entities to form a core group of dedicated participants in the implementation process who can meet on a regular basis to move the project forward. SARA will also proceed with the process of submitting the creek restoration planning document to the USACE for review and formal determination of the federal interest through its reconnaissance level study procedures and for better definition of the federal funding level, if any, available for the Project. In addition, local development plans, capital improvement programs, BRWM prioritization plans, watershed master plans, budgets and other strategic plans for this Westside Creeks' area should be updated to reflect the Westside Creeks Restoration Project. SARA will work with the appropriate local governments and agencies to assist in updating the plans, which should include community comprehensive plans, parks and recreation plans and neighborhood development plans, as well as the CIP programs and budgets for each agency or public entity.

Action Item 3. Implementation of Phase 1A Projects - Three initial "pilot" projects have been identified as opportunities for immediate funding and development under Group A of the Phase 1 projects. These sites were based upon the input received throughout the conceptual planning document phase which included WCROC and subcommittee meetings, public workshops, discussions with City and County leaders and a review of planned and ongoing public improvements; Alazán Reach 1, Martínez Reach 5 and Apache Reach 1. These projects are among the high priority projects identified for Phase 1 implementation, are located on three of the creeks and have a construction cost estimate just under $50 million. Alazán Reach 1 is a minimal restoration reach including trails, while Martínez Reach 5 and Apache Reach 1 are recommended as projects with fully integrated components of enhanced flood mitigation, stream restoration and recreational trails. In addition to these three reaches proposed for restoration in Phase 1A, continued coordination is recommended in San Pedro reach 2, and the reaches not proposed for restoration in Phase 1 should have trails constructed.

- Apache Reach 1 - There are a number of projects planned for Elmendorf Lake and dam that could occur at the same time as the restoration of Reach 1 of Apache Creek. These include the trails project for the San Antonio Alternative Housing project and the dredging and water quality enhancement project for Elmendorf Lake.
- Martínez Reach 5 - At the confluence of Alazán and Martínez Creeks, there are opportunities to connect via new trails Farias Park with Tobin Park which is located just downstream of the confluence of Alazán and Martínez Creeks in Alazán Reach 5.
- Alazán Reach 1 – The restoration of Reach 1 of the Alazán Creek has potential to provide connection into Woodlawn Lake as well as the Historic Basilica of the National Shrine of the Little Flower.
- San Pedro Reach 2 - Phase 1A should also incorporate continued coordination with the Federal Courthouse project, which is currently in the planning stages. Implementation of the San Pedro Reach 2 improvements would follow later in Phase 1. San Pedro Creek Reach 2 contains significant redevelopment opportunities as a result of the razzing of the City Annex Municipal Building, as well as the future demolition of the Police Station to clear the way for the Federal Courthouse and future plans for the Casa Navarro State Historic Site. There are also opportunities to tie downtown's civic area to Market Square. SARA will offer assistance and encouragement to the federal authorities to incorporate enhancements and aesthetic improvements for that portion of San Pedro Creek running through the property complex. Integration of the courthouse site design with the adjoining vacant City property and the Casa Navarro State Historic Site will be greatly enhanced by incorporating elements of the Westside Creek Restoration Project vision into this important downtown development.
- Implementation of "Trails Only" along 7.6 miles of stream segments (15 stream reaches) is also expected to take place during the early stages of Phase 1, pending available funding.

The general activities required for each of the Phase 1A projects is similar in nature, but is likely to vary considerably in the level of effort and intensity necessary for each;

- Detailed Planning - Further refinement of the Phase 1A pilot projects and trails, developing of the specific planning details required for each project (~5-10% design level) including determination of required property acquisition, permits, utility adjustments and design details necessary for developing revised costs and cost allocations by interested funding source and schedules for construction. This effort will be funded by SARA.
- Design - Preparation of final engineering designs, plans, specifications and contract documents for all required facilities. The funding source is to be determined in the detailed planning stage.
- Permit and Property Acquisition - Preparation and submittal of permit applications, development of property surveys and legal descriptions and support of land acquisition services required for all necessary facilities. The funding source is to be determined in the detailed planning stage.
- Utility and Bridge Adjustments - If required, relocation or adjustments of utility conflicts and modifications to bridge structures to accommodate the proposed trails, restoration and flood mitigation facilities. The funding source is to be


Martínez Creek Reach 1
Martínez Creek Reach 2
Martínez Creek Reach 3
Martínez Creek Reach 4
Martínez Creek Reach 5
Woodlawn Lake
Alazán Creek Reach 1
Alazán Creek Reach 2
Alazán Creek Reach 3
Alazán Creek Reach 4
Alazán Creek Reach 5
Alazán Creek Reach 6
Alazán Creek Reach 7
Apache Creek Reach 1
Apache Creek Reach 2
Apache Creek Reach 3
Apache Creek Reach 4
Apache Creek Reach 5
Our Lady of the Lake University
San Pedro Creek Reach 1
San Pedro Creek Reach 2
San Pedro Creek Reach 3
San Pedro Creek Reach 4
San Pedro Creek Reach 5
San Pedro Creek Reach 6
San Pedro Creek Reach 7
Downtown San Antonio
Market Square
San Antonio River
FIGURE 27. RECOMMENDED IMPLEMENTATION AND PHASING
Phasing
Phase 1 Projects #1, #2 and #3
(Refer to Table 9)
Phase 1 Projects
Trail & Future Phases
0
625'
1,250'
2,500'

determined in the detailed planning stage.

- Bidding and Construction - Soliciting and executing construction and initial maintenance contracts for the required trails, stream restoration facilities and stream channel modifications required for the flood mitigation objectives.

Action Item 4. Develop Cooperating Governmental and Private Agreements - SARA, the City of San Antonio and Bexar County will require agreements which establish all legal responsibilities for the flood management, operation and maintenance and security agreements required for all improvements associated with the project. Development of these agreements will also better define opportunities for additional partnership activities with other organizations and with private developers within the floodplain areas. Initial agreements for the first three projects can serve as "pilot" agreements and as templates for the entire remaining Westside Creeks Restoration Project. As outlined further below, many different policy decisions will be needed to establish the procedures required to cover a host of new technical and operational issues associated with this project. The development of these policies and agreements between the public entities will be a major undertaking.

Action Item 5. Develop Additional Planning Details for Group B and C Projects – Based on the detailed planning developed for the demonstration projects, the remaining Phase 1 reaches will be generally re-evaluated in order to develop additional and more refined planning details and to finalize the construction staging and sequencing plans for the overall Phase 1 project. The revised details will be presented for review to the WCROC and the public and private partners participating in the remaining Phase 1 projects. Deliverables for this activity will include:

- General Design Criteria - Project specific design criteria for trails, restoration activities and channel modification facilities will be developed to ensure consistency with project goals and provide guidance to planning and design professionals engaged to complete the various future project facilities.
- Updated Conceptual Design - Each of the remaining reaches within the project will be re-evaluated to incorporate preliminary design details in accordance with the revised criteria thereby providing further guidance to other related projects and improvement programs which must ultimately integrate and coordinate with the Westside Creeks Restoration Project.

TABLE 9. IMPLEMENTATION PHASING + SCHEDULE

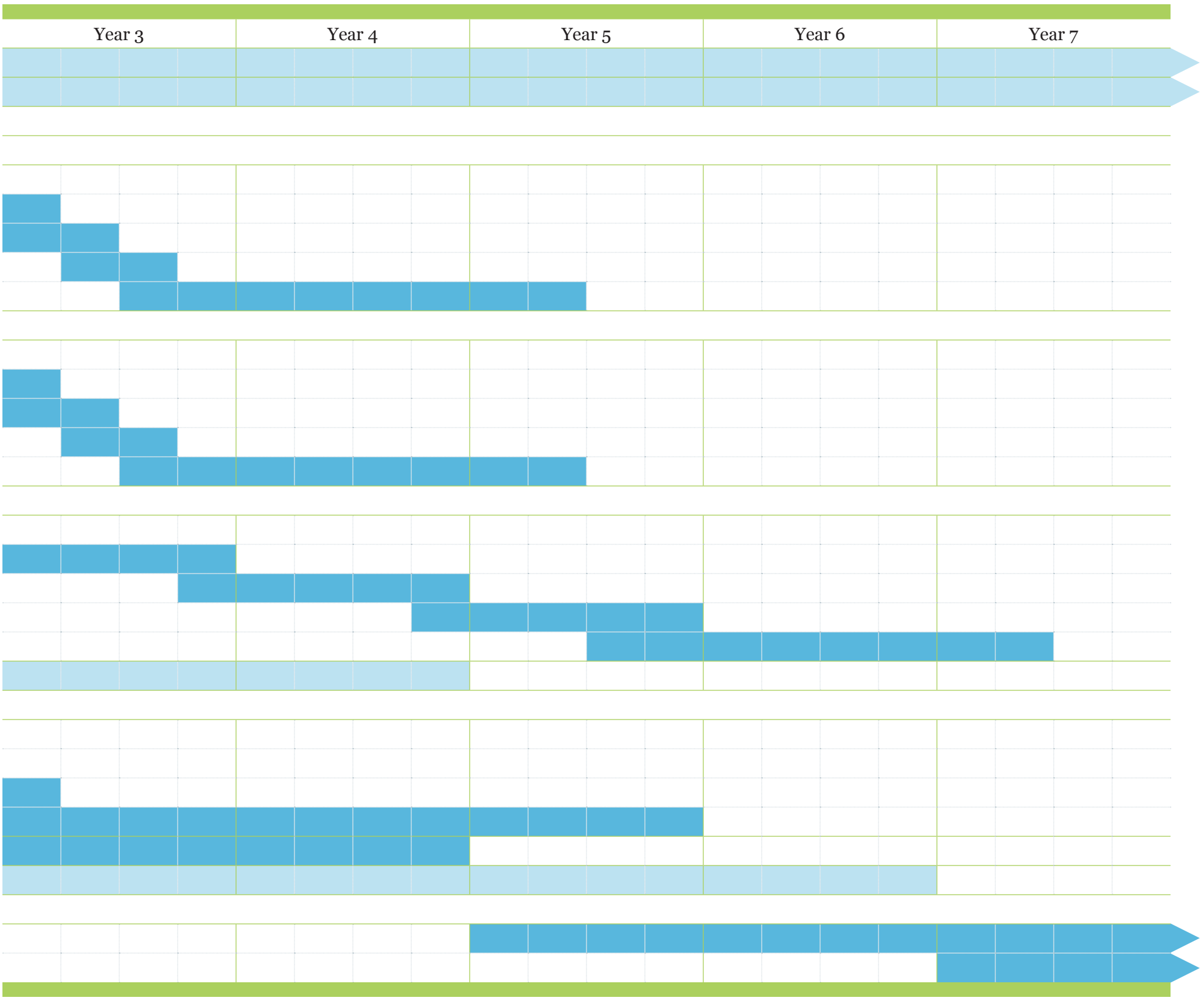
	Year 1				Year 2			
Maintain Community Support for the Project (Action Item 1)	■	■	■	■	■	■	■	■
Develop Public Agency Funding + Partnership Agreements		■	■	■	■	■	■	■
Implementation of Phase 1A Projects (~$60M)(Action Item 3)								
Project #1: Alazán Reach 1								
Detailed Planning					■	■		
Design							■	■
Permitting + Property Acquisition								
Utility Adjustment								
Bidding + Construction								
Project #2: Martínez Reach 5								
Detailed Planning					■	■		
Design							■	■
Permitting + Property Acquisition								
Utility Adjustment								
Bidding + Construction								
Project #3: Apache Reach 1								
Detailed Planning					■	■	■	■
Design								
Permitting + Property Acquisition								
Utility Adjustment								
Bidding + Construction								
Project #4: San Pedro Reach 2 - Coordination with Federal Courthouse (~$100K)					■	■	■	■
Implementation of Trails Only - Fifteen Reaches (~$10M)								
Detailed Planning					■	■		
Design							■	■
Permitting								■
Bidding + Construction								
Develop Cooperating Governmental + Private Agreements (Action Item 4)								
Develop Revised Planning Details for Groups B + C Projects (Action Item 5)								
Completion of Remaining Phase 1 Recommended Projects (~$240M)(Action Item 6)*								
Phase 1B: 3 Reaches (~$100M)								
Phase IC: 3 Reaches (~$140M)*								

** Additional 5 - 10 years depending on funding*

- Revised Cost and Schedule Estimates - Updated costs and construction schedules for all reaches selected for Phase 1 development will be established in accordance with the revised conceptual designs in order to allow more accurate budget estimates of required funds and resources to complete the Project.
- Recommended Funding/Partnership Agreements - Based on the results of the above activities, formal funding and partnership agreements will be proposed for the appropriate funding and execution agencies.
- Private Development Coordination - Individual property development opportunities will be better identified and discussions organized with the potential private developers to determine if additional agreements and coordination with the Westside Creeks Restoration Project may be appropriate.

Action Item 6. Completion of Remaining Phase 1 Recommended Projects – The remaining six reaches with restoration projects will complete the Phase 1 program. SARA will need to develop detailed engineering documents to integrate these flood mitigation, stream restoration and recreational components of the project with any private entity improvements within the creek area to form a cohesive series of executable individual construction projects that reflect the anticipated available funding for the Project. The timing of these remaining projects will be a function of the available funding and the constraints determined for the individual projects. The individual restoration projects will be proposed for subsequent construction in Groups B and C of Phase 1. Those restoration projects which are located adjacent to other projects with existing funding should be prioritized for early execution in order to take advantage of opportunities to consolidate efforts such as joint contracting, joint staging areas or shared soil and sediment spoils. For example:

- Apache Reach 3 contains an opportunity to advance the efforts of the Mission Verde Center at Cooper Academy multipurpose education, training and research center for renewable and energy efficient technologies and water management and conservation strategies.
- Martínez Reach 2 contains numerous vacant lots due to flood buyouts which have created a park-like environment along Martínez Creek.
- San Pedro Reach 2 contains the Federal Courthouse Complex, which is currently in the planning phase, but which offers great opportunity for shared benefits.



LOCAL POLICY RECOMMENDATIONS

Floodplain Management

A comprehensive floodplain management strategy should be developed for approval by SARA, City of San Antonio and Bexar County including both voluntary and targeted buy-out programs for frequently flooded properties adjacent to the creeks as needed for enhancing flood mitigation and stream restoration improvement opportunities. The priority for buyouts should be established for properties that suffer the most severe flooding and properties that have the greatest impact on flood damage reduction. The Watershed Master Planning process currently underway in the San Antonio River Watershed is developing candidate projects for flood mitigation across the basin, and this planning effort is being coordinated with the Westside Creeks Restoration Project.

Appropriate areas have been identified where there are opportunities to enhance both flood reduction and stream restoration, but close coordination will continue to be important as both of these programs continue into the next phase. It is recommended that a common entity be utilized to coordinate the design and construction of projects in the Westside Creeks area to help ensure that both stream stability and flood mitigation impacts are appropriately considered for each project.

Restoration

Memorandum of agreements should be developed between local partnering public entities (SARA, City of San Antonio and Bexar County) and federal and state resource agencies (such as the USACE, TCEQ, TPWD and others) to address permitting and development issues. Formal adoption of the Westside Creeks Restoration Plan by the County, City and other partnering agencies should also occur. These agreements should focus on implementation of the restoration plan and consistency with plan's guidance and USACE's restoration standards, TCEQ and TPWD criteria and local partnering agency criteria. The agreements should ensure that all new floodplain management work in the project area includes an element of restoration consistent with the Westside Creeks Restoration Project's vision. Where possible, all new initiatives should include multipurpose projects, adding recreation, neighborhood revitalization, transportation and economic development components to leverage available funding where possible.

Economic Development Incentives

Current residents and commercial businesses within the local Westside Creeks community area should be encouraged to take advantage of the economic development opportunities resulting from the Westside Creeks Restoration Project. Community economic development programs could be created which would provide support for business planning, access to start-up funding for new businesses, tax incentives for job creation in the neighborhood, low interest loan assistance for new construction and other economic development incentives appropriate to the program. Although potentially limited for the near-term, community development block grants programs and economic revitalization programs sponsored by state agencies should be considered and promoted for the entire neighborhood.

Tri-Entity Operation + Maintenance Agreement.

In developing further details to support this vision and restoration plan for the four Westside Creeks, focus should be given to both the short- and long-term maintenance of the creeks as implementation moves forward. Currently, the City of San Antonio is responsible for all upkeep and maintenance activities along the creeks consisting primarily of mowing, debris removal, bridge infrastructure and erosion repairs. Bexar County is responsible for development and implementation of multiple flood mitigation projects and SARA is leading the planning and stream restoration efforts. This has been a very successful collaboration to-date, but it can be improved by further focus and consideration of the special operations and management issues associated with the development of the future flood mitigation and stream restoration projects.

The recommended agreement should include provisions, at a minimum, to establish policies and provisions for the following operation and maintenance issues:

- Short-term mowing schedules transitioning towards native vegetation restoration, use of no-mow zones and removal of invasive species.
- Training of maintenance personnel in the proper use of herbicides and insecticides along the riparian corridors.
- Procedures for establishing times of operations and allowed activities for individual recreation areas.
- Litter and trash removal, cleaning and upkeep of creek areas and public open spaces.
- Budget agreements and funding identification.
- Vegetation and landscape replacement, sediment removal or other repairs, if needed, after flooding events.
- Lighting replacement and graffiti abatement where needed and appropriate.
- Responsibilities for public connections to and from creeks.
- Participation of neighborhood associations and private organizations in the operation and maintenance program.

Multi-Agency Security Agreement

In addition to the Tri-Entity Maintenance Agreement, the same three public partners should also enter into a Multi-Agency Security Agreement that adds the San Antonio Independent School District (SAISD) and/or VIA Metropolitan Transit (VIA) as other potential partners. Public safety and security consistently ranked as a top priority of Westside residents in the restoration of the creeks. Most of the current security problems associated with the creeks include the homeless population, transients and juvenile mischief. A Multi-Agency Security Agreement may include the following:

- Joint jurisdiction of the creek areas for all law enforcement agencies to include City of San Antonio, Bexar County Sheriffs, SAISD and VIA police.
- Target crime sweeps to keep transient populations out of the creekways.
- Bike and mounted police patrols.
- Crime prevention technology security alerts.
- Technology surveillance and cameras.
- Neighborhood sponsored activities for formal and informal watches over the creeks.

Public Art

Through public input and ratification by the WCROC, public art was recommended as a vital component of the Westside Creeks Restoration Program. As the project vision and restoration is implemented, a comprehensive public art program should be created as part of the design and construction phase of work. All capital budgets for phased implementation should include a specific budget line item for public art recommended to be at least 1% of the project total and supplemented with funding from private foundations in support of public art when possible. Public art is essentially art in a public place, and can include temporary and/or permanent visual art and installations, performance, historical and cultural interpretation, multi-media and landscaping. Essentially, public art is a celebration of identity and culture and an important platform that brings shared public spaces to vibrant life, making them accessible and educational.

In its purest form, public art may be found in all kinds of spaces along the creeks such as gateways, plazas, parks, civic buildings, churches and residential neighborhoods, as well as along pedestrian and vehicular corridors, in recreation areas and the public areas of private buildings. The use of public art within the Museum Reach of the San Antonio River provides a good example of how public art can be integrated into the infrastructure at key locations to enhance and improve the value of the public's experience, especially as related to a linear trails system along important waterways.

Successful public art adds value, in both aesthetic and economic terms, to places and neighborhoods. In many cities, public art is in itself a tourist attraction. It can be used to welcome and attract people, to contribute to and celebrate the uniqueness of particular places by referring to the unique combinations of site, climate, vegetation, landforms, cultures and histories which make up those places.

Public art may interpret and present historical and cultural connections between a place and communities and places in other parts of the world, demonstrate connections between organizations and their clients, as well as stimulate thought, humor and enjoyment. Its inclusion in capital projects provides additional employment and economic opportunities for trades people, artists and building suppliers.

Recreation + Open Space

The San Antonio Parks Department Master Plan recognizes the Westside as an under-served community and has targeted development of parks throughout this area to increase access to recreation and open space. These four creeks offer a far reaching opportunity for the Department to realize the Master Plans' objectives of increasing the quality of life for residents. This goal is also stated in the City Council adopted Community Plan for Guadalupe Westside.

This proposed trail and open space system also has great potential to realize some of the stated goals of the San Antonio-Bexar County MPO Safe Routes to Schools (SRS) Program. This program is designed to "promote walking and bicycling to school through education and incentives to promote walking and cycling as well as identifying infrastructure improvements. Future funding through the City's Linear Creekways Program will offer the opportunity for trail development of the Westside Creeks Restoration Project, and this funding should be captured within a formal inter-agency agreement which covers trails and amenities design standards, construction contracting responsibilities for each entity and operation and maintenance responsibilities for the trails. Finally, the enhancement of facilities to accommodate cyclists supports the goals of the Bicycle Master Plan and City's Office of Environmental Policy's Sustainable Transportation Program.

"I want to see the granddads come back with their grandkids and **fish like we used to.**"

- Roberto Rodriguez, SARA Board Member

Glossary

Term	Definition
ADA	The Americans with Disabilities Act. The Federal legislation that addresses many features that impact people with a variety of disabilities. One notable aspect of the Act that affects this project is in the area of accessibility.
Aquatic	The environmental zone which is inundated by water.
Bankfull Discharge	The most commonly accepted definition is from Dunne and Leopold (1978): "The bankfull stage corresponds to the discharge at which channel maintenance is the most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work results in the average morphologic characteristics of channels." This storm event is typically between the 1 and 2 year recurrence interval.
Bankfull Width	Width of the cross section at the bankfull elevation.
Bio Filtration	The use of living vegetation to reduce the amount of pollutants which might otherwise enter a waterway. The pollutants are removed or chemically degraded through a combination of physical and biological processes.
Catalyst Site	An area where there is an intersection of features (environmental, transportation, recreational, educational, social, etc) that makes it a likely catalyst or seed of redevelopment and economic revitalization.
Cross Sectional Area	Area of the cross section at the bankfull elevation.
Easement	Land which has been legally reserved for use by others.
Entrenchment Ratio	Floodprone width divided by the bankfull width. High entrenchment ratios suggest that storm flows have access to a floodplain and are therefore not confined to the channel. Streams with low entrenchment ratios are more susceptible to erosion because large storms that are confined to the channel exude significant stress on the bank.
Flood Bench	The relatively flat land surface which is above the bankfull stage, yet within the overall flood channel.
Flood Channel	The largest definition of a channel, which often conveys moderate to high flood discharges. Higher discharges will inundate the overbank areas.
Floodplain	The land area which becomes inundated during a flood event. Most often, this term is used in reference to the flood hazard areas that are defined by FEMA for flood insurance purposes. These FEMA floodplains are periodically updated to reflect the best estimates of the risk of flooding from an event that has a 1% chance of occurring during a year (commonly referred to as the "100 year" floodplain).
Floodprone	An area which has a high probability of frequent flood inundation.
Floodprone Width	The channel width at two times the bankfull depth.
Fluvial Geomorphology	The study of stream forms and the processes that shape them. Processes include erosion and sediment deposition, which are themselves influenced by geology, meteorology, hydrology, hydraulics and vegetative cover.
Geomorphology	The study of land surfaces and the processes that form and shape them. This report focuses primarily on fluvial geomorphologic processes of streams.
HEC-RAS	A hydraulic modeling application that was developed by the USACE. This application is used to simulate the effects of water being conveyed through a stream system, and can provide predictions of flow velocity, water surface elevation and excavation needs for proposed stream channel revisions.
Hydraulics	The study of fluid flow across a surface or within an enclosed system. For open channel gravity flow, hydraulic analysis can determine the depth and velocity of a given amount of flow.
Hydrology	The study of the relationship between rainfall and the ground surface. Analysis can determine the amount of rainfall that can be expected to be absorbed by plants, retained and evaporated from puddles and ponds, absorbed into the surface soil layers with delayed discharge into streams, and permanent infiltration to groundwater aquifers, with the remainder directly flowing from the surface into streams.
Mean Bankfull Depth	Cross sectional areas at the bankfull elevation divided by the bankfull width.
Meteorology	The study of weather, with this report predominantly concerned with the precipitation of rainfall, air temperatures, relative humidity, and wind.
Overbank	The portion of a channel's flood carrying capacity which is outside of the typical flood channel. This area will often be relatively flat, and floods infrequently.

Term	Definition
Point Bar	A feature of meandering streams, where sediment is deposited along the inside banks of bends due to a decrease in velocity as the water flows along the meander bend. These are typically gentle in slope and lower in elevation than the banks on the outside of the bend.
Pool	A bedform geomorphic feature of streams. Pools are deep areas of the stream channel, often located on the inside bend of a meander, with relatively deep, slow moving flow and fine stream bed materials.
Riffle	A bedform geomorphic feature of streams where the stream bed slope is relatively steep upstream of a pool, which results in relatively rapid, shallow flow and coarse stream bed material.
Riparian	The vegetation community that exists along a water course or body such as a stream or lake. These zones tend to have high levels of biological diversity, drawing from the aquatic, avian and terrestrial environments.
Rock Cross Vane	Manmade stream structures, which are designed to provide both grade control (preventing down-cutting of the stream bed) and lateral control (preventing lateral movement of the stream bed). These structures are often designed to produce a scour pool immediately downstream.
Rip Rap	Rock or other material used to armor shorelines, streambeds, bridge abutments, pilings and other shoreline structures against scour, water or ice erosion. It is made from a variety of rock types, commonly granite or limestone, and occasionally concrete rubble from building and paving demolition. It can be used on any waterways or water containment where there is potential for water erosion.
ROW (Right-of-Way)	The publicly owned land that is utilized for public infrastructure such as roads, storm drainage and utilities. For the purposes of this report, ROW may also include easements which are dedicated for public use.
Scour	The process of erosion of the stream bed or bank material by the flow of water. While scour is a natural process, its impacts can be influenced by human actions such as construction in the stream (changes to flow patterns and velocities) or upstream in the contributing watershed (changes to the volume and timing of storm runoff which enter the stream).
Sinuosity	Channel length divided by the valley length. Sinuosity helps describe the plan layout of the stream. Low sinuosity values indicate straighter streams with fewer bends or curves and high sinuosity values indicate streams with more bends or curves.
Stream Profile	A longitudinal illustration of the stream slope. This can be used to identify locations of varying stream slope or variations in stream depth along the length of the stream.
Stream Slope	A measure of how steep a stream section is. It is often measured in the amount of vertical drop in feet per foot downstream along the stream profile.
Sustainable	A term which identifies processes which can be expected to continue over a long term without significant human intervention. However, other influences such as increased pollution or the introduction of invasive weeds can change a sustainable environment to an unsustainable one.
Thalweg	The line defining the lowest part of the stream along its length. This point is the lowest of deepest portion of a cross-sectional view of a stream. This is often mistaken for the centerline of the stream.
Upland	Vegetation associated with dry areas away from water or wetlands; vegetation that is not located within the area influenced by a body of water.
Width / Depth Ratio	Bankfull width divided by the bankfull depth. High width/depth ratios (greater than 12) indicate the channel may be over-widened, shallow and not able to support its sediment load. Low width/depth ratios may indicate that the channel is too narrow and deep and thus experiencing high near bank stresses.
Xeriscape	A planting scheme that has low water requirements and reduces or eliminates the need for irrigation.