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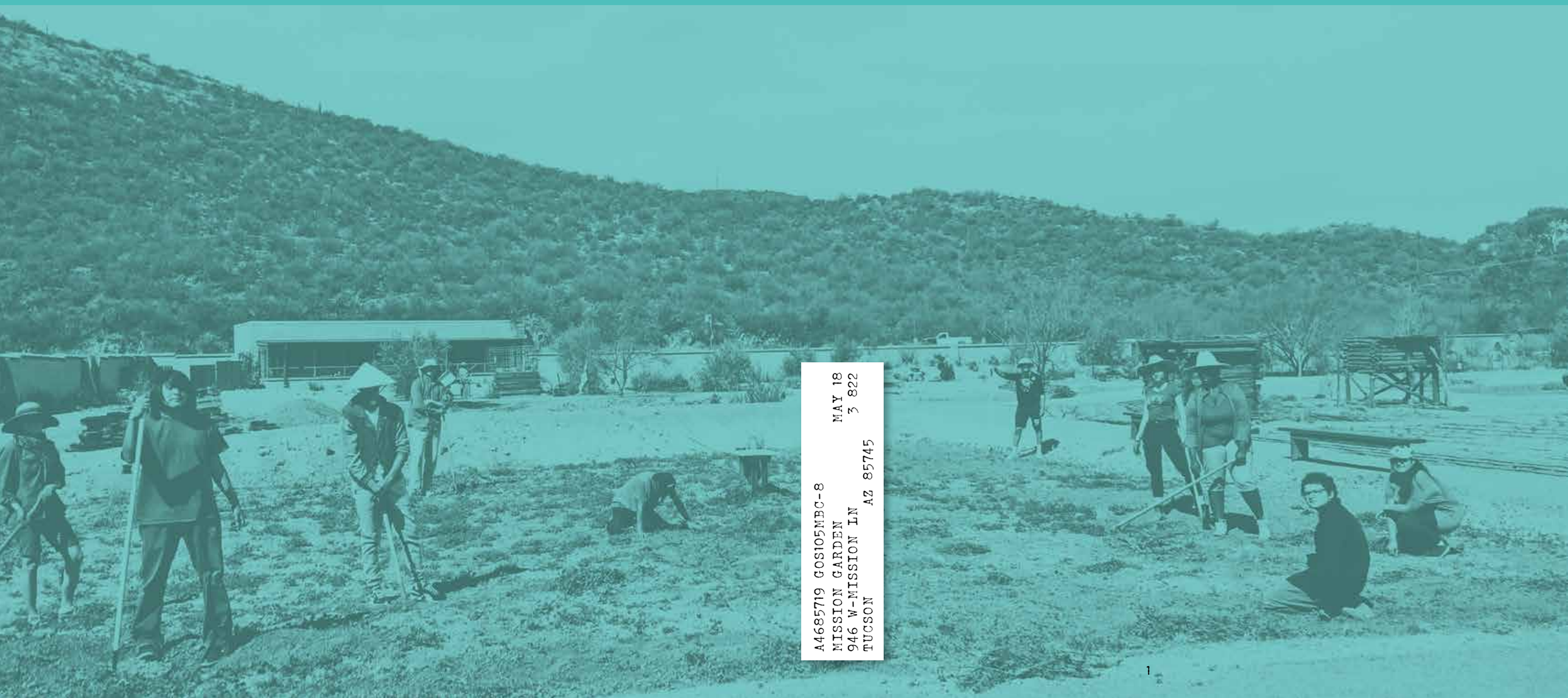
TOMORROW'S GARDEN

Uniting Tradition
Technology
Community



ABSTRACT

Today challenges of climate change, population growth, biodiversity loss, and water scarcity, lead farmers to ask new questions about how to grow food in a changing environment. Additionally, innovative technology and public food preferences present challenges and opportunities for farmers to consider before planting.

Honoring Tucson's diverse community and unique history, this study proposes the design of Tomorrow's Garden. This garden seeks to punctuate Mission Garden's historic timeline with a demonstration of sustainable and innovative agricultural practices. Outcomes of this proposal include the design of a garden that has the capacity to adapt to changing climate, as well as build community through design process and project implementation.

- TOMORROW'S GARDEN -

A Master's Report
by Brad Kindler

Submitted to the faculty of the
COLLEGE OF ARCHITECTURE,
PLANNING, & LANDSCAPE
ARCHITECTURE

In partial fulfillment of the
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TOMORROW'S GARDEN

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Table of Contents

Master's Report
Landscape Architecture
Brad Kindler - Spring 18'

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Graphics in this document have been gleaned from old Organic Gardening Magazines published by RODALE Press, as well as the 1974 Gardener's Catalogue published by William Morrow & Co. Inc. And lastly, the Desert Botanical Garden's "Plants and People of the Sonoran Desert Trail Guide. Happy Gardening.

PROJECT COLLABORATION

Tomorrow's Garden was made possible through the collaborative efforts of CAPLA, Mission Garden, the Ironwood Tree Experience, the Arizona State Schools for the Deaf and Blind, The National Parks Service, the Juan Bautista de Anza Trail, and the Western National Parks Association.

dedicated to all of the ancestors whom have passed along seeds of heart and earth.

Introduction

to·mor row
/tə' môrō/

the day after today; represents our present **innovative ethic** while offering opportunity for **adjustment** and **reinterpretation**; the knowable and influential future

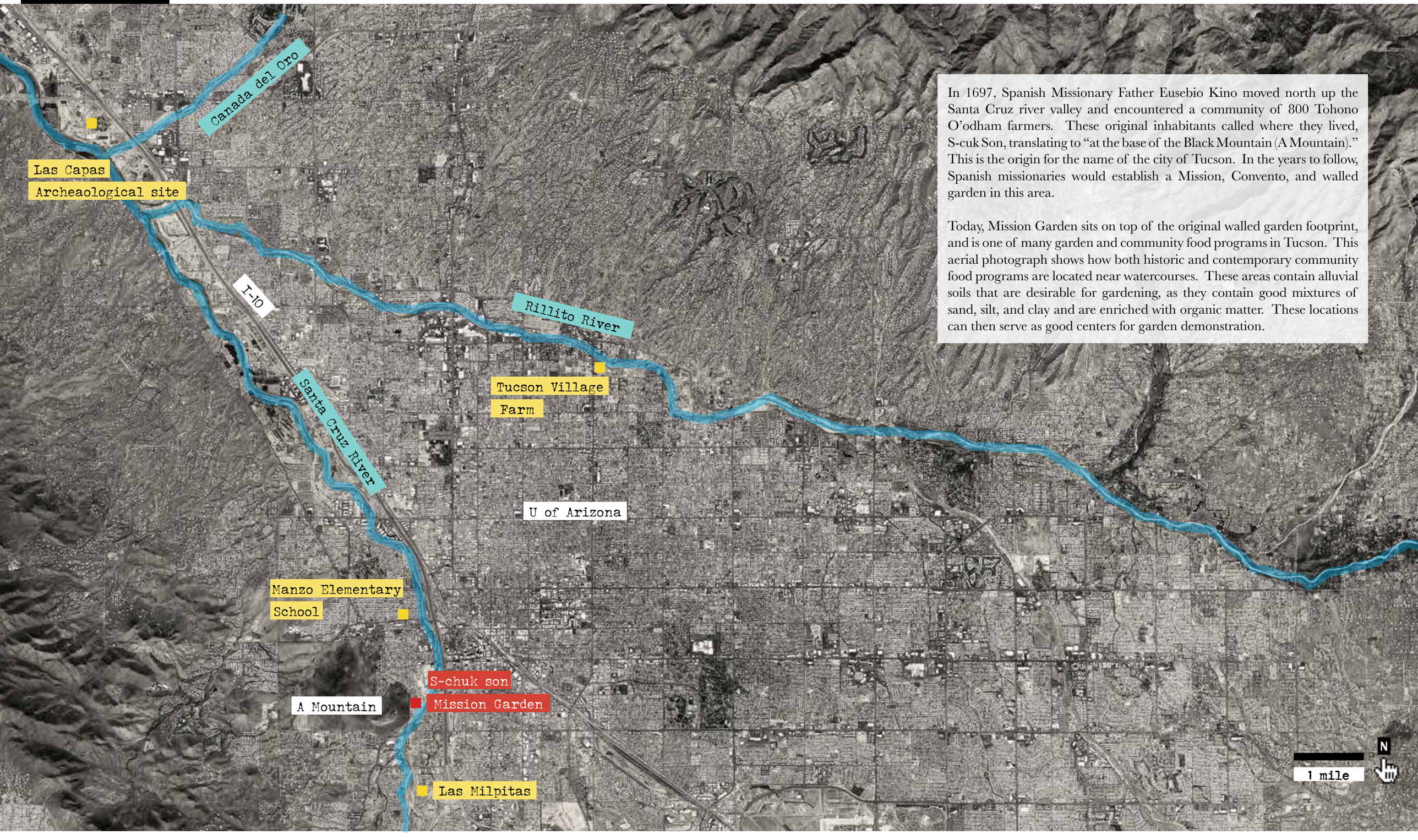
gar·den
/'gärd(ə)n/

a piece of land on which to cultivate plants, beauty, love, **community**, and imagination

* OUR PROJECT DEFINITION
of Tomorrow and Garden

This graphic was used to introduce Tomorrow's Garden during my MLA Master's Report presentation in the CAPLA Sundt Gallery on April 12th, 2018.

Site Context



In 1697, Spanish Missionary Father Eusebio Kino moved north up the Santa Cruz river valley and encountered a community of 800 Tohono O'odham farmers. These original inhabitants called where they lived, S-cuk Son, translating to "at the base of the Black Mountain (A Mountain)." This is the origin for the name of the city of Tucson. In the years to follow, Spanish missionaries would establish a Mission, Convento, and walled garden in this area.

Today, Mission Garden sits on top of the original walled garden footprint, and is one of many garden and community food programs in Tucson. This aerial photograph shows how both historic and contemporary community food programs are located near watercourses. These areas contain alluvial soils that are desirable for gardening, as they contain good mixtures of sand, silt, and clay and are enriched with organic matter. These locations can then serve as good centers for garden demonstration.

Mission Garden Overview

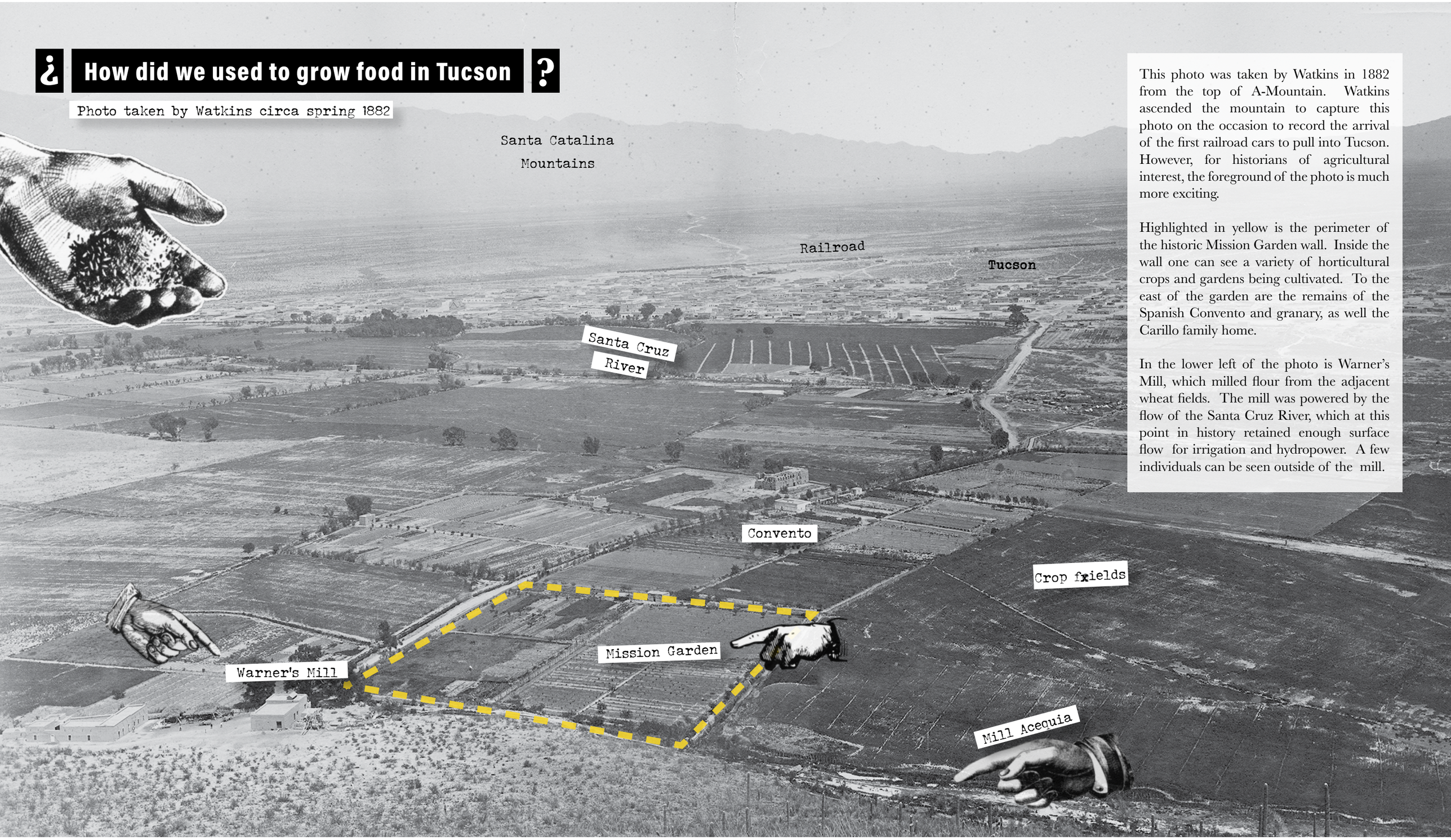
Mission Garden was established in 2007 and is a part of a larger community initiative called the Rio Nuevo Project. The garden is run, promoted and maintained by a non-profit organization called The Friends' of Tucson's Birthplace. This community based organization advocates and organizes to help actualize the larger historic landscape project called Tucson's Origin Heritage Park, which seeks to reconstruct the historic Mission and village of S-cuk Son in the adjacent area.

Mission Garden is housed inside of a 4-acre perimeter wall, employing 3 staff and working with dozens of volunteers, including University of Arizona students, to install and maintain historic educational timeline gardens. The gardens feature heirloom plants and historical artifacts that help to interpret the 4000 years of unique agriculture heritage found in Tucson.

Agricultural Community Building

¿ How did we used to grow food in Tucson ?

Photo taken by Watkins circa spring 1882



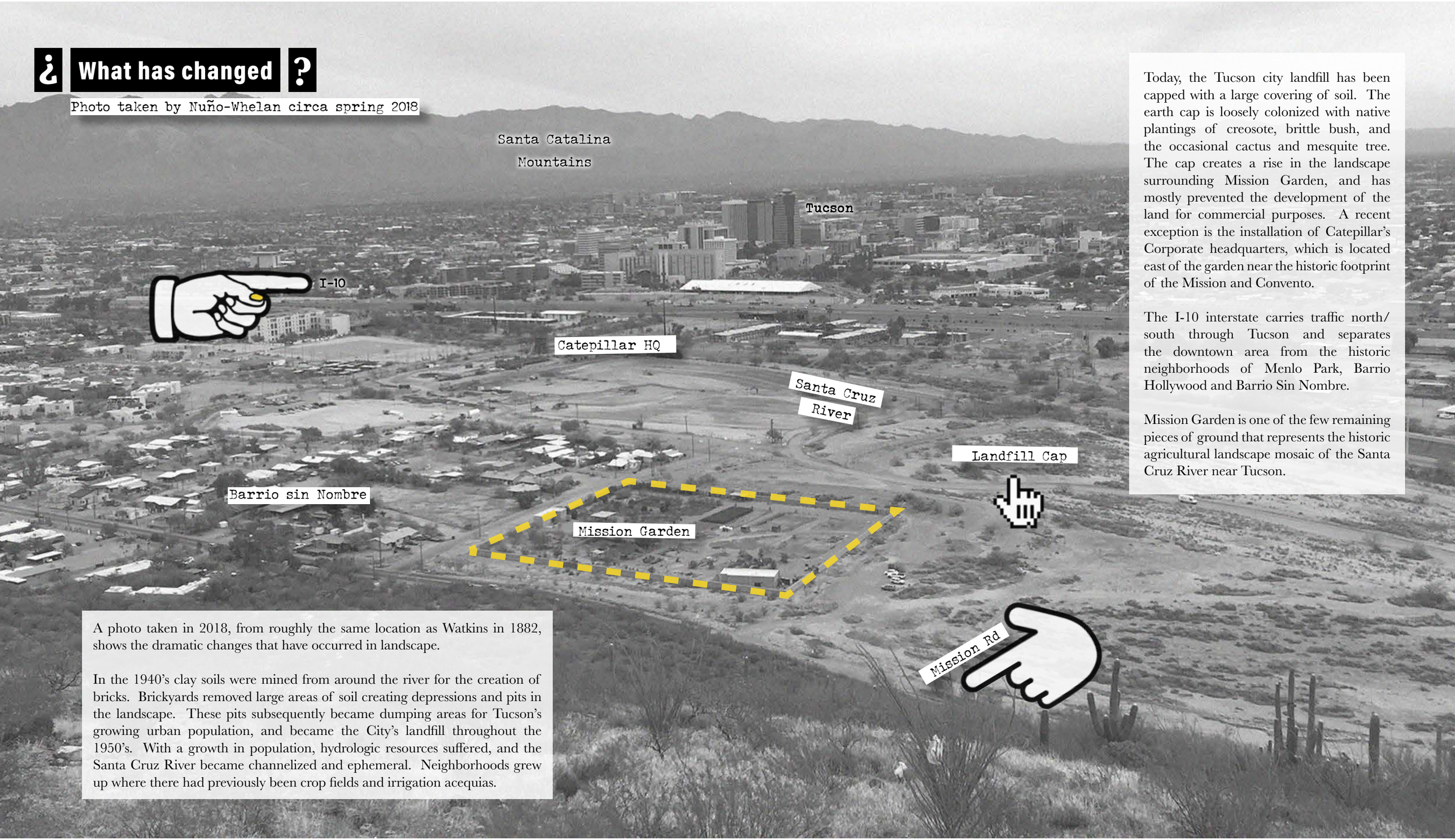
This photo was taken by Watkins in 1882 from the top of A-Mountain. Watkins ascended the mountain to capture this photo on the occasion to record the arrival of the first railroad cars to pull into Tucson. However, for historians of agricultural interest, the foreground of the photo is much more exciting.

Highlighted in yellow is the perimeter of the historic Mission Garden wall. Inside the wall one can see a variety of horticultural crops and gardens being cultivated. To the east of the garden are the remains of the Spanish Convento and granary, as well the Carillo family home.

In the lower left of the photo is Warner's Mill, which milled flour from the adjacent wheat fields. The mill was powered by the flow of the Santa Cruz River, which at this point in history retained enough surface flow for irrigation and hydropower. A few individuals can be seen outside of the mill.

¿ What has changed ?

Photo taken by Nuño-Whelan circa spring 2018



A photo taken in 2018, from roughly the same location as Watkins in 1882, shows the dramatic changes that have occurred in landscape.

In the 1940's clay soils were mined from around the river for the creation of bricks. Brickyards removed large areas of soil creating depressions and pits in the landscape. These pits subsequently became dumping areas for Tucson's growing urban population, and became the City's landfill throughout the 1950's. With a growth in population, hydrologic resources suffered, and the Santa Cruz River became channelized and ephemeral. Neighborhoods grew up where there had previously been crop fields and irrigation acequias.

Today, the Tucson city landfill has been capped with a large covering of soil. The earth cap is loosely colonized with native plantings of creosote, brittle bush, and the occasional cactus and mesquite tree. The cap creates a rise in the landscape surrounding Mission Garden, and has mostly prevented the development of the land for commercial purposes. A recent exception is the installation of Catepillar's Corporate headquarters, which is located east of the garden near the historic footprint of the Mission and Convento.

The I-10 interstate carries traffic north/south through Tucson and separates the downtown area from the historic neighborhoods of Menlo Park, Barrio Hollywood and Barrio Sin Nombre.

Mission Garden is one of the few remaining pieces of ground that represents the historic agricultural landscape mosaic of the Santa Cruz River near Tucson.

¿ What are we growing ?

Mission Garden Timeline Gardens

To illustrate the diverse heritage of agricultural tradition found in Tucson, Mission Garden demonstrates the technique, tradition, and technology of the various periods and cultures that have grown food in the region.

Beginning with a demonstration of the Early Agriculture period these gardens feature agave fields, heirloom seed varieties, and flood irrigation basins. Pre and Post contact gardens emphasize the Columbian Exchange of plant materials and cultural traditions. The Heritage Orchard utilizes cloned plant materials that were associated with area missions, ranches, and notable families. Mexican, Chinese, and Statehood gardens provided visitors with a more complete history of who gardened recently in the area and what types of crops and culinary traditions they brought with them.

The final garden to be developed along Mission Garden's historic timeline is Tomorrow's Garden.

1700's
Heritage Orchard

TOMORROW'S GARDEN

4200bc
Early Agriculture

Tohono O'odham
Pre/Post Contact
- 1697ad

Mexican & Chinese
Gardens
1800's

Statehood Era

Timeline

A timeline might give the impression that agricultural traditions, and the people that developed them, no longer exist. However, Mission Garden believes these timeline gardens represent continuity and change, and that the past is still potent in the seeds and stories we continue to cultivate in the present.

Site

With the opportunity to integrate Tomorrow's Garden into the larger landscape, the application of the Master's Project Abstract contains both Interior and Exterior design recommendation for Mission Garden

The location for Tomorrow's Garden is contained in the "Interior" yellow shape in the southeast corner of Mission Garden. The site is approximately 3,300 sq/ft and is completely free of surface obstructions and plant materials.

The "Exterior" boundary borders the south wall of Mission Garden and encompasses the informal service and staff parking lot, as well as portions of the landfill cap.

Mission Garden is a **4-acre walled garden** that is sits adjacent to the historic **Mission San Agustin** site and **capped Tucson landfill**.

100 feet

N

¿ How can we grow food at Mission Garden tomorrow ?

Today challenges of climate change, population growth, biodiversity loss, and water scarcity, lead farmers to ask new questions about how to grow food in a changing environment. Additionally, innovative technology and public food preferences present challenges and opportunities for farmers to consider before planting.

Taking these considerations before the Mission Garden Board of Directors, I was subsequently tasked with developing a garden intent that would address these issues, and serve as an introduction to Tomorrow's Garden for promotional literature.

Stitching together the opportunity for agricultural technology, traditional ecological knowledge, and community building, the following garden intent achieves a synthesis of themes and helped to drive the conception of project Goals and Objectives.

Garden intent

Honoring Tucson's diverse community and unique history, Tomorrow's Garden seeks to **punctuate Mission Garden's historic timeline** with a demonstration of **sustainable and innovative agricultural practices** that have the capacity to **adapt** to changing climate as well as **build community** through design process and project implementation.

Literature Review

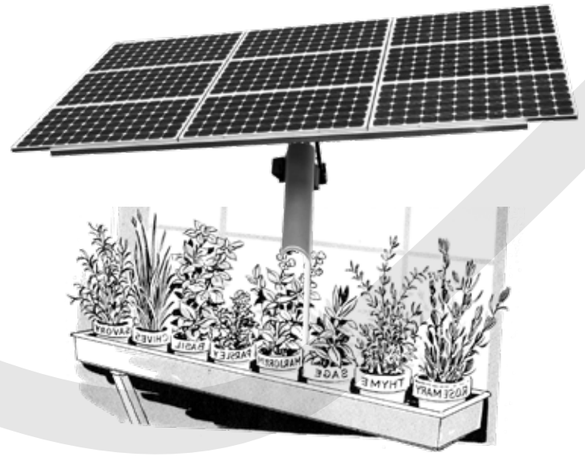
In order to better understand the depth of design opportunity and project planning for Tomorrow's Garden, a literature review was conducted on four relevant topics to the Master's Project. These topics included Public Process, Visitor Interpretation, Historical Arid Agricultural Technique, and Contemporary Arid Agricultural Technique.

Public Process

Visitor Interpretation

Historical Arid Ag. Technique

Contemporary Arid Ag. Technique



Public Process

The observant landscape architect is argued to be uniquely armed with the tools to help identify, catalog, and protect the cultural heritage of the communities they work for (Hester, 1985). What are these tools of community development, and how can they be put to this aspirational use? In addition to quantitative site analysis, and other metrics of physical documentation the landscape architect employs, the creative opportunity to identify and invoke the genius loci, or spirit of a place, is one of the most important skills a designer can bring to a community design centered project. This place-based approach to design and development requires one to, "uncover extraordinary and ordinary landscape or local and outside value, describing the cultural history and lifescapes, discovering indigenous idiosyncrasies that can be marketed, preserving sacred places, introducing the community to its genius loci, and inspiring place-appropriate design choices (Hester, 1985).

Community oriented design approach is a key foundation of development work for the US Peace Corps. Community-based design philosophy was an initial outgrowth of the necessity to include and empower women in community-program decision making, as they are often the individuals who will implement and benefit from the programming. Through many years of working in economic and environmental development situations, the US Peace Corps emphasizes partnership and undertakes programs to, "engage these partners in a process in which all voices within the community are participants in the analysis, design, implementation, monitoring of their joint activities and projects" (PACA 2007). This program design approach is called Participatory Analysis for Community Action, PACA, and is the basis for all community development programming worldwide for its current 7,000 volunteers.

To this end, PACA includes several key elements of organization for the volunteer to follow when implementing community development programming:

- Interviewing separate groups of the community, e.g., men and women, youth and adults
- Facilitating their discussion in small and large groups
- Formatting their ideas visually
- Helping them compare and contrast their own perceptions, e.g., as men and women
- Facilitating or using their own analysis for site selection and project design (PACA, 2007).

Shifting from a development volunteer context to a landscape architect's analysis, the process of community design changes slightly.

In his important 1985 article in Landscape Architecture Magazine, designer Randolph Hester articulates his vision and process for other designers to seize what he identifies as unique developments in the American landscape and society. Specifically, community oriented design process can help to address the emergence of environmental anomie, or the rootlessness many urban American's are feeling. Additionally, place appropriate economic development has the potential to market indigenous cultural landscape resources for economic renewal (Hester, 1985).

Just like the PACA model seen in the Peace Corps, community design in landscape architecture can be facilitated through the meeting and workshop process. The following 12 step framework provides a philosophical and activity orientated approach to community design.

1. Listening
2. Setting Community Goals
3. Mapping and Inventory
4. Introducing the Community to Itself
5. Getting a Gestalt
6. Drawing Anticipated Activity Settings
7. Letting Archetypes and Idiosyncrasies Inspire Form
8. Making a Conceptual Yardstick
9. Developing a Spectrum of Design Plans
10. Evaluating Before Construction
11. Transferring Responsibility
12. Evaluating After Construction

These 12 workshop design points inform the original basis for community-design as we know it in landscape architecture and planning, and provide a compass for initiating a public design process. Once a public processes direction has been charted there are additional approaches that can be used to address design.

Becoming familiar with the public participation model can be an asset to landscape architects in their professional practice and marketability. Currently, public participation is a legal requirement or prerequisite for most of the local and federal environmental government decision making (Creighton, 2005). However, there is a distinction to be made between those forms of public participation that emphasize getting information from, versus to constituents.

In many instances the public-process that is carried out to get information from the public is separate from the techniques of public design. Outreach that solicits information from the pubic for opinion or suggestion "do not provide a significant exchange of information and are not designed to result in genuine deliberation between affected citizens (Creighton, 2005). Examples of this type of public engagement include, open houses for projects, interviews and meetings, hotlines, polls and surveys. Polls and surveys are effective for assessing public opinion (Creighton, 2005). The advantage is that they measure a proportion of public opinion of the community at large. These types of techniques can also be organized scientifically and when done well can serve as a source of objective quantitative data. A downside of the process is that sometimes the poll or survey may only reflect the vocal or determined minority of public opinion.

In an initial opportunity to develop a basis for understanding the gastronomic and agricultural opinions of the Tucson public, a simple public survey was developed around the question of, "How will we grow food in Tucson tomorrow?" The paper survey was presented at two area Tucson events, Tucson Meet Yourself and the Food and Water in Arid Lands Conference. The handwritten public survey results have been recorded for later analysis and discussion. Again, it should be noted that in terms of public participation in polls and surveys, public opinion can be mixed especially if the public is superficially informed about the topic to begin with. Additionally, public opinion can change rapidly. Lastly, "knowledge about the mix of views in the general public does not necessarily tell the political balance of power in the community (Creighton, 2005). It is this last point that should be acknowledged by any attempt at getting information from public process, as the inherent goal of complete community representation should always be purposefully fostered.

Adopting a strategy to accurately reflect the depth of human diversity and opinion in a community, the designer can employ additional strategies to help ensure all voices are being heard. In the fields of Anthropology and Archeology researchers have implemented forms of Community Based Participatory Research, CBPR. CBPR engagement emphasizes that "indigenous and local communities – not scientists (or designers) are in charge of their own cultural history" (Atalay, 2012). This is an ethic and responsibility a designer should take seriously when working in a context of history and community identity. The questions of who is interested in what and why, are important concerns of economic and social justice in indigenous and local communities. For scientists or designers, transparency of purpose is a necessity, as access to the cultural space and heritage other people is a "gift not a right" (Atalay, 2012).

Trusting relationships can develop in a context of respect and reverence, and out of these relationships holistic design approaches can develop. A further example of a holistic approach to community design and planning, is to establish a directive to better plan for design communication of landscape ideas. To this end, work in Germany has identified opportunities to shift the communication from top-down, to bottom-up communication and cooperation (Luz, 2000). In working with farming communities there is a need to translate scientific or expert language into local language. Participatory and communication methods then can take the form of round tables, workshops, marketing and information campaigns. These tools helped to accelerate the project implementation, "suggesting that landscape ecology can be holistic only if public awareness and participation play an equal role with the expert views of natural scientists and planners (Luz, 2000).

Considering the discussion of holistic community design that seeks to incorporate innovative process, gender, cultural identity, and communication, we must also reflect on the need to interpret this method in an accessible way. The question of "How will Tucson grow food Tomorrow?" may be unanswerable in an objective sense. It is a question not about agricultural technique, but rather community identity and a shared pursuit of sustenance and celebration around food headed into an uncertain future. In his 2016 letter addressing 50 years on from the original "We Declaration" letter of activist landscape architects, Randolph Hester argues for a new "Transactive Language" to respond to an evolving Ecological Democracy. This language will be paramount to a holistic public design process. As Hester writes it will be, "a new civic language to elevate discourse, to allow citizens and designers to work together, and to enable the citizenry to decisions informed by ecological science and native wisdom (Hester, 2016). ■

Interpretation

Mission Garden currently employs several methods of interpretation and education for the public. Primarily staff and community volunteers provide personal interpretation to visitors and tour groups. Volunteer docents are trained in garden history and plant materials, and are assisted by staff when a question arises that they may not be able to answer. The garden also has a small building dedicated to displaying historical documents, photos and other interpretive artifacts. Additionally, there are several small signs throughout the garden describing garden timelines and cultural influences. Is this the right approach to interpretation and education at Mission Garden? The following literature review on "Interpretation and Education" helps to clarify and strengthen our efforts moving forward on the presentation of Tomorrow's Garden.

Why interpret a garden or cultural site? One answer that captures both an expression of education and heritage is stated as, "interpretation, either explicitly or implicitly, aims to stimulate, facilitate and extend people's understanding of place so that empathy towards heritage, conservation, culture and landscape can be developed" (Stewart, 1998). For Tomorrow's Garden, interpretation requires that we communicate to people historical facts, these facts relationships to the importance of the garden in the larger landscape, and lastly the development of a positive attitude towards ecological conservation of these landscapes. Interpretation is used to enhance the enjoyment of place, to convey symbolic meanings, and to facilitate attitudinal or behavioral change (Prentice, 1996). From this basis of why we interpret, it is a natural step to consider for whom and how we do it.

As landscape architects, we often look to define and display a sense of place. However, the humble among us realize that this is often difficult to find, define, design with, and subsequently present the "place" to the public. Additionally, every person comes to the garden and interacts with the space in a unique way. This individual quality of visitor interaction has been described in a study of visitor's identification with "place" at Mount Cook, New Zealand. Visitors have been categorized by "typology of visitor use." There are four common visitor typologies that have been described and in turn should be considered when approaching site interpretation.
"Seekers" are those individuals characterized by their need to actively seek out interpretive sources and program information. Within the Seeker category there are subcategories of Learners, Gatherers, and Filler personalities. These designations describe how much information people will bring with them about the topic before they arrive at the site. As a result of this spectrum of inquiry that Seekers possess, these visitors are the most likely group to become excited by and engage with interpretive materials and programming.

"Stumblers" are a category of visitor that interact with site interpretation in a haphazard and random fashion. Interpretation then is only one of many chance encounters that enriches their visit. Stumblers are further divided into Satisfied and Frustrated categories. It should be noted that frustrated visitors came away with this feeling as a result of not being able to easily find and engage interpretation.
"Shadowers" are visitors that prefer to be accompanied through a site with a docent or visitor that has been through the space before. Interpretation for this category of visitor then can become formal or informal and their experience can be influenced by the quality of material presented to them. "Shunners" shun interpretation for various reasons and make up a small minority of normal visitors. They fall into two categories Passive, uninterested in interpretation, and Avoiders who actively avoid interpretation.

These categories and definitions of user groups at Mount Cook help to better understand the psychology and behavior that visitors may bring to Mission Garden. It illustrates that the diversity of visitors must also be approached through a diversity of interpretive means both tangible, intangible, intellectual, and personal. Is also illustrates that no matter how much interpretation or interaction you have, some people will avoid what you offer. There are though methods by which we can skillfully reframe interpretation and coach the visitor's attention through design.

Of the various visitor typologies presented, all individuals are additionally engaging sites with mindless or mindful behavior and attention (Moscardo, 1996). Mindless attention is overly determined by past experience and information. Familiarity, repetition, stereotypes, and relevance of information presented are the primary causes of mindless engagement. Mindful visitors however actively process information and question the presentation of the setting. Visitors are more likely to be mindful when they have some control over the situation, find the information relevant, and are presented with variety, novelty and surprise (Moscardo, 1996). From this understanding four principles have been derived to encourage mindfulness in visitors and enhance their interpretive experience:

1. Present a variety of experiences.
2. Visitors should retain some control over their visit and interaction, and be presented with adequate information to orient themselves on site.
3. Interpretation should seek to make connections to visitor's personal experiences.
4. Interpretation should challenge visitors and encourage questioning.

From this framework of mindful interpretation we can encourage engagement and attention; we can additionally design interpretation so that visitor's find meaning in their experience.

As with other qualitative aspects of life the idea of human meaning for the most part is subjective. However, throughout the long history of the museum and park profession certain best practices have been identified that help to convey meaning to visitors. Writing in his 1957 book, "Interpreting our Heritage" Freeman Tilden address interpretation not as simply information but that additionally, "interpretation should capitalize on mere curiosity for the enrichment of the human mind and spirit" (Tilden, 1957). To this meaningful end he proposed six principles of interpretation:

1. Any interpretation that does not somehow relate what is being displayed or described to something within the personality or experience of the visitor will be sterile.
2. Information, as such is not interpretation.
   Interpretation is revelation based upon information but they are entirely different things. However, all interpretation includes information.
3. Interpretation is an art, which combines many arts, whether the materials presented are scientific, historical, or architectural. Any art is in some degree teachable.
4. The chief aim of interpretation is not instruction, but provocation.
5. Interpretation should aim to present a whole rather than a part, and must address itself to the whole person rather than any phase.
6. Interpretation addressed to children should not be a dilution of the presentation to adults, but should follow a fundamentally different approach. To be at its best, it will require a separate program.

Out of Tilden's framework The National Park Service began their own Interpretive Development Program (IDP) in 1994, with a definition of interpretation that, "facilitates an intellectual and emotional connection between the interests of the visitor and the meanings of the resource" (NPS). The IDP Model emphasizes three components of effective interpretation along with subcategories of further definition:

1. Knowledge of the resource
   The resource possesses meaning and has relevance.
   It has tangible characteristics: material objects you can perceive with your senses, palpable facts and info
   It has intangible meanings: concepts, ideas, abstractions and values, the "spirit of place."

2. Knowledge of the visitor
   Visitors are seeking experiences and meanings of personal value.
   They are autonomous and seek choice and control of their experience.
   They are diverse in learning style, physical and mental ability, gender, race, age, and nationality.
   Their visits occur within a personal and social context.

3. Knowledge of interpretive methods
   Interpretation facilitates a connection between the meanings of the resource and the interests of the visitor.
   Interpretation communicates themes that clarify relationships between tangibles and intangibles: good stories that make sense.
   Interpretation engages diverse audiences through a variety of methods.

Effective interpretation for the National Parks Service seeks to go beyond typical visitor center and kiosk formats. They have formalized an intellectual and scholarly background to their important public work. To date the interpretation at Mission Garden has been semi-orchestrated yet in many ways reflects some of the effective established techniques of interpretation. However, as with many volunteer run projects interpretation suffers when certain key people leave or materials remain unorganized. We then heed the warning advice of John Muir, "In drying plants, botanists often dry themselves. Dry words and dry facts will not fire hearts." It will be the task of Tomorrow's Garden to incorporate some of these social and philosophical concepts of interpretation into its design and interpretive display. ■

Historical Arid Agriculture

In 2015 Tucson was designated by the United Nations Education, Scientific, and Cultural Organization (UNESCO, 2015) a "City of Gastronomy" (UNESCO, 2015). The designation is an affirmation of the diverse border cultures and their food traditions that comprise Tucson's unique identity. According to Ethnobotanist Gary Nabhan, "The Tucson Basin deserves this honor not only for having some of the oldest continually farmed landscapes in North America, but also for emerging as a global hotbed for ideas on relocalizing food economies and growing food in a hotter, drier climate" (Kimble, 2015). The old farming evidence that Nabhan describes is archaeological evidence of farming and human settlement that dates to 2100 BC, a period of history known as Early Agriculture (Herr, 2009). It is out of this period that an assessment of historical arid agricultural tradition and technique can begin review.

Around 9,200 years ago, Balsas teosinte, a tropical grass was domesticated in central Mexico and served as the genetic basis for evolution of diverse maize varieties (Roney, 2009). Early maize, in addition to bottle gourds, squash, arrow root, and tree crops were planted in slash and burn agricultural practices that were characterized by clearing land of vegetation and burning the residues. These systems occurred throughout central America and were a complement to hunting and foraging subsistence economies. About 4,500 years ago there was a sudden explosion of maize agriculture found in both North and South America. It was during this period that maize agriculture, including beans and squash, was introduced into the Southwest and the Tucson basin (Roney, 2009). It was also during this time period that the area experienced an interval of cooler and moister climate which allowed for more predictable rainfall, few large floods, and aggrading alluvial sediments (West, 2009). Dispersed hunting and gathering cultures of the era began to cultivate maize as an opportunistic economy of diet, and by the early centuries A.D. had transitioned into semi-settled forager-farmer lifeways (West, 2009).

During the Early Agriculture period in the Tucson basin farmers settled their villages and planted their fields based on access to water. Fields were located near major streams like the Santa Cruz and principle tributaries where water was more abundant than the surrounding desert landscape. Archaeologists have termed these agriculturally appropriate areas, stream reach boundaries, as they constitute a natural uniform series of reaches, or floodplains (Gregory, 2009). Stream reach boundaries are also characterized by high water tables, increased vegetation, and enhanced sediment deposits with lower gradient floodplains. For early agriculturalists, the reach boundaries provided reliable water, arable land, abundant plants to eat, and materials for home construction. Surrounding landscape topography and wider floodplains below reach boundaries further assisted farmers and allowed for flood irrigation of fields with the summer monsoon rains. Agricultural irrigation proceeded under this practice for almost 2,000 years, until around 950 - 1100 A.D. when Hohokam farmers began to employ the use of irrigation canals to deliver water to crops (Mabry, 1995). These canals were often large projects for the inhabitants of the area, excavating canals 3 feet deep and 12 feet wide, that would carry water for many miles to terraced fields. With the introduction of canal irrigation to the Santa Cruz basin, new crops like bottle gourds, cotton, common beans, tepary beans, grain amaranth, and flour maize all appeared. Overtime, these canals took on a more engineered form through time as experience was gained. Early canals took a U-shape, while later historic period canals were formed in the shape of a trapezoid, with a larger width to depth ratio that was more efficient for moving water (Freeman, 1995).

In addition to canal irrigation both Hohokam and recent tribal farmers also employed the use of field rock piles to grow food and conserve moisture. However, these practices were located towards the bajadas, or broad slopes of alluvial materials at the base of escarpments and characterized another form of agricultural land intensification associated with growing populations (Fish, 1992). These rock piles acted as a lithic mulch which slowed, spread, sank rainfall, as well as shaded the soil surface afterwards, reducing evaporation. For the area farmers rock pile constructed works were primarily used for the cultivation of agaves. These ancient surface features of the Tucson Basin are most evident near Marana, where more than 2 square miles of these field features have been preserved and catalogued archaeologically (Fish, 1992). The agave species associated with these sites have been identified as both Agave parryi and Agave murpheyi, with also possible species associated with Mesoamerican origin. Interrupting the flowering of the agave by cutting off the young stalk, farmers concentrated the agave's reproductive energy into the carbohydrate rich core of the plant. This core was subsequently harvested, processed by removing the exterior leaves, and roasted over 48 hours in large sunken pits, to produce a sweet energy rich food (Fish, 1992). The cut and processed leaves of the agave also provided farmers a source of strong fiber material for textiles and cordage.

In addition to the cultivation of Agaves, native people regularly collected and ate other desert species creating a forager-farmer lifestyle that helped to diversify diet and economy. Archaeologists have identified several native plants present in Early Agriculture excavations including saguaro fruit, wild grass seeds, mesquite pods, false purslane, goosefoot and amaranth. At nearby Las Capas and Cortaro Farms sites, excavated evidence reveals people living there ate more than twenty kinds of plant species, in addition to maize (Diehl, 1995). This pattern of farming and forage diversity continued until about the first century AD, at which time maize, beans, squash, and cotton farming revolutionized the economy and diet diversity decreased to about ten species, two to four were cultivated crops (Diehl, 1995). After the decline of the Hohokam civilization descendent Pima tribes continued to draw on the rich traditions of their ancestors and created complex farmer-forager societies that continue to this day. Traditional food resources of the contemporary Tohono O'odham tribe include cultivated crops like 60 day maize, tepary beans, mottled lima beans, grain amaranth, and striped cushaw squash, as well as mesquite pods, cholla buds, panic grass, salt-bush, lambs-quarter, saguaro and barrel cactus fruits, and fiber and material providing crops like cotton, devil's claw, and bottle gourd (Desert Botanical Garden, 2017).

In 1699 Father Kino described the complex and rich desert irrigated agriculture of San Xavier writing, "The fields and lands for sowing were so extensive and supplied with so many irrigation ditches running along the ground that...they were sufficient for another city like Mexico" (Mabry, 1995). To the Spaniards these canals were known as "acequias." This word in Spanish is derived from the Arabic al-saqiyah, which would have come to Spain via the Moors of north Africa and their own tradition of arid-lands agriculture (Nabhan, 2008). Continuing cross-cultural agricultural encounter, the Tucson Basin was introduction to the Old World crops of Northern Africa, the Middle East, and Europe. The 17th century Jesuit and Franciscan missionaries brought seeds, cuttings, and livestock along with them to what was then the northwest territories of New Spain (Garcia, 2016). This influx of new foods, animals, plant materials, religions, and economy has been labeled the "Columbian Exchange" (Mann, 2011). This dynamic exchange is responsible for how we see the world today and presents Tomorrow's Garden with an opportunity to interpret our inextricably linked agricultural history and future. ■

Contemporary Arid Agriculture

Without wading too far into the field of agricultural technology opinion, the following is a discussion of several contemporary arid agricultural technologies and techniques that are transforming our food system. These examples should be understood within the context of scale that Tomorrow's Garden will encompass. The scale is what it says it is, a "garden" scale. This can be understood as cropping areas of 250 square feet; gardens that would have historically been the scale of cultivation as revealed by 2009 excavations at Las Capas, an Early Agricultural site on the outskirts of Tucson (Pringle, 2010). It is not a scaled down demonstration of industrial agriculture, nor an advocacy piece for technology and mechanization. Mission Garden has already firmly established its commitment to organic growing and seed heritage, and these values will be reflected in Tomorrow's Garden design. Mission Garden does though have the responsibility to discuss trends in agricultural development that affect our food system and environmental health, as there are solutions to growing food in an arid climate at both ends of the agricultural production spectrum. This larger discussion can then serve as an educational opportunity for engaging the public, and help to justify garden design decisions.

Here at the University of Arizona cutting edge solutions are being developed to supplement urban vegetable markets at the Controlled Environment Agriculture Center (CEAC) using Controlled Environment Agriculture (CEA). CEA is the production of plants and vegetables inside greenhouses. The exclusion of pests and possibility to control all components of a plants growth needs makes the interior growing system function. Control of temperature, planting medium, water and humidity rates, as well as light spectrum, and fertilization have led to successes in growing specialty crops (Both, 2012). This technique becomes valuably evident in arid lands agriculture through the case of growing hydroponic lettuce. These systems have demonstrated a 90% reduction in water use, and 10 times the increase in yield compared to field grown lettuce (CEAC, 2016). A CEA hydroponic system in Brooklyn, NY uses no soil and grows lettuce floating in Styrofoam rafts atop a pool of water enriched with chemicals nutrients (Beal, 2017). This is an example of a high value niche crop being grown and marketed with success, although not as a stand-alone replacement for field grown crops.

It is predicted that because of climate change and increasing demand, water cutbacks and shortages will increase in Arizona in the years ahead (Wines, 2014). Arizona has four main types of water accessible to the state, surface water, ground water, Central Arizona Project (Colorado River) water, and reclaimed water. According to the Arizona Department of Water Resources of the 6.96 million acre-feet of water annually used in the state, 70% is for agriculture (ADWR). In recognizing that water is one of the greatest limiting factors and potential costs for growers in arid climates, advances in irrigation and water delivery technology is a critical issue.

Drip irrigation systems can slowly and precisely deliver water to the root zone of growing plants. Compared to conventional irrigation systems, drip irrigation is highly water efficient, measuring gallons of water per hour applied to a field rather than gallons per minute (NCAT, 2017). In addition to applying water directly to where plants need it, other benefits include reduced evaporation and run-off, and a potential to reduce weed, pest, and disease pressures. These systems can be laid onto the soil surface or buried near the crop for increased water efficiency (SARE, 2006). This is especially suitable for our hot, dry, sunny and exposed climate. In addition to water efficiency, drip systems mitigate increasing salinity downstream, which is often the case in flood irrigation systems whereby irrigation water exiting a field furrow picks up dissolved solids from the soil and discharges them into nearby streams or adjacent fields (SARE, 2006).

Once these efficient production and irrigation systems are in place it is important to be able to monitor the systems for either errors or inefficiencies. There are a couple of different approaches to this from simply manually checking irrigation lines regularly to employing various remote sensing technologies. In the field the use of drone technology to monitor soil moisture and plant growth demonstrates possibilities to save grower's time and money. In California, thermal equipped drones have been able to capture areal images of fields to help determine if leaks are present in irrigation networks by analyzing current soil temperature (Smith, 2016). Areas of red and orange indicate warm dry soil, while purple and blue areas indicate cool moist soil. Drones can also be used spot variations in growth of field crops and help spot potential fertility and disease pressures.

Remotely monitoring conditions in Controlled Environment Agriculture systems often takes the form of general climate control of temperature and humidity of the greenhouse. However, the use of smart systems and technologies presents the opportunity to monitor plants systems at a more refined level of specificity. This level of refinement can include individual plants and crop canopies and includes remote camera monitoring technologies that record near infra-red images to help determine the onset of undesired growth modes (Story, 2015). A form of machine vision-guided plant sensing, the refined capability of these systems can further help improve efficiency for CEA systems.

The refinement of monitoring through technology is quickly becoming one of the hallmarks of technology trends in agriculture. At the field scale growers are looking to systems like Site Specific Crop Management (SSCM) or Precision Agriculture (PA). These systems are integrated hardware and software systems that allow the grower to enhance crop productivity and profitability, while optimizing chemical inputs and other soil amendments (Ulrich, 2017). There are several components to SSCM including, satellite-based auto-guidance for tractors, yield monitoring mapping, vehicle based soil sensors, site-specific management for soil pH and nitrogen (UNL Cropwatch, 2017). Employed collectivity or individually, these technologies are giving growers more information about their soils, inputs, harvests, and ultimately bottom lines.

Addressing the realities of water scarcity and yield increases are in a way dealing with the symptoms of a larger agricultural crisis. This crisis has many facets including human consumption, population growth, arable land availability, soil fertility, pollution, and climate change. Climate change however is a topic that keeps many scientists up at night, with the plethora of unknowns and best case scenarios that still appear dire in prediction. To address continued carbon pollution as a primary driver of climate change, growers have begun "carbon farming" as a potential mitigation strategy for carbon pollution.

Carbon farming is the practice of removing carbon dioxide from the atmosphere and storing it in the soil through various farming practices. Specifically, these practices include no-till planting, cover cropping, organic mulching, rotational grazing and composting (Barth, 2016). Other carbon sequestration regimes include agroforestry and silvopasture systems. Through these agricultural techniques carbon is removed from the atmosphere by plants where it is then sequestered in the soil through decay, promoting fertility and stability as soil organic matter. When quantified the sequestered carbon can qualify as a tradable carbon credit on carbon markets. Many of these markets are available internationally, and a few can be found in the US under cap-and-trade frameworks operating between states and polluters (Barth, 2016). When the political will or economic necessity of the carbon sequestration becomes evident, carbon farming may be yet another value-added product growers can harness to retain a profitable healthy farm. ■

Case Reviews

Furthering study into potential design opportunities and program organization, six case studies were investigated. These case studies provide real world examples of educational, technological, traditional, and interpretive gardens in the Sonoran Desert.

I was fortunate in that I was able to personally visit each one of these sites, and interact with the physical space and materials associated with them. This helped me to better conceptualize Tomorrow's Garden, as well as gave me ideas on planting arrangements, infrastructure development, and interpretative materials.

Las Milpitas

Tucson

Agrivoltaic Installation

Tucson

Desert Botanical Garden

Phoenix

Tucson Village Farm

Tucson

Manzo Elementary

Tucson

* Sweetwater Wetlands
(not pictured)

Manzo Elementary

Location: Tucson, Arizona

Designer: Moses Thompson and Students

Size: 85ft x 60ft

Features: Greenhouse, vegetable beds, counseling circle, native edible plants, greenhouse, water catchment system, topography changes, desert tortoise habitat, aquaponics system

Summary:
Manzo Elementary School opened its doors in 1939 on the westside of Tucson, near the Santa Cruz River. However, it wasn't until many years later that the school began to reimagine the use of its campus for ecological education. In 1994, the school founded the Desert Biome Ecology Project that helped reconstruct native desert habitat near the school. In 2012, Manzo was named the "Best Green School" by the US Building Council for additional improvements to its ecological programming, incorporating rainwater harvesting, vegetable gardens, solar arrays, chickens, vermicomposting, outdoor classrooms, and a greenhouse. These efforts helped to cement Manzo Elementary as the "Pride of Tucson's School District" and to be called "The Greenest Elementary School on the Planet." These designations are in large part through the efforts and organization of Manzo student counselor Moses Thompson, who connected the emotional needs of his students with the opportunity to heal with and in nature. His efforts encouraged the transformation of small interior courtyard spaces, that were mostly browning Bermuda grass, into dynamic spaces that showcase native plant materials, wildlife habitat, vegetable beds, and outdoor classroom spaces. These efforts have additionally created educational partnerships with the Desert Museum, Southwest Conservation Corps, The University of Arizona, the Audubon Society, and AmeriCorps.

Implications:
The scale in which the Manzo Elementary School gardens are situated (85'x60') are similar to Tomorrow's Garden. In a small area, there is a wealth of edible plant materials, habitat, vegetable growing, sustainable infrastructure, and seating. The educational component of the garden facilitates hands-on student involvement and encompasses aspects of biology, ecology, health and nutrition, biology and leadership. There are also infrastructural components like rainwater harvesting cisterns and a greenhouse that help with year-round growing and aquaponics programming. ■

Reference:
http://www.gomanzo.com

https://greeneducationfoundation.wordpress.com/2013/03/27/reconciliation-ecology-project-at-manzo-elementary-school/

http://ediblebajaarizona.com/growing-education-and-edibles

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Agrivoltaic Installation

Location: Tucson, Arizona - Biosphere 2, Rincon High School, Manzo Elementary School

Designer: University of Arizona

Size: 3 locations, garden scale (20ft x 20ft) installations under PV panels.

Features: Photovoltaic panels, sunken garden beds, drip irrigation systems, citizen science, youth education, academic research, interdisciplinary

Summary:
Agrivoltaics is an innovative experiment of co-locating conventional photovoltaic systems with food production. According to University of Arizona assistant professor Greg Barron-Gafford agrivoltaics is a new way of "doing agriculture in the dry lands of the world." Currently Barron-Gafford administers three agrivoltaics systems at various locations in and around Tucson including, Rincon High School, Manzo Elementary, and Biosphere 2. These co-located systems have evolved in response to research suggesting that ground mounted photovoltaic systems alone produce a localized warmer environment, a phenomenon called the "solar heat island effect." Vegetation planted underneath the photovoltaic systems evapotranspirate moisture out of leaf stomata and subsequently lower temperatures around the PV installation. The cooling effect improves panel efficiency and produces more energy per parcel of land. Additionally, the shade on the plants underneath help to lessen irrigation needs and can be beneficial to certain crops at specific times of the year.

Implications:
The Mission Garden Board of Directors have advocated for additional solar installations at the garden to assist in sustainable energy generation. Photovoltaic installation potential in Tomorrow's Garden is dependent upon the ability to secure the array with a footing that doesn't disturb the underlying archaeology. The PV installation at Rincon High School is secured to an above ground footing and has the potential to serve as a model for a Tomorrow's Garden installation. Agrivoltaics systems help to demonstrate innovative agriculture practices by combining vegetable production with energy production. An agrivoltaic installation can also serve as a design element for a shaded area of seating and learning. Installations to date have helped to facilitate community and university partnership. ■

Reference:
https://uanews.arizona.edu/story/ua-researchers-plant-seeds-make-renewable-energy-more-efficient?utm_source=uanow&utm_medium=email&utm_campaign

https://www.youtube.com/watch?time_continue=1&v=R35vs2VTwug

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Las Milpitas Community Farm

Location: Tucson, Arizona
South Cottonwood Lane & Silverlake Rd

Designer: Community Food Bank of Tucson

Size: 6 acres

Features: Community garden, educational programming, permaculture design, drip irrigation, community gathering space, greenhouse, outdoor kitchen

Summary:
Las Milpitas de Cottonwood is a six-acre community garden and working farm near the Santa Cruz River along Silverlake and South Cottonwood Lane. The farm is organized and run by the Community Food Bank of Southern Arizona, an area non-profit organization that works in assisting area residents with access to food. The project at Las Milpitas provides community garden space, materials, and gardening education to area residents. The program emphasis is on making healthy and local food more accessible to low-income families, with gardening resources provided at no cost to the participants. In addition to gardening, Las Milpitas also seeks to cultivate community through garden activities and education. Weekly programming includes gardening workshops, fruit tree pruning, vermicomposting, cooking classes, yoga, and backyard chickens. A series of these workshops are also offered in Spanish. The farm is additionally active in promoting social, economic, and environmental justice projects in the community and is active in leadership and job training for local students and residents.

Implications:
The scale of the farm is similar to that of Mission Garden and is located along the Santa Cruz River and near the Loop Trial. The incorporation of community gardens into the larger farm plan encourages community involvement, including that of area youth. The farm has substantial infrastructure including tractors, greenhouses, and large irrigation networks that demonstrate another scale of agricultural application in the area. The emphasis on ecological production and the incorporation of permaculture design has promoted dedicated space to the planting of native perennial foods. The emphasis on social, economic, and environmental justice has created a culture of dialogue, leadership, and activism around the garden, and has encouraged the personal development of many participants and area residents. At Las Milpitas, a central community gathering space, cooking infrastructure, and art have all been used to integrate the farm with this larger philosophical vision. The aspect of empowerment thorough gardening is relevant to Tomorrow's Garden, as community integration, healing, and health have been identified as thematic aspects of Mission Garden. ■

Reference:
http://www.communityfoodbank.org/Locations/Las-Milpitas

https://www.youtube.com/watch?v=CYtBUHjvyvk

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Desert Botanical Garden

Plants and People of the Sonoran Desert Trail

Location: Phoenix, Arizona

Designer: Desert Botanical Garden, Native tribal advisors and area Ethnobotanists

Size: 1/3-mile trail

Features: Native crops, medicines, ceremonial and domestic infrastructure, interpretive activities, ethnobotany, post-Spanish contact garden, i.e. year-round agriculture, garden and museum

Summary:
The Desert Botanical Garden houses five different walking trails of various themes and associated plantings. One of five branched trails, "The Plants and People of the Sonoran Desert Trail" is a 1/3-mile hike that takes visitors through indigenous built and botanical history. It was designed to be a living garden of Native tribe's lifestyle and foodways. Tribes represented include the Tohono O'odham, Pima-Maricopa, San Carlos Apache, and ancient Hohokam. Along the trail one encounters three different biomes, the Sonoran Desert, Grasslands and Chaparral, and two habitat types, the mesquite woodland and cottonwood gallery forest. Along the trail visitors encounter different food growing, gathering, and processing techniques that were employed by Native tribes. This includes the presentation of corn, beans, and squash agriculture, as well as the collection mesquite pods and other native desert foods. Visitors can also visualize how these forager-farmer communities organized in a domestic setting by stepping inside of a traditional Akimel O'odham roundhouse and Apache Wickiup. Visitors are also presented with a tactile experience of pounding and grinding mesquite pods with traditional tools. This presentation imparts an experience that is both garden and museum.

Implications:
The combination of Native agricultural techniques with infrastructure in a nationally renowned botanical garden lends credibility to the notion that, to understand the peopling of the Sonoran Desert we must understand its forager-farmer history. Additionally, the native foodways and gardening techniques produced immensely rich cultural traditions and material arts that continue to inspire creativity and identity for all people living in the Sonoran Desert. Additionally, "The Plants and People of the Sonoran Desert Trail" has a small publication (trail guide) for sale that helps to interpret the hike and provides additional information on plant materials and cultural traditions found on the hike. This trial guide is a good example of something visitors can bring home with them from the garden as both an educational resource and memento. Lastly, agricultural plant materials represented are sourced from Native Seeds/SEARCH. ■

Reference:
https://www.dbg.org/trails-exhibitions

https://www.dbg.org/2016/plants-people-trail

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Tucson Village Farm

Location: Tucson, Arizona - 4210 N. Campbell Ave

Designer: Pima County Cooperative Extension and the University of Arizona

Size: 1+ acres

Features: Vegetable beds, youth education, desert adapted gardening strategies, 4H and community organization partnerships, water catchment, proven seed varieties, interpretation, art and cooking spaces.

Summary:
Tucson Village Farm (TVF) began in 2010 and is a program of Pima County Cooperative Extension and the University of Arizona. The location of the garden is along N. Campbell Ave. near the U of A Cooperative Extension Office, Master Gardener demonstration gardens, and the Rillito River. TVF programming is designed to help area youth reconnect with healthy food and provides a hands-on instructional approach towards this goal. This involves the planning, planting, maintenance, and harvest of garden vegetables. The working farm has dedicated staff and AmeriCorps positions to help implement youth programming and maintain plants and animals. The production focus of the farm is holistic, adopting strategies of organic production by promoting soil fertility, integrated pest management, and herbicide/pesticide free growing. The site incorporates sustainable infrastructure in sunken planting basins, water catchment systems, drip irrigation, and overhead shading. There are several interpretive signs describing the garden and planting strategies. These signs also post QR codes for additional visitor information.

Implications:
Tucson Village Farm is an example of a successful community and youth education seed-to-table project. The consistent public demonstration of viable desert adapted gardening techniques provides evidence that gardening is possible in Tucson with attention to soil, water, plant variety, and planning. The educational programming associated with farm is well organized and covers all aspects of growing, including composting, cooking, irrigation, and animals. The incorporation of shade, art, and cooking infrastructure adds another dimension to the farm, creating a space that is holistic in its approach to food. The farm is also associated with other nearby garden demonstrations including the U of Arizona's Master Gardeners Program and the U of Arizona Extension greenhouses. The educational synergy created between these spaces facilitates an inspiring horticultural encounter for visitors and can be helpful in motivating people to try new techniques and plant varieties in their home garden. ■

Reference:
https://tucsonvillagefarm.arizona.edu

https://extension.arizona.edu/gardening

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Sweetwater Wetlands

Location: Tucson, Arizona

Designer: City of Tucson

Size: 60 acres

Features: Passive and interactive educational materials, QR code stations, hiking trails, weekly guided tours by Tucson Audubon society, youth education, wildlife habitat, wetlands.

Summary:
Sweetwater Wetland was constructed by the City of Tucson to assist in the cleaning of backwash water from Tucson's Reclaimed Water Treatment Plant. The outdoor areas consist of 17.5 acres of constructed wetlands with 14 acres of recharge basins. Water from the treatment plant's filters is piped to Sweetwater Wetlands' settling basins where solids suspended in the water drop out. Cleared water flows downhill where it slowly filters through vegetation and is cleaned by microorganisms. Water lastly arrives at recharge basins where it resupplies area groundwater. Recharged groundwater is pumped back and retreated at the Reclaimed Water Treatment Plant and is subsequently used for irrigation in Tucson's parks, schools, and golf courses.

Sweetwater Wetlands additionally serves as an outdoor classroom with posted printed signs and QR code displays for visitor education. These QR code stations can be scanned with a smartphone and link visitors to additional information about the topics of plants, water, birds, and wildlife biology. The site is also associated with the environmental program Project WET that works with high school students on themes of water education. Area birding tours are led by the Tucson Audubon Society, listing 288 bird species identified on site.

Implications:
Sweetwater Wetland's educational installations present visitors with interactive tools that interpret the site and provide a depth of information often not available during a self-guided tour. Diverse educational materials like QR Codes and online materials provide a range of visitor interpretation that also help to accommodate various user groups. The site has more than 2.5 miles of pathways, with 1000 feet paved for ADA accessibility. This allows for access into the site and the appreciation of its many ecological and wildlife features. Partnerships with local groups help to raise awareness and appreciation of the site. The site is connected to the adjacent Tucson Loop Bike Trail. ■

Reference:
https://www.tucsonaz.gov/water/sweetwater-wetlands

http://tucsonaudubon.org/go-birding/get-started-with-birding/great-places-to-bird/sweetwater-wetlands/

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Design Outcomes

Having established a garden intent for Tomorrow's Garden, researched relevant academic topics, and visited local case review sites, the next step in the process of project implementation was to write a Design Program.

The following pages address the Goals and Objectives laid out in the Design Program, showing how the Tomorrow's Garden project proceeded through initial stakeholder involvement, into garden design and finally educational opportunities through creative interpretation.

DESIGN PROGRAM

America's Most Versatile Program

with EXCLUSIVE GOALS & OBJECTIVES

INVOLVE **GARDEN STAKEHOLDERS IN THE DESIGN OF TOMORROW'S GARDEN**

Stakeholder workshops for design ideas

DESIGN **A GARDEN THAT EMBODIES SUSTAINABILITY AND IDENTITY**

Design Tomorrow's Garden form and program

Recommend design suggestions for exterior site integration

EDUCATE **VISITORS**

Design interpretive educational materials

Looking back into old Organic Gardening Magazines it becomes evident that for many years now we have been advertising devices and gardening programs that entice us with technology and the promise of less work. One of these labor saving "Future" technologies is seen in the 1957 graphic below, advertised as the 26" Roof *VP* MOWER.

It is true that there are tools and technologies that have changed the nature of gardening and farming for the better. However, the take away message is that yesterday's new, quickly becomes tomorrow's old....yet the garden work remains.

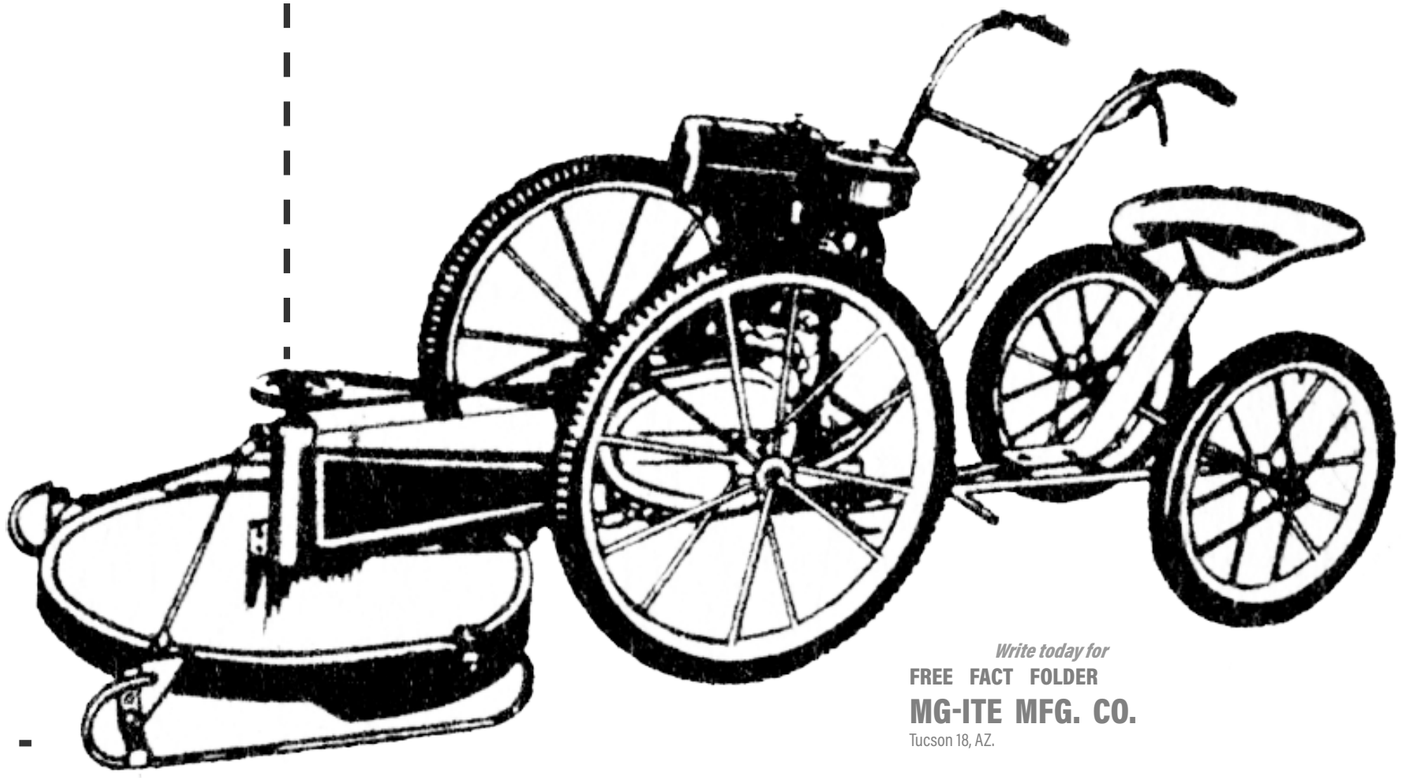
BUILDS COMMUNITY

•

HONORS TRADITION

•

RESILIENT DESIGN



SOCIAL SITE ANALYSIS

Addressing the first Goal of the Design Program, "Involve garden stakeholder in the design of Tomorrow's Garden," I set out to connect with the local non-profit organization the Ironwood Tree Experience (ITE).

For a few years ITE has supported Mission Garden by bringing youth leaders from their various outdoor and educational programs to Mission Garden to plant trees and learn about agricultural history. In fact, it was with a group of ITE youth and community leaders that an initial discussion about the direction of Tomorrow's Garden was held in the winter of 2016. Connecting with ITE directors Eric and Suzanne Dhruv, we dialogued about how to incorporate an upcoming youth internship opportunity into the Tomorrow's Garden program. With funding through the National Parks Service, Juan Bautista de Anza Trail, and the Western National Parks Association, we agreed to a partnership that would incorporate 11 Tucson youth interns into a design program that would teach local history, as well as ask that interns to participate in the creation of history, by leaving their mark on the design of Tomorrow's Garden.

In addition to youth interns, I recruited local adult stakeholders from the large pool of Mission Garden staff, volunteers, and Board of Directors. It was important to incorporate a diverse set of voices into the discussion what Tomorrow's Garden would represent and how it may look, as these are the individuals who will inherit the design, maintain the garden, and interpret it to visitors. I as a student designer, am simply passing though Tucson, and although gardening is my passion, this particular garden is greater than any one person.

INVOLVE

WORKSHOP PROCESS DIAGRAM

Over the course of several weeks I designed and facilitated a series of community design workshops. The workshops were attended by youth leaders from the Ironwood Tree Experience and Mission Garden stakeholders.

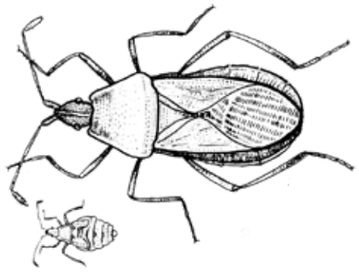
The process by which the workshops proceeded included brainstorming sessions on the challenges facing growing food in Tucson tomorrow, solutions to these challenges, and a community dialogue and voting session that produced democratic garden elements.

Workshop outputs also included garden design concept sketches, historical background research, garden element research, and process documentation.

Community Process

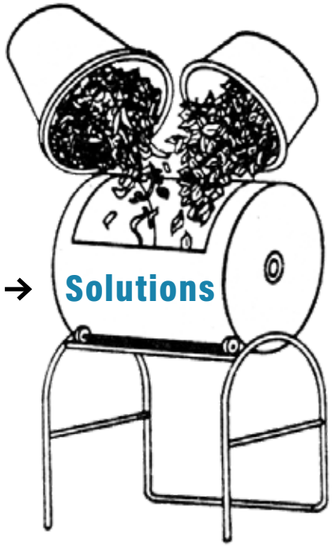
Creative Minds Come Together!

Challenges



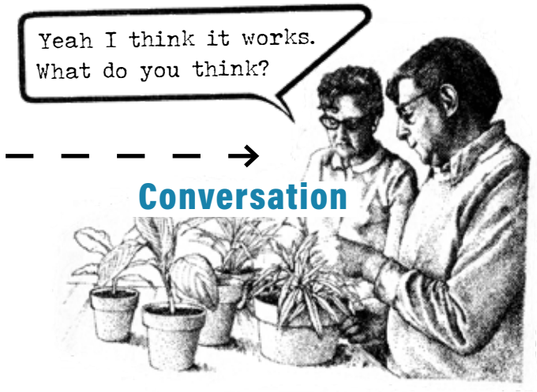
What challenges do we face growing food at Mission Garden tomorrow?

Solutions



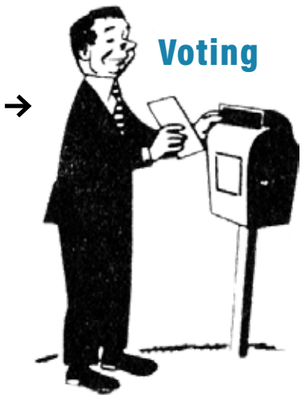
What are possible solutions?

Conversation



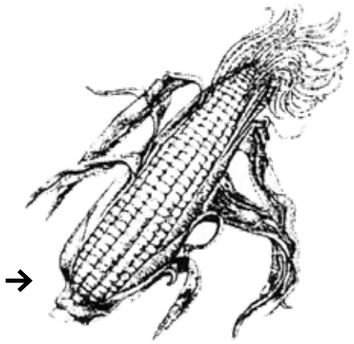
Community conversation about the identified challenges and solutions

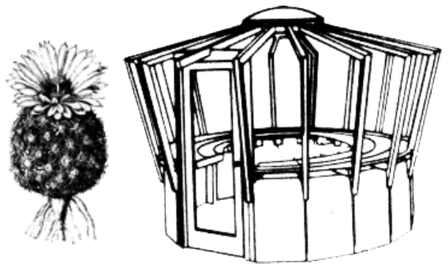
Voting



All solutions being equal, adults and youth stakeholders voted on which solutions they thought should be represented in Tomorrow's Garden

Elements





Garden Elements identified

WHAT CHALLENGES DO WE FACE GROWING FOOD AT MISSION GARDEN TOMORROW?

The initial public process workshops were spilt, with youth and adult stakeholders participating in their own respective 2 hour design charrettes. The first half of the charrette was dedicated to the brainstorming of Challenges and Solutions to growing food at Mission Garden.

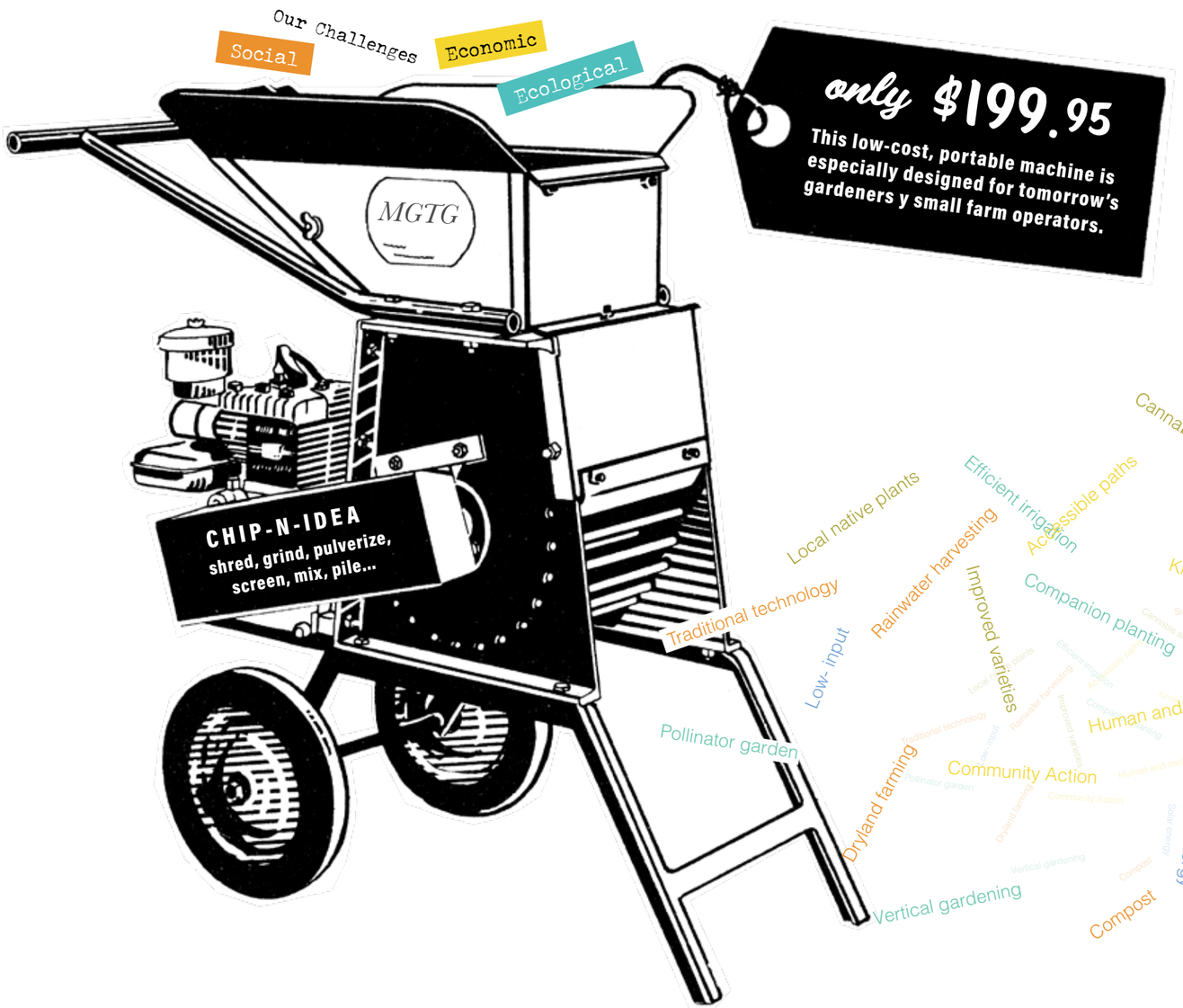
This graphic details a combined youth and adult list of Challenges derived by answering the question, What challenges do we face growing food at Mission Garden Tomorrow?

Placing these Challenge answers into Ecological, Social, and Economic categories reveals that 19 of them are Ecological in nature, 12 are Social, and 7 are related to Economic issues. Categorizing these answers helps to point in the direction of the collective thinking of the two stakeholder groups. It reveals that more ecological issues were identified when answering the question of what challenges we face.

Background words represent identified Challenges to the above question.

INVOLVE

WHAT ARE POSSIBLE SOLUTIONS?



In the next step of the workshop process we advanced the community conversation from a discussion of challenges to the question of, What are possible solutions?

This graphic details the machinations of the stakeholder groups as you toss the problematic feedstocks of Challenges into the hopper of the brainstorming shredder. A jumble of individual answers exits the shredder, all providing insight into how and what might be included in the final design of Tomorrow's Garden.

Distilling the Solution responses produces five categories, and reveals that stakeholder thinking towards to Solutions, tends to emphasize Traditional and Modern techniques to overcome Challenges. This categorization is important because it again illuminates the greater collective wisdom of the stakeholder crowd, and helps to steer the following combined workshop conversation in a productive and democratic direction.

13 Traditional technique

11 Modern technique

7 Technological systems

6 Social

4 Plant materials

PLEASE SEND ME COMPLETE INFORMATION ON THE CHIP-N-IDEA CHALLENGE TO SOLUTION SHREDDER.

NAME_____

ADDRESS_____

TOWN_____ **STATE**_____

INVOLVE

COMBINED WORKSHOP RESULTS

Challenges + Solutions + Voting – – – – – → Elements

After separate youth and adult workshops that investigated questions of Challenges and Solutions to growing food at Mission Garden, a combined workshop was held to initiate dialogue around these outputs. In total, 20 stakeholder participants attended the combined workshop, which was held at Mission Garden on February 20th, 2018.

The combined youth and adult workshop asked stakeholders to engage in a dialogue about which Challenges and Solutions they thought were most important to the program of Tomorrow's Garden. After these conversations and further categorization of topics, a vote was held on which Solutions would be incorporated into the design of Tomorrow's Garden.

All Solutions were written out on half sheets of paper and were placed around a central table during the half way break in the two hour workshop. Upon returning the workshop, stakeholders were given 5 Tohono O'odham pink beans, and asked to place 1 bean on top of the 5 Solutions they individually thought most important.

The graphic on the right organizes the democratic outcomes by Solution category and number of votes.

The figures below shows the winning 7 Solutions that will be turned into garden elements to be featured in Tomorrow's Garden.

11 Drought Tolerant Plants

10 Community Action

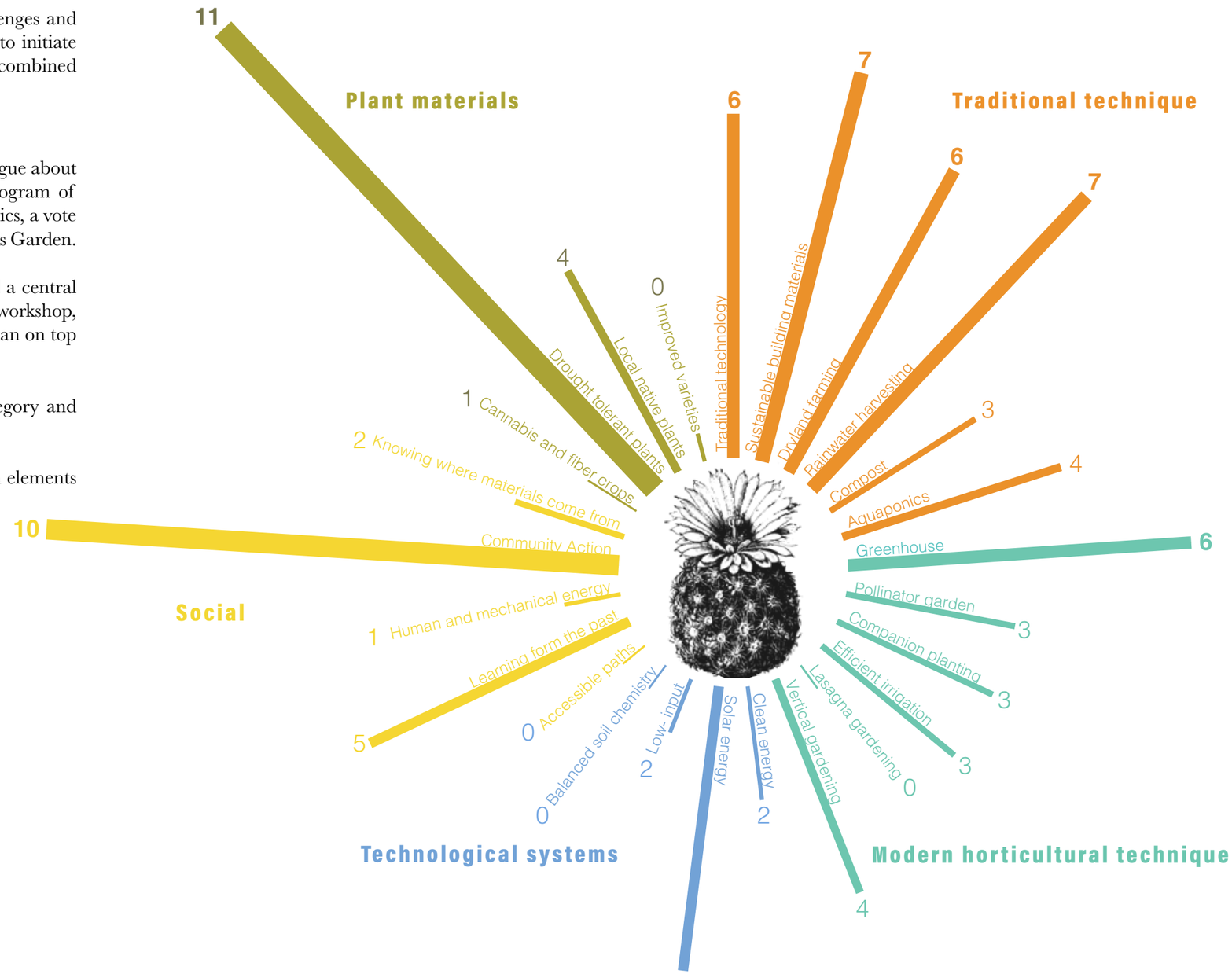
7 Sustainable Building Materials

7 Rainwater Harvesting

6 Traditional Technology

6 Dryland Farming

6 Greenhouse



SITE DESIGN

Having completed a review of the garden stakeholder workshops, and addressed questions pertaining to the design program of Tomorrow's Garden, we now turn to a brief physical site analysis of the garden.

The above panoramic image of the Interior garden site convey's the empty nature of the existing site conditions. Additionally, the garden is bound on all four sides by elevated stabilized decomposed granite pathways.

The exterior wall of the garden runs the length of the site along the south edge, and creates a formidable barrier between interior and exterior landscapes.

Utilities are located in both the southeast and northeast corners of Tomorrow's Garden.

An unseen physical site analysis reveals just below the surface of Tomorrow's Garden are archaeological layers that contain artifacts, features, and even human remains of the previous communities than lived and farmed there.

Site excavations in the Tomorrow's Garden boundaries are limited to 12" - 18" below the existing soil surface to protect yet unsurveyed historic features.

The potsherd to the right was found by the author in an adjacent cropping field to Tomorrow's Garden in spring of 2016. It surfaced after our cover crop had been plowed under, and represents an example of Classic Hohokam pottery dating from AD 1050 - 1450.

PHYSICAL SITE ANALYSIS

EXISTING UTILITY INFRASTRUCTURE

Electrical

Future acequia feature

Irrigation

SOIL TYPE - PIMA SILTY CLAY LOAM

Pathway

65'

75'

Pathway

ARCHAEOLOGICAL LAYERS

3,300 ft²

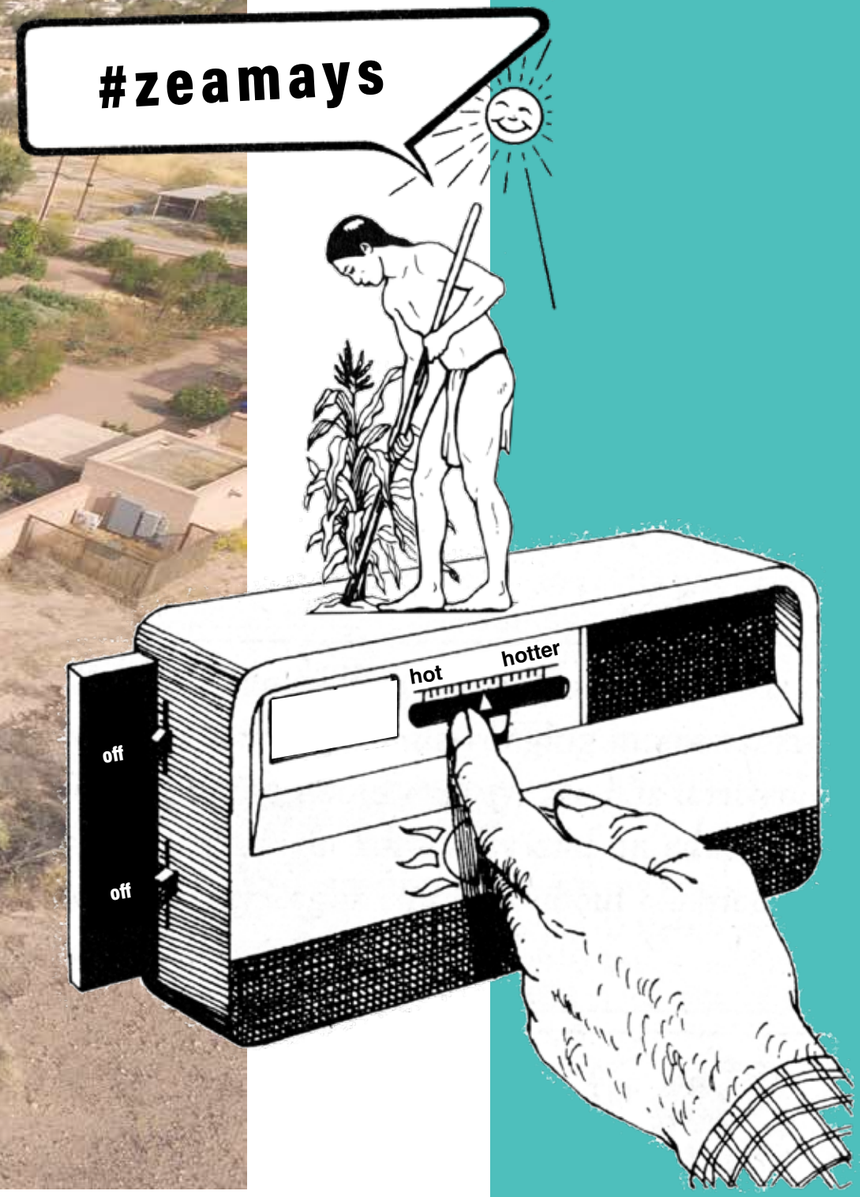
55'

45'

Pathway

Unused Gate

N



A physical site analysis of the Tomorrow's Garden interior is visualized through layers of existing utility infrastructure, laid down in a soil type of Pima silty clay loam, which contains deeper layers of unsurveyed archaeological features.

Existing vegetation is minimal, consisting of annual weed species.

DESIGN

ITE YOUTH DESIGN SKETCH

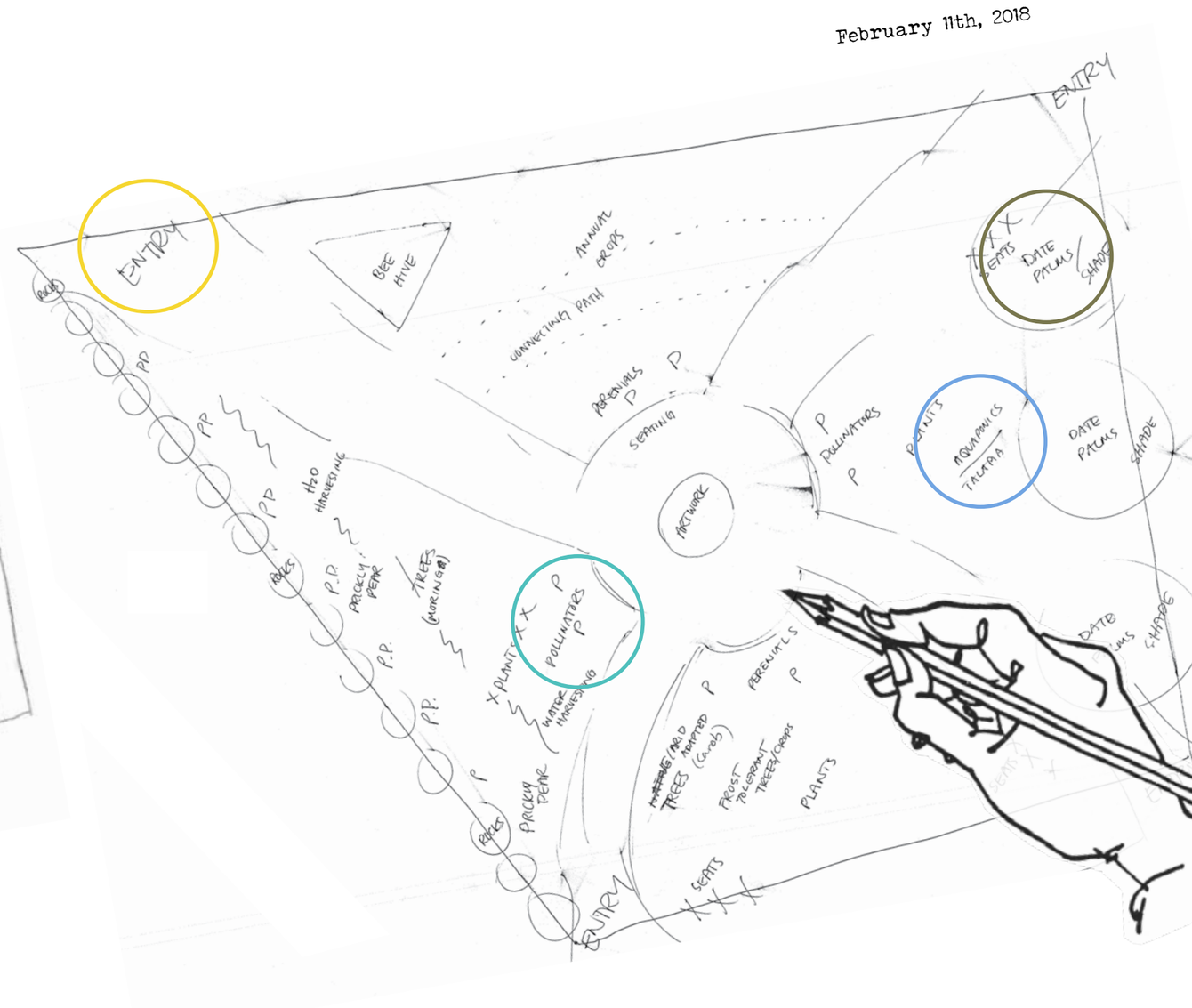
During the second half of the individual design workshops, stakeholders were broken into small groups and given base maps and trace paper to sketch out garden design ideas.

Groups self organized and developed a variety of design iterations, with some unique elements such as date palm trees, as well as shared design ideas like a central gathering space.

MG ADULT DESIGN SKETCH

Even at this early stage in program implementation, stakeholders were beginning to place Solutions into the site and arrange them in spatial ways that emphasized circulation and potential programming.

Colored circles added onto the stakeholder sketches correspond to Solution categories, they highlight notable stakeholder design suggestions.



Traditional technique

Modern technique

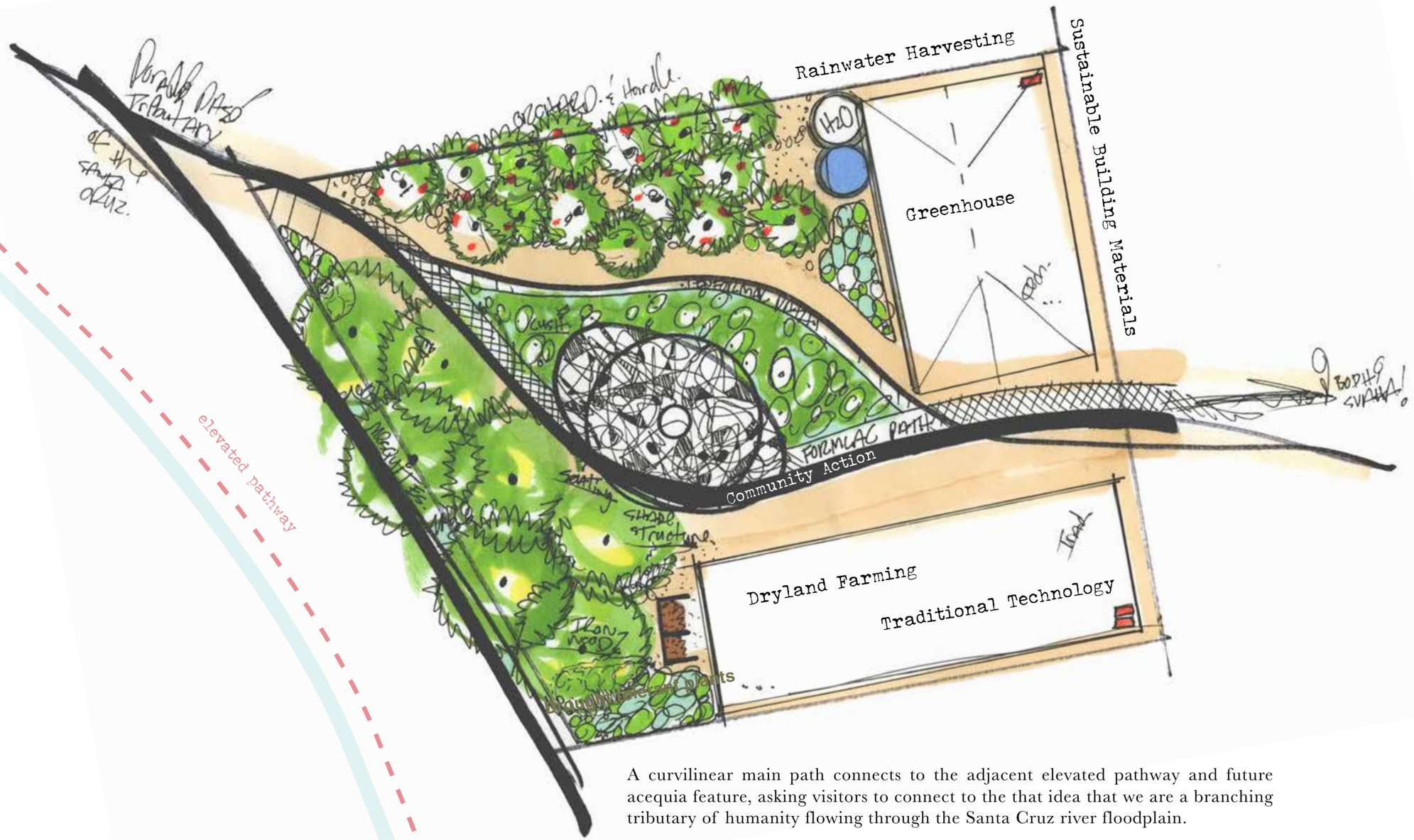
Technological systems

Social

Plant materials

not to scale

INTERIOR CONCEPT SKETCH



This integrated conceptual sketch combines the seven democratically elected Elements, stakeholder sketch suggestions, and philosophical ideas generated from stakeholder conversations.

Integrated

- Seven elected elements
- Stakeholder sketch suggestions
- Physical design constraints
- Philosophical and intellectual concepts

A curvilinear main path connects to the adjacent elevated pathway and future acequia feature, asking visitors to connect to the that idea that we are a branching tributary of humanity flowing through the Santa Cruz river floodplain.

Additionally, this central pathway culminates in a central gathering space, invoking the phrase “Por aqui paso,” “Through here passed.” This phrase asks visitors to contemplate their place in Mission Garden’s diverse historical timeline, and what are our responsibilities to the Earth in the years ahead.

not to scale

DESIGN

TOMORROW'S GARDEN PLAN VIEW

Honoring Tucson's diverse community and unique history, Tomorrow's Garden seeks to **punctuate Mission Garden's historic timeline** with a **demonstration of sustainable** and **innovative agricultural practices** that have the capacity to **adapt to changing climate** as well as **build community** through design process and project implementation.

Elected Design Solutions

1 Rainwater Harvesting

Rainwater tanks have the potential to capture 2,200 gallons of H20

2 Greenhouse

A glass greenhouse supports climate-controlled aquaponics growing

3 Drought Tolerant Plants

Native and desert adapted plants provide food, habitat, and beauty

4 Community Action

A visitor-oriented shaded center facilitates education and interpretation

5 Sustainable Building Materials

Locally made adobe, ferrock pavers, and shade structure

6 Traditional Technology

Experimentation with companion planting, olla irrigation, and composting

7 Dryland Farming

A traditional farming technique that utilizes heirloom crop diversity and maximizes available soil moisture.

Additional Design Solutions

Improved varieties orchard - features selections of fruit trees that have been cultivated for superior fruit and arid adaptability

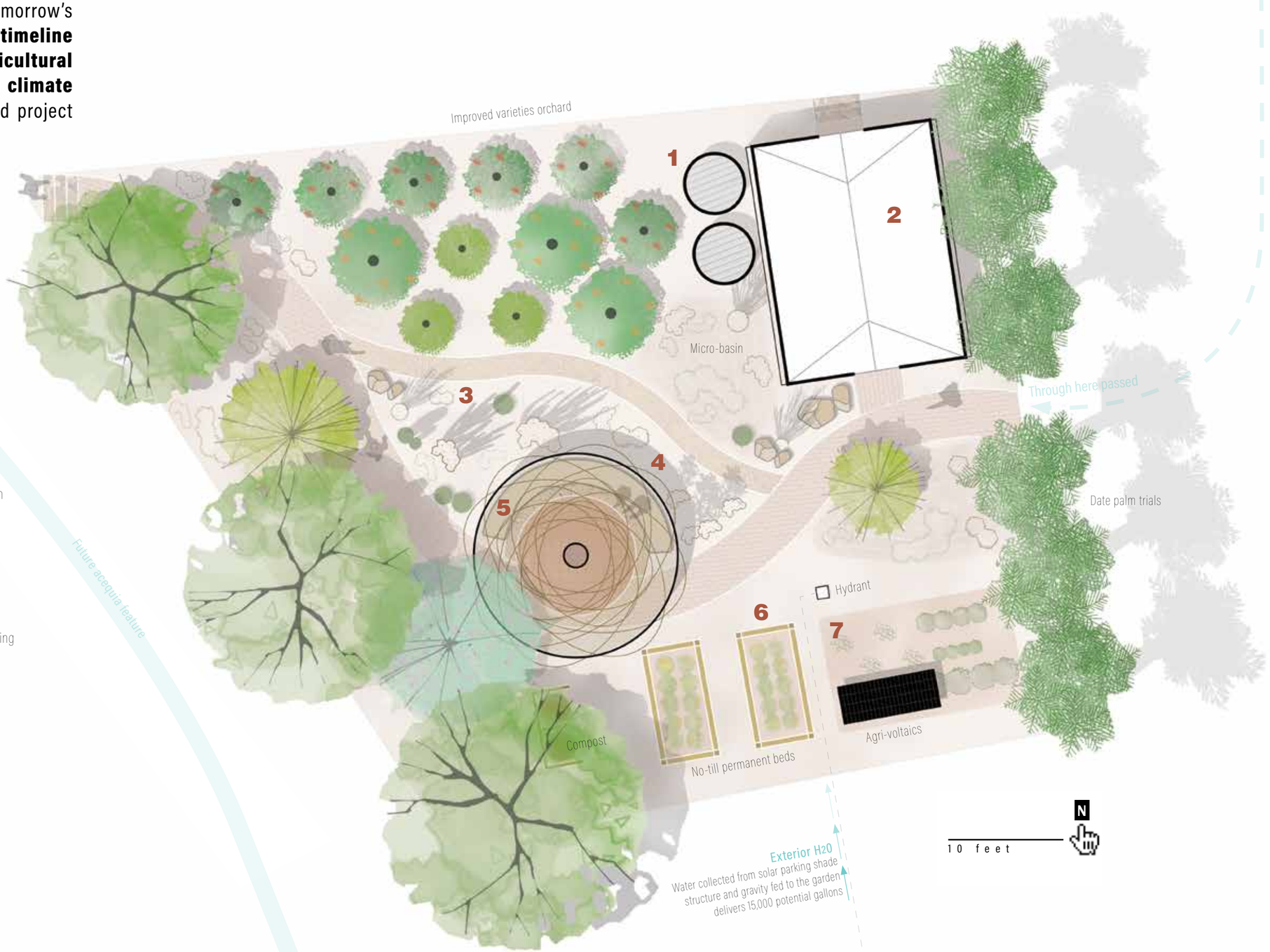
Micro-basins - are featured in the landscape to collect water run-off and allow this precious resources to slow, spread, and sink into the soil

Date palm trials - experimentation with a delicious arid-adapted crop

Compost - forms the basis of sustainable soil fertility

No-till permanent beds - additions of organic matter and the reduction of compaction promote soil health and improve water holding capacity

Agri-voltaics - are the co-location of energy and food production. A small scale system allows for research and experimentation



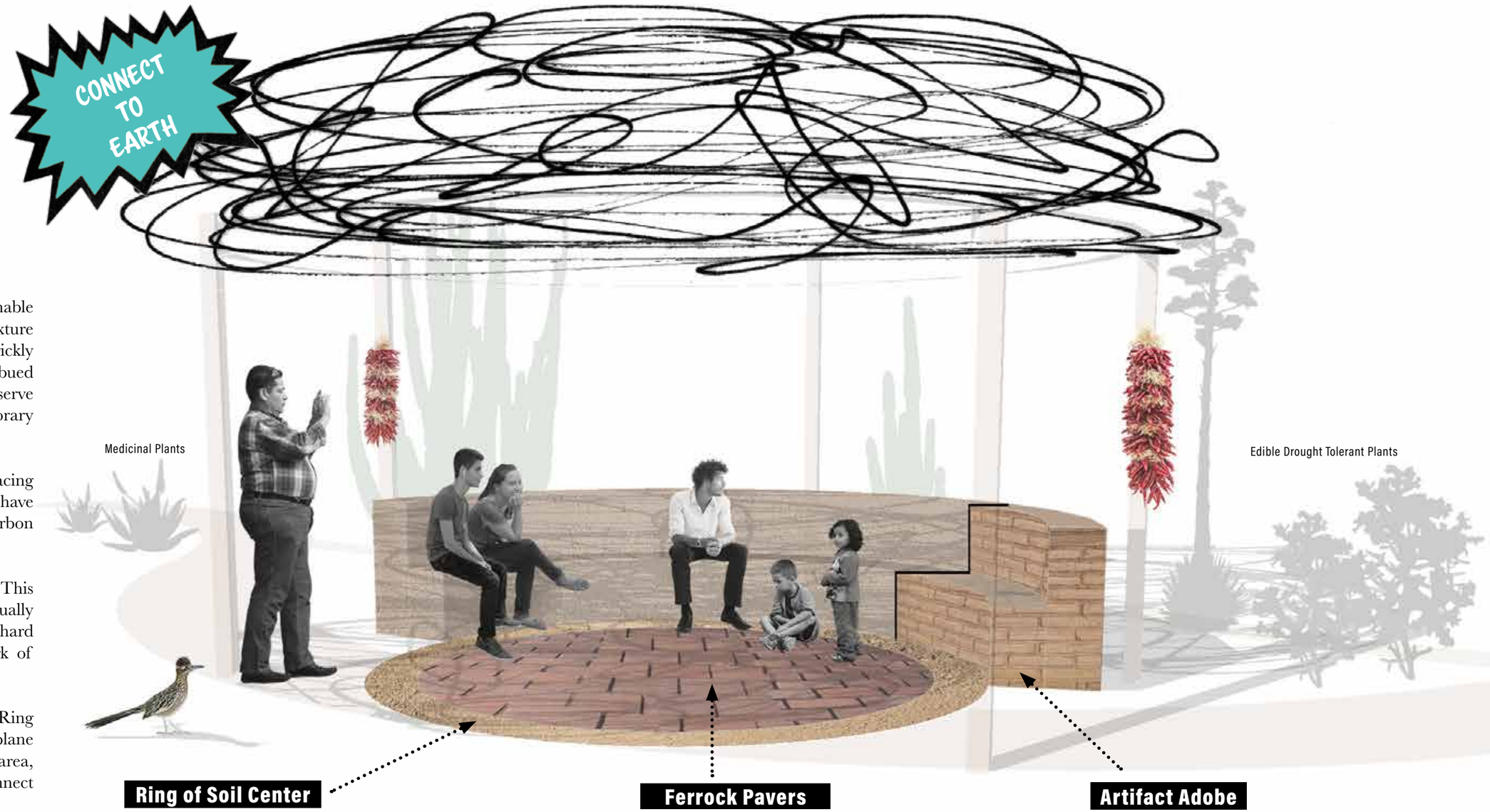
Special thanks to ITE interns and MG stakeholders who contributed their energy and creativity during our public process design workshops. This work was made possible in partnership with the following organizations.

This perspective looks west towards A-Mountain from the east entry of Tomorrow's Garden. Visible in the perspective are Elements of a Greenhouse, Drought Tolerant Plants, Dryland Farming, Sustainable Building Materials, and an activated central gathering space that promotes Community Action.

DESIGN

TOMORROW'S GARDEN PERSPECTIVE

This perspective looks north into the visitor-oriented shaded center. Here are showcased Sustainable Building Materials that help to convey the environmental design ethic promoted by stakeholders, and also serve to interpret the space.



Interpretation

Artifact Adobe - This sustainable material is made on-site from a mixture of soil, sand, straw, water, and prickly pear juice. This adobe will be imbued with contemporary artifacts that serve as a reminder of our contemporary archaeological layer.

Ferrock Pavers - These surfacing materials are locally produced and have the chemical ability to sequester carbon from the atmosphere.

Orchard Pruning Shade Structure - This central garden feature can be continually renewed by weaving annual orchard prunings into a durable framework of overlapping circular steel.

Ring of Soil Center - The exposed Ring of Soil Center acts as a ground plane threshold into the central shade area, and allows for visitors to directly connect the Earth.

DESIGN

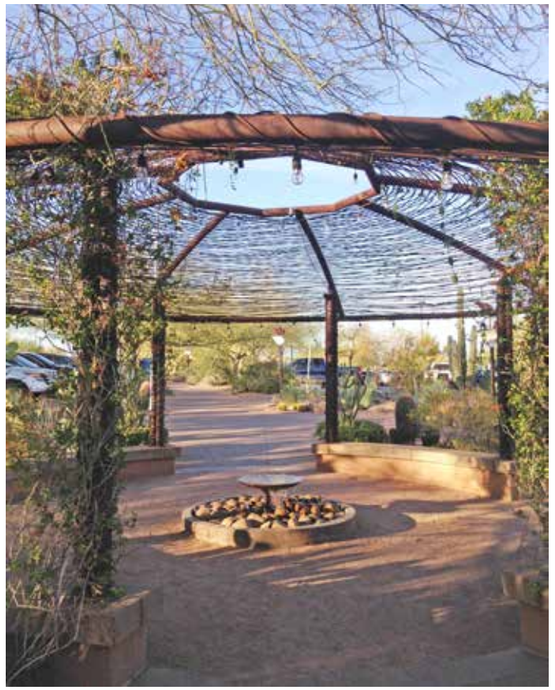
EXTERIOR DESIGN

To better understand the design intention behind the central shade structure, this page documents how I arrived at the structure form.

To the right is a precedent image of a circular steel ramada that greets visitors at the Desert Botanical Garden in Phoenix. The use of steel in the desert represents a durable material that has the capacity to stand for a long period of time and support the weight of roof coverings and climbing plant materials. The framework of Tomorrow's Garden ramada could be similar to this design.

With a steel framework in place, it will be possible to weave annual sticks and vines that are derived from the orchard, into the structure.

This woven roof is representative of the many birds nest's found at Mission Garden.



Entry Steel Ramada Sculpture - Desert Botanical Garden

Grape Pruning

Friday

Bird Nest

Saturday

Annually pruned materials from the orchard are piled in a windrow, and wait to be chipped. It is possible to take these waste materials and turn them into resources for art and shade.

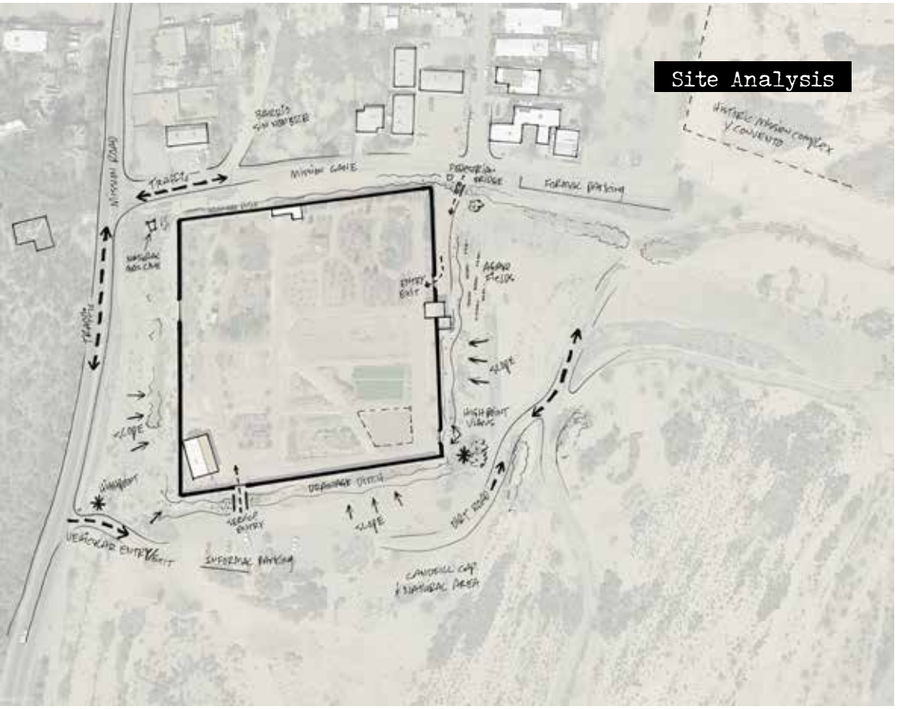
Annual Pruning

Waste

John Dougherty Sculpture - Desert Botanical Garden

Art y Shelter

Resource



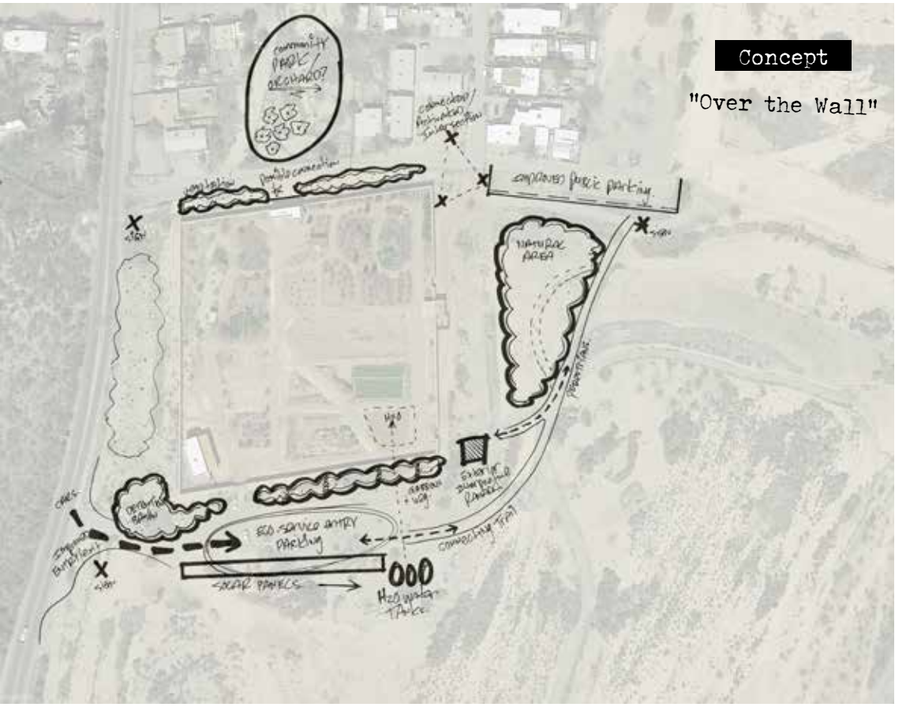
The graphic to the left details a site analysis of the exterior landscape surrounding Mission Garden.

To the west of the garden is Mission Road and A-Mountain.

North is Barrio sin Nombre and Mission Lane.

South and east sides of the garden is bordered by a landfill cap, which produces a downward slope towards the garden.

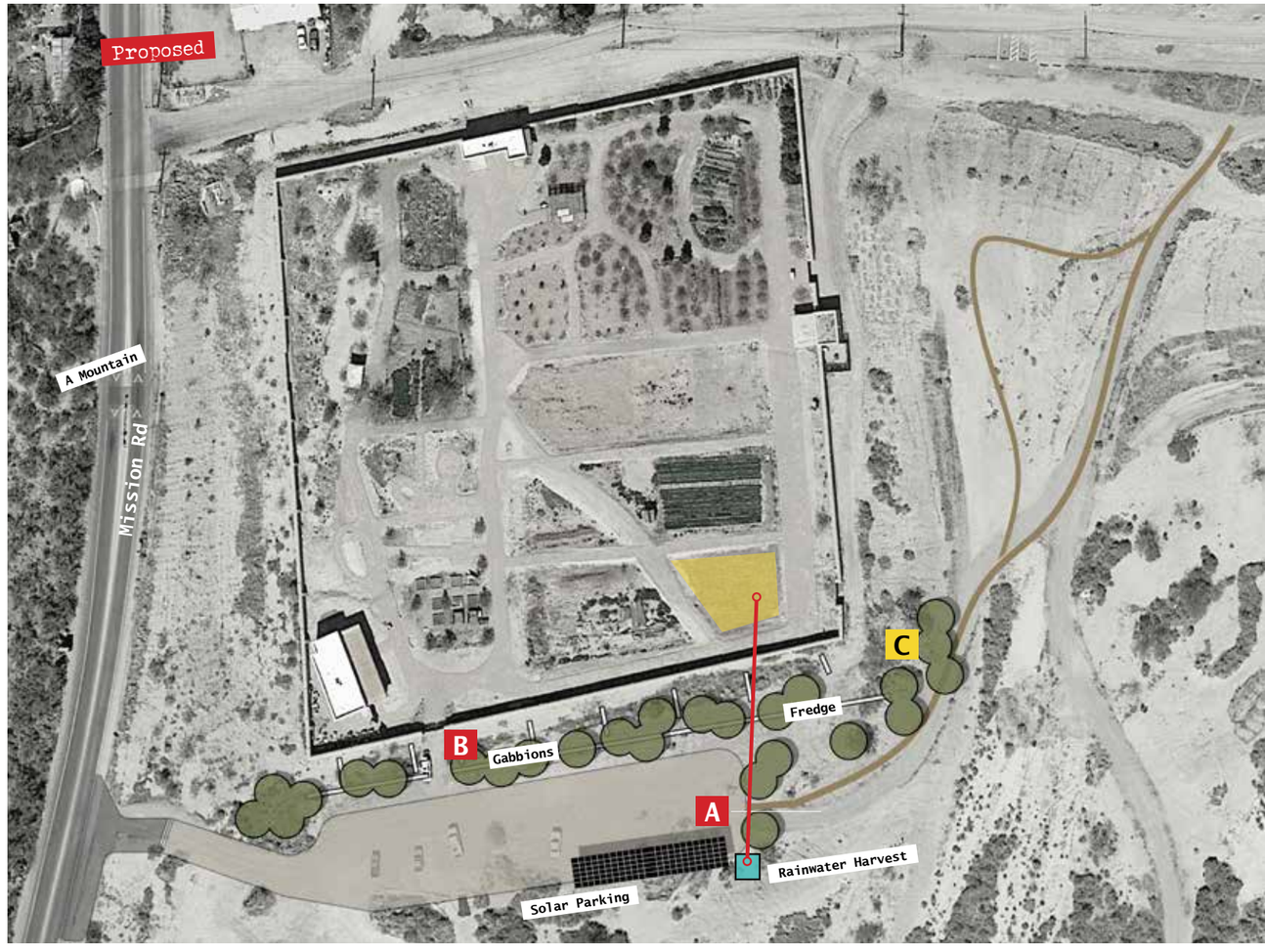
Water drains around the garden by way of a ditch that channels runoff to the northeast towards the Santa Cruz River.

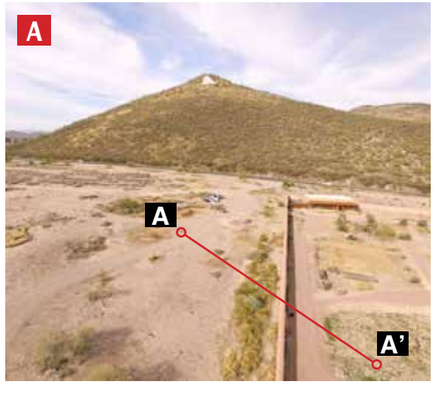


The concept "Over the Wall" seeks to connect exterior design opportunities to interior design opportunities in Tomorrow's Garden.

Two options that accommodate this concept intention include the installation of a solar parking ramada on the east side of the garden in the service and staff parking area.

Also on the east side of the garden, is a runoff ditch that is currently devoid of substantial vegetation. Improving this area with stone gabbions would support enhancements of hydrological and vegetation resources.





Uphill of Tomorrow's Garden, this area presents the opportunity to integrate solar parking with rainwater harvesting, and irrigation into the site.

This empty ditch offers the opportunity to slow, spread, sink, and shade, water by designing traditional living fencerows called fredges.

N

100 feet

C

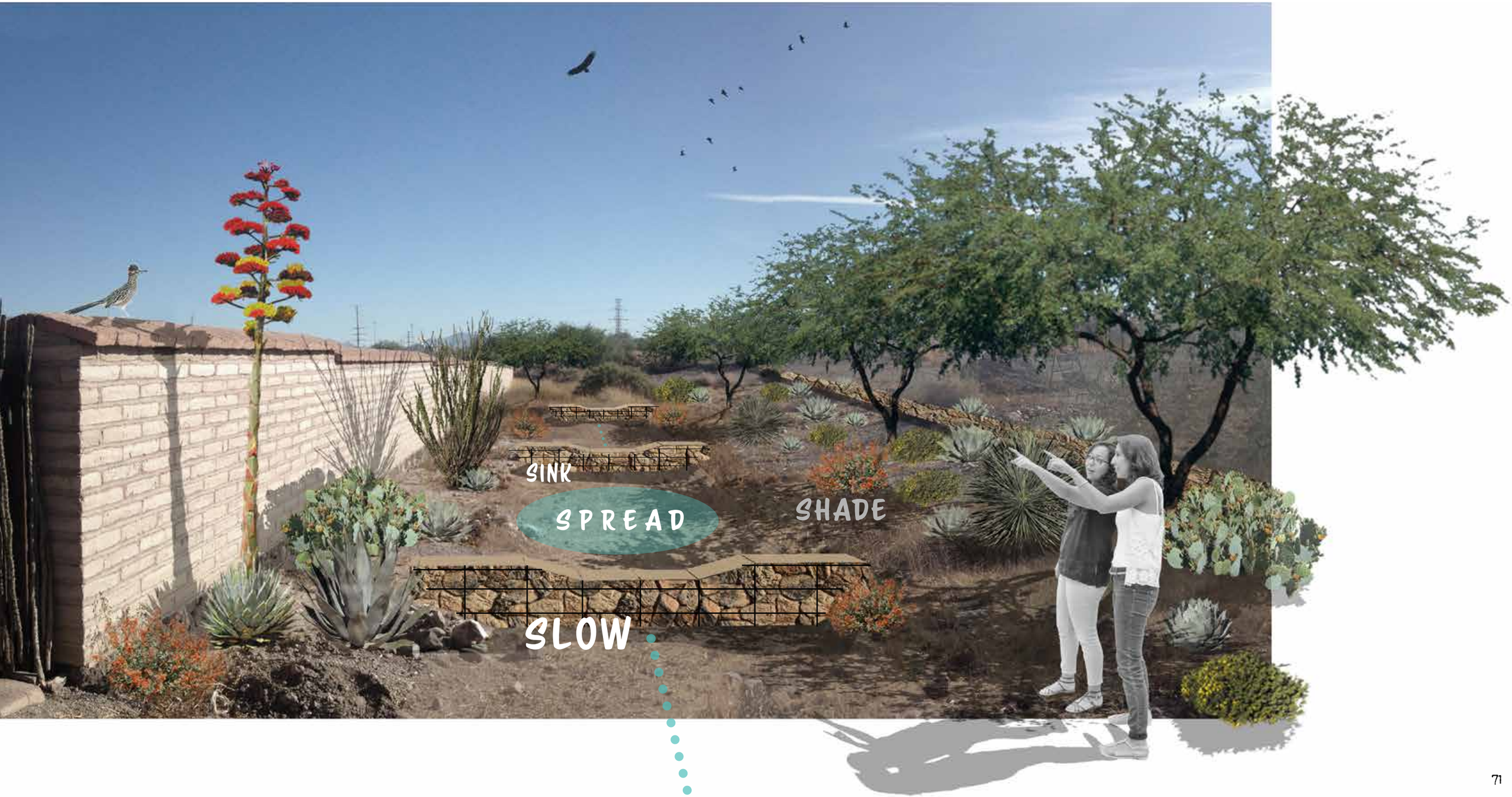
This area contains potential future design programming with pathways to connect the north of the site, and provide views down into the garden from the highpoint on the adjacent landfill cap.

DESIGN

EXTERIOR DESIGN PERSPECTIVE

This exterior design perspective shows what it could look like if you were to install stone gabbions structures periodically along the stretch of the exterior ditch. During rainfall events gabbions would act to slow, spread, and sink water into the landscape. As a result of this improvement to the local hydrologic cycle, more native trees and plants could be supported in the landscape, which in turn support other species through shading and forage.

This area also serves as an increasingly formal entry to the southwest half of Mission Garden, and would benefit from the aesthetic improvements these landscape interventions would provide.



DESIGN

RAINWATER HARVESTING

The potential to catch rainwater outside of the Mission Garden's exterior wall is possible through the integration of a solar parking shade structure and rainwater harvesting tanks. Located uphill from Tomorrow's Garden, stored rainwater can be passively delivered through gravity to a plumbed hydrant located on site.

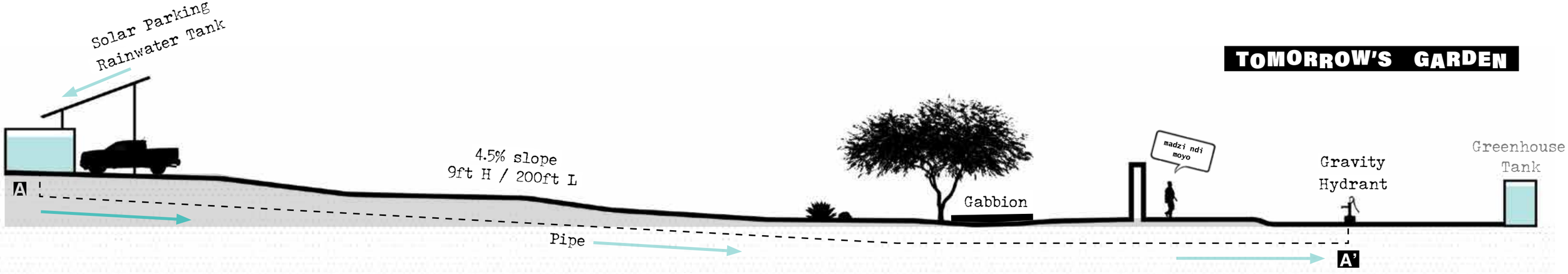
Solar panel specifications come from models that were recently offered by donation to Mission Garden. Water harvesting calculations are based off these solar panel dimensions.

2 **Canadian Solar CS6X-335M-FG Panels**

Array dimensions 19.5' x 52'

2,028 sq/ft

= 15,170 g/yr



EDUCATE VISITORS

The last goal in the Design Program of Tomorrow's Garden is to provide educational opportunities to visitors. This is important, as weekly Mission Garden docents give tours to dozens of community groups, area schools, local residents, and visitors from around the world. Our ability to creatively and effectively convey information about the history of the garden, and the techniques and ethics represented there, will ultimately help to impart a meaningful experience to visitors.

EARTH INTERPRETATION

EDUCATE

TUMACACORI FIELD TRIP WITH ITE YOUTH

In March, Ironwood Tree youth interns and program staff visited the Tumacacori Mission at the Tumacacori National Historical Park near Tubac, Arizona. During our visit we were able to learn about the existing historical adobe ruins of the Tumacacori Mission, the Juan Bautista de Anza expedition and trail, as well as the ecology of the surrounding area.

While hiking the Juan Bautista de Anza trail between Tumacacori and Tubac, we encountered an incredible amount of garbage that had recently been swept north when the river flooded during a rain event. In discussing this garbage, we became disheartened that we were leaving future generations large amounts of garbage to clean up. We wondered if we could somehow use this garbage in building materials for Tomorrow's Garden.

Out of this creative conversation we conceived of the idea of "Imbued Adobe."

At Mission Garden we are working with adobe to build several garden features. A recipe of clay soil, sand, straw, water, and prickly pear juice mix together to make a durable brick that can be used in construction. It is also possible to incorporate other items such as garbage, poetry, personal belongings, and messages into the adobe, creating a structural brick imbued with contemporary artifacts.

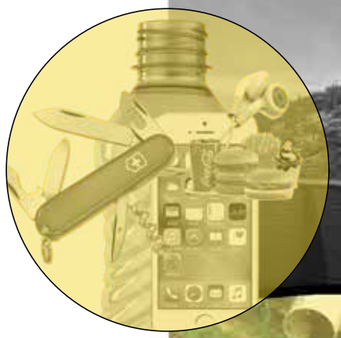
EDUCATE

IMBUE ADOBE

¿ What is our archaeology ?

EDUCATE

All societies and leave artifacts. However, modern society has altered that landscape so much that we now inhabit the new geologic epoch of the Anthropocene. Tomorrow's Garden interpretive features asks visitors to contemplate their relationship to this impact.



In the early 1900's degraded Convento ruins were used for storage. Grain fields surround the complex

800 Tohono O'odham people were living and farming in the village of S-cuk Son in 1697 when father Kino arrived

Modern

Historical

Prehistorical

Bedrock

Water

EDUCATE

NARRATED INTERPRETATION

Removing one's shoes, sitting on top of the Imbued Adobe bench and placing one's feet into the Ring of Soil, visitors to Tomorrow's Garden are encouraged to participate in a Narrated Interpretation.

This interpretive piece could be delivered by a docent or accessed individually through scanning a QR code that is placed near the bench.

EDUCATE

INTERPRETATION TEXT

Welcome to the garden and individual introductions. Sit down onto into chairs/benches and onto the Earth. Ask to remove shoes if wanted. Process is as follows…

I would like to share a story with you all, the name of the story is "Por aqui paso - Through here passed." It is a story of time and the people of this area.

Begin to connect to your posture and breathing. 3 breaths in through the nose out of the mouth, then quietly through the nose thereafter.

1. Having arrived here….Feel the sensation of breath through the nose and bring an awareness to smell and scent. Are there emotions or memories associated these sensations? Acknowledge them. 3 - 5 breaths.

2. Bring attention to your ears and sounds. This allows us to orient ourselves in space. When you hear things, what do you feel, are there memories and emotions associated with sound? Acknowledge them. 3 - 5 breaths.

3. Bring your attention to feeling of skin, sensations on the face, neck, hands, and feet. Are their emotions or feelings associated with them. Acknowledge them. 3 – 5 breaths.

With the attention of feeling brought into the feet, perceive your connection to the Earth, the soil. Imagine that you are sending down roots out from your feet and into the soil. As you your roots go down and away from the desert sun, you begin to feel the change in temperature as you enter the cool Earth. Slowly your roots negotiate the space between the spaces of soil, looking for precious moisture and balanced nutrition, interacting with countless insects and microbes to create a web of life and chemistry just under surface of our ordinary perception. About a foot below the surface you notice subtle changes in the texture and composition of the soil….

Through here your roots pass a layer of soil that in recent memory has been worked by a farmer, who used a tractor or a team of yoked animals to turn the soil with a plow. Your roots pass a piece of a lost steel tool, they pass a blue and white porcelain dish brought into the field for lunch and accidently broken then left behind, all returning to the soil. Your roots sense the presence of grass pollen, and the dried amber stems of wheat and barley. This decaying organic matter enriches soil by helping it to hold water and improve structure.

Another few inches down and you pass more loosened soil, this time dug by hand with tools made of stone, wood, and bone. Your roots glide over the smooth clay surface of a potsherd, fired red on one side, black on the other. Here in this layer of soil you begin to sense the presence of water brought to the field from an acequia, an canal dug by hand to deliver fresh water to the crops being grown here. Your roots mingle with the roots of corn, tepary beans, squash, and cotton, the soil holding and supporting many species of plants and providing nourishment you and generations of your community. You hear the words, S-cuk son, and know them to mean the here at the base of the Black Mountain.

Pushing down deep into the Earth, passing beneath agricultural soil, into the sand and clay, your roots hit the fresh, cool, clean groundwater of the Santa Cruz River, perched on top of a layer of impenetrable black volcanic bedrock. Encountering the stone, the water is forced to rise and becomes the lifeblood of our farming and gardening ancestors, the lifeblood of indigenous communities, religious leaders and missionaries, settlers, soldiers, and immigrants from all corners of the Earth, and all whom, Por aqui paso - Through here passed. In this ancient water your roots drink up the memory Tucson.

Begin to bring awareness back your breath, to the inhale and exhale. 3 - 5 breaths. Slowly open your eyes, rub your hands together, clap or place them on your eyes. Please share what you are feeling with your neighbor.

Tomorrow's Garden is as much about memory as it is about innovation. It is a space for conversation, amendment, education, and atonement, all while celebrating our diverse histories and lifestyles. As we can see and feel, all the roots of nature, as well as those human history, converge in the Earth. Without judgement, the Earth continually allows us an opportunity to work together and share in her abundance.

Public Notice

For many years we've had an ongoing conversation about what to call the final garden space in Mission Garden's historic timeline. Initially, the space was referred to as the Garden of the Future in both interpretative materials and guided tours. However, after considerable conversations with the Mission Garden Board of Directors we decided to rename the space to Tomorrow's Garden.

Although still technically the future, tomorrow is an achievable and empowering destination for the human mind to imagine. This is in contrast to language of the Future, which invokes American fascination with gadgetry and passive technological salvation. This view incorrectly strives to solve problems with the same individual consumer mentality that produced them. The problems of climate change, biodiversity loss, water scarcity, population growth, and pollution are collectively generated, and as such must be collectively solved.

In this spirit, Tomorrow's Garden demonstrates solutions that are grounded in the potential for technology to assist in the transition to a sustainable society, but does not solely relay on them. In fact, through the public process workshops it was revealed that stakeholders were more in favor of demonstrating traditional agricultural solutions over technological techniques. To me, this says that people recognize the wisdom that exists in our prior relationships to the Earth, and that to learn about and put into practice that wisdom will help us to solve some of the challenges we face. Tradition also emphasizes the need for us to listen and dialogue, both of which serve as the basis for healthy democracy.

It is my sincere hope that Tomorrow's Garden will demonstrate our collective desire to act in harmony with the Earth and dialogue about an appropriate use of her resources. In doing so, future generations may as well.

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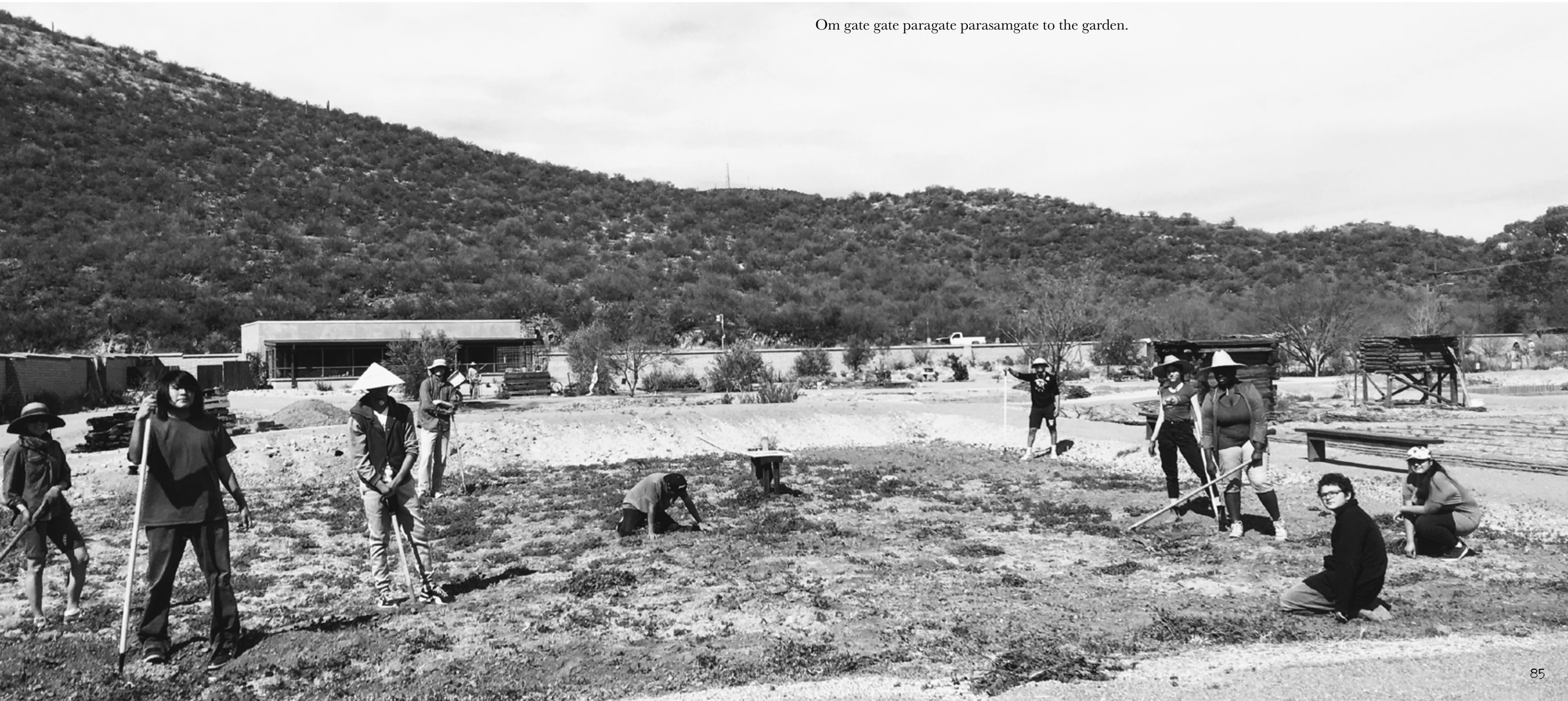

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