



FLOODING IN THE FORGOTTEN AMERICAS

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URBAN DESIGN AND
PLANNING

URBAN PLANNING AND
LIGHTING DESIGN

URBAN DESIGN AND
SUSTAINABLE
PLANNING

REAL ESTATE FINANCE
AND URBAN PLANNING

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PROBLEM STATEMENT

Our mission is to aid and engage our case colonias through localized green infrastructure projects. To aid each colonia, a unique green infrastructure project will assist in either moving or holding excess storm water. In order to engage communities, each strategic green infrastructure project must function as usable green space for public use.



Colonias are defined as residential areas with close proximity to the US/ Mexico border - that often lack some of the most basic living necessities such as potable water, septic or sewer systems, electricity, paved roads or safe and sanitary housing. These communities are already threatened by a myriad of infrastructure deficiencies, which make them uniquely susceptible to the problem of flooding.

WHY DO THE COLONIAS FLOOD?

Flooding has always been a part of the Rio Grande Valley especially because of the water cycles and soil conditions. Various irrigation systems are found throughout Hidalgo and Cameron County due to the history of agriculture in this area. These agricultural lands were never modified for today's development. The land across the Valley is characterized by flat terrain resulting from the fact that this area is an delta of the Rio Grande river. The land here is a mix of sand, silt and clay, with clay being the most dominate. Therefore these soils do not "soak up" or allow much water to absorbed by the ground, and as a result, water takes a long time to infiltrate or pass down to the ground causing the valley to flood.

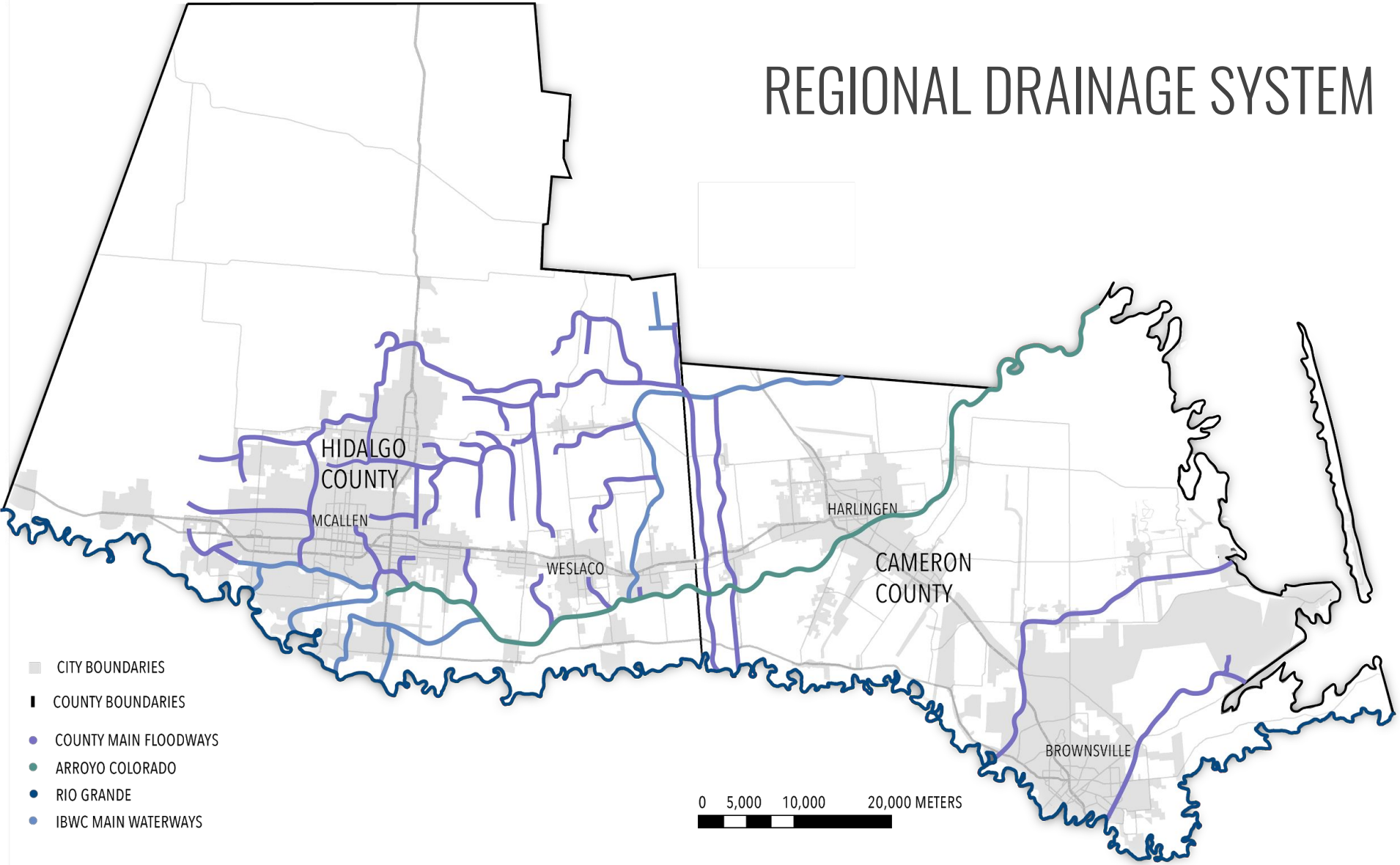
[18in. Minimum flood water depth in homes and businesses]

[2,700 Residences and businesses flooded post Great June Flood of 2018]

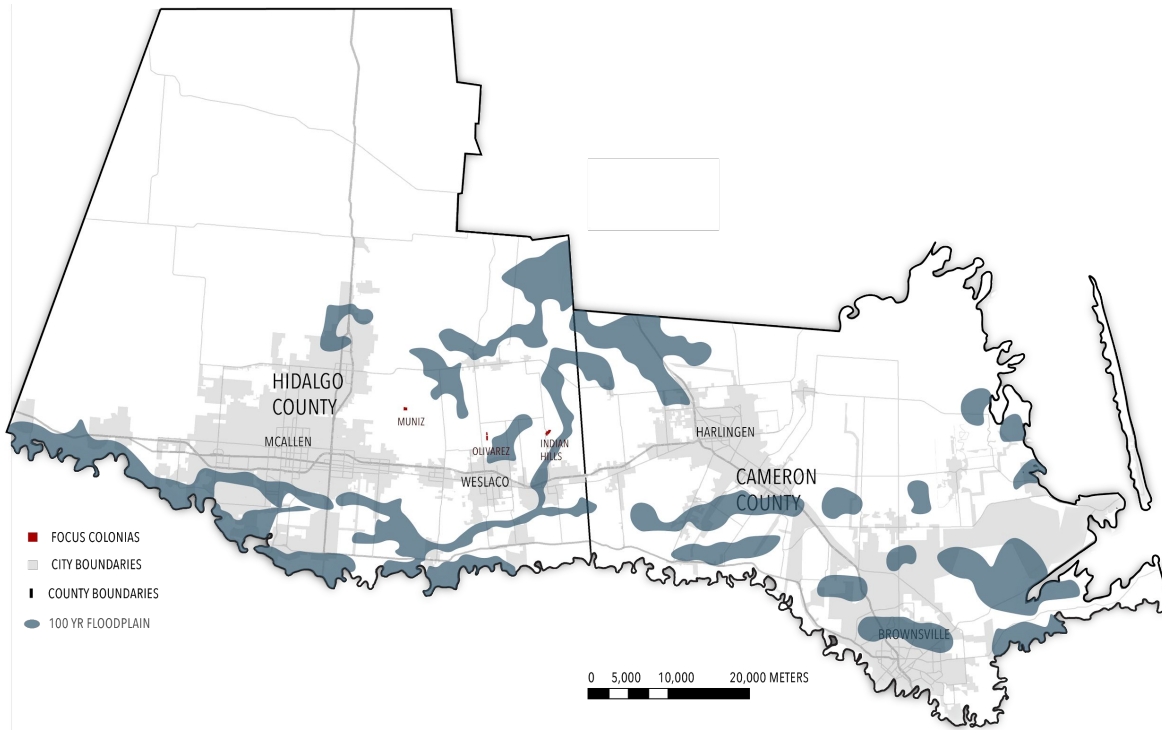
[1/3 Of the homes in this region have access to regional drainage systems]



REGIONAL DRAINAGE SYSTEM



Regional drainage systems are managed by local authorities and policy agencies. There are four main waterways that carry water out from the colonias. The International Boundary & Water Commission, Arroyo Colorado and Rio Grande is managed by the Texas Water Development Board while the remaining floodways are sought after by the county. These systems of floodways, canals, and ditches are disproportionately located throughout the Valley, leaving communities more vulnerable to flooding than others.

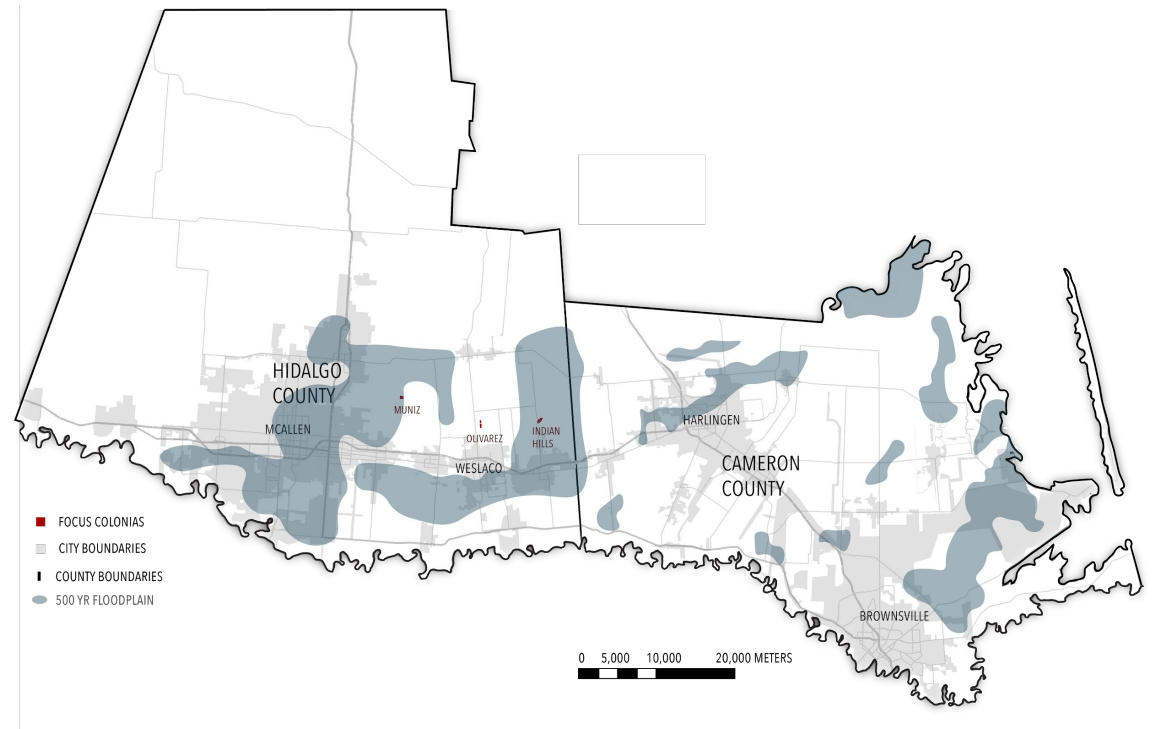


100 YR FLOODPLAIN

The term “100 year flood” is a misnomer. In reality, the term means residents living in a 100 year flood zone have a 1% chance of flood risk any given year. However, one-third of flood loss claims are from properties located outside of the mapped floodplains.

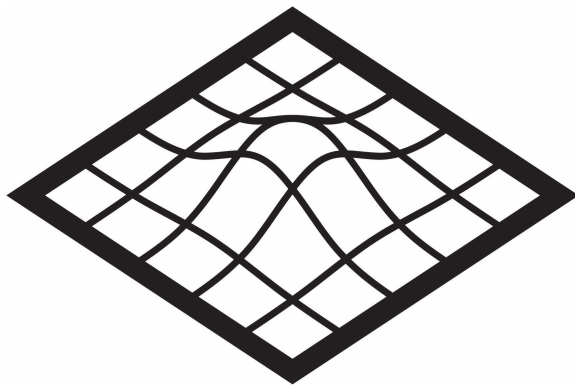
500 YR FLOODPLAIN

The lack of proper storm drainage, coupled with the low and flat elevation of this region makes the colonias highly susceptible to flooding. Everyone lives in a flood zone, whether the risk is low, medium or high.



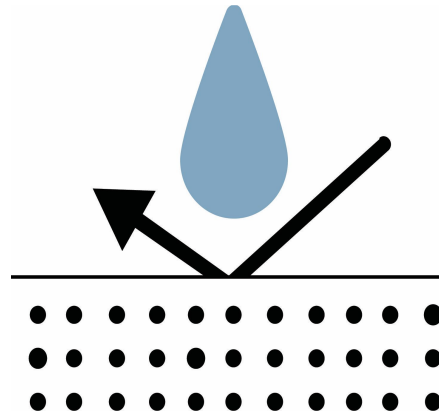
CHALLENGES TO FLOOD MITIGATION IN THE VALLEY

TOPOGRAPHY



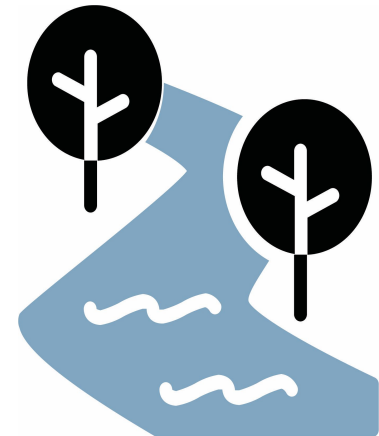
[The topography of most colonias causes water to pond and flood]

SOIL QUALITY



[Sand, silt, and clay are the soil composition of the communities.]

WATERWAYS

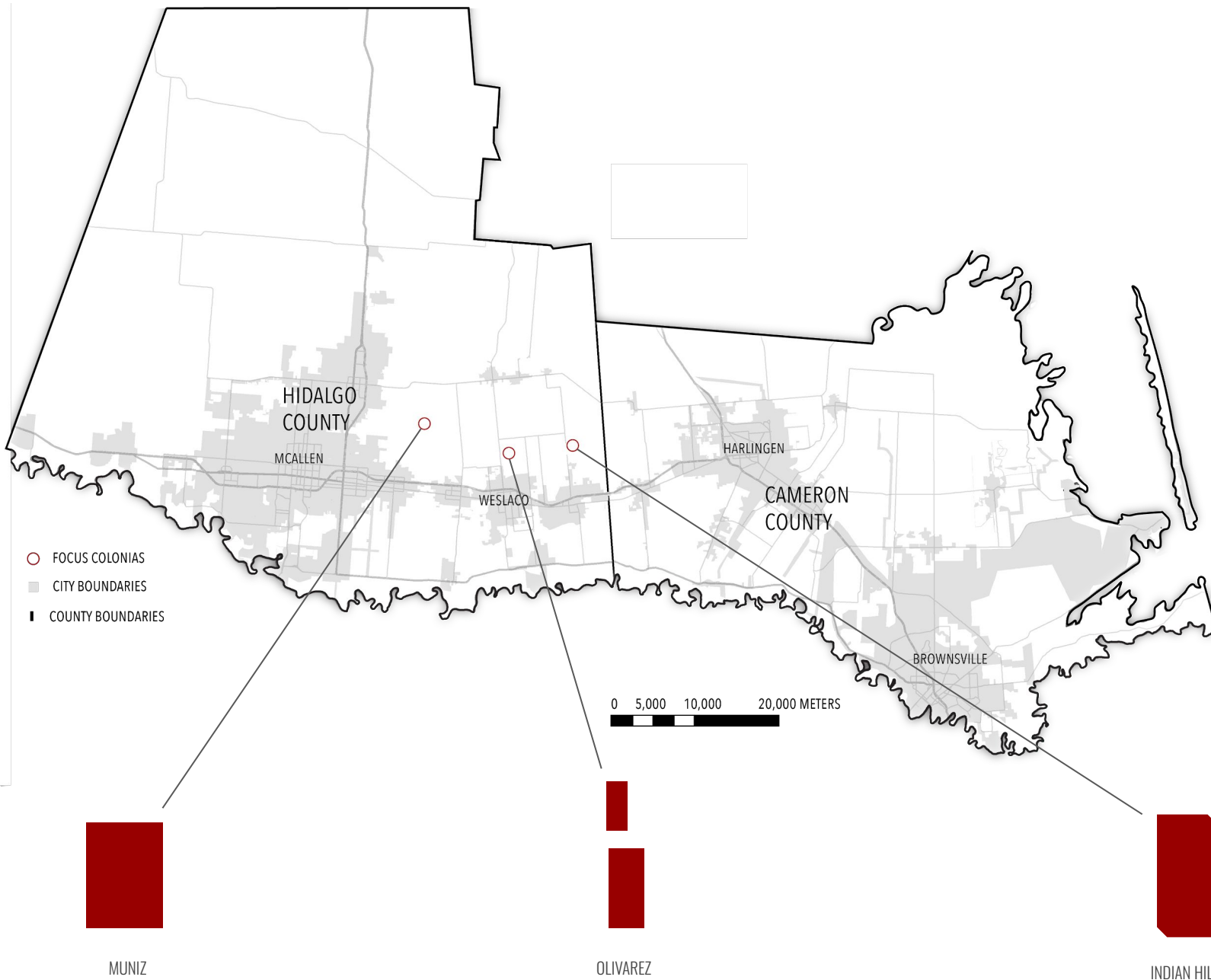


[Waterways are designed to hold water, exacerbating flooding.]



CASE STUDIES

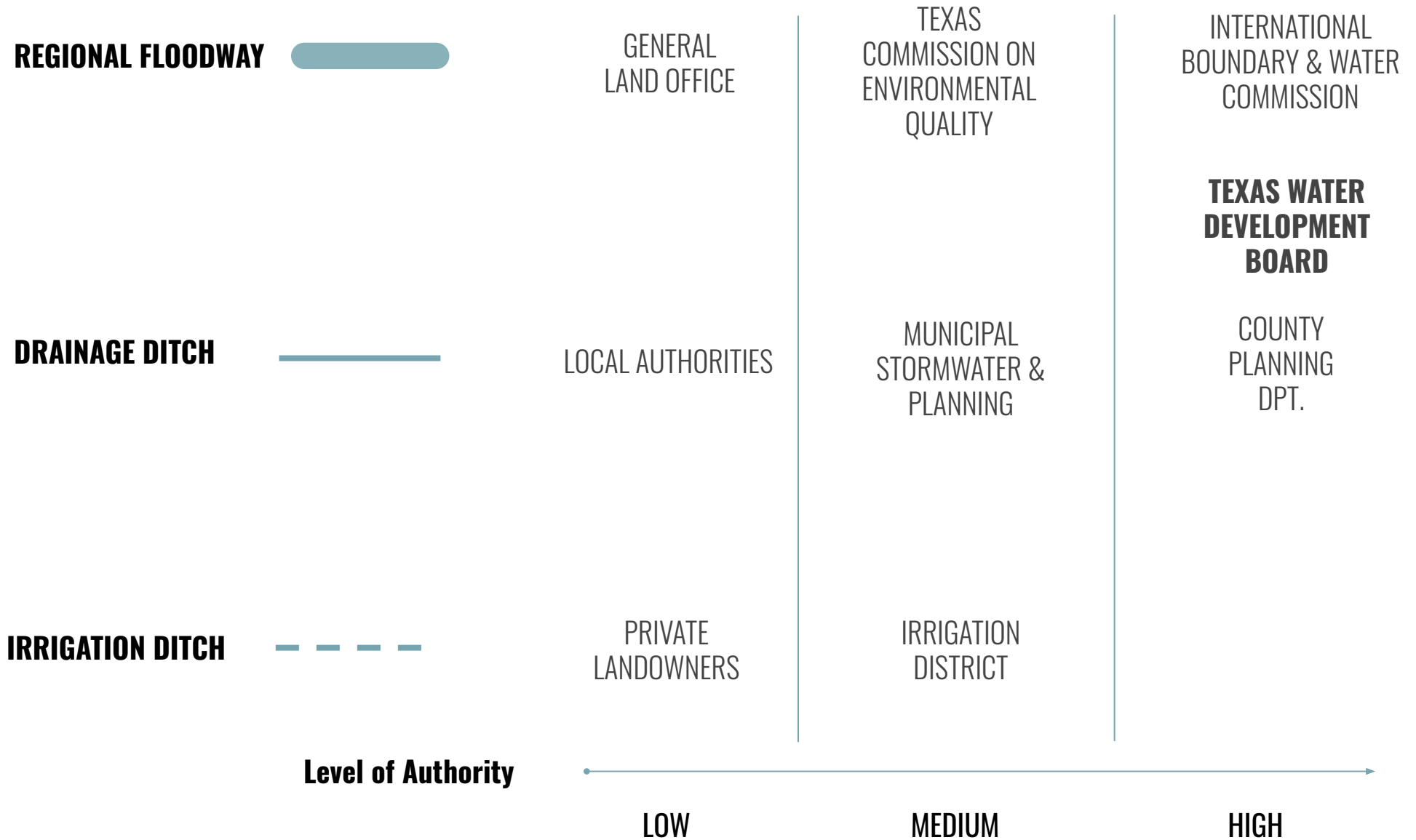
FOCUS COLONIAS



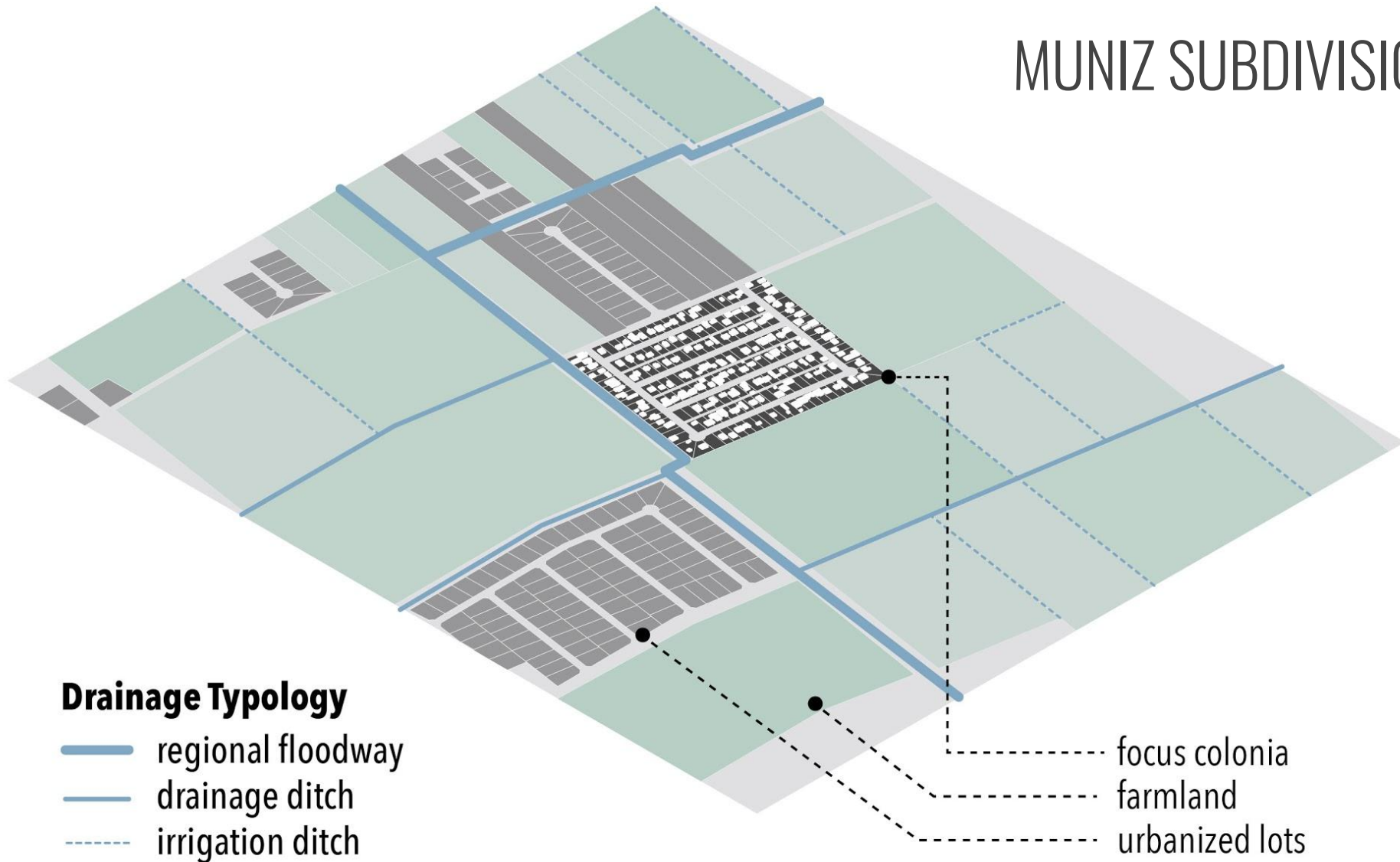
We've selected **three colonias** to further study the existing flooding implications and drainage systems. Understanding how water moves and interacts with an area helps us understand why certain areas flood, why others are dry, where our drinking water comes from, and how our infrastructure and development affects the natural flow of water.

DRAINAGE TYPOLOGY OF THE RIO GRANDE VALLEY

MANAGEMENT AND CONSTRUCTION



MUNIZ SUBDIVISION



Drainage Typology

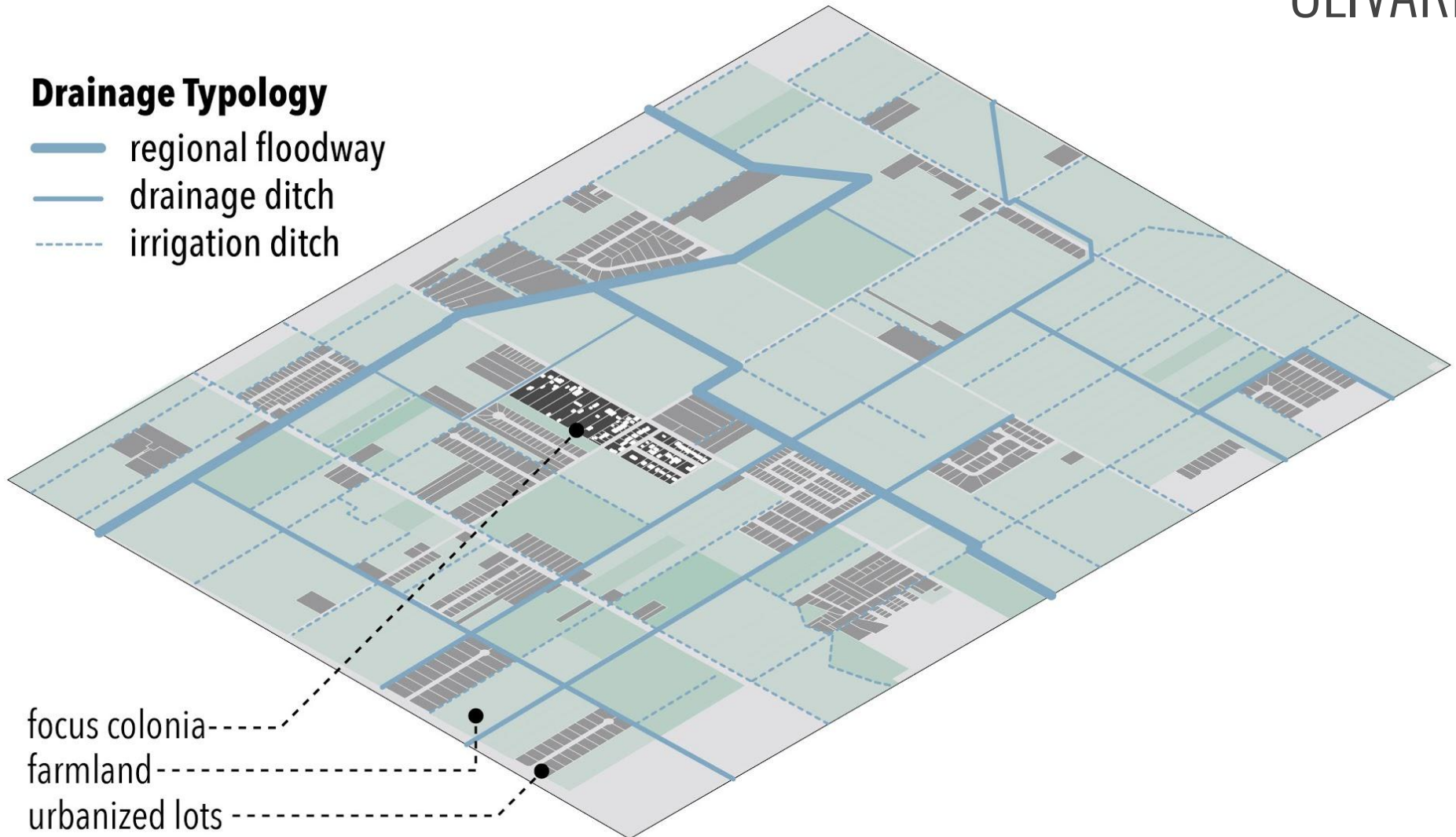
- regional floodway
- drainage ditch
- - - irrigation ditch

- focus colonia
- farmland
- urbanized lots

Located on former agricultural field, Muniz Subdivision represents the condition of many colonias in the Valley. The community has a population of about 370 and has access to potable water, paved roads and electricity. However, regularly inundated by precipitation events, the community requires increased investment in flood mitigation. The community is situated directly next to a “regional floodway”. However, in the case of this colonia, the regional floodway is a 8ft deep trench, that often fails during large precipitation events.

Drainage Typology

-  regional floodway
-  drainage ditch
-  irrigation ditch



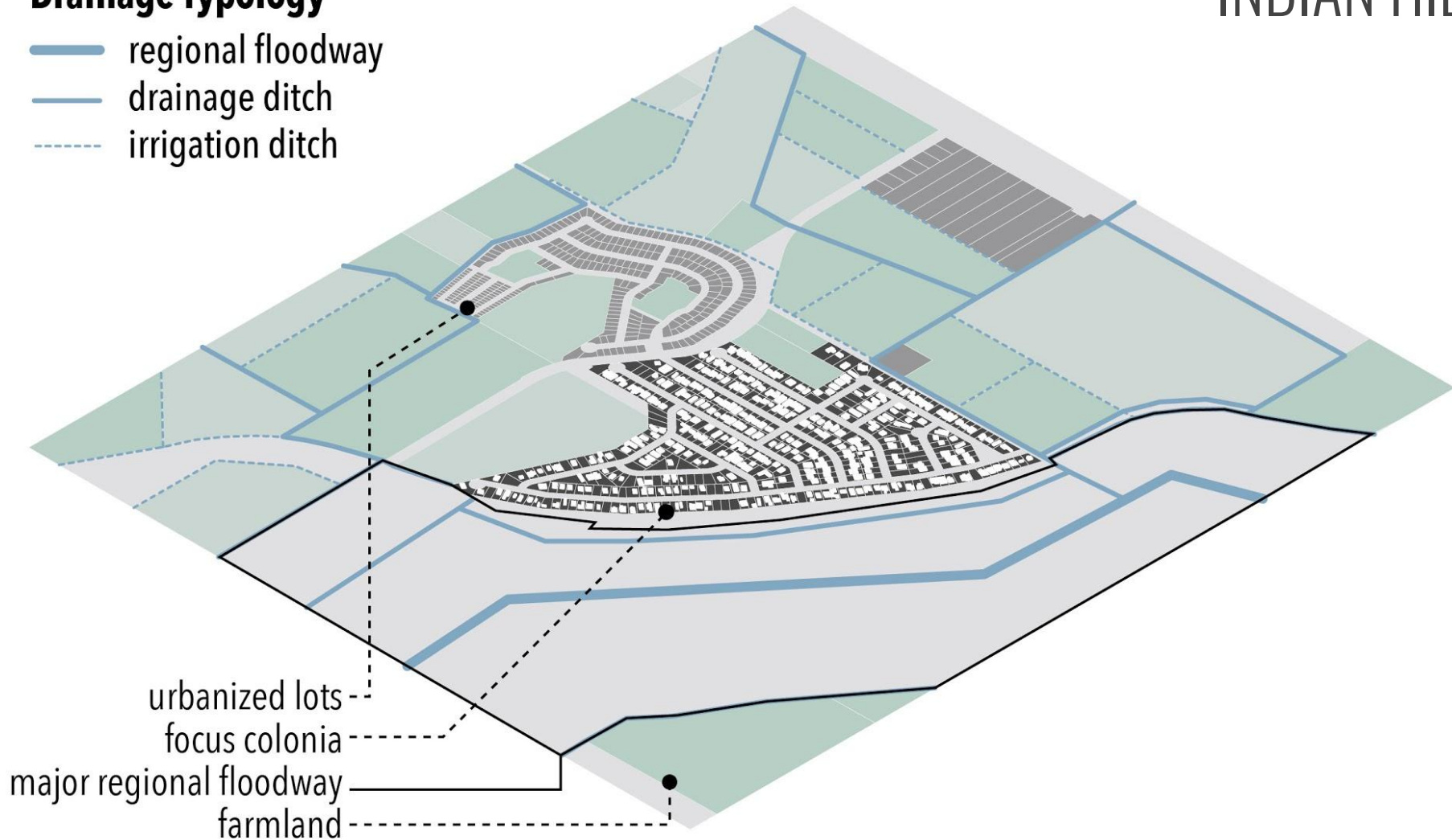
focus colonia
 farmland
 urbanized lots

Olivarez is just north of Weslaco. Similar to Muniz, the community is surrounded by agricultural development, however its proximity to Weslaco means that the area surrounding the colonia is urbanizing, with other urbanized lots beginning to encroach on the settlement.. With a population of 670, the site has basic infrastructure systems and paved roads. However, the community is poorly connected to nearby regional drainage systems, and most of the flood mitigation infrastructure in the area is still comprised of irrigation ditches.

INDIAN HILLS

Drainage Typology

- regional floodway
- drainage ditch
- - - irrigation ditch

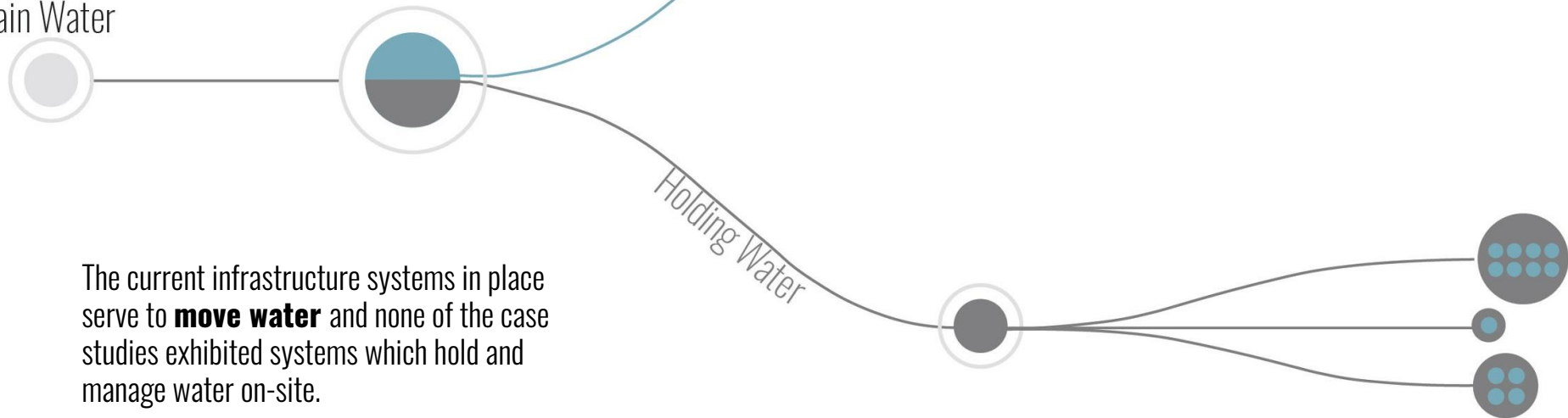


Indian Hills is a large colonia situated northeast of Weslaco along a major regional floodway. The colonia has a population of around 1,000 residents, and is situated next to a major regional floodway. It presents a very different condition from the previous two case studies. There is sufficient drainage infrastructure directly adjacent to the site, however a lack of integration with the community means that water still struggles to move from the site to the floodway.

HOW WATER IS MANIPULATED

An important conclusion that arose from looking at the various case studies is that flood mitigation systems either **move or hold water**.

Rain Water



The current infrastructure systems in place serve to **move water** and none of the case studies exhibited systems which hold and manage water on-site.

- | | | | | | |
|--|-------------|--|----------------------------------|--|--------------------------|
| | Low Cost | | Ditches | | Rain Gardens |
| | Medium Cost | | Rain Gutters | | Detention Ponds |
| | High Cost | | Pipes & Underground Sewer System | | Park Systems & Bioswales |



LID AND GREEN INFRASTRUCTURE

LOW IMPACT DEVELOPMENT (L.I.D)

WHAT IS LID?

LID is an approach to land development that works with nature to manage stormwater as close to its source as possible. LID employs principles such as **preserving and recreating natural landscape features**, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product.

WHY LID IS IMPORTANT?

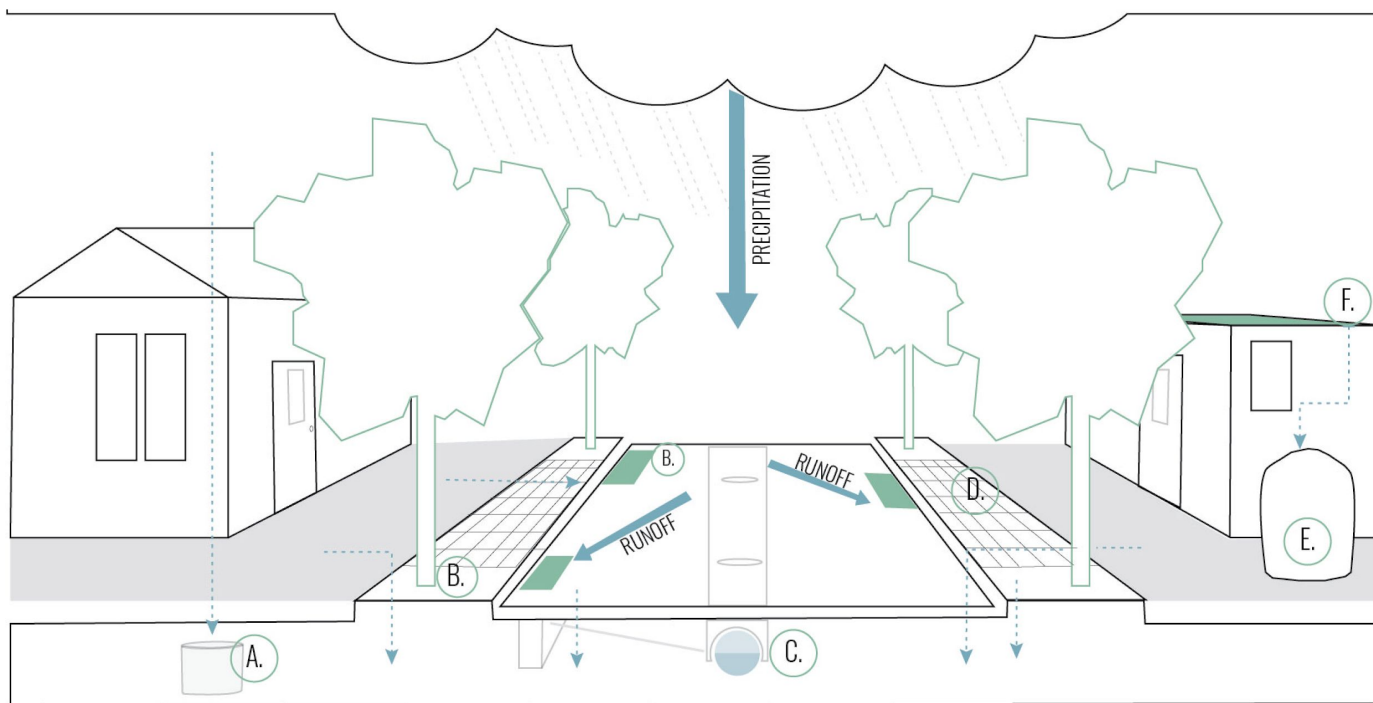
Reduced Number of Costly Flooding Events. In communities that rely on ditches and drains to divert runoff to local waterways, flooding can occur when large volumes of stormwater enter surface waters very quickly. **Holistically incorporating LID practices reduces the volume and speed of stormwater runoff** and decreases costly flooding and property damage.



GREEN INFRASTRUCTURE STRATEGIES

WHAT IS GREEN INFRASTRUCTURE?

Green infrastructure is a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits. While single-purpose gray stormwater infrastructure - conventional piped drainage and water treatment systems - is designed to move urban stormwater away from the built environment, **green infrastructure reduces and treats stormwater at its source** while delivering environmental, social, and economic benefits.



A. Dry Well B. Storm water Planter C. Storm Drain D. Permeable Paving E. Rainwater Harvesting Cistern F. Green Roof

GREEN INFRASTRUCTURE STRATEGIES

HOLDING

1

DRY WELL

A dry well is an underground structure that **collects** unwanted water, most commonly surface runoff and stormwater and in some cases greywater.

2

BIOSWALE

Contained vegetated areas that **collect** stormwater runoff. Using bioretention practices, these planters collect and filter water through various layers of vegetation and soils

4

PERMEABLE PAVEMENT

A porous surface which **catches** precipitation and surface runoff, storing it in the reservoir while slowly allowing it to infiltrate into the soil below.

5

RAIN CISTERN

A specific container that **holds** stormwater or rain runoff

6

GREEN ROOF

Green roofs can sustain a variety of plants and invertebrates, and provide habitat for various species

MOVING

3

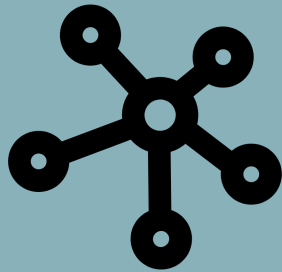
STORM DRAIN

Infrastructure designed to **drain** excess rain and ground water from impervious surfaces such as paved streets, parking lots, footpaths, sidewalks, and roofs



WHY CHOOSE GREEN INFRASTRUCTURE **IN THE COLONIAS?**

CONNECTIVITY



WATER QUALITY



DECREASED
CAPITAL COSTS



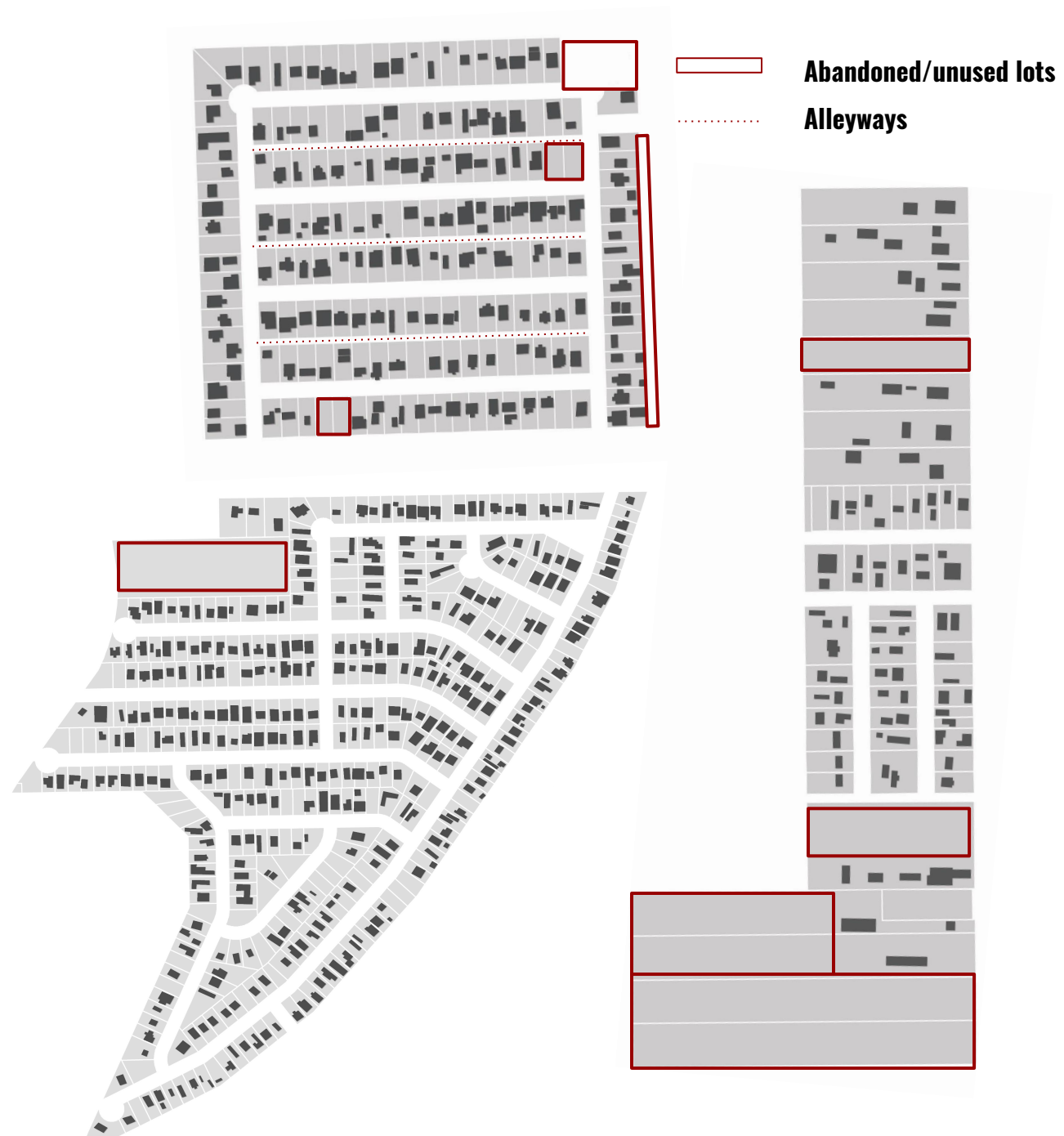


GREEN
INFRASTRUCTURE
CASE SPECIFIC PROPOSALS

IMPLEMENTATION

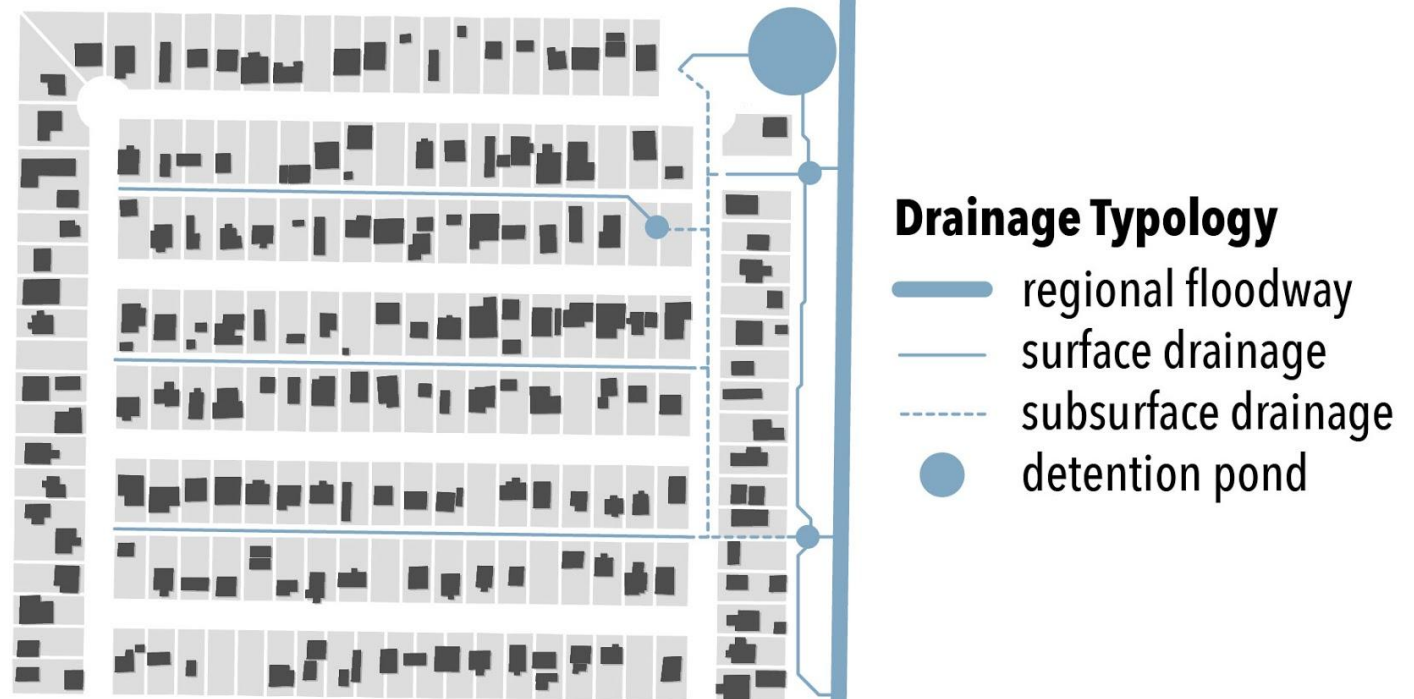
The three case colonias each presented different and unique opportunities for the implementation of green infrastructure projects.

However, each project utilizes similar methods for implementing these projects through the use of abandoned/unoccupied lots and alleyways. This allowed for the creation of new green spaces that accommodate localized green infrastructure solutions while preventing the displacement of existing structures and residents.



MUNIZ SUBDIVISION Drainage Diagram

The goal of this intervention is to create more systems to handle water on-site through bioswales and detention, as the regional drainage canal directly adjacent to the site is insufficient in handling water during large storm events. **A hybrid approach is necessary to leverage the existing drainage infrastructure** and provide improved flood mitigation.



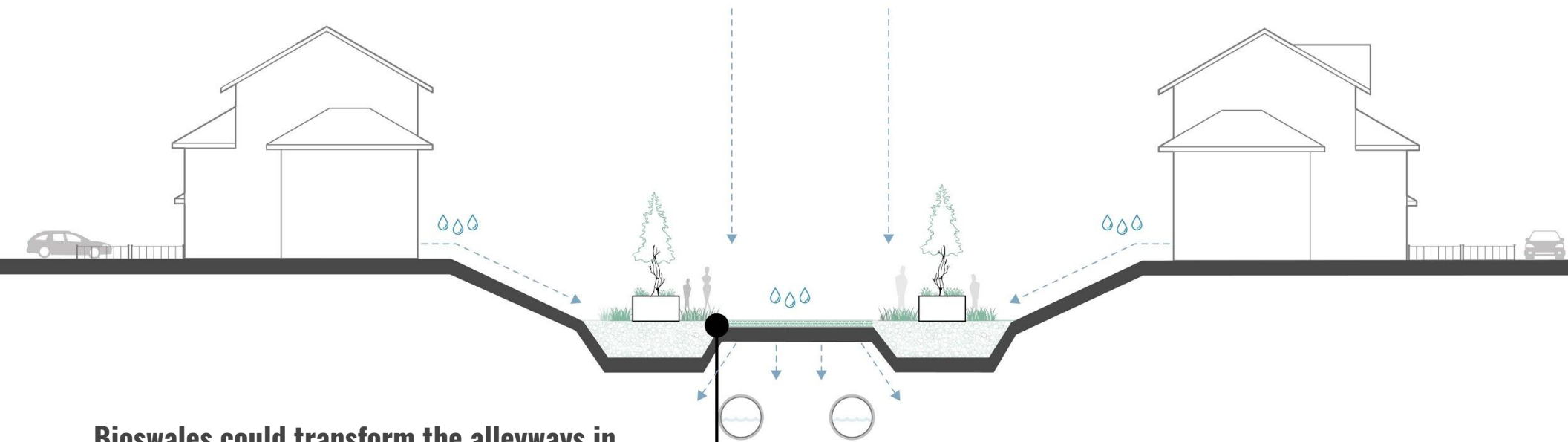
MUNIZ SUBDIVISION Infrastructure Plan

By implementing a **network of bioswales** along the alleyways of the colonia, and creating a number of detention ponds, Muniz can better connect itself with adjacent regional drainage systems and grow more resilient in the face of large precipitation events. The detention ponds are dry outside of large precipitation events and can be used as recreational spaces during this time.

This plan seeks to create a series of interventions which both moves water and holds water.

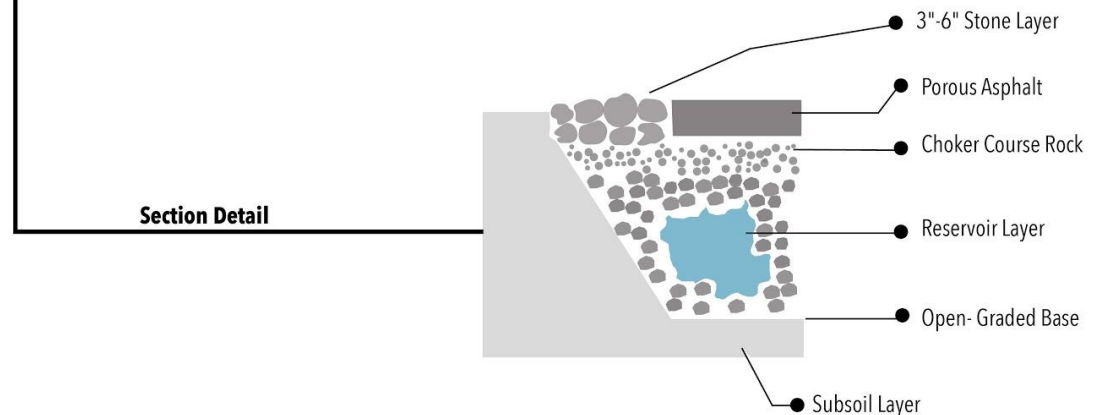


MUNIZ SUBDIVISION Alley Bioswale Section

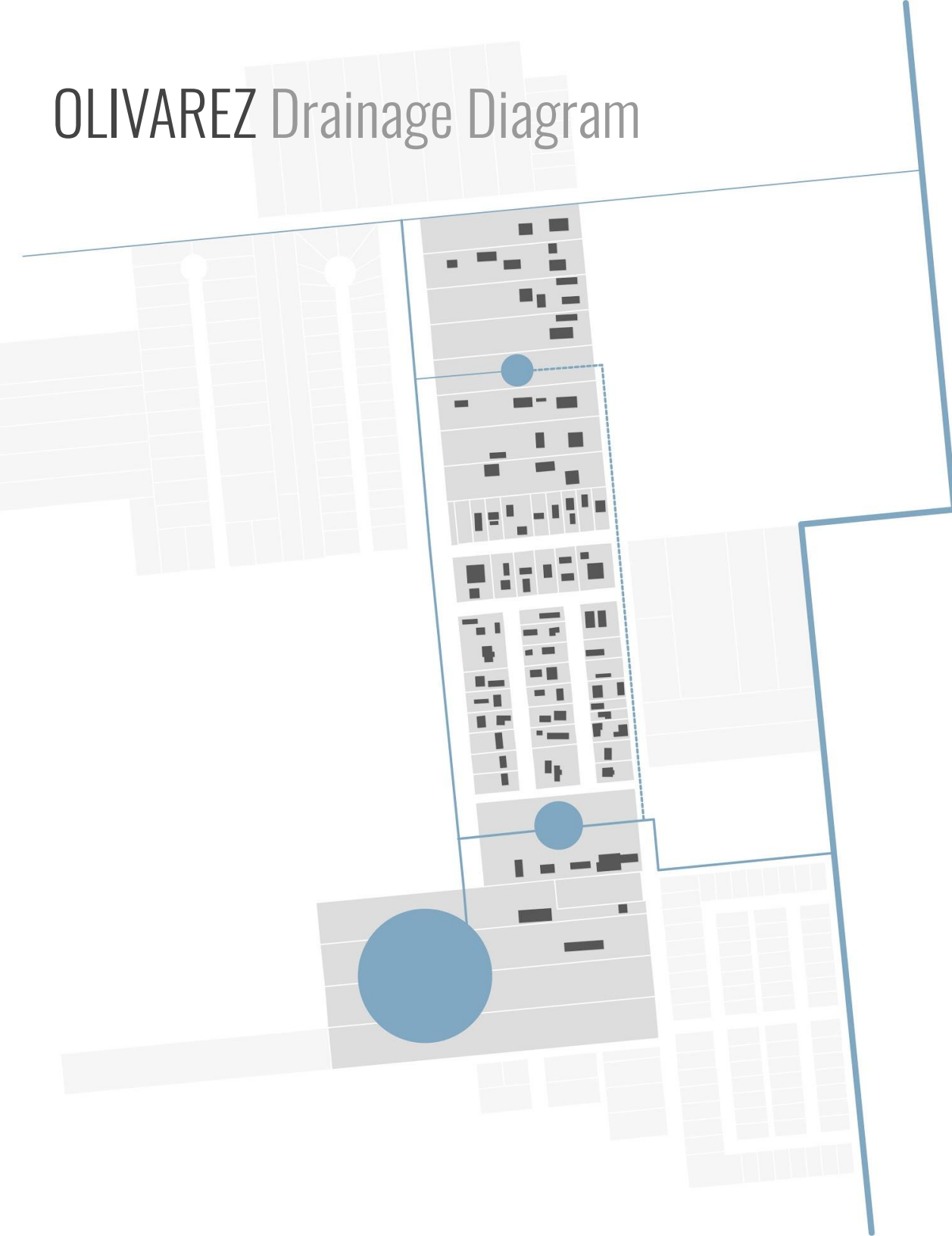


Bioswales could transform the alleyways in Muniz into linear park systems that filtrate storm water and connect colonia residents.

The bioswales could be combined with subsurface drainage pipes to increase the capacity of these systems to handle storm water during large precipitation events. These systems could positively benefit colonia residents by taking an underutilized space (alleyways) and turning them into a community amenity that additionally act as crucial flood mitigation infrastructure.



OLIVAREZ Drainage Diagram



The goal of this intervention is to create more systems to handle water on-site through bioswales and detention ponds. **Holding water on-site** has the potential to greatly alleviate flooding during large precipitation events in Olivarez. The colonia sits adjacent to a severely underdeveloped regional drainage canal. The canal is a mere 6ft deep and lacks direct access to a large natural hydrological system. Greater integration with this feature is not enough, and the site must develop its own drainage infrastructure to mitigate flooding in the area.

Drainage Typology

- regional floodway
- surface drainage
- - - subsurface drainage
- detention pond

Infrastructure Plan OLIVAREZ

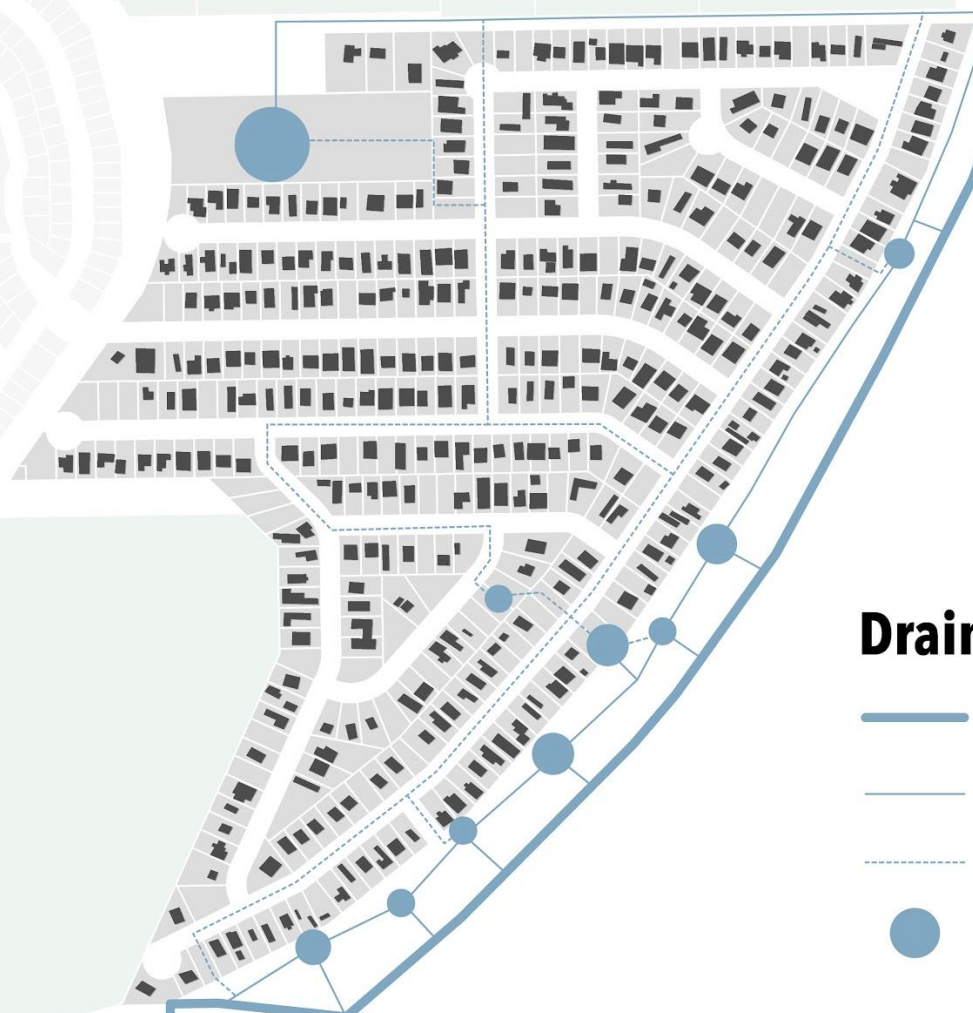
The goal of this intervention is to create more systems to handle water on-site through bioswales and detention, as the regional drainage canal directly adjacent to the site is insufficient in handling water during large storm events. These interventions also have the possibility of greatly expanding green space in the colonia and creating community amenities that greatly impact residents in the greater region.

The utilization of a large number of undeveloped lots in the colonia has the potential to create a new network of green spaces adjacent to the community while also providing spaces for water to be held when the local regional drainage canal becomes overburdened. This new park system could become a central node for the community and greatly improve the quality of life through the creation of new recreational space.



INDIAN HILLS Drainage Diagram

The goal of this intervention is to facilitate the movement of water through the site towards the a large regional floodway directly east of the colonia. The floodway directly adjacent to the site is sufficient in handling water during large storm events **and moving water is a necessary approach to** providing improved flood mitigation. However, a series of detention ponds provide recreation spaces and natural filtration nodes for the moving water.



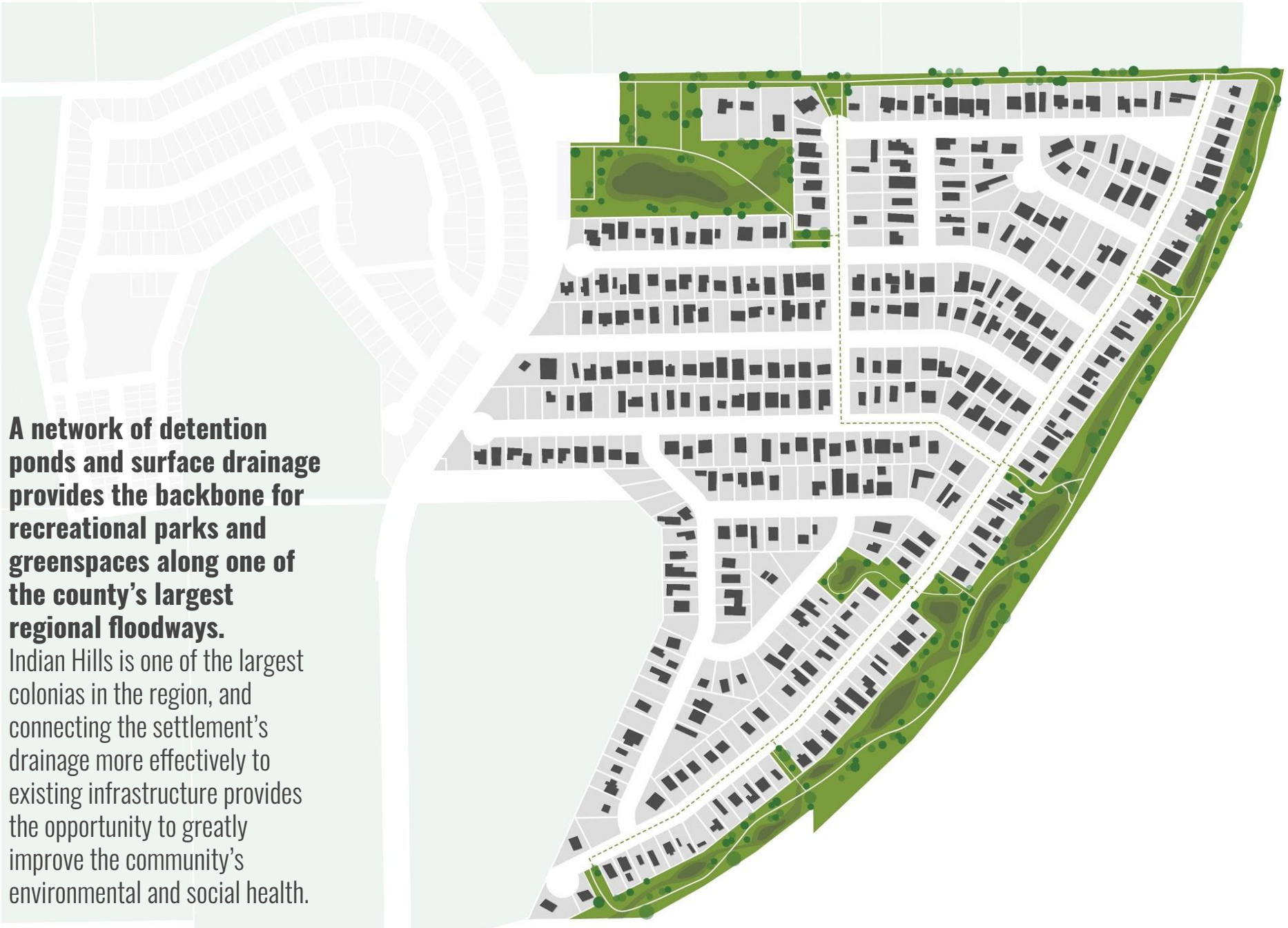
Drainage Typology

- regional floodway
- surface drainage
- - - subsurface drainage
- detention pond

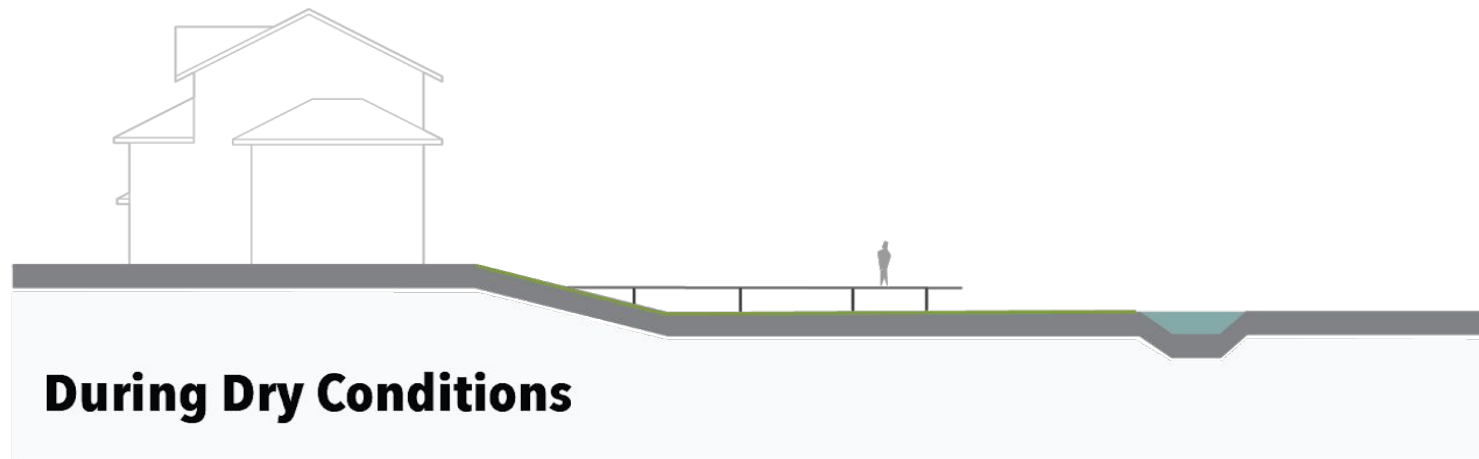
INDIAN HILLS Infrastructure Plan

A network of detention ponds and surface drainage provides the backbone for recreational parks and greenspaces along one of the county's largest regional floodways.

Indian Hills is one of the largest colonias in the region, and connecting the settlement's drainage more effectively to existing infrastructure provides the opportunity to greatly improve the community's environmental and social health.

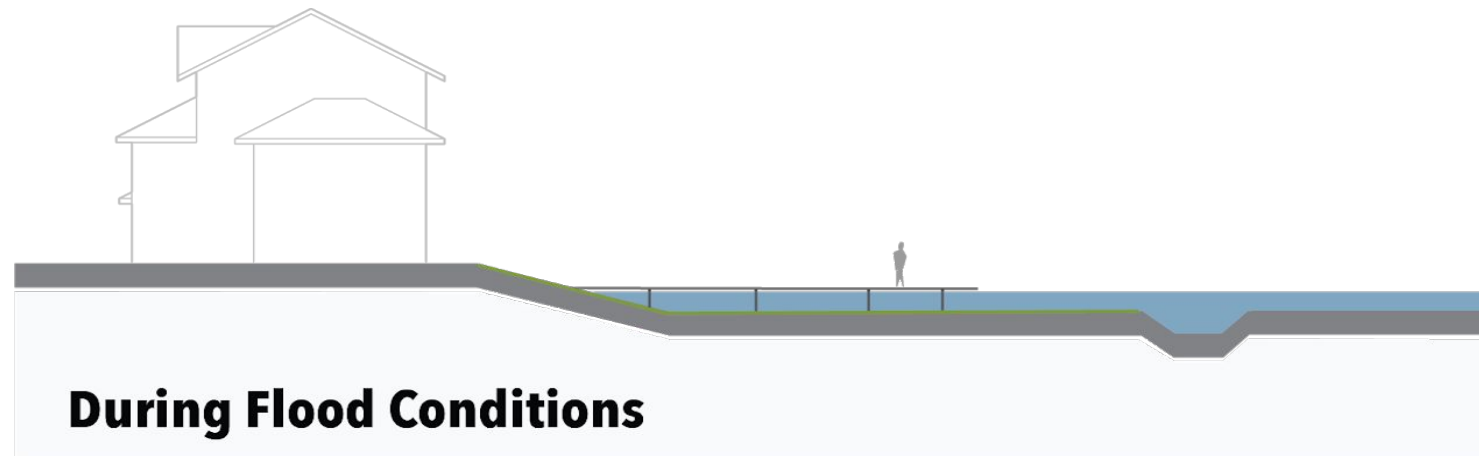


INDIAN HILLS Regional Floodway Park Section



Bed Rock Top Soil

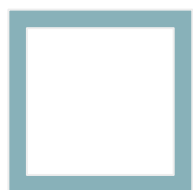




MANAGEMENT
STRATEGIES AND
ASSOCIATED COSTS

WHO MANAGES THESE SYSTEMS?

Local authorities oversee the construction, maintenance and management of local drainage systems to ensure that they are providing adequate, reliable source of water to the colonias. **Policy agencies provide information, financial assistance, support for planning, and outreach** for the conservation and responsible development of water for Texas.



POLICY AGENCIES

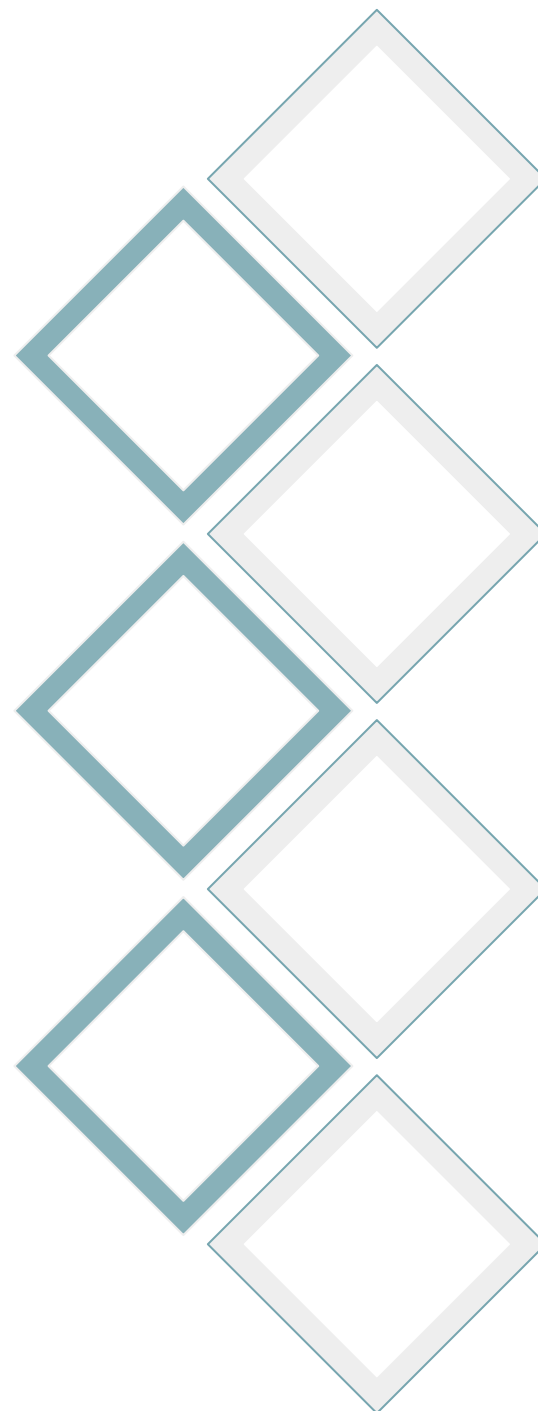


LOCAL AUTHORITIES

Texas Water Development Board

Texas Commission on Environmental Quality

General Land Use Office



Int. Boundary & Water Commission

Drainage/Irrigation Districts

Local Municipal Stormwater Planning Dep.

County Planning Dept.

GREEN INFRASTRUCTURE ASSOCIATED COST

Permeable Pavement - Pavers

Low \$5.30/sq ft
Mid \$7.10/sq ft
High \$12.00/sq ft

Permeable Pavement - Joint Material

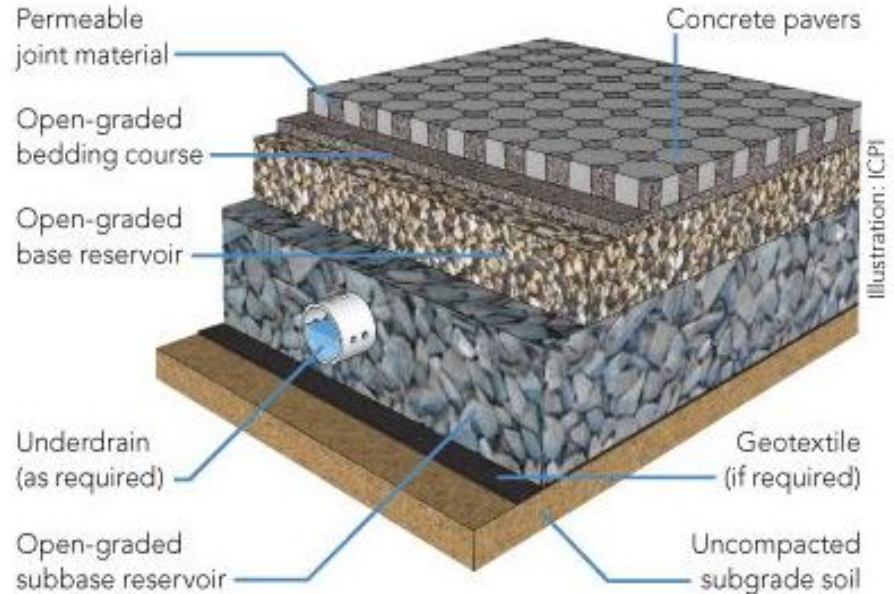
Low \$5.50/ sq ft
Mid \$6.34/ sq ft
High \$8.13/ sq ft

Permeable Pavement - Open-graded Base Reservoir

Low \$5.50/ sq ft
Mid \$6.00/ sq ft
High \$11.60/ sq ft

Permeable Pavement - Open-graded Subbase Reservoir

Low \$1.72/ sq ft
Mid \$3.32/ sq ft
High \$11.60/ sq ft



Permeable Pavement helps re-establish a natural hydrologic balance and reduces runoff volume. It undergoes a process of trapping and slowly releasing precipitation into the ground instead of allowing it to flow into storm drains and out to receiving waters as effluent.

GREEN INFRASTRUCTURE ASSOCIATED COST

Conventional Stormwater Storage

Low \$2.26/cf
Mid \$11.55/ cf
High \$22.71/ cf

Downspout Disconnection

Low \$9.00/ downspout
Mid \$35.00/ downspout
High \$156.00/ downspout

Amended Soil

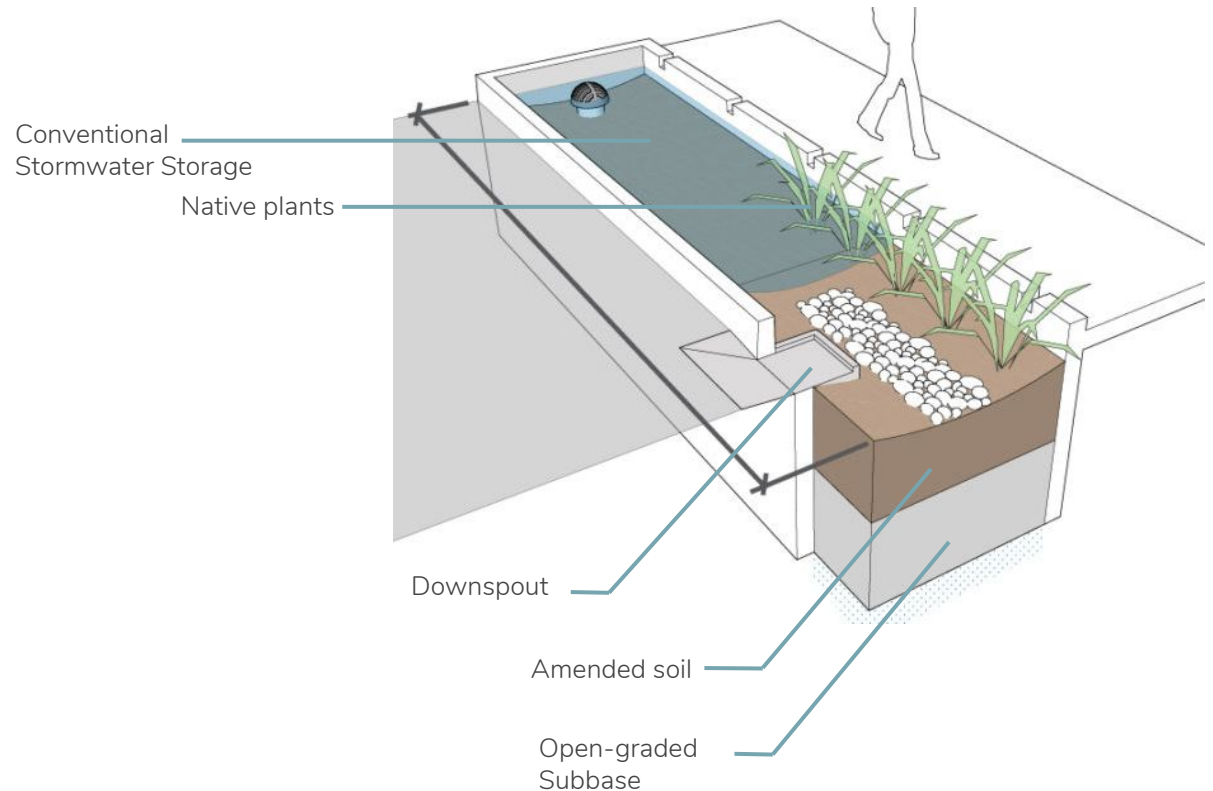
Low \$15.00/ sq ft
Mid \$30.00/ sq ft
High \$60.00/ sq ft

Open-graded Subbase

Low \$1.72/ sq ft
Mid \$3.32/ sq ft
High \$11.60/ sq ft

Native Plants

Low \$0.02/ sq ft
Mid \$0.100/ sq ft
High \$0.130/ sq ft



Bioswales are storm water runoff conveyance systems that provide an alternative to storm sewers. They can absorb low flows or carry runoff from heavy rains to storm sewer inlets or directly to surface waters.

$$\begin{array}{l} \textcircled{1} \quad \text{Empowerment} \\ + \\ \textcircled{2} \quad \text{Education} \\ = \\ \textcircled{3} \quad \text{Implementation} \end{array}$$

Colonia residents are known for their sweat equity and their willingness to make a change in their colonia. **For this reason continued colonia member empowerment and education is a fundamental piece for accomplishing public projects.** This project highlighted the major organizations responsible for the creation and maintenance of new flood mitigation projects. Organizing to pressure these organizations to implement more comprehensive green infrastructure projects could benefit colonia residents and communities in the long run.

QUESTIONS?

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