“We borrow from nature the space upon which we build”

- TADAO ANDO

# Ponderosa

EMILY ANDERSON

## STAY TRUE TO THE ENVIRONMENT

WORK WITH THE ENVIRONMENT

REFLECT THE VARYING SURROUNDING LANDSCAPE

LOCALLY SOURCE AND BE TRUE TO MATERIALITY

## EXPERIMENT WITH GREEN BUILDING SYSTEMS

UTILIZE PROVIDED RESOURCES

PRODUCE ENERGY, CYCLE WATER, PRODUCE FOOD

BUILD WITH RECYCLED OR RE-PURPOSED MATERIALS

## PROVIDE ACCESSIBLE ENVIRONMENTALLY FRIENDLY LEARNING THROUGH PRACTICE

TEACH INHABITANTS HOW TO UTILIZE THEIR DWELLING THROUGH FOUR ELEMENTS: WATER, EARTH, SUN, AIR

SHOW THEM HOW TO LIVE MORE SUSTAINABLY VIA SMART HOME SYSTEM

SPREAD AWARENESS OF OUR IMPACT ON OUR ENVIRONMENT

PONDEROSA PINE
*PINUS PONDEROSA*

# CONTENTS



Ponderosa is a home away from home in Central Oregon, catering to adventurers who were drawn to the area by its impressive natural landscapes. This house is site designed and integrated, meaning that it uses its surrounding landscape to produce a livable environment all year round, without the use of energy-absorbing building systems. Ponderosa is able to collect, circulate, and process its own water, passively heat and cool itself, collect solar energy, and uses re-purposed and recycled materials, allowing it to function as a living part of the landscape. These systems will be highlighted through the elements: water, earth, sun and air, as methods for embodying knowledge. To monitor the houses functionality, a smart home system is included, aiding the houses functionality. The experiences provided from the alternative green building systems along with the fluctuation of tourists, promote a new wave of sustainable housing.

# RESEARCH

** EACH SECTION'S PHOTO IS A PICTURE FROM THE PROPOSED SITE**

# PONDEROSA PINE

ucanr.edu

## COMMONALITIES BETWEEN TREE AND HOUSE

- Provide shelter from the elements
- Process sunlight into energy
- Exist in dry areas
- Built to last
  - The oldest Ponderosa Pine reached 600 year old
- Site conditions influence form
- Mostly fire retardant
  - The Ponderosa Pine's bark protects from fire, wheras Ponderosa's rammed earth walls add fire retardency
- Regenerate by seed
  - Visitors of Ponderosa leave with metaphorical dropped pine cones of knowledge to use elsewhere

# OREGON'S WATER CONCERNS

Integrated Strategies for a Vibrant and Sustainable Central Oregon, Barr, Geos Institute

DECLINING SNOW PACK

DECLINING SURFACE WATER AVAILABILITY

INCREASING COMMUNITY COMPETITIVENESS

HIGH COSTS TO SUPPLY WATER

## RECOMMENDED STRATEGIES PONDEROSA TAKES ON

- Conserve Water Resources
- Increase Ground Water Recharge
- Decrease Water Demand
- Increase Water Storage
- Protect and Restore Aquatic Areas
- Initiate Conversation - Minded Land Use Planning
- Restore Historic Range of Forest Habitat Conditions + Plant Communities


Steelhead Falls, 6 miles from site

# LIVING BUILDING CHALLENGE

An iterative program that promotes the growth of living buildings through award


■ scale jumping allowed

▲ core imperative

## LBC IMPERATIVES PONDEROSA AIMS FOR

### PLACE

- ▲ Ecology of Place
- ■ Urban Agriculture
- Habitat Exchange
- ■▲ Human Scaled Living

### WATER

- ■▲ Responsible Water Use
- ■ Net Positive Water

### ENERGY

- ■▲ Energy + Carbon Reduction
- ■ Net Positive Energy

### HEALTH + HAPPINESS

- ▲ Healthy Interior Environment
- Healthy Interior Performance
- Access to Nature

### MATERIALS

- ▲ Responsible Materials
- Red List
- Responsible Sourcing
- Living Economy Sourcing
- Net Positive Waste

### EQUITY

- ▲ Universal Access
- ▲ Inclusion

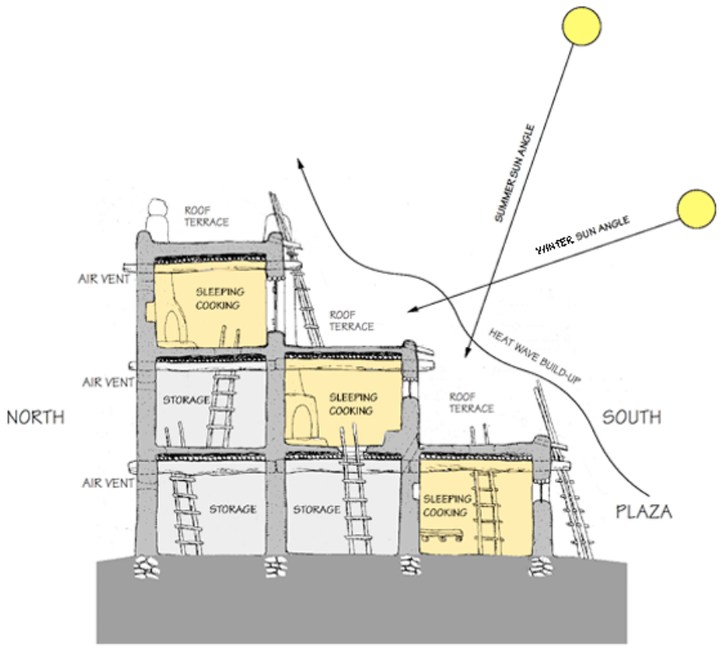
### BEAUTY

- ▲ Beauty + Biophelia
- ▲ Education + Inspiration

# ANCIENT BUILDING TECHNIQUES

Thousands of years of architecture to look back on, three referenced below.

## PUEBLO

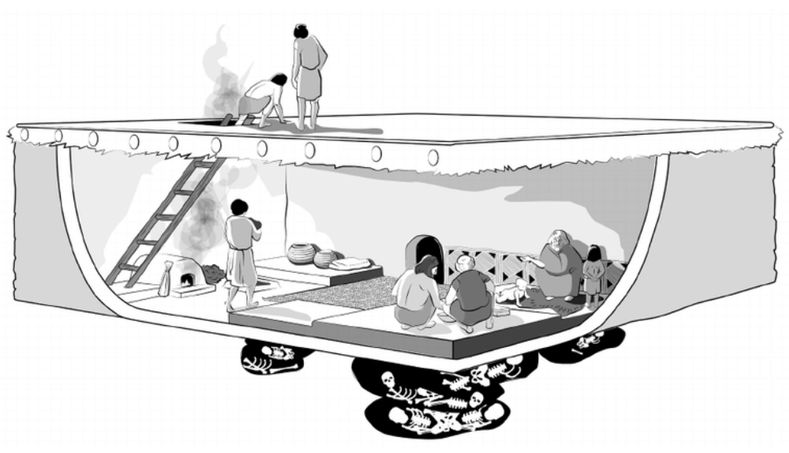



1150 AD - Present with adaptations

Present day New Mexico

Adobe walls, roof terraces, usage of sun angles, recessed storage to maximize cool spaces, passive heating and cooling, community stacking

## CATAL HOYUK

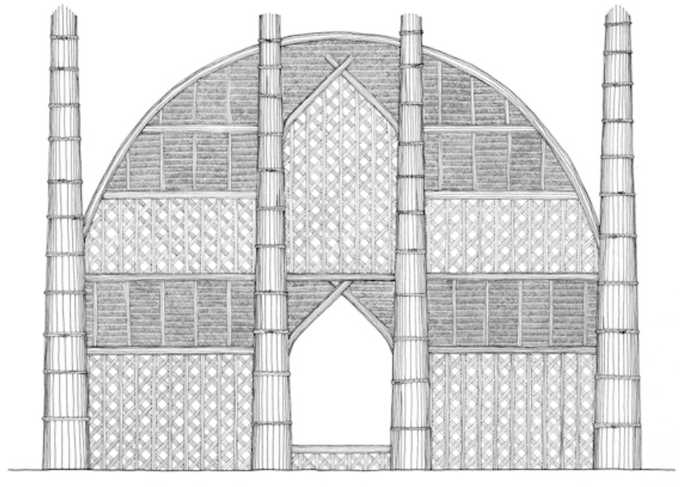


7000 BC

Present day Anatolian Plain, Turkey

Adobe walls, roof terraces, passive heating and cooling, complex community planning, use of natural resources

## MUDHIF



3000 BC

Present Southern Iraq

Gathered reed columns from new and re-used reeds, sun altering lattices, passive cooling, ability to float on watery landscape

# ORIGINAL BUILDING TECHNIQUES

Hundreds of years of architecture originating in the chosen location.

## MOLALA

Plank Houses

985 BC

Present day Central Oregon

Cedar Plank Construction, Cedar used due to its predictable segments and water resistant bark, partially submerged to control temperature and shelter from elements, interior cedar fiber mats, occasionally further submerged storage areas for more stable temperature

# MODERN SMART-HOME TECHNOLOGY

amazon.com, wink.com



## Amazon Smart Home System

Alexa
Lights
Thermostat
Speaker
Door Locks
Operate Garage Doors
Appliances
Plugs + Outlets
Smart TV
Irrigation
Wifi
Security
Video Assistants

## Wink Hub Smart Home System

Security
Lighing
Outlets + Switches
Doorbell
Door Locks
Opperate Garage Door
Thermostat
Irrigation
Fans
Water Heater
Wifi
Shades
Alexa, Google
Speakers

# LOCAL REPURPOSED RESOURCES

## CONSTRUCTION AND DEMOLITION WASTE

Concrete

Wood

Gypsum

Metals

Glass

Plastics

Doors

Plumbing Fixtures

## NATURAL ABUNDANCE

Earth

Rock

Pine

Cedar

Obsidian

# TOURISM INFLUENCE

Oregon Travel Impacts - Statewide Estimates, Dean Runyan Associates

## TOURISM DEMOGRAPHIC

Top economic influencer

28.8 million overnight visitors in 2017

Industry grows about 2.2% each year

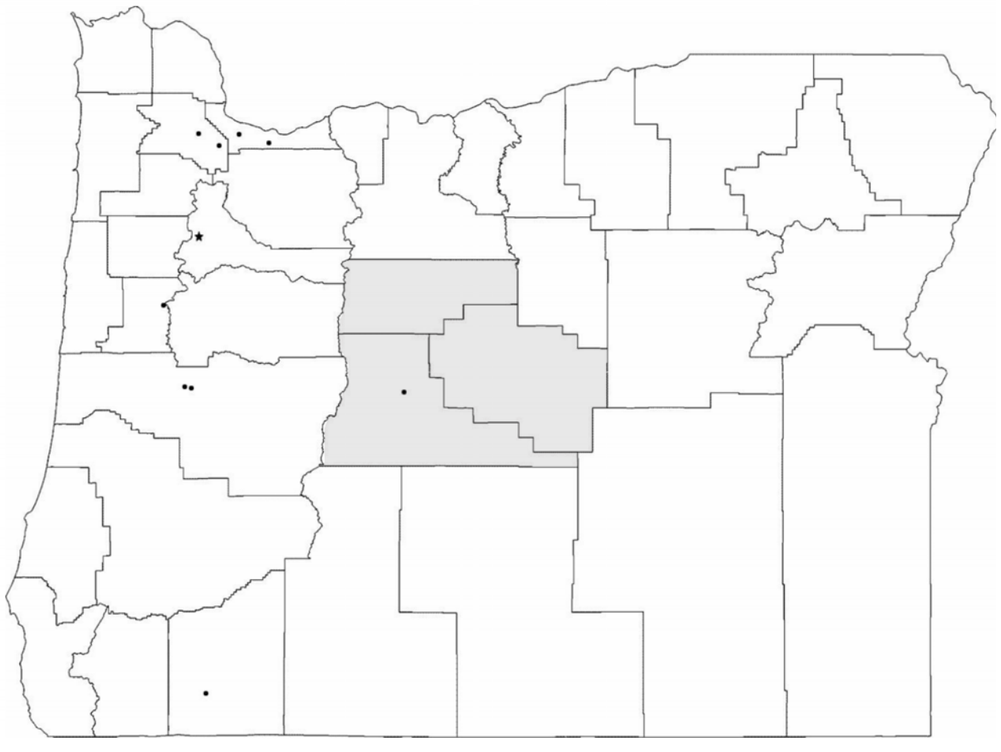
Largest employer

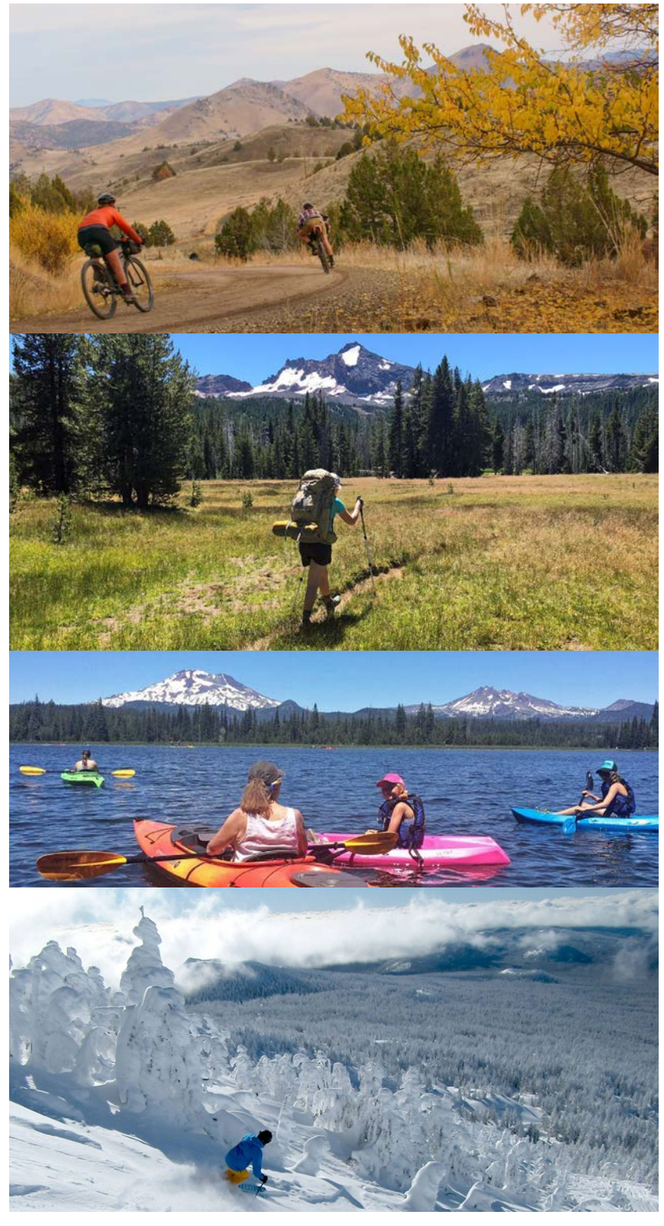
## DEMOGRAPHIC

54th fastest growing county

Grown 25% since 2010

75% population between 18-65





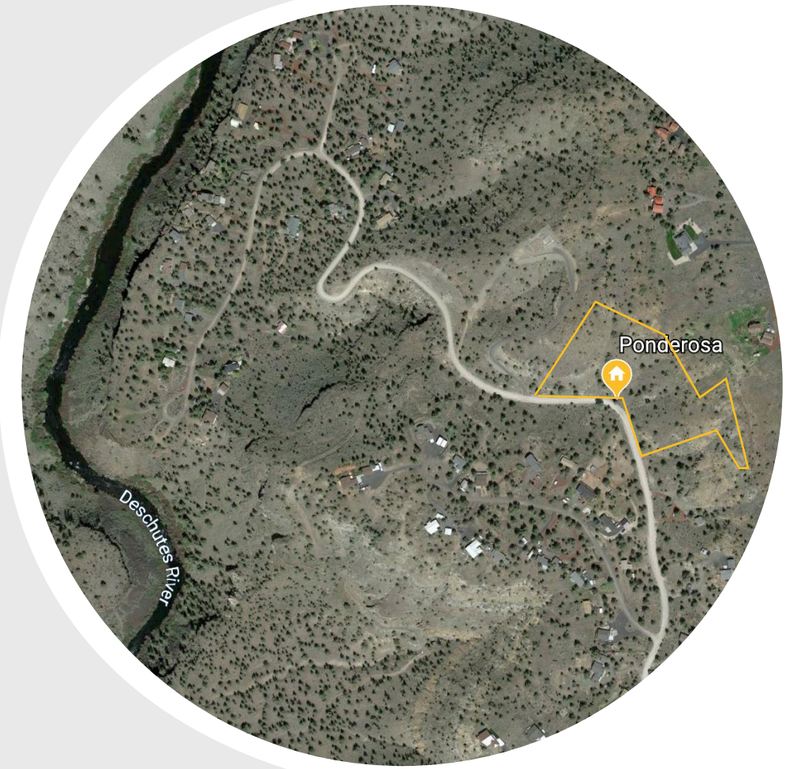
# SITE ANALYSIS

# AREA BREAKDOWN

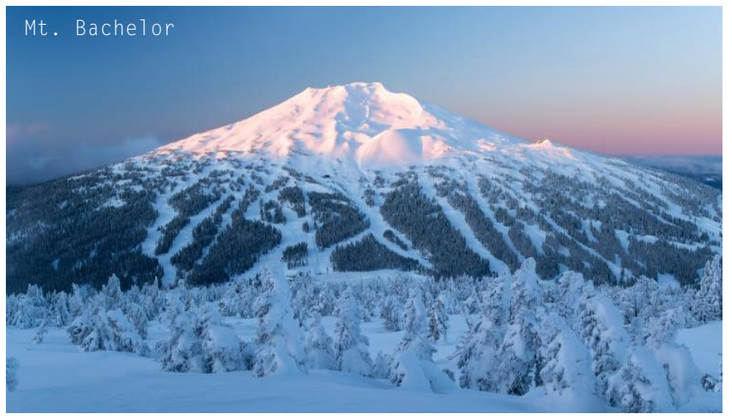
Jefferson, Deschutes and Crook Counties









# SITE

0 SW Sundown Canyon Rd. LOT 82-12,
Terrebonne, Oregon 97760

6.41 Acres

Water and Electricity Available at the road

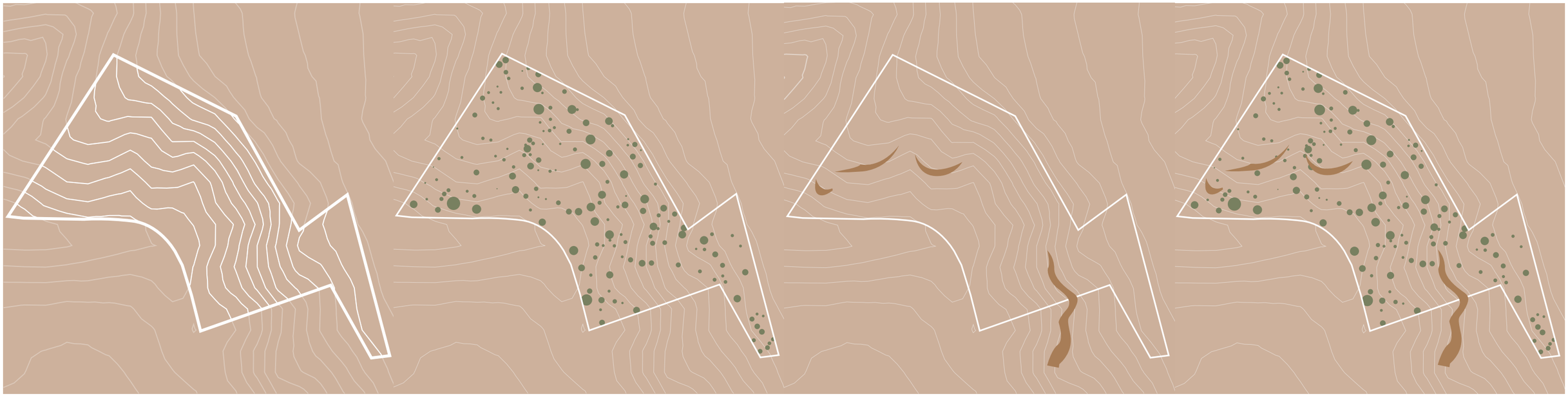
Approved for Septic, Not on Site

Crooked River Ranch Community

Easy Earth Massing

Southwest Facing

On the Cascade Break Between Forest and High Desert



# NATURAL INFLUENCERS

## WINTER

Primarily Southern Winds

Wet and Snowy

Cold

Overcast

Minimal Solar Power

## SUMMER

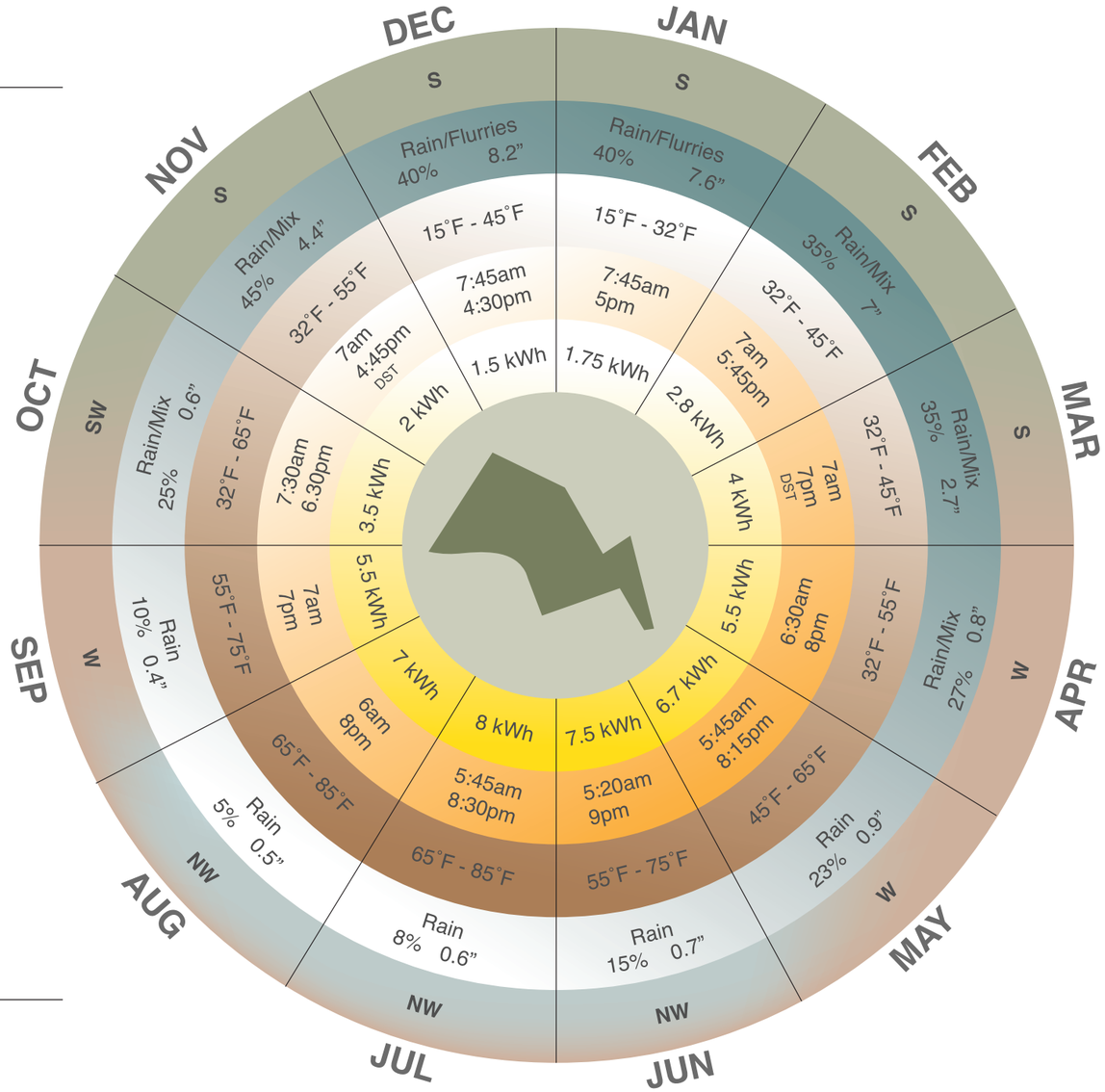
Primarily Western Winds

Dry

Hot

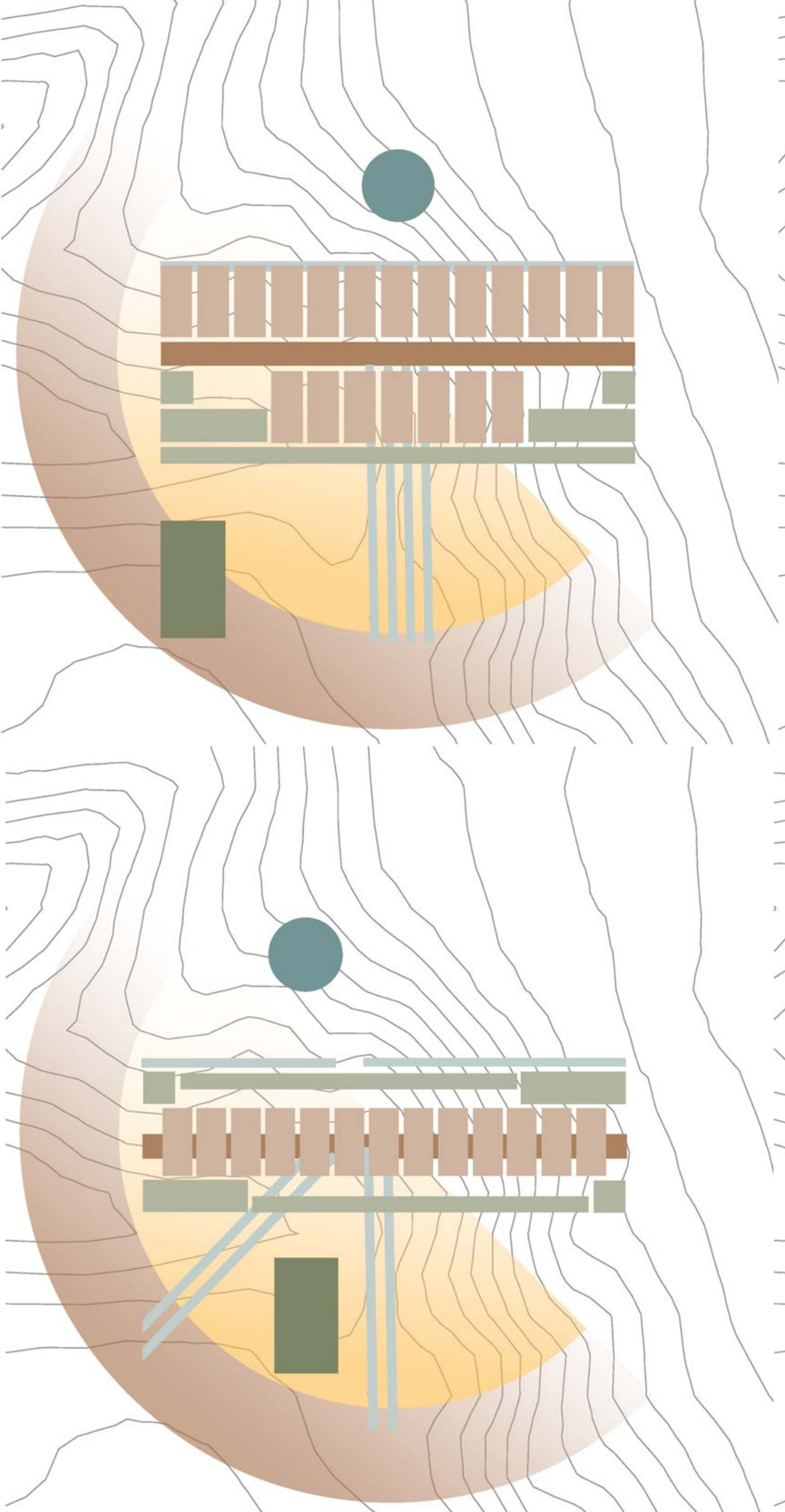
Sunny

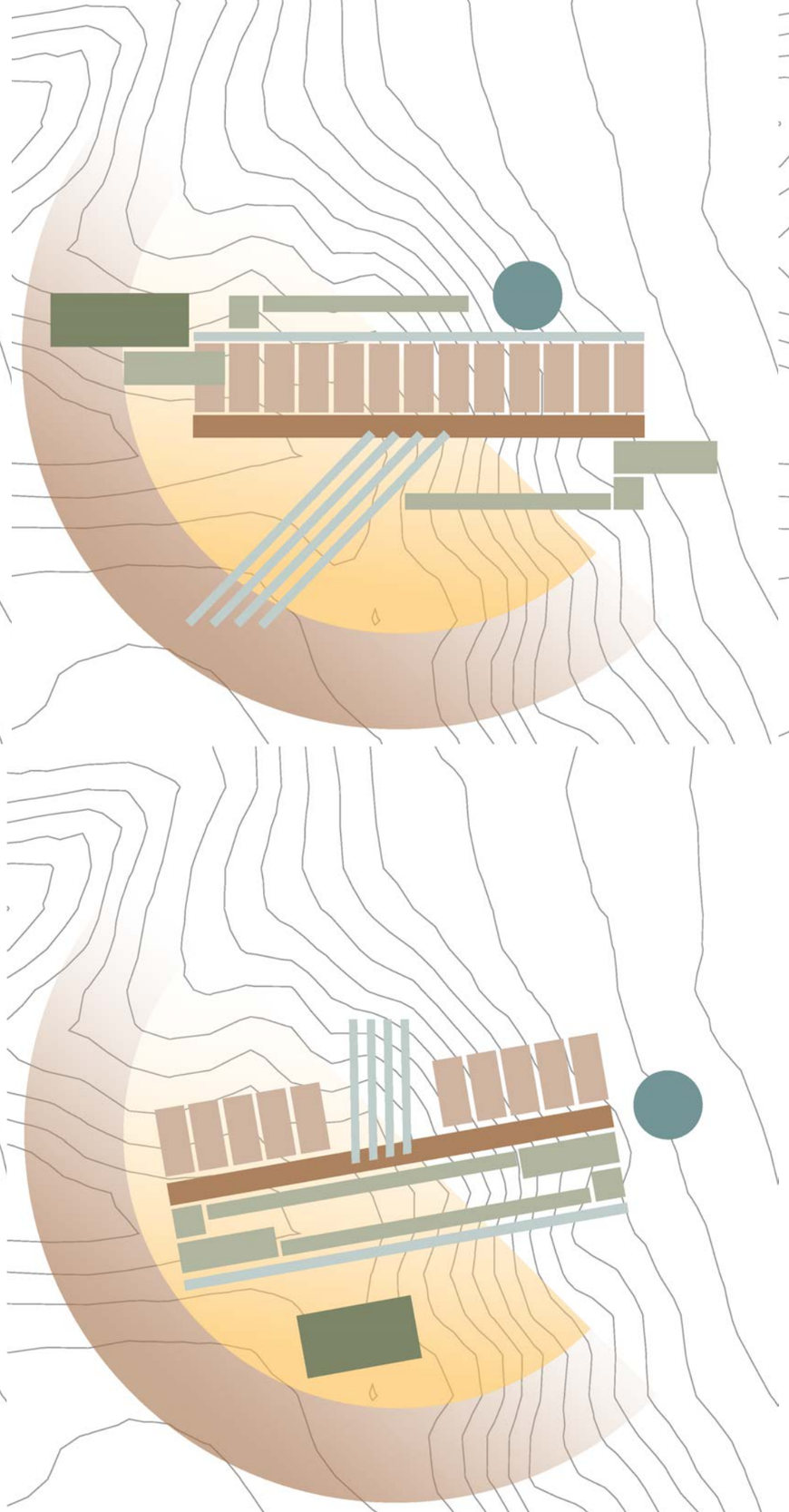
High Solar Power Capabilities

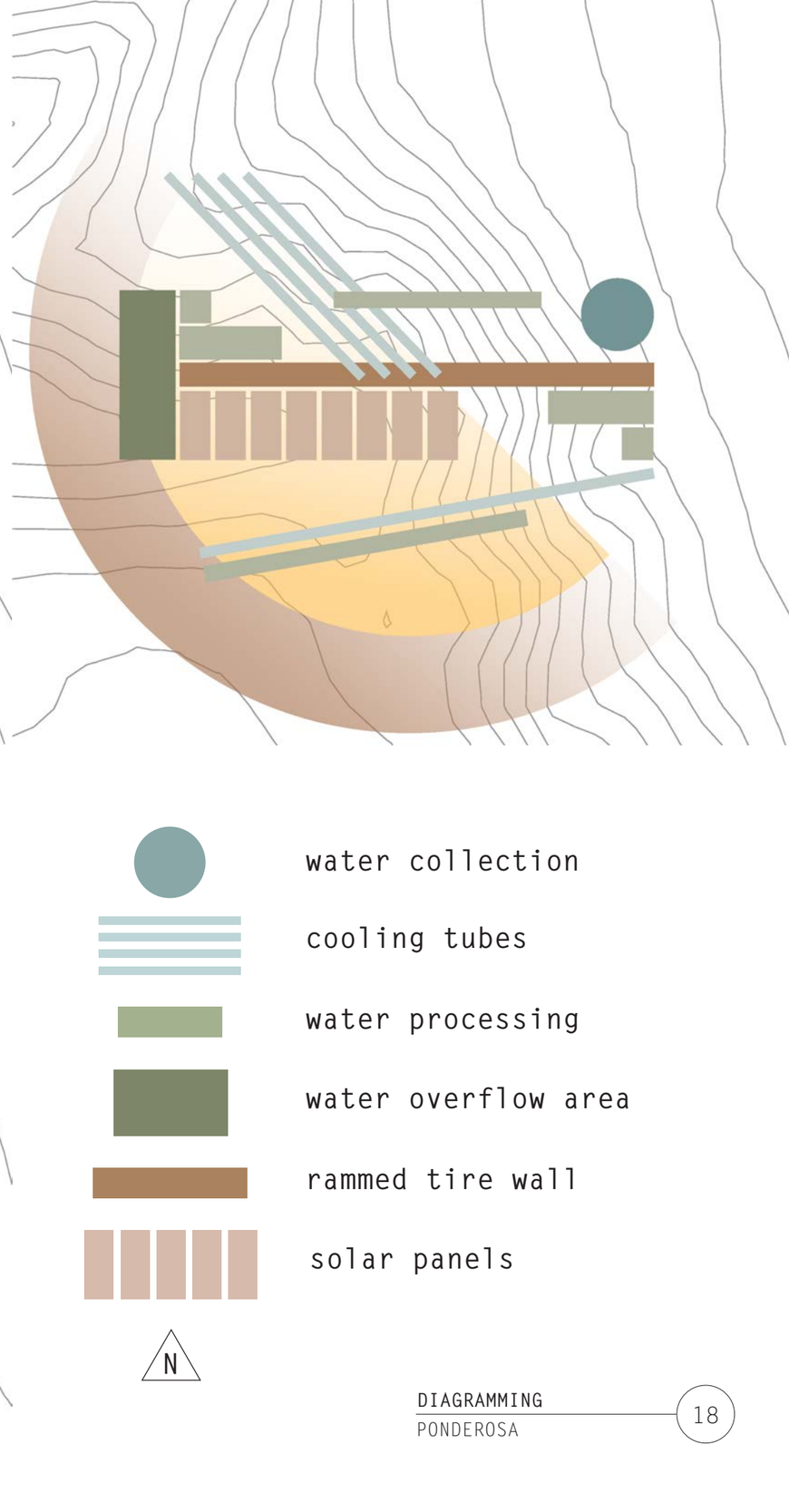



- The site also sits in a seasonal fire zone

# DIAGRAMMING











water collection

cooling tubes

water processing

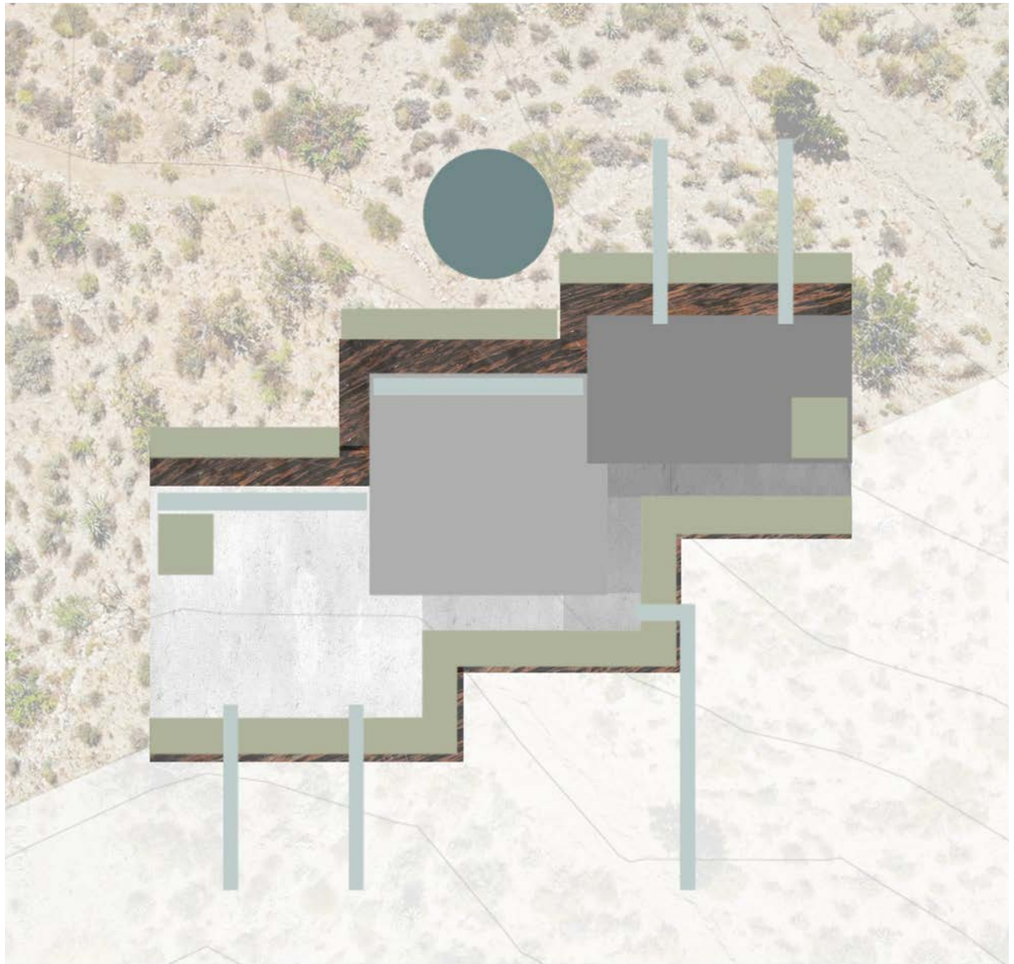
water overflow area

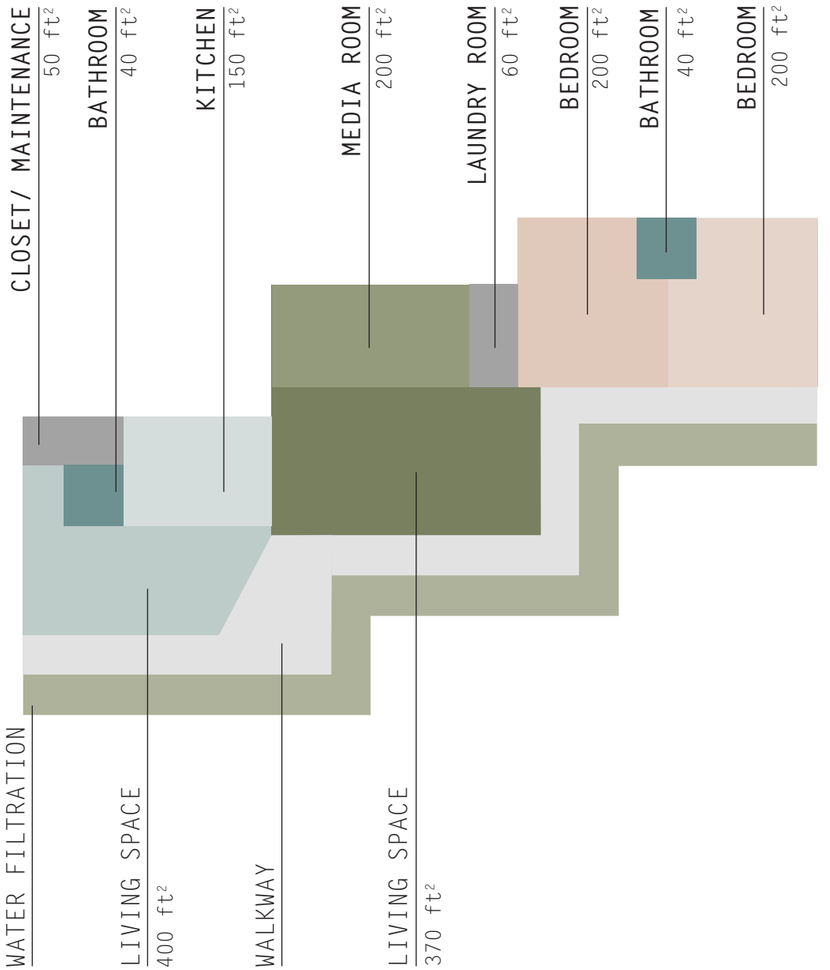
rammed tire wall

solar panels

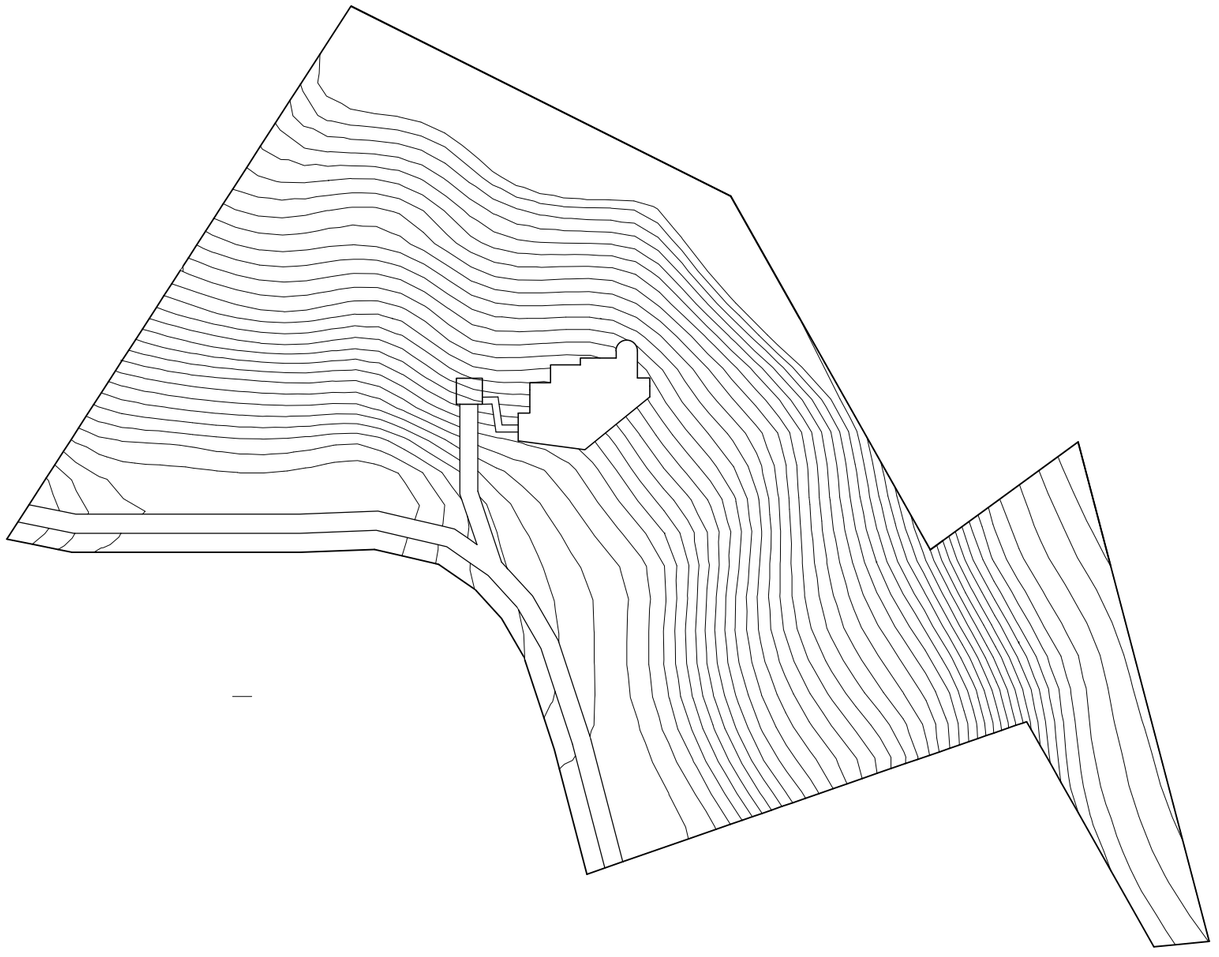
N

# SCHEMATICS




CLOSET/ MAINTENANCE
50 ft²
BATHROOM
40 ft²
KITCHEN
150 ft²
MEDIA ROOM
200 ft²
LAUNDRY ROOM
60 ft²
BEDROOM
200 ft²
BATHROOM
40 ft²
BEDROOM
200 ft²
WATER FILTRATION
LIVING SPACE
400 ft²
WALKWAY
LIVING SPACE
370 ft²

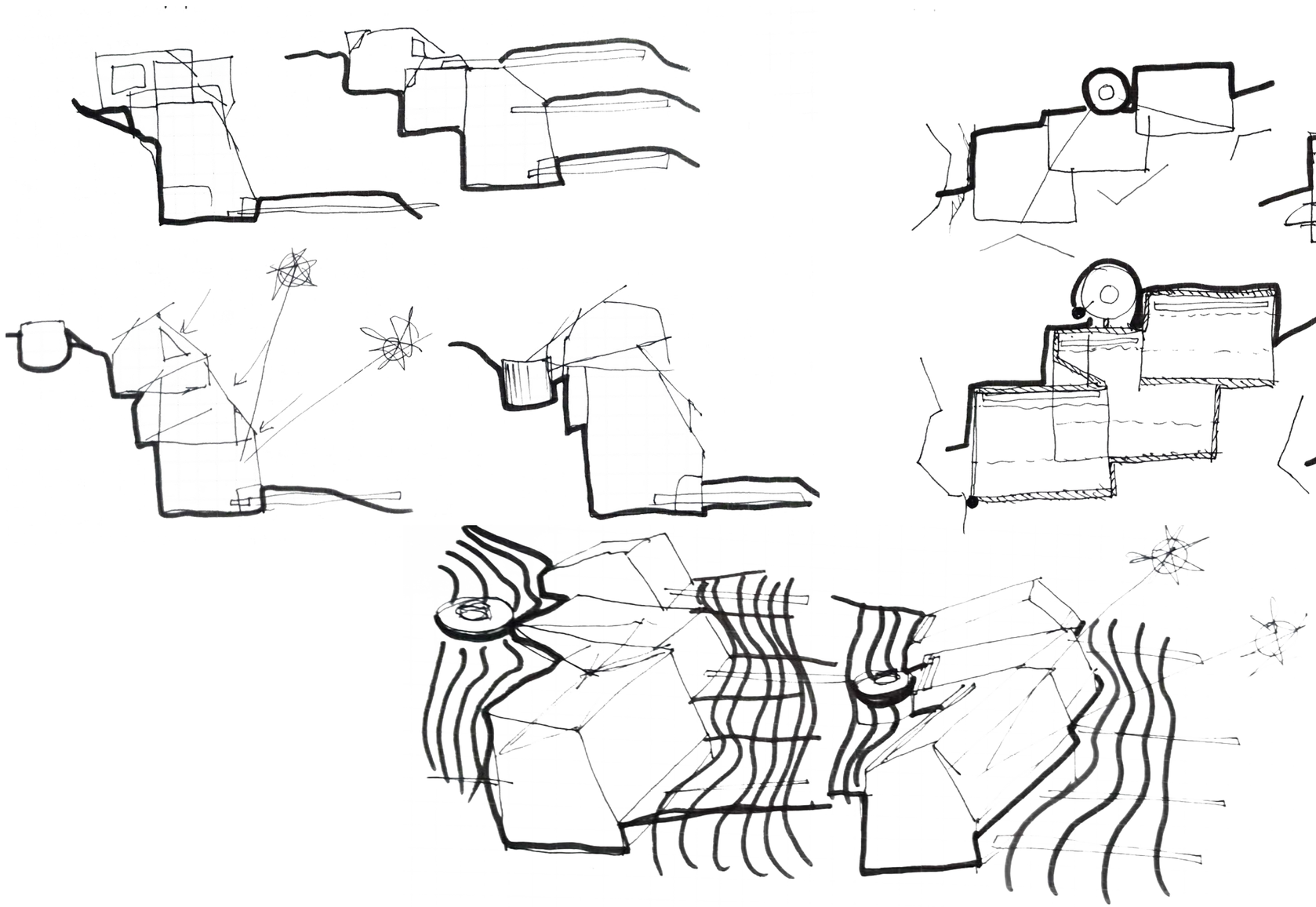
# TRANSLATED SITE



SITE PLAN
SCALE 1/128”=1’0”

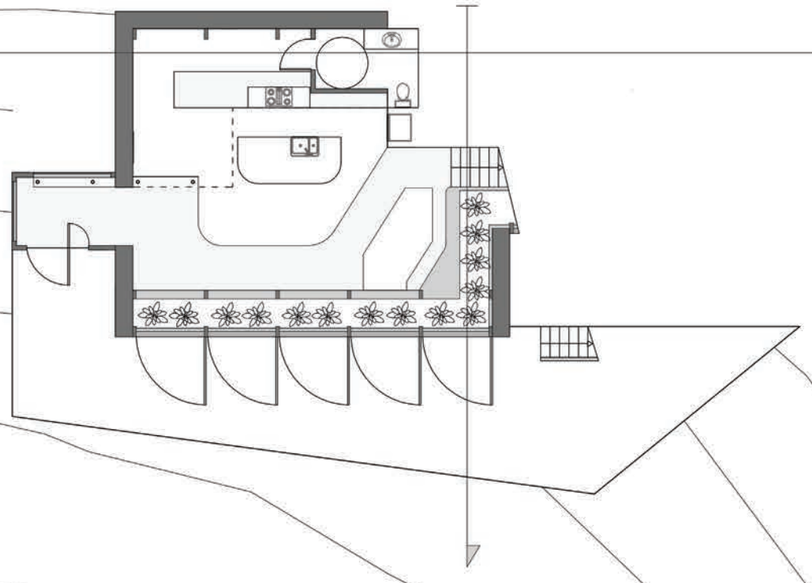
# TRANSLATION OF FORM

# PROGRESS SKETCHES



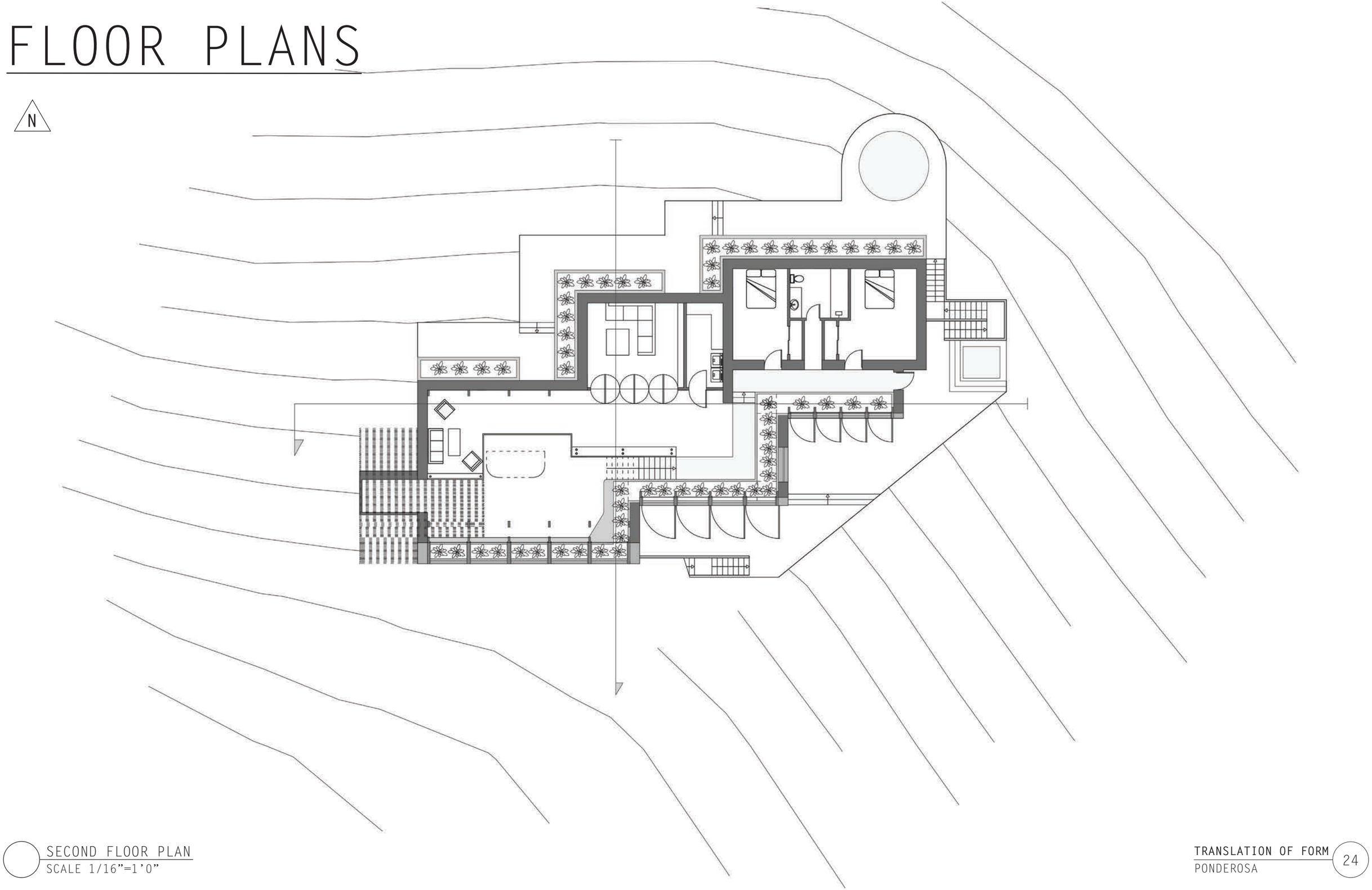
# FLOOR PLANS

N



FIRST FLOOR PLAN
SCALE 1/16”=1’0”

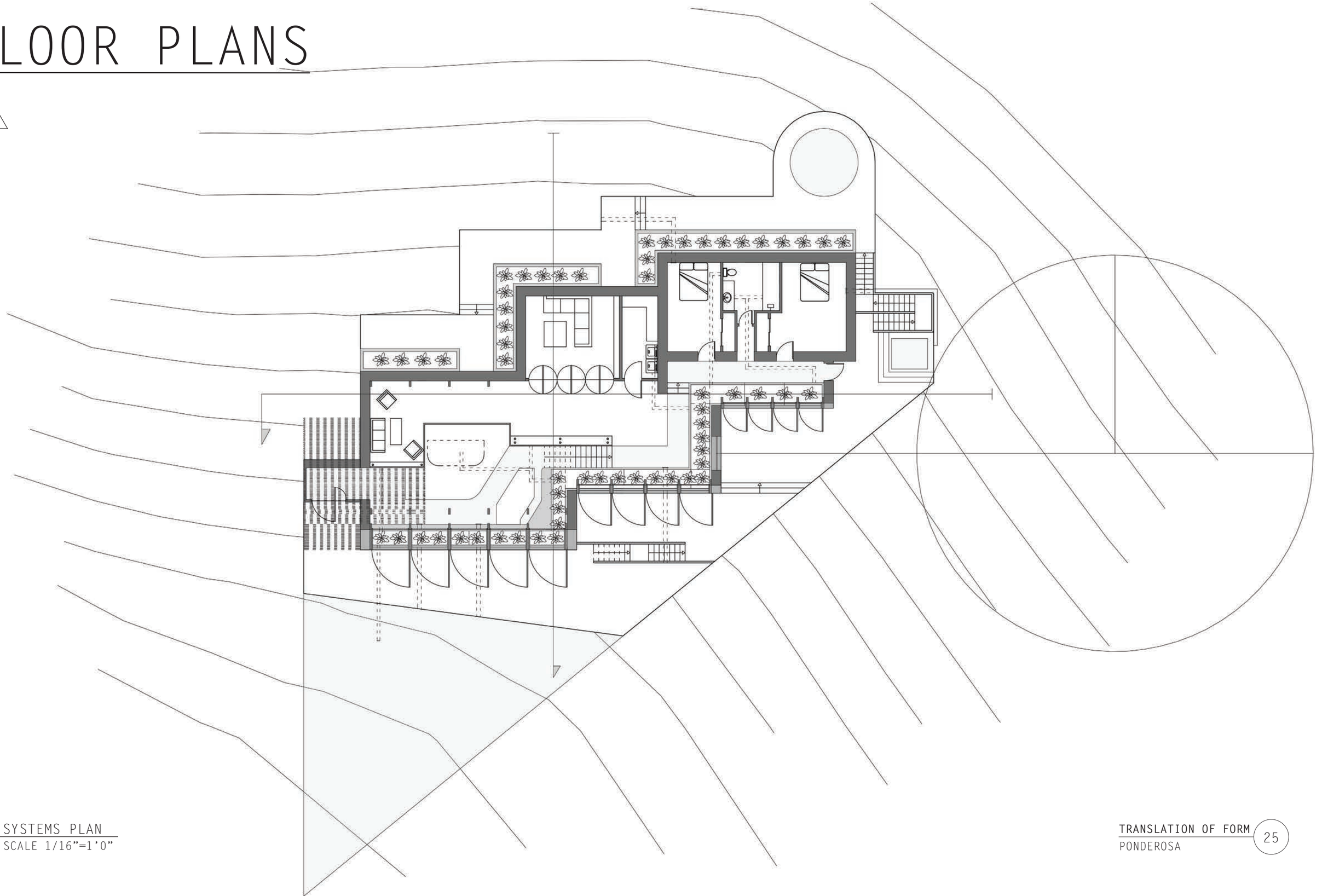
# FLOOR PLANS




SECOND FLOOR PLAN
SCALE 1/16”=1’0”

# FLOOR PLANS

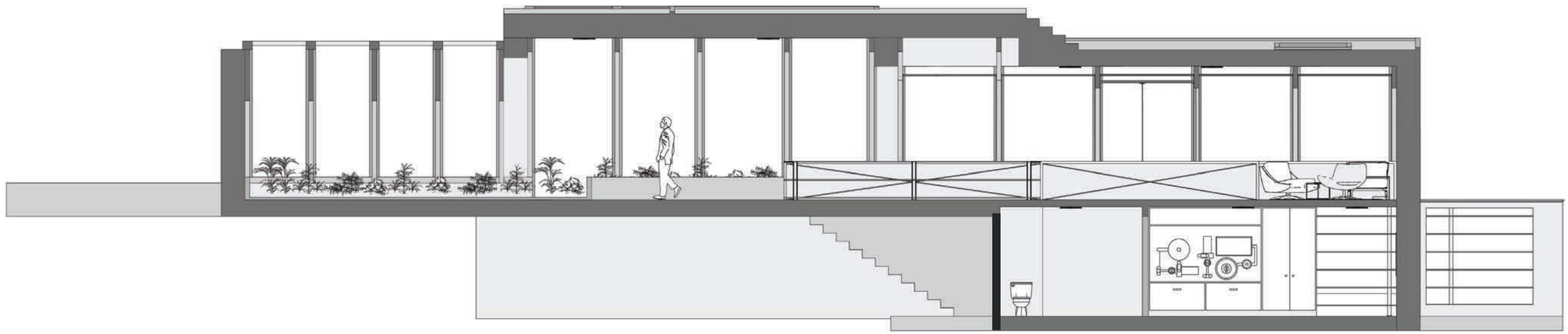
N



SYSTEMS PLAN
SCALE 1/16”=1’0”

# SECTIONS

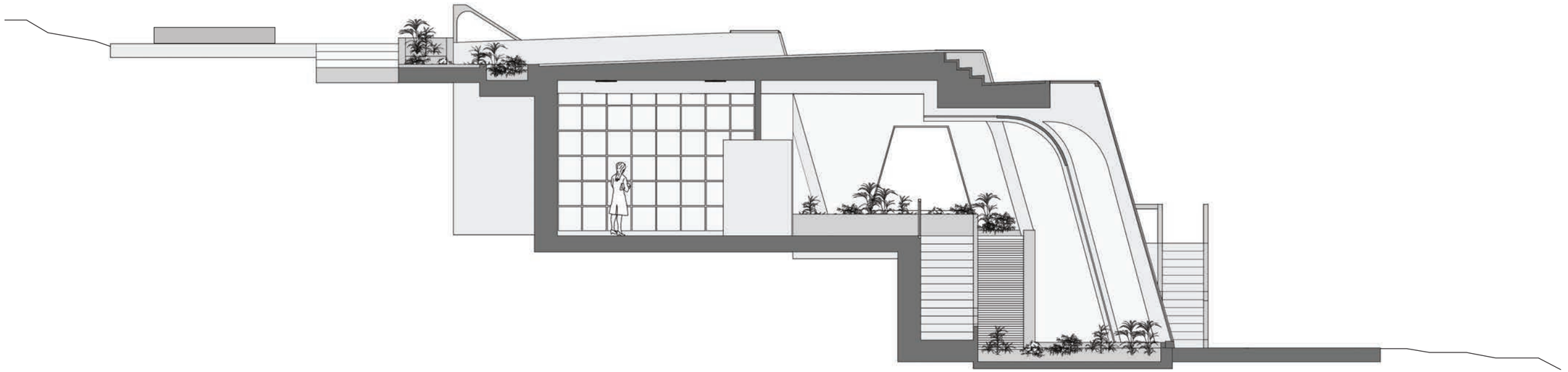
N



SECTION, SOUTH
SCALE 1/32”=1’0”

# SECTIONS

N

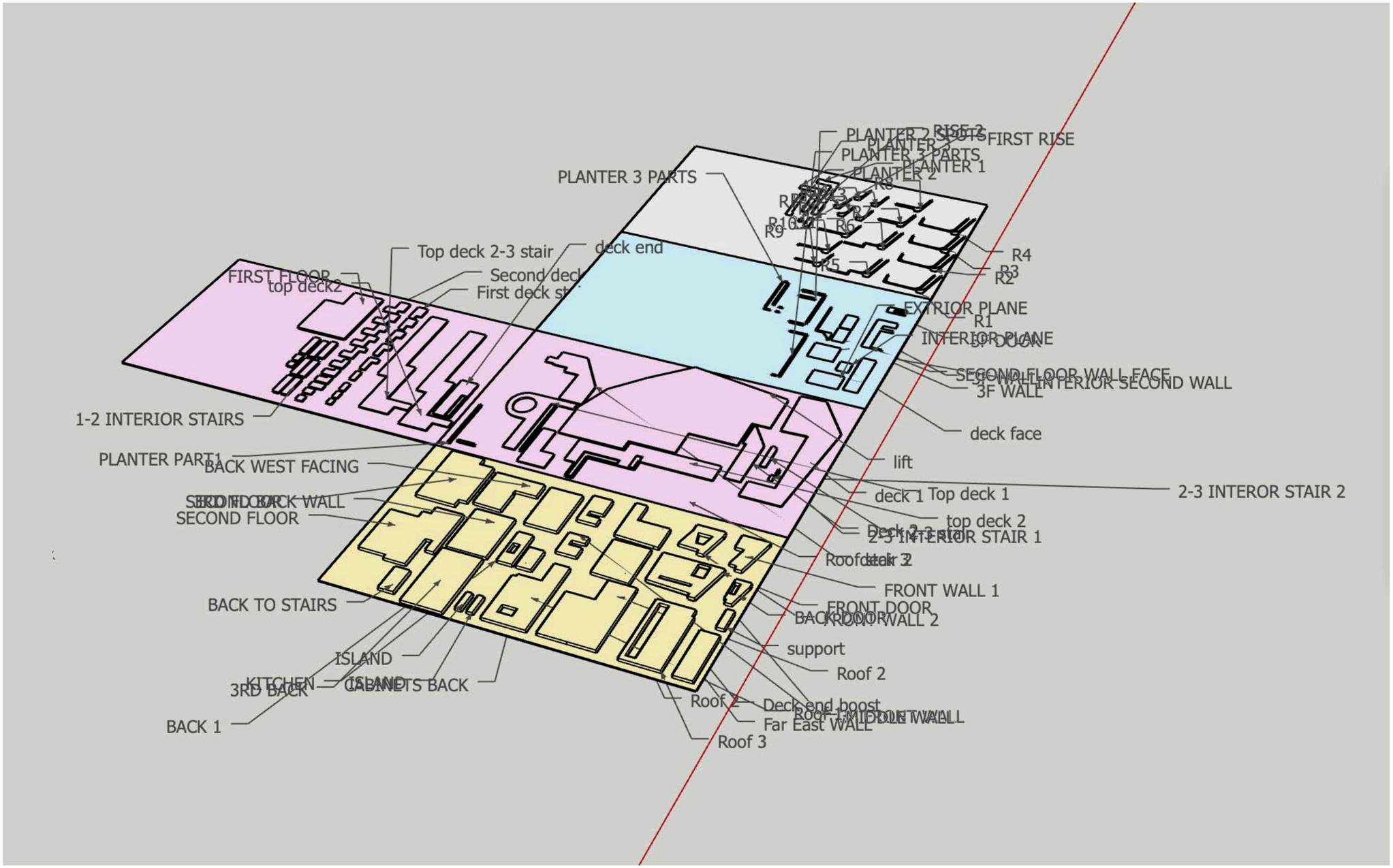


SECTION, EAST
SCALE 1/32”=1’0”

# CONCEPT MODEL

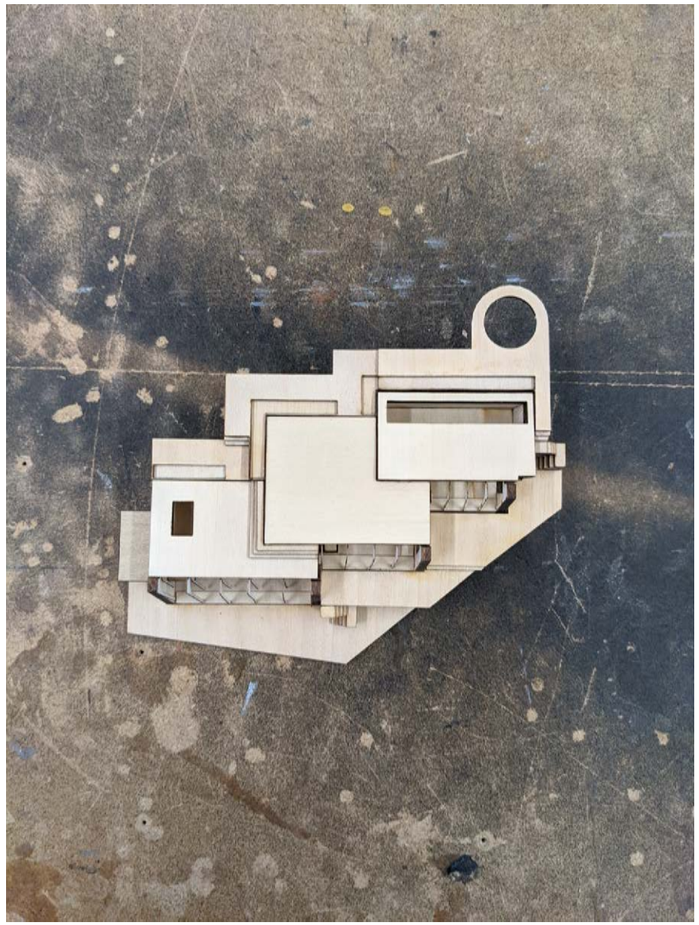
SCALE 1/16”=1’0”

# MODEL PLANNING



# MODEL

SCALE 1/16”=1’0”



*slight adjustments were made to the house post production of this model

# RENDERINGS

# AERIAL VIEW

Ponderosa seamlessly integratng into the landscape, allowing for a walkable roof with stunning views.
Half of the roof is comprised of the Tesla Solar roof, collecting available solar energy.

# EXTERIOR ENTRY

Central Oregon’s landscape forces movement of ones body through elevation changes. Ponderosa mimics this, allowing for deeper integration within site on a larger scale,

# ENTRY LOOKING IN

Southern sun rays kiss the faces of rammed earth walls and inhabitents, fuling passive heating and warm moods. Interior planters grow supplemental produce and herbs, while cleaning gray water. This process is highlighed by a water feature flowing from the second floor to the second.

# KITCHEN

An overlook provides conversation flow between second and first floors, while maximising vertical space.

# SECOND FLOOR OVERLOOK

A sitting space on the second floor provides the perfect nook to read a book or have an intimate conversation while enjoying panoramic views of Central Oregon.

# SECOND FLOOR LOOKING EAST

Shades, opperable from the houses app, control the ammount of light within the space, while still allowing the planters to recieve full light by the use of interior butresses.

# BEDROOM PASSAGEWAY

A trapezoidal window frames the mountinous landscape, while highlighting a Ponderosa Pine tree that grows on site. A shift in floor levels vertically and horizonatally creates a leveled increase of private space.

# ELEMENTAL SYSTEMS

# WATER

earthshipbiotecture.com

NOT TO SCALE

Water is collected from the roof. The roof size was dictated by the water needed for three people over the course of a year.

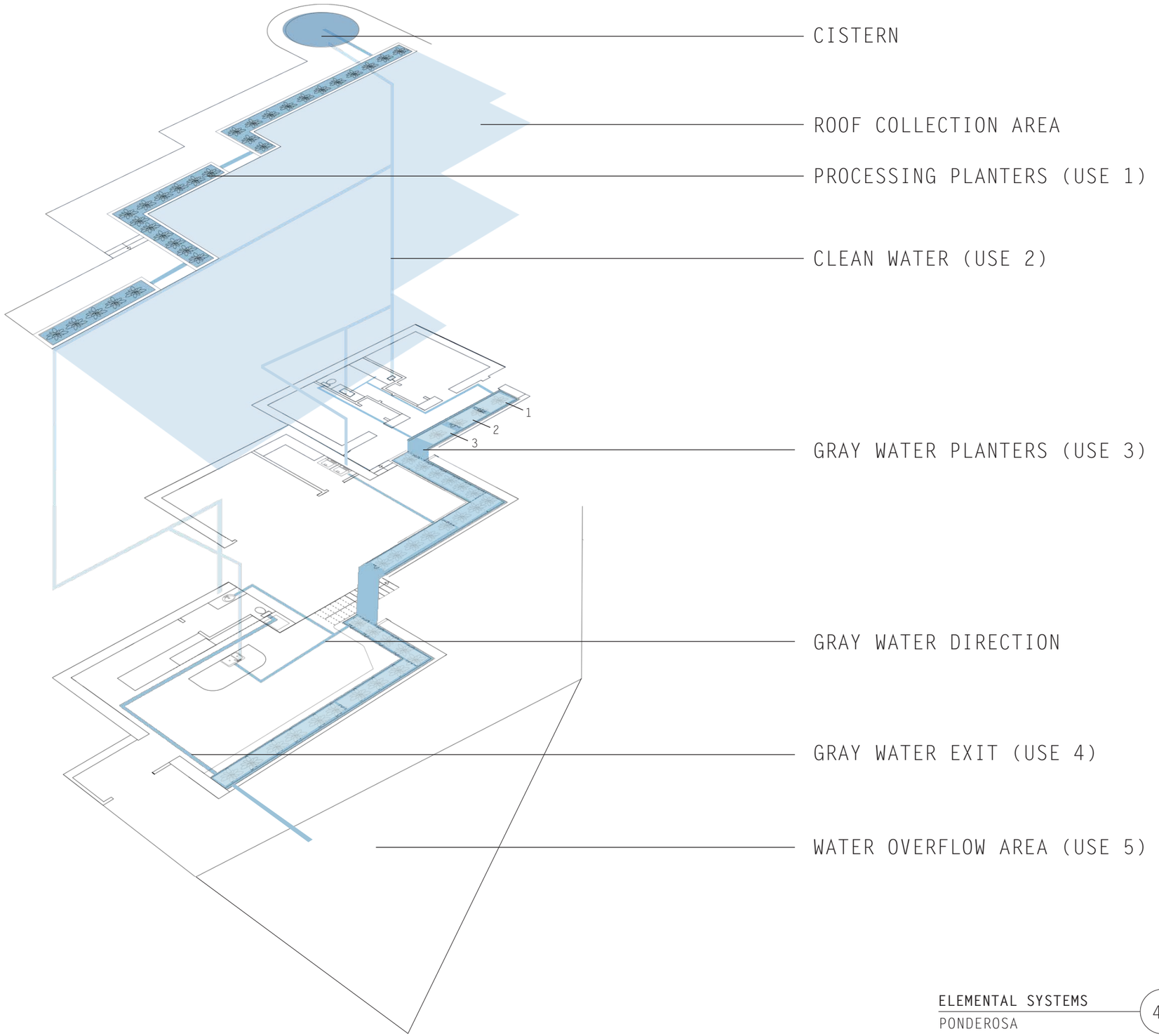
The water drains into the planters, where it is then pumped into the cistern.
**(use 1)**

Water is then directed from the cistern to sinks, showers, and washing machines.
**(use 2)**

Gray water is then directed to the interior planter where it circulates through 3 processing cells.
**(use 3)**

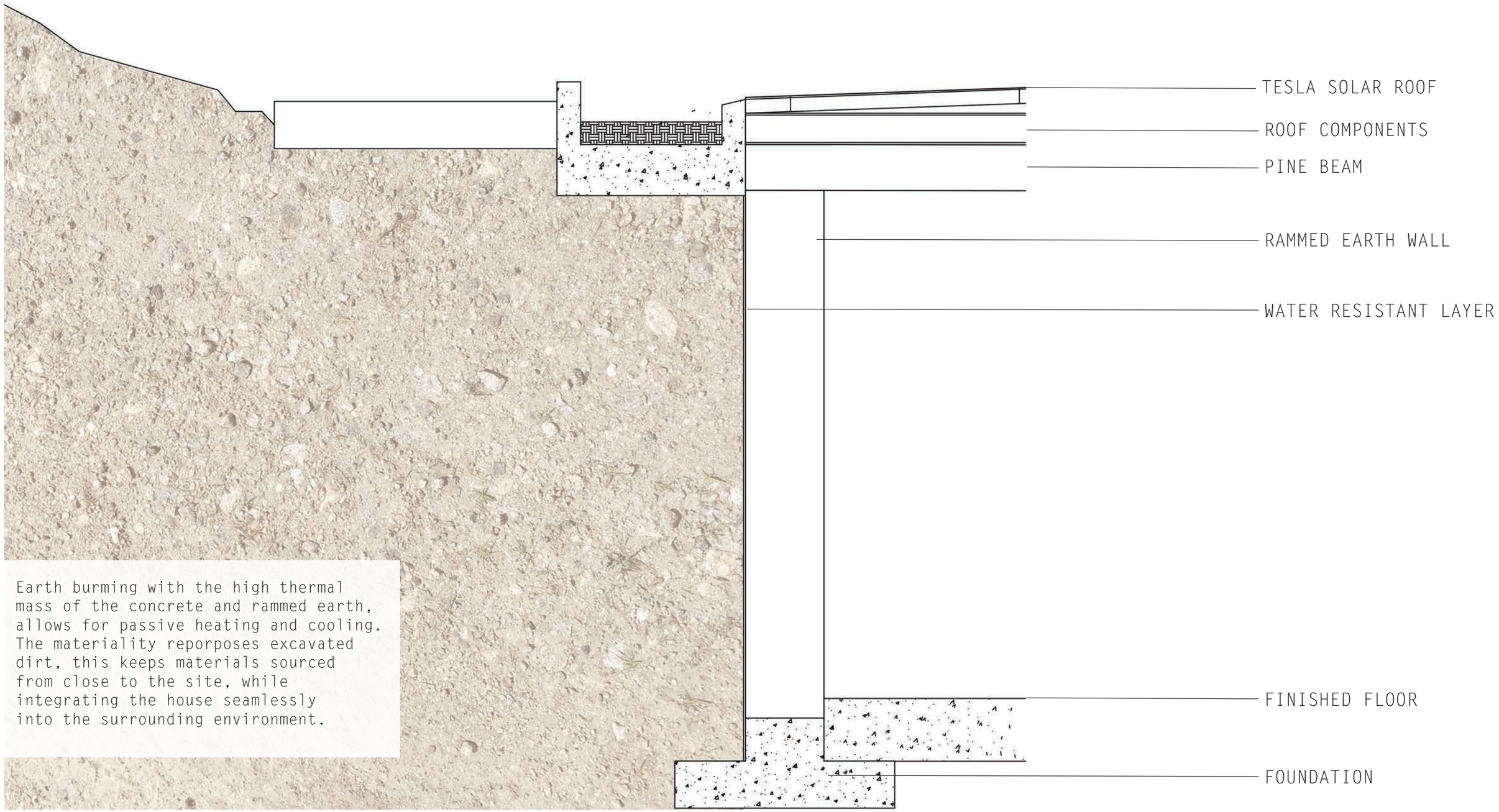
The processed gray water is then used to flush the toilets, turning it into unprocessable black water.
**(use 4)**

Excess processed gray water is released back into the environment, providing water for native plants.
**(use 5)**



# EARTH

smarterhomes.org




Earth burming with the high thermal mass of the concrete and rammed earth, allows for passive heating and cooling. The materiality reporposes excavated dirt, this keeps materials sourced from close to the site, while integrating the house seamlessly into the surrounding environment.

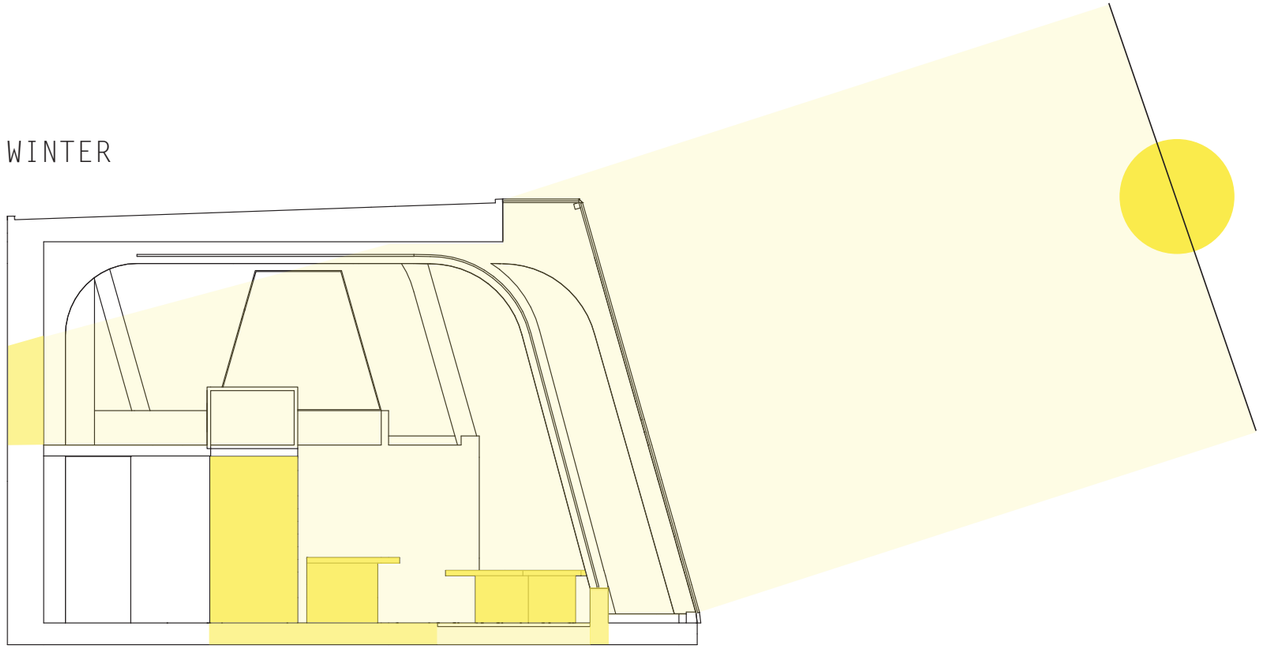
SCALE: 1/2” = 1’0”

# SUN

solarelectricityhandbook.com

NOT TO SCALE

## WINTER

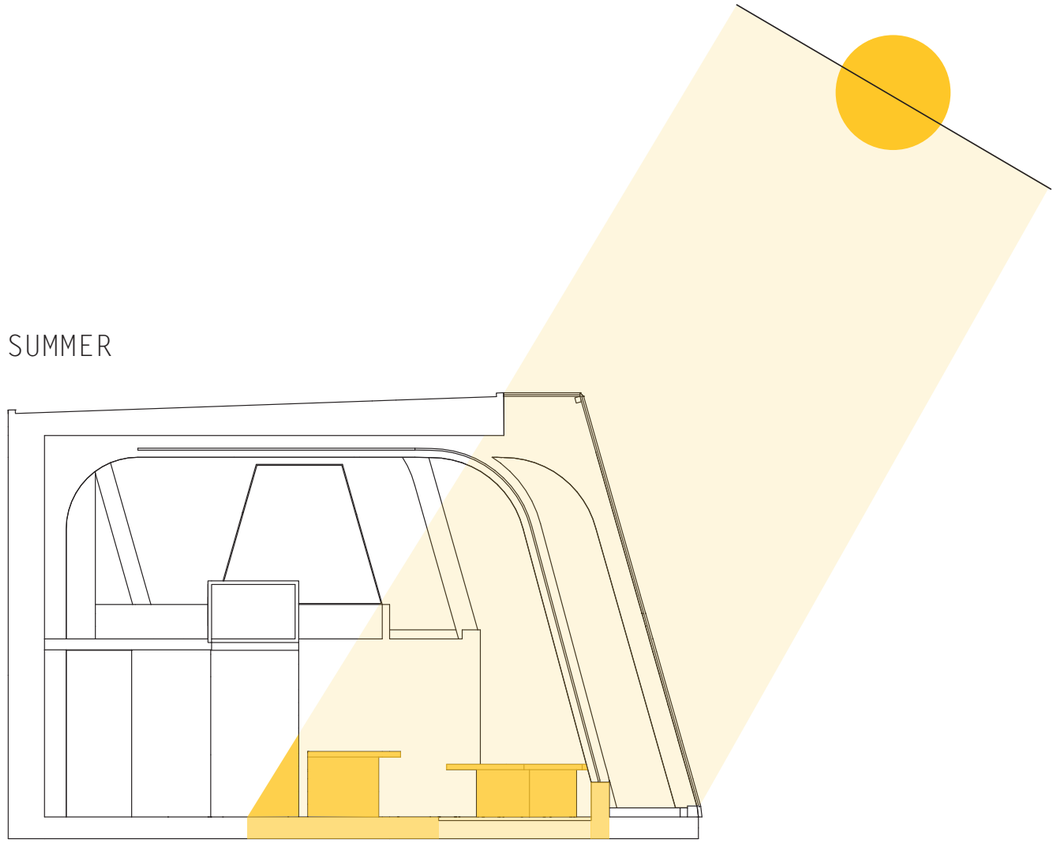


Angle 22°

The sun angle in the winter allows for more absorbtion of solar heat, creating a warmer atmostphere.

The high thermal mass of the concrete and rammed earth, allows the balance of heat dispersion between day and night. Daylight heat energy is absorbed, collecting interior heat durring the day, while releasing it to warm the interior at night.

## SUMMER



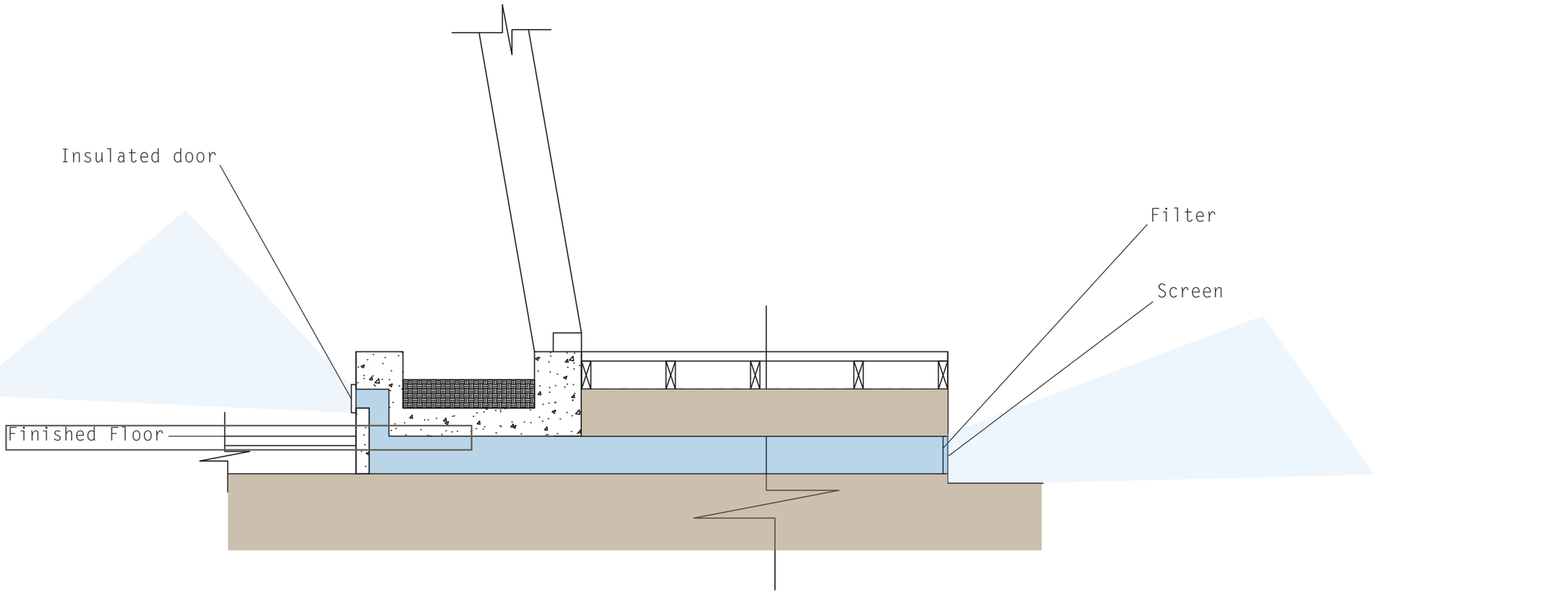
Angle 70°

The sun angle in the summer touches fewer heat absorbing interior pieces, trapping less solar heat.

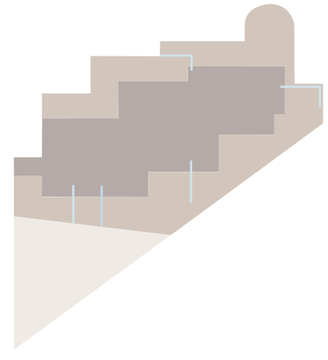
# AIR

earthshipbiotecture.com

SCALE: 1/2” = 1’0”




Cooling tubes use the temperature of the earth as a way to cool and funnel fresh air into the interior. The air is drawn through 15’ tubes, and as it warms, travels up and out of the space. This provides supplementary airconditioning to the interior durring summer months.



# SMART HOME SYSTEM

To help manage the systems in the house, and add a visual aid, Ponderosa is equipped with a smart home system. An in-house interface and correlating app, will control systems, provide house statistics, and opperate in-house appliances and lighting.


## HOUSE OPPERATIONS

Security
Lighing
Doorbell
Door Locks
Wifi
AI Assistant
Speakers
Appliances

## SYSTEM STATISTICS

Thermostat, Via Systems
Water Monitoring
Solar Energy Consumption
Vents + Cooling Tubes
AI Assistant

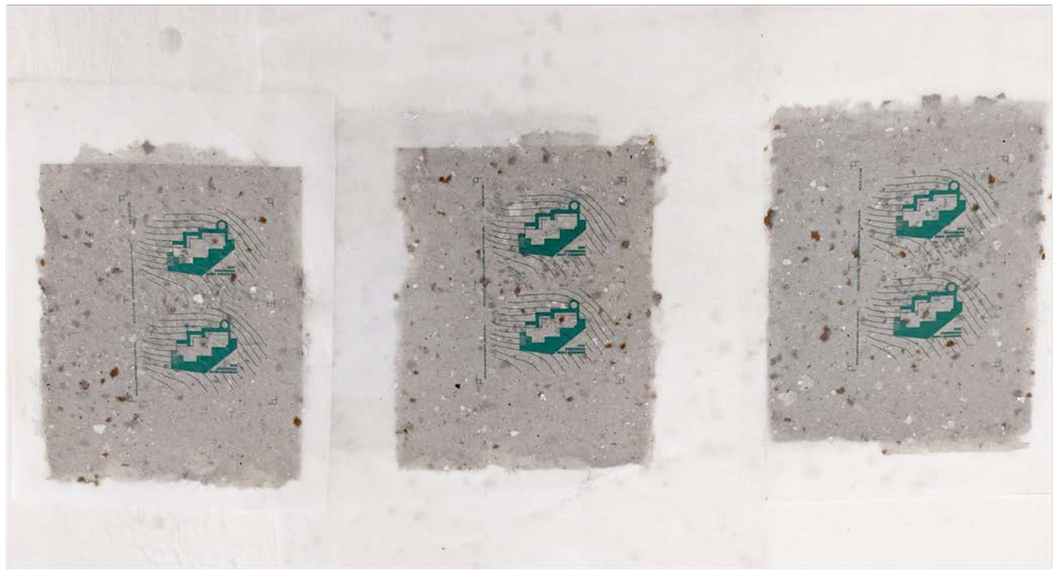
# ADDITIONAL COMPONENTS

# WALK-THROUGH + SHADOW VIDEO

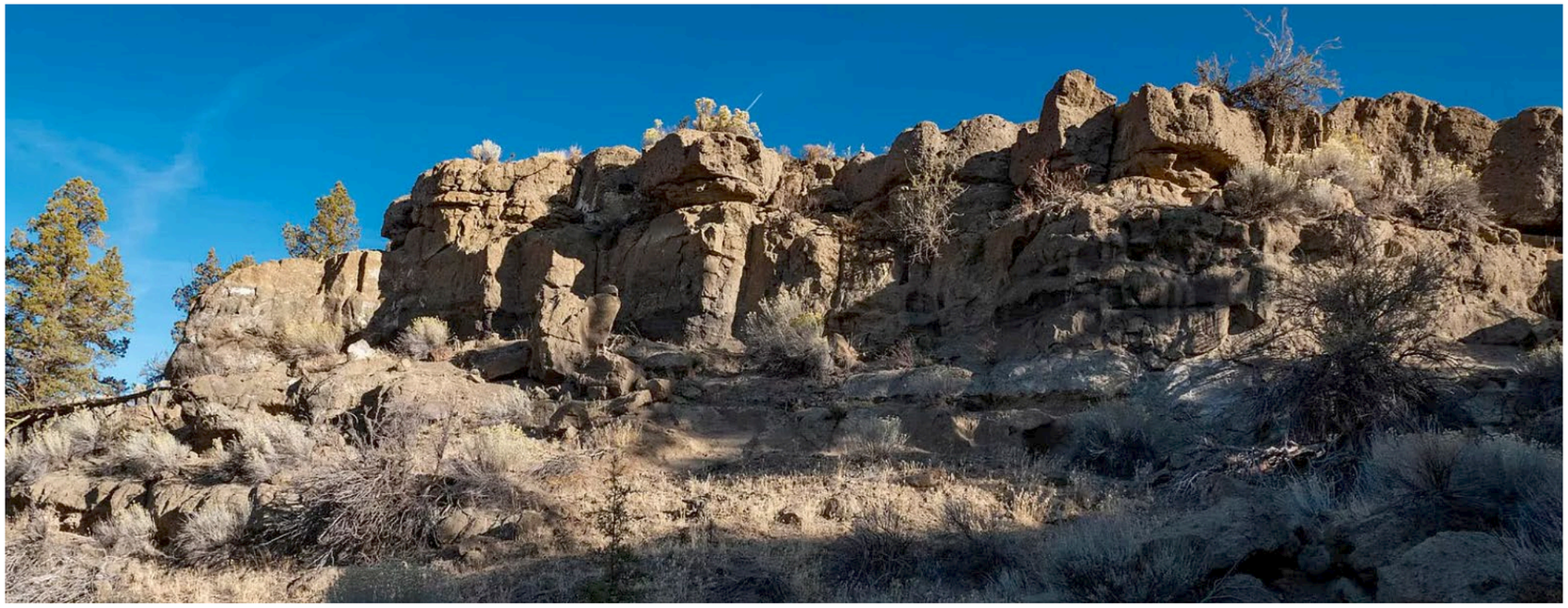
# 16th SCALE STAIR EARRINGS

Durring model production, a set of stairs was accidentally glued upsidedown. This inspired the production of 16th scale staircase earings, to gather funds for site model production. The stairs within Ponderosa’s design facillitate the integration of adventure, further relating the house and the external landscape.

# TAKE-AWAY CARDS




The Take-Away Cards for the BFA show are comprised of paper collected over the course of the semester and recycled into new handmade paper that was screenprinted on. Laminated between the two sheets of paper, is a layer of flower seeds. When planted, place in full sun.



# NARRATIVE

# ODE TO THE PONDEROSA PINE

I am true and strong,

humble yet grandiose.

I provide refuge,

While I aid health, and foster wellbeing.

Impervious to fiery harms.

I open up,

Dropping armored eggs,

For the next round will grow.

To sow

dry grounds

I forever know.

It takes time.

Although,

It is but a page

from a flip book,

as tall as me.

# INTRODUCTION

Ponderosa is a home away from home in Central Oregon catering to adventurers who were drawn to the area by its impressive natural landscapes. This house is site designed and integrated, meaning that it uses its surrounding landscape to produce a livable environment all year round, without the use of energy-absorbing building systems. Ponderosa is able to collect, circulate, and process its own water, collect solar energy, passively heat and cool itself, and uses repurposed and recycled materials, allowing it to function as a living part of the landscape. The experiences provided from the alternative green building systems along with the fluctuation of tourists, promote a new wave of sustainable housing.

Ponderosa is named for its relationship to the Ponderosa Pine, a native evergreen tree to Central Oregon. Between house and tree there is poetic symbolism. Both entities provide shelter, process sunlight, and have adapted into their landscape. Pine cones dropped from the Ponderosa Pine represent the germination of sustainable knowledge into one's psyche, hoping to grow the Ponderosa forest.

This research paper will talk about Ponderosa in the context of four elements: earth, water, sun, and air. It will look at them through site and architectural lenses, translating Central Oregon into architecture.

# PHILOSOPHY / SOCIETAL & ENVIRONMENTAL IMPACT

It is true that we are products of our environment. Not only does this apply to the accumulation of past relationships, conversations and experiences, but as a product of the environment that has collectively been built around us. Massive amounts of collective experiences create the world which we live within, without which we would have no way to describe universal everyday experiences. Simple objects with simple actions, such as a cup to drink from, is a culmination of thousands of years of the same ingrained knowledge passed down through early life cognition.

As humans we have the ability to receive our world through multi-modal perception; packets of sensory information such as sight, touch, taste, smell, sound, and deeper ingrained more complicated senses (Lachs).  The information perceived allows us to tap into our embodied cognition. This is the connector that processes the perceived information with past experiences, such as a cup, to hold liquids (McNerney). There is a third process that is also happening simultaneously, theorized by JJ Gibson in his Affordance theory, which states that our environment gives opportunity for human interaction through one's embodied cognition (Matei). Going back to the cup analogy, this gives an object with a purpose an action; raise, sip, and swallow.

Working from these basic principles of physiology, Ponderosa uses these theories as a call to action to understanding healthier living practices. It does so through its relationship with nature, categorized into four environmental elements: earth, water, sun, and air. These elements are noted in biophilic components that become the space, noted further in Translation of Form, page 10 .

It is no secret that many practices picked up after the industrial revolution and the second world war, such as the use of plastics, consumerism, and capitalism, are unhealthy to our permanent environment. Architecture is not excluded from this. The mass production of inexpensive, un-environmentally thoughtful buildings has caused them to account for 76% of energy consumption, 40% of US primary energy consumption, and their associated greenhouse gas emissions (US Department of Energy 145). Not only is architecture harsh on energy consumption, but it has a dramatic effect on our landfills as well. Demolition and construction waste account for 40% of waste in the nation's landfills (Hower).

Ponderosa is a flagship home representing a new wave of housing, aiding the evolution of modern architectural practices on a grassroots level. The house accomplishes this by working with its surrounding environment, not against it. It is taking this stance through three main imperatives, the first one being to stay true to the environment. This encompases working with the surrounding landscape, reflecting the varying exterior environment, locally sourcing materials and staying true to their materiality. The second imperative focuses on experimenting with green building systems. This is in accordance with the subcategories of working with the surrounding environment, producing solar energy, cycling water, producing food, and giving a purpose to re-purposed building materials. Finally the third imperative is to provide accessible environmentally friendly learning through practice. This is where another factor of Ponderosa's purpose comes into play, the tourism industry.  Ponderosa will cater to the adventurers trekking to Central Oregon by giving them an equally environment-driven experience in an airbnb. It will bring in rotating audiences to maximize the population's experience with living alongside  green building systems. The house will inform visitors and teach them how to utilize the building to the best of its ability, show them how to live more sustainably, and spread awareness of our impact on our environments, via an immersive app. The app will control the cutting-edge smart home system as well as provide up-to-date statistics on how the house is performing at any one time.

Impeccable natural surrounding landscapes have caused the tourism industry in Central Oregon to boom. People are flocking from all over the country to visit some of the best sites for hiking, skiing, snowboarding, climbing, and adventuring alike. In 2017, Central Oregon had 28.8 million overnight visitors and an overall growth rate of about 2.2% a year; as a result, tourism ranks as the top economic influencer and largest employer for the area (Dean Runyan Associates i). Tourism is affecting Central Oregon in other ways as well. The influx of visitors has caused a lot of people to move to the area, resulting in a 25% population increase since 2010 and ranking Deschutes County the 54th fastest growing county in the nation (US Census Bureau).

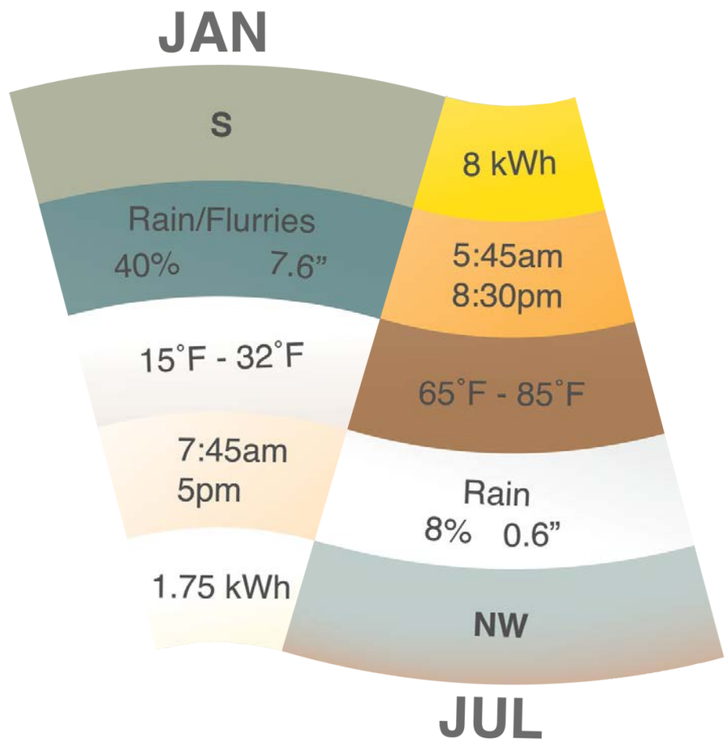
# SITE RESEARCH

The site chosen for Ponderosa is an open lot within the Crooked River Ranch community in Terrebonne, Oregon. The Deschutes River runs close to the sight, bringing Central Oregon's wonders into the backyard of Ponderosa. Other attractions in the area include, but are not limited to: Mt. Bachelor, The Three Sisters, Mt. Jefferson, Oregon Badlands, Smith Rock, Steelhead Falls, Lava Lands, and a multitude of state parks. Central Oregon's landscape is very diverse due to its placement along the Cascade break. Here a mountainous, rainy, forested area creates a rain shadow that results in a high desert landscape (Trambley).

Although the high desert is a beautiful microclimate, it comes with an important downfall. Water is a limited resource in Central Oregon, creating three major concerns for the area: a declining snowpack, declining surface water availability, and community competitiveness for those resources. Collective solutions that The Geos Institute recommended Oregon to follow include: conserving water resources, increasing ground water recharge, decreasing water demand, increasing water storage, initiating conversation dialogue, and restoring forest range and native plant communities (Barr 2-3). Ponderosa will have a positive effect on Central Oregon's water intake by collecting its own water resources and cycling them into the ground on its own accord to recharge ground water.

Ponderosa's site was chosen due to particular features of the landscape that would aid the usability of the home's green building systems. Physical features such as dramatic topography work in accordance with environmental factors like southwest sun and weather patterns to maximize the collaboration between built form and the natural landscape. Central Oregon has a little bit of everything in terms of weather, making it a great example location to show how green building systems work in a ranging climate. The summer will bring a hot, dry climate with high solar energy opportunities and primarily western winds. In the winter, Ponderosa will have wetter, slightly overcast weather that dampens solar energy intake, while having primarily southern winds (WeatherSpark). As the seasons transition, the house will change with the environment to keep a habitable interior landscape.

People have been collaborating with the natural environment for thousands of years to create a more habitable landscape. Most importantly, this landscape was collaborated upon by the Molala. The tribe worked with the environment to build plank houses; these houses were built from cedar planks due to their predictable sizes and waterproofness (Ethnohistory Research, LLC and Lewis). Like Ponderosa, these houses used the earth for passive heating and cooling, providing warmth in winter and a cool hideaway in the summer. However, their architecture did this by submerging plank houses further into the ground vertically (Ethnohistory Research, LLC and Lewis).



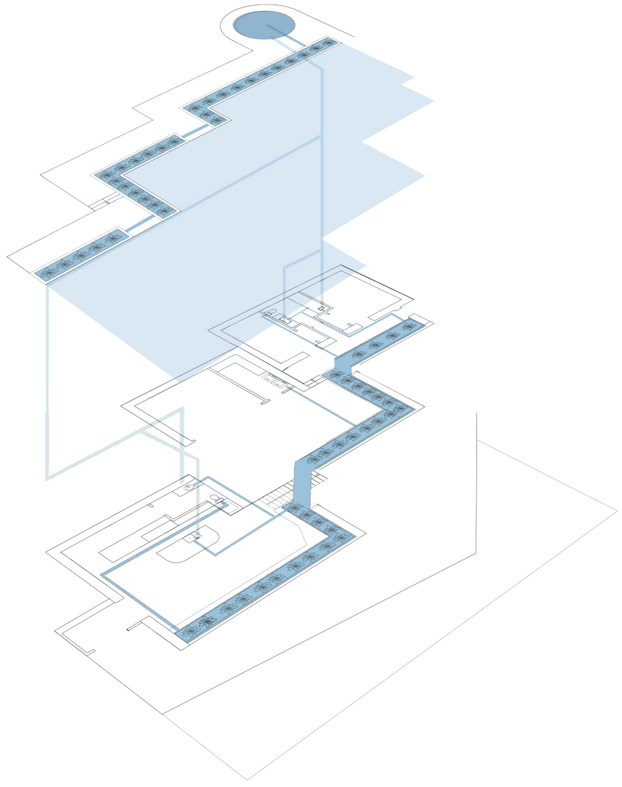
# TRANSLATION OF FORM

Ponderosa is more than a house, it is a living part of the landscape. The house has been designed to work with the natural factors of the environment, causing it to be site designed and net-zero. It is fully integrated with each of the four elements: earth, water, sun, and air. Each one will be elaborated on below.

Earth is what most strongly bonds Ponderosa to Central Oregon. Dramatic topography on site bridge two different residential planes, and slopes down to the southwest corners of the property. Etched into the hillside is Ponderosa. The home utilizes the hill as a thermal earthmassing berm, allowing for the hillside to aid in keeping a balanced temperature inside throughout changing seasons. According to Speltz, J, and Haves in Thermal Benefits and Cost Effectiveness of Earth Berming, earthmassing works by naturally equalizing the temperature between earth and interior space. It absorbs the solar heat from the day to raise the earth's temperature to match the surrounding interior, and lets the heat go to warm up the space when it drops below the temperature of the earth (Speltz). To enhance this effect, stretching out from the hillside are rammed earth walls created from the soil removed to build the foundation of the building. The tactile nature of the rammed earth walls brings a physical memory to the purpose it is serving, activating one's embodied cognition and setting into a firmer memory. To mimic the trails and height change on site, Ponderosa breaks up the living plane onto three levels,

creating an interior topography that follows the exterior. This causes the space to activate the body, enhancing mood and productivity through physical movement. Following the progression of space is the progression of privacy, stepping up into a more private space each transition.

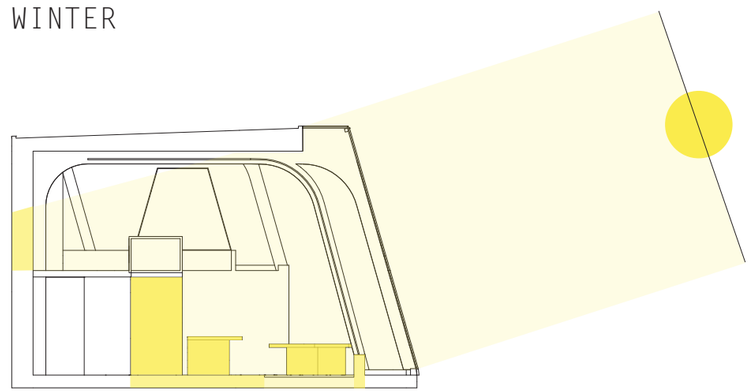
Water is equally essential to the space, both in design and in function. The house's size has been dictated by the amount of water needed to provide enough for three inhabitants over the course of the year. According to the Department of Consumer & Business Services, in the state of Oregon, it is only legal to collect rainwater from your roof. Ponderosa has a base footprint of 2,700 square feet, and water collected from the roof will fill up a cistern on its highest topography level. This allows gravity to bring water through the space. Ponderosa follows the framework Michael Reynolds uses in his Earthships, practiced through Earthship Biotecture. The home uses the collected water and employs it five times. First, the water is collected from the roof and funneled into exterior planter beds, where it waters its first round of plants before collecting in the cistern. The water is then used a second time for the sinks, shower and washing machine, turning the water into gray water. The water is then processed back into usable water by feeding it through a three-celled planter on each floor that winds along the southern face of the house. This, in turn, waters the plants in the interior planter, acting as the third use. As the water flows down through the house, it reaches its fourth use, water in the house's toilets, turning the water into black water. Due to the inability to process the water on site again, Ponderosa releases the water into the surrounding environment, promoting native plant growth as its fifth and final use.



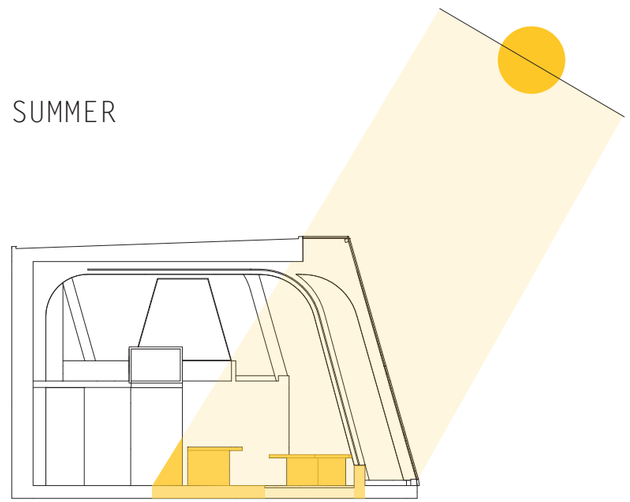
Ponderosa's ability to use its collected water five times conserves water, reduces water availability competition, and increases groundwater recharge. To iterate the water's usage into the human psyche, a waterfall acts as a visual signifier to how the water is flowing through the planters in the house.

Along with water, the sun is the lifeforce of Ponderosa. Sunlight reaches into the space through large operable southern windows, casting heating rays across the thermal massing of the house. An interior framing, flying buttress system is highlighted by the golden rays on the pine wood. The framing guides light through the planters along the window, providing ample light for the interior vegetation to grow and produce supplemental food for Ponderosa's inhabitants. If the light grows too strong in the house, shades patterned with cutouts, and operated by the home's app, are built into the framing that dapple the interior with smaller rays of light. The interior of Ponderosa has a trail though the space made from pine, a material with a lower thermal mass, creating a cooler surface to walk on where the sun hits on hot days. Due to the fact that sunlight is so influential to this house's proper function, living in the house teaches one how to use the sun to the best of its ability. Ponderosa's smart home app will let you know the best times of day to manipulate the sunlight, therefore setting a sun routine. Not only does sunlight power the internal passive heating system, but its solar energy is captured as well. Just over a third of Ponderosa's roof is Tesla's solar roof, providing an efficient energy source for the home.

WINTER



SUMMER



Onsite, there are primarily southern winds in the winter, and western winds in the summer. To use the environment to the best of Ponderosa's ability, cooling tubes will be set underground. These tubes will draw in air, cool it as it passes under the earth, and release the air into the house when all the windows are closed. As the fresh, cold air rises and warms up, it will be released through vents in the top of the space, which will also be operable from the app. Heading to the exterior of the house, the large panels of windows looking to the south will be operable. This will take on a fin-like form that will funnel wafts of western winds through the house, filling Ponderosa with fresh air and providing exterior access to interior garden beds. However, due to the house's location, there is a seasonal fire hazard. During that time of year the interior plants will partially help alleviate poor interior air quality. While the exterior rammed earth walls protect the house to a degree from flames due to the fire retardant earth.

Ponderosa is a synergetic part of the surrounding environment, therefore it takes consideration when living within it. Many moving parts come together to create the ecosystem that is Ponderosa. To help maintain the house there will be an associated app, in which you can operate blinds, open cooling vents, and track every system-related house statistic at any given time. The app will streamline all the information in regard to the green building systems, as well as act as a smart home feature with interfaces within the house. As a smart house, Ponderosa's app will also allow users to turn off and on lights, operate appliances, regulate temperature and have an integrated personal AI assistant to help users live more sustainably.

Ponderosa will be the flagship house for a new wave of future-facing homes, pioneering green building systems as humanity looks toward a healthier future. Every visitor will learn from their experience and be more likely to alter their current life to act more sustainably. Ponderosa makes design decisions that are built to last, paying off financially and environmentally in the long run. Hopefully soon humanity will adapt to living in a net-zero Ponderosa forest.

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# CASE STUDIES + ANNOTATED BIBLIOGRAPHY

# HASSAN FATHY

A CASE STUDY OF GOURNA

**PROJECT:** Gourna, New Gourna
**LOCATION:** Luxor, West Bank, Egypt
**DATE:**1948-1952
**MATERIAL:** Mud brick
**GOAL:** Highly sustainable, housing for low income families

Architect Hassan Fathy was only really known to the Egyptian elite for a good portion of his career, but in recent years he has been recognized for his efforts in architecture creating Gourna. Gourna was created as a functional solution to house the poorest level of people in Egypt. It was created out of the ethos of functional architecture that should be available to even the poorest people. He has stated in his book Architecture For the Poor, “Well, we cannot house them cheaply even when we do standardize, and we cannot house them with any semblance of human dignity unless we destandardize, which is said to be expensive. It is a pity that government authorities think of people as “millions.” If you regard people as “millions” to be shoveled into various boxes like loads of gravel, if you regard them as inanimate, unprotesting, uniform objects, always passive, always needing things done to them, you will miss the biggest opportunity to save money ever presented to you, (Fathy, 23)” Gourna set out to create just that. The village was set up with brick building facilities that allowed the community to be built and grow for almost no cost to the community. It created architecture that was sustainable, low energy, and referenced historical Egyptian vernacular like no other modern buildings.

# PAOLO SOLERI

A CASE STUDY OF ARCOSANTI

**PROJECT:** Arcosanti, Arcology
**LOCATION:** Mayer, Arizona
**DATE:** 1970
**MATERIAL:** Concrete
**GOAL:** Highly sustainable living, Utopian sustainable  ethos

Paolo Soleri started creating Arcosanti after releasing that we are not confronting our systemic infrastructure that is a direct result of door sustainable practices. This has created a materialistic consumer society, lack of individualism, and in turn a lot of produced waste. Soleri aimed to form Acrosonti on his ethos of arcology, “the fusion of architecture with ecology, a comprehensive urban perspective. In nature as organisms evolve, they increase in complexity and become a more compact system. A city should similarly evolve, functioning as a living system, (Arcosanti website).” Acrosanti reframes how we exist in our environment based on six principles. Urban scale acting as a human scale, aims to reduce car usage and make a more walkable city. Food and energy nexus brings growing centers into the center of the city aiding in the connection of knowing how your food is produced. Marginalized consumption reduces material and energy usage. This partners with elegant frugality, be resourceful and true to the material. Lastly, urban effect creates multi-use public space, while bounded density aims to grow upwards and inwards, minimising the sprawl of humanity.

# MICHAEL REYNOLDS

A CASE STUDY OF EARTHSHIP BIOTECTURE

**PROJECT:** Earthship Biotecture
**LOCATION:** Taos, New Mexico
**DATE:** 1970s- Present
**MATERIAL:** All repurposed/ recycled with main structure coming from rammed earth tires
**GOAL:** Highly sustainable off-grid community, living building

In 1970 Michael Reynolds started to create a building he called an earthship, a vessel on which to sail the land. These buildings are designed around six design principles; catching rainwater, the use of solar power, food production, wastewater treatment, passive heating and cooling, as well as using recycled construction materials. The primary structure of these buildings are rammed earth tires built up against an earth berm that allows passive heating and cooling. In warmer climates they can add in an air conditioning system that uses a pipe going through the earth berm to pull in air, cool it from the insulation of the earth, and bring it into space. The warming of this air causes it to rise and is then let out through a top hatch in the roof of the building. The rainwater catchment systems are used to gather water then it is used three times to maximise its use. It first is used to wash and drink from sinks where it turns into grey water, then filtered through the plants in the atrium or surrounding areas and filters back to the house tobe used to flush toilets, creating black water which can't be recycled on site. The houses as a whole function completely off the grid, and can be adapted for almost any climate. Currently the majority of the houses are in the south west, but there are a growing number farther north and seem to be growing in popularity in Canada.

# ÇATALHÖYÜK

A CASE STUDY OF COMMUNITY

**SITE:** Çatalhöyük
**LOCATION:** Anatolian Plain, Turkey
**DATE:** 7000 BC
**MATERIAL:** Plaster, Earth
**APPLICATION:** Use of environment, passive heating and cooling, interesting community framework

The Çatalhöyük people created a very interesting way of interacting with the landscape 9000 years ago. Their community didn't have streets or pathways, but was a hive-like cluster of living spaces built with earth walls and ceilings. Due to their interconnected walls and lack of pathways between living spaces, the community used the rooftops as an extension of public space. It has been theorized that this space was communal activities such as cooking and children's play space. Creating a community of housing that is integrated within itself provides a collective passive heating and cooling. This huddles warmth between the dwellings, and uses the earth to provide a more controlled temperature from its passive heating and cooling. Going down the ladder and into the space the walls were treated and often redone with plaster to keep them looking fresh and as a rotating canvas for murals. These artworks possibly depict the transition of hunter gatherer lifestyle to domestic life. The artwork tells stories of hunts and non domesticated animals, spirituality, free-flowing geometries, and the integration of bull horns and animal skulls within the architecture of the buildings. Under the houses people would bury their loved ones, and oftentimes there was a coordination of free-flowing geometric artwork and buried children.

# PUEBLO

A CASE STUDY OF ENVIRONMENTAL CONSIDERATION

**SITE:** Pueblo
**LOCATION:** New Mexico
**DATE:** 1150 AD
**MATERIAL:** Earth
**APPLICATION:** Use of environment, passive heating and cooling, interesting community framework

Pueblo housing is a combination of apartment style dwelling interwoven with Kivas, an often keyhole shaped ritual religion gathering space. The combination of rectilinear housing and the curved Kivas, created beautiful lasting geometries on the landscape. The Pueblos were built with adobe walls that adjoined other dwellings vertically and horizontally. Pueblos located above another used the roof space of the lower dwelling as a yard space, and the pueblo whose roof it was had an entry on top, rather than on the side. This was used as a defence mechanism from attack. This was aided by the placement which was often on mesas or a rocky plateau. In the case of Mesa Verde, they used the shelter provided to not only shelter from others, but to shade direct sunlight and protect their Pueblos from the southwest sun. Descendants from different Pueblo tribes still use the architecture style to work with the environment. The architecture has also been gentrified and used to create an iconic southwest adobe style that is often used.

# MA'DAN

A CASE STUDY OF MUDHIF HOUSES

**SITE:** Marsh area
**LOCATION:** Southern Iraq
**DATE:** ~3000 BC
**MATERIAL:** Reeds
**APPLICATION:** Use of environment, passive cooling

Ma'dan Mudhif or Tuhul houses date back over 5,000 years ago. These houses are floating islands created in the marshes of Iraq made from reeds bent into parabolic arches. They feature a succession of arches bound together by woven mats and lattice, allowing for air and light flow into the space. The bounded reed columns that make up the structural elements of the house are about ten meters long. To provide regidness to the columns, the core consists of repurposed reeds from older Mudhif houses. These provide stability while the newer reeds are aged into their permanent form. With proper care the houses can be built in the minimum of three days and last twenty-five years, while regenerating into the next after that. Each house has an odd number of reed columns to accommodate the hospitality practices of having the host of the space sit at the front with an equal number of guests on either side of them.

# MOLALA

## A CASE STUDY OF PLANK HOUSES

**SITE:** Central Oregon
**LOCATION:** Pacific Northwest
**DATE:** 985 BC
**MATERIAL:** Cedar
**APPLICATION:** Use of proposed environment, Passive heating and cooling

Pueblo housing is a combination of apartment style dwelling interwoven with Kivas, an often keyhole shaped ritual religion gathering space. The combination of rectilinear housing and the curved Kivas, created beautiful lasting geometries on the landscape. The Pueblos were built with adobe walls that adjoined other dwellings vertically and horizontally. Pueblos located above another used the roof space of the lower dwelling as a yard space, and the pueblo whose roof it was had an entry on top, rather than on the side. This was used as a defence mechanism from attack. This was aided by the placement which was often on mesas or a rocky plateau. In the case of Mesa Verde, they used the shelter provided to not only shelter from others, but to shade direct sunlight and protect their Pueblos from the southwest sun. Descendants from different Pueblo tribes still use the architecture style to work with the environment. The architecture has also been gentrified and used to create an iconic southwest adobe style that is often used.

# ANNOTATED BIBLIOGRAPHY

PARAGRAPHS FROM SOME CASE STUDIES ARE REPEATED, AS ARE REFERENCES FROM THE NARRATIVE

## EARTHSHIP BIOTECTURE

“Earthship Biotecture Off-Grid Design Principles.” Earthship Biotecture, 14 Sept. 2020, earthshipbiotecture.com/design-principles/.

In 1970 Michael Reynolds started to create a building he called an earthship, a vessel on which to sail the land. These buildings are designed around six design principles; catching rainwater, the use of solar power, food production, wastewater treatment, passive heating and cooling, as well as using recycled construction materials. The primary structure of these buildings are rammed earth tires built up against an earth berm that allows passive heating and cooling. In warmer climates they can add in an air conditioning system that uses a pipe going through the earth berm to pull in air, cool it from the insulation of the earth, and bring it into space. The warming of this air causes it to rise and is then let out through a top hatch in the roof of the building. The rainwater catchment systems are used to gather water then it is used three times to maximise its use. It first is used to wash and drink from sinks where it turns into grey water, then filtered through the plants in the atrium or surrounding areas and filters back to the house tobe used to flush toilets, creating black water which can’t be recycled on site. The houses as a whole function completely off the grid, and can be adapted for almost any climate. Currently the majority of the houses are in the south west, but there are a growing number farther north and seem to be growing in popularity in Canada.

## HOUSES OF THE OREGON TRIBES

Ethnohistory Research, LLC | David G. Lewis. “Houses of the Oregon Tribes.” QUARTUX JOURNAL, 21 Aug. 2017, ndnhistoryresearch.com/2016/12/31/houses-of-the-oregon-tribes/.

The site chosen is Bend, Oregon, which is in the territory of the Molalla tribe along with an overlap of a couple others. Their building techniques used mat and plank construction depending on season and temporality. Most commonly there was the use of plank houses, which were partially submerged underground occasionally up to ten feet. They primarily used Western Red Cedar planks because of its abilities to split easily into predictable lengths and its resistance to rain rot and pests. Due to this it was used frequently in different ways within the space. The bark, which had most of the rain resistance, acted as roofing. Wood or bark planks were used as walls, and engineered to be tied together. The interior also used the Cedar, by reducing the material to its fibers and weaving them into mats, bedding and clothing. Oftentimes the community members would dig holes into the walls and floor underground to store goods. The earth temperature kept the goods at a more stable temperature than the exterior and added longevity. The Kalapuya tribe occasionally the buildings would be covered in dirt to passively heat and cool the space for long term living. The plank houses were often dramatic and covered in art, and were arranged around a central community space.

## ARCHITECTURE FOR THE POOR

Fathy, Hassan. Architecture for the Poor. The American University in Cairo Press, 2016.

Architect Hassan Fathy was only really known to the Egyptian elite for a good portion of his career, but in recent years he has been recognized for his efforts in architecture creating Gourna. Gourna was created as a functional solution to house the poorest level of people in Egypt. It was created out of the ethos of functional architecture that should be available to even the poorest people. He has stated in his book Architecture For the Poor, “Well, we cannot house them cheaply even when we do standardize, and we cannot house them with any semblance of human dignity unless we destandardize, which is said to be expensive. It is a pity that government authorities think of people as “millions.” If you regard people as “millions” to be shoveled into various boxes like loads of gravel, if you regard them as inanimate, unprotesting, uniform objects, always passive, always needing things done to them, you will miss the biggest opportunity to save money ever presented to you, (Fathy, 23)” Gourna set out to create just that. The village was set up with brick building facilities that allowed the community to be built and grow for almost no cost to the community. It created architecture that was sustainable, low energy, and referenced historical Egyptian vernacular like no other modern buildings.

## ÇATALHÖYÜK

German, Senta. “Çatalhöyük (Article) | Neolithic Sites.” Khan Academy, Khan Academy, 2014, www.khanacademy.org/humanities/prehistoric-art/neolithicart/neolithic-sites/a/atalhyk.

The Çatalhöyük people created a very interesting way of interacting with the landscape 9000 years ago. Their community didn’t have streets or pathways, but was a hive-like cluster of living spaces built with earth walls and ceilings. Due to their interconnected walls and lack of pathways between living spaces, the community used the rooftops as an extension of public space. It has been theorized that this space was communal activities such as cooking and children’s play space. Creating a community of housing that is integrated within itself provides a collective passive heating and cooling. This huddles warmth between the dwellings, and uses the earth to provide a more controlled temperature from its passive heating and cooling. Going down the ladder and into the space the walls were treated and often redone with plaster to keep them looking fresh and as a rotating canvas for murals. These artworks possibly depict the transition of hunter gatherer lifestyle to domestic life. The artwork tells stories of hunts and non domesticated animals, spirituality, free-flowing geometries, and the integration of bull horns and animal skulls within the architecture of the buildings. Under the houses people would bury their loved ones, and oftentimes there was a coordination of free-flowing geometric artwork and buried children.

## MULTI-MODAL PERCEPTION

Lachs, Lorin. “Multi-Modal Perception.” Noba, 2020, nobaproject.com/modules/multi-modal-perception.

Multi-modal perception is the theory that we perceive the world in packets of sensory information. Senses including but not limited to sight, touch, smell, taste and sound are recorded though the body’s hardware and then perceived through the processing in the mind’s software. There is infinite information we are able to bring in, but we choose specific packets to focus on. In any environment there are levels to objects, spaces and senses, and these inform our interaction within space. We choose to process specific information that is valuable to our current task, sorting through our available information.

## A BRIEF GUIDE TO EMBODIED COGNITION: WHY YOU ARE NOT YOUR BRAIN

McNerney, Samuel. A Brief Guide to Embodied Cognition: Why You Are Not Your Brain. 4 Nov. 2011, blogs.scientificamerican.com/guest-blog/a-brief-guide-to-embodied-cognition-why-you-are-not-your-brain/.

This resource talks about embodied cognition, where the mind is connected to one’s body and the body influences the mind. It goes into Descartes theory of dualism where “there is a great difference between mind and body, in as much as body is by nature always divisible, and the mind is indivisible… the mind and soul of a man is entirely different from the body.” When reflecting on this, I saw the mind as software for the hardware of the body. They exist on two planes of existence, the body a vessel separate from the exponential possibility of thought. When applying this to space, the built environment influences the mind’s software through the hardware of the body. “This is not just the innocuous and obvious claim that we need a body to reason; rather, it is the striking claim that the very structure of reason itself comes from the details of our embodiment… Thus, to understand reason we must understand the details of our visual system, our motor system, and the general mechanism of neutral binding.” Going further into the infiltration of this theory into everyday life, we relate to one another by personifying our emotions and thoughts. We use the hardware that our environments provide, intaking information with our hardware, and expressing the outcome in the language brought upon us by our perceptions of the environment.

## PUEBLO

“Pueblo Indians.” Pueblo Indians - New World Encyclopedia, 2019, www.new-worldencyclopedia.org/entry/Pueblo_Indians.

Pueblo housing is a combination of apartment style dwelling interwoven with Kivas, an often keyhole shaped ritual religion gathering space. The combination of rectilinear housing and the curved Kivas, created beautiful lasting geometries on the landscape. The Pueblos were built with adobe walls that adjoined other dwellings vertically and horizontally. Pueblos located above another used the roof space of the lower dwelling as a yard space, and the pueblo whose roof it was had an entry on top, rather than on the side. This was used as a defence mechanism from attack. This was aided by the placement which was often on mesas or a rocky plateau. In the case of Mesa Verde, they used the shelter provided to not only shelter from others, but to shade direct sunlight and protect their Pueblos from the southwest sun. Descendants from different Pueblo tribes still use the architecture style to work with the environment. The architecture has also been gentrified and used to create an iconic southwest adobe style that is often used.

## BIOPHILIA HYPOTHESIS

Rogers, Kara. “Biophilia Hypothesis.” Encyclopædia Britannica, Encyclopædia Britannica, Inc., 25 June 2019, www.britannica.com/science/biophilia-hypothesis.

Biophelia talks about how humans affiliate with nature on a genetic basis. Since the start of the Industrial Revolution capitalism has driven the divergence from our innate connection to nature. The narcissistic tendencies that have come with the greed of capitalism, have driven the separation of humans from nature. This helps facilitate the mass production of products, but has caused irreversible damage to the environment. There is also the sub-theory that the more we depend on technology the farther away we are from nature, and the stronger our pull back to the environment is. Biophilic elements and theories aim to reunite people with their internal desire for nature by influencing design with nature inspired elements. The influence of biophilia in design in part aims to re-establish our connection with the natural environment therefore aiding conservation as our internal desires grow. Studies have shown that time spent in natural environments aids mental, spiritual and physical health. This is particularly important to establish as our connection to our virtual world brought on by our technological advances changes the states of our life both physically and mentally.

## MUDHIF HOUSES CAPTURE SPIRIT OF IRAQI CULTURE

Russell, Eric, and Brandt Smith. “Mudhif Houses Capture Spirit of Iraqi Culture.” Www.army.mil, 13 Apr. 2010, www.army.mil/article/37269/mudhif_houses_capture_spirit_of_iraqi_culture.

Ma’dan Mudhif or Tuhul houses date back over 5,000 years ago. These houses are floating islands created in the marshes of Iraq made from reeds bent into parabolic arches. They feature a succession of arches bound together by woven mats and lattice, allowing for air and light flow into the space. The bounded reed columns that make up the structural elements of the house are about ten meters long. To provide rigidness to the columns, the core consists of re-purposed reeds from older Mudhif houses. These provide stability while the newer reeds are aged into their permanent form. With proper care the houses can be built in the minimum of three days and last twenty-five years, while regenerating into the next after that. Each house has an odd number of reed columns to accommodate the hospitality practices of having the host of the space sit at the front with an equal number of guests on either side of them.

## UX DAILY: BROWSE ALL TOPICS

“UX Daily: Browse All Topics.” The Interaction Design Foundation, www.interaction-design.org/literature/topics/affordances’.

The Affordance theory by JJ Gibson states an affordance as a perpetually reliable feature of your environment. This environmental feature gives an opportunity for interaction through purpose. Our hardware perceives not only shapes, but spatial relationships and prior experience drives action. This can easily be seen in the world with the actions of push, pull and turn. Their shapes within the context of their environment drive action through the communication between sight and the knowledge grown from using our hardware to communicate with the environment. This theory helps u nderstand the body language of built space, translating it into an environment we can understand. The dialogue in spaces is not hindered by location, community or spoken language, but can be influenced by prior experiences.

## WHAT IS ARCOLOGY?: IDEOLOGY OF PAOLO SOLERI

What Is Arcology?: Ideology of Paolo Soleri. www.arcosanti.org/arcology/.

Paolo Soleri started creating Arcosanti after releasing that we are not confronting our systemic infrastructure that is a direct result of door sustainable practices. This has created a materialistic consumer society, lack of individualism, and in turn a lot of produced waste. Soleri aimed to form Acrosonti on his ethos of arcology, “the fusion of architecture with ecology, a comprehensive urban perspective. In nature as organisms evolve, they increase in complexity and become a more compact system. A city should similarly evolve, functioning as a living system, (Arcosanti website).” Acrosanti reframes how we exist in our environment based on six principles. Urban scale acting as a human scale, aims to reduce car usage and make a more walkable city. Food and energy nexus brings growing centers into the center of the city aiding in the connection of knowing how your food is produced. Marginalized consumption reduces material and energy usage. This partners with elegant frugality, be resourceful and true to the material. Lastly, urban effect creates multi-use public space, while bounded density aims to grow upwards and inwards, minimising the sprawl of humanity.

**A SPECIAL THANKS TO ALL OF MY TALENTED CLASSMATES AND SUPPORTIVE PROFESSORS**

PLEASE GO AND PLANT SOME PINECONES IN YOUR PROSPEROUS FUTURES