AUM QASR VALLEY ENVIRONMENTAL REHABILITATION PROJECT
A CONNECTION TO AN ELEVATED URBAN FABRIC

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Abstract

Natural drainages systems are known to be important areas for recreational uses and ecosystem productivity. However, they can cause significant problems such as poor water quality and soil contamination if they are left degraded and unproductive. It has been shown globally that such areas near development can bring various advantages to human interaction with the landscape and enhancing the quality of natural habitat, when rehabilitated. Valleys in the city of Riyadh have undergone dramatic degradation with a continuous uncontrolled exploitation. Environmental rehabilitation strategies have been established by local agencies to bring back such degraded areas to serve the city drainage system and community livability. The main focus of this project is to involve landscape architecture planning and greenways techniques to create a master plan that interprets convenient rehabilitation solutions to the site conditions and habitat. Establishing an informed master plan is intended to connect people with their adjacent valley, create a sense of place, and improve the natural valley appearance.

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INTRODUCTION

Project Significance

Aum Qasr is one of the natural valley watercourses running on the southwest side of Riyadh, Saudi Arabia. It is considered to be one of the most significant depressed natural areas in the Plateau of Najd, in which the city of Riyadh was built upon. The valley is a tributary of the Hanifah Valley, which is the largest natural area in the city. The underutilized site is located between different neighborhoods from which all the sides give the valley a significance for further development. This rehabilitation development will provide the people in the city with a unique destination and a rehabilitated natural landmark within the urban fabric. Due to the fact that there is a lack of water resources in this arid region, and a high dependence on the desalination plants, the natural areas within the city need to be rehabilitated with their primary environmental functions in mind. The valley bed features need to be rehabilitated to control the discharged water generated from street water runoff and the rising of groundwater levels. Beside its environmental function, the new development will include trails connected to adjacent neighborhoods, recreational activities and other amenities.

Why should we care about an urban natural valley?

- Attract many user types
- Improve the water flow entering the valley bed
- Eliminate the negative impact of dumping solid and liquid wastes
- Promote preservation and educational awareness
- Integration into the life of the adjacent urban fabric

Research Question

How can an underutilized depressed valley adjacent to neighborhoods be designed to rehabilitate its ecological function while enhancing the overall recreational activities alongside the site?

Goals and Objectives

Provide recreational activities and public engagement

- Establish a connection between natural valley and neighborhood
- Create linear recreational movement
- Engage people to move and interact with the natural valley

Rehabilitate valley natural function

- Rehabilitate valley upland edges to minimize erosion and waste dumping
- Make natural desert features in the project

Integrate stormwater management solutions

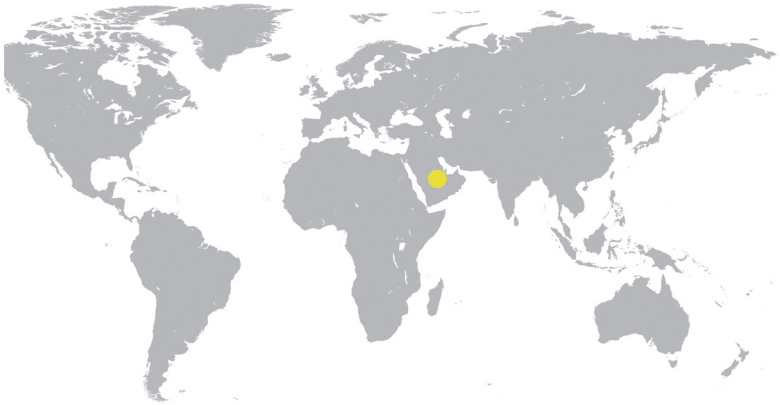
- Treat surface water runoff
- Improve stormwater outlets

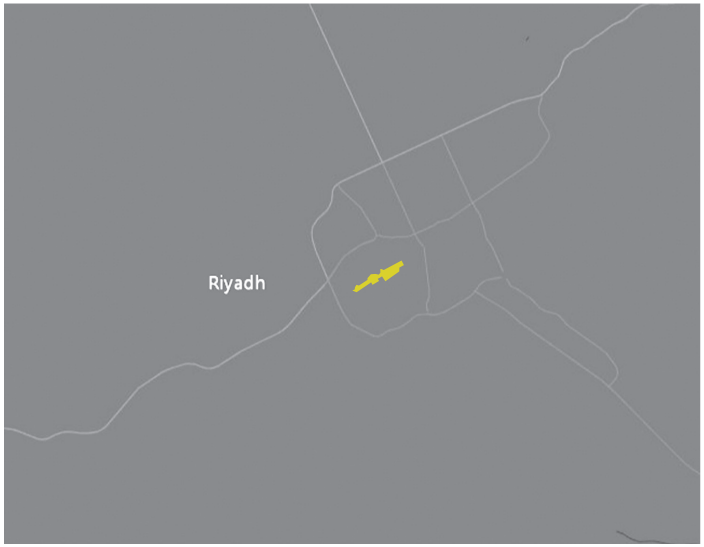
Improve human comfort outdoor

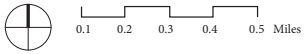
- Create microclimate areas to alleviate heats and in the summer days
- Install shade structures for relief and valley viewing

Site Location

Aum Qasr Valley is located in the west side of the city, near the Hanifa valley. The valley is surrounded by a gridded urban form consisting of a blend of residential and commercial parcels. The current condition of the Aum Qasr site is neglected and has remnants of industrial activities and waste elements. All the valleys and its natural basins are important ecological zones need to be protected. In the past, some parts of the valley were used as agricultural, recreational, cultural hubs. Also, they were used as a sustainable resource for food and water. However, the existing valley is a continuous ribbon of degraded land that interconnects the valley and urbanized areas.







- Site stretches for about 4 miles
- The valley cuts through a plateau of sedimentary bedrock
- Upland is empty and eroded in some parts

LITERATURE REVIEW

The literature review is comprised of three main categories which are related to the project site development. The first section examines the environmental rehabilitation strategies that are associated with the site location and the needed solution applications. Strategies will examine the integration of valley naturalization solutions in terms of soil stabilization and valley revegetation, which in turn will improve the natural drainage system of the habitat. It will inform the design process to remediate the site and solve the environmental problems. The second section studies the linear greenways along the valley while also looking at how such an area could be enhanced to bring aesthetic elements, human interactions, and protection to the natural valley. This area is significant for humans to find recreational and educational opportunities as well as an alternative environment for the lack of the open green spaces in the city. Pedestrian and bicycles friendly areas will be introduced to the site to compliment open public parks. The third section will examine water management solutions to control seasonal water runoff coming to the valley from adjacent urban watersheds. The most problematic effect is an increase in the impermeable surface areas within the urbanized portions of the site, which changes the natural drainage system of the waterway. Reviewing a framework for establishing water management solutions that deal with urban catchment areas and controlled surface water movement is essential to achieve our goals of a successfully rehabilitated valley.

Urban Valley Rehabilitation

Environmental rehabilitation refers to the reparation of degraded lands that are not environmentally functional. One primary goal in a rehabilitation approach is that it needs to restore the ecosystem productivity to serve the community and people in a short period of time. In contrast, “a rehabilitation project resembles a restoration attempt in adopting the indigenous ecosystem’s structure and functioning as the principal models to be followed, insofar as they can be determined or guessed” (Aronson, 1993). This improved ecosystem can be achieved through rehabilitation strategies followed by a succession of plant and animal communities. It involves the process of energy flow and nutrient cycling to occur and to sustain the human interference (Aronson, 1993). Generally, some practical solutions need to be integrated in an attempt to achieve goals of rehabilitation on the site. When soil becomes eroded in stream valleys or wetlands, the sedimentation it leaves on the terrestrial and freshwater environment can cause degradation in the natural habitat and water quality. Also, soil erosion cost is being increased worldwide because of the loss of soil productivity. The eroded soil has a direct negative impact that causes the destruction of waterways, infrastructure, and the overall unhealthy environment.

The increased amount of sedimentation being assembled by eroded soil results in the blocking of the drainage channels, flooding, and causes water to become unclear or murky. The lack of vegetation cover is another factor that can cause soil erosion. Sloping lands that are left untreated by vegetation cover have an increased tendency for runoff, which increases the problem of soil erosion during the rainy seasons (Marsh, 2005). To understand how an environmental problem such as the soil sedimentation, we need to look at the big picture and try to understand how such a problem may arise. “A soil erosion-sediment transport system is made up of four essential components: erosion, transport, storage, and export" (Marsh, 2005). Transport is the movement of soil particles by runoff from its erosion source, to an area where particles can be stored or exported. Storage is an area where the bulk of sedimentation is assembled. Once the deposition of sediment is moved, this process is called export. Also, when sedimentation is accumulated near erosion areas, there will be a greater impact of soil erosion. A good solution is, “controlling the linkage between sediment sources and transport processes; mainly channel flows in swales, ditches, and streams that can distribute the sediment down the system and over large areas” (Marsh, 2005).

There are four primary factors that contribute to soil erosion. They include, “vegetation, soil type, slope size and inclination, and the frequency and intensity of rainfall. Rainfall and the runoff it generates are the driving factors, whereas vegetation, soil texture, and slope are the resisting factors in the system" (Marsh, 2005). The possibility of having land eroded is associated with the slope in which water flows over it. Slope can increase the flow of water runoff because the water in an inclined and high land will have a vast amount of mass and velocity. Vertical cliffs are an example of extremely steep slopes where an incline of 50 degrees or more will cause rapid runoff and in turn degrade the soil even further (Marsh, 2005).

“A bank stabilization strategy can be viewed as two pronged, with structures that minimize impairments to vegetative growth used to provide shorter term stabilization and, vegetative planting implemented to provide minimized erosion rates for the longer term” (Yochum, 2015). They both can produce a notable relief of flow velocity of water and slow down the rate of sedimentation to a stream.

Basic plant structures such as leaves and branches can minimize the speed of rain and its dynamic energy and therefore, the loss of soil will be reduced. Also, when a layer of soil contains organic litter and plant debris, it can absorb the dynamic energy of water. This can be achieved through proper tree canopies that provide shade, and in turn, they can reduce the soil moisture evaporation. The extension of plant roots below the ground surface and surface debris strengthens the soil. This rough ground surface will eventually become a barrier, thus slowing the flow velocity and energy input into the ecological system (Dewberry, 2008). The density of cover plays an important role in controlling erosion whether it is in the shape of tree canopies or accumulated groundcover. Additionally, erodibility could be decreased when the soil particles are bigger; an example of this is that of bigger pebbles and stones that need a high velocity of water to move them apart (Marsh, 2005).

In areas where possible erosion could occur along streams, the need to integrate solutions such as filter strips or low-high grasses, and ornamental vegetation that blocks water from entering the streams are necessary. Also, the main advantages of such elements can make a healthy wildlife habitat. By collecting sediment and organic materials, vegetated areas help create a buffer between watercourse and the sources of its contamination. For example, herbaceous plants are necessary types of vegetation that can trap and filter contaminated elements (ADEQ, 2005).

“Grasses, ground cover, shrubs, and trees can effectively protect the soil provided the slope is not steeper than three horizontal units to one vertical unit and the water velocity is not more than five feet per second.” The plants should be native to the natural area with properties of rhizome type roots and should be drought tolerant. In difficult areas, such as steep slopes, a geotextile fabric should be placed and anchored to the soil before the vegetation is planted (Skipwith, 2010). Moreover, plants could be selected in different vegetated zones across the waterway. Where there is a higher potential for flooding, the need for heavy vegetation is desirable so that the plants may have the opportunity to regenerate the ecosystem (Skipwith, 2010).

The vegetated buffer along the stream valley has a variety of plants in terms of their function. The first zone adjacent to a stream should have vegetation that helps control flooding and reduces pollutants, and overall, enhance the stream ecosystem. The second zone, which is further away from the stream bed, could be characterized by plants that are used alongside recreational activities which could be near natural trails and bike paths. In such areas, the plants need to survive and do well under shade conditions or intensive sun. The vegetation in the third zone exists in areas that divide the natural areas in between residential blocking. This vegetation could include lawns, gardens, and stormwater basins to help infiltrate and collect street water runoff (Hudson, 2010).

The introduction of afforestation strategies and reseeding from intact-plants in the ADA greenhouses, showed a successful thriving and regrowing in this natural area of the Hanifa Valley. Moreover, there was an effective way that they have transformed the valley bed into a lush area. This process has been done through the distribution of planting cells along the bare areas that would eventually seed and regrow in a large scale (ADA, 2010).

There are some native plants that provided a successful adaptation in the natural areas in Riyadh, which include plants such as, “Acacia gerrardii, A. raddiana, A. ehrenbergiana, A. tortilis, Rhazya stricta, Lycium shawii, Pennisetum divisum, Lasiurus scindicus, Ochradenus baccatus, etc” (Thomas, 2011). There are other plants that have been introduced to this area that have been considered to be a positive input into the Hanifa Valley ecosystem, and those such plants are, Pennisetum setaceum (Fountain Grass), Acacia farnesiana (Sweet Acacia), and Bouteloua curtipendula (Sideoats Grama). These plants in other areas of the project located far from the stream valley showed the establishment of low maintenance and low-water use.

Grade stabilization structures are another type of rehabilitation strategy. These structures are durable in their resistance to water flow velocity. They also protect the bank and its grade alignment from slumping away. This structure typically borders the stream valley where its edges are exposed to erosion and causes soil degradation. They consist primarily of stone to form hardened structures. They include“ rocks, drop structures, concrete or riprap chutes, gabions, pipe drop structures, diversion ponds, water and sediment control basins, or the use of bio-logs” (ADEQ, 2005). Stone structures in streambank restoration projects have been noticed to be successful solutions in restoration design. Rip rap is built in a way where its high bulk weight adds to the ability to cohere together, providing a natural stream protection. These structures provide effective solutions that are often combined in areas of unstable slopes or at the toe floodplain to minimize erosion. The toe areas are critical in terms of protection because of their high possibility of erosion. They can be built in shorter periods of time where vegetation establishment may take a longer period to effectively accomplish the same task. They are also stronger in enduring high stream velocities.

A hydraulic analysis is sometimes used to measure the stream flow so that a proper selection of rock size can be integrated into the project (NRCS, 2007). Additionally, vegetated rock walls are another type of measure in that they can provide a durable structure used for surface erosion and natural aesthetic elements. “This system is appropriate at the base of a slope where a low wall may be required to stabilize the toe of the slope and reduce its steepness” (NRCS, 2007). Check dams constructed of lined stone structures across the stream is yet another way of stabilizing soil and aids in trapping sediment. They are durable structures that can withstand the force of extraordinary water velocity. Water penetrates slowly through the check dams and then reduce its speed.

“The decrease in the slope of the hydraulic gradient lowers the shear stress, thereby reducing the erosive forces” (Skipwith, 2010). Beside the environmental solutions necessary in rehabilitation, the aesthetic elements in natural areas are essential in which that they can emulate the surrounding native lands. The local materials and landscape are characteristic in which they shape the identity of place (Sawyers, 2007). The natural elements that exist in the local landscape can provide inspiration that can be applied in future projects. The phenomena seen in water movement over cliffs or terraces of stones in an area can be used as an aesthetic prototype in landscape design. Looking at the surrounding landscape and how it is composed can illustrate a picture of inspiration for the design. For example, the mountains, cliffs, and vegetation around the natural areas are elements we need to learn from so that they can contribute to aesthetic design decisions (Sawyers, 2007).

Greenways

An Overview of Greenways

A greenway can be defined as a linear corridor surrounded by a densely vegetated area relative to open spaces (Flink, 1993). Another definition describes it as a natural corridor that extends over the ecosystem and then connects two different landscape images, a stream for example and a path for human or animal movement. The movement along the greenway provides an accessible connection to multiple open spaces such as recreational uses and access points for pedestrians. Thus, enhancing such natural areas will preserve the remnant of the landscape features such as green areas or water corridors. When we think about developed natural areas, its overarching goal is that it will revitalize the urban waterfront to provide a comfortable pedestrian movement and experience within the protected landscape alongside (Flink, 1993).

There are varied aspects for developing stream valley areas with its adjacent walkways that will provide opportunities for enhancing the ecological value to promote stream water quality while bringing a unique experience for visitors and neighbors alike. The revegetation of the valley bed with natural vegetation may also help restore wildlife habitats and create a complex and interesting biodiversity along these greenways. To understand how greenways can be a design guide for enhancing the Aum Qasr Valley, it would be essential to understanding the five types of greenways.

1. Urban Riversides
It is a greenway developed along underutilized city waterfronts.

2. Recreational Greenways
It is a path extended along natural corridors, can be located alongside neglected rail-beds, or public-right-of-ways.

3. Ecological natural corridors
Usually, They occur in the natural areas that have a significant function in the ecosystem along rivers and streams, in which wildlife species move and human interactions may be experienced by some sort of activity, one such as a hike.

4. Scenic and Historic routes
greenways are extended along roads, highways, and water courses to keep pedestrians safe from car paths.

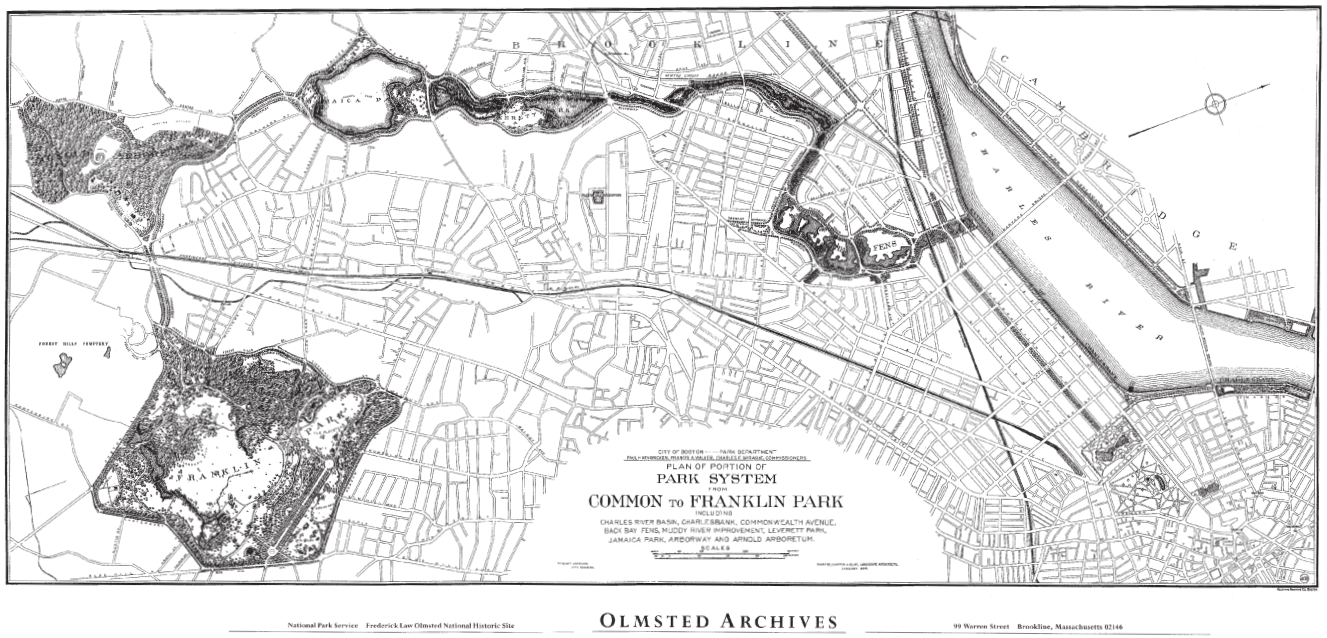
5. Comprehensive Greenway Networks
They can be developed areas in the shape of green infrastructure that have been combined from separated open spaces and greenways (Little, 1990). These greenways can benefit the community in a larger contextual framework and can preserve vital missing habitats through the creation of an environment that has a diverse plant and animal species palette.

Additionally, greenways have a unique function; they can help to absorb and filter contaminants from street water runoff. Within the urban setting, greenways will provide people a unique and separated environment that includes accessible ways to move and reach different destinations in the neighborhoods. Its trails will be popular for walking, jogging, relaxing in a way that to be an alternative haven of a polluted and congested neighborhoods. Moreover, they will provide alternative routes for commuters going to school or work, where this will reduce the heavy local traffic highly (Flink, 1993).

Urban development is known as a major threat to natural areas and fragmentation. As urban development increases, a huge amount of im-pervious surfaces will replace the natural landscape. Human activities and uncontrolled street water runoff will generate a negative impact on valley formation and vegetation. Water, in manmade structures such as storm pipes, has high overflow movement which has an increased negative potential to carry sediments as it flows. This type of water flow and sediment accumulation can be detrimental to natural landscapes (Smith,1993).

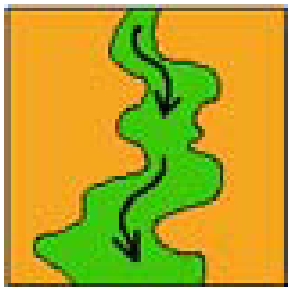
A Brief History of Greenways

Greenway is a new term that arose about the 1950s. Unlike the design of linear open spaces, they had been recognized for a century before the term greenway emerged. The concept of a greenway was crystallized by Fredrick Law Olmsted in his design of linear open spaces and its potential connection to city parks and neighborhoods. He linked separated parks to each other so that people could find access in between. His first vision of linking such areas was in California 1865. Later, Olmsted had applied his design in reality, which was later immortalized in his Brooklyn Prospect Park. This project was to be linked between Central Park and Coney Island. Parkways had been linked between Coney Island the ocean parkway. Olmsted and Vaux have shown a successful design of connected linear parks and open spaces in Buffalo and Chicago. They focused specifically on social and aesthetic issues, while, in Emerald Necklace, located in Boston, Olmsted emphasized the solving the problems of drainage and water quality. This resulted in a significant enhancement of flood storage, waste disposal, and the linkages to adjacent neighborhoods (Smith,1993).



Emerald Necklace park system 1894

In 1970, a major comprehensive greenways plan was revealed when a student at North Carolina State University worked on a streamside park project. He proposed a network of greenways that would move across the city's neighborhoods. His main focus was to implement solutions on the ground where a focus was placed on issues of the floodplain, easements, and path locations. Additionally, the concept of linear open spaces would host unique recreational activities while, at the same time bringing an appealing image through the presence of a vegetated buffer and overall healthy environment (Little, 1990).



Greenways as conduit used for human or animal to move in the landscape

The Function of Greenways

As the urban areas and its sprawl have negatively affected the quality of natural areas, there was a great chance that urban problems could be mitigated through greenway development. Greenways could deliver clean water to waterways and help to mitigate excessive heat through the process of plant evapotranspiration (Smith, 1993). Greenways can be integrated with natural areas to link multiple open spaces. Thus, nearby neighborhoods and businesses would thrive because it would bring multiple opportunities for recreational activities and ecological advantages. The linear park or greenway and its shapes host amenities for people and the increase of vegetated cover would make an urban setting desirable close to where people live.

Greenways as a source of water or food for species

Greenways in Urban Settings

Environmental degradation can be solved by integrating a successful greenway strategy that would eventually improve the overall natural drainage of stream valleys and recreational spaces. Greenways are a main focus in urban areas because of the high percentage of residential built lands. Urban areas can utilize greenways to serve as walkable trails and support to restore the missing natural and cultural characteristics of the site. Additionally, the recovery of some waterfront areas, not only used for public use, but also as a flood mitigation strategy through design of parklands with built-in flood storage (Walmsley, 1995). Trails are considered a main component of greenways. Trails can be on land or water, serving a wide variety of purposes, such as passive and active recreation, alternative transportation, and infrastructure maintenance" (Flink, 1993). These issues are important to consider for implementing successful greenway strategies. They include:"

- The type of users
- The type of trail: land or water based, single or multiple-user oriented
- How the trail will fit into the existing natural landscape
- The type and width of the trail tread
- The type of tread surface
- The type of the trail user "
  (Flink, 1993).

Community needs should be considered so that trails can accommodate desirable needs and demands. The most common type is that of a community-oriented pedestrian trail. This pedestrian trail would provide a convenient place for hiking, biking, walking, jogging, and picnics. Such a natural area would be isolated in a way that pedestrians can find a safe and pleasant corridor free of traffic and polluted urban areas (Flink, 1993). One popular type of trail is the one running through the urban landscape or waterways. They are usually defined by the condition of the trail and its width. The design of the trail would depend on the user and what the trail is intended to accommodate. Mostly, single path, it can be made to accommodate many different types of uses. Uses of such types of trails can be distinguished by striping or signing the path surface to suit the pedestrians interest and function (Flink, 1993).

The overall construction of a trail should integrate other features, including amenities, landscape vegetation, and interpretive signage. The interpretive signage provides an easy way to identify the interesting elements on the site. For example, standardized symbols have been used internationally, commonly known as pictographs. “Greenway signs can be divided into six categories: informational, directional, regulatory, warning, festival, and educational” (Flink, 1993). One of the advantages of using such signage is that they give the greenway a unique characteristic identifying facilities and points of interest. On the other hand, besides the natural trail design, they take into consideration the beautification of the greenway which is also essential. This can be made through developing planting plans that adapt and function within site conditions. Using screening vegetation to provide privacy when it is needed, while canopy trees are used to provide shade for areas exposed to extreme sun radiation. Vegetation in the greenway is significant in that they can add a unique characteristic for a place. They can be arranged to shape evergreen canopies and shaded areas to accentuate an interesting outdoor area and create microclimates. Plant types should vary in plant arrangement, color, and growth (Flink, 1993).

Stormwater Management

Another important aspect of studying in the site is water management.The main benefit of integrating stormwater mitigation is to control groundwater recharge and decrease surface water runoff. Also, providing a proper drainage structure or landscape solutions that can mitigate the possibility of getting sedimentation and soil erosion on the trail. Such structure allows water to move underneath or absorb naturally (Flink, 1993).

Surface water and subsurface water issues could be problematic if they are not controlled properly. There are some solutions that could be integrated into the project development to solve the problems associated with water runoff. The first method is known as an open drainage system where water is naturally drained and treated at the surface level. These systems include swales, sheet flow, and ditches. Another system is a drainage way system where a built system can pass through the subsurface level, and may include structures such as culverts, drain inlets, and catchment basins (Flink, 1993).

There are different water management systems that can improve water quality and drainage problems, including structural and non-structural systems. The structural encompassing principles take account of strategies such as vegetated drainage swales, detention/retention basins, infiltration basins, and constructed wetlands. While non-structural systems include a variety of solutions associated with planning policies and land development such as rain gardens, permeable pavements, and green buffer zones (Pazwash, 2011).

The shape of basins have been divided into two main categories, including open basins and underground basins. Open basins mainly focus on the way water can enter naturally on a depressed land. This kind of basin can have different shapes; wet basins, dry basin, and detention ponds. Wet basins are appropriate areas for flood control, can facilitate the infiltration of pollutants, and can be considered as a fragile ecosystem. While the dry basin can be filled with water temporarily during rainy seasons. Thus, the amount of percolated water can be stored and used. Other storm water basins do not appear on the surface land, generally called underground basins and usually utilize engineering efforts to build such systems underground and to install pumps to move water up to the surface (Bergue, 2000).

“Bio-retention is a treatment process that removes pollutants from stormwater through a combination of physical, chemical, and biological mechanisms in a vegetated soil media” (Pima Report, 2015). A rain garden is considered to be an example of a bio-retention system where modified soil in the basin can be reused to improve infiltration. The bio-retention system can be a good drainage system if planted with native vegetation and covered with rock mulch convenient for arid zones. Another major system that could be integrated is a swale. This system can contain vegetation and rock materials composed in a shallow bed. These components are vital in reducing runoff pollutants and diminishing the rate of velocity of water. Also, swales can play an important role in moving the runoff to downstream where other drainage systems exist (Pima Report, 2015). When there is a developed project with an abundance of landscaped areas, swales can be integrated and appear within a lush green area. However, if they exist around a developed landscaped areas, they would preferably be planted with native plant and rock materials to blend in with the natural landscape (Pima Report, 2015).

Dry Detention Basin

Vegetated Swale

The site is seeded with native plants and featured with check dams to catch and infiltrate water runoff

A detention basin is an area where storm water enters and is held temporarily until it slowly moves out through a discharge structure. They are usually lined with vegetation to allow water to soak into the subsurface. Water in detention basins are often not retained for a long period; it needs to be drained properly after a rainfall event. On the other hand, wet ponds appear to be areas that hold water in the shape of small lake. They both are useful solutions in reducing the problems associated with the high rate of runoff and water contamination (Pazwash, 2011). Infiltration basin can also control water quality of storm water. This system infiltrates a certain amount of water known as water quality storm. At the same time, it can drain out an excess amount of water runoff through discharge structure to an adjacent detention basin (Pazwash, 2011). An optimal storm water management system would work better if it integrates a combination of detention and infiltration basins, with underground water cistern. The amount of water being stored in the storage system can be beneficial for irrigation of landscaped areas (Pazwash, 2011). Bio-retention techniques are other types of drainage systems that can be applied close to parking lots, landscape areas, and large buildings. Water can enter these depressed areas and then percolate through different soil layers that employ different uses. The layers include vegetated zones and soil beds where water collects and ends up getting drained out through a perforated pipe at the bottom.

Water harvesting on site

Literature Conclusion

Urban valley rehabilitation

- Rehabilitate urban valleys would reduce contamination of soil to serve multiple human uses.
- The increase of impervious surfaces along the valley heightens the risk of erosion and valley degradation.
- The introduction of native plants and local materials are main components to protect and beautify the valley.
- A watershed boundary should be studied to evaluate the amount of water that enters the valley. By doing this, we can reach to good design strategies that mitigate flooding and erosion potentials.
- Valley remediation and vegetation are proved to improve wildlife habitat and people's livelihood. It increases the number of patches for species to find food and cover.

Greenways

- A greenway along the urban valley provides human linkage to the neighborhood and a conduit for wildlife species to move and disperse.
- Integration of greenway will provide valley water protection by encouraging placements of site vegetation and stabilization features.
- Microclimate zones can be created along the greenway as areas for heat alleviation and environmental education.
- The green corridor offers various recreational activities along the valley such as walkability and connectivity opportunities.

Stormwater management

- Create depressions in the site in the shape of water catchments basins and check dams can hold and infiltrate water into the soil or used for plants.
- The design of detention basin can reduce the water speed and pollutants running into the valley by holding it temporarily and release it again.

CASE REVIEWS

Natural Valleys Beautification

Stormwater Management

Waterways Rehabilitation

Stormwater Outlet and Green Infrastructure

Waterways Stone Stabilization

Check dams and Stones features

The case reviews in the next pages were selected because they are relevant to the research and site problems. The next projects are diverse and show various aspects of integrating rehabilitation solutions and recreation opportunities. Some examples have dealt with stream stabilization and beautification, while other have incorporated areas for human interaction with water and nature. Finally, mitigating stormwater problems were studied. It was important to integrate natural processes and site drainage techniques to manage water close to its source of origin.

Hanifah Valley Rehabilitation Project

Location: Riyadh, Saudi Arabia
Client: Arriyadh Development Authority
Construction Date: 2004 - 2007

Design summary

The Hanifah Valley is located in the west side of the city and, with a prominent portion that cuts through the Najd Plateau of Saudi Arabia. It is the most important natural land and watershed in the region of Riyadh. It is stretching for about 120 kilometers long where it encompasses ecological zone that begins from the Tuwaiq escarpment in the northwest until it stops in a sandy desert areas southeast of Riyadh. It had been used as the main resource for water and food before urban sprawl occurred. Recent rehabili-tation projects have maintained and solved various issues such as unregulated indus-trial use and the preparation of natural valley drainage.

Design implications

- Preparation of natural drainage channel
- Create public parks and pedestrian paths
- Revegetate the floodplain with drought tolerant plants
- Soil stabilization for erosion control
- Stream bank alignment.

Project objective

The primary development strategy is that to create recreational areas for the people in the city to respire and find a lush natural land within the urban fabric. It created healthy environment after it was degraded as well as provide opportunities for human to inter-act with the valley course pleasantly. A new feature of recharging the aquifer and re-cycle water entering the valley emerged when the stream bed has been restored natu-rally.

Wadi Al Azeiba Project

Location: Muscat, Oman
Client: Client: Municipality of Muscat
Designer: Atelier Jacqueline Osty & associés,
Area: phase 1: 2 hectares – phase 2: 13 hectares

Design summary

This urban park functions as an artery; it cuts through the urban neighborhood and stretches to the valley bed ending in the Gulf of Oman. The development will add val-ue to it and make it a central area for attracting nearby residents and businesses. Be-cause of its vital location and proximity to downtown and airport, it is essential to reha-bilitate the land and reduce potential flooding risks. The environment features in Oman were reflected on this site to emphasize their surrounding landscape. The designer applied recreational terraces derived from the mountain levels bringing people down to the valley bed. The two different levels upper and down were featured in various ele-ments. The higher level is lined with palms to emphasize and border pedestrian walk-ways. The lower level where it is adjacent to Valley bed has natural vegetation compo-sition.

Project objective

The objective of this project was transforming a site that was problematic and useless into a vibrant linear park. This park got a makeover to connect the neighbors to the improved environment. The designers also focused on creating a linear park that contains walkable areas stretching until they connect to the sea front.

Design implications

- Linear parks
- Create linear park that contains walkable areas and circulates through nature
- Link the park to adjacent neighborhoods
- Recreational terraces to bring people down to the valley bed.
- Revegetate the valley bed with drought tolerant plants
- Use resilient vegetation convenient in either wet and dry areas.
- Restore the valley basin to function in rainwater events.

Tujunga Greenway and Stream Restoration

Location: Coldwater Canyon Ave and Oxnard Blvd
Los Angeles, California
Size: 1.2 miles (~16 acres)
Project Type:
Park/Open space
Recreational trail
Stormwater management facility
Designer: Mountains Recreation & Conservation Authority
Completion Date: 2007

Design summary

The Tujunga Wash concrete channel is a tributary of the Los Angeles River. It is extended for about a 13-mile urban stream on the north side of the city. The greenway project revitalized the area along the concrete wash 10 feet above it into a responsive ecological greenway. The artificially constructed stream functions like a wet bed that receives and infiltrates water coming from the channelized concrete wash. This new source of water will recharge groundwater which in turn will supply nearby neighbor-hoods and irrigation needs. Additionally, unique pedestrian experience has been cre-ated along the artificial stream and its new vegetation. It contains recreational path-ways and seating areas.

Project objective

The new project is meant to be a unique source of regional water supply and underground recharge. Also, it has restored a vital natural habitat along the wash and brought human connectivity and innovative experience to adjacent neighborhoods.

Design Implications:

- A source of regional water supply and underground recharge
- Constructing artificial stream as a new source for water demands
- Creating appealing natural habitat along the wash
- Public parks
- Recreational trail
- Stormwater management facility
- Pedestrian linkages to adjacent neighborhoods through access points

Meadow Creek Restoration Project

Charlottesville, VA
Designer
Vanasse Hangen Brustlin, Inc
Completion Date 2013

Design summary

The Meadow Creek restoration project is 1.4-mile long and is a part of Chesapeake Bay watershed. The restoration project has helped to stabilize the degraded bed through the establishment of natural channel design principles. This led to a significant reduc-tion of erosion and sedimentation through the improved floodplain and introduced new streamside habitat.

Project objective

Degraded waterways have been enhanced to improve water quality. Also, it helped to protect public land which is primarily used for human access and recreation. The project also preserves a national recreational trail passing along and wildlife habitat areas.

Design Implications:

- Natural channel design (NCD)
- Stream side vegetation to slow surface water runoff and reduce erosion risks
- Vegetative buffer to provide food sources for aquatic organisms and wildlife
- Create stream meanders and natural floodplain to slow water during flood

Before

After

Boneyard creek restoration

Location: Urbana, Illinois
Client: City of Champaign
Landscape Architect: Hitchcock Design Group

Design summary

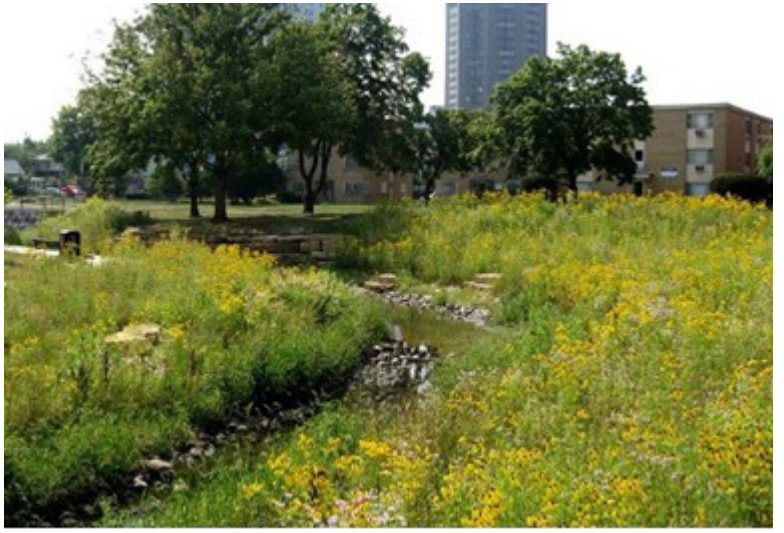
Boneyard Creek has a constructed waterway that cuts through urbanized areas and part of the university. There is detention basin surrounded by meandering trails and play areas. The water will flow from the detention basin and pass underneath a bridge where there it becomes a natural waterway. This natural waterway is lined with stones and planted along to control erosion and improve water quality. The natural waterways end up getting into its original shape as an artificially engineered channel.

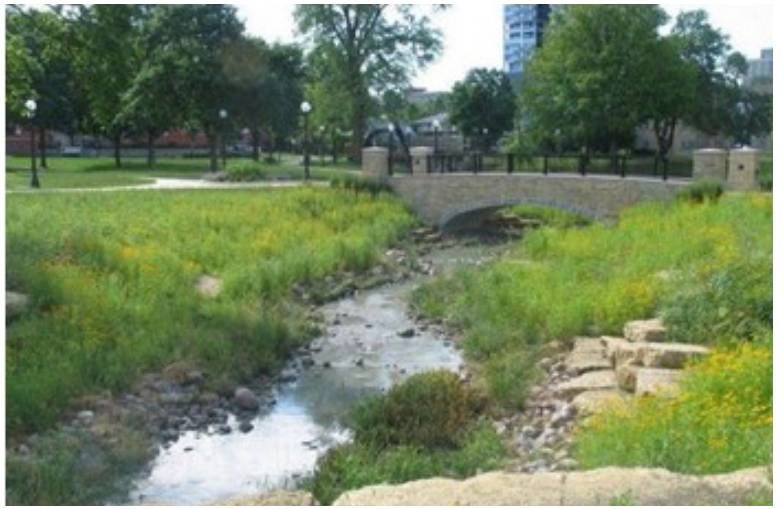
Project objective:

- Stormwater flood mitigation to increase basin's holding capacity
- Improve the ecological function by improving wildlife habitat and water quality
- Create convenient bike paths

Design Implications:

- Make ideal soil for rain gardens and bioswales, mostly low
- clay contents
- Use herbicide treatments to establish native plants and create wildlife habitat
- Use large natural stones to stabilize the creek banks
- Utilize drop in elevation to create water features and amenities
- Create detention basin and children gathering areas





Little Sugar Creek Greenway + restoration

Location: Charlotte, NC
Completed 2011
Designer: WILL BELCHER

Design summary

This greenway is located north of downtown Charlotte and stretching for about 15 miles. It cuts through various neighborhoods and attractive zones which make it feasible for rehabilitation intervention. While this greenway continues spreading, it connects with neighborhoods and several communities. Stormwater solutions were utilized on site to capture and infiltrate water runoff such as rain garden and wetlands in the floodplain.

Project objective

- Connect people to nature through connectivity and walkability
- Restoring water quality and natural habitat
- Combine the natural habitat and its amenities to the communities
- Introduce alternative transportation option
- Convert engineered parking lot covering the stream lot into open public park
- Restore stream bed and banks
- Offer educational opportunities for communities and students

Design Implications:

- Transportation corridor for commuters by bike or foot
- Create greenway along rehabilitated stream with pedestrian linkage to neighborhoods
- Integrate educational opportunities for community and students
- Create habitat for wildlife and aquatic species along the stream

Riverside Lünen

Location: 44532 Lünen, North Rhine-Westphalia, Germany
Budget: 850,000 euro
Designer: WBP Landschaftsarchitekten
Size: 21,000 square meters
Date of Construction: 2013-2015
Client: Municipality of Lünen

Design summary

A greenway runs along the Lippe River east and west and has terraced levels to connect to the riparian corridor. The greenway is graded in a way that provides a unique movement through different level of grassy sloped lands. The proposed contour lines are well-adapted to the original contours and used to connect the two levels without altering the natural land. This project is well blended with the nature of the area and helped to maintain native vegetation and softscape to emulate that feel.

Project objective:

- Environmentally responsive design
- Less contour change

Design Implications:

- Open linear park
- Amphitheater stairs face the river
- Low impact project on previous site condition
- Repetitive use of plants with low plant variation

Conclusion

- Offer public spaces to link the valley to the urban fabric
- Create a conduit for movement and interaction with the valley
- Install art works and offers spaces for public engagement with landscape
- Excavation and replacement of contaminated soil
- Create desert natural feel
- Provide secluded playgrounds areas
- Use materials from the site such as rocks and boulders to separate and buffer vegetated areas
- Create depressed areas where water can be stored and reused again instead of irrigation supplements
- Offers educational and interpretive signage
- Opportunities for learning by integrating to the natural valley

SITE INVENTORY AND ANALYSIS

Riyadh Climate

Riyadh climate is classified as arid hot desert climate in the Köppen climate classification system. The average temperature in the summer range between 40-45 C/ 104-110 F while the temperature in the winter is approximately between 20-27 C 68-80F. The city gets rainfall ranges between 100-130 mm about 5" annually. However, the city experiences irregular rainfall during the year. The humidity in the city is considerably low with an average of 19% because of the city shortage of surface water and situated far from the sea. In other hand, building blocks are clustered in proximity to each other where in the same time it lacks open and green spaces. This issue has raised the urban heat island significantly and affected on the human comfort outdoor. Along the Hanifa valley and its tributaries and in the bottom level the temperature drops down due to the presence of agricultural and open lands.

Site Existing Problems

Mineral activities

Dumping of construction waste

Encroachment of property

→ Topography change in valley bed clogged waterways and natural drainage system →

Stagnant swamp

Flooding risk and soil destabilization

Flooding

High risk of desertification

Sewage dump

Soil and water pollution

→ Groundwater pollution Create stagnant swamp →

Damage to utilities and infrastructure

Increase of epidemic diseases

Overlap of industrial and agricultural and residential activities

→ Lack of development and investments →

Loss of natural and aesthetic appearance


Al elb dam


Turaif district


Al Badiah historical place


Hanifa valley natural drainage channel


Location

Site Context

Riyadh


Hanifa park land


Diplomatic quarter

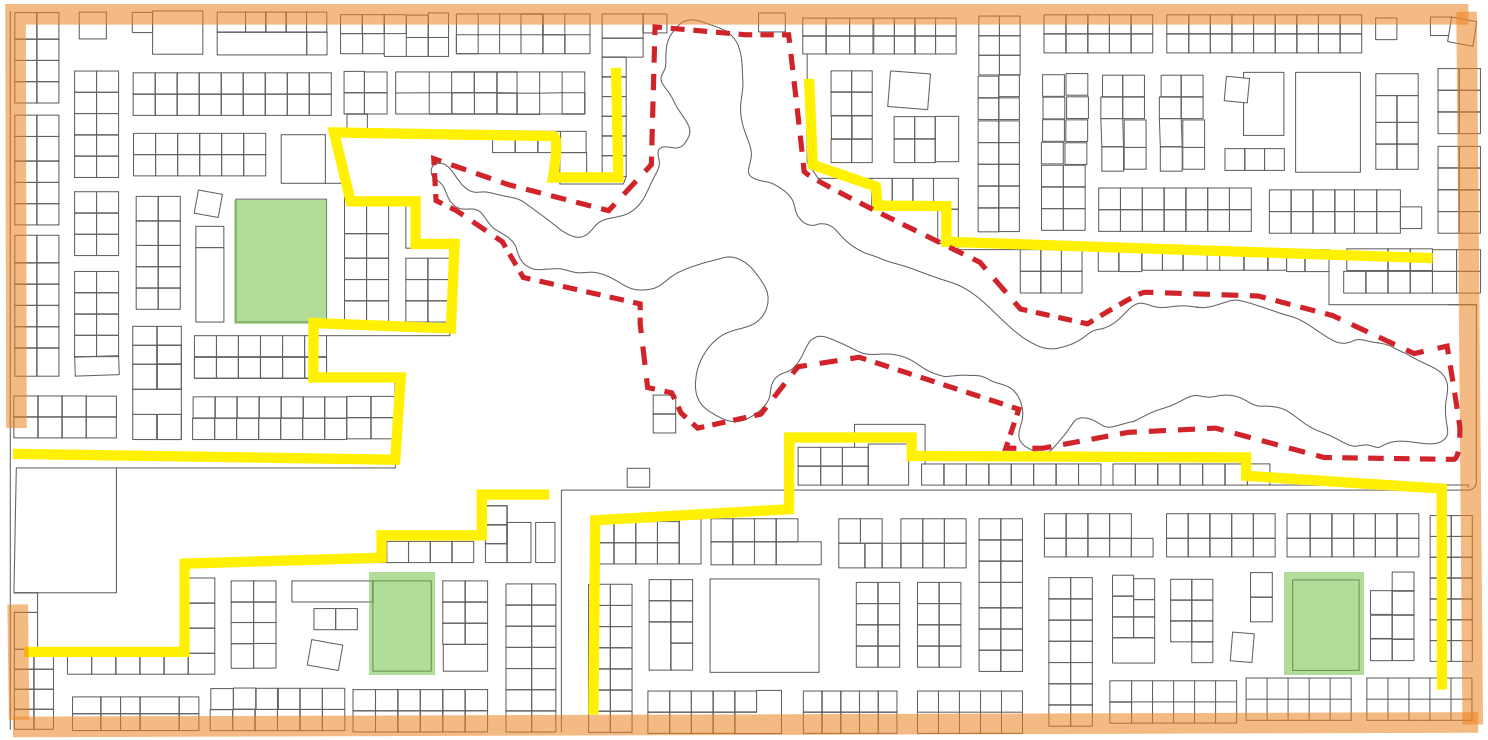

Bioremediation facility


Namar dam and park


Wastewater treatment plant

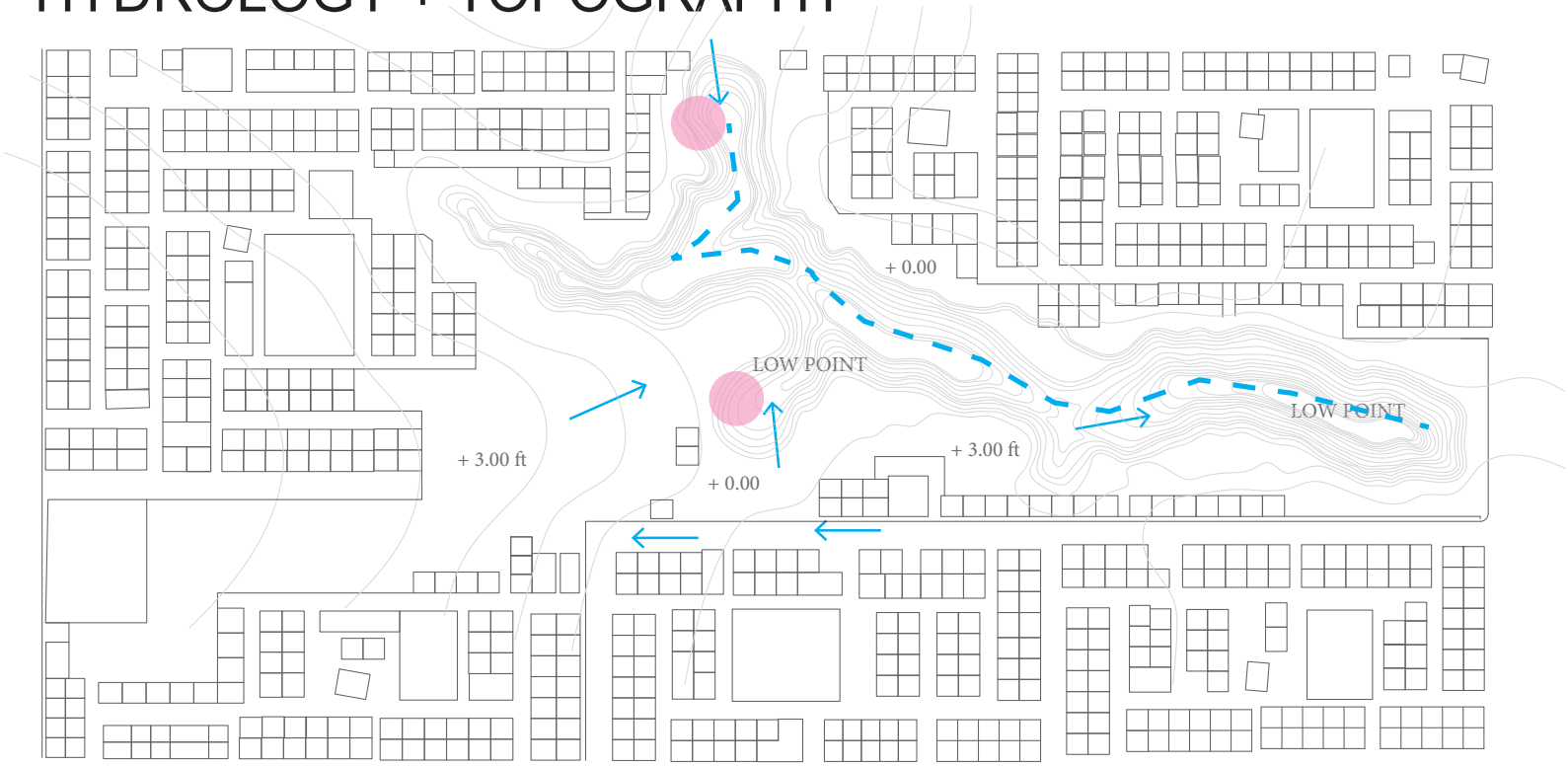
The area is a vacant degraded land and a source of contamination. The city development authority is proposing to rehabilitate all degradable tributaries along the valleys cutting some parts of the city to make healthy environments and encourage recreational activities. Analyzing these contaminated lands will lead to a better understanding of the surrounding conditions.

SURROUNDING AMENITIES



Water flow in the site occurs in two different ways, infiltration and overflow. Pollutants and erosion can be detected at the runoff point of origin.

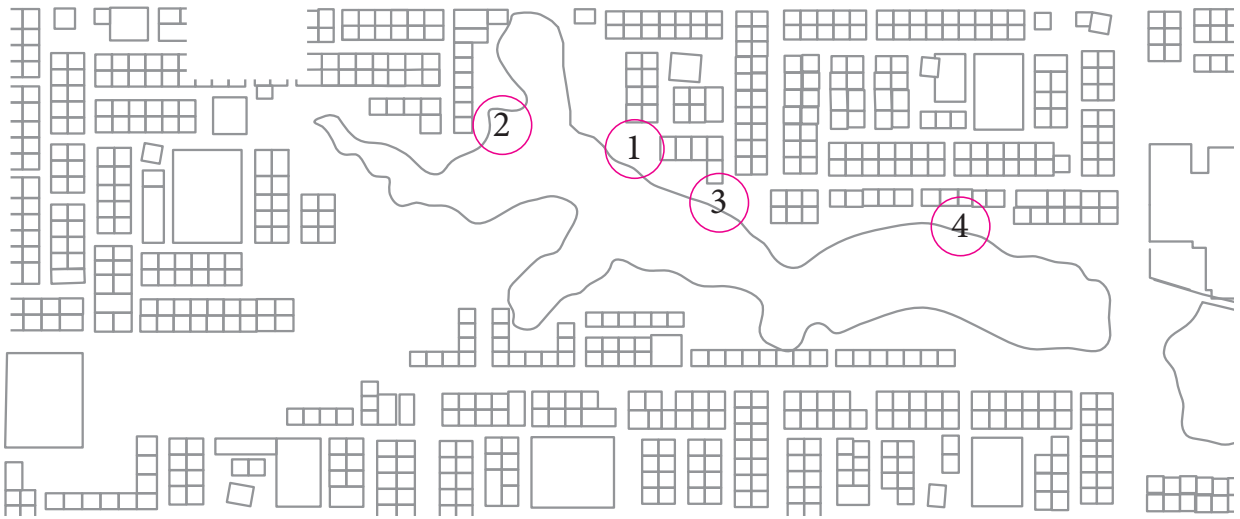
HYDROLOGY + TOPOGRAPHY



The site is situated within major streets surround it. The site is accessible from all directions while walkways accessibility to the site is not available. People around the area are heavily dependent on vehicles and cannot find separate pedestrian paths along the streets. The urban grid is de-signed to be highly porous to allow people to get to the site from various directions. Also, a new metro station and line is being built on the south border of the site which would add value to the valley.

CIRCULATION

VIEWS



+ Opportunities

- It can provide a good connection to neighborhoods to strengthen human experience
- Upland level has low topography variations
- The site is surrounded by three municipal parks which provides additional recreational and ecological linkage.

- Constraints

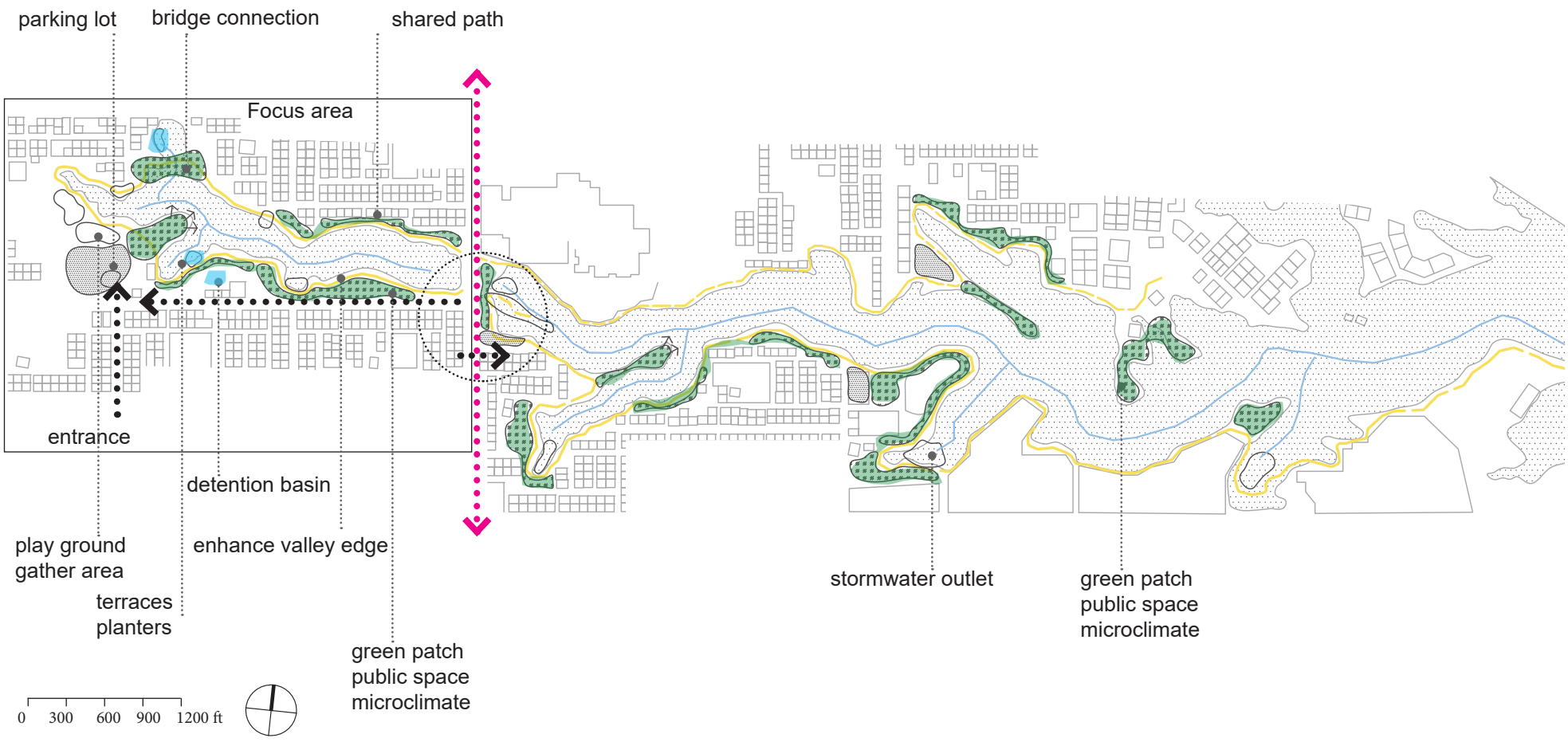
- Establish native plants on degraded site
- Valley remediation and stabilization
- Need for stormwater mitigation systems and green infrastructure
- No convenient sidewalk to the site

DESIGN APPLICATION

Design Program

	Create recreation activities and public engagement		
GREENWAY AND PUBLIC ENGAGEMENT	Establish a connection between the valley upland and valley bed	Active and passive recreation	Curvilinear trail up/down valley Valley-bed front park - stone placement for movement across
	Establish a connection between the valley upland and adjacent neighborhoods	Passive recreation and open plaza	Seating area - inviting gate
	Create public linear park for recreational Activities	Active and passive recreation	Amenities - seating areas - interpretive signage playgrounds - art works and view
	Linear recreational movement	Active recreation	Shared path Vegetated buffer
	Integrate stormwater management solutions		
WATER MANAGEMENT AND DRAINAGE	Reduce risk of flooding during rainy seasons entering the floodplain	Stormwater mitigation	Detention basin
	Improve the performance of stormwater culvert outlet	Erosion prevention and sediment control	Stormwater terraces
	Alleviate surface water runoff	Water harvesting	Vegetated swales + microcatchments

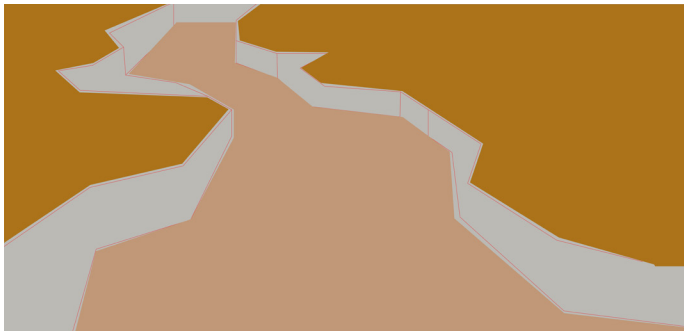
Regional Conceptual Plan



Final concept focuses on gathering spaces, trails, and other amenities that complement the natural landform.

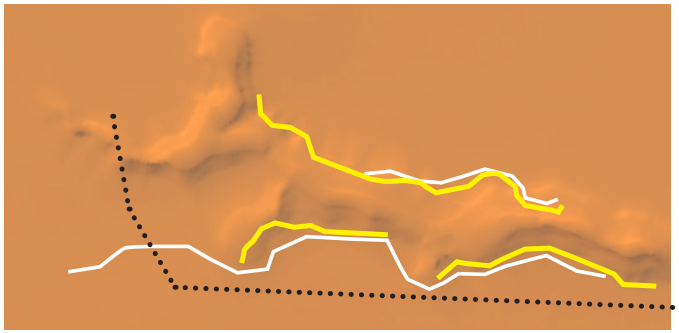
Focus Area Conceptual Diagrams

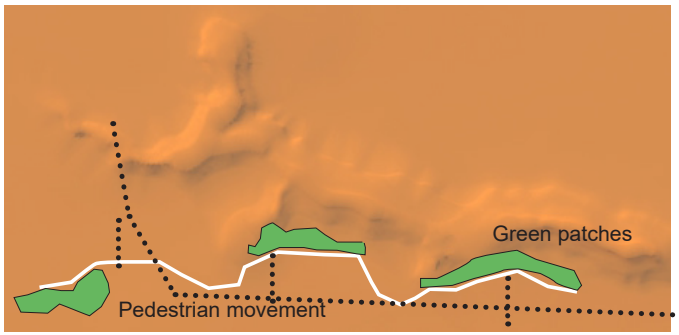
Concept development focused on natural landforms and site-adapted features. The walkways will meander along the valley edge to create patterns of desert exploration and relaxation. This project blends with the form and color of the surrounding valley. It creates oasis-like areas functioning as human embracing and heat relief. The design makes an interpretation of local formalism into an environmentally rehabilitated paradigm and nature-inspiring experience.



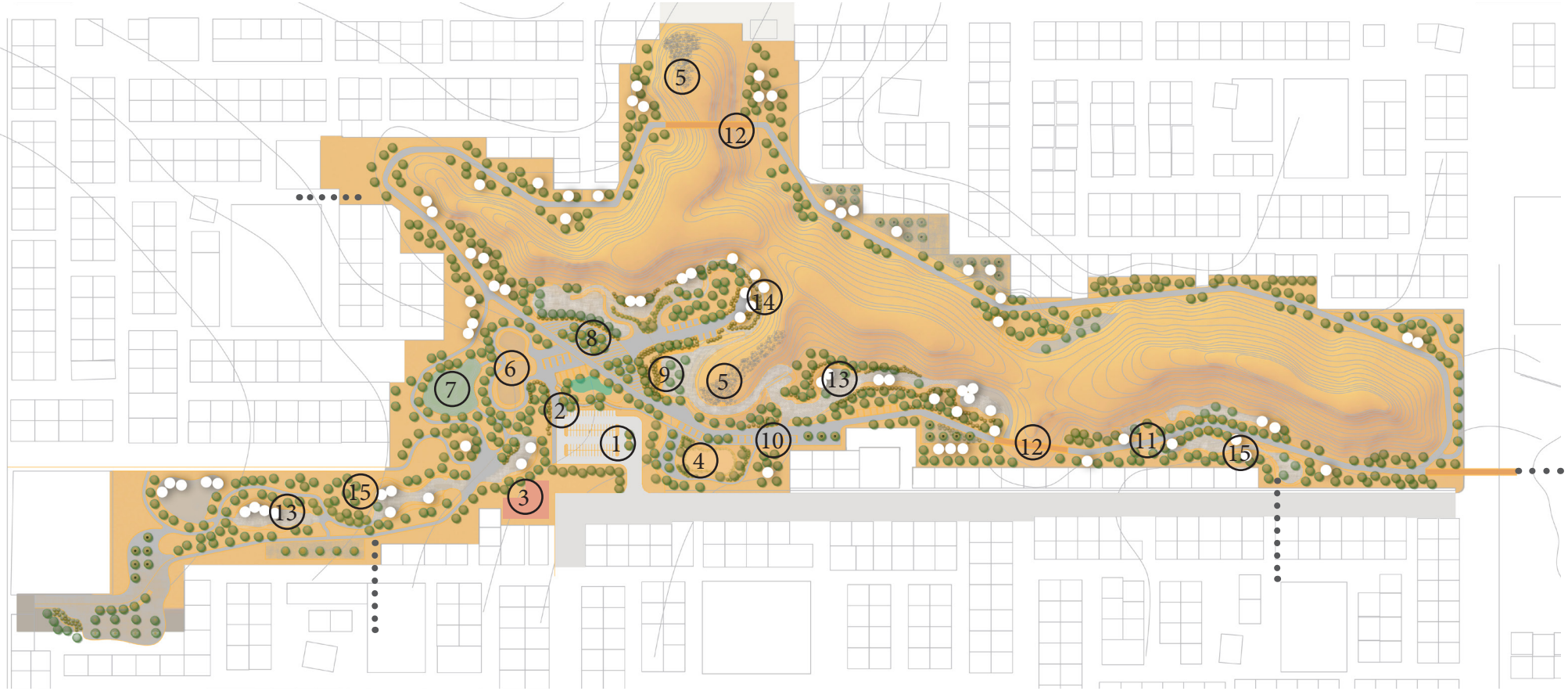
Conceptual phasing plan

1. Site excavation
2. Soil replacement
3. Create a layer of fertile soil for plants
4. Create change of landforms and microclimate areas





Focus Area Master Plan



0 100 200 300 400 ft

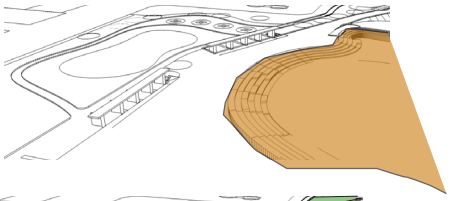
1. VISITORS PARKING
2. ENTRANCE
3. RESTROOMS
4. DETENTION BASIN
5. STORMWATER OUTLET ENHANCEMENT
6. PLAY GROUND
7. OPEN TURF
8. OPEN PLAZA
9. TERRACE SEATING AREAS
10. EDUCATIONAL AND INTERPRETIVE SIGNAGE
11. SHARED PATH (GREENWAY)
12. PEDESTRIAN BRIDGE
13. MICROCLIMATE AREAS
14. SHADE STRUCTURE
15. MICROCATCHMENT WATER HARVESTING

CONNECTION TO PUBLIC SPACES

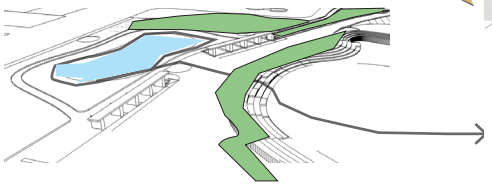
Focus area: entry plaza and walkways

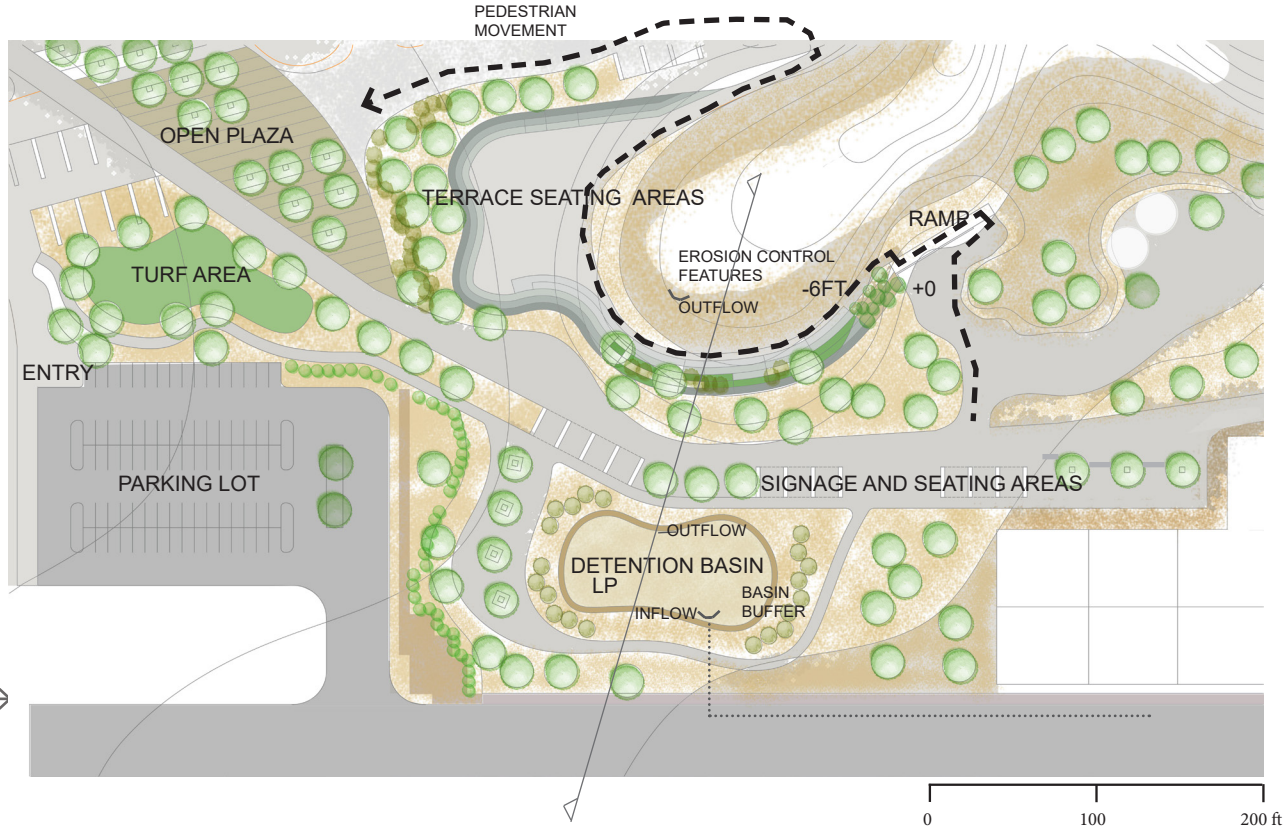
1 Existing problems:
Soil contamination
Erosion
Unregulated dumping of water

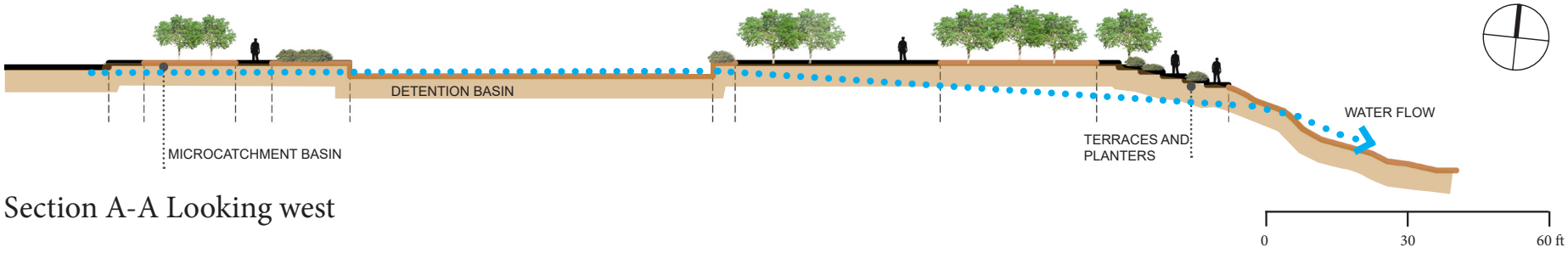
2 Rehabilitated soil:
cut and fill soil



3 Enhance drainage function and revegetation of degraded soil





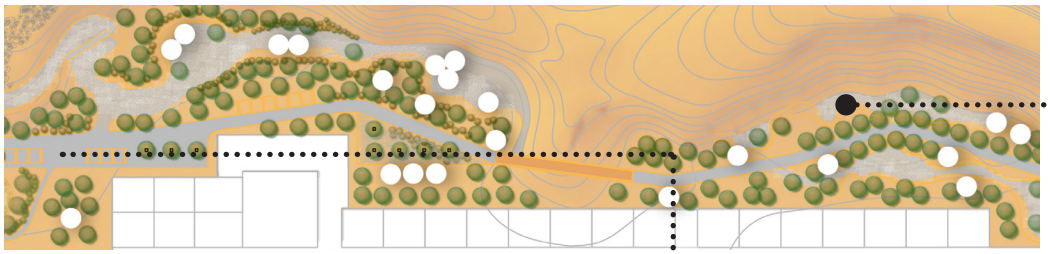


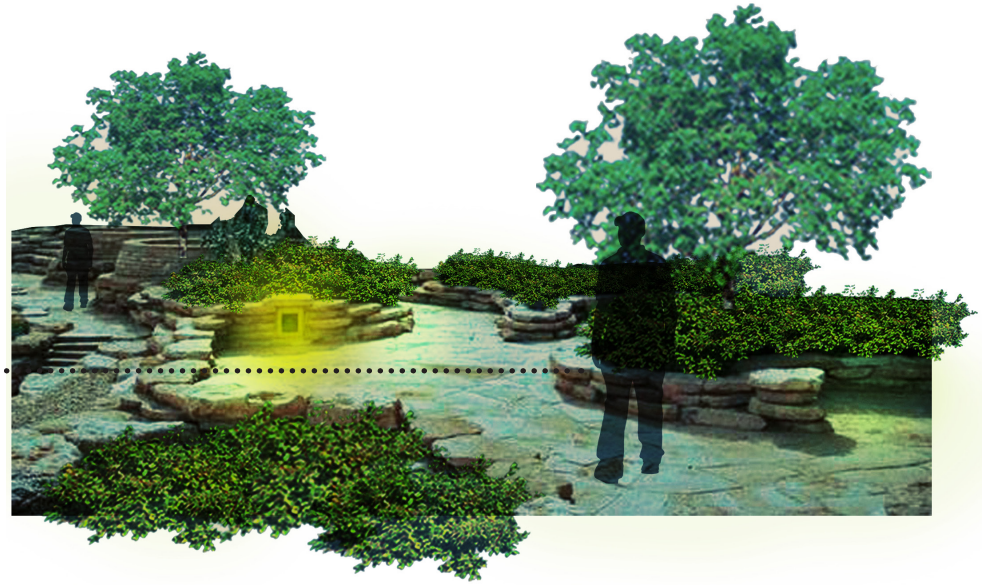
Section A-A Looking west

PERSPECTIVE

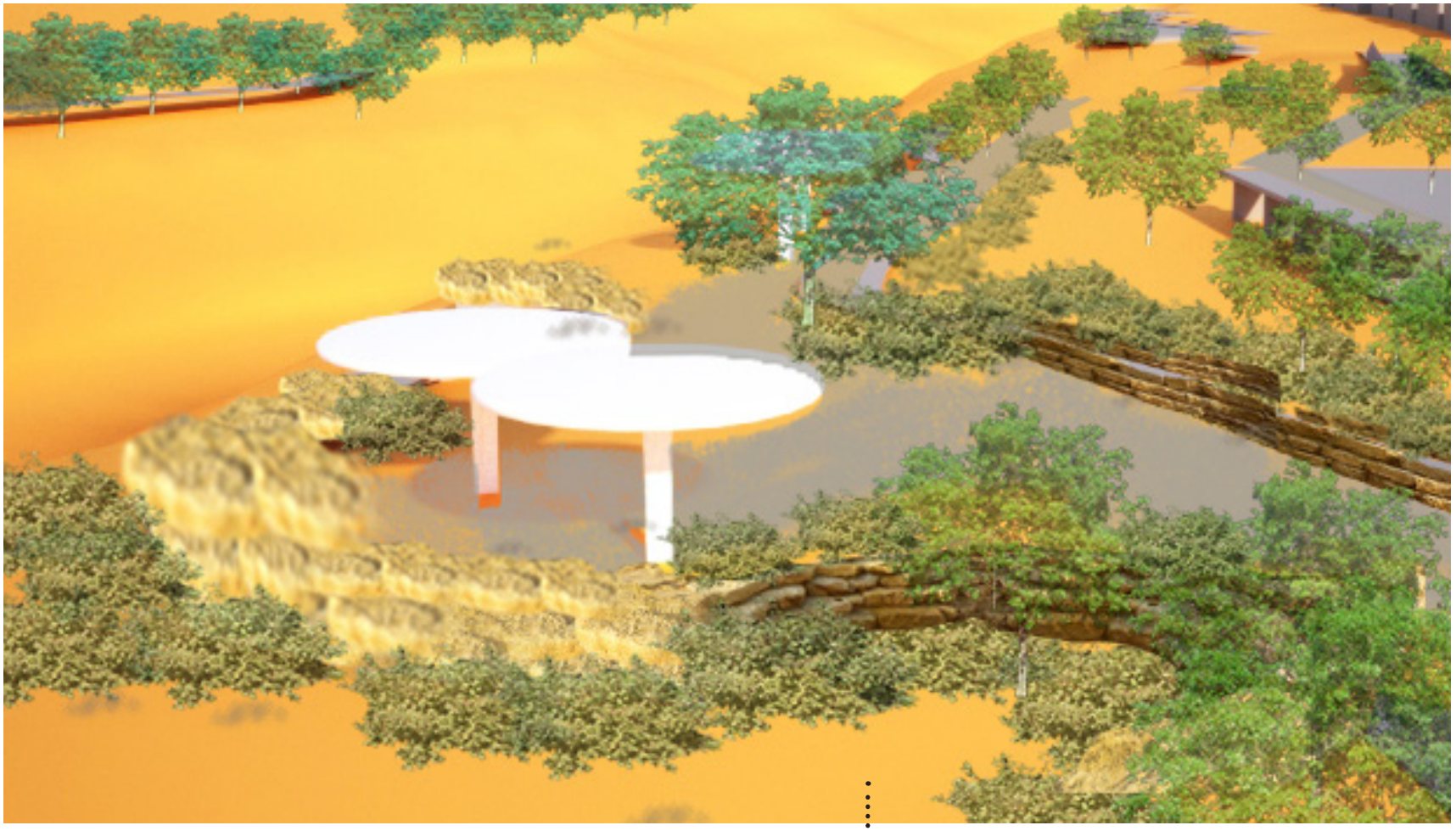
Terrace seating areas will replace an expansive area with a low slope along the valley edge. It is convenient for people to get to the lower levels through a variety of steps and planters.

Lighting features are integral components with other site features. They can be installed inside rock walls and underneath the planting beds. The meandering walkways are characterized by an integrated natural feel of site topography and landscape.

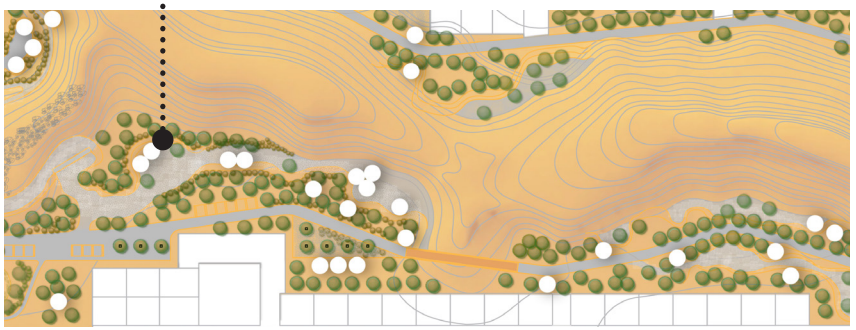




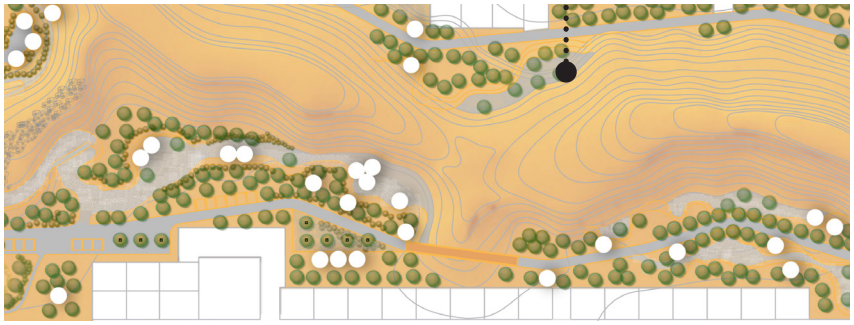
A shared path is suitable for pedestrians, joggers, and neighbors to move around the valley. It connects open plazas adjoining the neighborhoods to open seating areas along the valley edges.



Shade structures and stone formations will be introduced to the valley edge. Shaded areas are used as ramadas to provide shelter hubs and viewpoints. They are bordered by stone formation and low maintenance vegetation to accentuate areas of microclimate and relaxation zones.

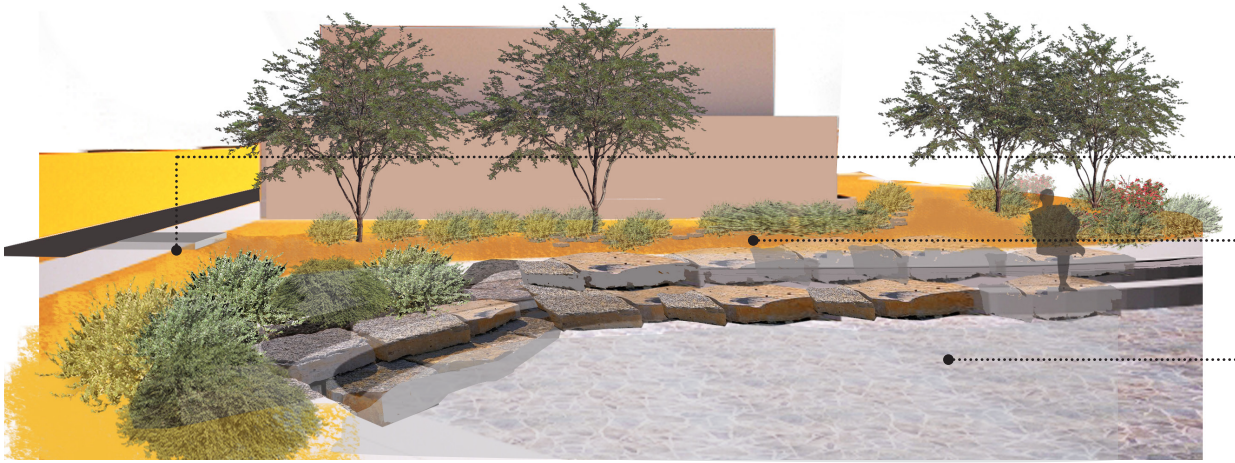


This perspective demonstrates a prototype of desert hardscape and landscape adapted to the harsh environment and cliff escarpment. The site features will provide a source of nature exploration and immersion in the secluded valley areas.



Shade structure
and art works

Valley edge vegetation
and stone formation



Stormwater street inlet

Water harvesting
microcatchment
swale

Depressed area buffered with
stone formation and vegetation

Water harvesting basins and microclimate areas are important aspects that accommodate site conditions. Water harvesting basins are used to collect limited rainwater to plants. The enclosed gather and seating areas will bring efficient use and cool relief during summer days.

Site rock features and shade canopies have been introduced to the valley edges to provide people with a sense of place and contemplation of the city plateaus.

In conclusion

This project has been done in an attempt to understand and investigate the environmental problems associated with the degraded valleys in Riyadh, Saudi Arabia. When looking at the specific concerns, the literature review and case reviews were essential steps to informing the design process. The project outcomes resulted in developing design strategies that dealt with improving the landscape. The overall product created a conduit for human interaction with an emphasis on ecological function. The Aum Qasr Valley will provide remarkable sights throughout the day while paying close attention to vegetation to create abundant greenery along the terraced pathways and valley edges.

Future Research:

Riyadh vegetation

Use the natural valleys for stormwater mitigation, agricultural and recreational activities.

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