Rethinking Urban Design: Urban growth and stream corridor connection

By Clelia Busadas

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Cover images: (Bottom) Coyote Creek Trail in North San José. Source: Lolke Bijlsma
(Left) Market Park development in San José. Photo by the author

Rethinking Urban Design:
Urban growth and stream corridor connection

A Planning Report Presented to
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EXECUTIVE SUMMARY

This report presents an integrated and sustainable approach to accommodate for new developments in floodplain areas while improving the stream corridor. It aims to guide future city staff, planners, and developers in promoting a healthier balance between the urban environment and the natural creek ecosystem.

San José is a densely built-out city and one of the largest cities in Northern California by population and area. The city is located in the center of the Santa Clara Valley and surrounded by the Santa Cruz Mountains, the Diablo Mountains, and the San Francisco Bay. Various creeks and rivers flow from the foothills to the shore of the San Francisco Bay passing through the natural valley floor and the city of San José. This report focuses on the Berryessa BART (Bay Area Rapid Transit) Urban Village (BBUV) site located in the northeast area of San José, where new developments are proposed to accommodate the emerging population. The site lies on a flood-prone zone at the confluence of Coyote Creek and Upper Penitencia Creek. Historically the land cover along these creeks supported diverse habitat, native grassland, valley oak savannas, and alluvial fans but, overtime, these natural lands have been converted to accommodate urban infrastructure, alternating the creeks and riparian functions.

Flooding is a natural process of river landscapes. However, the risk of flooding in developed lands can threaten life and property significantly. Historically, rivers have served the community by providing a number of benefits such as fisheries, irrigation, travel, as well as access to commerce industry and flood control. Over the years, the land cover adjacent to rivers and streams, have changed to accommodate urban infrastructure increasing the risk of flooding and the loss of property and lives along with wildlife habitat damage.

Flooding in San José has occurred repeatedly since 1850. Several flood events occurred prior and post the construction of the Coyote and Anderson Dams in the mid-1900s. However, the most damaging flood event occurred in February 2017 when, due to heavy rains, the Anderson Reservoir reached its highest capacity and created a large flow over the spillway into Coyote Creek. This caused the creek to overflow its banks, flooding the adjacent neighborhood. Thousands of residents were evacuated and homes, business and streets where inundated by creek water. Even though no loss of life or injuries were reported, public and property damages exceeded 70 million dollars.

By recognizing the site history, land use conditions, and challenges of the area, this paper explores a set of actions that can help improve urban development on flood prone areas while improving creek ecosystems, expanding recreational opportunities, and minimizing flood risk. Details of the existing site conditions is provided in Chapter 2.

Research papers, case studies, and literature reviews were conducted to understand, define, and analyze different strategies in support of urban developments within flood prone areas. Further discussion of the analyzed literature is provided in Chapter 3.

In chapter 4, this document analyzes four case studies to identify potential benefits and limitations of urban river restorations. Through the analysis of these four cases, a set of design recommendations are provided in Chapter 5.

As new developments rise near waterways, there are new opportunities to incorporate environmental benefits into redesign. Well-designed infrastructure that supports urban development and flood protection can restore creek habitat, improve riparian corridors and enhance water quality. This research considers that with the correct planning policies and design strategies, the BBUV can be successful as both an urban development, and a riparian zone for the city of San José.

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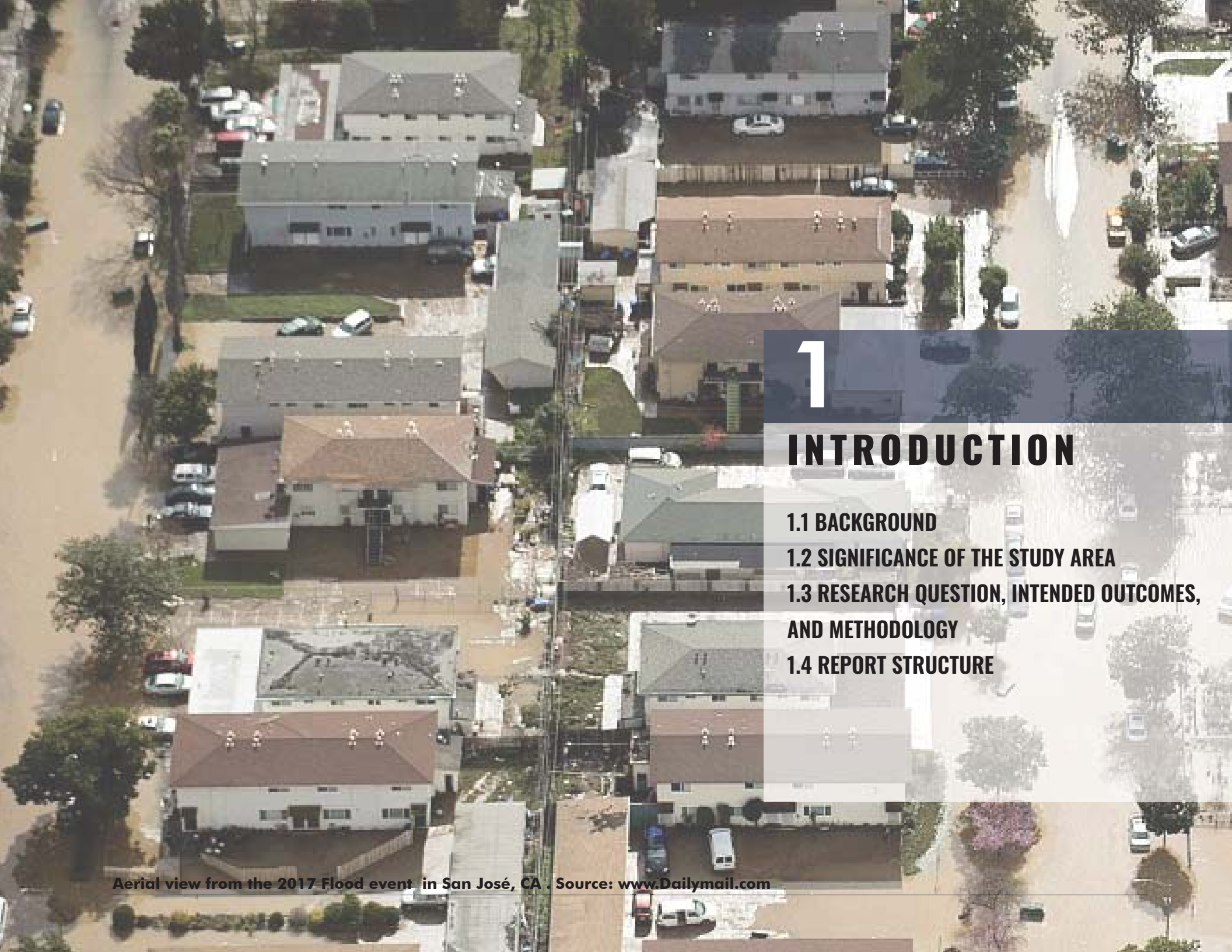


1

INTRODUCTION

Aerial view from the 2017 Flood event in San José, CA . Source: www.Dailymail.com

Introduction

Flooding in San José has occurred repeatedly since 1850. The most significant flow recorded in Coyote Creek was in 1911, prior to the construction of the Coyote Dam (1936) and the Anderson Dam (1950) in the upper watershed, south of San José. After the construction of the Anderson Dam, several flood events occurred in the area where floodwater ravage public and private property. In 2017, one of the most significant flooding events occurred in San José. Due to heavy rain, the Anderson Reservoir reached its highest capacity and created a large flow over the spillway into Coyote Creek, causing the creek to overflow its banks and flood adjacent neighborhoods. Almost 14,000 residents from Rock Springs, Olinder, Naglee Park, Roosevelt, and Berryessa neighborhoods were evacuated and sheltered, and hundreds of homes, businesses, and streets were inundated by creek water along Highway 101 between the reservoir and the San Francisco Bay.[1]

Over the years, land use changes have drastically reduced and altered the natural habitat along Coyote Creek. As urban growth continues in San José and the Bay Area, it is essential to understand the consequences new developments can cause in flood risk areas. This research paper investigates urban development in flood-prone areas and explores alternatives to satisfy urban growth, flood prevention, and stream revitalization. The report focuses on the San José Flea Market area within the Berryessa Bay Area Rapid Transit (BART) Urban Village (BBUV), northeast of San José, CA. Due to its proximity to the new Berryessa BART station, this area will be the center for future residential, office and commercial developments. However, this particular area is located on a flood hazard zone, adjacent to Coyote Creek and Upper Penitencia Creek.

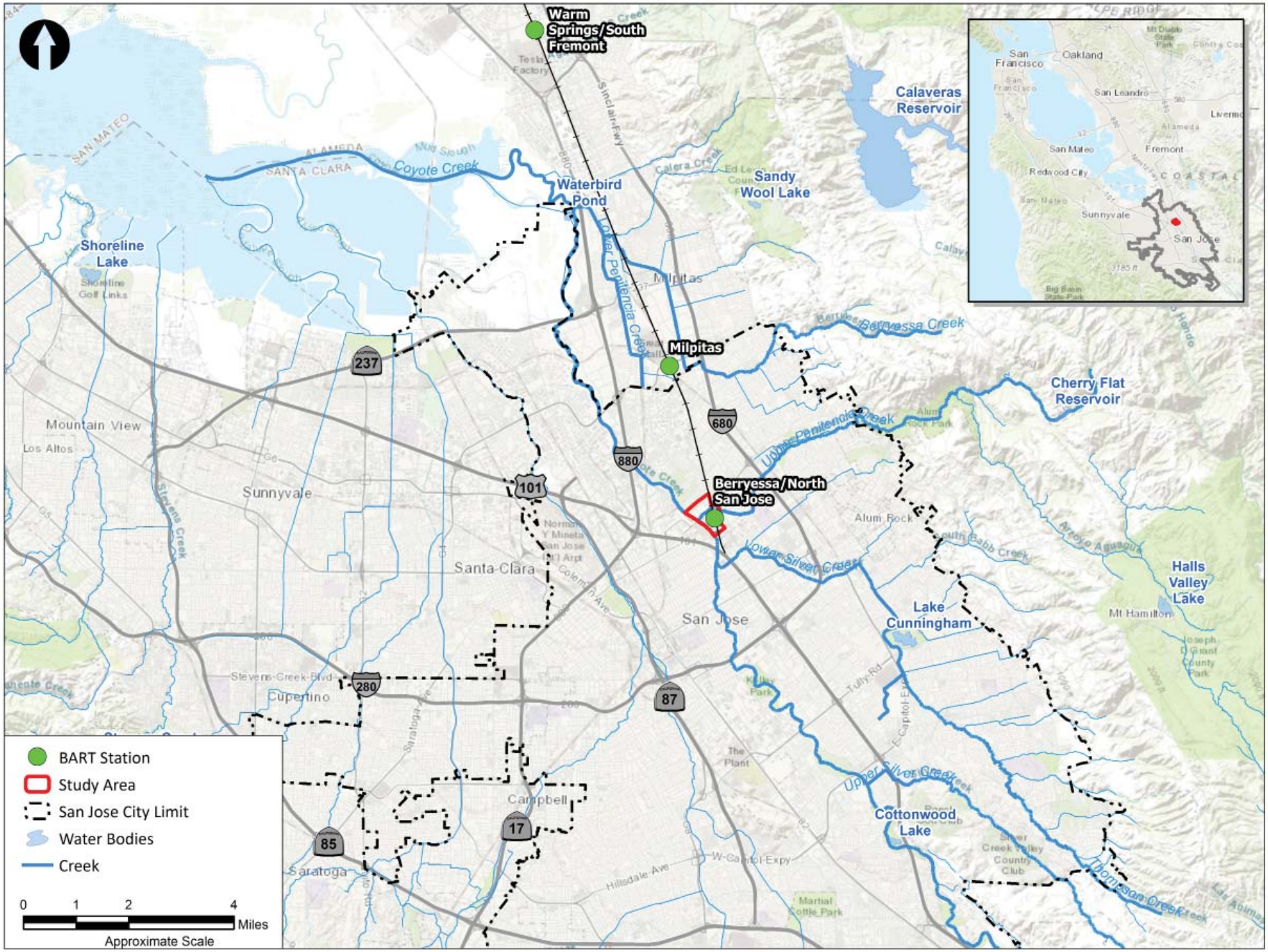
As technology advances, cities can rely on computational systems to improve many aspects of urban life that can simulate building and infrastructure performance. In this paper, site conditions and future changes will be analyzed with computational systems such as ArcGIS and Adobe Illustrator to assess feasibility, plan implementation, and an overall design for development in floodplains and adjacent to waterways.

1.1 Background

In 2011, the City Council of San José adopted the Envision San José 2040 General Plan in order to accommodate the population growth in the area with a strategic plan. Urban Villages are an essential concept in this plan; they consist of places where people live, work, enjoy, and are typically located near public transit hubs. The BBUV project in San José is one of the first transit-oriented urban villages in the city since it surrounds the new Berryessa/North San José BART station. This new urban village is planned to accommodate more than 22,000 jobs, mixed-use developments, pedestrian, and biking infrastructure. The BBUV area is located in the northeast part of San José, adjacent to Coyote Creek, Marbury Rd., Sierra Rd., and N. White Rd. and comprehends about 270 acres. This area is also traversed by the Upper Penitencia Creek that originates in the Diablo Range, the hills to the east of the city, and connects with Coyote Creek at the intersection of Berryessa Rd. As mentioned, the report focuses on the San José Flea Market and BART station area within the BBUV. Figure 1 shows the site's location within the city of San José and its relation to the Bay Area.

Floodplains are areas adjacent to streams and rivers subject to inundation. The 100-year flood hazard area means that there is a 1% probability of flood occurrence in any year. Areas adjacent to the BBUV are in a floodplain zone, meaning that a 1% chance of

1 "Floods In San José Push 14,000 People Out Of Their Homes," *NPR.Org*, accessed May 3, 2020, https://www.npr.org/sections/thetwo-way/2017/02/22/516700121/floods-in-san-jose-push-14-000-people-out-of-their-homes.



Map: Santa Clara Valley Water District. Data Sources: ESRI, NLCD, NOAA, USFWS and SCVWD.

Figure 1. Study area location within the city if San José. Map created by the author

flood can occur. The BBUV framework is still under development, and with that, it is a critical time to determine what design guidelines should be applied for this type of project. Determining what can be applied for any future development is key to avoid any harm caused by flood events, prevent any building and infrastructure damage, and prevent environmental disasters while improving the stream corridor. The image below (Figure 2) shows the BBUV area and the 100-year flood hazard area provided by the Federal Emergency Management Agency (FEMA); it is worth noting how vulnerable the site is if a flood event of a 100-year magnitude occurs.

The existing area of the San José Flea Market, within the urban village area, is a potential site for future development, and there are already plans to build in this lot. Right now, the site is used as an outdoor market along the pavement surface. There are minimal structures that can be damaged in case of flooding, but this zone will be the center for future developments due to its proximity to the BART station. New developments will remain vulnerable to flood and erosion, threatening the surrounding community if design and construction regulations are not taken into considerations.

In addition to building on a floodplain zone, another critical factor that this report focuses, is to improve the stream corridor along Coyote Creek and Upper Penitencia Creek, in order to revitalize the connection of people with the creeks, prevent flood hazard, as well as improving trails along the creek that connect the BART Station to other parts of the city.

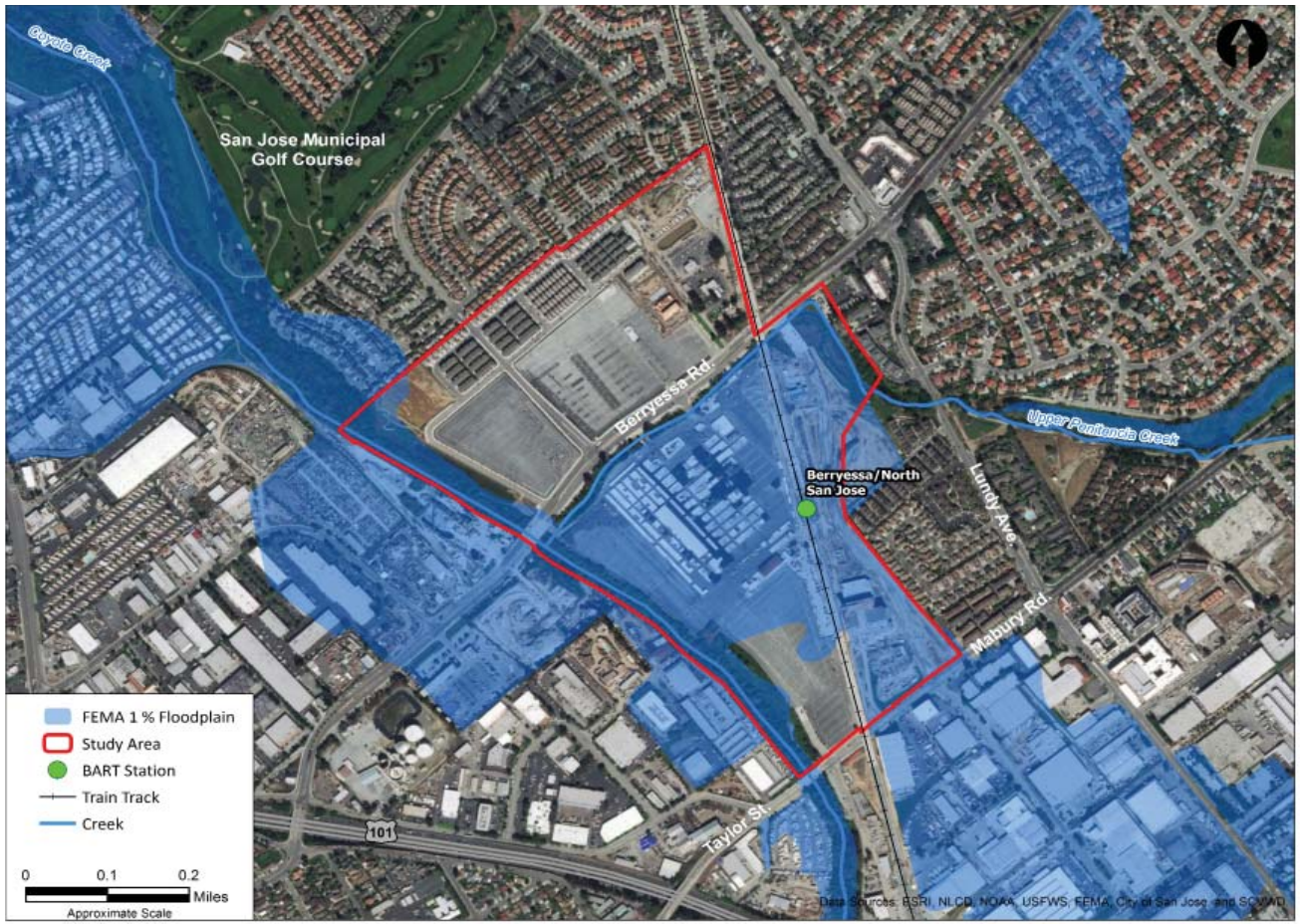


Figure 2. The Berryessa BART urban Village boundary and the 100-year floodplain. Map created by the author.

1.2 Significance of the study area

This research paper demonstrates how new developments and waterways can be integrated into the design process to allow land development and future city growth minimizing potential flood hazards. The main considerations for selecting this place to conduct the research include the strategic location for new development and its closeness to stream corridors with enormous potential for revitalization.

- ***Strategic location for new development***

The Berryessa BART station is the first phase of the 16-mile regional BART system extension into Santa Clara County. In combination with Santa Clara Valley Transportation Authority (VTA) bus transit and shuttle services, the site will become a hub for public transportation services. It is projected that 25,000 daily passengers will use the train by 2030. Along with the existing growing population in San José, it is expected that the population in this specific area will increase as well. For that reason, additional infrastructure and development will be needed to allocate the population's demands, that could bring challenges to the local governments to support urban growth and impact the local community and the environment.

- ***Urban Creek Revitalization***

Urban growth has drastically reduced and altered the natural habitat along Coyote Creek and Upper Penitencia Creek over the years. Floodplains areas were changed to accommodate building and transportation infrastructure, and the riparian corridor has become narrow and discontinuous.[2]

Figure 3. Coyote Creek flooding on February 2017 at Berryessa Rd. Source: SCVWD 2017 Flooding Report

Coyote Creek

Coyote Creek is the longest creek in the county located in the Coyote Creek Watershed; it extends from Morgan Hill (south of San José) to the San Francisco Bay. Areas surrounding Coyote Creek ownership vary from public entities, such as local municipalities, the Santa Clara Valley Water District to private owners, creating challenges for consistent maintenance and use. In February 2017, due to a heavy rainfall, the Anderson Reservoir reached its highest capacity creating a large flow into the Coyote Creek. The creek overflowed at several locations throughout San José and Morgan Hill and flooded adjacent neighborhoods as well as main highways and streets, causing serious damage. Figure 3 shows the floodwaters in the February 2017 flood event adjacent to the study area.

2 "Coyote Creek Flood Protection* | Santa Clara Valley Water," accessed April 26, 2020, https://www.valleywater.org/coyote-creek.

Upper Penitencia Creek

Upper Penitencia Creek is located in central and east San José and it is one of the tributary creeks of the Coyote Creek. The creek extends from Diablo Range, east of San José, to the confluence of Coyote Creek. For this particular research, the focus will be on the creek area within the BBUV and the creeks confluence area.

1.3 Research question, intended outcomes, and methodology

Research question

The primary purpose of the study is to explore what urban design best practices can accommodate for new developments in floodplain areas while improving the stream corridor. Furthermore, the study analyzes how the City of San José can ensure that the design elements for the proposed BBUV respond to the need of the adjacent community.
The study aims to propose a set of design recommendations where new developments and environmental improvements coexist. Likewise, it assists cities to better plan for smart design to mitigate the impact of urban development in floodplain areas and integrate flood hazard reduction elements into a comprehensive plan.

Intended Outcomes

The study area has enormous potential for new development along with the integration of environmental-friendly features, stream revitalization, and open space areas that residents and visitors can enjoy. This research will provide a set of design recommendations for future developments in the BBUV area.

Additionally, a list of materials and construction methods will be provided to assess a proper water distribution to public waterways and determine what building and landscape approaches can be implemented to reduce water runoff, and mitigate adverse impacts to the creek.

Meanwhile, the city of San José must guarantee that the design elements respond to the need and safety of the adjacent community by setting a set of policies for any development within a certain distance to a stream corridor. The city can create a modify existing land use codes and impose policies and procedures that new developments would be required to follow. These policies will reduce the risk of flooding while accommodating new developments and improving the natural creek habitat.

Methodology

To identify the best elements of a successful riverfront design, a literature review was conducted that presented important background information and helped to understand what is needed in a successful design. Then, four river restoration projects, located in urban areas, were analyzed according to their urban context, design elements, environmental value, and flood prevention. Each project offered several design alternatives that can be implemented into the study area and helped to delineate best practices for sustainable public space with environmental value. The sites revealed characteristics that have potential to bring into the BBUV design as well as how to address design and construction challenges.

1.4 Report structure

This chapter introduces the research paper and provides an overall context and information about the report and the study area.

Chapter 2 provides a detailed description and history of the site, evaluates the BART extension project, the BBUV proposed project, the existing neighborhood characteristics, and the history of the Flea Market.

Chapter 3 includes a review of research papers and case studies of strategies used to determine the negative impacts of urbanization. In addition, a literature review was conducted to define, analyze, and summarize the criteria and guidelines of successful riparian buffers along creeks. Then, reports and articles related to developments that should be built on floodplains and near waterways were examined to assess future developments near streams, better understand how to accommodate growth, minimize negative environmental impacts, and reduce flood risks simultaneously.

Then, Chapter 4 analyzes riverfront design projects and city examples of resiliency. Four built projects that integrate urban developments and waterways by design practices that do not harm the environment and reduce future flood risk are analyzed. The chapter summarizes key findings in order to determine the best design guidelines for waterfront developments that can be implemented in the study area.

Chapter 5 introduces key design guidelines into the study area, as well as describes creek protection and restoration activities that could occur throughout the site.

Finally, chapter 6 summarizes key findings, provides final recommendations for the study area, and describes limitations of the study.

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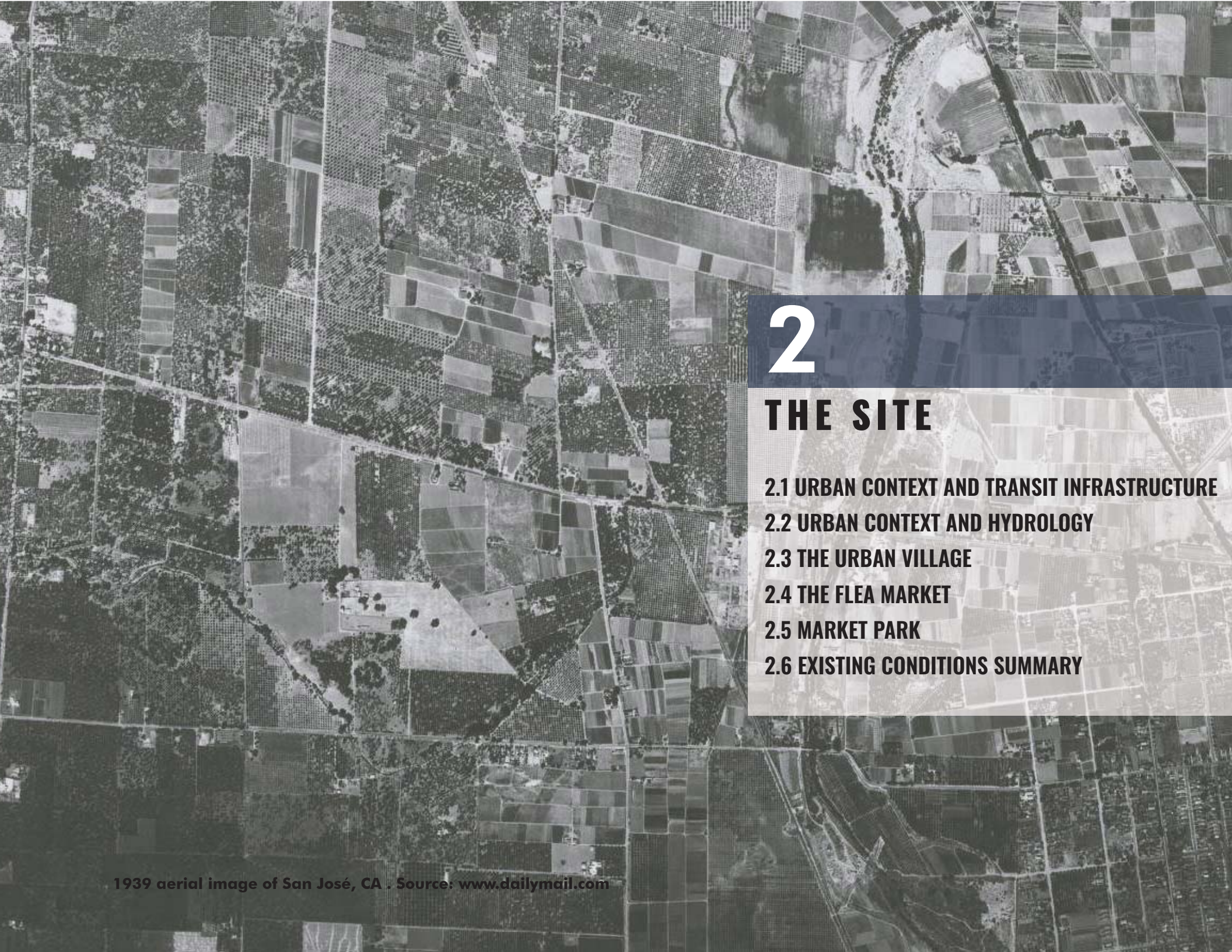


1939 aerial image of San José, CA . Source: www.dailymail.com

2

THE SITE

2.1 Urban context and transit infrastructure

The Berryessa district is located in the northeast area of San José, between Coyote Creek and the Diablo Range foothills. In the late 19th century, Berryessa was a small farming community surrounded by apricot and prune orchards owned by Latino and Portuguese families. In the 1970s, when farmland activity started to decrease, the orchards were subdivided and converted into single-family homes and shopping centers. Today the area is distinguished as a bedroom community to Silicon Valley workers. The neighborhood is made up predominantly of single-family homes, townhouses, retail plazas, and industrial uses.[3]

Transportation has been a key component for success of any developing city. The railroad was the primary mode of transportation during the 19th century, connecting cities and ports. The most important railroad network was the connection between San José to San Francisco in 1864, providing San José an international seaport to export its agricultural and industrial products. In 1869, additional rail lines were built connecting San José to Sacramento and the east coast. The railroad network provided local producers reliable transportation for their goods and products to eastern markets and overseas, while importing materials such as coal, iron, and oil into Santa Clara Valley. Between 1920 and 1960, the fertile lands, fruit orchards, and the diverse employment population made San José and Santa Clara the perfect location for food processing, canneries, warehouses, cold storage facilities, and industrial uses. Around the 1960s the canning and agricultural activity started to decline. Due to urbanization and the use of other modes of transport, the area became less competitive with other agricultural regions. As a result, the majority of the canning facilities closed and orchards were subdivided for urban uses.[4]

Over the years, some railroads were abandoned while others have been converted into commuter rail services transporting people around the Bay Area such as Caltrain and BART. The BART District was formed in the 1960's, but, at that time, Santa Clara County opted to stay out of bringing BART to the county. While trying to cope with growing congestion along I-680 and I-880 corridors, an investment study was conducted in 2001 that identified the need for transit alternatives. After the study, the environmental process for the BART Silicon Valley Extension Program started, being approved in 2007. The project extends the railway 16 miles from South Fremont to Santa Clara, and it will be built in two phases; Phase I consists of the construction of Milpitas and Berryessa/North San José, while Phase II will serve downtown San José to Santa Clara.[5]

The Berryessa BART station is located between Berryessa and Mabury roads, adjacent to the San José Flea Market in east San José. The station will be the first BART station in San José and it is one of two station that are part of the 10 mile Berryessa Extension in the first phase of the 16-mile BART Silicon Valley Extension project. From there, the extension of BART will include four more stops: one in the Alum Rock neighborhood, a stop in downtown San José, a stop in San José Diridon station, and the last one in downtown Santa Clara (Figure 4). It is a unique opportunity for San José to receive a regional rail service like BART that will connect San José with north and east bay cities, as well as San Francisco. The Berryessa Station's site is owned by the Santa Clara Valley Transportation Authority (VTA) that also developed and constructed the Berryessa BART Extension project; once the project is completed the train system will be operated by BART. The Berryessa BART station is expected to open for passengers' service sometime in 2020 and it is expected that by 2030 approximately 25,000 passengers will use the service daily.[6]

3 Sean Campion and April Mo, Transit-Oriented Displacement? (The Center for Community Innovation (CCI) - UC Berkeley, May 2011), accessed December 2, 2019, http://communityinnovation.berkeley.edu.

4 "Railroad Steam Locomotive and Cars – History San José," n.d., accessed December 2, 2020, http://historysanjose.org/wp/plan-your-visit/history-park/railroad/.

5 "VTA's BART Silicon Valley Extension Program | VTA," accessed December 2, 2019, https://www.vta.org/projects/bart-sv.

6 "Berryessa Transit Center & Berryessa/North San José BART Station | VTA."

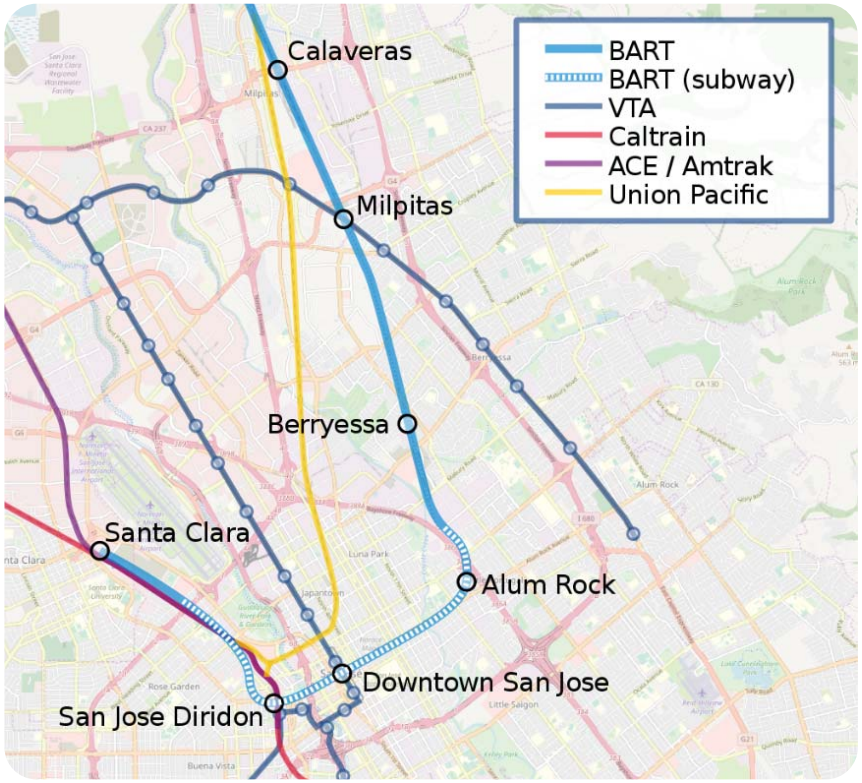


Figure 4. BART Berryessa and downtown San José/Santa Clara extensions. Source: Silicon Valley BART Extension - www.wikipedia.org

It is projected that the BART Silicon Valley Extension will bring service to downtown San José and the Diridon Station in 2025, but because of lack of funding the project may be delayed, and the Berryessa Station will function as the main BART terminal for the city.[7]

To support BART ridership, land uses around the Berryessa Station will change; higher density developments and circulation infrastructure will be needed to connect the new station with the surrounding areas.

7 SPUR, The Future of the Berryessa BART Station, July 10, 2014, accessed December 2, 2019, www.spur.org.

2.2 Urban context and hydrology

As mentioned previously, the site is adjacent to two main creeks, the Coyote Creek and the Upper Penitencia Creek located within the Coyote Creek Watershed, the largest and most diverse watershed in the Santa Clara County (Figure 5). The 321-square-mile Coyote Creek Watershed extends from the natural Diablo Range down to the urbanized valley floor and San Francisco Bay.[8] The land uses, within the watershed, varies from oak forest, grassland to the urban areas of Morgan Hill, San José, and Milpitas.[9] Historically, the water and sediment from the Diablo Range discharged to the valley during wet seasons, depositing sediment on alluvial fans. Water flows that did not discharge into Coyote Creek infiltrated into permeable soils and recharged the groundwater basins. Willow groves, marshes, floodplains and wetlands provided abundant riparian and aquatic habitat.

Since the arrival of Spanish explorers in 1769, the natural land resources and waterways have changed to accommodate diverse land uses. Over the years, the watershed functions have been altered. Coyote and Anderson dams were built in 1932 and 1950, respectively, to store water for irrigation, groundwater recharge, regulate flows to Coyote Creek, and supply water to the emerging community. Also, levees and engineered channels have been constructed to protect neighborhoods from damaging floods. Due to the increase of impervious surfaces, stormwater that used to infiltrate in pervious soils, now runs off into underground culverts or engineered channels leading directly to Coyote Creek or its tributaries. In addition, natural willow groves, marshes and riparian corridors have been transformed to accommodate the growing population.[10]

8 "Coyote Watershed," accessed May 1, 2020, https://onewaterplan.wordpress.com/watersheds/coyote-watershed/.

9 "Coyote Creek Map," accessed May 1, 2020, http://explore.museumca.org/creeks/1390-OBCoyote.html.

10 Ibid.

Coyote Creek it is the main waterway of the watershed and the longest creek in the county, running approximately 63.6 miles northward from the confluence of its East Fork and Middle Fork, south of San José to the San Francisco Bay. Historically, the lands along Coyote Creek supported diverse habitat of native grassland and valley oak savannas that occupied the well-drained alluvial fans and natural levees along the creek.

Figure 5. Coyote Creek Watershed.
Source: SCVWD - https://iwrmp.wordpress.com/water-quality/coyote-watershed/

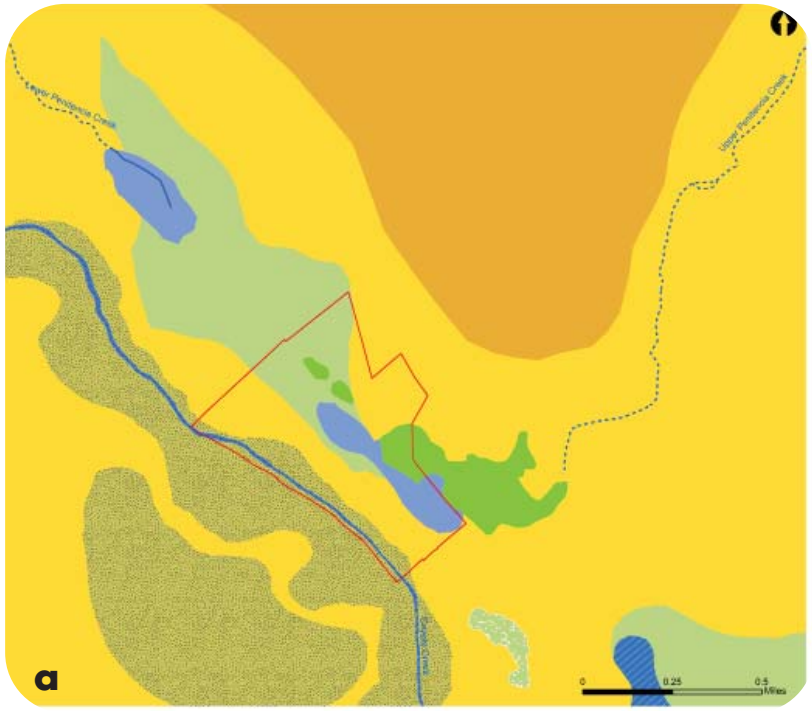
Upper Penitencia Creek is one of Coyote Creek's main tributaries located in the middle of the watershed. It originates on the Diablo Range, east of San José, passes through Alum Rock Park and ends at the confluence with Coyote Creek at Berryessa Rd. The historical landscape of the creek included extensive wetland and riparian areas surrounded with oak savanna, grassland and California sycamore trees. In the early 1800s, the Upper Penitencia Creek did not drain directly into Coyote Creek; instead, a natural levee along Coyote Creek directed the flows northward into a wet meadow and seasonal freshwater wetland, which then drained to Lower Penitencia Creek in the wet season (Figure 6.a). The creek had low sinuosity and intermittent flow; coarser sediment was deposited in the upper reaches while fine sediment where carried and deposited in the lower reaches downstream.[11]

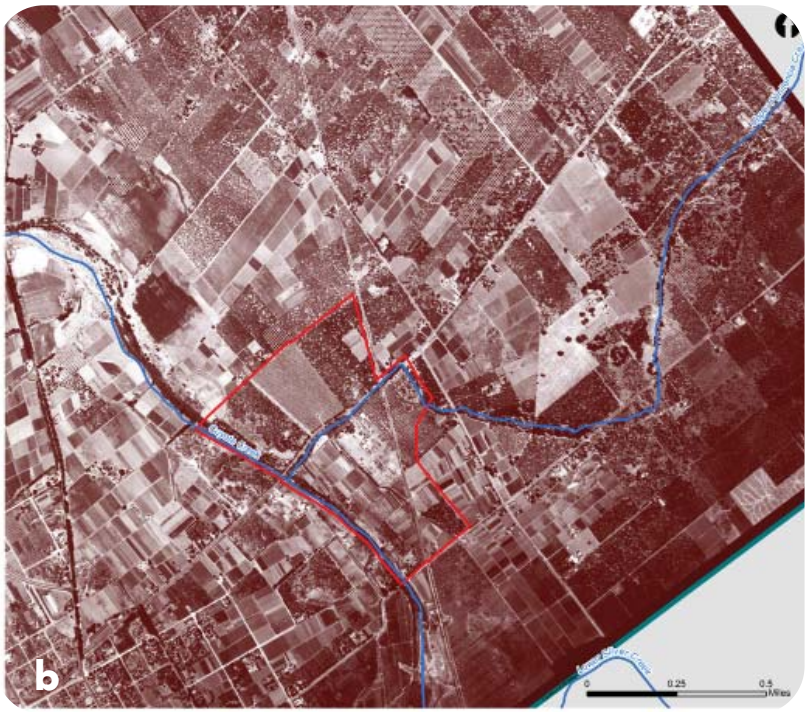
The main changes in land use along this two creeks have been the conversion of natural lands first to agricultural, and then to urban uses. Side channels were filled in the early 20th century to increase available land for agriculture use, and then to build urban infrastructure. Around 1850, a permanent straight reach was created to connect the Upper Penitencia Creek with Coyote Creek to irrigate agricultural lands; and the Mabury bypass was established to capture flow during large flood events.[12]

Figure 6 shows the land uses cover changes overtime. The first image (Figure 6.a) shows the natural course of the creeks, wetlands and grasslands. From the1939 aerial image, (Figure 6.b), farmland, mains roads and the connection between Upper Penitencia Creek and Coyote Creek can be visualized. Figure 6.c shows the current land uses adjacent to the creeks. The creeks conditions range from channelized sections and natural habitat areas. Although about 75% of the valley floor is urbanized, the extensive parklands and open space along the creeks provides recreational opportunities for residents while supporting wildlife.

11 Amy Richey et al., Resilient Landscape Vision for Upper Penitencia Creek (Richmond, CA: San Francisco Estuary Institute - Aquatic Science Center, December 2018).

12 Ibid.





Legend

Historical (fluvial) Channels

- Intermittent
- Perennial
- Study Area

Historical Habitats

- Alkali Meadow (low concentration)
- Coyote Riparian: Bar with Riparian Woodland
- Coyote Riparian: Low Flow Channel
- Oak Savanna / Grassland
- Oak Woodland
- Seasonal Lake / Pond
- Sycamore Grove
- Valley Freshwater Marsh
- Wet Meadow
- Willow Grove

Figure 6. a. Shows the natural course of the creeks, wetlands and grasslands. b. The 1939 aerial image shows the agricultural lands, roads and the connection between Upper Penitencia Creek and Coyote Creek. c. Shows the current land uses adjacent to the creeks. Source: Santa Clara Valley Historical Ecology, SFEI 2015

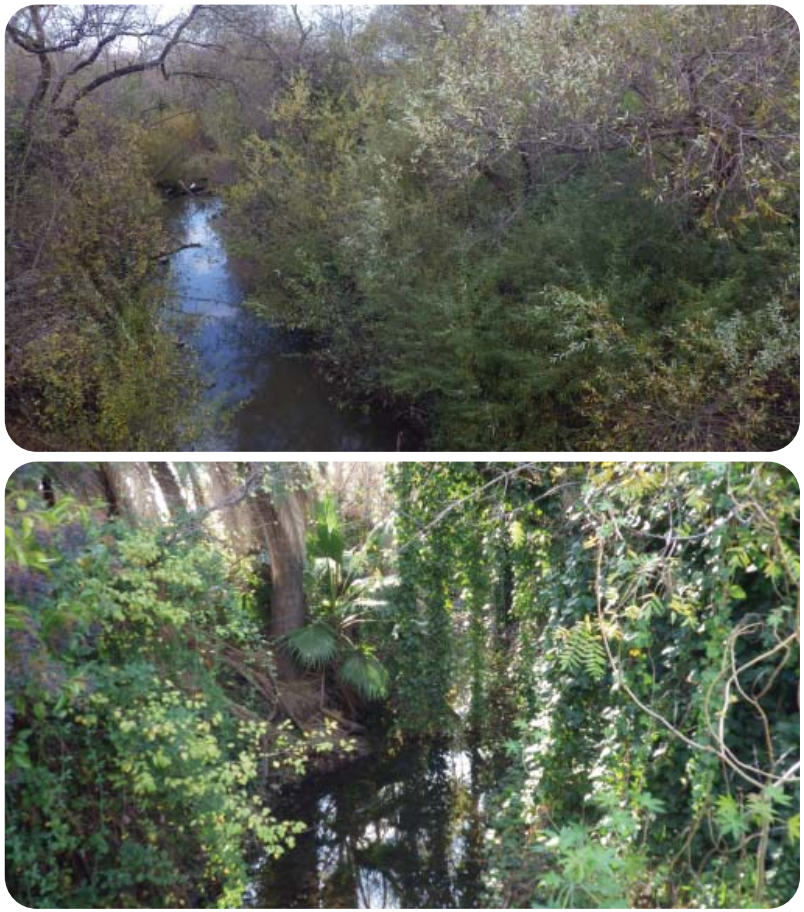


Figure 7. Coyote Creek (top) and Upper Penitencia Creek (bottom) current conditions. Photo by author

Despite the changes on the creek channels, coarser and fine sediment is still transported along Upper Penitencia Creek out to Coyote Creek. Coarse sediment is trapped under bridges and culverts, causing localized flooding issues and fish passage barriers, and the deposition of excessive sediment from Upper Penitencia to Coyote Creek can decrease flow capacity and cause flooding issues in Coyote Creek.[13] Additionally, the increase paved and impervious areas have increased water runoff during storm events raising the risk of flooding.

13 Ibid.

2.3 The Urban Village

The planning framework for the BBUV is in the process of being completed[14], but there are some considerations and opportunities to make improvements.

The BBUV is located northeastern of the city of San José, bounded by Highway 101, Interstate 680, and Interstate 880. The actual boundaries of the urban village are Shore Drive to the north, Lundy Avenue to the east, Coyote Creek to the west, and Mabury Road to the south. The Berryessa BART Station is located in the center of this urban village.[15] The current area consists of detached houses, townhouses and small retail plazas, and the San José Flea Market which is south of the BART station. This urban village is the first regional transit oriented urban village plan to be developed in San José. It is a key location for new developments; the plans aim for high quality spaces for work, living, circulating and gathering people.

Transit Oriented Developments (TOD) consist of mixed-use developments that include residential, retail, and office spaces within walking distance to public transport.[16] Since the construction of the new BART station is almost over, there are limiting opportunities to do a more integrating design with the flea market site. The BART station site has been elevated to meet the 100-year flood requirements while several retaining walls have been constructed between the station and the flea market area interrupting pedestrian connectivity.[17] Currently there is a 3 to 4 foot grade change between the VTA site and the flea market site, however developers are planning to build a plaza that will slope down to connect both sites.

14 "Berryessa BART | City of San José," accessed May 1, 2020, https://www.sanjoseca.gov/your-government/departments/planning-building-code-enforcement/planning-division/citywide-planning/urban-villages/urban-village-plans-under-development/berryessa-bart.

15 Ibid.

16 Campion and Mo, *Transit-Oriented Displacement?*

17 SPUR, *The Future of the Berryessa BART Station*.

2.4 The Flea Market

The San José Flea Market site is adjacent to the Berryessa BART station and planned to be redeveloped to allow accommodation of new residences, offices and retail businesses.

In 1960, George Bumb opened the San José Flea Market on an abandoned farmland on Berryessa Road. While working in the solid waste and landfill business, and inspired by the swap meets in Southern California, Bumb had an idea to do a profitable business with the things that people discarded. The family business started with the concessions of stands for sandwiches, beverages, and snacks. Only 20 sellers were working the first day that the Flea Market opened its doors. Today, the market comprises 120 acres in total, hosts more than 6,000 vendors every week, and has more than 4 million visitors each year; being one of the largest open-air markets in California.[18] For more than 55 years, the market has provided vendors a place to sell household items, tools, fresh produce, and a variety of services, and it has provided the community with a place for people to gather, entertain, do family shopping, eat, and play.[19]

The Flea Market land was originally zoned for agricultural use. However, in 2007, when the Bumb family learned that VTA was planning on constructing a new BART station adjacent to their property, and that the city's vision was to build a transit-oriented village around the station, they applied for a zoning change. The Bumb family anticipated that the land would sell at a higher value under a non-agricultural zoning designation. After a series of council meetings and the concerns expressed by the flea market's vendors, the City approved the rezoning of the flea market site to a Planned Development Zoning District, allowing a flexible zoning for mixed-use development in accordance with the city's master plan.

Figure 8. San José Flea Market in the 1960s. Source: www.sjfm.com

Currently, the north portion of the flea market site is under construction where 1,000 dwelling units including single-family homes, townhouses and apartments, 100,000 square feet of commercial uses such as supermarket, pharmacy, and retail, and park and open space are being developed.[20] The south portion, where the flea market shops are located, is still under design development; however, the proposal includes office space, high-density residential units, retail space, a parking structure, a public park and open space. The development of the area will force the vendors of the flea market to lose their jobs, but there are efforts from different organization to relocate them to another site. At the same time, the new development could include an area where the vendors can be located to continue with their job while providing the community with fresh produce.

18 "Garden at the Flea | San José," accessed December 2, 2019, https://www.sanjose.org/listings/garden-flea.

19 "Facts About the San José Flea Market, History - San José Flea Market," *The San José Flea Market*, accessed December 2, 2019, https://www.sjfm.com/AboutUs/OurHistory.aspx.

20 "The San José Flea Market Southside Rezoning (EIR) | City of San José," accessed December 2, 2019, https://www.sanjoseca.gov/your-government/departments-offices/planning-building-code-enforcement/planning-division/environmental-planning/environmental-review/active-eirs/the-san-jose-flea-market-southside-rezoning/-fsiteid-1.

As mentioned before, transportation has been an essential feature for any developing city. Having a new BART station in San José will increase population as well as the number of businesses and the number of new developments, just as the railway did in the 1870's. For the same reason now, it is considered essential for planners, development agencies, and policy makers to weigh the economic benefits and the environmental and safety costs associated to the new emerging development. As the plan for the development of the Flea Market is still in process, it is necessary that decision-makers explore alternatives that integrate urban developments, creek revitalization, flood control and connectivity throughout the area.

Figure 9. San José Flea Market today (2019). Photo by the author

2.6 Market Park

Market Park is the proposed transit village near the Berryessa BART Station that would transform the existing flea market into a transit hub. HMH, the service company behind this development, is in charge of developing the master plan, design, engineering, and infrastructure as well as project management for the 120-acre site. This project includes more than 4,000 housing units, 1.5 million square feet of office space, 101,000 square feet of retail space, open space, connection to trails and road infrastructure near the BART Station. Figure 12 illustrates the complete site plan of the proposed development.

The Market Park project is divided into two areas, the Northside and the Southside. The Northside is located north of Berryessa Rd., where the Flea Market parking area used to be, is currently under construction (Figure 11). Around 1,000 total residential units have been completed, and over 100,000 square feet of retail and commercial businesses are under development.

The Southside, located south of Berryessa Rd., is currently in the entitlement process. The project includes 3,600 total residential units, over 1.5 million square feet of office space, and up to 3,400 square feet of retail businesses with access to the new Berryessa BART Station. Figure 10 shows a proposed design of the ground floor for the retail area adjacent to the BART station. [21]

21 "Market Park," *HMHca*, n.d., accessed April 13, 2020, https://www.hmhca.com/projects/market-park/.

Figure 10. (Left) Proposed Ground Floor Retail Adjacent to BART.
Source: www.marketparksanjose.com

Figure 11. (Right) Northside development under construction. Photo by the author.

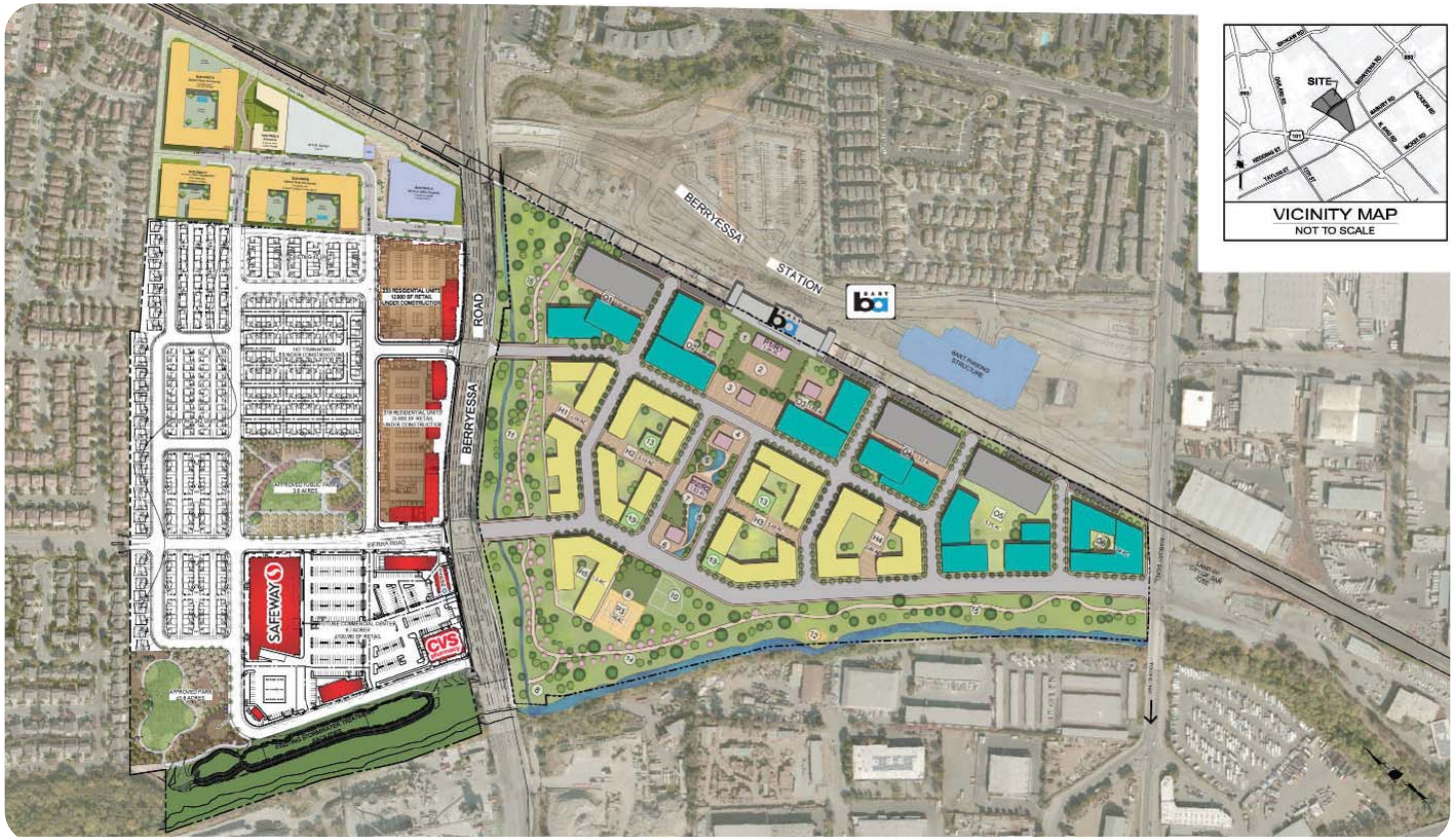


Figure 12. Proposed site plan for the Market Park project.
Source: www.marketparksanjose.com

2.7 Existing conditions summary

A site visit was conducted to assess the existing conditions of the area. Figure 15 illustrates some of the main characteristics of the site that include but are not limit to poor accessibility, impaired habitat, bank erosion, illegal encampments, and garbage accumulation on creeks and banks.

Although public access is not allowed in the creek banks, homeless encampments can be found mostly along Coyote Creek. Trash accumulation can be found in the creeks and in its banks polluting the water and soil. Creek banks are steep and show signs of erosion from excessive vegetation and drainage outlets. The paved area of the market had encroached the creek channel which increased the volume and flow of water runoff into the creeks and eroding their banks.

The confluence of Upper Penitencia Creek and Coyote Creek is by an under paved pipe. The pavement on top of the creek confluence connects the south side and north side of the flea market. Although the connection is needed, the culvert could clog with branches, sediment and trash causing creek overflow.

Connectivity between the site and the BART station is currently uninterrupted by a 3ft wall. Even though there are plans to connect both sites, it is critical that pedestrian connectivity is provided throughout the site.

The site has a lot of potential for renovation and creek restoration that can enhance the area and provide the community with an open space near a natural waterway. Chapter 5 will provide design recommendations to accommodate new developments and revitalize the creeks corridor.

Figure 13. Creek confluence and Coyote Creek rail underpass Berryessa Rd. Photo by the author.

Figure 14. Existing Flea Market parking lot near Mabury Rd. Behind is the BART station and its parking garage. Photo by the author.

Figure 15. Existing site conditions. Map and photos by the author.


Market Park - Northside


Upper Penitencia Creek


Flea Market


Pedestrian barrier


Railroad underpass


Bank at Upper Penitencia

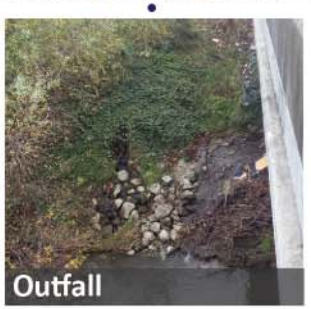

Steep bank at Upper Pen. Ck.


Creek confluence


Garbage on Coyote Creek


Bank at Coyote Creek


Bank erosion


Outfall

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3

LITERATURE REVIEW

Source: www.library.unsw.edu.au

Introduction

Urban rivers have environmental, social, cultural, and economic values. By providing protection of nature and fisheries, recreation areas, irrigation and flood control, rivers have served humans and nature on a variety of purposes.[22] Over the years civilizations settled along riverbanks where they have established, taking advantages of the natural resources that the river offers to them. The natural course of rivers, floodplains and wetlands have been altered over the years by civilizations, increasing the dangers of flooding and loss of property and lives along with damage to the wildlife habitat. Floodplains are areas bordering rivers and streams, its natural landforms allow these areas to flood, and the likelihood of flooding is high in a given year. Although these natural landforms play an important role in the function of floodplain ecosystems, urban communities have settled and developed on these areas.[23]

Urbanization on floodplain areas and near waterways is a process that affects growing cities. Urbanization modifies hydrologic cycles, especially water volumes increased by water runoff. The future BBUV project in San José is adjacent to two main creeks, the Coyote Creek and its tributary the Upper Penitencia Creek. On February 2017, a major flood event happened near this area and along the Coyote Creek. Over the years, San José has grown in population and size, and the accelerated process of urbanization growth is expected to rise. Due to the urbanization process, areas adjacent to the creeks have been built and paved damaging the stream's stability and storage capacities.[24] For that reason, it is vital to understand the negative impacts of urbanization on waterways and how these impacts can be minimized.

The purpose of this literature review is to gain a better understanding of the negative impacts of urbanization near waterways. Land use planning is needed when new developments are proposed near waterways to avoid or mitigate these negative impacts. In addition, to minimize the negative impacts of development on floodplain, a literature review was conducted to better asses what a riparian corridor is, its benefits, and how it can be integrated adjacent to waterways and developments to minimize the negative impacts of urbanization. Finally, not all urbanization development is negative; a short literature review was conducted to compare how different developments (low and high density) could minimize the negative impacts on waterways and gain insight into the most effective methods to accommodate urban growth. Furthermore, a set of criteria was evaluated to determine what an ecological successful river restoration projects might include.

The scope of literature evaluated for this report includes research on topics related to urbanization, land use, stream revitalization, river daylighting, creek uncover, riparian corridor and watershed functions.

22 Bulent Cengiz, "Urban River Landscapes," in *Advances in Landscape Architecture*, ed. Murat Ozyavuz (Turkey: InTech, 2013), 551–586, accessed October 6, 2019, http://www.intechopen.com/books/advances-in-landscape-architecture/urban-river-landscapes.

23 Ibid.

24 Xiaomin Ji et al., "Impacts of Urbanization on River System Structure: A Case Study on Qinhuai River Basin, Yangtze River Delta," *Water Science and Technology 70*, no. 4 (August 2014): 671–677.

3.1 Negative impacts of urbanization

Multiple studies sustain the awareness that urbanization has negative effects in waterways and streams. Researchers used remote sensing technology and access to Geographical Information Systems (GIS) to collect data, analyze urban growth in different parts of the world, and analyze the negative impacts of urbanization on waterways.

Suriya and Mudgal's 2012 research, incorporated land use changes into a hydrological model to study the effects on land use and streams in the Thirusoola subwatershed in Chennai. In this research, they used remote sensing technology and GIS to conduct a flood risk assessment. Additionally, they used HEC HMS to model the rainfall runoff accordingly with the land use changes. In their study, they confirmed that infiltration is reduced in urban watersheds, increasing water runoff into waterways leading to higher flood peaks and volumes. Their conclusion was that land use changes and urbanization adversely affects the hydrological process.[25]

Nirupama and Simonovic's 2007 study used satellite remote sensing technology to classify land use pattern and integrate this information with meteorological and hydrological data records to estimate potential risk from river floods in the Upper Thames River watershed in Ontario, Canada. The study compared urban development from 1974 and 2000. Only 10.07% of the study area was developed in 1974 and increased to 22.25% in 2000. The increase of impervious areas produced higher peak flows in the drainage channels. Additionally, forest reserves and available surface water have been reduced over the decades. Some limitations on the study found that rapid urbanization could not be assessed without the integration and analysis of the latest land use data and satellite imagery. Using the City of London, Ontario, as an example, the study concludes that progressive urbanization increases the risk of flooding.[26]

Duran, Gunek, and Sandal, at the same time, used remote sensing and GIS techniques to study how urban settlements, unplanned and illegal urbanization has degraded agricultural areas, river basins and caused flooding in the city of Mersin, South of Turkey. The study analyses urban growth for the 1972 to 2006 period. The rapid and random urban centers expansion has caused changes on land covers, where forest and agricultural land has been reduced. Additionally, the research found that there is an increase on the annual temperature due to urban development, the lack of greenery and the use of heat absorbing structures. The study found that not only urbanization deteriorated river basins but also that intense agricultural activity increased detrimental effects in the waterways by introducing pesticides and fertilizers causing pollution and aquatic habitat disruption.[27]

Urbanization also impacts natural drainage patterns that deteriorates water quality and the natural structure of river basins. Additionally, the reduction of pervious surfaces intensifies water runoff, increasing flood peaks, water volumes, and the risk of flooding.[28] Beighley, Melack, and Dunne assessed the effect of urbanization and climate condition by simulating streamflow for three land use scenarios. The simulation of streamflow has determined that urbanization increases the magnitude of peak discharges and annual runoff. Since the streamflow used in the model depends on climatic variations, the results can differ. Additionally, they used HEC-HMS rainfall and runoff models to simulate stream flow in the Atascadero Creek watershed located on the central coast of California.[29] Another research project conducted on Sims Bayou in Houston Texas, has shown that population growth extended into the 100-year floodplain between the 1980 to 2000 period. In addition to the increase of impervious surfaces, from 15% to 18%, the households subject to flooding grew from 2,100 in 1980 to 3,500 households in the 1990s.[30]

25 S. Suriya and B.V. Mudgal, "Impact of Urbanization on Flooding: The Thirusoolam Sub Watershed – A Case Study," *Journal of Hydrology* 412–413 (January 2012): 210–219.

26 N. Nirupama and Slobodan P. Simonovic, "Increase of Flood Risk Due to Urbanisation: A Canadian Example," *Natural Hazards 40,* no. 1 (January 9, 2007): 25–41.

27 Celalettin Duran, Halil Gunek, and Ersin Kaya Sandal, "Effects of Urbanization on Agricultural Lands and River Basins: Case Study of Mersin (South of Turkey)" (2012): 10.

28 Ibid.

29 Edward Beighley, John M. Melack, and Thomas Dunne. "Impacts of California's Climatic Regimes and Coastal Land Use Change on Streamflow" (n.d.): 15.

30 Leslie A. Muñoz et al., "The Impact of Urbanization on the Streamflows and the 100-Year Floodplain Extent of the Sims Bayou in Houston, Texas," *International Journal of River Basin Management 16,* no. 1 (January 2, 2018): 61–69.

In a similar way, Campana and Tucci studied the relationship between hydrologic models and the Urban Plan for Porto Alegre, Brazil. Campana and Tucci simulated four alternative scenarios to analyze the relationship between the Urban Plan and the Diluvio Creek performance and to evaluate the risk of flooding for each scenario. They found that urbanization in floodplain areas increases the risk of flooding due to an increase on peak discharge and volume. In this case, modeling tools were used to demonstrate the potential effects of planned urban development on stormwater runoff. The Urban Plan for Porto Alegre was developed without taking into consideration the possibility of flooding resulting from the land use changes and development being proposed.[31]

Based on the literature review related to the negative impacts that urbanization has on stream and riverbed, the findings confirm that urbanization increases impervious surfaces and water runoff while deteriorating the water environment and the natural structure of river basins. In addition, there is a change on the streams stability and consequently the storage capacities of river channels.[32] In relation to the biological system, results have shown that biological and chemical characteristics of streams changes degrade the habitat and biologic integrity, increase pollutant concentrations and chemical sediments,[33] while reducing stream and water quality.[34] Finally, riparian corridors, natural vegetation, and woodland have been reduced along creeks to accommodate other uses.

3.2 About riparian corridors

Over time, communities have started to understand the natural riverfront benefits for inhabitants and wildlife; such as: recreation features, flood control, wildlife habitat, improved water quality, increased property values and tax base[35], as well as offer connectivity and open space areas for recreational and educational uses. As Cengiz mentioned in his research, once the community appreciates the values of natural waterways, they tend to protect, restore, and maintain their riverfronts.[36]

By nature, rivers are in constant change, and these natural variations can be affected by the changes in its surrounding areas. Development and urbanization on floodplain and wetlands could lead to extreme flooding events and destructive natural disasters. It is recommended not to build large structures within the 100-year floodplain since this can increase the impervious surfaces, aggravate runoff, and increase the risk of flooding damage; instead, developments on riverfronts should be designed to minimize floodplain intrusions, such as trails and parks.[37] Human activities can degrade the stream riparian corridor or reduce wildlife diversity, weakening the ecological ecosystem.[38] Although urban growth cannot be stopped, waterways can be protected if natural riparian corridors around streams and waterways are maintained to preserve their ecological integrity and connectivity.

31 Néstor A Campana and Carlos E.M Tucci, "Predicting Floods from Urban Development Scenarios: Case Study of the Dilúvio Basin, Porto Alegre, Brazil," Urban Water 3, no. 1–2 (March 2001): 113–124.

32 Ji et al., "Impacts of Urbanization on River System Structure."

33 Christopher W May and Richard R Horner, "The Cumulative Impacts of Watershed Urbanization on Stream-Riparian Ecosystems" (n.d.): 6.

34 Richard D. Klein, "Urbanization and Stream Quality Impairment," *Journal of the American Water Resources Association* 15, no. 4 (August 1979): 948–963.

35 Cengiz, "Urban River Landscapes."

36 Ibid.

37 Ibid

38 Christopher W. May et al., "Effects Of Urbanization On Small Streams in the Puget Sound Ecoregion," Watershed Protection Techniques; Ellicott City 2, no. 4 (1999): 79–90.

3.3 The buffer strip

The riparian buffer strip is a permanent linear vegetation strip adjacent to an aquatic ecosystem. The vegetated buffer strip maintains and improves water quality by trapping and removing pollutants, such as herbicide, pesticides or sediment. Additionally, buffer strips may provide habitat for a variety of animals and plants. A riparian corridor is a connected strip of vegetation where organisms will likely move over time; these corridors are critical for reconnecting fragmented habitat.[39]

Riparian buffer strips and riparian corridors are essential to preserve the natural ecosystem along creeks and can reduce the negative impacts of urbanization. However, modifications and restorations on only short stretches of the river may not be sufficient enough to address the large-scale problems affecting the river and its watershed.[40] River restoration in urban areas can be difficult because of the lack of available land, social regulatory, and jurisdictional conflicts. By identifying the principal threats, it is possible to select the most effective procedures and restoration techniques to restore and address the degradation on specific locations of the river.[41]

In her study, "The Functions of Riparian Buffers in Urban Watersheds", Jennifer Leavitt evaluated the conditions of two watersheds in Portland, the Rock Creek and Richardson watersheds, to determine the effectiveness of the existing buffers for protecting the stream system. First, the author established some criteria on the corridor functions by studying how the riparian buffer interacts with the stream, and then the author analyzed urbanized buffers to evaluate if they provide the same functions. The research results showed that the maximum and minimum summer water temperatures were higher where the buffer upstream was destroyed and deteriorated. Although changes in hydrology were not taken into consideration, the temperature on water stream is linked to the conditions of the buffer affecting aquatic species.[42]

River restoration can be used to minimize the negative impacts of urbanization and to improve water quality, reduce flood risk, and provide recreation areas for the community. Lammers and Day analyzed multiple urban river restoration projects and its benefits and explored these concepts on a planned river restoration project on South Platter River in Denver, Colorado. The proposed redevelopment included plans for restoring the floodplain and discharging recycle wastewater to the river during dry seasons. After the analysis, they concluded that some significant benefits such as habitat, water quality, and reduce flood risk were improved, although there were other potential benefits that were not quantified. Furthermore, the restoration of the floodplain could enhance water quality and habitat, but these benefits need to be monitored throughout and after the project is completed to ensure that these benefits are accomplished.[43]

Similarly, Cockeril and Anderson's 2014 study discussed challenges and successes of restoring urban streams. They analyzed monitoring data from various restoration projects on urban streams prior and after the construction of the projects to assess if the stream conditions, project goals and project implementation aligned. The study concluded that restoration projects protect the built environment and improve the aesthetics of the creek giving a fake image of what an ecologically stream restoration is. While some of the benefits of the restoration project were real, the main goal of restoring the ecological and habitat of the creek were not accomplished.[44]

39 Richard A Fischer and J Craig Fischenich, "Design Recommendations for Riparian Corridors and Vegetated Buffer Strips" (n.d.): 17.

40 Roderick Lammers, and Colin Day, Urban River Restoration: Bringing Nature Back to Cities (Institute for the Built Environment, Colorado University, 2018).

41 Fischer and Fischenich, "Design Recommendations for Riparian Corridors and Vegetated Buffer Strips."

42 Jennifer Leavitt, "The Functions of Riparian Buffers in Urban Watersheds" (n.d.): 38.

43 Lammers, and Day, Urban River Restoration: Bringing Nature Back to Cities.

44 Kristan Cockerill and William P. Anderson, "Creating False Images: Stream Restoration in an Urban Setting," JAWRA Journal of the American Water Resources Association 50, no. 2 (April 2014): 468–482.

The restoration of Boone Creek in North Carolina, analyzed by Lammers and Day, is a clear example of an ecological restoration failure. The city implemented several restoration projects to protect local infrastructure, reduce flood risk, improve stream aesthetic, improve ecology and return the creek to a natural stream stage. Studies found that none of the restoration projects addressed the existing threats such as pollution and high-water temperatures of the creek. Although some of the project goals and benefits were real, it failed to address the natural causes of the creek degradation, not improved its habitat.[45]

Riparian buffer strips and riparian corridors are important for stream ecosystem. As a result, it is key to understand the guidelines and principal considerations that these riparian corridors should have to be ecological successful and provide all its benefits. However, an integrated watershed analyses is needed to understand the creek dynamic on specific areas.

After analyzing various studies, it was found that the principal positive functions of the riparian corridor include but are not limit to:

- Provide shade and canopy to maintain stream temperatures
- Provide wildlife habitat
- Stabilize banks and provide organic debris
- Provide aesthetic amenities and recreation features
- Remove sediment and pollutants, that can be detrimental to the health of the creek, before entering the stream

In addition, for a riparian buffer to be successful, the research found that at least the following criteria should be followed:

- At least 100 feet width is recommended to provide adequate stream protection, however, the actual width of the buffer will depend on the creek location, the necessary area to maintain the riparian functions, and the land use activities that surround the creek.[46] A fixed width buffer often fails to support all ecological functions of a riparian corridor, while a variable width may be difficult to administered, but is more ecological based.[47]
- Some areas of the riparian corridor may be contracted or expanded to accommodate unusual or historical development patterns, stream crossings or ponds, however, its integrity should be continuous.
- Minimize fragmentation, crossing and breaks to provide continuity, ecological integrity, and buffer connectivity.[48]
- It is recommended that the riparian corridor have a three-zone system: the streamside, middle core and the outer zone. Vegetation may vary on each zone to satisfy the needs of the riparian habitat.[49]
- Storm water runoff and drainage: riparian buffer can provide storm water treatment and filtration.
- During design, plan and construction of the riparian buffer, the limits of the stream buffer system, its functions and development should be reviewed to ensure that all the riparian functions are accomplished.
- Education and enforcement to teach the public the importance of the riparian buffer, its characteristics and needs is critical for its protection and maintenance.
- Avoid mitigation sites when riparian areas are destroyed; although some regulations and jurisdictions require that compensatory mitigation sites be built when buffer zones are destroyed, this is not sufficient enough to restore the natural and ecological areas of the riparian corridor.[50]

45 Lammers, and Day, Urban River Restoration: Bringing Nature Back to Cities

46 T Schueler, "The Architecture of Urban Stream Buffers," Watershed Protection Techniques; Ellicott City 1, no. 4 (1995): 225–233.

47 May and Horner, "The Cumulative Impacts of Watershed Urbanization on Stream-Riparian Ecosystems."

48 Ibid.

49 Schueler, "The Architecture of Urban Stream Buffers."

50 Stormwater Management Office, Understanding the Functions of Riparian Buffer Areas (Hillsboro MO, n.d.).

- Identify best location and prioritize these places for riparian buffer to optimize their performance.[51]
- Reconnected riparian zones to ensure ecological and physical functionality.[52]

In order to allow developments to be built on floodplains and near waterways it is critical to follow these recommendations to maintain and protect the riparian corridors and minimize the negative impacts of urbanization while enhancing the natural habitat along the streams.

3.4 Protecting water resources

The approach that cities and communities follow to accommodate urban growth has a profound impact on the quality of streams and rivers.[53] Developments that protect and do not harm natural lands teach and allow the community to understand the importance of natural resources and that protection is needed. Water quality experts believe that high-density developments may be the path to protect water resources.

The U.S. Environmental Protection Agency (EPA) modeled three scenarios to examine and understand the impacts of low and high-density developments on water resources. The analyses demonstrated that the higher density scenarios generate less storm water runoff per house and produces less impervious surfaces than lower density developments. Additionally, low-density developments would minimize runoff when it is measure by acre, however, when measured by the house number, higher densities produce less storm water runoff. In addition, higher density developments use less land to accommodate the same amount of units than low density minimizing the negative impacts on watersheds.[54]

An additional research studied storm water runoff in relation to different developments densities and patterns. The Belle Hall Study examines two hypothetical scenarios, for a site in Mount Pleasant, South Carolina, to study the impacts of these scenarios on the water quality. In the Sprawl Scenario, the properties are developed in a conventional suburban pattern; with low-density housing and shopping centers disperse throughout the area. While the Town Scenario uses traditional neighborhood patterns, more compact mixed-use, high-density neighborhoods. In both scenarios, the number of housing and commercial units are kept the same; however, the building type and lot size vary. The result of the study showed that the volume of water runoff from the Sprawl Scenario was 43% higher than the Town Scenario, and sediment loads were three times higher under the Sprawl Scenario. Compacted developments are best for watersheds and water quality, consume less land, preserve wildlife habitat, have more sustainable infrastructure, and maintain continuity of natural systems.[55]

Another study conducted by Purdue University, analyzed two possible sites in Chicago to accommodate new development. The sites were in the city and the urban fringe. It was found that the higher density located on the urban core would produce 10 times less water runoff than the low-density development located on the urban fringe.[56]

As indicated in the described studies, denser development produces less runoff, water pollution, and less impervious surfaces. In addition, compact high-density developments consume less land than sprawl developments, land that can be protected and preserved for ecological purposes.[57]

51 Keith E. Schilling, Peter J. Jacobson, and Calvin F. Wolter, "Using Riparian Zone Scaling to Optimize Buffer Placement and Effectiveness," Landscape Ecology 33, no. 1 (January 2018): 141–156.

52 Birgita Hansen et al., Minimum Width Requirements for Riparian Zones to Protect Flowing Waters and to Conserve Biodiversity: A Review and Recommendations (School of Biological Sciences, Monash University, April 2010).

53 Ben Grumbles and Brian F Mannix, "Protecting Water Resources with Higher-Density Development" (n.d.): 45.

54 Ibid

55 Dover, Kohl and Partners, The Belle Hall Study Sprawl vs. Traditional Town: Environmental Implications (Mount Pleasant, South Carolina, 1996), scdhec.net.

56 Grumbles and Mannix, "Protecting Water Resources with Higher-Density Development."

57 Ibid.

3.5 Guidelines for successful river restoration projects

River restoration projects aim to protect stream and coastal ecosystems while improving its habitat. Although there are a variety of river restoration techniques to solve environmental problems, there is no agreement on what makes a successful river restoration effort. Palmer et al. proposed five criteria for measuring ecological success on river restoration projects:

1. Guiding image of dynamic and healthy river: the vision of the river restoration should be reflected on the project design, which will guide the project team through the entire project.

2. Improved ecosystem: ecological conditions have to be measurable

3. Increased resilience: after the restoration, the river ecosystems should be self-sustaining and resilient, so minimal maintenance is needed.

4. No lasting harm: should be identified in the construction phase.

5. Complete ecological assessment: a prior and post assessment should be completed to determine restoration success.

Overall, the most effective river restoration projects lie at the intersection of the three principal axes of success: stakeholder success, ecological success, and learning success. Palmer et al. study focuses on the five criteria to measure ecological success but recognizes that a successful restoration project has these additional axes. Ecological success reflects what ecosystem functions have been improved. Human satisfaction, including aesthetic, recreation and economic benefits, are reflected in the stakeholder success; while learning success reflects advances in scientific knowledge and management practices that will benefit future restoration action.[58]

The river restoration project should focus on environmental quality, habitat restoration and flood protection. In addition, it should provide accessibility, public facilities, and ecological value to the neighborhood.

3.6 Conclusion

As population and urban growth continue to increase, it is essential to understand the adverse effects that urbanization and sprawl have on water resources, streams and its surrounding habitat. Changes on the natural stream ecosystem can cause damage that can range from disruption on wildlife and aquatic habitat to disaster events such as flooding. Through this literature review, an analysis of the negative impacts of urbanization was made as well as a determination of how riparian corridors play a key role along rivers to maintain its natural functions. Since urban growth is expected, it was found essential to understand what type of developments can be placed near streams, the functions of the riparian buffer corridor and what considerations are needed to maintain its natural state. Developments planned near waterways should be taken into special consideration to understand the requirements necessary to maintain the natural creeks and its habitat.

As indicated on the literature review, higher density developments are better than sprawl developments if we consider water quality and land use. The Belle Hall Study, Chicago examples and the EPA research confirm that compact and higher density developments reduce the negative impacts on floodplains and streams since they produce less water runoff and pollution and consume less land. As new developments are built, it is vital to analyze and follow riparian corridor criteria as well as requirements to protect waterways, wildlife, stream habitat and control water flow. Additionally, other design elements were identified which minimize water runoff and pollution, such as green water storm systems, native vegetation, rain gardens, and others. Accommodating new population with urbanization can have negative impacts but with planning, policies and environmental justice can be done successfully.

58 M. A. Palmer et al., "Standards for Ecologically Successful River Restoration," *Journal of Applied Ecology* 42, no. 2 (2005): 208–217.

4

RIVERFRONT PROJECTS

Menomonee Valley Redevelopment and Community Park aerial view. Source: www.landscapeperformance.org

Introduction

To determine the land use types and developments that should be built within the study area, various existing riverfront designs were explored. The selection process involved searching designs and proposed projects online to find examples of river waterfronts sites that have undergone a medium to large-scale re-development in the last 20 years. Each project was researched to ensure significant redevelopments have been made to accomplish river and riparian revitalization, flood protection and the integration of new development near waterways while assessing safety, access and economic issues.

The four projects presented in this chapter provide a detailed description of the projects goals, their design purposes, planning, implementation, challenges and design features. The sites selected may not be the same as the study site, but they exhibit similar characteristics that can be use in the San José flea market site.

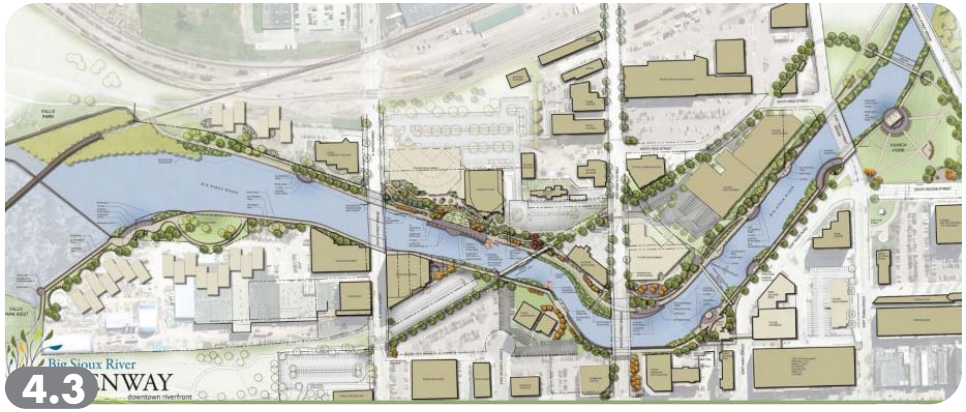
Lists of projects:

4.1 Corktown Common, Ontario, Canada

4.2 Meadow Creek Stream Restoration, Charlottesville, Virginia, USA

4.3 Sioux Falls Downtown River Greenway, Sioux Falls, South Dakota, USA.

4.4 Menomonee Valley Redevelopment and Community Park, Milwaukee, Wisconsin, USA



4.1 Corktown Common

Location: Corktown Common is located in the southeastern portion of the West Don Lands neighborhood in Toronto, Canada

Original land use: Industrial, brownfield

New land use: Public Park

Size: Approximatly19 acres

Completion Year: 2012

Design Purpose

Corktown Common is an 18-acre public park located in the southeastern portion of the West Don Lands neighborhood in Toronto, Ontario, Canada bordering the Don River. The park was built to remediate industrial lands and provide flood protection to a new emerging neighborhood. The urban park includes landscape design such that when a flood occurs, the park would flood in certain areas, preventing life hazards and any nearby structural damage. The park was built on a 5-meter (16 ft.) tall flood protection landform that protects the West Don Lands neighborhood against flooding. A combination of topography, vegetation, and a variety of features created a vibrant urban park that mixes urban lifestyle with ecology. In addition, the park retains 100% of annual rainfall on site, through the capture, treatment, and reuse of rainwater and stormwater for irrigation.[59] Figure 16 illustrates the park site plan showing the flood protection landform and park features.

Figure 16. Corktown Common site plan showing the flood protection landform. Source: www.landscapeperformance.org

59 Elise Shelley, Jane Wolff, and Elise Hunchuck, Corktown Common, Landscape Performance Series (Landscape Architecture Foundation, 2016), accessed May 3, 2020, https://www.landscapeperformance.org/case-study-briefs/corktown-common.

Background

Toronto's industrial production decreased by the late 20th century leaving abandoned hazardous lands exposed to the Don River threatening 519 acres of adjacent riverfront areas.

Planning and Implementation

Waterfront Toronto, the agency in charge of developing the site and funded by the federal, provincial, and city governments, wanted to revitalize the Lake Ontario shoreline by increasing the environmental, social and economic value of the underutilized floodplain land in downtown Toronto. Corktown Common was part of the master plan designed to rehabilitate the abandoned waterfront of Lake Ontario.

Corktown Common was the result of a collaborative work between the landscape architect, civil and provincial governmental organizations and community organizations. The design integrated flood protection along with infrastructure, recreational features and ecological needs of the site. The construction of the landform that protects the adjacent community from flood events allowed the development of new buildings and affordable units near the park.

Access and connectivity

The park is the meeting place for the adjacent community and visitors. It can be accessed from different entrances adjacent to Bayview Ave. Within the park, the trail connects the various features and induce visitors to explore the park. The multiuse pathways, surrounded by native vegetation, also connect with the broader Don Valley Trail network.

Environmental quality and ecological value

The existing brownfield site was transformed into a public park that integrates infrastructure, ecology and recreation. The design included the use of different soil types and depth to support the development of marsh, woodland, and prairie that provides habitat for local wildlife and opportunities for visitors to enjoy the sights. A holistic sustainable approach, included in the site, is the collection and treatment of stormwater through a constructed wetland; the recycling of stormwater minimizes the amount of potable water use for irrigation and park maintenance. Diverse native vegetation, including trees, shrubs and grass, provides aquatic and on land habitat for different animals and organisms.[60]

Each area of the park such as the lawns, the wetlands, the urban prairies and the marsh provides different biological opportunities for habitat restoration. Likewise, the park offers areas of recreation like a playground, a public pavilion, athletic fields, and trails.[61]

Flood prevention

The park offers flood protection to the lands adjacent to the city's port and the city's core, which have been vulnerable until the construction of the park. The landscape design and topography play an important role on preventing flood hazard in the area. The 16ft. high landform protects the eastern downtown from any major flood events, even a 500-year storm, and creates safe conditions for the development of the park and surrounding residential and commercial neighborhoods. The flood protection landform was made of clay soil and recycled fill material from nearby developments.[62]

After the completion of the project, new developments started to be built around it. In 2015, the house of athletes of the Pan American Games was built and several other developments are currently under construction in the surrounding area.

60 "From the Archives: Corktown Common," last modified August 9, 2016, accessed April 9, 2020, http://blog.waterfrontoronto.ca/nbe/portal/wt/home/blog-home/posts/from-the-archives-corktown-common.

61 Ibid.

62 Shelley, Wolff, and Hunchuck, Corktown Common.

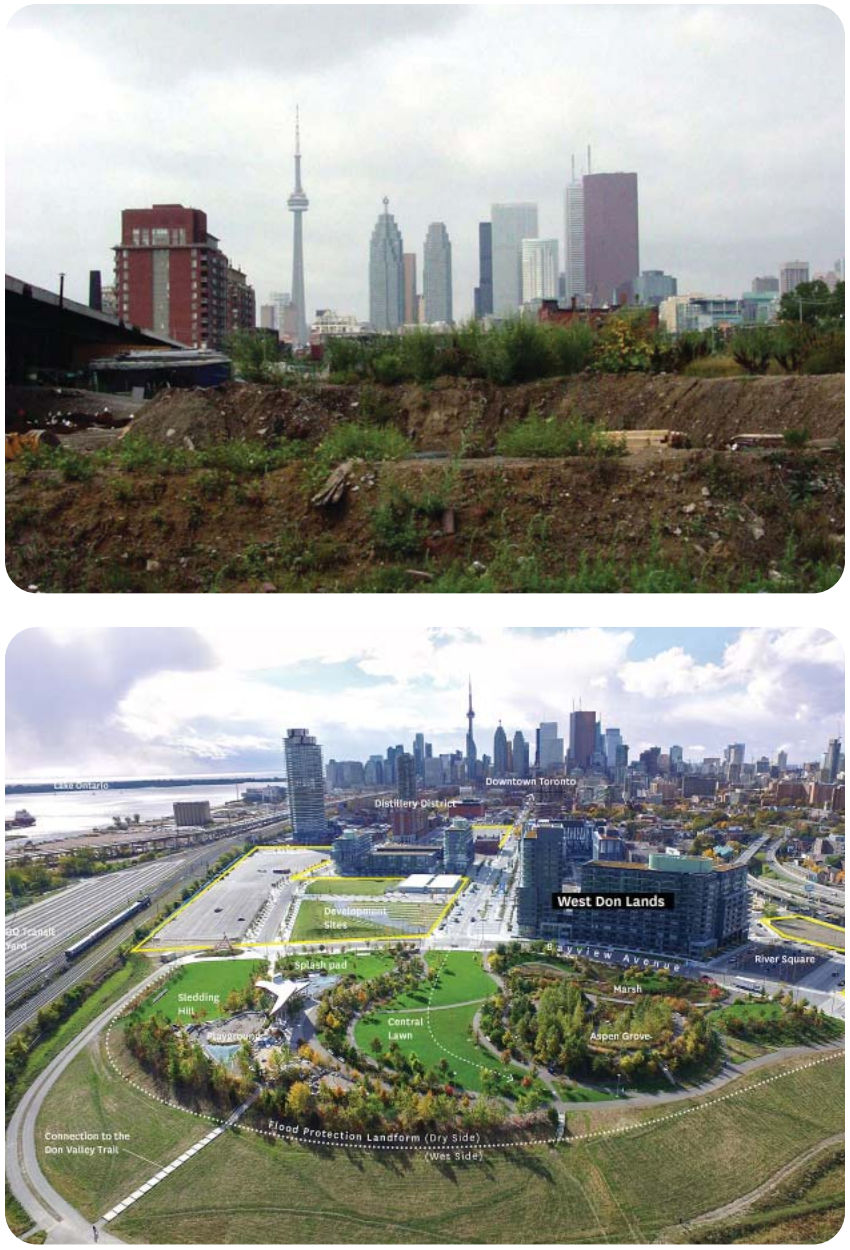


Figure 17. Corktown Common before (top) and after (bottom) renovation. Source: www.landscapeperformance.org

Design elements and amenities

The park not only provides flood protection, it also provides a desirable public destination for the community. On the top and sloping down the earthen flood protection landform, the park offers infrastructure for the neighboring community such as playgrounds, pubic art, restrooms and a pavilion for people to gather. Because the park was developed on a floodplain, the design and natural elevation create a natural barrier to rising water. The park splits into two sections a floodable area and a protected area; to the east, the landform is designed to hold back a 500-year flood, while the western portion stays dry and provides open space for the neighborhood. The topography of the park also creates a microclimate zone that attracts wildlife throughout the year and provides a proper place for native plants to grow. A mix of meadows, marshes, and vegetated groves complement the pedestrian path that connects the park with the Lower Don River Trail.[63]

Challenges

About 210 hectares at the edge of downtown Toronto were prohibited to be urbanized due to water saturation. In order to address this saturation, 1.7 million cu ft. of clay soil and other fill materials were used to create the 16ft tall earthen flood protection landform. Due to being devoid of ecological value, the flood protection berm was transformed into an ecological public space by installing horticultural soil. This type of soil allows native plants and trees to grown while providing habitat for birds and insects. Another challenge was the unfamiliarity of the gardeners to the variety of herbaceous species. The gardeners did not know what plants to keep when doing maintenance work, so a sign of representative grass was installed on the riverside to show the various native vegetation.[64]

63 "Corktown Common: Flood Protection and a Neighbourhood Park | 2016 ASLA Professional Awards," last modified 2016, accessed December 2, 2019, https://www.asla.org/2016awards/172397.html.

64 Shelley, Wolff, and Hunchuck, Corktown Common.

Project performance and takeaways

This example combines landscape design with ecological, social, and aesthetic purposes. The design protects the emerging community from flooding and provides the neighbors with a protected open space that enhance natural habitat. The most important characteristic of this project is that the park was designed and constructed to protect the community from flooding before the new urban developments around the area were built.

The use of recycled material to create the landform and the closed loop of water treatment are sustainable approaches that can be utilized in the San José flea market site. Topography work can be conducted in the site, by expanding the creek channel, removing steep banks and creating a floodplain and riparian corridor. The extra space provided by the riparian corridor along the creeks will allow the creek water to expand to the floodplain in rain or flood events. Additionally, the riparian area can work as a stormwater treatment site, where storm water can be collected and filtrated before entering the creeks.

Figure 18. Marsh, woodland, meadow and aquatic plants can be found throughout the park. Source: www.asla.org

Figure 19. Bike and pedestrian path surrounded by Ontario's native vegetation. Source: www.asla.org

4.2 Meadow Creek Stream Restoration

Location: Meadow Creek is located on the edge of the city of Charlottesville, Virginia, USA. The stream restoration project comprehends 1.4-mile and it is surrounded by parkland, residential neighborhoods, and a commercial district.

Size: 9,000 linear feet of stream restoration and 72 acres of conservation easement

Original land use: Public Park and Open Space

New land use: Public Park and Open Space

Completion Year: 2013

Figure 20. Aerial view from Meadow Creek after the restoration showing the new meanders, grading, and erosion control.
Source: www.landscapeperformance.org

Design Purpose

The project consisted of 9,000 linear feet of stream restoration and the conservation of 72 acres as easement land, of which 40 acres are new public parkland. The restoration project was the result of a collaboration with Nature Conservancy staff and the department of public works of the City of Charlottesville. The main goals of this project include, but are not limited to, decrease sedimentation, improve stability, improve habitat, enhance surrounding forest, protect infrastructure, and create educational and recreational opportunities. The restoration design followed the natural channel approach to establish a dynamically meandering pattern to reconnect the stream with its floodplain and reduce bank erosion and sedimentation.[65]

65 Landscape Architecture Foundation, Leena Cho, and Margaret Graham, Meadow Creek Stream Restoration (Landscape Architecture Foundation, 2014), accessed March 15, 2020, https://landscapeperformance.org/case-study-briefs/meadow-creek-restoration.

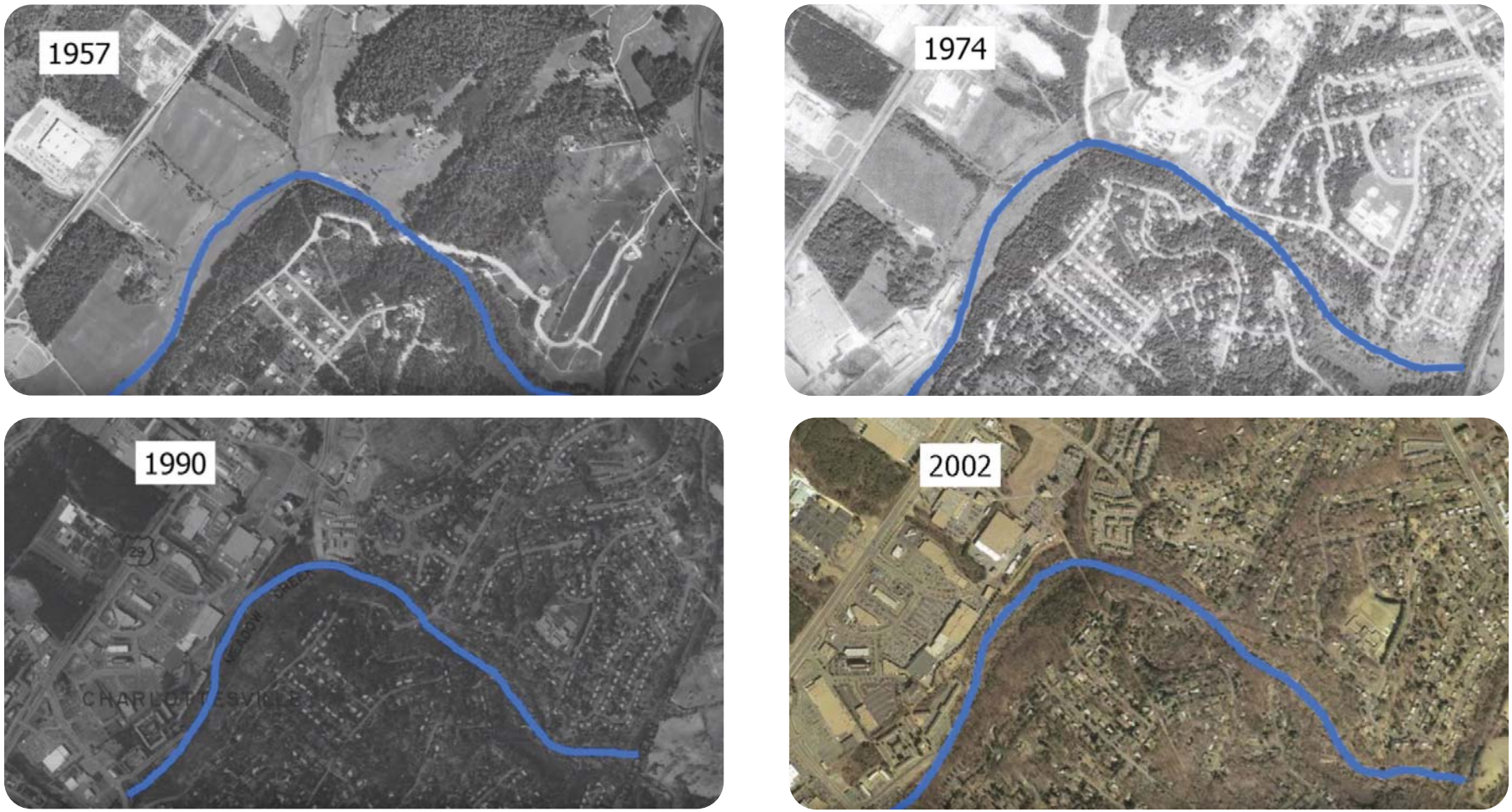


Figure 21. Land cover changes along Meadow Creek from 1957 to 2002. Source: www.landscapeperformance.org

Background

Meadow Creek is part of the Rivanna River watershed, which is part of the larger Chesapeake Bay watershed. Over the years, the Rivanna River watershed health has been threatened by increased sedimentation, stream bank erosion and the lack of forested riparian areas. Meadow Creek watershed comprises about 5,800 acres, with most of it being built out with mixed residential and commercial uses. Historically, this area was used as agricultural land for grazing. As the watershed developed over the years with buildings and impervious surfaces, the water runoff flowing into the creek increased the stream volume and velocity, eroding its banks.[66]

Figure 21 shows the changes along Meadow Creek from 1957 to 2002 where the agricultural lands were developed with residential and commercial uses.

66 "Meadow Creek Restoration | Charlottesville, VA," accessed March 15, 2020, https://www.charlottesville.gov/1119/Meadow-Creek-Restoration.

Planning and implementation

In 2005, the City of Charlottesville conducted a Water Quality Management Study which identified bank erosion as the main source of sediment in Meadow Creek and its tributaries. Similarly, the Albemarle Stream Assessment conducted in 2003, found that some reaches along the creek presented severe erosion and inadequate buffers. Later on, the Rivanna Watershed Conservation Action Plan, developed by The Nature Conservancy, identified increased sedimentation, due in part to stream bank erosion and the lack of forested buffers in riparian areas. The increased sedimentation due to uncontrolled stormwater runoff, stream bank erosion and the lack of fostered riparian areas threatened the health of the river and watershed. Due to the creek impairment, a restoration project was submitted to the US Army Corps of Engineers. After approval and funding from the Virginia Aquatic Resources Trust Fund (VARTF), the City, the Rivanna Water and Sewer Authority (RWSA), and the Nature Conservancy coordinated efforts in order to ensure the restoration and protection of the stream.

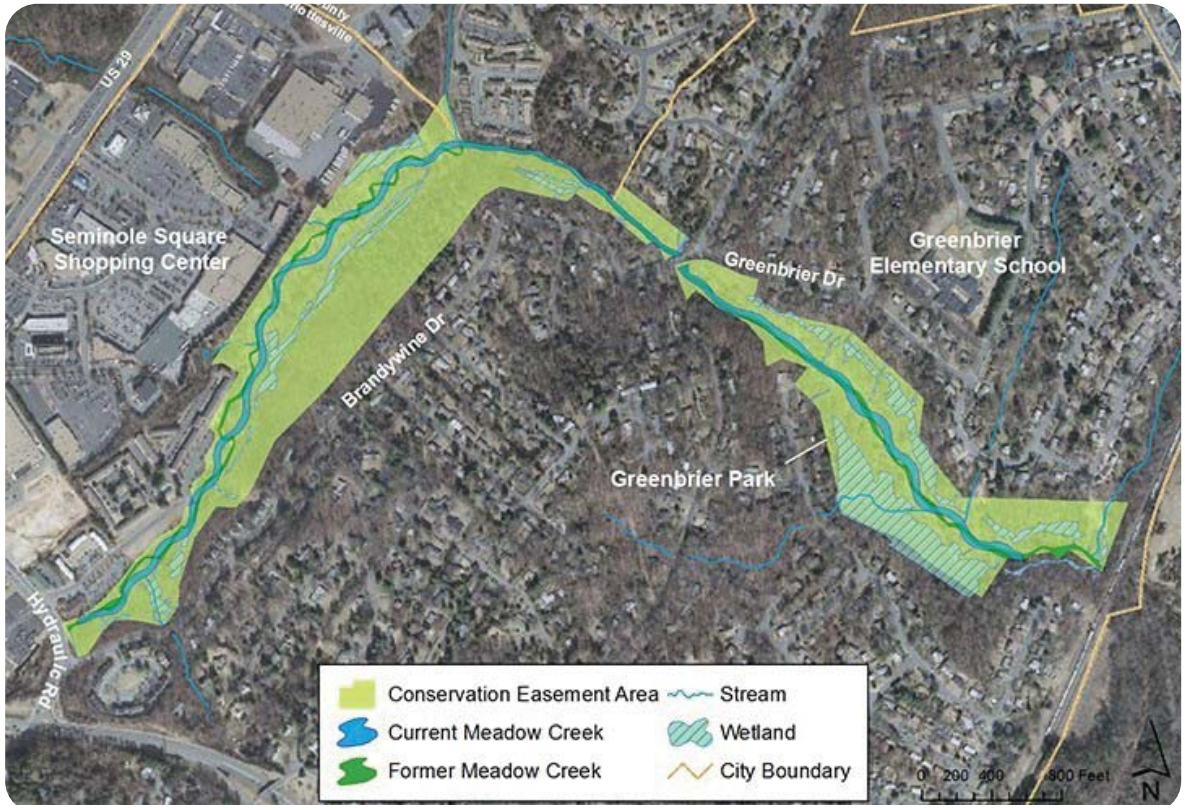


Figure 22. Meadow Creek site plan showing the restored meandering path against the former stream. Source: www.landscapeperformance.org

The work done consisted in adding meanders in some locations to reduce steep banks, allowing the stream to expand into the floodplain areas while reducing water velocity and volume. Through modeling and field data collection the stream designers realized various approaches to determine what would be the most appropriate stream pattern, where meanders and straight parts should be, and how wide those areas should be, considering utilities and stormwater volumes that get into the stream.

In the construction phase no soil was taken out of the project area. The removed soil was used to fill in other areas of the corridor, helping develop variation on the floodplain topography when needed, such as berms or depressions areas. The holistic design for the stream restoration project, implemented in-stream structure to help direct the water flow to the center of the channel and help control its grade. Additionally, work performed along the creek helped to stabilize the stream banks, provide natural habitat, and enhance riparian buffer.[67]

67 Ibid

Access and connectivity

This project preserved about 1.5 miles long of the exiting trail that is part of the 20-mile long Rivanna Trail, an important National Recreational Trail and a Virginia Birding and Wildlife Trail. Through the maintenance and accessibility to the trail, the site serves as a demonstration site providing educational opportunities to residents and visitors. Along the trail, signage was installed to display the restoration project and educate the public. As part of the project, there is a plan to create a multi-use path on the new parkland that will connect other sections of the trail and provide recreation areas for users.

Environmental quality and ecological value

Prior to the restoration, the creek was showing degradation issues, such as steep and eroded vertical banks, caused from high volumes of stormwater runoff coming from the watershed that carved out the banks and eroded them over time. Due to the bank erosion, trees and unconsolidated sediment fell into the creek burying the stream bottom and threatening aquatic life.

This project is improving the creek and forest health. One of the main goals of the project was to recreate a healthier native forest to improve habitat and water quality. Along the corridor, they built root wads into the side of the channel to help stabilize the stream banks and provide natural habitat by planting herbaceous and native vegetation. The planted willow and alder stakes have deep roots that help with stream stabilization, holding down the soil in place. [68]

Flood prevention

Due to uncontrolled stormwater runoff from impervious surfaces, the volumes and speed of stormwater entering the waterway increased, eroding the streambanks and producing more sediment.[69] For that reason, restoration was needed to rehabilitate the channel banks and floodplain. The natural channel design approach created meanders and reduced the bank height to reconnect the creek with its floodplain. Pools and riffles were created to slow the stream flow, while wetlands slow the quantity of stormwater entering the channel. New vegetation along the stream enhanced the stream bank stability, filtered runoff and restored the natural habitat of the site.

In case of a flood event, the floodplain and wetlands will hold up the water that overflows from the creek, while the natural riparian corridor will slow down the flow entering the stream coming from stormwater and drainage systems.

Through conservation easement, this project protects 72 acres of land along Meadow Creek, including public parks and wetlands that protect the natural creek habitat and forest providing the community an open space for recreation and education.

Figure 23 shows the before and after images of the restoration project in one area of the creek. The use of stones and vegetation alongside the creek helps to direct the water flow through the channel.

Design elements

This project focuses on stream rehabilitation, water quality, environmental quality and habitat restoration while providing open space to the adjacent community. The existing trail was preserved, and additional signage was installed along the trail route to show the visitors the restoration project. Additionally, a multi-use trail is planned for the new parkland as well as an open field and playgrounds for recreation.

A survey, after the project was completed, showed that the frequency of visitors to the Greenbrier Park has increased and that residents are very positive about the restoration changes done in the stream and parklands. People observed that the overall condition of the park has improved, as well as the sitting areas, cleanliness, landscape conditions, accessibility and paths.[70]

68 Ibid.

69 Ibid.

70 Landscape Architecture Foundation, Cho, and Graham, Meadow Creek Stream Restoration.

Challenges

The urban setting and the variety of organizations involved in the project were the main challenges for this project. Due to its urban setting, the stream overlapped with multiple infrastructure, sewer and stormwater drainage. Working closely and in collaboration with the different stakeholders such as utility providers, designers, neighbors, and the city, the design team created a cohesive project and addressed further challenges.[71]

Project performance and Takeaways

In 2014, a research team used the Bank Erosion Hazard Index (BEHI) method to assess the stream bank erosion and estimate the total loading sediment from eroding banks. They estimated that sediment loading was reduced by 1,790 tons per year. Although there were some limitations on the monitoring process, it is key to monitor the performance of the restoration project to find where the project has failed.[72] Over the years, maintenance work has been done in efforts to address bank erosion and stability. Although maintenance work has been conducted, a more comprehensive plan is proposed to remove and replace in stream structures that are not functioning properly.[73]

The connection and enhancement of the floodplain and wetlands are key components of this project along with bank stabilization and erosion. It is important to notice, that maintenance and monitoring work was performed to evaluate the performance of the restoration project. In addition, short-term and long-term active involvement to monitor physical, biological and functional performance of the stream corridor is needed to evaluate if the project goes as planned. A monitoring program can be applied in the BBUV site to monitor creek, wetland and floodplain performance. Additionally, regular inspections and maintenance work will be needed to prevent trash, sediment and dead vegetation accumulation.

Figure 23. Meadow Creek Stream Restoration. The images shows the degraded creek and eroded bank before restoration (top); the bottom image shows the restored stream with wider and vegetated riparian. Source: www.landscapeperformance.org

71 Ibid.

72 Ibid.

73 "Meadow Creek Restoration | Charlottesville, VA."

4.3 Sioux Falls Downtown River Greenway

Location: located in Sioux Falls, South Dakota, USA.

Size: Approximately 3.4 acres

Original land use: River Greenway - Retrofit

New land use: Recreational trail and waterfront redevelopment

Completion Date: 2012

Design Purpose

The project goal is to improve the Sioux Falls Downtown bike trail and greenway, create a recreation destination for the community, and enhance the economic development along the Sioux River corridor.[74]

Background

The previous industrial uses and car storage polluted the river over the years. Around the late 1960s the ideas of a greenway trail along the river began. The greenway plan was initiated in 1970, which included the restoration of Falls Park, develop a bicycle trail system that encircles the city, and protect the 100-year floodplain area by keeping it in its natural state. Within the floodplain area, developments are not allowed except for open areas with soccer fields, trails and parks such, as Spencer Park and Tomar Park.[75]

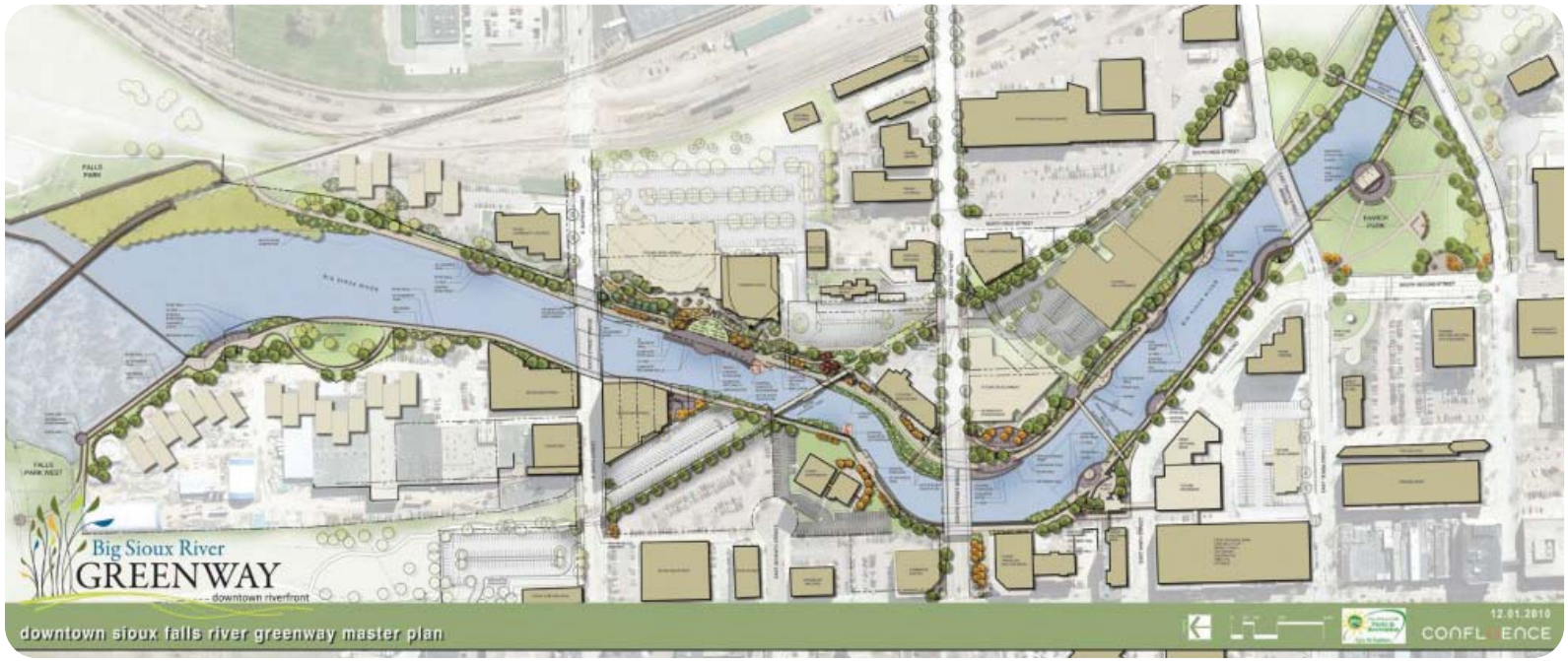


Figure 24. Sioux Falls Downtown River Greenway master plan. Source: www.landscapeperformance.org

74 James Matthew, Bailey Peterson, and Erika Roeber, "Sioux Falls Downtown River Greenway," Landscape Performance Series, last modified October 4, 2015, accessed March 5, 2020, https://www.landscapeperformance.org/case-study-briefs/sioux-falls-greenway.

75 Sioux Falls River Greenway, 2016, accessed March 15, 2020, https://www.youtube.com/watch?v=hcjJREl084I.

Planning and implementation

The trail and greenway master plan for Sioux Fall was established in 1975. In 2004, Designs Studios West Inc. (DWS) prepared the Greenway and Riverfront Master Plan for the City of Sioux Falls. The design studio coordinated public and private agencies efforts and multiple public meetings to understand what was needed for the master plan. Because of the size and complexity of the project, the site assessment and design for the master plan was divided into four zones: The Downtown Riverfront, The Parks, The Westside and The Confluence. (Figure 25).[76]

This report just analyzes Zone 1 of the master plan, the Downtown Riverfront. The Sioux Falls Downtown River Greenway designed by Confluence, completes a trail loop between Falls Park and Fawick Park along the Sioux River. This project consisted on three phases, two completed in 2012. The first phase of the project created an urban river walk, a pedestrian bridge, and a small amphitheater. The second phase created a new plaza with water features and increased the access points to the greenway. Along with the social benefits that this project brings, it also improves the aesthetics of the downtown area and creates an important infrastructure that supports economic development and recreational opportunities. In phase three of the river greenway improvement, the City wants to beautify the west bank of the Big Sioux River in downtown and extend the trail between the upper falls at Falls Park to Kiwanis Park. Figure 24 shows the proposed site plan of the Big Sioux River Greenway project.

In all phases of the project, including design and construction, the design team held multiple public meetings to understand the community needs. Also, coordination and collaboration with U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, South Dakota Game, Fish, and Parks, and the South Dakota Department of Environment and Natural Resources was needed to achieve the plan.[77]

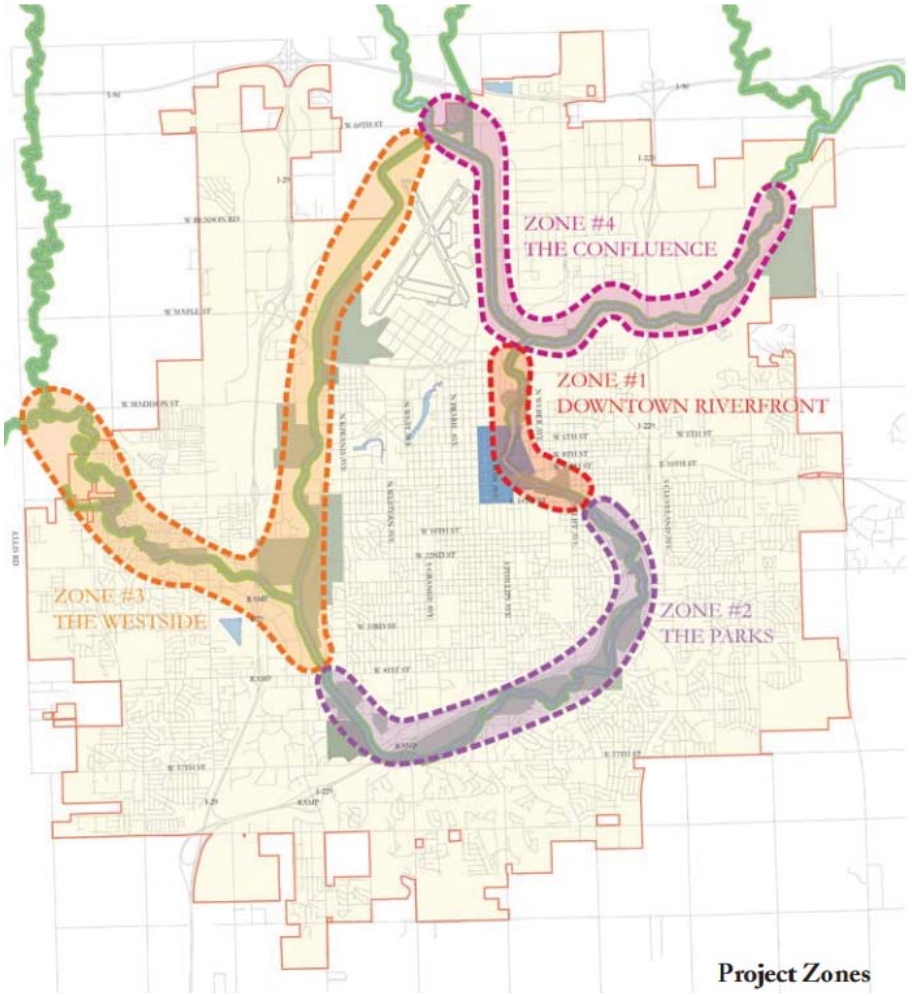


Figure 25. Big Sioux River Greenway project zones. Source: City of Sioux Falls

76 "Greenway and Riverfront," accessed April 5, 2020, https://www.siouxfalls.org/planning-dev/planning/long-range/master-plans/parks/greenway-riverfront.

77 Matthew, Peterson, and Roeber, "Sioux Falls Downtown River Greenway."

Access and connectivity

The Downtown project includes 1,550 ft. of new pedestrian and bike trails that connects with the City River Greenway trail. The trail also provides recreational opportunities, such as river overlook and educational panels with historical and environmental information about the river and downtown. The access to the trail was improved by the addition of two ADA compliant ramps and two new stairways. A new 200 ft. long pedestrian bridge, that replaced an old railroad bridge, provides additional access to the trail and serves as a bypass during storm events when the trail is inaccessible. Additionally, in response to the community request, a canoe and kayak landing area was incorporated to provide access to the water for aquatic sports.[78]

Environmental quality and ecological value

Although the focus of the project was to create an urban river walk, vegetation was one of the main elements to enhance the project. Native and hardy plants were utilized throughout the project as aesthetic features and to help to soften the walls needed for the construction of the sloped walkways.[79]

Flood prevention

Since the project is located in the floodway of Big Sioux River, the design needed to accommodate the trail and gathering places without increasing the flood risk. FEMA would not allow it to increase the 100-year water surface elevation, so the project team added sloped walkways to create a continuous trail route.

Figure 26. Canoe and kayak landing (top). Bike and pedestrian trail (bottom) Source: www.landscapeperformance.org

78 "Downtown River Greenway Project in Sioux Falls, South Dakota Receives Awards," PRWeb, accessed April 6, 2020, https://www.prweb.com/releases/2013/4/prweb10621662.htm.

79 Matthew, Peterson, and Roeber, "Sioux Falls Downtown River Greenway."

Design elements

The project includes features that enhance the river trail and invites visitors to the site. Approximately 1,600 ft. long bike and pedestrian trails were renovated and enhanced with educational panels that provide historical and environmental information. An abandoned railroad bridge was replaced for a pedestrian bridge to enhance accessibility. An amphitheater and a plaza with water features were built to provide gathering areas to the community. Also, a canoe and kayak launch area were provided to allow visitor access to the river. Throughout the project, the local Sioux quartzite stone, was used as an accent element in walls, the amphitheater and the pillars that surround the amphitheater. Figure 26 and Figure 27 illustrate some of the amenities that the site offers to the community.

Challenges

In addition to the floodways restrictions, the design team had to accommodate the existing sanitary sewer into the renovation; extra work had to be performed in order to accommodate the concrete footings and flood walls, resulting in project delays and additional costs.

After the installation of the Sioux quartzite stone used throughout the project for walls and pillars (Figure 27) the joints began to fail due to expansion and contraction of the filling. The mortared joint had to be replaced with caulked joints instead.[80]

Project performance and Takeaways

The project created a lively and vibrant pedestrian riverfront while supporting local businesses in the downtown area. The improved infrastructure provides better river access and connectivity between the east and west banks of the river while sustainable features improved the site landscape. By reducing the risk of flooding, the project provides the community a place to gather, entertain, and connect with the river.

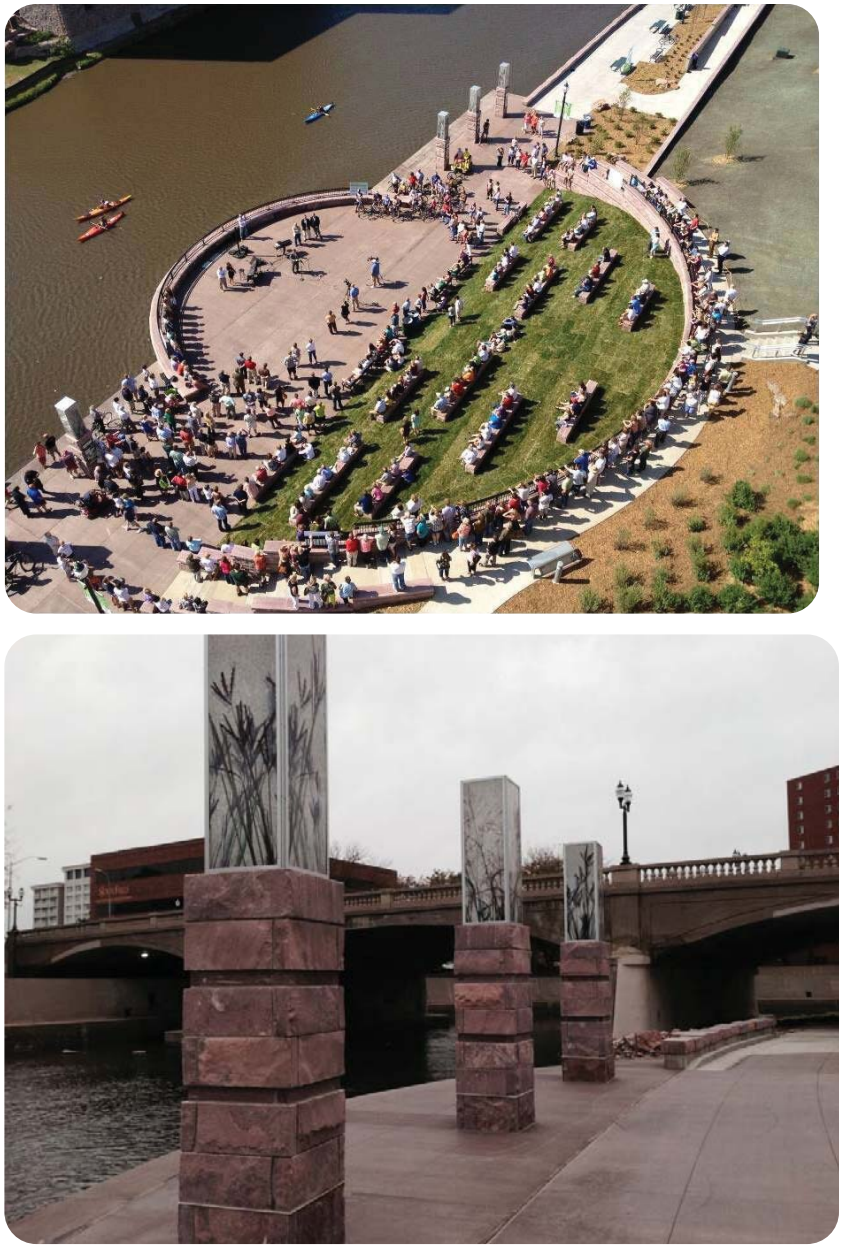


Figure 27. Public event at the amphitheater (top). Source: City of Sioux. Pillar created by local artist utilizing local quartzite stone (bottom). Source: www.landscapeperformance.org

80 Ibid.

4.4 Menomonee Valley Redevelopment and Community Park

Location: The Menomonee River Valley is located in Milwaukee, Wisconsin, USA. The site was a former industrial area abandoned in the 1990s.

Size: 140 acres

Original land use: Brownfield

New land use: Industrial park, open space and stormwater management facility

Completion Date: 2006

Design Purpose

The master plan proposed in the early 2000s for the Menomonee River Valley created a centralized park and shared stormwater treatment area within the 140-acre light industrial redevelopment. Over 60 acres, the park offers recreational space, landscape and habitat along the Menomonee River while the stormwater facility increases usable land for future owners and business. The environmental purpose of the project consisted of managing 100-year flood volumes, improve water quality, eliminate the need of irrigation, and increase usable land. With regards to the social aspect, the project intended to create public access to the river, provide an open space to the community for educational and recreational opportunities, and improve bike and pedestrian access and connectivity. Through the revitalization and the increasing number of new developments, jobs and visitors, additional economic benefits to the city and the community were created.[81] Figure 28 shows an aerial view of the proposed redevelopment and community park.

Figure 28. Menomonee Valley Redevelopment and Community Park aerial view. Source: www.landscapeperformance.org

81 Public Policy Forum. Redevelopment in Milwaukee's Menomonee Valley: What Worked and Why? September 2014.

Background

The 1200-acre Menomonee River Valley was a wild rice marsh and home of American Indians. By the mid-1800s the settlement of Milwaukee filled the marsh with soil, gravel, and waste to create a dry land for additional development. The river was straightened and canals were created to allow shipping routes. By the early 1900s, the Valley became the manufacturing center and Milwaukee was known as the "Machine Shop of the World". Industries for farm machinery, rail cars, electric motors, and cranes were developed in the Valley providing jobs to the people but damaging the natural resources. By the late 1900s, manufacturing practices declined, and the Valley was abandoned, contaminated, and left with vacant industrial buildings; also, bridges were demolished isolating the valley with the surrounding areas. The neighboring residents suffered the consequences of the changes, they had limited access to job and recreation, and poor environmental quality.[82]

Planning and implementation

To transform a largely abandoned industrial corridor into a vibrant center of industry, entertainment, and recreation, in 1998, the City of Milwaukee, the Menomonee Valley Business Association and the Milwaukee Metropolitan Sewerage District in collaboration with other government agencies, businesses, design professionals, community organizations, and citizens prepared a land use plan for the Menomonee River Valley. Planning and community engagement played a vital role for the Menomonee Valley revival.

Since 1999, the new infrastructure has improved the connections between the Valley and the surrounding community, companies have moved into the Valley, new job opportunities have been created, trails, parks and recreational areas have been built, and a shared stormwater system has been established. The rehabilitation of the Valley has shown economic and environmental improvements over the years. Today, the Menomonee River Valley continues to receive local and national recognition for its successful improvements.[83]

Figure 29. Menomonee Valley Redevelopment and Community Park before (top) and after (bottom) restoration. Source: www.landscapeperformance.org

82 Joe Peterangelo, and Rob Henken, Redevelopment in Milwaukee's Menomonee Valley: What Worked and Why? (Milwaukee, WI: Public Policy Forum, September 2014).

83 "Menomonee River Valley - History," Menomonee River Valley, accessed April 5, 2020, https://www.thevalleymke.org/history.

Access and connectivity

The new and renovated infrastructure improved vehicular and pedestrian access to and through the Valley, increasing accessibility to the site. The trail network connects the site with the rest of the city allowing residents and visitors to access the Menomonee River for recreational and educational purposes. In addition, the new park adjacent to the trail and the Urban Ecology Center has enhanced the natural and recreational opportunities for the residents.

Environmental quality and ecological value

The main goal of the project was to transform the abandoned and contaminated brownfield site into a biodiverse area that includes trees, grass, and wetland areas while protecting and improving the river's watershed. Through the implementation of the project, 3,000 ft. of riverbank was restored and stabilized, contaminated debris and soil was managed on site, and concrete from demolition was recycled to create a stormwater infiltration system beneath the wetlands. The use of native trees and drought-tolerant native plants minimize the need for irrigation. Additionally, the site manages 100-year flood volumes increasing the available land for future developments.

Flood prevention

The site, located within the 100-year floodplain, was not able to support building loads and new infrastructure. The project team used a unique fill management program to remediate contamination and raised the site allowing developments to be out of the floodplain area. At the same time, the project includes a park to treat and manage stormwater runoff and improve water quality. (Figure 30)

Design elements

Design standards and guidelines were established to provide a continuous design throughout the project. Lighting was installed in some areas along the trail while railings and furniture such as benches, trash bins and bike parking were place along the river walk. To provide a pedestrian friendly environment along the river the building structures facing the river incorporated architectural elements and features along with lighting.

One of the main sustainable features of the site during construction was the reuse of existing material. They created a bedrock and site elements by recycling exiting concrete. In addition, picnic tables were built from salvaged wood and recycled glass from local brewing companies was used to create glass installations throughout the park. Also, the site reused the existing historic chimneys as symbols of the Valleys history and resurgence. Figure 31 shows some of the design elements that can be found within the project.

Figure 30. Wetland provides flood storage. Source: www.landscapeperformance.org

Challenges

One of the main challenges of the project was the existing conditions of the site. Various constrains made the site unsuitable for redevelopment; the site was within the 100-year floodplain, the soil was not likely to support new infrastructure, and the site presented significant environmental contamination. The project team used a unique fill program to raise the site out of the floodplain and remediated the soil contamination. The project team also created a park that treats and manages stormwater runoff and provides the community with access to the river and open space.

In addition, the lack of funding from the City Park Department was an additional challenge of the project. Due to grants given and other funding sources that supported the project, including the Wisconsin DNR, US EPA Great Lakes Initiative, Milwaukee Metro Sewerage District, and Menomonee Valley Business Partners, the project was completed.

Project performance and Takeaways

Through an analysis of data, documents, interviews with public and private sectors, the landscape team was able to identify the elements needed to accomplish a successful restoration plan that can be replicated elsewhere in the future. The project combined environmental remediation, new infrastructure, open space, access to the river, and educational amenities while reducing flood risk and enhancing the environment. This multi benefits project provided the city and the community with a place to work, play and enjoy.

After the completion of the project, more than one million square feet of buildings were constructed with sustainable features and LEED certification. Green infrastructure such as bioswales and rain gardens were installed to manage the sites stormwater and wastewater. The stormwater treatment park constructed in 2006 successfully handled a 100-year flood event in 2008.[84]

Figure 31. Reuse of the historic chimneys became a symbol of the Valley's resurgence (top). Recycled concrete used to create site elements (bottom). Source: www.landscapeperformance.org

84 Public Policy Forum, Redevelopment in Milwaukee's Menomonee Valley: What Worked and Why?, September 2014.

Conclusion

Restoration projects in urban areas involve risks, challenges and ecological and socioeconomic constraints. However, urban development and creek rehabilitation can improve the quality of life, provide an adequate open space, improve water quality and habitat, minimize flood risk, and increase economic benefits. The precedent projects are examples of successful restoration projects and show, that even though challenges and constraints exist, good planning, coordination and effort can lead to a successful product.

Through the analysis of the precedent riverfront restoration projects, it is important to notice that all the projects provided flood protection, habitat enhancement, and creek rehabilitation along with social and economic benefits. However, it is worth noting that each project focuses its efforts on specific topics, which make each project unique. Corktown Common worked with topography and landscape to create a flood protection barrier that allows development adjacent to the park to be built. Meanwhile, Meadow Creek restoration focused on habitat enhancement, creek and floodplain connection, reduction bank erosion and bank stabilization, along with native forest restoration. Sioux Falls focused on enhancing the greenway trail providing the community with better pathways and social gathering areas and improving the site to attract new developments for future economic benefits. Menomonee River Valley combined an industrial park, open space and stormwater management facilities providing the community an open space for recreation and at the same time a place for work and new developments to rise.

Key Takeaways

- ***Combine landscape design with ecological, social, and aesthetic purposes***
- ***Multi-purposed open spaces that accommodate park, stormwater facilities and floodable areas***
- ***Parks designed to enhance natural habitat, provide recreation areas and protect the community from flooding***
- ***Community engagement and stakeholder coordination for a successful plan that accommodate the community and city needs.***
- ***Connect and enhance of the floodplain and riparian corridors***
- ***Improve infrastructure that provides better river access and connectivity throughout the site***
- ***Provide the community a place to gather, entertain, and connect with the river***
- ***Integrate green infrastructure throughout the site to reduce water runoff, manage wastewater and enhance the site landscape***
- ***Utilize native vegetation and drought tolerant plants to minimize maintenance and irrigation***
- ***Monitoring and maintenance is needed prevent sediment and debris accumulation and to ensure that the project is performing as planned***
- ***Recycle existing materials and structures to emphasize the local history of the site***

5

DESIGN RECOMMENDATIONS

Coyote Creek Trail in North San José. Source Lolke Bijlsma

5.1 Proposed design

Based on the lessons and best practices identified in the case studies and in the literature, the design recommendations in this chapter seek to guide designers, planners, and stakeholders on the adoption of a comprehensive approach for the future of BBUV. These recommendations and guidelines suggest adopting a holistic and collaborative approach to integrate urban development, flood control, safety, and connectivity throughout the area while enhancing the existing neighborhood and the natural resources of the area. Also, features such as murals, signs and streetscape should be incorporated into the design to reflect the site history and the community and neighborhood character.

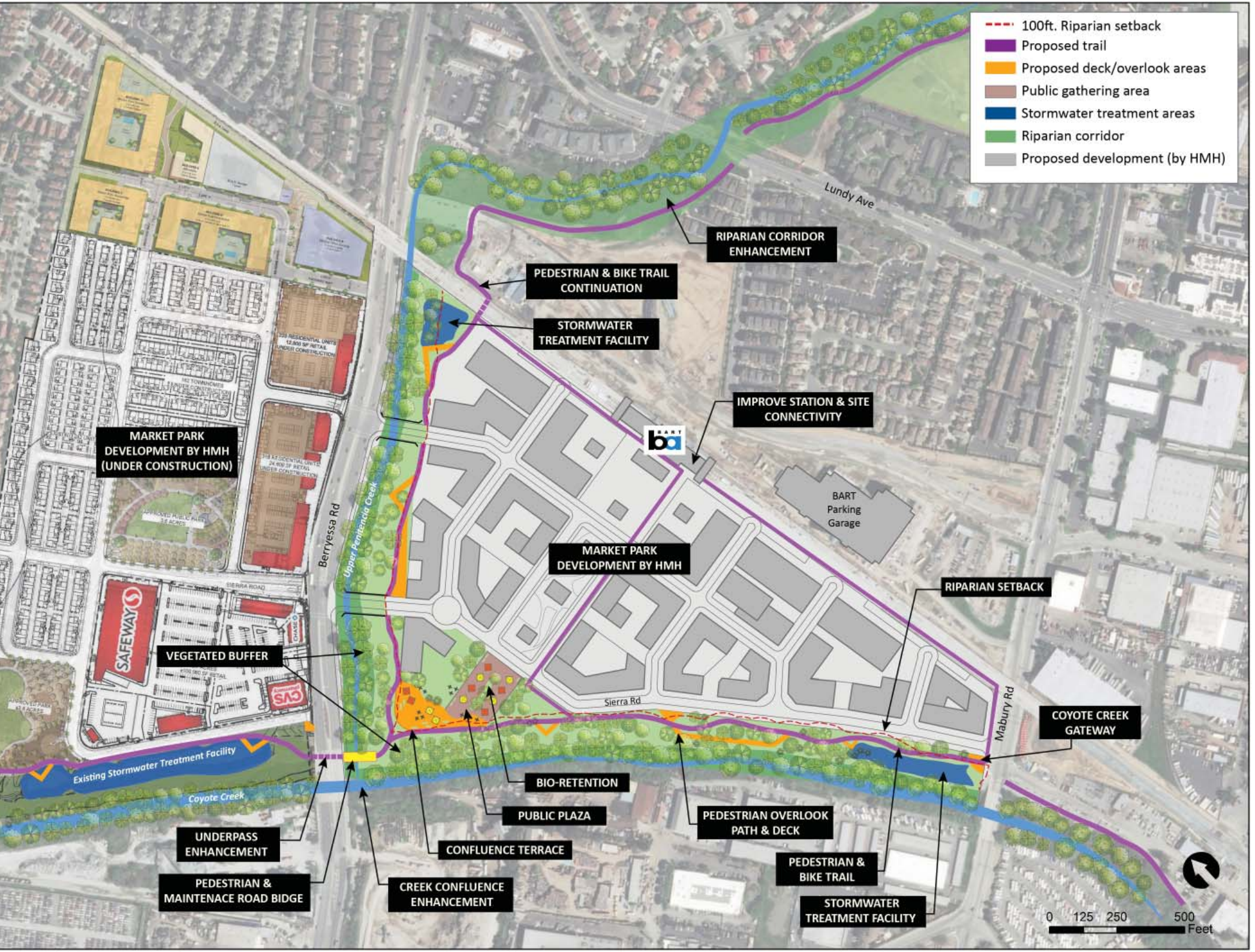
Figure 32 illustrates the proposed site plan and some of the key features that the design should include. The author creates this conceptual site plan to better illustrate where the improvements should be made. To better determine details on dimensions, plants, materials, and hydrologic models, a team of experts - engineers, ecologists, and landscape architects between others - will be needed.

The author used the proposed plan of the Market Park, created by HMH, and modified it to accommodate the 100ft riparian corridor and other amenities. Sierra Rd., sidewalks and buildings were retrofitted to allocate the vegetated buffer and public facilities.

The proposed recommendations are designed to address the following subjects:

- Access and connectivity
- Urban development and open space
- Flood protection and environmental quality
- Interaction with water
- Safety
- Design elements and amenities
- Planning and management

Figure 32. Proposed site plan. Map created by the author.


100ft. Riparian setback
Proposed trail
Proposed deck/overlook areas
Public gathering area
Stormwater treatment areas
Riparian corridor
Proposed development (by HMH)
Lundy Ave
RIPARIAN CORRIDOR ENHANCEMENT
PEDESTRIAN & BIKE TRAIL CONTINUATION
STORMWATER TREATMENT FACILITY
IMPROVE STATION & SITE CONNECTIVITY
MARKET PARK DEVELOPMENT BY HMH (UNDER CONSTRUCTION)
BART Parking Garage
MARKET PARK DEVELOPMENT BY HMH
Berryessa Rd
Upper Penitencia Creek
RIPARIAN SETBACK
VEGETATED BUFFER
Sierra Rd
Mabury Rd
COYOTE CREEK GATEWAY
Existing Stormwater Treatment Facility
Coyote Creek
BIO-RETENTION
PUBLIC PLAZA
PEDESTRIAN OVERLOOK PATH & DECK
UNDERPASS ENHANCEMENT
CONFLUENCE TERRACE
PEDESTRIAN & BIKE TRAIL
PEDESTRIAN & MAINTENACE ROAD BIDGE
CREEK CONFLUENCE ENHANCEMENT
STORMWATER TREATMENT FACILITY
0 125 250 500
Feet

5.2 Access and connectivity

An important design consideration for the site is the accessibility and connectivity of the site with the existing neighborhood and the rest of San José and the Bay Area. BART service will provide a rail network that connects the city of San José with East and North Bay cities as well as San Francisco. While commuters will use this service to travel to and from San José, it is essential that a trail network connect the station with the neighborhood throughout the city. The urban village plan will provide higher density housing, office and retail that will supports BART ridership, although it is necessary that the existing San José community also be stimulated to use the train service, as a mode of transport. For that reason, connectivity and easy access to the station is crucial. In addition, to minimize car use, public bus systems along with bicycle and pedestrian paths should be accessible from different points of the city.

City trail connection: the existing Coyote Creek Trail is not a continuous trail; in some areas, the creek trail is not developed or accessible due to private properties adjacent to the creek. The Upper Penitencia Creek trail is more continuous and connects Alum Rock Park and the BART Station. With the new development, the Upper Penitencia Creek trail will merge with the Coyote Creek Trail. Both trails can be better integrated into a network of trails that connect parks and neighborhoods with other areas of San José and its downtown. As it is shown in Figure 33, the city of San José has a trail program that interconnects different trails throughout the city but not all of them are open or accessible. Coordination with San José Public Works will be needed to plan a strategic and holistic trail design for the BBUV site.

Sioux Falls and Menomonee Valley provide excellent examples of trail connectivity. In Sioux Falls, the 19-mile trail system runs along the river, and connects different neighborhoods throughout the city, while working as an access point for neighbors to the amenities along the greenway. The new pedestrian bridge, ADA ramps and new stairways improved the access to the trail as well. Similarly, the Menomonee Valley site integrated an improved bike and pedestrian trail to connect the new business hub with the rest of the town. These examples can serve as a guide to enhance trail connectivity throughout the site.

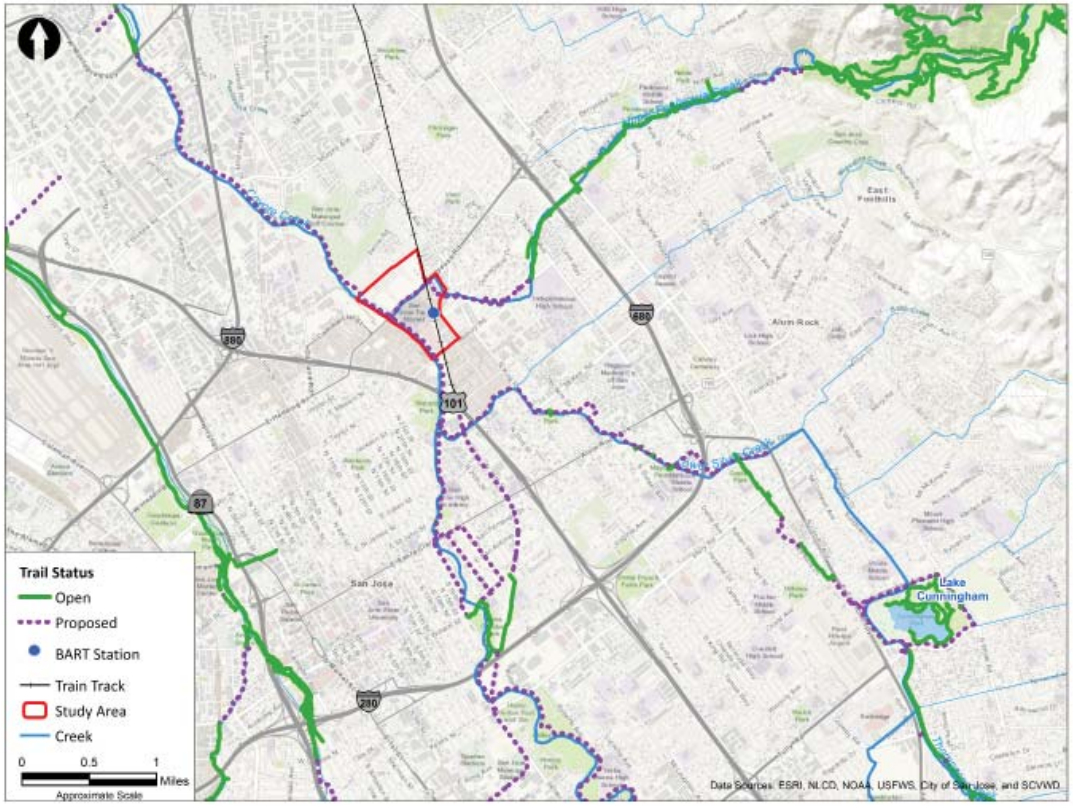


Figure 33. Trail map showing the proposed and open trails network planned by the city of San José. Map created by the author.

Creek trail connection. Enhancing the connection between the Coyote Creek trailhead and the Upper Penitencia Creek trail at the confluence of both creeks should also be considered. The Berryessa Rd. underpass can be used as a trail entry point and the pre-existing parking lot adjacent can also be used to allow a central location for visitors to leave their cars while using the trail so as not congest other businesses and residential areas.

Connection between the site and BART. There is an existing grade change between the station and the flea market site. The BART station site has been elevated to meet the 100-year flood requirements and retaining walls divide the station and flea market area interrupting the pedestrian connectivity and accessibility. Design solutions should integrate accessibility into the project, where the connection between the station and the adjacent site will avoid any physical barriers such as floodwalls or steep terrain. Alternatives such as ramps and landscape design could be explored to connect both sites while providing accessibility. Additional pedestrian pathways within the urban village could provide shortcuts between the BART station, parking areas, and the creek trails.

Residential trail connection. Planners should consider emphasizing the connection between the residential areas and the city transit hub by improving protected bike lanes on busy streets like Berryessa Rd. and Mabury Rd. In addition, multi modal connections are recommended at transit stations and gathering areas.

Trail design standards. For pedestrian and bike paths, trails should comply with ADA standards. Permeable pavement should be used for pedestrian and bike trails while maintenance roads can be made by fine granite, rock or wood mulch and wide enough to allow the entrance of maintenance equipment. Wayfinding sings and lighting will be needed along the trails and transit stations. Adequate signage for intersecting trails and for trails detour will be needed as well. Additionally, public amenities such as bike share stations, restroom facilities, and bicycles racks can be placed near the transit hub and gathering areas.

Figure 34. Coyote Creek Trail at Hellyer Park.
Source: www.backpackerverse.com

5.2 Recommended Actions

- *Consistent residential and city trail network*
- *Universal signage for wayfinding and informational panels*
- *Establish and follow trail design standards*
- *Access and connection between the station and adjacent neighborhood.*

5.3 Urban development and open space

The existing land uses that surround the BBUV are industrial and low-density residential. Since industrial activity is important for San José's economy, most of the industrial land will not be rezoned. This makes the flea market redevelopment a key player for the increase of high density and mixed-use within the neighborhood. With this said, urban design standards should be applied to new developments to guide the proportion of building mass and open space required for the site. Throughout the municipal code, the city can establish building heights, setbacks, and openings that will have a positive impact on the neighborhood. Furthermore, higher density and compact development will accommodate more residents with less harm on the environment. The building design should prioritize people and pedestrian scale, by making it attractive and active, and by adding pocket parks or plazas where people can gather.

As demonstrated by the cases reviewed in the previous chapter, once the site is flood proofed, future developments can bring economic and aesthetic benefits to the area. Those projects integrated urban development and open space harmoniously, while increasing connectivity with the surrounding areas, protecting the community from flooding and providing recreational and educational uses along the water corridor while allowing new businesses to develop. it is

New office buildings, commercial activity and residential buildings will increase the vibrancy of BBUV neighborhood. However, it is important for the city authorities to prevent displacement and the rise of the housing costs in the existing neighborhood. In recent years, Oakland Fruitvale neighborhood managed to maintain its cultural identity while improving its economic development. Sonja Diaz, a researcher from the UCLA's Latino Policy and Politics Initiative, led a study on the Fruitvale's neighborhood to understand the impacts the Fruitvale Transit Village may have had on the neighborhood's prosperity. Her team found that homeownership, median household income, and educational attainment increased in the majority-Latino neighborhood between 2000 and 2015.[85] Providing community services for the neighborhood had a positive impact on the educational attainment and provided motivations for the residents to stay in place.

In addition to the opening of the Fruitvale Transit Village (Figure 36), where housing units and retail stores were developed, the village also included a charter high school, a community center, a public library and a small clinic that serve the community. The design of the village opens to a big corridor improving the connection between the station and the exiting neighborhood and providing a safe public space for Latino businesses, events and street vendors. This example shows that gentrification and displacement can be minimized by prioritizing the need of the existing community, providing services to the existing and new population, ensuring economic opportunities for the most disadvantaged, and developing affordable housing units within the new transit-oriented development.[86]

The city of San José can implement policies to regulate rent prices, and ensure that a number of units within the new development are affordable. Also, the development should offer affordable retail spaces and spaces for community services such as daycare, small education services, etc.

85 Bejanmin Schneider, "How Transit-Oriented Development Can Prevent Displacement - CityLab," last modified April 2, 2018, accessed May 1, 2020, https://www.citylab.com/equity/2018/04/how-transit-oriented-development-can-prevent-displacement/556373/.

86 Ibid.

Figure 35. Proposed urban village project of offices, homes and retail at 4300 Stevens Creek Blvd. in San José (left) shows the combination of open space, green infrastructure and build environment.
Source: www.mercurynews.com

Figure 36. Fruitvale Transit Village in Oakland, CA (right).
Source: www.pgadesign.com/

5.3 Recommended Actions

- *Compact and high-density buildings*
- *Harmonious integration of building mass and open space*
- *Design standards for attractive ground floor*
- *Pedestrian scale: active ground floor and secluded areas*
- *Neighborhood scale: pocket parks within the urban development*
- *Variation in building heights, setbacks and opening.*
- *Holistic design throughout the site*
- *Provide affordable units within the project*
- *Safe public space for events and street vendors*
- *Provide affordable retail spaces and spaces for community services*

5.4 Flood protection and environmental quality

An important design recommendation for the site is to restore the riparian corridor along Coyote Creek and Upper Penitencia Creek. The river will be given more room by constructing a new floodplain that would provide habitats and help reduce flood risk by keeping water in the channel and within the floodplain. Widening, the channel and restoring the floodplain would allow more water to be stored in the river during flood, minimizing the risk of flooding in the adjacent community. Likewise, improving the floodplain and riparian buffer would dissipate flow velocity after rain events, decrease downstream flow, minimize bank erosion, enhance water quality and reduce the amount of stormwater discharge to the natural stream channel.

Buffer and riparian corridor. A 100ft. buffer along the Coyote Creek and Upper Penitencia Creek is proposed to allow the development of the riparian corridor and extension of the floodplain. Developments, such as building structure or streets, are restricted within the floodplain areas. The 100ft. buffer can include three distinct vegetated zones to ensure safe wildlife movement, healthy riparian corridor and adequate stormwater treatment. Additionally, other uses such as parks or soccer fields could be designed on the floodplain while not interfering with floodplain performance. It should be noted that the riparian corridor should be continuous to minimize riparian disruption, even under bridges and road pass, like Mabury Rd. and Berryessa Rd.

The alternative proposed for Coyote Creek and Upper Penitencia Creek is to create a 100ft. buffer from the exiting top of the bank. Native and dense vegetation, tall trees and shrubs along the creek will be maintained to provide wildlife habitat, protect native species in the creek, and allow water temperature control. This alternative will complement the proposed Market Park project.

Figure 37 shows a cross section of the exiting condition of Coyote Creek and its adjacent area, the Flea Market Parking Lot. The proposed cross section shows a possible alternative for channel widening. This alternative proposes widening the channel by excavating the banks, removing existing trees and vegetation, but it will allow for remediation later on, by extending the floodplain.

For Upper Penitencia Creek the proposed alternative would extend the riparian corridor about 100ft from the drip line or existing top of the bank. Likewise, Coyote Creek, the Upper Penitencia Creek will maintain the native vegetation and trees to ensure a prosperous habitat for natural species that live in the creek and expand its floodplain to provide more vegetation on the riparian corridor. By removing the exiting parking lot, a riparian corridor with native vegetation can be developed while giving place to the creek's floodplain. Figure 38 illustrates the cross sections for the existing and proposed alternative for Upper Penitencia Creek.

Corktown Common project provides an excellent example of flood protection by combining topography, vegetation, and landscape design. It also captures and treats rainwater and stormwater. Similarly, the alternatives proposed for Coyote Creek and Upper Penitencia Creek will work with the topography to widen the channel and connect the creek with its floodplain while working to include more vegetation to improve stormwater treatment. On the other hand, the Sioux Falls project accommodated the trail and gathering places, without increasing flood risks, and protects the 100-year floodplain by limiting development within the floodplain and allowing non-structural uses like parks and soccer fields within it. These type of uses enable the floodplain to flood without damaging structures and minimizing risk of flooding to adjacent areas. Furthermore, the Meadow Creek project used the natural channel approach to reduce erosion, decrease sediment, enhance habitat, and reconnect the stream with its floodplain. Although this case study created a dynamic meandering pattern for creek restoration, its holistic design approach can be applied in the BBUV site.

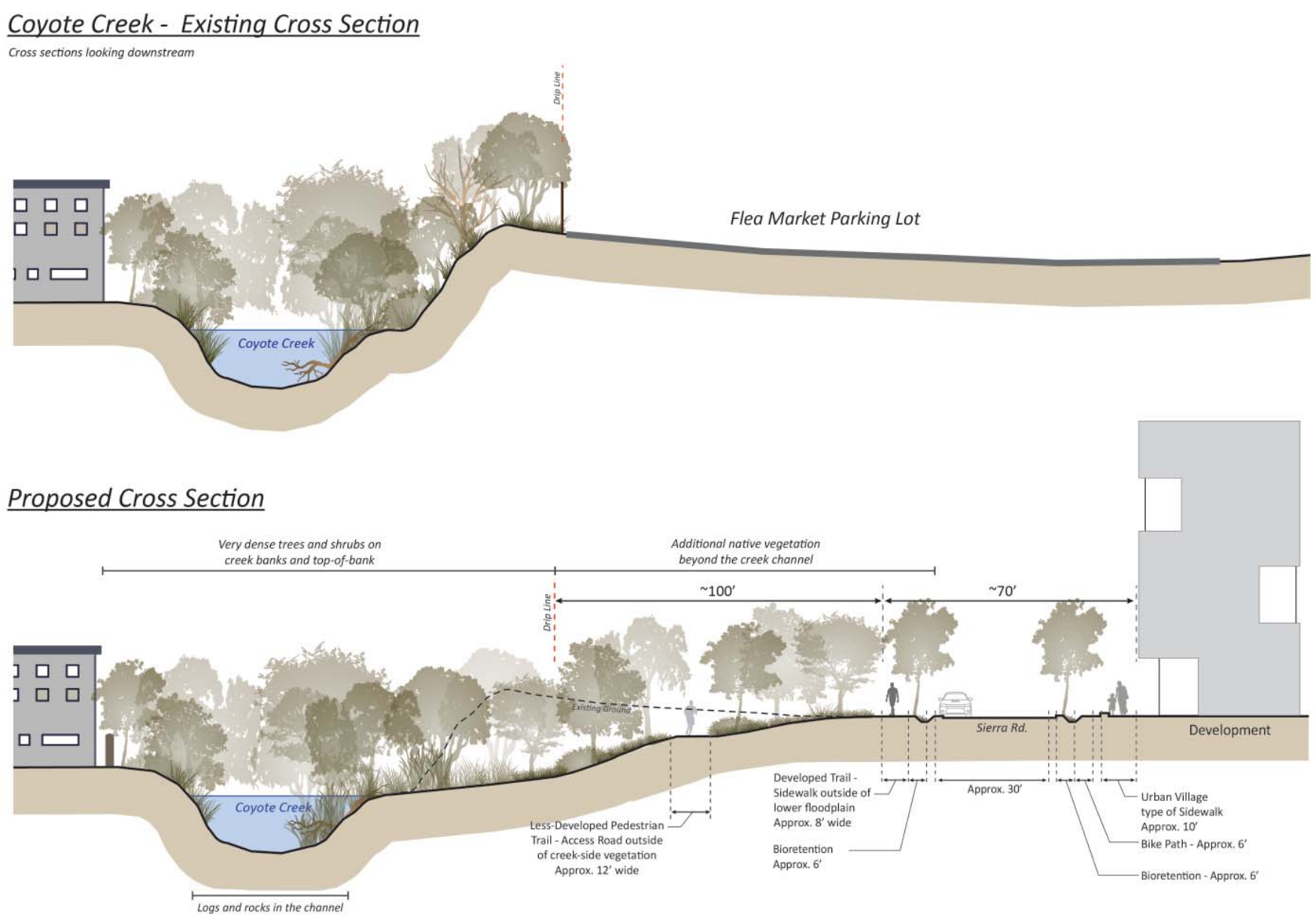


Figure 37. Existing and proposed cross sections for Coyote Creek. Not to Scale. Created by author.

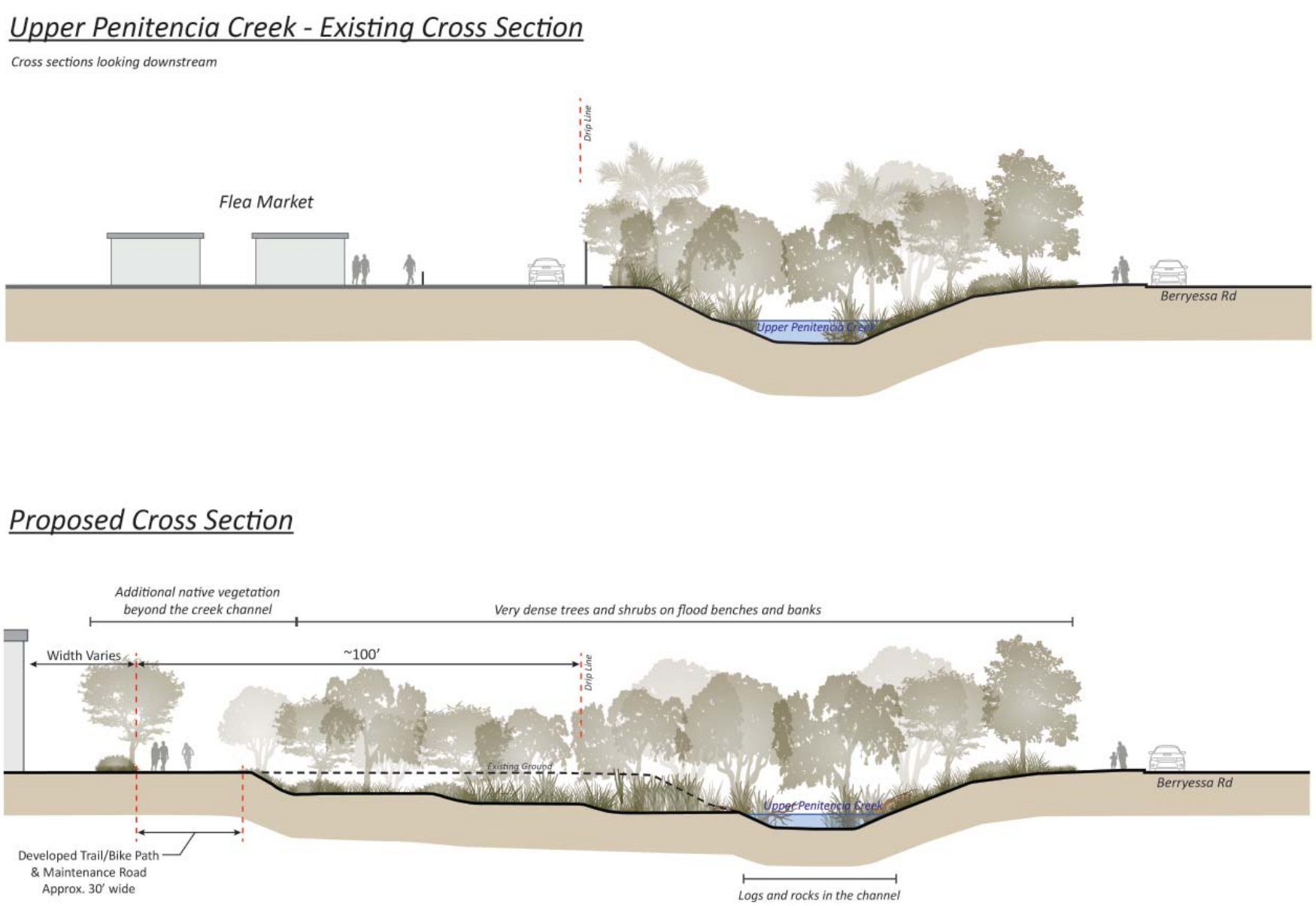


Figure 38. Existing and proposed cross sections for Upper Penitencia Creek. Not to scale. Created by author.

Stormwater treatment. An integrated stormwater system could reduce the amount of stormwater entering the streams. The drainage outfalls should be directed into stormwater parks or riparian areas where well drainage soils, plants and stones filtrate stormwater before getting to the watercourse improving water quality. Additionally, the 100ft. riparian corridor will contribute to reduce the flow velocity and minimize bank erosion. Design regulations, installation and maintenance of these areas should be supervised by the city and environmental agencies for adequate performance.

The city of San José created a complete plan related to green stormwater infrastructure that provides innovative ideas on how public and private properties should integrate green infrastructure within developments. The Green Stormwater Infrastructure Plan (GSI Plan) aims to serve as an implementation guide by laying out strategies, targets, and tasks needed to include green stormwater infrastructure into existing and new developments and to implement and institutionalize its concepts into municipal engineering, construction, and maintenance practices.[87] The city is implementing this type of infrastructure in city's own lands; however, it will be necessary that the city imposes new construction to integrate these type of features. Along with obligate new developments to accommodate green infrastructure in their design, regularly control and monitor will be necessary to ensure that the system is performing effectively.

Two stormwater management areas are proposed for the site. One located on Coyote Creek and Mabury Rd. where an existing drainage outfall is located and the other one will be located near Upper Penitencia Creek and the train track underpass. The purpose of the stormwater treatment site is to provide a wetland area where water coming from the drainage system can be storage, filtered and then slowly released to the creek. The benefits include water quality by filtrating any pollutants coming from streets and buildings runoff, minimize bank erosion, and reduce water flow into the creek.

Figure 39. Stormwater Treatment Basin at Qunli Stormwater Park in Heilongjiang Province, China. Source: City of San José, GSI Plan

Figure 40. Integrated treatment and ponding area in Hassett Park in Campbell, Australia. Source: City of San José, GSI Plan

87 City of San José, *Green Stormwater Infrastructure Plan*, September 2019.

Green features. To complement the stormwater treatment facilities, it is recommended that developments include green infrastructure such as green roofs, rain gardens, and permeable pavement to minimize water runoff.

Green roofs are vegetated roofs that absorb rainwater, filtrate it, and release slowly. These roofs can be installed in different developments such as multifamily, residential, commercial or industrial buildings. Although its installation required additional structural support and maintenance, they provide insulation, noise reduction, and aesthetic features. Figure 41 shows the existing green roof in the Academy of Science in San Francisco, CA.

Bio-retention areas retain and filter stormwater. Bio-retention gardens can be used in yards, plazas, parks, rights of way, parking lots, and other landscape areas. They consist of a vegetated surface layout on a layer of different type of soils such as sand, compost, and bedrock that filtrate water and remove pollutants from runoff while reducing stormwater volume. Figure 42 shows an example of the biofiltration system in the De Anza College.

Permeable paving such as pervious concrete, turf, and porous asphalt reduces runoff volumes, improves water quality and groundwater recharge. It can be used in parking lots, driveways, plazas, sidewalks, and bike and pedestrian paths.

Menomonee Valley redevelopment transformed an abandoned industrial corridor into a center of work, entertainment, and recreation by combining landscape and stormwater. The project team used special soil to remediate contamination and elevate the site to keep the future development out of the floodplain area. Native trees and vegetation were added to the site to protect and improve the river area. Also, recycled concrete from the site was used to create stormwater infiltration beneath the treatment wetlands. The combination of landscape design, green infrastructure, and recycle of existing materials can be applied in the BBUV site. The current flea market area sits on pavement, this concrete can be treated and use in the future for trial pavement and bedrock for stormwater treatment or planting areas.

Figure 41. Green roof in the Academy of Science in San Francisco, CA. Source: www.ecourbanhub.com

Figure 42. De Anza College - Media and Learning Center, Cupertino, CA. Native vegetation and the bio-filtration system treats and stores stormwater runoff. Source: Office of Cheryl Barton (O|CB)

Garbage on riparian corridor and creek. One of the main issues for water quality is the quantity of existing trash in the channel. Along with safety measurements, trash removal is key to maintain water quality, minimize water and habitat pollution and allow water to flow continuously. Creeks clean-up programs for residents, neighbors and volunteers can be implemented to help maintain the creek habitat integrity.

Figure 43. Volunteer Creek Clean-Up Event Flyer organized by Kelly Park Disc Golf Course in 2019. Source: www.svdgc.org/

Community connection with natural resources. In an effort to improve water quality and highlight the stream enhancement techniques it is essential for neighbors and visitor to have a close interaction with the creek. Although access to the creek will not be allowed, areas for plant and bird watching, outdoor classrooms, and educational panels can help to entertain and teach the community the value of the creek, its riparian corridor, and the history of the site. Additionally, programs such as "Adopt a Creek" or similar can be planned to help maintain the site and give the residents a sense of ownership.

5.4 Recommended Actions

- *Buffer, riparian corridor and floodplain: proposed a 100ft buffer along the creek to connect the creek and its floodplain and allow the development of a continuous riparian corridor.*
- *Use of landscape and riparian corridors for stormwater treatment.*
- *Include green infrastructure throughout the site to minimize water runoff*
- *Community connection with the natural resources to enhance the value of creek and site*
- *Reduce trash on waterways by encouraging regular cleanup events*

5.5 Interaction with water

The undeveloped creek corridor provides designers with a unique opportunity to develop an ecologically open space and natural riparian corridor, offering residents and visitors a pleasant place for recreation and education. Although the BBUV plan proposed urban parks and recreation areas within the urban village, the water edge along the creeks should vary according to adjacent uses.

Habitat improvements. Prioritize future habitat improvements along the creek and protect the river habitat. As development areas increase along the creek and the area becomes increasingly populated, wildland will be a valuable resource to the community. Programs that support recreation and habitat restoration at the same time can be planned. Specific sites can be identified to allow recreational activities such as picnic areas, playgrounds, while other areas can be designated for conservation and restoration programs.

Creek site visibility. Areas with open views to the creek and riparian corridor are recommended for safety reasons but also for aesthetic and educational purposes. Similarly, to the case studies, the BBUV development could add social amenities, educational and recreational areas within its open space to encourage the community to enjoy the natural resources. Even though direct connection to the water will not be allowed for safety and water quality reasons, the riparian corridor can offer an excellent place for the community to enjoy.

To address the design recommendation, the proposed site plan assigns designated areas for creek overlook, decks and paths where the public can access without interrupting the natural environment. The creek overlook paths intent to visually connect the public with nature. In addition, and overlook terrace is proposed at the creek confluence for recreation and educational purposes.

Open space areas. The creeks will remain with natural and wild vegetation for restoration purposes and ecological enhancement. Some areas will be designated for educational engagement, outdoor classroom, and wildlife and plant observation, and would be less congested than other open areas. Areas adjacent to the water will have limited access and will be designated for habitat and wetland restoration.

Although closeness to the creek is not recommended for habitat enhancement, spaces that break the monotony of the trail can be designed by integrating benches, picnic tables, stationary spaces or meeting points. These recreational and restoration areas can be delineated by using natural elements such as shrubs, stones, logs or short fences and have signs indicating access points.

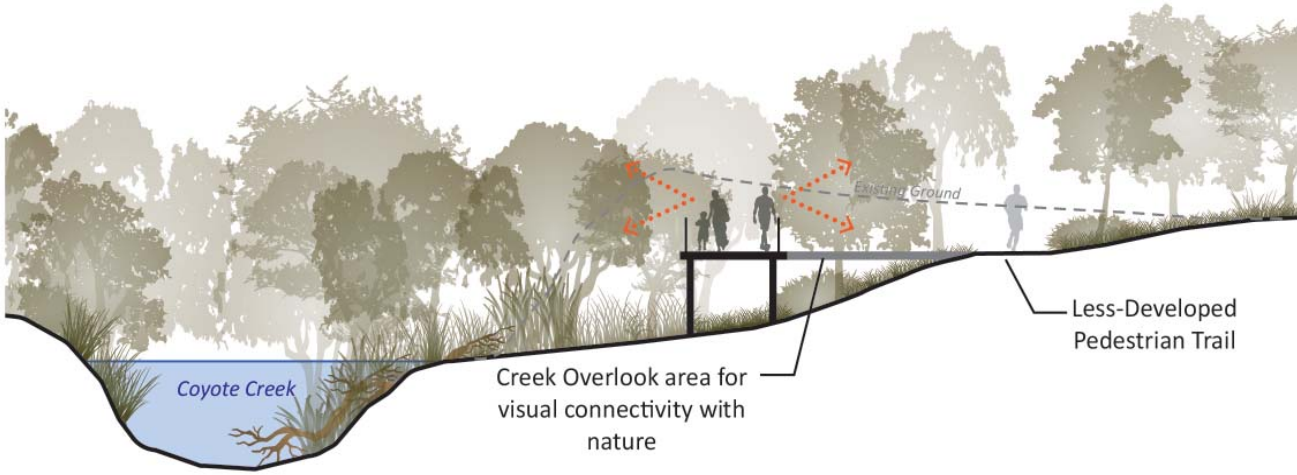


Figure 44. Overlook path for visual connectivity with the creek and nature. Created by the author

5.5 Recommended Actions

- *Creek overlook decks and trails*
- *Overlook terrace at the creek confluence for recreation and education opportunities*
- *Prioritize habitat improvements along the creeks*
- *Sector areas for people to get a better view of the creek and the water and integrate daily use features*
- *Use natural elements to delineate specific areas: trail, recreation, education or restoration areas*
- *Keep native and heavy vegetation near water streams*
- *Educate visitors to value the natural resources*
- *Provide creek site visibility*

Figure 45. a. Creek visibility from pedestrian path.
Source: www.waterfrontoronto.ca
b & c. Benches and rest areas made with natural resources.
Source: www.landscapeperformance.org and www.inhabitat.com

5.6 Safety

The perception of safety is one of the main challenges for the site. The presence of informal settlements and homeless encampments along the creeks is one of the most critical issues in the area.

Light fixtures. Lighting will be an essential element along the trails and site, especially in the underpass of Berryessa Rd. Light fixtures must meet brightness standards and be located every 50ft on trails. Additional pedestrian and emergency lighting is recommended near transit stops and street crossing. Along with lighting, emergency call boxes should be located every quarter mile or so. Security presence or monitoring system should be provided on regular basis to provide a sense of security to the users, mainly in dark hours.

Signs. Wayfinding and educational signage should be standardized with universal iconography and text on different language, for example, Spanish and English should be used. These wayfinding and other signs should be made on a resistant material and be vandal-resistant structures to minimize damage risk. Also, colored concrete or painted signage on the trail are good ways to minimize vandalism on signage.

Enhance the creek side visibility. To minimize vandalism, trash dumping and illegal encampments it is necessary to have a clear visibility to the creek channel and riparian corridor. A clear view from the trail to the riparian corridor will allow security to alert of illegal encampments to proper authorities.

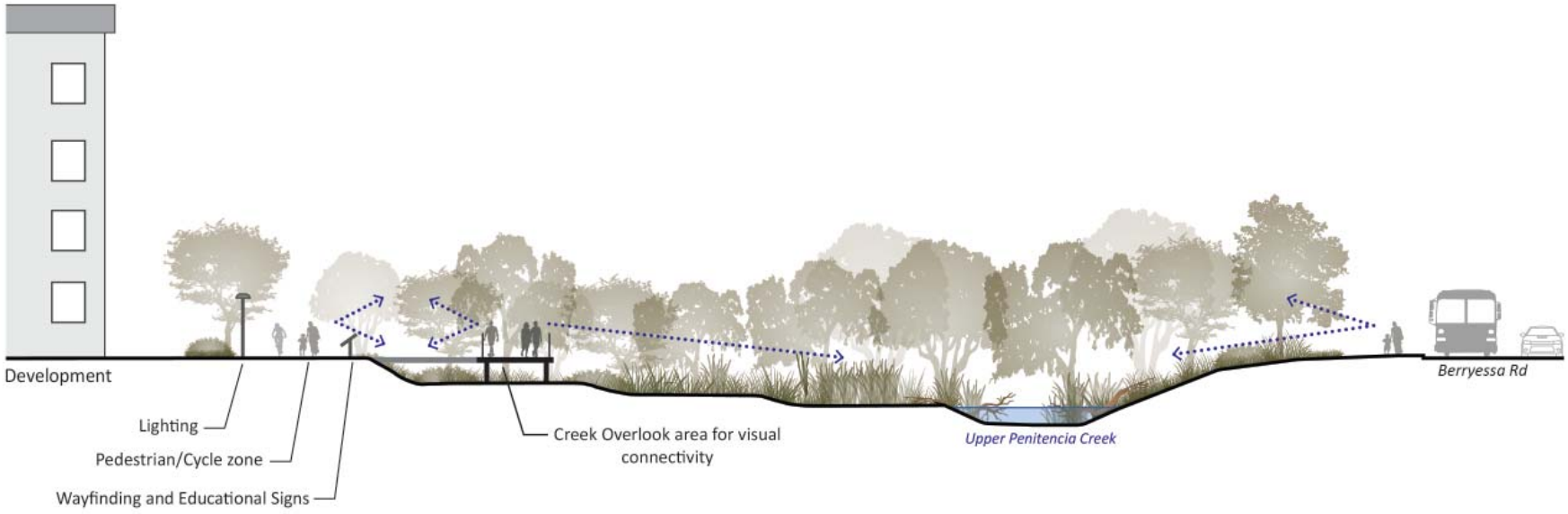


Figure 46. Safety features and creek visibility along Upper Penitencia Creek. Created by the author.

Figure 47. Way-finding signs and educational signs along the trails and in stationary areas.
Source: www.tangelocreative.com.au and www.snyder-associates.com/

Figure 48. a. Light fixtures along the creek trail, illuminating the pedestrian and bike trail. Source: Atlanta Betline Eastside Trail - Curbed Atlanta

b. Ligthing design that can be applied on the public plaza or overlook terrace. Source: www.i.pinimg.com

c. Lighting along the the pedestrian bridge. Source: www.lampartners.com

5.6 Recommended Actions

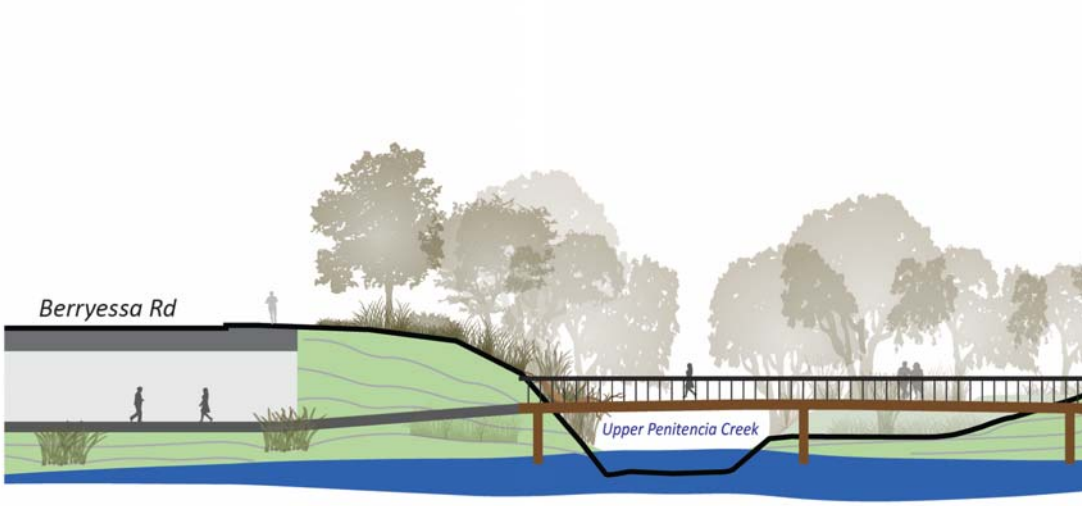
- *Install lighting, emergency call boxes and monitoring systems along trails and the urban village*
- *Provide clear wayfinding signs with universal iconography*
- *Enhance creek side and riparian corridor visibility*

5.7 Design elements and amenities

Healthy urban creek corridors provide an important aesthetic and recreational value to the community allowing them to connect with nature. For this project the connection with the creeks provide not only social and environmental benefits but also economic benefits and connectivity with the rest of San José. Pedestrian and bike trails along the creeks allow the residents to connect to and from the transit hub to downtown and other neighborhood in San José, while providing recreational space for outdoor activities.

Amenities. Although the proposed plan for the urban village accommodates retail spaces throughout the site, it is necessary to provide the community with public areas and facilities where temporary local producers and markets can be allocated. Also, pop-up fairs, food trucks, and farmers markets can be stationed along the corridor attracting people during the weekend or some days during the week. Additionally, small coffee shops or food stands can be located along the creek corridor to serve trail users and decentralize people within the urban village. Neighbors that are walking, jogging or biking can stop by these shops to get a refreshment in a peaceful open space without getting into the retail area within the urban village. Likewise, outdoor fitness equipment, bicycle racks, and art exhibitions can be display throughout the urban village and creek corridors. The site will attract workers and commuters mostly during the weekdays, meanwhile recreational programs could be planned for weekends, such as farmers markets, fairs, music in the park, etc. Figure 49 illustrates some of the amenities and features that can be incorporated throughout the site.

Similar to the Sioux Falls case, areas adjacent to the river were designed to gather people, created a recreational destination whether for small or large events, and allow business and retails to develop. To create a place for people to spend time and enjoy, it will be necessary to provide sanitary amenities, formal and informal seating areas, stationary areas and informational signs for the park users and visitors.







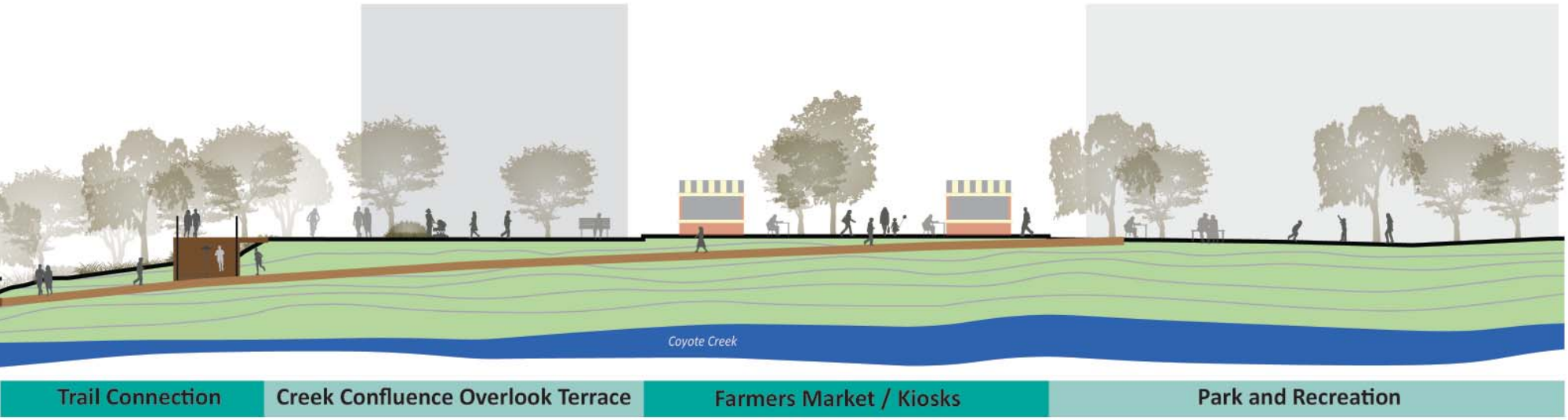



Figure 49. Cross section at the confluence of Coyote Creek and Upper Penitencia Creek and amenities that can be incorporated throughout the site

Figure 50. Conceptual site plan and design elements. Created by the author.

Figure 50 illustrates some of the design elements and amenities that can be incorporated into the site. Besides providing sanitary amenities and safe areas for gatherings and recreation, public areas are intended to provide the community with features that highlight the history, character and identity of the neighborhood.

5.7 Recommended Actions

- *Provide sanitary amenities and meeting points*
- *Offer recreational and gathering areas for events during the weekend, such as farmers markets, fairs, etc.*
- *Allow the location of coffee or food stands along the creek trail corridor to decentralize the retail space in the urban village*
- *Incorporate features that highlight the community character*

5.8 Planning and management

Stakeholders Coordination. Due to the multiple stakeholders, agencies and governing bodies that will participate on the site development, it is critical to ensure the coordination and management between the different entities. From a planning perspective, urban development and stream enhancement needs an interdisciplinary team where engineering, ecologists, landscape and urban designer's efforts align. Furthermore, these agencies should plan and coordinate efforts to complement their objectives and work plans, while reducing construction costs and time.

Even though the city is working on the design guidelines for the BBUV, it is critical that a regulatory agency or a neighborhood committee oversees and monitors the performance of the project. Public participation and engagement should continue during the planning, design and construction phases.

5.8 Recommended Actions

- *Coordination and clear communication between stakeholders*
- *Regulatory agency or neighborhood committee to monitor all phases of the project*
- *Community engagement*

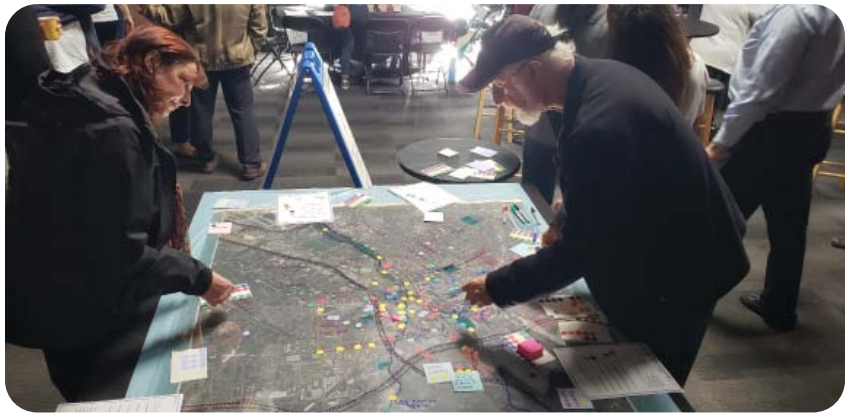


Figure 51. Community workshop with local residents and stakeholders about the future of the Diridon Station Area. Source: SJSU - URBP 295 - Fall 2018

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6

CONCLUSION & FINDINGS

Upper Penitencia Creek Trail. Source: San Francisco Estuary Institute (SFEI)

6.1 Conclusion and Findings

The proposed design guidelines for the BBUV and creek corridors provided in this study represent merely one-step toward urban development and stream enhancement. The recommendations focus primarily on the stream enhancement strategies that may be feasible in the efforts to enhance creek functions, provide flood protection to the emerging and exiting neighborhood, and enhance network connectivity within the BBUV area and San José. Although this study focuses in one small reach of the Coyote Creek and Upper Penitencia Creek, a holistic study and plan is necessary at the watershed scale to identify the specific threats affecting the river and provide better techniques for environmental benefits, fish habitat and flood protection. None less these design guidelines would serve as a starting point for future research and design.

The creek restoration in urban setting involves risks, challenges, ecological and social constraints. However, urban developments that include this natural resources as part as their design can also increase social and economic benefits by providing recreation and job opportunities, while improving the creek habitat. The integration of ecological, social and economic aspects provide the framework for future developments throughout the city.

The projects revealed even though challenges and constraints exist; planning, coordination efforts led to a successful project. The riverfront restoration projects analyzed in chapter 4 gave the author the insight for the recommended design guidelines for the BBUV site. From urban development, soil remediation, to social and economic benefits, these projects successfully convert unutilized brownfields into environmental friendly areas. Thus, providing the community with flood protection, and a place to work, live and enjoy. A combination of topography, landscape work, riparian buffer, creek and floodplain connections all help to enhancing the creek habitat, water quality and stormwater treatment. Last, the incorporation and extension of pathways and trails provided better connectivity and the enhancement of urban developments for future benefits.

Although the historical San José Flea Market will be removed and there are uncertainties of where the market will be relocated, stands can be display within the urban village to benefit local producers. At the same time, it is necessary that the city regulate housing prices to minimize high cost of housing within the neighborhood once the urban village projects is completed. Displacement and gentrification should be minimized as much as possible and the history and culture of the neighborhood should be celebrated.

While the proposed Market Park would accommodate office, housing, retail and open space, it is very important that the creek and landscape buffer be maintained for the proper work of the riparian corridor and creek channel.

6.2 Limitations

The study offered design recommendations for the site and creek restoration, but it is limited to the specific hydrological studies where current flow volume, channel widening and depth, floodplain slope, etc. are analyzed in detail. Further engineering studies should be made to evaluate street crossing over the creeks and the confluence of Coyote Creek and Upper Penitencia Creek.

Due to the multiple agencies and stakeholders involved in the project, it is necessary that their work is coordinated and that they integrate planning and management effectively to help to allocate staff and money.

Furthermore, the study analyzed the east side of the Coyote Creek and the lower reach of the Upper Penitencia Creek. It will be necessary to extend the study area to the watershed level for a comprehensive study and holistic restoration.

Four case studies were analyzed to highlighted the best practices for flood protection, urban development and environmental benefits; however, an ideal study would analyze these projects in depth, monitor their performance in different times of the year, and evaluate the design effectiveness.

Thus, the design recommendations presented in this report provide a guide of the features that should be consider in the project design and creek rehabilitation work. Constant maintenance work needs to be done to guarantee the correct function of the design and to evaluate and monitor the riparian and creek performance, sediment inputs, stormwater treatment and flow volumes.

Preventing creek damage is more efficient and cost-effective than restoring damaged waterways functions, for that reason it is necessary that the negative impacts of urbanization be minimized by creating an integrated plan that can accommodate urban infrastructure and aquatic ecosystem simultaneously. Land use and policies can reduce the number of developments in floodplains and help protect public safety, reduce property damage, preserve natural floodplain functions, protect streams, and restore aquatic habitat.

Through the analysis of research studies and riverfront projects, it should be emphasized that with the right planning and design strategies the BBUV can be a success as both a transit-oriented development and a riparian zone for the city of San José.

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