

## ABSTRACT

Title of Thesis: GREENING THE GETAWAY: DESIGNING A  
LUXURY RESORT FOR THE ECO-CONSCIOUS  
TRAVELER

Cameron Jamal Smith  
Master of Architecture  
2023

Thesis Directed By: Professor Michael Binder  
School of Architecture, Planning & Preservation

In many ways, traveling can be viewed as an unnecessary luxury that only causes our environment more harm. Not only because of the transportation to our destinations, but also due to the tremendous amounts of energy it takes to maintain our place of lodging. Many luxury resorts and hotels are designed with over-the-top pools, landscapes, and decor, giving little consideration for how such features affect our planet. This thesis demonstrates how to eliminate the negative impact of such establishments by designing a luxury resort that is also regenerative. In the process, we will explore construction techniques, materiality, interior design, and landscaping methods to ensure that the final resort is as environmentally friendly as possible.

Furthermore, while most resorts are located in highly developed regions where access to electricity and water supply are readily accessible, this resort will be constructed in the Chihuahuan Desert near Big Bend National Park in Texas. This desolate location emphasizes that regenerative design is possible even in areas where resources are extremely scarce. The desert is often seen as dull and lifeless but, in reality, its natural beauty and solitude offer a

unique experience that would be an ideal destination for a resort. However, it is important that this resort does not impede on this natural beauty but rather enhances it. To accomplish this, consideration will be given to historic Native American construction methods in the region. They often constructed homes using what the land provided them with. By using this tactic as inspiration, it will allow this resort to become part of the landscape rather than forging a new one on the site.

In the end, with this thesis, we will explore the means to design a desert resort where humans, wildlife, and plant life can flourish with a positive impact on the environment.

GREENING THE GETAWAY:  
DESIGNING A LUXURY RESORT FOR  
THE ECO-CONSCIOUS TRAVELER

by

Cameron Jamal Smith

Thesis submitted to the Faculty of the Graduate School of the  
University of Maryland, College Park, in partial fulfillment  
of the requirements for the degree of  
Master of Architecture  
2023

Advisory Committee:  
Professor Michael Binder Chair  
Professor Lindsey May  
Professor Ronit Eisenbach  
Professor Yana Vandergoot



# Table of Contents

|                                                        |                                     |
|--------------------------------------------------------|-------------------------------------|
| Preface .....                                          | <b>Error! Bookmark not defined.</b> |
| Table of Contents .....                                | ii                                  |
| List of Figures .....                                  | iv                                  |
| CHAPTER 1: THE RISE OF ECOTOURISM .....                | 1                                   |
| What is Ecotourism and Sustainable Systems .....       | 1                                   |
| Luxury Tourism and Its Effect on the Environment ..... | 5                                   |
| Refining Luxury Tourism .....                          | 7                                   |
| CHAPTER 2: BIG BEND AND DESERT ECOSYSTEMS .....        | 11                                  |
| The Draw of Big Bend National Park .....               | 12                                  |
| Project Site .....                                     | 14                                  |
| Challeneges of the Site .....                          | 15                                  |
| CHAPTER 3: PRINCIPLES OF DESERT ARCHITECTURE .....     | 19                                  |
| Native American Architecture .....                     | 19                                  |
| Modern Desert Architecture .....                       | 23                                  |
| CHAPTER 4: REGENERATIVE ARCHITECTURE .....             | 30                                  |
| Water Management .....                                 | 31                                  |
| Power and Electricity .....                            | 35                                  |
| Heating and Cooling .....                              | 37                                  |
| Waste Management .....                                 | 41                                  |
| CHAPTER 5: CONSTRUCTION AND MATERIALITY .....          | 45                                  |
| Exterior Materiality .....                             | 45                                  |
| Interior Materiality .....                             | 49                                  |
| CHAPTER 6: SUSTAINABLE LUXURY .....                    | 52                                  |
| Resort Identity .....                                  | 52                                  |
| Amenities and On-Site Experiences .....                | 57                                  |
| CHAPTER 7: MAINTENANCE AND RESORT UPKEEP .....         | 61                                  |
| Transportation .....                                   | 61                                  |
| Operation and Workface .....                           | 64                                  |
| Chapter 8: DESIGN SOLUTION .....                       | 66                                  |

|                                       |        |
|---------------------------------------|--------|
| Selecting and Handling the Site ..... | 66     |
| Form .....                            | 69     |
| Function .....                        | 71     |
| Conclusion .....                      | 74     |
| <br>Bibliography .....                | <br>80 |

## List of Figures

FIGURE 1 – Difference Between Ecotourism and Other Forms of Tourism (Source: undp.org)

FIGURE 2 – Obstacles of Sustainable Tourism (Source: luggagehero.org)

FIGURE 3 – Global Luxury Tourism Market (Source: prnewswire.com)

FIGURE 4 – Rio Grande in Big Bend National Park (Source: expedia.com)

FIGURE 5.1 – View of Y.E. Mesa Ranch (Source: kindlandwater.com)

FIGURE 5.2 – View of Y.E. Mesa Ranch (Source: kindlandwater.com)

FIGURE 6.1 – Geographic Location of Big Bend National Park (Source: keranews.org)

FIGURE 6.2 - Geographic Location of Big Bend National Park (Sources: nps.gov)

FIGURE 7 – Taos Pueblo in New Mexico (Source: pinterest.com)

FIGURE 8 – Adobe Bricks being made (Source: unansea.com)

FIGURE 9 – Kinetic Façade on the Al Bahar Towers (Source: architecture.org)

FIGURE 10 – A White Street in Los Angeles (Source: optimistdaily.com)

FIGURE 11 – A Natural Oasis in Al Ain, UAE (Source: facebook.com)

FIGURE 12 – How Hydropanels Function (Source: thewaternetwork.com)

FIGURE 13 – Natural Ventilation Strategies (Source: archdaily.com)

FIGURE 14 – How Geothermal Heat Pumps Work (Source: skepticscience.com)

FIGURE 15 – Radiant flooring vs. air conditioning (Source: ecohome.net)

FIGURE 16 – How a Clivus Multrum Composting Toilet Works (Source: researchgate.net)

FIGURE 17 – Thorncrown Chapel (Source: [fineartamerica.com](http://fineartamerica.com))

FIGURE 18 – Rammed Earth Construction, Nk'Mip Desert Cultural Centre  
(Source: [materialdistrict.com](http://materialdistrict.com))

FIGURE 19 – A destination resort, Patina Maldives (Source: [designboom.com](http://designboom.com))

FIGURE 20 – The Amangiri (Source: [cntraveler.com](http://cntraveler.com))

FIGURE 21 – Bliss and Stars Wilderness Retreat (Source: [blissandstars.com](http://blissandstars.com))

FIGURE 22 –Resort Site Plan (Source: Author)

FIGURE 23 –Resort Site Zones (Source: Author)

FIGURE 24– Passive Systems (Source: Author)

FIGURE 25 – Exterior Materiality (Source: Author)

FIGURE 26 – Interior Materiality (Source: Author)

FIGURE 27 – Water Collection/Usage Diagram (Source: Author)

FIGURE 28 – Energy Collection (Source: Author)

FIGURE 29 – Farm Diagram (Source: Author)

FIGURE 30 – Final Presentation Boards (Source: Author)

# CHAPTER 1: THE RISE OF ECOTOURISM

Traveling seems to be an activity enjoyed universally. Whether for the food, the culture, or the new sights, the desire to travel is ubiquitous. Unfortunately, however, this desire is not without consequence. Every trip taken is to the detriment of our planet's environment. With all factors considered, it could be argued that traveling is largely unnecessary; that we are wasting our resources for nothing more than a few days of leisure. This argument could apply especially to the luxury travel industry, where in many cases the gaudier and more excessive, the better. Even with this in mind, it is still natural for people to want to explore the world, see new things, and treat themselves without stress, therefore the tourism industry will continue to thrive. So, then the question becomes how can we continue to vacation lavishly, while simultaneously helping our planet? This is the question that the ecotourism and sustainable tourism industries seek to address.

## Section 1: What Are Ecotourism and Sustainable Tourism?

'Sustainable tourism' and 'ecotourism' are often used interchangeably. While they are heavily related to one another, there is a major distinction between the two. Sustainable tourism is described as travel that has "minimal impact on the environment and local communities"<sup>1</sup>, implying that it has no substantial effect on the environment, neither positive nor negative. On the other hand, according to the

---

<sup>1</sup> "Ecotourism vs. Sustainable Tourism." 2021. Integra LLC. January 8.  
<https://www.integrallc.com/ecotourism-vs-sustainable-tourism-2/#:~:text=Industry%20consensus%20agrees%20ecotourism%20is,the%20environment%20and%20local%20communities>

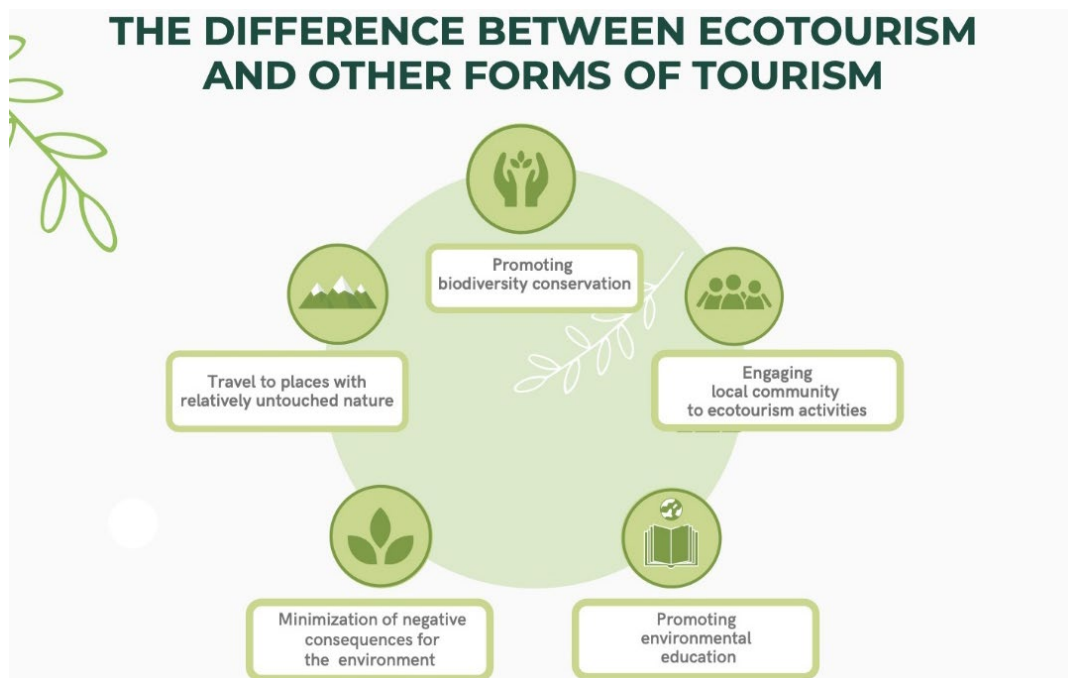
Global Ecotourism Network, ecotourism is “responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and creates knowledge and understanding through interpretation and education of all involved: visitors, staff and the visited”. Furthermore, the GEN goes on to explain that ecotourism “holds eco- & socio-centric values and ethics”, “Creates an ecological and social conscience.”, and “is non-consumptive in relation to nature” <sup>2</sup>. These key elements frame a concept that not only focuses on benefiting our environment but the communities around it as well. It is largely agreed upon that ecotourism is considered more responsible as it seeks to create positive change rather than just avoiding negative change. While the term ecotourism has been around since the 1960s, it has really gained momentum in the industry only in recent years. The sustainability movement has played a large role in this shift as newer generations are starting to become privy to the effects that their actions can have on the environment at a much

---

<sup>2</sup> “Definition and Key Concepts.” 2022. GEN - Global Ecotourism Network. Accessed November 6. <https://www.globalecotourismnetwork.org/definition-and-key-concepts/>.

younger age, and they continue to explore environmentally friendly alternatives to more harmful practices. Additionally, the topic of climate change and sustainability has been more relevant than ever in politics which has led to the introduction of formal documents such as the Mohonk Agreement.

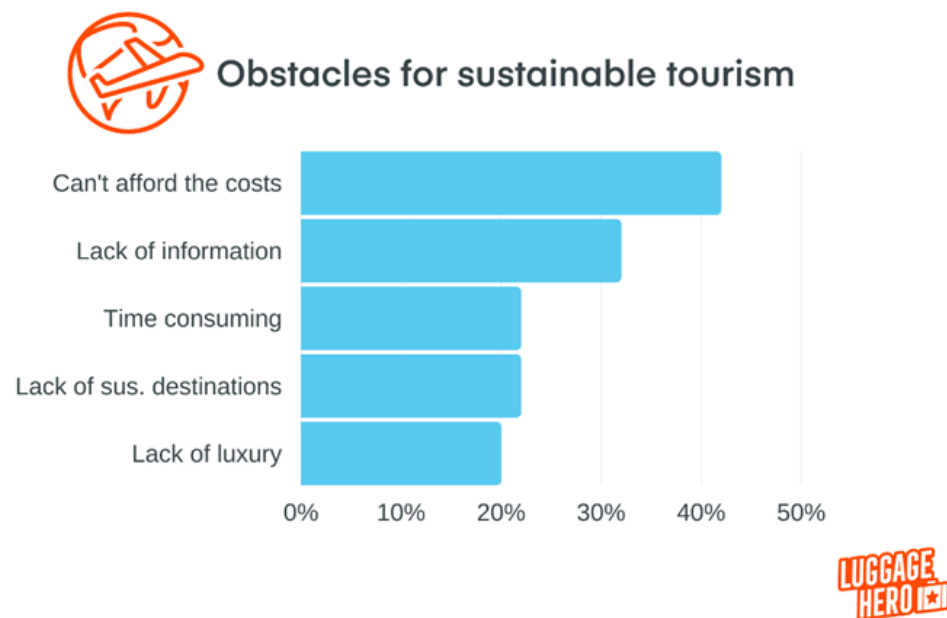
The Mohonk Agreement is an official framework used by the United Nations World Tourism Organization (UN-WTO) to determine whether a tourist establishment can be deemed ecotourism or sustainable tourism. It was drafted in the Mohonk Mountain House in New Paltz, New York in November 2000. The document offers a list of specific criteria that an establishment must adhere to, including social/cultural, ecological, and economical benefits. This clear set of standards assists in the prevention of greenwashing among businesses in the industry. Greenwashing is



**FIGURE 1: Difference Between Ecotourism and Other Forms of Tourism (Source: undp.org)**

“the dissemination of false or incomplete information by an organization to present an environmentally responsible public image”<sup>3</sup>. Rather than being able to simply deem themselves ‘sustainable’ through ambiguous statistics and figures, with the Mohonk Agreement in place, businesses have to be truly intentional and dedicated to the cause. Many of the beneficiaries from documents like the Mohonk Agreement are impoverished, less developed regions of the world. This is because it allowed them to separate their ecotourism establishments from those that used greenwashing to attract visitors. Additionally, true to the definition of ecotourism, not only are ecotourism establishments in these regions designed with sustainable practices in mind but they also provide opportunities for those in the region.

Even with the recent interest in ecotourism, one sector of the industry that has only very recently been tapped into is luxury ecotourism. One could argue that the



**FIGURE 2: Obstacles of Sustainable Tourism (Source: [luggagehero.org](http://luggagehero.org))**

<sup>3</sup> Furlow, Nancy E. n.d. “Greenwashing in the New Millennium.” Essay. In Journal of Applied Business and Economics.

concept of luxury ecotourism is almost oxymoronic. Perhaps today, this is, in large, true but why is that? Furthermore, why is it even necessary that such an abstract figment be considered?

## *Section 2: Luxury Tourism and Its Effect on The Environment*

One of the largest aspects of luxury is comfort and creating a stress-free environment. Not only does this mean not thinking of the everyday stresses of work and life, but also the stresses of others and the outside world. The ideal vacation does not involve constant reminders of those less fortunate and the declining state of our environment. Luxury travel instead involves a certain level of hedonism, indulging oneself in anything pleasurable. Because of this one of the biggest criticisms of luxury travel is its tendency to be very wasteful. When on vacation, people are more likely to forgo their normal, conscientious practices such as carrying reusable bags and bottles. It is estimated that, while on vacation, each visitor will produce 1 to 12kg of solid waste per day. If this trend remains unchanged, it is predicted that, by 2050, we will see a 251 percent increase in solid waste production caused by tourism<sup>4</sup>. Even further exacerbating this issue is the problem of littering. Again, because of the detachment that tourists feel from their normal responsibilities at home, they are more likely to engage in more reckless or problematic behaviors such as littering which not only hurts the land but the community in the area as well. This wastefulness is also seen in food waste as visitors are far more likely to overconsume or request more

---

<sup>4</sup> Environment, UN. "Tourism." UNEP, [www.unep.org/explore-topics/resourceefficiency/what-we-do/responsibleindustry/tourism#:~:text=In%20a%20'business%2Das%2D,in%20the%2021st%20century](http://www.unep.org/explore-topics/resourceefficiency/what-we-do/responsibleindustry/tourism#:~:text=In%20a%20'business%2Das%2D,in%20the%2021st%20century).

food than they are capable of consuming, which leads to a substantial amount of food being disposed of.

Littering isn't the only source of pollution from luxury tourism establishments. Light and sound pollution also tend to be major contributors to the negative impact on the environment. In some ecosystems, light plays a major role in the behaviors of the organisms that reside in it. By disturbing the normal rhythm of natural daylight, this could easily perturb their biological clocks interrupting all forms of life around them. Much of the same can be said about noise pollution as well. A sudden increase in volume in an area that is otherwise largely hushed can startle the animal population, pushing them from their respective environments.

Another major repercussion of luxury travel is the energy consumption. After transportation, the next largest use of energy comes from running guest services. This includes the running of heating and cooling systems, the pool and spa systems and other amenities. Much of the energy needed to run these services is produced through the burning of fossil fuels which releases CO<sub>2</sub> into the atmosphere and contributes to climate change. Along with CO<sub>2</sub>, other greenhouse gases are released as well including nitrous oxide and methane.

The altering or disturbing of natural landscapes is yet another issue that the luxury tourism industry must address. When construction takes place on a largely undeveloped site, it is crucial that we consider the effects that it has on the existing habitat. It is first most important that an effort is made to preserve the existing indigenous aesthetic. We must, too, consider the impact that we could have on the

soil quality. In order to protect the soil quality around a site, we must be strategic in our approach to both construction and planning. We must limit the amount of land that we occupy or traverse through. As we trek through soil, through time it becomes compact and less permeable. This leads to issues of soil erosion and deterioration. As this worsens, it also begins to disturb the natural cadence between both the flora and fauna in the area and could ultimately lead to the total degradation of an ecosystem.

If everyone was made aware of all of the harm that luxury tourism can have on the environment it is likely to give many travelers hesitance about such practices or some cause for concern. So, from here we must reevaluate and ask ourselves, *what exactly are the basic things that we want to accomplish by going on such excursions and how can we obtain them without disturbance to our natural environment?*

### Section 3: Redefining Luxury Tourism

Despite some criticisms about the superficial nature of luxury travel, it is a widely sought-after experience. In fact, according to one study conducted by Global Market Insights, the luxury tourism market is expected to reach a value of over \$82 billion by the year 2030 <sup>5</sup>. The desire to travel has been even further exacerbated by the slowing of the Covid-19 pandemic. As travel regulations become less stringent again, more people are looking to get out of their homes and explore the world again. Luxury tourism in particular provides travelers with a high level of comfort and convenience that is often harder to come by when budget traveling. Carrie

---

<sup>5</sup> Simms, Demetrius. "The Luxury Tourism Market Is Expected to Reach \$82 Billion by 2030, a New Reports Says." Robb Report, 10 Aug. 2022, [robbreport.com/travel/destinations/luxury-tourism-market-expected-to-reach-82-billion-1234737336/](https://robbreport.com/travel/destinations/luxury-tourism-market-expected-to-reach-82-billion-1234737336/).

McDougall, President of Cultural Crossroads best described this desire by stating that “travelers looking for a luxury trip want their dreams to become reality. They look for something unique, above their expectations with superb service where their needs and wants are fulfilled. This includes exclusivity, privacy, and everything from relaxation to adventure, with pampering and extras.” In this quote, McDougall highlights a great point. Luxury tourism is not easily defined. Every person has their own definition of what ‘luxury’ is for them, however, more often than not, their definition consists of some combination of the “5 C’s”: culture, cuisine, community, content, and customization.

Culture refers to tourists’ desire to experience the traditions and customs of the region in which they are visiting. They want to feel as though they have been truly immersed in the destination. Cuisine, clearly, refers to the desire to taste the foods and specific flavors of the region as well as try high-end, quality foods. Guests often want to have a myriad of dishes. Community indicates the social aspect of traveling.



In this case, the term refers more so to the community within the place of lodging.

**FIGURE 3: Global Luxury Tourism Market (Source: prnewswire.com)**

Social hours and events give guests the opportunity to mingle amongst other similar travelers. Content addresses traveler's need for adventure and exploration but with an added level of comfort and convenience. Luxury travelers want to feel that their needs can be met with ease. They want to see new sights and try new activities without the hassle of booking and planning but rather have those options readily available. Lastly, customization focuses on the need for flexibility. Guests want to be able to do things at their own pace, wherever they please, how they please. The more options that are available, the happier and more comfortable they are <sup>6</sup>.

When fully analyzing each of these five qualities, one may start to realize that neither of them even alludes to opulence, riches, and gaudiness but rather to experience and adventure. This goes to show that all of the more wasteful, superfluous displays and offerings are not needed. True luxury is about the memories that one can gain more so than the material things. Ironically, in many ways, it is our desire to see the amazing sights that our planet has to offer that is hurting our planet. This thesis seeks to create a mutual symbiotic relationship between humans and our environment rather than a parasitic one where humans indulge while the environment suffers.

---

<sup>6</sup> "The 5 C's: A New Definition of Luxury Travel." Hospitality News & Business Insights by EHL, [hospitalityinsights.ehl.edu/new-definition-luxury-travel](https://hospitalityinsights.ehl.edu/new-definition-luxury-travel).

## CHAPTER 2: BIG BEND AND DESERT ECOSYSTEMS

As previously mentioned, luxury ecotourism is widely unheard of due to having only recently taken off. A majority of the projects that have been completed are located in one of two types of ecosystems: forests or coastal settings. Because of the ease of access to water and other resources, these locations seem ideal for ecotourism. With access to natural resources being a top priority, ecotourism in the desert is even more unprecedented. While desert tourism in general has steadily grown in popularity over the years, few have accepted the challenge of building a sustainable place of lodging there, especially in the United States.

In order to find the ideal location for such an establishment, there are a few criteria that we must review. First off, we must consider where is there potential for this type of market. The optimal location would be in or near an established tourist hub with plenty of natural beauty. The ideal site must maintain a balance between isolation and accessibility. While being in complete isolation could render it difficult to create a significant impact on a specific community, locating the site in an overpopulated area could alter the serene aspect that appeals to most travelers. This leads to the next criterion. We must discern what it is that this market is searching for by visiting this area. In many cases, desert tourists in the U.S. are traveling for one of three reasons: events and music festivals, hiking and outdoor recreation, or meditation. With ecotourism being the ultimate objective, it is the latter two that would make the most sense to appeal to. With these factors in mind, the location that makes the most sense for a new luxury ecotourist resort is Big Bend National Park, in the Chihuahuan Desert in western Texas.

### Section 1: The Draw of Big Bend National Park

Big Bend National Park is considered to be one of the most remote locations in the United States. The park itself is actually larger than the U.S. state of Rhode Island at 1,250 sq mi. It is located entirely in Brewster County which sits just across the Rio Grande from the Mexican border to the south. Brewster County is actually the largest county in the state of Texas and, at 6,180 sq mi, it is just shy of the land area of the entire state of Hawaii. Despite the vast size of the county however, in the year 2020, its population sat at only 9,546 inhabitants. While this isolation may be off-putting to some, it seems to be the draw to the area for many. The number of annual visitors to this once largely untreked park has steadily risen over the years, with 581,000 tourists visiting the park in 2021, up 25% from 201. Even with the growing number of visitors, because of its vast size, it is still relatively easy to feel as if you are in complete solitude.

Often deemed Texas' Gift to the Nation, Big Bend National Park is primarily known for its archeological sites, rich cultural history, and recreational opportunities. Visitors to the park have discovered traces of history dating back to the year 10,000



**FIGURE 4: Rio Grande in Big Bend National Park (Source: expedia.com)**

B.C. including the bones of a giant pterosaur, the largest winged creature ever known, and a 50-foot crocodile. With over 1,200 fossil species, the park's fossil record is considered one of the most diverse of any national park in the U.S.

Furthermore, relics of the Native American tribes that once settled the land have been found along with 18th-century presidios, or forts, of Anglo settlers who arrived in this part of North America in the 1500s, battling and enslaving the Native peoples.

Despite this, the indigenous culture is still very much alive around the park today.

The most modern and evident however, is the history of the ranchers who arrived in the area in the late 19th century, seeking fortune from the mining of mercury and other precious metals and gems, the raising of livestock, and farming. Ultimately though, these ranchers halted their efforts in the late 1930's as families in the area began to push for the preservation of the land and in 1944 Big Bend was officially declared a national park.

As previously mentioned, Big Bend is also renowned for its recreational offerings. "With over 100 miles of paved roads, 150 miles of dirt roads, and about 200 miles of hiking trails, the park offers nearly limitless opportunities for scenic driving, hiking, camping, backpacking, mountain biking, horseback riding, bird watching, wildlife and observation". Big Bend was also found to have the darkest sky in the contiguous U.S. making it also great for stargazing. "Additionally, the Rio Grande borders the park for 118 miles providing options for half-day floats to extended excursion by raft, canoe, or kayak"<sup>7</sup>. Additionally, as tourism really took off in the area, the park has opened a variety of exhibits including the Fossil Discovery Exhibit as well as five different visitor centers. Some of Big Bend's natural attractions include the Rio Grande River which flows along the Mexican border, a

---

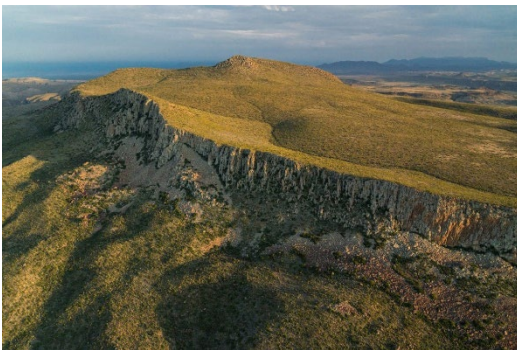
<sup>7</sup> "Big Bend National Park (U.S. National Park Service)." 2022. National Parks Service. U.S. Department of the Interior. Accessed October 14. <https://www.nps.gov/bibe/index.htm>.

number of canyons throughout the park, the Chisos Mountains, and several natural hot springs. The park's diverse landscape and vast variety of offerings makes it a prime location for ecotourism. Furthermore, this establishment would be the first of its kind in the region.

### Section 2: Project Site

.. The selected site for the thesis is a 34,000-acre plot of land sitting just six miles north of the park's main entrance. The land is so desolate that, at the moment, it has no formal address but is rather referred to as Y.E. Mesa Ranch. The plot lies directly adjacent to Highway 385, the well-maintained, main corridor into Big Bend. However, because of its vast acreage, it will be easy to convey a scene of complete isolation even with the added convenience of being close to a major highway.

The site features a beautiful, diverse landscape with plenty of topography to work with. Within its boundaries are mountains, rolling hills, valleys, cliffs, and even plateaus. There are also a number of dried creek beds that begin to fill occasionally during rainy seasons. The site is also rich with fauna and flora. The region is known to host white-tailed deer, mountain lions, desert cottontails, black bears, and even populations of javelina, a pig-like mammal



**FIGURE 5.1 + 5.2: View of Y.E. Mesa Ranch (Source: kindlandwater.com)**

found mostly in Latin America. There are also a number of snake and lizard species native to the area. The most common plant species around the site are of course cacti and yucca species, but there are a number of tree species on the site as well including cottonwood and desert willows.

The full expanse of the site's 34,000 acres will not be occupied by the resort. Instead, the resort itself will occupy only a small fraction of the site. The rest of the site could be subdivided into different uses. A majority of the site is to be left completely undisturbed, while other parts could be slightly manipulated with trails and bike paths for guests to explore. The site is so large that there is even potential for an environmentally friendly ranch and farm to occupy part of the land where food and livestock can be raised for the resort and surrounding communities.

### *Section 3: Challenges of Site*

The Big Bend region is certainly a beautiful area for a new luxury ecotourist resort but there is no shortage of challenges that come along with building in the area.

Ironically, it is one of Big Bend's most attractive features that also makes it incredibly difficult to work in, its isolation. There is a US population of only 50,000 residents within a 100-mile radius of the park. The nearest two airports are the Midland International Air & Space Port (MAF) and the El Paso International Airport (ELP), which are 230 miles and 320 miles from the park, respectively. The nearest town to the park is a small ghost town called Terlingua. With a population of 110, Terlingua sits only 33 miles from the park's center. The town of Alpine, with a population of 5,900 residents, is one of the next closest major towns and even hosts an Amtrak station but the town sits 106 miles away. This isolation leads to several

major concerns and questions to be addressed. Firstly, the issue of transporting guests to the chosen site. With the nearest airport being over 200 miles away and the nearest train station being 100 miles away, this raises the question, what are some ways in which guests are able to get to the site in a more environmentally friendly fashion? Additionally, with very few established towns and a sparse population, what are some ways in which the resort could maintain a staff, and how will the resort positively impact the community if there are no communities nearby? Last is the issue of



**FIGURE 6.1 + 6.2: Geographic Location of Big Bend National Park (Sources: keranews.org, nps.gov)**

construction. How can this project be constructed in an environmentally friendly manner with it being so far away from material suppliers?

Next, there is the issue of climate. Big Bend National Park has a hot semi-arid climate, with temperatures often exceeding 100 °F at lower elevations during the summer and late spring. On the other hand, during the winters, the area is usually mild during the days but subfreezing temperatures at night are not uncommon. This major swing in temperature makes it difficult to create an establishment for both of these extremes. Furthermore, these temperature swings are seen not only season-to-

season but from day-to-night. Overnight temperatures can drop as much as 30 degrees from daytime highs. To further complicate this as previously alluded to, elevation also plays a great deal in the temperature. Elevations in the Chisos Mountains are usually around 20 degrees cooler than those in low desert elevations <sup>8</sup>. Lastly, the ridges and cliffs often create shadows that can greatly impact temperature, sunlight, and vegetation growth. Often times, mountains in the region will have a lush, green side where sunlight is plentiful, and a dry, barren side where it is usually shaded. All of this goes to show just how complex the climate can be in the region, giving way to the questions, how can this resort be made highly adaptable to the large temperature swings seen in the Chihuahuan Desert and how can it be strategically placed to best accomplish this?

Lastly, and arguably the most complex to solve, is the issue of infrastructure which also stems from its distant proximity. In the area, there are few bodies of water aside from the Rio Grande. Many ranches in the region have resorted to using wells. While this could be helpful in some regard, due to building codes and the pristine water quality necessary for a luxury resort, other alternatives will have to be implemented as well. In addition, means of getting electricity to the resort will need to be created. This can be accomplished through renewable energy sources but with such a complex environment, it could be difficult to establish which method would be most effective. With electricity also comes heating and cooling. Together, all of these issues raise the questions; in such an arid region, how can the resort be supplied with

---

<sup>8</sup> "Weather." National Parks Service, [www.nps.gov/bibe/planyourvisit/weather.htm](http://www.nps.gov/bibe/planyourvisit/weather.htm).

potable water; which renewable source of energy would be most suitable for this environment; and what passive systems can be implemented for heating and cooling?

## CHAPTER 3: PRINCIPLES OF DESERT ARCHITECTURE

Although the desert can be a complex place to build, it hasn't stopped developers from completing projects and even megaprojects in the most arid locations. From resort towns such as Sedona, Arizona and Palm Springs, California to sprawling metropolises like Las Vegas, Nevada and Dubai, UAE, building in the desert is no foreign concept. However, what makes this project especially complex is its focus on sustainability and energy regeneration. Through time, cities like Las Vegas and Dubai especially, have put large-scale infrastructure in place that has made it easy to develop in the area. While effective, these systems are far from sustainable. Despite being the 163rd most populous city in the world in 2022, Dubai had the 11th highest carbon footprint in the world and the 29th highest level of carbon emissions per capita. Las Vegas, on the other hand, while much better in these rankings (103rd highest carbon footprint and 234th per capita), has earned itself the title of the fastest warming city in the US due to its excess use of concrete and asphalt in temperatures that are already elevated <sup>9</sup>. Although largely unpracticed, building sustainably in the desert isn't a completely alien notion. In fact, this concept has been practiced for thousands of years even in the Big Bend region.

### Section I: Native American Architecture

Native Americans are generally acknowledged for their arts and traditions, but their innovative work in construction is often forgotten about. Native American

---

<sup>9</sup> "Global Gridded Model of Carbon Footprints." Global Gridded Model of Carbon Footprints, [www.citycarbonfootprints.info/](http://www.citycarbonfootprints.info/).

culture largely emphasizes solidarity with nature and respect for other walks of life. These values hold true even in their architecture.

As previously mentioned, there was once a fairly large Native American presence in Western Texas. The tribes that resided in this area were classified as Puebloan Native Americans. The term ‘Puebloan’ refers to Native American tribes that settled in the Southwestern region of the United States that shared similar religious, agricultural, and communal practices. The Big Bend region, in particular, was home to the Jumano tribe. The Jumano tribe at its peak during the 16th century consisted of about 20-30 thousand members living along the Rio Grande<sup>10</sup>, but the area has since seen a dramatic decrease in its indigenous population over the centuries. This is largely due to the lack of protection and history of discrimination the native peoples have faced. In all of Texas, only 3 reservations exist today, the nearest being Ysleta Del Sur Pueblo near El Paso, TX, over 200 miles away. However, the rich history of the Jumano people who once resided in the mountains and valleys of Big Bend is evident.

The Jumano peoples were largely nomadic, migrating through northern Mexico, New Mexico, and Texas throughout their history. Their nomadic nature has resulted in a wide array of practices observed through the ruins of former villages and rancherias (a small settlement often consisting of huts), rendering it difficult to fully understand their practices and true identity. So, while little is known of their language

or faith, through artifacts and relics, historians have gathered enough information to generate an overall understanding of how the Jumano people lived.

The Jumano peoples were hunter-gatherers, hence their nomadic way of life. They generally followed where the large animal populations would migrate, the bison being their primary game. With the bison they hunted, they would not only use its meat for nourishment, but they would use its bones for tools and its hides for shelter. Their primary form of nomadic shelter was the teepee. These teepees were typically constructed using anywhere from three to fifteen timber poles which were then clad in bison hides which had been sewn together. These structures were easy to transport and reconstruct whenever necessary <sup>10</sup>. As for the shelter in their permanent settlements, the Jumanos would utilize either sticks and reeds in rancherias or masonry in pueblos. In these pueblos, they would begin by creating a shallow ditch around the perimeter of the home before using adobe bricks to create a foundation.



**FIGURE 7: Taos Pueblo in New Mexico**  
(Source: pinterest.com)

They would then use wood to construct the walls and roof before covering them in plaster made from a combination of mud and straw, adding to the strength and impenetrability of the structures. Many villages would then add paint to these homes, red and yellow most

---

<sup>10</sup> Hickerson, Nancy P. 2019. "Jumano Indians." TSHA. April 27.  
<https://www.tshaonline.org/handbook/entries/jumano-indians#:~:text=The%20Jumanos%20were%20buffalo%20hunters,form%20in%20twentieth%2Dcentury%20scholarship>

commonly <sup>11</sup>. This same method was used to construct larger structures in the villages as well, even buildings up to five stories. The lack of rain and dry climate in the Southwestern region made it possible for these structures to stand for extended periods of time; otherwise, the mud would continuously dissolve with each rainfall, resulting in the ultimate collapse of the structure. However, even in the case of the occasional rainfall, proper maintenance had to take place in order to preserve the structural integrity. In the Jumano tribe, every so often the women of the village would go out and have to replaster the walls to make sure the exterior stays impenetrable from the rain, wind, and pests <sup>12</sup>. So, with all of this information considered, what can we learn from the Pueblo Native Americans and how can their principles apply to modern works of architecture today? This question can be answered from both a literal and figurative point of view.



**FIGURE 8: Adobe Bricks being made (Source: unansea.com)**

From a literal sense, we could learn from the resourcefulness of the indigenous peoples. Using materials found on the land such as mud, sticks, and straw, not only enabled their homes to, quite literally, become part of the landscape, but it also took no machinery to manufacture, meaning no harmful greenhouse gases being released. From a more figurative view, we can learn from some of the indigenous

---

<sup>11</sup> “Pueblos: Community Houses.” 2022. Texas Beyond History. Accessed December 13. <https://www.texasbeyondhistory.net/kids/houses/pueblos.html>.

<sup>12</sup> 2022. Jumano Nation of Texas Since 1500. Accessed December 13. <https://jumano-nation.com/#:~:text=The%20Jumano%20Nation%20is%20alive,and%20history%20of%20our%20ancestors.>

ways of thinking. As previously mentioned, the Native Americans treated all other organisms with respect. The bison especially was considered sacred and was often celebrated through ceremonies and prayer. They expressed a great sense of gratitude towards the bison as it was believed that these animals were sacrificing their own lives for the good of the indigenous peoples. Furthermore, they even viewed their homes as living organisms that they must respect and care for, not just simple objects from which they dwelled. Architect and historian Rina Swentzell best summarizes this concept by describing, "a world in which a house or structure is not an object—or a machine to live in—but is part of a cosmological world view that recognizes multiplicity, simultaneity, inclusiveness, and interconnectedness" <sup>13</sup>. This quote ultimately explains that built architecture is not just for humans, but all that inhabit the surrounding environment.

## *Section 2: Trends in Modern Desert Architecture*

As previously explained, with large metropolises like Dubai, Phoenix, Las Vegas, and Riyadh, it is clear that us humans have found ways to dwell in such extreme conditions comfortably. Each of these cities regularly have days with temperatures exceeding 115°F with Dubai having the highest temperature recorded at an astounding 125.78°F in July 2002 <sup>14</sup>. However, even so, each city hosts over 2,000,000 residents in its metropolitan area, with almost 5 million and 7 million

---

<sup>13</sup> "Pueblo Architecture." 2022. Wikipedia. Wikimedia Foundation. December 7. [https://en.wikipedia.org/wiki/Pueblo\\_architecture#cite\\_note-swentzell90-6](https://en.wikipedia.org/wiki/Pueblo_architecture#cite_note-swentzell90-6).

<sup>14</sup> Buckeridge, Miles. 2022. "What Is the Hottest Temperature Ever Recorded in the UAE ?" What's On. July 19. [https://whatson.ae/2022/07/hottest-temperature-ever-uae/#:~:text=The%20official%20record%20for%20the,%2Dsweating%2052.1%C2%BAC%20\(125.78%C2%BAF\)](https://whatson.ae/2022/07/hottest-temperature-ever-uae/#:~:text=The%20official%20record%20for%20the,%2Dsweating%2052.1%C2%BAC%20(125.78%C2%BAF))

calling Phoenix and Riyadh home respectively. So how have the challenges of such extreme conditions been addressed and, furthermore, where can they stand to be improved? While effective, air conditioning can be a costly and environmentally unsustainable method for cooling. Aside from more extreme measures like Dubai's attempts at sending weather-changing drones into the sky <sup>15</sup>, these cities have implemented a number of simple mechanisms to combat these soaring temperatures. These include the use of shading, vegetation, windows for air flow, and reflecting surfaces. These four elements are the main factors driving desert architecture.

Shading is a simple and common tactic used in desert architecture to ensure a space is kept at a comfortable temperature. It has been utilized in desert architecture for thousands of years. Shade was the primary consideration in the invention of the mashrabiya window, a 12th century window, often seen in Islamic architecture, that utilizes wooden lattice to bring in air and let in light, while simultaneously diffusing the light to prevent interior heat gain <sup>16</sup>. Since this invention, architects have



**FIGURE 9: Kinetic Façade on the Al Bahar Towers (Source: architecture.org)**

implemented a number of other creative design solutions to accomplish this. Shading devices that can be utilized include awnings, overhangs, louvers, and trellises. Overhangs seem to be the most prevalent feature of residential desert

<sup>15</sup> Cohen, Ariel. "How Dubai Is Using Laser Drones to Shock Rainwater out of the Sky." Forbes, 10 Dec. 2021, [www.forbes.com/sites/arielcohen/2021/07/28/dubai-is-using-laser-drones-to-shock-rainwater-out-of-the-sky/?sh=1ccefb7254ce](https://www.forbes.com/sites/arielcohen/2021/07/28/dubai-is-using-laser-drones-to-shock-rainwater-out-of-the-sky/?sh=1ccefb7254ce).

<sup>16</sup> "Mashrabiya." Wikipedia, [en.wikipedia.org/wiki/Mashrabiya#:~:text=A%20mashrabiya%20or%20mashrabiyya%20\(Arabic,sometimes%20enhanced%20with%20stained%20glass](https://en.wikipedia.org/wiki/Mashrabiya#:~:text=A%20mashrabiya%20or%20mashrabiyya%20(Arabic,sometimes%20enhanced%20with%20stained%20glass).

architecture. In recent years, the use of dynamic or kinetic shading structures has taken off. This type of shading structure adapts to the lighting conditions at the time of day, letting in more light when conditions are favorable and providing shade when more light is unfavorable. One of the most notable examples of these kinetic facades is seen on the Al Bahar Towers in Abu Dhabi, UAE. Designed by Aedas Architects, these dual high-rise office towers feature a modern take on the mashrabiya.

Approximately two meters (6.56ft) from the building's exterior surface sits a kinetic screen made up of fiberglass triangles that are programmed to fold, bringing in more light when needed, and open up, diffusing the light when necessary. These maneuvers are computer-controlled to adjust to optimal solar conditions. Not only does the screen provide shade, resulting in a cooler interior and less need for air conditioning, but it also enabled the architects to use more transparent glass panes that allow more sunlight in, reducing the need for artificial lights and offering better views out. For its unique and revolutionary design, the Al Bahar towers were awarded the 2012 Tall Building Innovation Award by the Council of Tall Buildings and Urban Habitats <sup>17</sup>. In addition to shading structures like the one seen on the Al Bahar Towers, landscape architects also often implement structures such as canopies and pergolas for shading, creating enjoyable exterior spaces.

.....The use of vegetation and trees is often thought of as merely aesthetic, but when it comes to desert architecture, the placement of greenery is highly beneficial for its cooling effects as well. One of the main ways trees especially keep a building cool is

---

<sup>17</sup> Cilento, Karen. 2012. "Al Bahar Towers Responsive Facade / Aedas." ArchDaily. ArchDaily. September 5. <https://www.archdaily.com/270592/al-bahar-towers-responsive-facade-aedas>.

through the shade it provides, which could not only block the sun from the interior of the building but could also help regulate the ground temperature. Researchers have found that trees are most effective in places where they shade roofs or windows. In addition, trees can also promote efficient wind flow to a building. The placement of trees around a building, not only affects wind patterns, but also wind velocity. If manipulated strategically, trees can either increase or decrease the speed at which wind hits a building. This is due to their resistance of wind flow <sup>18</sup>. Furthermore, vegetation also cools through a process called evapotranspiration. Evapotranspiration occurs when strong sun rays cause water from leaves to evaporate which cools the air around them, much like sweating. Through transpiration, it is found that a tree can provide up to 6 kilowatts of cooling, “equivalent to the cooling of two small air conditioning units”. However, it is found that trees only provide this cooling effect if they are growing well and are in favorable conditions. If the tree itself is not flourishing, it will not let off enough water to feel its effects <sup>19</sup>. Together, these cooling benefits have led city leaders in desert cities around the world to create ambitious initiatives to increase the tree population in their cities. City leaders in Tucson, AZ, for example, have pledged to plant 1 million trees in their city by 2030 with Mayor Regina Romero publicly stating, "Climate change waits for no one" <sup>20</sup>. It

---

<sup>18</sup> Srivastava, Ar. Prashansha. 2019. “Effect of Tree Placement on Wind Flow Pattern in Building in Warm and Humid Climate.” *International Journal of Scientific & Engineering Research* Volume 10 (Issue 9): 1659–63. doi:10.14299/000000.

<sup>19</sup> Misni, Alamah. 2018. “Vegetation Produce an Extensive Cooling Effect.” *Asian Journal of Quality of Life* 3 (10): 179. doi:10.21834/ajqol.v3i10.114.

<sup>20</sup> McVeigh, Quinn. 2021. “Planting a Million Trees in the Semi-Arid Desert to Combat Climate Change.” *EHN*. May 14. <https://www.ehn.org/planting-trees-arizona-climate-change-2652806561.html>.

is for these reasons that, oftentimes, works of desert architecture are either surrounded by an elaborate landscape or feature vegetated courtyards.

.. Windows and air flow go hand in hand when it comes to cooling an interior space in the desert. Again, as demonstrated by the mashrabiya windows in Islamic cities, airflow without the addition of excess sunlight is highly beneficial if executed correctly. This is why many modern desert homes feature large, operable window systems under overhangs and shading structures, so that air will be able to easily pass through the interior and residents can get plenty of natural light without the effects of solar heat gain. This topic of cross-ventilation and other more technical methods of cooling will be discussed later in more depth.

.....Lastly, the use of reflection is often seen in works of desert architecture. There are three popular ways that architects tend to implement reflection into their designs. First, is with the use of light shelves, which is a device that reflects natural light for daylighting without the extra solar heat gain. While effective, this tends to be more of an addition rather than a driving factor in the design. The second use, however, is definitely more apparent and definitely the most utilized of the three. Desert



**FIGURE 10: A White Street in Los Angeles (Source: [optimistdaily.com](http://optimistdaily.com))**

architecture generally uses a lighter color palette in its façade and exterior surfaces. While darker colors, like black, absorb light ultimately heating the surfaces, white and other lighter colors reflect light. For this very reason, some cities, such as Los Angeles, have elected to paint some of their streets white to

prevent the heat island effect that results from the heating of traditional dark asphalt surfaces <sup>21</sup>. As for the third use, some architects have utilized reflections in their most apparent form, mirrors. The use of mirrored glass has been a trend seen in many works of desert architecture over the past few years and is often raised as a topic for debate as it has both positive and negative effects <sup>22</sup>. There are two major benefits of mirrored facades. One being the illusion it creates. Reflective surfaces in such a beautiful, natural environment allow the building to become a chameleon of sorts, completely disappearing into the landscape. The second benefit is the reflection of the light off of the building which results in a cooler interior. From the interior, while you are still able to have light, it is highly diffused with most of the rays being reflected off of the glass. However, this leads to one of the two main criticisms. One is the tendency for these structures to create a glare that renders it highly uncomfortable to even look at. With this, also comes the possibility of heat gain on the exterior of the building. The light that is being reflected off of the glass may be redirected towards the ground or other objects which could drastically increase their temperatures. This situation was seen at its extreme in 2013 when 20 Fenchurch, a high rise building in London with a reflective façade, reflected rays directly at a parked car. After only two hours, the rays had melted part of the car's bumper and mirror caps <sup>23</sup>. Furthermore, as a result of the building "disappearing" into its environment, it makes it more

---

<sup>21</sup> Bardsley, Daniel. 2021. "The Heat Is on: How Cities Choose to Combat Rising Temperatures." The National. The National. July 5. <https://www.thenationalnews.com/uae/environment/the-heat-is-on-how-cities-choose-to-combat-rising-temperatures-1.890638>.

<sup>22</sup> Boyle, Darren. 2017. "'Chameleon House' in the California Desert Blends into Its Surroundings Because It Is Covered in Mirrors"; Daily Mail Online. Associated Newspapers. March 10. <https://www.dailymail.co.uk/news/article-4300810/Chameleon-house-California-covered-mirrors.html>.

<sup>23</sup> Dandelion Energy. "All You Need to Know about Home Geothermal Heating & Cooling." Dandelion Energy, 7 Dec. 2022, [dandelionenergy.com/all-you-need-to-know-about-home-geothermal-heating-cooling](https://dandelionenergy.com/all-you-need-to-know-about-home-geothermal-heating-cooling).

difficult for wildlife in the area to see. It is not uncommon for birds and other wildlife to run directly into the surface usually harming or killing the animal in the process. While some architects have found ways to mitigate some of these issues, mirrored facades are still often condemned by many.

## CHAPTER 4: REGENERATIVE ARCHITECTURE

In recent decades, we have seen a tremendous growth in awareness surrounding the declining well-being of our planet; however, there is still a dramatic shift that needs to take place in the way we combat this issue. The term sustainable is commonly used to refer to practices that are less bad for the environment than the standard. While this, of course, is a move in the right direction, we need to start to implement systems that actually improve the environment; this is where regenerative architecture is introduced. In architecture, the term regenerative refers to “the idea of creating a building that mimics the restorative aspects found in nature”. Rather than lessening or eliminating the impact that a project has on the environment to achieve net-zero, the concept of regenerative architecture involves creating a net-positive impact. Because of its greater advantages on the environment, it is often said that “regenerative architecture is becoming the new sustainability”. The key factor to accomplishing regeneration is treating nature as a shareholder in your project. Rather than building on a site, one should strive to build with the site, enhancing what is existing to create a singular, seamless system and experience. Through the integrated use of technologies and natural resources, each system can work together to act as a single machine. If executed correctly, not only can a regenerative building have a positive effect on the site and its occupants, but also neighboring communities as they may be given the opportunity to partake in the resources created by the project

As one might expect, assessing which systems one should incorporate to operate most efficiently is no easy task. There are a number of factors that can have a great influence on which systems should be included on a site including topography,

climate, flora and fauna, as well as soil composition. In a region as extreme as the desert, these characteristics play an even more critical role in the final design. Furthermore, there are several utilities that must be taken into consideration: water, electricity/power, heating and cooling, and waste management. The key to creating a fully integrated system is finding common solutions for multiple issues. By doing this you can essentially create a chain of mechanisms that work as a cycle.

### Section 1: Water Management

In the desert, water is most certainly a precious commodity. In most desert regions, it can seem almost impossible to come by and this site is no exception. The site sits over 40 miles from Rio Grande, the region's only major body of water and receives an average of only 11 in of precipitation a year spread across 47 days a year. This raises our first challenge: How do you generate and maintain a steady supply of potable water on such a dry site? As suggested previously, we can first look to nature for answers.



**FIGURE 11: A Natural Oasis in Al Ain, UAE (Source: facebook.com)**

Natural oases serve as the quintessential model for freshwater generation on the site. An oasis is “an area made fertile by a source of freshwater in an otherwise dry and arid region.”<sup>24</sup> Generally, the source of this freshwater is underground water systems called aquifers that stem from existing bodies of water and essentially create

---

<sup>24</sup> “Oasis.” Education, [education.nationalgeographic.org/resource/oasis/](http://education.nationalgeographic.org/resource/oasis/).

an underground river. Oases can also be formed through rainstorms and surface rivers. What makes oases such an incredible model is their ability to sustain their water supply over time. Typically, an oasis is surrounded by thick vegetation, most often some types of palms. This vegetation is not just a result of the water supply but also assists in maintaining it. The plants help provide shade which can cool and protect the area from harsh sun rays, ultimately slowing down the process of evaporation. Additionally, the roots of the plants hold water which aid in sustaining the underground water supply. In well-sustained oases, a microecosystem is created, attracting a new population of organisms to settle in the area. In this same way, humans have adapted this technique with the creation of wells. When there is an existing underground aquifer but not enough ground pressure for the water to reach the surface of a site naturally, we can create a direct path ourselves to the water through wells. While there are several types of wells, most wells use a pump to pull the water up from the ground and the water is then filtered through a screen for particles and stored. This technique for water collection is actually quite common in western Texas even today. Many of the ranchers who settled in the area in the 19th century would use this method and, over the years, through the use of new technologies and mechanisms, we have found ways to make wells more efficient and clean.

The second viable means of harvesting water is through rainwater collection. Rainwater is generally collected through drainage pipes from a building's roof and stored in cisterns or rain barrels for later use. New technologies have also made it possible to collect rainwater through permeable pavement and even gardens as well.

While rainwater collection may seem like an impractical solution in the desert, it is more efficient than one would think. According to climate data collected by the Persimmon Gap climate center, just 6 miles south of the site, the area averages around 11 inches of precipitation each year <sup>25</sup>. This means that with a roof area of just 5,000 square feet, one could collect up to 34,200 gallons of water a year. With studies showing that the average hotel uses around 100-200 gallons of water per occupied guestroom per day <sup>26</sup>, that is enough to supply one occupied guestroom for between 171 and 342 days.

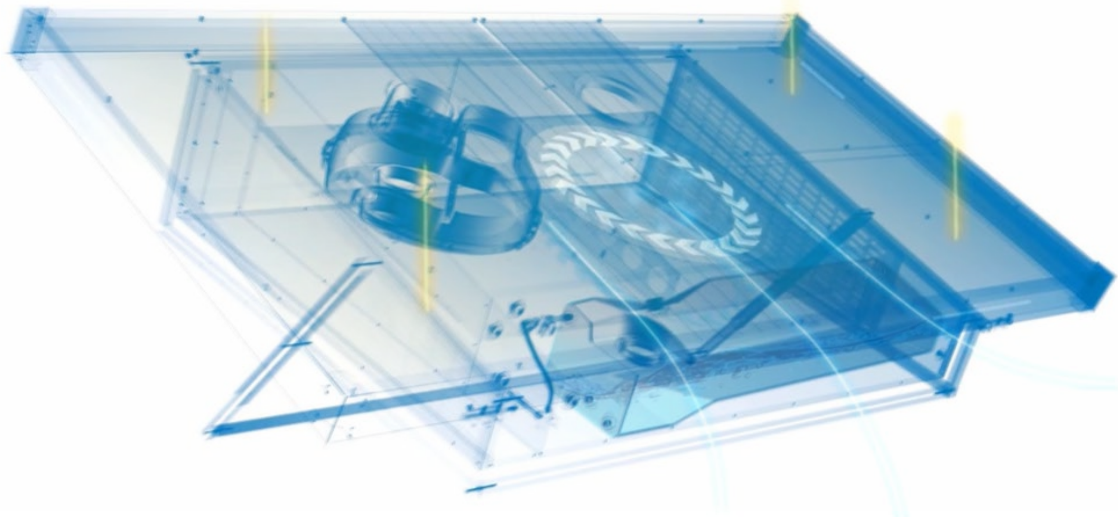
Lastly, the third viable method for collecting water is through condensation. An atmospheric water generator (AWG) is a relatively new technology that uses condensation and humidity in the air to create potable drinking water. They do this through the use of cooling refrigeration coils that assist in drawing moisture from the air to create water droplets that are then collected. While this technology does take energy, AWGs are able to function using solar power. In fact, in recent years, the creation of hydropanels has made it possible to harvest drinking water through the solar panels themselves. These sophisticated panels use fans to draw in air which is then pushed through a water absorbing material. This water is then collected and cleaned in the panel before being released for storage and consumption. Like traditional PV panels, these hydropanels can be configured in arrays to produce water for both small residential developments and larger commercial establishments. Each

---

<sup>25</sup> "Persimmon Gap, Texas." PERSIMMON GAP, TEXAS - Climate Summary, [wrcc.dri.edu/cgi-bin/cliMAIN.pl?tx6959](http://wrcc.dri.edu/cgi-bin/cliMAIN.pl?tx6959).

<sup>26</sup> Reichardt, Klaus. Measure Your Hotel's Water Consumption, Then Start Saving., 18 Feb. 2007, [www.4hoteliers.com/features/article/1889](http://www.4hoteliers.com/features/article/1889).

panel produces just over a gallon a day, which may not seem like much but in an array of 20 panels, this adds up to over 9,400 gallons of water each year. These panels are a perfect example of a common solution for multiple issues. Not only do they provide energy but water as well. Even more impressive is the fact that the water is made potable by the panel itself <sup>27</sup>, which introduces us to the next issue.



**FIGURE 12: How Hydropanels Function (Source: source.co)**

While all three of the methods for water harvesting listed here are viable options for this site, only one of those produces potable water on its own. Without treatment, both well water and rainwater are not considered suitable for consumption, however, there are two options for making use of these water sources. The first option is to treat the water on-site. There are several types of water filters that are able to remove practically all pollutants to make these waters potable including UV filters, quantum filtration systems which use electrons, and gravity filters. On the other hand, the second option is to run the water from these systems through a different plumbing

---

<sup>27</sup> “How Do Hydropanels Work?” SOURCE Water, [www.source.co/how-hydropanels-work/](http://www.source.co/how-hydropanels-work/).

network so that it can be utilized for other uses such as irrigation, flushing toilets, and cleaning uses. Both options have their own pros and cons but, in either case, they achieve the ultimate goal of not wasting water. Throughout the entire water cycle on the resort site, it is crucial to “close the loop”, no water should be considered waste. Even water that is flushed from a toilet can be treated and used for subsurface irrigation. Not only does closing the loop assist in maintaining the resort but it also prevents other bodies of water from being polluted by wastewater from the site.

### Section 2: Power and Electricity

When it comes to generating power and electricity, the key component to regeneration is renewable energy. Renewable energy is “energy derived from natural sources that are replenished at a higher rate than they are consumed”<sup>28</sup>. While there are several types of renewable energy, only a few are applicable in this case.

Active solar energy is arguably the most well-known and utilized form of renewable energy. First introduced in the 1950’s, Solar power collection involves the conversion of the sun’s rays into energy through photovoltaic panels. These panels use PV cells to absorb energy from the sunlight. As the cells absorb energy, they begin to move which creates electricity flow. This energy can then be stored to help maintain power overnight. Solar power is the most versatile of all the renewable energy types as it can be used effectively almost anywhere. In fact, solar power would be exceptionally effective on the site of this project. The area is in one of the sunniest regions in the

---

<sup>28</sup> “What Is Renewable Energy?” United Nations, [www.un.org/en/climatechange/what-is-renewable-energy#:~:text=Renewable%20energy%20is%20energy%20derived,plentiful%20and%20all%20around%20us](http://www.un.org/en/climatechange/what-is-renewable-energy#:~:text=Renewable%20energy%20is%20energy%20derived,plentiful%20and%20all%20around%20us).

US with over 280 days and 3,200 hours of sunlight a year. Furthermore, the use of solar power allows the resort to function completely off-grid.

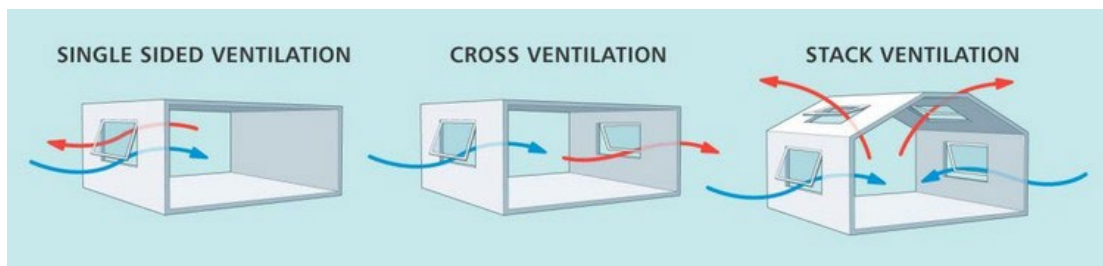
Another viable source of renewable energy on the site is wind energy. First utilized in the 1880's, the production of electricity through wind follows a much simpler process. Wind energy is collected through wind turbines. As the wind pushes the blades of a turbine around, they spin a generator which then produces energy. While there have been recent efforts to use wind power in more urban settings, typically wind farms are utilized in rural areas where there are large expanses of land for turbine arrays and few obstructions. Additionally, they are usually placed at higher elevations where the wind tends to be much stronger. A standard wind turbine requires a wind velocity of about 6mph to sustain a steady rotation. Around the site, the wind maintains an average velocity of around 9mph year-round with higher velocities experienced in the spring and summer. With this being said, wind energy is a more than reasonable option for the region. In fact, Texas is the largest generator of wind energy in the US, accounting for nearly half the country's total. However, most of the state's wind farms lie in the High Plains region near Amarillo and Lubbock. This is more so due to the larger population in that region than the viability relative to western Texas. In such a sparsely populated region as Big Bend, there is no need to produce such a large amount of energy therefore wind farms have been constructed elsewhere. However, many ranches in the region do utilize windmills to produce power at a small scale.

### Section 3: Heating and Cooling

With a climate as extreme as the desert, heating and cooling is a critical aspect of creating a pleasant setting for guests. While typically maintaining a comfortable temperature is accomplished through the use of AC units and HVAC systems, there are other means and techniques for influencing the temperature within the resort. In fact, many of these methods require little to no electricity or source of energy. These are referred to as passive systems. On the contrary, there are also a number of active systems that utilize renewable energy to manage the temperature more sustainably than conventional HVAC systems.

Natural ventilation is one of the most straightforward and least expensive means for cooling. In fact, it is practically priceless as it merely involves the strategic placements of openings in a building's envelope. Natural ventilation refers to the way in which heat escapes a building and wind passes through it. If executed correctly, the wind can have significant effects on the comfort level of a building's interior. There are several configurations for natural cooling. Cross ventilation is highly effective as it involves placing openings on opposite sides of a room so that air enters on one side and exits from the other. Typically, there would be a lower opening on the side with the fastest summer wind velocities and a higher opening on the opposite side. This is due to the tendency for heat to rise so as air enters it pushes the heat out as it exits. This is a tactic seen in all configurations of natural ventilation. Single-sided ventilation, on the other hand, involves the use of openings on only one side of a space to help air circulate around a room before exiting out the same side. Similar to

cross ventilation, the openings should be placed on the side of the room that receives the highest wind pressure and there tends to be an upper opening and a lower opening so that cool air is pushed in low and then warmer air is pushed out high. Out of all the natural ventilation strategies, single-sided tends to be the least effective as it produces the least air circulation. It is usually used in situations where cross ventilation is not possible such as double loaded corridor units. Lastly, stack ventilation more so focuses on removing hot air than sustained airflow. With this configuration, openings are usually placed low in a room and high on the roof plane or at the top of an atrium. As the air enters the lower points, it is then pushed up and out of the space taking the heat with it. This method, however, is only effective when the indoor temperature is higher than the outside temperature, therefore it is usually not utilized independently. In all of these configurations, the addition of a ceiling fan can also assist in sustaining significant airflow and pulling heat up. It should be mentioned that the fan, of course, would be considered an active system due to the energy it requires to function.

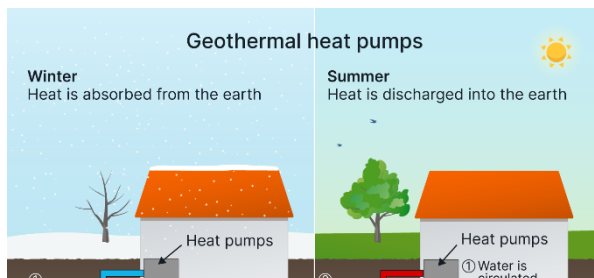


**FIGURE 13: Natural Ventilation Strategies (Source: archdaily.com)**

Passive solar strategies involve the use and manipulation of the sun without the use of systems that require or generate electricity, including PV panels. Rather than creating energy like active solar systems, passive solar design involves creating ways to limit the amount of energy required to maintain comfortable interior

conditions. This is accomplished through the use of simple mechanisms such as strategically placed windows, sunrooms, and shading structures. While these may seem like simple elements to implement into any design, they must be thoroughly studied and planned to make sure that they serve their purposes sufficiently. For example, to effectively utilize an overhang, one must take into account the orientation of the overhang, the sizing of windows, and even the altitude of the sun (angle at which the sun shines) on the site year-round. These factors will ensure that interior heat gain from the sun is avoided during the summer months but captured during the winter months. One could also consider the treatment of the windows. New technologies such as motorized louver systems have made it easier than ever to maintain pleasant conditions within a building's interior without the use of HVAC systems.

Geothermal energy uses the temperature of the earth to generate heat and electricity for human use. To create electricity, geothermal wells are typically drilled around 150-400ft into the ground, but some go as far as 2 miles beneath the earth's crust. For this reason, electricity generation from geothermal energy is usually limited to power plants and larger infrastructural realms. However, heat production is a much more viable solution for smaller sites where heat wells only have to extend four to six

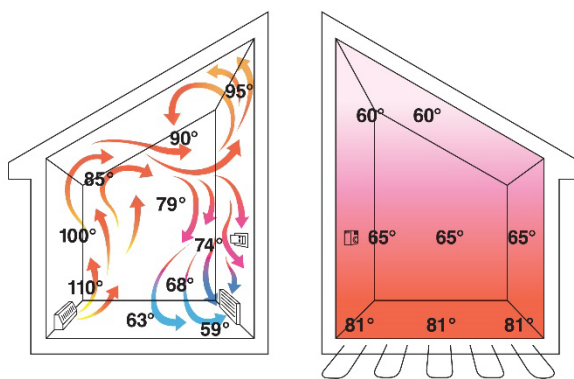


**FIGURE 14: How Geothermal Heat Pumps Work** (Source: skepticscience.com)

feet below ground. This is because the upper ten feet of the earth maintains a temperature between 50-60 °F year-round meaning that it is typically cooler than outside

temperatures during the summer and warmer than outside temperatures during the winter <sup>29</sup>. This difference in temperature is made useful with a system called a heat exchanger. A heat exchanger is essentially a network of pipes that pulls heat up from the earth and into a building's air delivery system during the winter and pulls heat down from the building and into the earth during the summer months. Furthermore, the heat pulled from the interior during the summer months can also be used to heat water.

In connection with water heating, hydroponic radiant flooring systems are another sustainable way of heating a home. While there are other types of radiant flooring systems, hydroponic radiant flooring in particular is seen as the most-environmentally friendly. Rather than heating the air of a room, radiant floors use a system beneath the floor which not only heats the surface but relies on the concept that heat rises, warming the room overall. Hydroponic radiant floors in particular pump hot water through a network of tubes under the floor finish to heat the surface.



**FIGURE 15: Radiant flooring vs. air conditioning (Source: ecohome.net)**

Aside from the environmental benefits, radiant flooring also generates no noise unlike typical HVAC systems, creates a more even temperature gradient through a room, and can be configured into zones so that only some rooms are heated.

<sup>29</sup> “All You Need to Know about Home Geothermal Heating & Cooling.” 2020. Dandelion Energy. March 13. <https://dandelionenergy.com/all-you-need-to-know-about-home-geothermal-heating-cooling>.

Hydroponic radiant floor systems can also be paired with solar-powered water heaters. Furthermore, less known is the fact that this same system can be utilized for cooling. Chilled water can be run through the subflooring tubes to produce a cooling effect during the summer months as well. However, this system is usually implemented in the ceiling rather than flooring for cooling. Again, this is because heat rises while the denser, cold air sinks.

Lastly, roof ponds rely on day to night temperature swing for heating and cooling. As implied by the name, roof ponds utilize pools of water over the building envelope that are strategically covered during the night to hold heat and exposed during the day to gather heat. This practice can also be reversed during the summer months so that the waters are cooled during the night and covered during the day as to not let the heat in. This method would be extremely effective in an area such as Big Bend where the temperature can swing as much as 30°F from day to night.

#### Section 4: Waste Management

The term *waste* management as used in this thesis is slightly deceiving. You see, in the natural world, there is no such thing as waste. Everything serves its purpose and is then naturally recycled. As mentioned previously, we should strive to mimic these principles of nature even in the way we view waste.

Biomass energy refers to the production of energy from organic materials <sup>30</sup>. The term biomass is very broad. It can be used to describe processes ranging from the

---

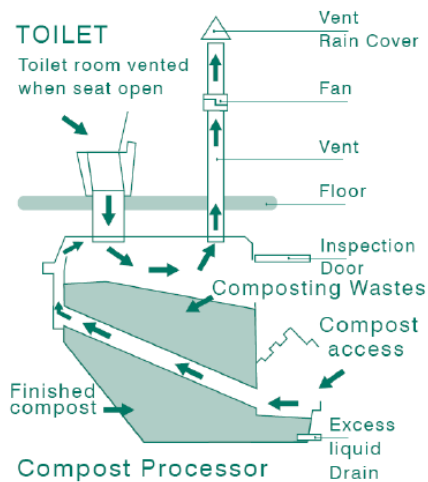
<sup>30</sup> “Biomass Energy.” 2022. National Geographic Society. Accessed December 13. <https://education.nationalgeographic.org/resource/biomass-energy>.

burning of wood for heat to the processing of corn or animal excrement to produce biofuel for vehicles or electricity. On the site of this project in particular, the most viable source of biomass energy stems from waste. Like any lodging facility, with its steady flow of visitors, this resort is sure to produce a large amount of waste. While it is possible to limit the amount of plastic or paper waste being produced, it is almost inevitable to completely avoid. It is for this reason that we must find ways to utilize it on site.

One of the most valuable types of waste comes from food. Food waste can quite easily be composted which involves the natural decomposition of organic materials into nutrient rich soil. This soil can then be used for growing produce on the site. This cycle would ultimately work as a loop. As produce is used it is then composted to grow more produce and so on.

Solid waste such as plastic, paper, and glass should also be managed properly. There are few means for recycling these products on-site, however, surprisingly there are 3 recycling centers within a 50-mile radius of the site meaning that if collected properly this waste could be sent to recycling facilities with ease. The collection process can be as simple as offering guests incentives for separating the solid waste properly.

Another form of waste that is often overlooked is human waste. Human excrement is great for composting as well. It provides excellent soil with an abundance of nutrients however it must be done in a very strategic manner to avoid crop contamination from harmful pathogens. The waste must be covered and takes



**FIGURE 16: How a Clivus  
Multrum Composting Toilet  
Works (Source: researchgate.net)**

about a year to fully biodegrade and for the pathogens and bacteria to die. There are actually several versions of composting toilets that have been utilized over the years. Composting toilets are waterless systems that enable users to easily complete the composting process. The simplest version, deemed the Humanure Bucket Toilet, is simply a container which holds the waste and is emptied once or twice a week. In a luxury resort, however, this would not be the most practical

choice. Using these types of toilets involves adding filler materials such as wood chips, peat moss, dirt, or saw dust after each use to limit odor. On top of this, they require a great deal of maintenance. One alternative, however, the Clivus Style Composting Toilet, follows a similar process but holds a much larger amount of waste; so much more, in fact, that they only have to be emptied once or twice a year, allowing nearly the full decomposition process to take place in the toilet system itself. The system is also emptied differently. Rather than having a compartment which is taken out to empty, the created compost is pushed down to a chamber where it can be conveniently shoveled out. The chamber also has a drain for liquids. Furthermore, a filler material only needs to be added every so often just to assist with the decomposition process, eliminating the need for guest intervention. Lastly, there are a number of commercial composting toilets that utilize other mechanisms for convenience. One of these, the Nature's Head composting toilet, uses a fan to

eliminate unpleasant odors along with a system that periodically adds peat moss to the container semi-automatically; a specific handle just has to be turned. Additionally, the toilet is able to separate urine from solid waste, which is crucial as wet waste tends to encourage bacteria growth and slow the biodegrading process. Compared to the Clivus system, the only major disadvantage is that, similar to the Humanure Bucket, the toilet does have to be emptied manually every 3-4 weeks <sup>31</sup>.

---

<sup>31</sup> “Batch System Maintenance.” Clivus Multrum Composting Toilets, [www.clivusmultrum.com.au/support/maintaining-your-clivus-multrum/batch-system-maintenance](http://www.clivusmultrum.com.au/support/maintaining-your-clivus-multrum/batch-system-maintenance).

## CHAPTER 5: CONSTRUCTION AND MATERIALITY

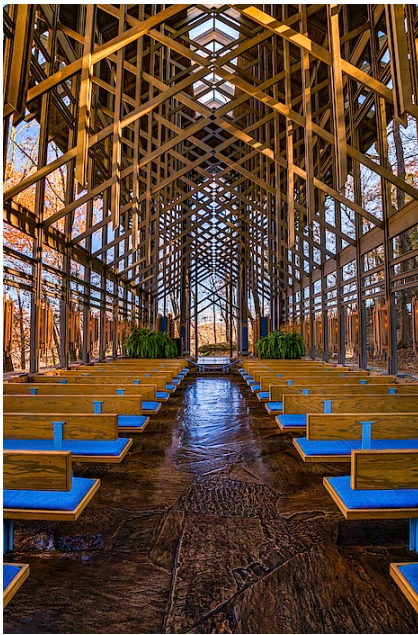
In order to be truly regenerative and environmentally friendly, we must consider the full life cycle of the establishment including its construction. Not only must a building function regeneratively, but it must be constructed responsibly as well. In urban regions, where there are many facilities and options for material production, a project of this scale would be relatively simple to construct. However, in such a remote, rural area, *what are some ways that we can eliminate the environmental impact of construction or even make it regenerative as well?*

### Section 1: Materiality

When it comes to constructing sustainably, materiality is arguably the most important aspect, as it affects all of the others. The materials from which a building is constructed will determine the amount of labor and expertise needed as well as the machinery and means from which it can be built. With all of these factors to consider, one can begin their decision making by first analyzing which materials are the most accessible in the region. Using locally sourced materials will limit the amount of transportation needed to bring materials to the site, therefore lessening the carbon emissions before construction even takes place. In this case, there are five primary materials that we should consider – sand, gravel, stone, wood/plants, and clay. These

are some of the most common raw materials one would find around the site, so now we must ask ourselves, *how can these materials be utilized for construction?*

The first, and certainly the most popular means is the use of light frame wood construction. The largest advantage of light frame wood framing is its ubiquity. Standard lumber is readily available pretty much anywhere in the US. Because of this, there would also be little stress in finding skilled laborers. Additionally, as its name suggests, it is lightweight, meaning that mobility and construction would be relatively easy, requiring less workers than other means. In fact, it was for these reasons that E. Fay Jones' design for the Thorncrown Chapel is renowned today.



**FIGURE 17: Thorncrown Chapel**  
(Source: [fineartamerica.com](http://fineartamerica.com))

Because of the chapel's remote location, atop a hill in an Arkansas forest, Jones decided to use locally source lumber "no larger than what two men could carry through the woods", thereby eliminating the use of heavy machinery and their resulting carbon emissions and disturbance to the natural environment. By applying those same principles to this site, soil erosion and disturbance can be avoided as no large vehicles will need to come to the site. However, as with any material, there are some disadvantages. Firstly, lightwood framing

requires a lot of insulation especially in an area with such an extreme climate. Moreover, wood framing in general is not very fireproof, and while wildfires aren't very common in the area, they do occur occasionally. Lastly, again stemming from

their popularity, they offer no novelty for guests in comparison with other materials. Other related products, such as composite woods, however, could be highly advantageous to use. Composite wood utilizes recycled wood products such as sawdust, fibers, and chips along with recycled plastic to create wood boards for decking and railing. While it isn't a feasible choice for structural purposes, it is a great option for non-loadbearing exterior uses.

The second most common material and perhaps the most popular in most US desert regions is adobe. As mentioned in chapter three, adobe construction has been utilized in the region for centuries by the surrounding Native American populations. It involves the use of compacted soil along with straw or grass and water to create forms to build with. There are a number of advantages to using adobe as opposed to wood. It is far less expensive, offers high sound protection, is noncombustible, and materials can be made on site which lessens the need for high-emission trucks for transportation. Furthermore, it has a high thermal mass which allows it to hold heat in for hours before slowly releasing it through the interior overnight, assisting with temperature management. There are also several means of adobe construction. The most standard is through the use of bricks. Typically, with this method, bricks are cast using 11x14in wooden forms before being sun-dried for 7-10 days. This process can take place on the site of the project if the soil conditions are right <sup>32</sup>. The next construction method is the creation of rammed earth walls. While this method is definitely rising in popularity, it is still not very widely used. It involves compacting

---

<sup>32</sup> Baraya, Santiago. 2020. "Adobe: The Most Sustainable Recyclable Building Material." ArchDaily. ArchDaily. August 26. <https://www.archdaily.com/945692/adobe-the-most-sustainable-recyclable-building-material>.



**FIGURE 18: Rammed Earth Construction,**  
**Nk'Mip Desert Cultural Centre**  
 (Source: [materialdistrict.com](http://materialdistrict.com))

soil into wooden forms repeatedly, vertically moving the frame up until the desired height is reached, not unlike the process of using cast-in-place concrete except these materials are all natural and require less energy to produce. The resulting wall is highly aesthetic and

reflects the layering process. The two main disadvantages of using rammed earth compared to the brick method are the need for much thicker walls and the difficulty of finding experts with this type of construction experience. Arguably the two most unorthodox methods of adobe construction are with earthbags and with straw bales. Earthbags are sacks filled with sand and clay that can be stacked and covered with adobe. These sacks are made with either natural materials like hemp and burlap or more protective, synthetic materials such as polypropylene. The main drawback of this method however is that the bags must act only in compression not tension. Because of this, when using this method, one must only use compressive geometries like domes and arches. While vertical walls can be constructed, their maximum heights are far more restricted unless additional support is provided by a traditional wood structure. Straw bale adobe construction, on the other hand, involves stacking rectangular blocks of straw like bricks before reinforcing them with wood, bamboo, or rebar and covering them with adobe plaster. Because the bales are placed in their entirety, the walls tend to be very thick, measuring around 18in from interior to exterior. This, however, is advantageous in that the bales are excellent insulators, can

be load bearing without the need for a secondary structure, and are surprisingly fire resistant. Similar to using rammed earth, the latter two methods also require a very specific skillset, therefore finding labor for the project may be difficult <sup>33</sup>.

Another necessary material that must be considered is the type of glass that will be implemented into the project. One alternative to conventional glass panes is smart glass panels. Smart glass is a specially designed type of glass that reacts to external temperatures. When temperatures are elevated, the glass becomes translucent, filtering the light as it passes through to prevent solar heat gain. When temperatures are cooler however, the glass becomes more transparent to allow maximum heat gain. This type of glass has also been adapted for remote use allowing occupants to adjust the transparency manually to their liking. Not only does this new technology assist with energy efficiency but it also eliminates the need for blinds and curtains.

## Section 2: Interior Materiality

When it comes to environmentally friendly interior design many of the same principles apply. Ensuring that your materials are natural, locally sourced, and free of harmful toxins are the best ways to create a sustainable interior. There are many natural materials found throughout Texas that can be utilized on the site. Bamboo, for example, which grows abundantly in Central Texas, is one of the fastest growing plants, therefore it is highly renewable and can be used in a variety of ways. It can be

---

<sup>33</sup> How to Build Straw Bale Houses | Pros and Cons. 2022. YouTube. YouTube.  
[https://www.youtube.com/watch?v=W7\\_LfVF2qSg](https://www.youtube.com/watch?v=W7_LfVF2qSg).

used for wood flooring, reinforcement as previously mentioned in straw bale construction, and several companies have even used the fibers of the bamboo to create bedding. Another one of these materials is wool. Texas has more sheep than any other state in the US meaning there is a large supply of wool. Not only can this wool be used for clothing but also for bedding, rugs, and even thermal insulation.

Like the exterior, there are also a number of new interior design innovations that have been implemented over the years. These technologies can be broken down into three specific categories. They are either examples of recycling, upcycling, or downcycling.

...Recycling is the most commonly used term of the three and is often used in place of the other two despite their slight distinctions. Recycling refers to the conversion of a product or resource into another product or resource of similar value. The emphasis here is on the phrase ‘of similar value’. One example of recycling that is applicable to the site in question is the conversion of post-consumer plastic bottles into bedding, specifically polyester. While the bottles can be refilled and used again, they are instead turned into something else. There are several companies including Under the Canopy and Buffy that specialize in this, turning plastic into items of comfort <sup>34</sup>. It is because of their recyclability that products like stainless steel, aluminum, and cardboard are also considered sustainable. Similar to recycling as well is the term reuse. The distinction, however, is that the process of reusing does not involve changing the form of an object. An example of this is the use of locally reclaimed weathered wood or furnishings.

---

<sup>34</sup> Erin Bunch, Erin. 2022. “18 Best Eco-Friendly Bedding Brands You Can Feel Extra Good Snuggling In.” Well+Good. October 13. <https://www.wellandgood.com/eco-friendly-bedding/>.

Upcycling refers to the process of using resources that would normally be considered waste to create something of greater value. One such instance of this is the use of broken glass bottles or mirrors for terrazzo flooring or countertops. Terrazzo is a mix of crushed stones, glass pieces, and sometimes even seashells held together with an epoxy resin mix. This mix can be applied to surfaces, appearing as sheets of stone, or formed into tiles. While there were little to no ways of reusing the bottle it could be broken down further and made into a larger product <sup>35</sup>.

Downcycling is the conversion of a product into a material of lesser value. An example of this is the conversion of plastic bottles into carpet fibers. Again, instead of reusing the bottles, in this case they are converted into a component or subproduct of another product <sup>36</sup>.

Lastly, another way to practice interior design sustainably is by using resources in the community. As mentioned previously, the region is rich with culture, whether from the indigenous population or the influence from Mexico just south of Big Bend National Park. With this, many of the locals express their culture through art forms such as tilemaking, sculpting, and painting. By using their products, not only does it require less transportation, but it also offers the opportunity to help out the community and local businesses. Furthermore, much of their work is created using natural materials such as clay.

---

<sup>35</sup> “3 Reasons Terrazzo Should Be Your Sustainable Flooring Choice.” 2022. TERRAZZCO. May 23. <https://terrazzco.com/terrazzo-sustainable-flooring-choice/>.

<sup>36</sup> “Upcycling vs. Recycling vs. Downcycling: The Conscious Consumers Guide.” 2022. Hive Brands. July 25. <https://hivebrands.com/blogs/news/upcycling-vs-recycling-vs-downcycling>.

## CHAPTER 6: SUSTAINABLE LUXURY

As mentioned in chapter one, one of the primary reasons tourists elect to go to luxury resorts opposed to budget lodging is for the ‘content’ that comes along with them.

Guests want to seek unique experiences and excursions when on vacation. Whether that experience involves relaxing or thrill-seeking, guests want to feel that they have options and that those options are readily available to them without hassle. However, the objective of this thesis remains; to create a regenerative, ecotourism establishment. With this in mind, what are some of the excursions and amenities that should be included in the program of this resort and how can community involvement be incorporated into these experiences? Furthermore, what audience should this resort attract and how should it attract them?

### Section 1: The Resort Identity

The fundamental difference between a resort and a hotel is the amenities. While hotels seek to offer guests a place to stay while exploring a destination, resorts seek to create a destination for guests, whether they choose to branch off from the resort or not. The means in which resorts create these destinations vary greatly. There

are ten different types of resorts, most of which are applicable in this case <sup>37</sup>. The ten resort categories are:

- Recreation Resorts
- All-Inclusive Resorts
- Destination Resorts
- Ecotourism and Ecological Resorts\*
- Adults-Only Resorts
- Family-Focused Resorts
- Clothing Optional Resorts
- Dude Ranches
- Historic Resorts
- Casino and Amusement Park Resorts

All but the latter 2 are strong possibilities for the site. While a resort does not have to perfectly fit the parameters of only one of these categories, it is crucial to choose resort types that enhance each other rather than contradict one another; the most obvious example of contradicting uses being a clothing-optional, family resort. The Regenerative Oasis is predetermined to be an ecotourism resort but what other

---

<sup>37</sup> “10 Different Types of Resorts.” 2022. Trek Baron. February 10. <https://trekbaron.com/types-of-resorts/>.

uses could be incorporated into the resort? To determine this, we should first understand each type fully.

Recreation resorts center around activity, with there being two different types of recreation resorts, health-based and sports-based. Health-based recreational resorts are meant to cater to your relaxation and health needs. They offer amenities such as bath houses, spas, and yoga. Sports-based recreational resorts, on the other hand, are exactly as they sound; they focus on a recreational sport. The majority of sports-based resorts are either golf resorts or ski resorts, however, there are other types such as polo clubs, surf resorts, and even tennis resorts.

All-inclusive resorts offer a wide variety of amenities that guests may enjoy whenever and however they please. Their slightly higher prices generally cover the costs of food, drinks, amenities, and often times excursions and tips. Because of this, these resorts tend to be larger in scale as they have to have a steady flow of guests to keep restaurants and excursions functioning. One major drawback of all-inclusive



**FIGURE 19: A destination resort, Patina Maldives**  
(Source: designboom.com)

resorts is their tendency to offer only the lowest quality of food and drinks to guests. This is due to the abbreviated costs that restaurants must work with for products.

Destination resorts are resorts centered around a specific place or feature, usually somewhere popular. A few examples include winery resorts in Italy or California's Napa Valley, island resorts in the Maldives where a resort

can occupy the entirety of an island, and safari resorts in the Serengeti of Tanzania.

Adults-only and family-focused resorts, as expected, are complete opposites and, for that reason, usually have completely different aesthetics and amenities available. Adults-only resorts do not allow any guests below a certain age, typically 18, but there are some resorts that cater solely to seniors, not allowing guests younger than retirement age. Generally, adults-only resorts are more luxurious and offer either a lively experience with nightlife options and entertainment or a more relaxing environment with spas and romantic dining options. Family-focused resorts are typically less luxurious and feature more colorful, ‘fun’ aesthetics. Despite the moniker family-focused, these resorts typically place more of an emphasis on the child’s experience, with the expectation that parents will gain satisfaction more so from their children’s happiness. There are some resorts, however, that do offer childcare facilities and teen clubs on site for youths to enjoy while their parents are away.

Clothing optional resorts can be viewed as a subcategory of adults-only resorts, as there are generally age restrictions for guests. While some resorts feature clothing optional facilities such as pools and bath houses, others are much more liberal in their policies, allowing guests to roam the resort as they please. In most cases, these resorts are in more private isolated locations such as hidden beaches and market themselves as judgment-free facilities. They offer all of the benefits that come

with typical adults-only resorts but with the added option of being nude while partaking in the amenities.

Dude ranches offer one of the more unique forms of vacation. Rather than focusing on pampering or luxury, they allow guests to experience what it is like to tend to a ranch. They are generally located in rural areas, are more rugged and rustic in nature, and offer guests learning experiences as they are taught skills like shoeing horses and tossing lassos. There are also some dude ranches that put their guests to work, waking them up at dawn to experience all that comes with working on the ranch. Of course, true to any resort, guests are still given some level of comfort and leisure with these activities, but overall, these resorts are more so for those looking to learn than those looking to relax.

Historic resorts and casino & amusement park resorts are both highly sought-after experiences but are not applicable to the site of this thesis. While there is a rich history in Big Bend, there are not enough sustained historical sites to warrant the creation of a historic resort. Furthermore, these resorts are typically in historic buildings themselves like converted plantations in the southern United States or castles in Europe. Considering the site's desolate location, there is little to no opportunities for such a destination. Casino and amusement park resorts require one of the two facilities to attract visitors: a casino or an amusement park. Both of these

are not only impractical for this site, but require tremendous amounts of energy to run and, for that reason, are highly unsustainable.

Each of these resort types come with a specific target audience, aesthetic, general location, and scale. Answering each of these factors will give a better idea as to what type of resort the Regenerative Oasis will be. By reanalyzing the current

tourists of Big Bend National Park, we can determine that the most common types of visitors are either looking for recreational activities or solitude. These visitors also range greatly in age from families with young children to lone retirees. The ideal aesthetic



**FIGURE 20: The Amangiri**  
(Source: cntraveler.com)

for this resort is one of luxury with depictions of the regional vernacular. Lastly, the location will, of course, be rural and desolate with little to no development in the immediate vicinity. The resort itself will be relatively small with a much larger campus for activities and exploring. Taking all of these factors into account, one could conclude that the most viable possibilities would be for this resort to function as a recreation, destination, and ecotourism resort. With this decided, what does this inform about visitor experience and the amenities offered?

## Section 2: Amenities and On-Site Experiences

To get a better sense of what amenities and experiences should be included in such an establishment, we can begin by exploring a few case studies that accomplish some of the goals of this resort.

Similar in scale and location, the Amangiri is a desert resort in Canyon Point, Utah, US. It features only 34 rooms and sits on over 600 acres of protected land. This resort is specifically targeted towards affluent travelers. With rooms starting at a rate of \$1,800 per night, it is not uncommon for celebrities to visit this resort, given its exclusivity and level of luxury. While the resort does not have specific age restrictions set in place, its aesthetic and amenities reflect that of an adult establishment. Because of this, this resort could be classified as both a destination and health-based recreational resort. Tucked between the red rocks of the Colorado Plateau, the Amangiri offers striking views of the Utah desert and these views are showcased at every opportunity around the resort. Amenities at the resort include a full-service spa, yoga studios, private treatment terraces, two expansive pools, and even a salon. Additionally, there are two full-service restaurants on site, each serving first-class meals with Native American-inspired dishes. Additionally, the resort hosts a number of cultural events throughout the year to celebrate the indigenous culture in the region. On the surrounding site sits over 12 miles of trails and even an iron bridge raised 400ft above the ground that guests can cross to reach panoramic views from the site's highest peaks. Furthermore, because of the resort's high cost, guests are able to partake in a number of premium private tours including air tours via helicopter or hot air balloon. With all of its amenities and luxurious offerings, much can be learned from the Amangiri. However, where the resort differs greatly from the scheme envisioned for the Regenerative Oasis is its lack of regenerative or even sustainable practices and infrastructure, its narrow affluent target audience, and its relatively small array of offerings for more common recreational activities such as biking,

camping, and backpacking <sup>38</sup>. These points raise the question how can this project offer a unique array of recreational activities and experiences, while also maintaining a more affordable price? Furthermore, how can the resort do this while also being regenerative?

While not exactly a hotel or resort, the Bliss and Stars Wilderness Retreat accomplishes many of the criterion set in place for the this resort including regeneration. Located in the South African bush, 150 miles north of Cape Town, Bliss and Stars is a retreat center that sets up three to seven-night themed events for guests to sign up for. These themes include couples' retreats, silent retreats, star-bathing retreats, self-compassion retreats, and even cooking retreats. Each of these retreats is hosted by a guide that ensures that each guest is comfortable and well-attended to. The retreat center itself consists of only 5 suites, 2 of which are elegant, tented suites located away from the main chalet. Much like the Amangiri, while there isn't any guest age restriction, both the aesthetic and room arrangements suggest that the establishment is geared towards adults. Even with its exclusivity and beautiful,



**FIGURE 21: Bliss and Stars Wilderness Retreat (Source: blissandstars.com)**

desolate location, suites at the Bliss and Stars retreat center still manage to sell for just a fraction of the price of Amangiri's, at only \$580 per person for a three-night stay; resulting in a price of \$1,160 for a couple's three-night stay as opposed to \$5,400 for

---

<sup>38</sup> "Experiences - Things to Do in Utah Desert, USA - Amangiri." 2022. Aman Resorts. Accessed December 13. <https://www.aman.com/resorts/amangiri/experiences>.

the same length of time at the Amangiri. Amenities at Bliss and Stars include private outdoor decks in each room for stargazing, a plant-based menu with foods sourced from local farmers, natural hiking trails created from animal paths, and a pool. In addition, the retreat is also regenerative, with 100% of its energy being solar powered and all of its water being provided through natural springs. Additionally, Bliss and Stars stores wastewater using it for irrigation, clears invasive species from the adjacent Doring River to “help the positive circularity of the local ecosystem”, and uses wood from invasive species for fire. As far as benefits to the community, the retreat center has also created a bursary program in which 5% of all of their proceeds is allocated towards, making their retreats more accessible to all, regardless of financial status <sup>39</sup>.

In many ways, the Bliss and Stars Wilderness retreat makes up for what the Amangiri lacks and vice versa. Bliss and Stars offer guests luxurious accommodations at affordable rates. Its small scale paired with its retreat style format gives the establishment a communal atmosphere while also feeling exclusive. Additionally, its efforts towards regeneration and community engagement are highly admirable. The Amangiri, on the other hand, provides guests with world-class amenities, highly flexible accommodations, and a truly exclusive experience. It can be argued that while the Amangiri exudes extravagance and wealth, Bliss and Stars embodies harmony and biophilia. In either case, there are aspects that can be implemented into this thesis.

---

<sup>39</sup> “Bliss & Stars.” 2022. Regenerative Travel. October 3.  
<https://www.regenerativetravel.com/resorts/bliss-and-stars/>.

## CHAPTER 7: RESORT OPERATION

As stated before, although one of its best qualities, the site's seclusion also makes it incredibly challenging to develop. Because of the lack of people and infrastructure in the immediate vicinity, the resort will require some creative solutions for not only getting people to the site, including the employees, but also getting food and products there as well. Furthermore, these solutions should reflect the resort's eco-friendly values.

### Section 1: Transportation

The first issue that must be addressed is transportation as it is critical for not only keeping up the clientele for the resort but for the management and operation of the resort as well. The entrance to the site from Highway 385 sits 192 miles south, roughly 3 hours and 20 minutes, from the Midland International Air & Space Port (MLF) and 284 miles east, or about 4 hours and 40 minutes, from El Paso International Airport. Moreover, there is also the Alpine Amtrak station just 68 miles north, 1 hour and 20 minutes, away. However, not only should the resort provide the means for getting guests to the resort but also a means for them to get to specific points of interest within the National Park itself like trailheads and its several visitor centers. Both the park entrance and Persimmon Gap visitor center are a mere 6 miles south from the site's entrance but the Chisos Basin Visitor Center which sits at the center of the park and is the terminus of many of the park's trails is 45 miles south. With all of this said, *how can the resort provide transportation while also being sustainable and environmentally friendly?*

The most obvious answer to this question is to implement all-electric vehicles (EVs) to transport visitors between these sites but is this feasible? At this time, not necessarily. Today, even the most efficient fully electric vehicle available in America, the 5-passenger Lucid Air Grand Touring, has a maximum electric range of only 520 miles, making the 570-mile round trip from El Paso out of the question without a charging stop. This, also, is not even considering the fact that vehicles with higher passenger counts will likely be needed for pickups. EVs like the 7-passenger Rivian R1S and Tesla Model X or even the 14-passenger Ford E-Transit only have maximum ranges of 316 miles, 348 miles, and 126 miles respectively, meaning none of them would be able to make the roundtrips to ELP or MLF airports without stopping to charge. Furthermore, one of the biggest issues with utilizing all-electric vehicles on this site is the lack of EV infrastructure in the region. While, of course, the vehicles are able to be charged from the resort itself overnight, there are very few places for the vehicles to charge quickly away from the site. EVs can use either Level 1, Level 2, or Level 3 charging. Level 1 is standard home 120 volt charging which takes about 40-50 hours to fully charge most EVs. Level 2 chargers are 240 volts like the outlets used to power most dryers. These are capable of charging a vehicle in just 12 hours. The fastest chargers, Level 3 DC Fast Chargers, however, are specially made at public stations. They use 480 volts, providing EV's with 10 to 20 miles of charge per minute. This means that most EVs can be fully charged from empty in just 15 to 20 minutes <sup>40</sup>. For the resort shuttle service to function efficiently, they would

---

<sup>40</sup> "Types of Electric Vehicle Chargers." Duke Energy, [www.duke-energy.com/energy-education/electric-vehicles/charging-your-ev/types-of-chargers](http://www.duke-energy.com/energy-education/electric-vehicles/charging-your-ev/types-of-chargers).

require Level 3 charging stops at each airport. There are a total of five fast charging ports within a 5-mile radius of ELP and twelve within a 5-mile radius of MLF, eight of which are only compatible with Tesla vehicles. With all of this said, EV shuttle service to and from the airport is not viable at the moment. However, it is very much possible to use EVs to transport guests to and from the national park itself. With a roundtrip distance of around just 90 miles, both the Rivian and the Tesla would be capable of making 3 trips for a total of 18 guests dropped off without a charge while the E-Transit could make 1 full trip for 13 guests.

Another solution to this issue is the use of hybrid vehicles. While these vehicles do still use fuel, they do so much more efficiently than standard fuel vehicles. The 8-passenger Chrysler Pacifica Hybrid, for example, reaches 82 highway miles per gallon when using both fuel and battery power, a significant increase from the standard Pacifica's 29 mpg <sup>41</sup>. This solution would allow the vehicles to make the full roundtrips from El Paso and Midland using only 7 and 5 gallons of fuel respectively.

The format of the pickup and drop-off process is also crucial as it affects the efficiency of the service. If shuttles ran all day at specific times, there is a risk of making unnecessary trips. Perhaps the solution instead is to have guests predetermine when they will be needing transportation to and from the airport to ensure that the drive is needed at that specific time. Shuttles could also make stops at the Alpine Amtrak station en route from ELP or MAF whenever necessary to lessen the number

---

<sup>41</sup> Hybrid vs Gas with a Chrysler Pacifica | Santa Ana, CA, 18 June 2021, [www.ocauto.com/blog/do-you-go-hybrid-or-gas-with-a-chrysler-pacifica/](http://www.ocauto.com/blog/do-you-go-hybrid-or-gas-with-a-chrysler-pacifica/).

of trips required each day. As for trips to the national park, these could function in either a similar fashion or on a specific schedule as the consequent trip isn't as severe.

### Section 2: Operation and Workforce

The next issue that should be addressed how to maintain a full crew to run the resort. The nearest towns to the site are Marathon, Alpine, Study Butte-Terlingua, and Lajitas 38, 68, 71, and 83 miles away, respectively. However, with a combined population of around 6,700 and 87% of those being from Alpine, getting workers who are willing to make the commute is no easy feat. One way this issue can be tackled is through the same means that most national parks house their workers. Many times, park rangers are given a specific place on site for housing which they pay relatively low rents for. This format offers workers the convenience of no commute and lowered rent. Additionally, the coworkers living there would ultimately gain a sense of community among the team, making for an easier and more satisfying work environment. Furthermore, perhaps the resort could employ drivers from the much larger metros of El Paso and Midland who are willing to drive the shuttles to the resort each day and possibly even allow other employees to carpool to the resort as well.

Another aspect of the operation is getting food and products to the site. This issue could be resolved through the community aspect of ecotourism. The resort could buy produce and dairy from local farmers and ranchers. Local cooks can also be hired to make cuisines inspired by the flavors from the region. Not only would this provide a unique experience for guests, but it would also offer locals that aren't able to afford their own restaurants the chance to practice their craft in a different way.

The same could be offered to local craftsmen. Their products could be purchased as resort décor or be displayed at the resort's gift shop to be sold. Overall, the resort could serve almost as a market, presenting locals with an outlet for selling their goods and putting their skills to use.

As far as getting more mainstream brands and goods to the site, perhaps the resort could act as its own vendor, having its own electric van dedicated to picking up products from wholesale big box suppliers in Midland, El Paso, or even Fort Stockton just 90miles north of the site. This would enable EV cargo vans such as the BrightDrop Zevo, with its fully electric range of 250 miles and over 600 cu. ft. of cargo to make the full 180-mile roundtrip without charge <sup>42</sup>. Buying from bulk wholesalers also reduces the number of trips needed as well as the amount of packaging used.

---

<sup>42</sup> "Brightdrop Zevo: All-Electric Delivery Van." BrightDrop, [www.gobrightdrop.com/products/brightdrop-zevo](http://www.gobrightdrop.com/products/brightdrop-zevo).

## CHAPTER 8: DESIGN SOLUTION

### Section 1: Selecting and Handling the Site

Throughout the design and planning process, there were two primary considerations: guest experience and functionality. While these two often resulted in conflicting concepts, ultimately these issues were able to be resolved.

The first step within this design process was deciding where within the site's 34,000 acres would make the most sense for the resort. This was decided through the use of a few simple criteria, access to water, solar conditions, wind conditions, ease of construction, views, and access from the adjacent Highway 385. With these criteria in mind, a site was selected along a hill within a large valley. Its proximity to an arroyo, an inactive submersible well, and an existing vehicular dirt road made this specific portion of the site ideal for development. Additionally, its location within the valley gave the resort stunning mountain views in every direction.

The proceeding factor was deciding how to layout the components of the resort. These decisions were made by analyzing the different types of tourists who would be visiting this resort and the qualities that each would desire from their place of lodging. These four tourist types consisted of the *adventurers*, the *soul-seekers*, the *scholars*, and the *bon-vivants*. Out of all of these groups, the adventurers are the prominent types of tourists in the area. This type of traveler desires a sense of ruggedness and uniqueness within their lodging while still maintaining some level of comfort. They seek to partake in activities such as hiking, climbing, biking, etc. The soul-seekers visit the area to disconnect from the outside world, taking part in

activities such as yoga, art, meditating, and self-reflection. This particular group values their privacy, solitude, and serenity. The scholars consist of those looking to explore wildlife, geology, history, or other many unique opportunities for learning. While they, of course, are seeking peace and privacy, they often desire to have some sort of expertise and guidance as well as opportunities to observe the happenings of the site. Lastly, the bon-vivants, while the Big Bend region doesn't particularly appeal to this type of traveler, with the inclusion of luxury amenities and cultural experiences, the resort could serve as a new catalyst for these types of tourists. Bon-vivants seek what many may call "the finer things in life", looking to immerse themselves in the culture with ease, comfort, and exclusivity being a few of their priorities as well as socializing with other like-minded travelers. Together, these different qualities encouraged the creation of multiple sections within the resorts; the Central Village which served as the hub of most activities and social gatherings; Farm Hill which sat next to a 3-acre farm and offered some of the best views; The Overlook some of the furthest villas which sat high above the rest of the resort; and The Sanctuary placed at the northernmost end of the site away from all of the activity and much further spaced out than the other regions. Creating these different zones and allowing guests to book by villa would ensure that every guest can alter their own experience to their liking. Furthermore, each area consisted of studio, one-bedroom, and two-bedroom villas. At the southernmost point of Farm Hill also sat three premium two-bedroom villas, which hosted the best views looking over the valley along with large freestanding tubs.

## KEY

- 1 | PARKING
- 2 | GUEST LODGE
- 3 | SPA
- 4 | EVENT YARD
- 5 | STARGAZING YARD
- 6 | RESTAURANT
- 7 | GREENHOUSES
- 8 | COMPOSTING
- 9 | FARMING CENTER +  
EQUIPMENT STORAGE
- 10 | TERRACED GARDEN
- 11 | POULTRY FARM
- 12 | GOAT FARM
- 13 | SLOPED GARDEN

## VILLAS

- S | STUDIO
- I | ONE BDRM
- II | TWO BDRM

# SITE PLAN



FIGURE 22: Resort Site Plan

(Source: Author)

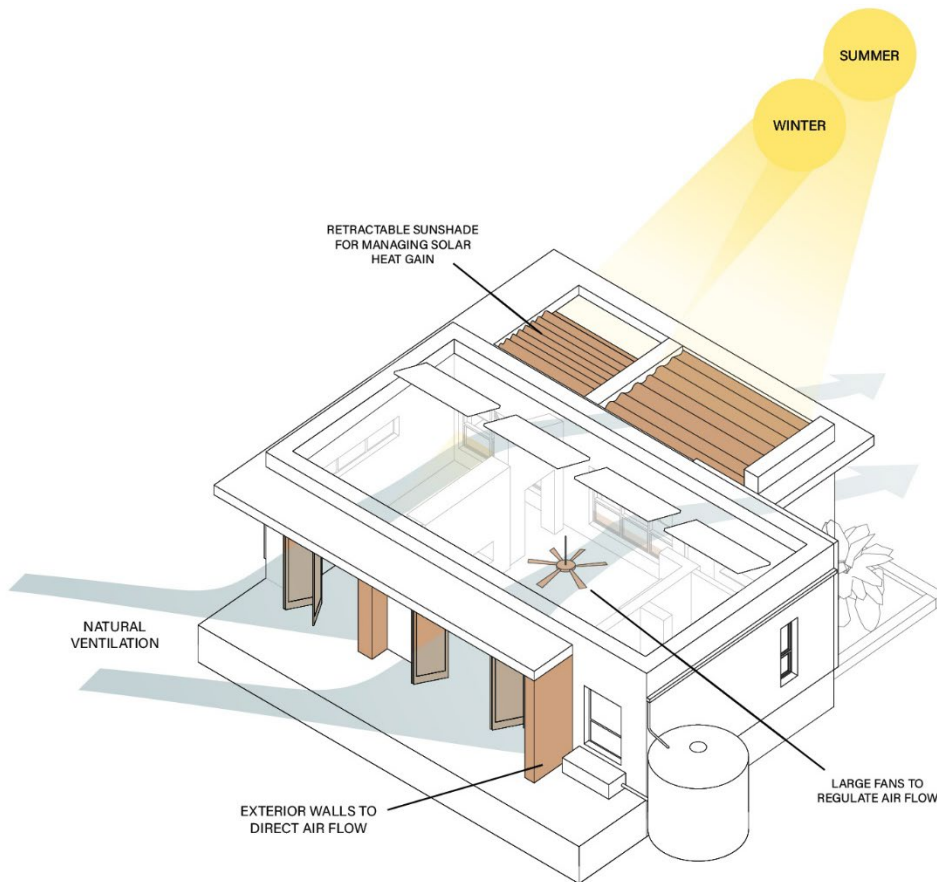
FIGURE 23: Resort Site Zones

(Source: Author)



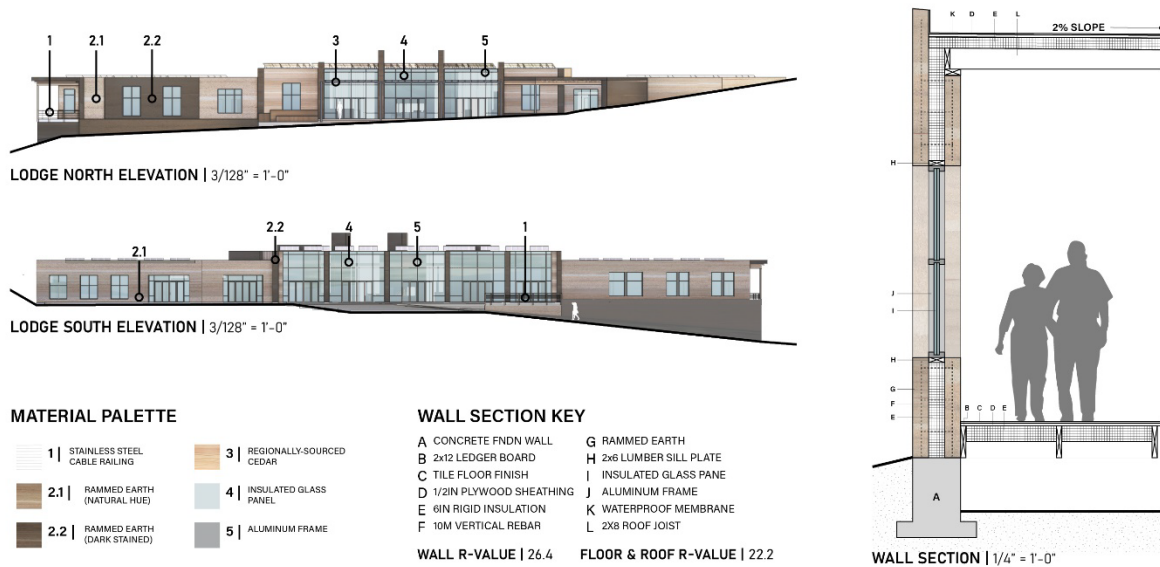
## Section 2: Form

A number of passive systems were incorporated to limit the amount of energy required in each building. Natural ventilation and passive solar strategies were two of the main driving factors in the actual form of the buildings. Each building had methodically placed fins that assist in directing the consistent northeasterly winds through the interior. On the south elevations, each building was either equipped with large cantilevers with moveable shade screens or louvers. In either case, each south elevation receives ample glazing to allow light and heat in when necessary. Additionally, all buildings utilized large bifold door systems to let light and air in and allow the lines between the indoors and outdoors to be erased.



**FIGURE 24: Passive Systems (Source: Author)**

In terms of materiality, each structure is constructed from rammed earth, a more modern take on the adobe construction used by the native and Mexican population in the regions. Each rammed earth wall was packed with six inches of rigid insulation and all glazing was double paned insulated glass to ensure comfortable conditions inside requiring far less energy. This use of natural material also extended to the interiors where recycled and organic materials were utilized such as recycled glass countertops, adobe flooring, organic cotton bedding, and recycled paper pillow stuffing.



**FIGURE 25: Exterior Materiality (Source: Author)**

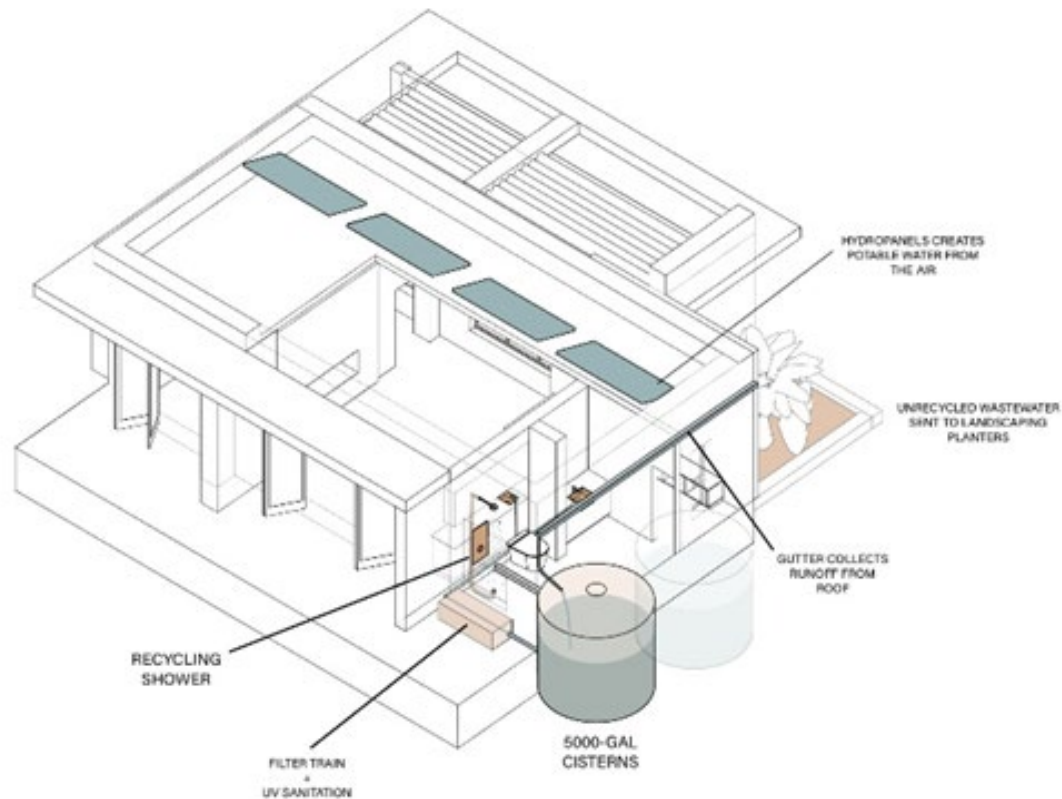


**FIGURE 26: Interior Materiality (Source: Author)**

### Section 3: Function

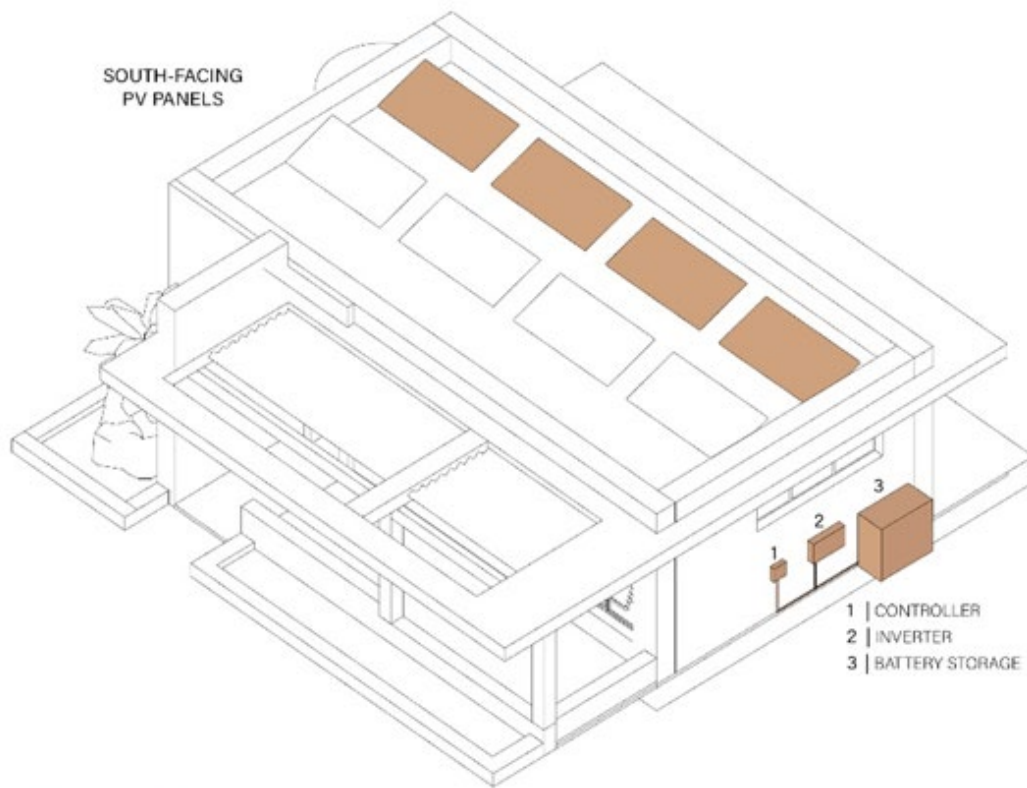
The next step in the process involved investigating how this resort would function. As mentioned in previous chapters, providing water for the resort proved to be a challenge on such an arid site. This was accomplished through the use of both hydropanelers and rainwater collection. Each villa and building would utilize its own independent water system. The rainwater collection for each building would take place throughout the construction process with the use of temporary tensile structures. By using these, the initial supply of water alone will sustain the resort for up to two years. Additionally, the estimated rate of collection is higher than the rate of usage, proving that, under normal circumstances, the resort will have a net-positive water supply. Not only are the means for collecting the water sustainable but so are the means in which the water is utilized. Each villa is equipped with a recycling shower system that actively reuses and filters the water that goes down the drain. The toilets are also composting toilets meaning no water would be used there. The wastewater

from each villa is sent out into the surrounding landscaping.



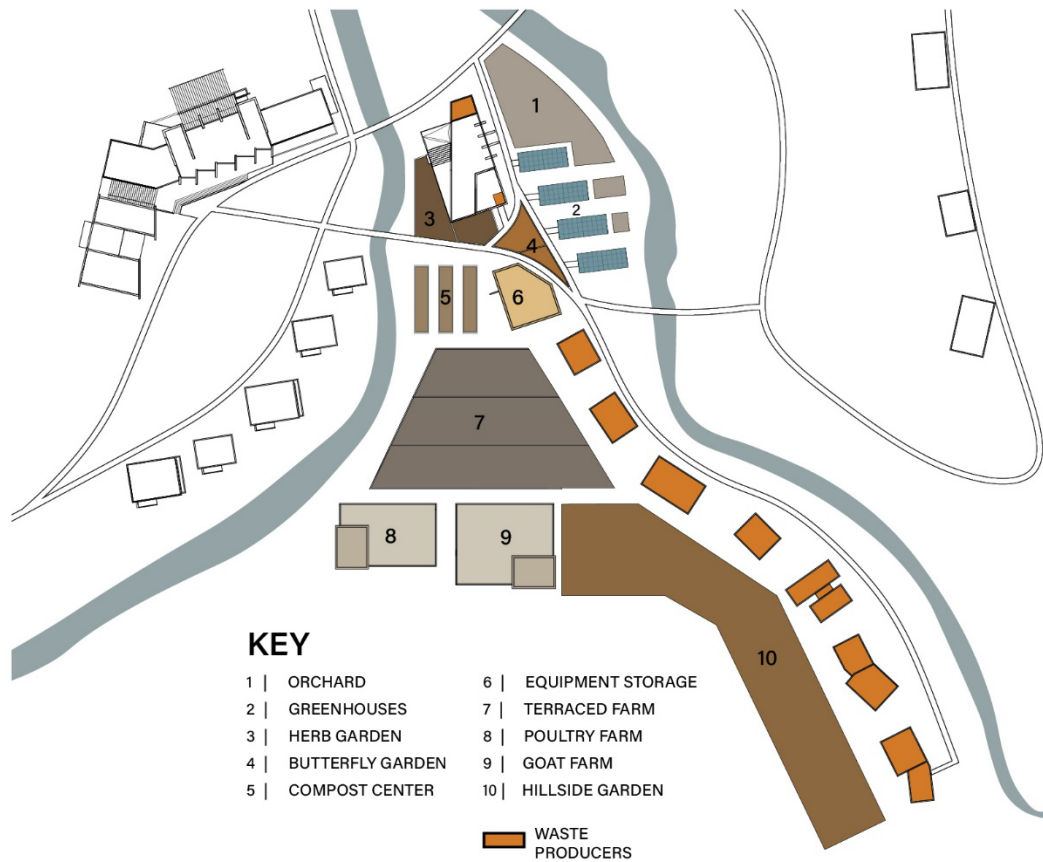
**FIGURE 27: Water Collection/Usage Diagram (Source: Author)**

Providing energy to the villas also proved to be a challenge. While it was initially assumed that both solar and wind energy were viable options in this environment, wind power proved to be far less fruitful than expected therefore solely solar power was used with 310 rooftop solar panels to be exact producing 305,022 kilowatts/year compared to the 290,998 kilowatts/year needed to power the resort making it net-positive energy site as well.



**FIGURE 28: Energy Collection Diagram (Source: Author)**

One of the largest developments throughout the design process was the addition of the farm. At just over 3 acres, the farm provides a small portion of the site's food and includes a terraced garden, an area for handling compost, as well as a small poultry and goat farm. The farm arose from the idea of handling humanure. Humanure cannot be used to grow crops for human consumption, however, crops grown with humanure can be eaten by animals to later be digested and turned into manure which can be used for crops eaten by humans. Alternatively, the farm animals could serve as a source for meat for the restaurant. The food that isn't gathered on the site can be obtained from other local farms, creating great economic opportunities for the local economy.



**FIGURE 29: Farm Diagram (Source: Author)**

#### Section 4: Conclusion

In the end, the resulting resort became a place of connection between humans and nature. Even with it being a luxury resort, through the architecture, visitors are encouraged to connect with what is outside of the rammed earth walls. Furthermore, by demonstrating how a net-positive water and energy establishment can be constructed in such an extreme environment, it should encourage other lodging properties to move towards greener design in their properties where resources are much more abundant. Ultimately, this resort is not only regenerative in its usage but in its experience.



# GREENING THE GETAWAY

DESIGNING A LUXURY RESORT FOR THE ECO-CONSCIOUS TRAVELER

## OBJECTIVE

In many ways, traveling can be viewed as an unnecessary luxury that only harms our environment; not only because of the transportation to our destinations, but also due to the tremendous amounts of energy it takes to maintain our place of lodging. This thesis demonstrates how to eliminate the negative impact of such establishments by designing a luxury resort that is also regenerative. In the end, this resort will become a place where humans, wildlife, and flora can flourish symbiotically.

**581**  
THOUSAND

visitors to Big Bend National Park (2021)

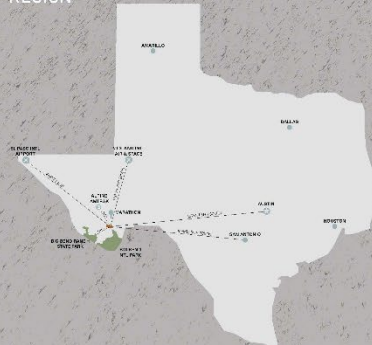
**87%**

of travelers reported wanting to travel more sustainably

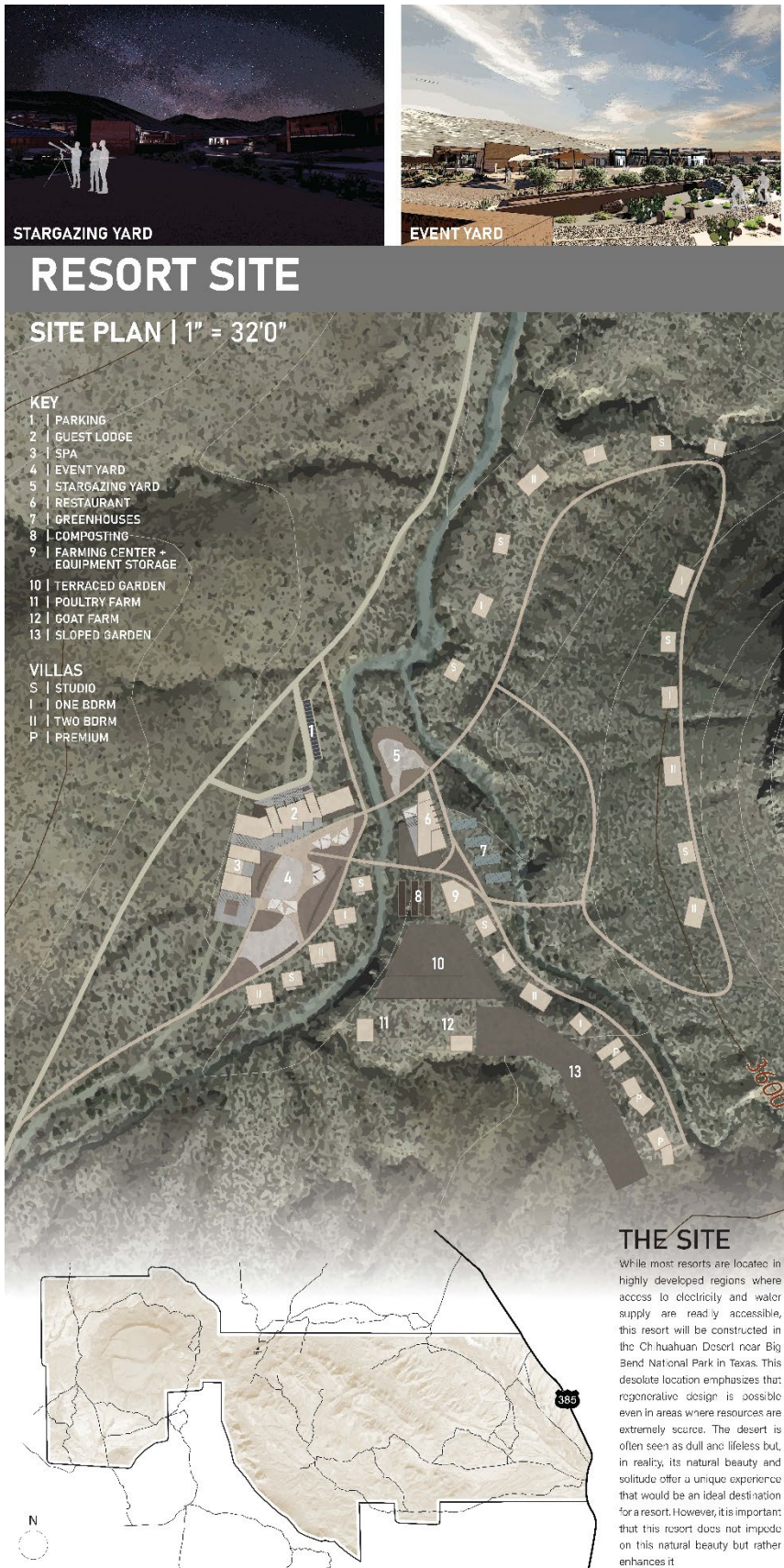
**20%**

of those travelers cited a lack of luxury options as their reason for not traveling sustainably

## REGION



**FIGURE 30.1: Final Presentation Boards**  
(Source: Author)



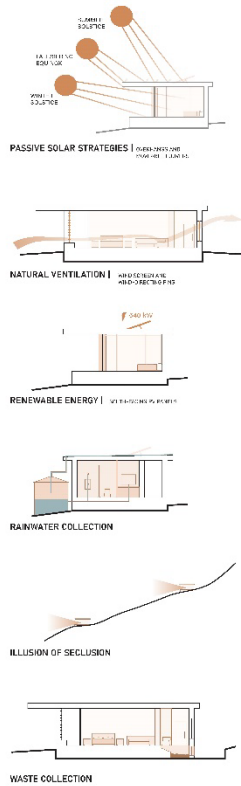
**FIGURE 30.2: Final Presentation Boards**  
(Source: Author)



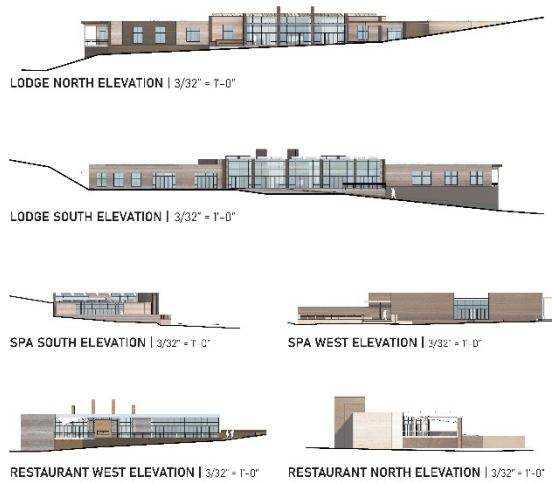
**FIGURE 30.3: Final Presentation Boards**  
(Source: Author)

## MAIN LODGE AND AMENITIES

### BUILDING PRINCIPLES



### ELEVATIONS



### LODGE + SPA + RESTAURANT FLOOR PLANS

- 3/4" = 1'-0"
- KEY**
1. ENTRY PORCH
  2. KITCHEN
  3. WASH & MANAGE/VENT ROOM
  4. VESTING ROOM
  - 5A. REST ROOM
  - 5B. TUB, GUEST BATHROOM
  - 6C. REST ROOM + GUEST ROOM
  6. STORAGE
  7. SPA TREATMENT
  8. GUEST GIFT SHOP/LOBBY
  9. YACHTING ROOM
  10. SAL. ROOM
  11. STAFF ROOM
  12. SAUNA
  13. HYDROTHERAPY ROOM

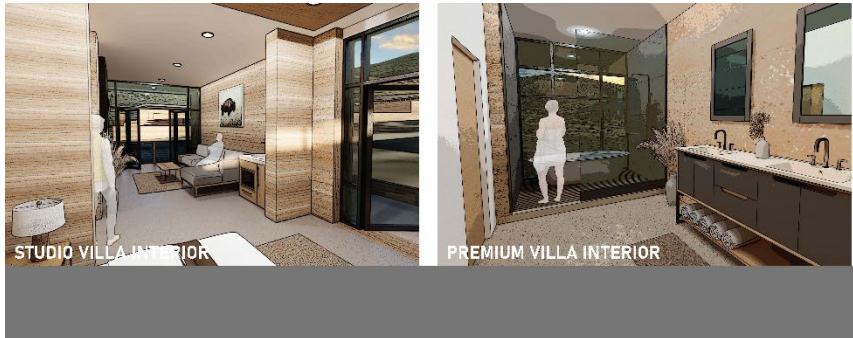


### PANORAMIC SITE VIEW

#### KEY

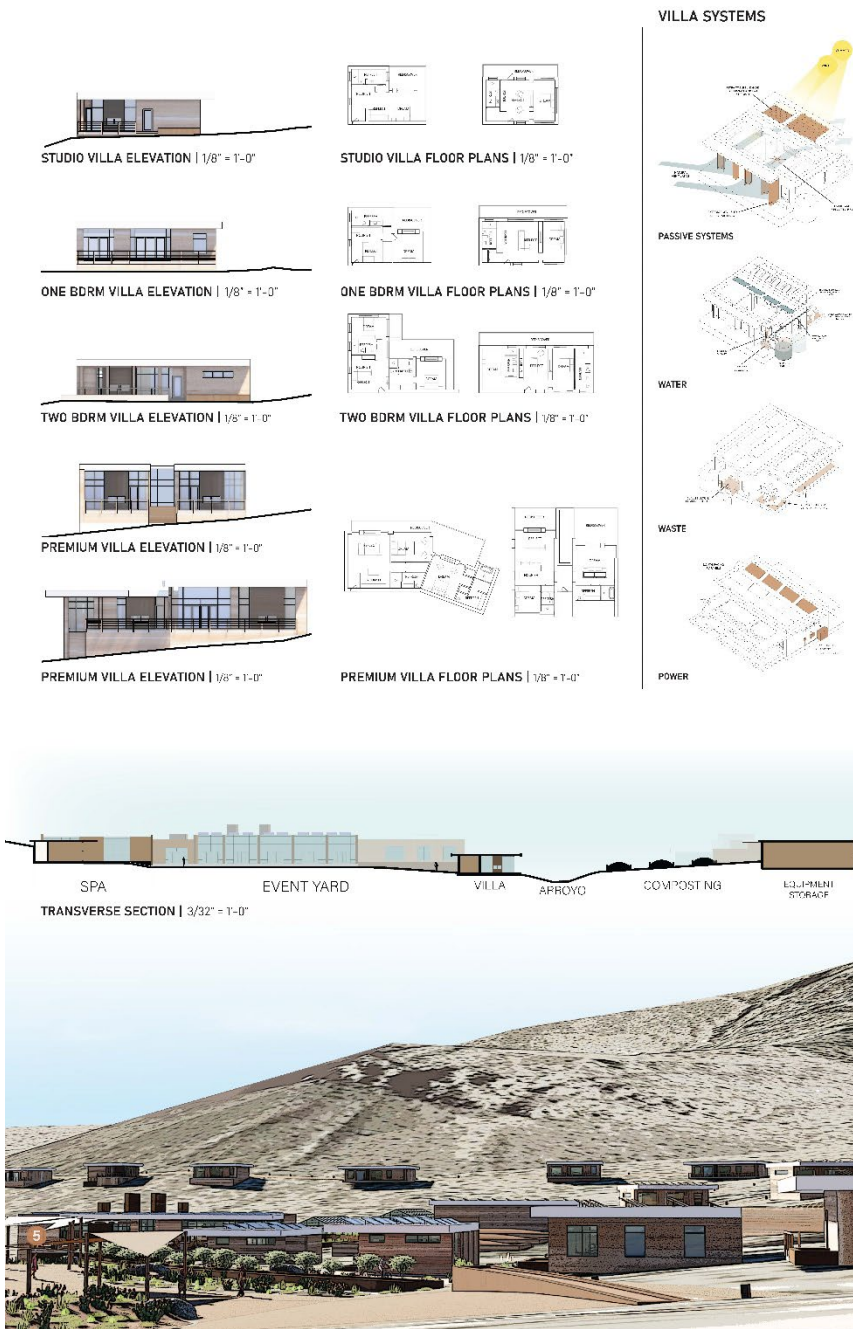
- |                    |                |
|--------------------|----------------|
| 1   SPA            | 4   EVENT YARD |
| 2   LOUNGING PATIO | 5   RESTAURANT |
| 3   GUEST LODGE    | 6   FARM       |

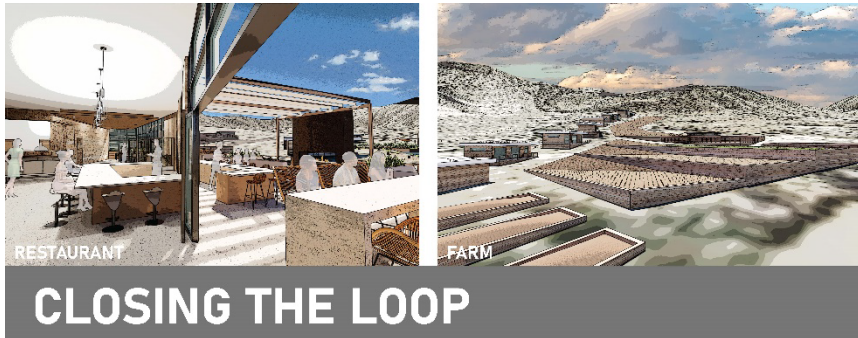




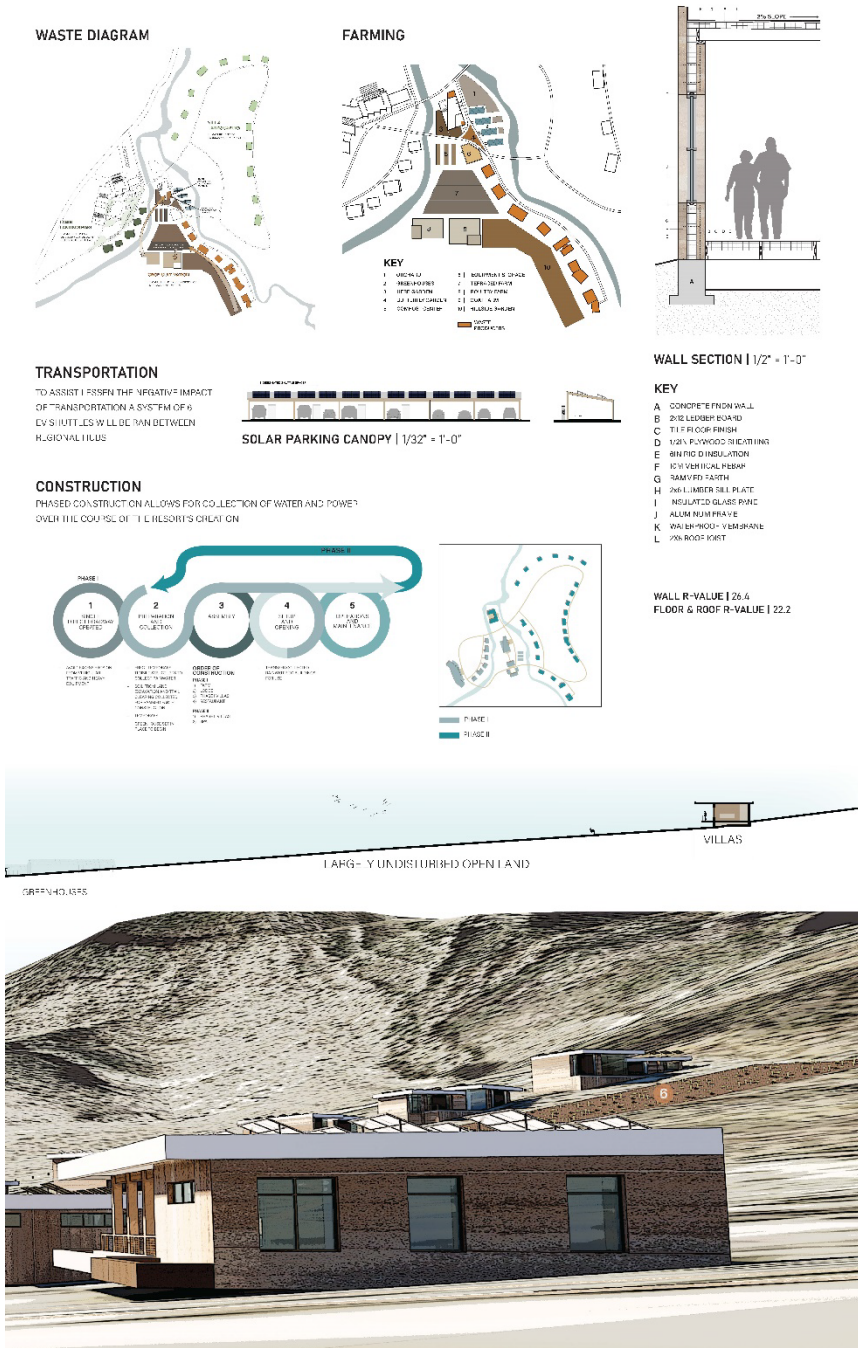
**FIGURE 30.4: Final Presentation Boards**  
(Source: Author)

## VILLAS





**FIGURE 30.5: Final Presentation Boards**  
(Source: Author)



## Bibliography

“10 Different Types of Resorts.” 2022. Trek Baron. February 10. <https://trekbaron.com/types-of-resorts/>.

“10 ECO Building Materials Revolutionizing Home Construction.” 2022. Elemental Green | Dream Discover Design. July 8. <https://elemental.green/10-eco-building-materials-revolutionizing-home-construction/>.

2021. What Is Smart Glass? Brennan. July 13. <https://brennancorp.com/blog/what-is-smart-glass/>.

2022. EPA. Environmental Protection Agency. Accessed December 13. <https://www.epa.gov/heatislands/using-trees-and-vegetation-reduce-heat-islands>.

2022. Jumano Nation of Texas Since 1500. Accessed December 13. <https://jumanonation.com/#:~:text=The%20Jumano%20Nation%20is%20alive,and%20history%20of%20our%20ancestors>.

2022. The Making of Rammed Earth Walls. Harmony Projects. <https://www.youtube.com/watch?v=XrDLI1t37Lk>.

“3 Reasons Terrazzo Should Be Your Sustainable Flooring Choice.” 2022. TERRAZZCO. May 23. <https://terrazzco.com/terrazzo-sustainable-flooring-choice/>.

“The 5 C’s: A New Definition of Luxury Travel.” Hospitality News & Business Insights by EHL, [hospitalityinsights.ehl.edu/new-definition-luxury-travel](https://hospitalityinsights.ehl.edu/new-definition-luxury-travel).

“All You Need to Know about Home Geothermal Heating & Cooling.” 2020. Dandelion Energy. March 13. <https://dandelionenergy.com/all-you-need-to-know-about-home-geothermal-heating-cooling>.

“Amangiri - Aman Resorts.” 2022. Accessed December 14.  
[https://www.aman.com/sites/default/files/2021-06/amangiri\\_experience\\_guide\\_2021.pdf](https://www.aman.com/sites/default/files/2021-06/amangiri_experience_guide_2021.pdf).

Baldwin, Eric. 2022. “Designing Shadows: 10 Dynamic Screen Façades from the United Arab Emirates - Architizer Journal.” Journal. May 31.  
<https://architizer.com/blog/inspiration/collections/uae-screens/>.

Baraya, Santiago. 2020. “Adobe: The Most Sustainable Recyclable Building Material.” ArchDaily. ArchDaily. August 26. <https://www.archdaily.com/945692/adobe-the-most-sustainable-recyclable-building-material>.

Bardsley, Daniel. 2021. “The Heat Is on: How Cities Choose to Combat Rising Temperatures.” The National. The National. July 5.  
<https://www.thenationalnews.com/uae/environment/the-heat-is-on-how-cities-choose-to-combat-rising-temperatures-1.890638>.

“Batch System Maintenance.” *Clivus Multrum Composting Toilets*,  
[www.clivusmultrum.com.au/support/maintaining-your-clivus-multrum/batch-system-maintenance](http://www.clivusmultrum.com.au/support/maintaining-your-clivus-multrum/batch-system-maintenance).

“Big Bend National Park (U.S. National Park Service).” 2022. National Parks Service. U.S. Department of the Interior. Accessed October 14. <https://www.nps.gov/bibe/index.htm>.

“Biomass Energy Basics.” 2022. NREL.gov. Accessed December 13.

<https://www.nrel.gov/research/re-biomass.html>.

“Biomass Energy.” 2022. National Geographic Society. Accessed December 13.

<https://education.nationalgeographic.org/resource/biomass-energy>.

“Bison Bellows: A Day to Thank the Bison (U.S. National Park Service).” 2022. National Parks Service. U.S. Department of the Interior. Accessed December 13.

<https://www.nps.gov/articles/bison-bellows-11-25-15.htm#:~:text=The%20bison%20provided%20them%20with,Plains%20Indians%2C%20bis on%20equaled%20survival>.

“Bliss & Stars.” 2022. Bliss & Stars Retreat. Accessed December 13.

<https://blissandstars.com/>.

“Bliss & Stars.” 2022. Regenerative Travel. October 3.

<https://www.regenerativetravel.com/resorts/bliss-and-stars/>.

Borlea (Mureșan), Simona Ioana, Ancuța-Elena Tiuc, Ovidiu Nemeș, Horațiu Vermeșan, and Ovidiu Vasile. 2020. “Innovative Use of Sheep Wool for Obtaining Materials with Improved Sound-Absorbing Properties.” *Materials* 13 (3): 694. doi:10.3390/ma13030694.

Boyle, Darren. 2017. “‘Chameleon House’ in the California Desert Blends into Its Surroundings Because It Is Covered in Mirrors&nbsp;” *Daily Mail Online*. Associated Newspapers. March 10. <https://www.dailymail.co.uk/news/article-4300810/Chameleon-house-California-covered-mirrors.html>.

“Brewster County, Texas.” 2022. Wikipedia. Wikimedia Foundation. Accessed December 13.

[https://en.wikipedia.org/wiki/Brewster\\_County,\\_Texas#Demographics](https://en.wikipedia.org/wiki/Brewster_County,_Texas#Demographics).

“Brightdrop Zevo: All-Electric Delivery Van.” BrightDrop,  
[www.gobrightdrop.com/products/brightdrop-zevo](http://www.gobrightdrop.com/products/brightdrop-zevo).

Buckeridge, Miles. 2022. “What Is the Hottest Temperature Ever Recorded in the UAE ?”

What's On. July 19. [https://whatson.ae/2022/07/hottest-temperature-ever-uae/#:~:text=The%20official%20record%20for%20the,%2Dsweating%2052.1%C2%BAC%20\(125.78%C2%BAF\)](https://whatson.ae/2022/07/hottest-temperature-ever-uae/#:~:text=The%20official%20record%20for%20the,%2Dsweating%2052.1%C2%BAC%20(125.78%C2%BAF)).

Erin Bunch, Erin. 2022. “18 Best Eco-Friendly Bedding Brands You Can Feel Extra Good Snuggling In.” Well+Good. October 13. <https://www.wellandgood.com/eco-friendly-bedding/>.

Cilento, Karen. 2012. “Al Bahar Towers Responsive Facade / Aedas.” ArchDaily. ArchDaily. September 5. <https://www.archdaily.com/270592/al-bahar-towers-responsive-facade-aedas>.

Cohen, Ariel. “How Dubai Is Using Laser Drones to Shock Rainwater out of the Sky.”

*Forbes*, 10 Dec. 2021, [www.forbes.com/sites/arielcohen/2021/07/28/dubai-is-using-laser-drones-to-shock-rainwater-out-of-the-sky/?sh=1ccefb7254ce](http://www.forbes.com/sites/arielcohen/2021/07/28/dubai-is-using-laser-drones-to-shock-rainwater-out-of-the-sky/?sh=1ccefb7254ce).

Conte, Niccolo. 2022. “Which US State Generates the Most Wind Power? There's a Clear Winner.” World Economic Forum. April 26. <https://www.weforum.org/agenda/2022/04/us-wind-electricity-generation-renewable-energy/#:~:text=Wind%20power%20is%20the%20largest,by%20Iowa%2C%20Oklahoma%20and%20Kansas>.

<https://www.weforum.org/agenda/2022/04/us-wind-electricity-generation-renewable-energy/#:~:text=Wind%20power%20is%20the%20largest,by%20Iowa%2C%20Oklahoma%20and%20Kansas>.

Dandelion Energy. “All You Need to Know about Home Geothermal Heating & Cooling.”

*Dandelion Energy*, 7 Dec. 2022, [dandelionenergy.com/all-you-need-to-know-about-home-geothermal-heating-cooling](https://dandelionenergy.com/all-you-need-to-know-about-home-geothermal-heating-cooling).

“Definition and Key Concepts.” 2022. GEN - Global Ecotourism Network. Accessed November 6. <https://www.globalecotourismnetwork.org/definition-and-key-concepts/>.

Dhar, Michael, and Ailsa Harvey. 2022. “How Do Solar Panels Work?” LiveScience. Purch. February 11. <https://www.livescience.com/41995-how-do-solar-panels-work.html>.

“Ecotourism vs. Sustainable Tourism.” 2021. Integra LLC. Intergra LLC. January 8. <https://www.integrallc.com/ecotourism-vs-sustainable-tourism-2/#:~:text=Industry%20consensus%20agrees%20ecotourism%20is,the%20environment%20and%20local%20communities>.

Ennos, Roland. 2015. “Can Trees Really Cool Our Cities down?” The Conversation. November 22. <https://theconversation.com/can-trees-really-cool-our-cities-down-44099#:~:text=Evapotranspiration%20occurs%20when%20the%20sun's,left%20to%20warm%20the%20air>.

Environment, UN. “Tourism.” *UNEP*, [www.unep.org/explore-topics/resourceefficiency/what-we-do/responsibleindustry/tourism#:~:text=In%20a%20'business%2Das%2D,in%20the%2021st%20century](http://www.unep.org/explore-topics/resourceefficiency/what-we-do/responsibleindustry/tourism#:~:text=In%20a%20'business%2Das%2D,in%20the%2021st%20century).

“Environmental Impact of the Desert Metropolis; Let's Talk Climate Crisis in Las Vegas.” 2021. Medium. Medium. June 10. <https://flatworldx.medium.com/environmental-impact-of-the-desert-metropolis-lets-talk-climate-crisis-in-las-vegas-1c0adac97688>.

“Experiences - Things to Do in Utah Desert, USA - Amangiri.” 2022. Aman Resorts. Accessed December 13. <https://www.aman.com/resorts/amangiri/experiences>.

Furlow, Nancy E. n.d. “Greenwashing in the New Millennium.” Essay. In Journal of Applied Business and Economics.

“Global Gridded Model of Carbon Footprints.” Global Gridded Model of Carbon Footprints, [www.citycarbonfootprints.info/](http://www.citycarbonfootprints.info/).

Hickerson, Nancy P. 2019. “Jumano Indians.” TSHA. April 27. <https://www.tshaonline.org/handbook/entries/jumano-indians#:~:text=The%20Jumanos%20were%20buffalo%20hunters,form%20in%20twentieth%2Dcentury%20scholarship>.

“Hot Air Rises, Cold Air Sinks: The Affect on Home Climate.” 2022. Smart AC Controller. Cielo. January 3. <https://cielowigle.com/blog/hot-air-rises-cold-air-sinks/>.

“How Do Hydropanels Work?” SOURCE Water, [www.source.co/how-hydropanels-work/](http://www.source.co/how-hydropanels-work/).

“How Do Wind Turbines Work?” 2022. Energy.gov. Accessed December 13. <https://www.energy.gov/eere/wind/how-do-wind-turbines-work#:~:text=Wind%20turbines%20work%20on%20a,a%20generator%2C%20which%20creates%20electricity>.

How to Build Straw Bale Houses | Pros and Cons. 2022. YouTube. YouTube.

[https://www.youtube.com/watch?v=W7\\_LfVF2qSg](https://www.youtube.com/watch?v=W7_LfVF2qSg).

Hybrid vs Gas with a Chrysler Pacifica | Santa Ana, CA, 18 June 2021,

[www.ocauto.com/blog/do-you-go-hybrid-or-gas-with-a-chrysler-pacifica/](http://www.ocauto.com/blog/do-you-go-hybrid-or-gas-with-a-chrysler-pacifica/).

“Introduction to Geothermal Drilling.” 2012. Geothermal Pros and Cons. April 19.

<https://geothermalprosandcons.net/introduction-to-geothermal-drilling/>.

Littman, Jacob Alexander. 2009. “Regenerative Architecture: A Pathway beyond Sustainability.” Thesis, Amherst, MA. UNIVERSITY OF MASSACHUSETTS AMHERST.

Lucia. 2016. “Desert Dwellings: How to Design for the Desert.” Modlar.

<https://www.modlar.com/news/180/desert-dwellings-how-to-design-for-the-desert/>.

Marabito, Maria. 2022. “Are Adobe Houses Sustainable?” Treehugger. Treehugger. March

11. <https://www.treehugger.com/are-adobe-houses-sustainable-5116189>.

“Mashrabiya.” Wikipedia,

[en.wikipedia.org/wiki/Mashrabiya#:~:text=A%20mashrabiya%20or%20mashrabiyya%20\(Arabic,sometimes%20enhanced%20with%20stained%20glass](https://en.wikipedia.org/wiki/Mashrabiya#:~:text=A%20mashrabiya%20or%20mashrabiyya%20(Arabic,sometimes%20enhanced%20with%20stained%20glass).

McVeigh, Quinn. 2021. “Planting a Million Trees in the Semi-Arid Desert to Combat

Climate Change.” EHN. May 14. <https://www.ehn.org/planting-trees-arizona-climate-change-2652806561.html>.

Misni, Alamah. 2018. “Vegetation Produce an Extensive Cooling Effect.” Asian Journal of Quality of Life 3 (10): 179. doi:10.21834/ajqol.v3i10.114.

Morrow, Baker H., and V. B. Price. 1997. *Anasazi Architecture and American Design*. Albuquerque: University of New Mexico Press.

Méndez, Lola. 2022. “The 9 Most Recyclable Materials on the Planet.” Reader's Digest. Reader's Digest. July 21. <https://www.rd.com/list/most-recyclable-materials/>.

“Oasis.” *Education*, education.nationalgeographic.org/resource/oasis/.

“Passive Solar Home Design.” 2022. Energy.gov. Accessed December 13. <https://www.energy.gov/energysaver/passive-solar-home-design>.

“Persimmon Gap, Texas.” PERSIMMON GAP, TEXAS - Climate Summary, wrcc.dri.edu/cgi-bin/cliMAIN.pl?tx6959.

“Pros and Cons of Radiant Floor Heating.” 2020. New Avenue Homes. New Avenue Homes. December 1. <https://www.newavenuehomes.com/blog/radiant-floor-heating>.

Pros and Cons of Superadobe Earthbag Homes. 2020. YouTube. YouTube. <https://www.youtube.com/watch?v=RiP1WJ2m-HU>.

Prowler, Don. 2016. “Sun Control and Shading Devices&nbsp;&nbsp; ” WBDG. September 8. <https://www.wbdg.org/resources/sun-control-and-shading-devices>.

“Pueblo Architecture.” 2022. Wikipedia. Wikimedia Foundation. December 7. [https://en.wikipedia.org/wiki/Pueblo\\_architecture#cite\\_note-swentzell90-6](https://en.wikipedia.org/wiki/Pueblo_architecture#cite_note-swentzell90-6).

“Pueblo Indians.” 2022. Encyclopædia Britannica. Encyclopædia Britannica, inc. Accessed December 13. <https://www.britannica.com/topic/Pueblo-Indians>.

“Pueblos: Community Houses.” 2022. Texas Beyond History. Accessed December 13. <https://www.texasbeyondhistory.net/kids/houses/pueblos.html>.

Reichardt, Klaus. Measure Your Hotel’s Water Consumption, Then Start Saving., 18 Feb. 2007, [www.4hoteliers.com/features/article/1889](http://www.4hoteliers.com/features/article/1889).

Sevcenko, Melanie. 2016. “Power to the Poop: One Colorado City Is Using Human Waste to Run Its Vehicles.” The Guardian. Guardian News and Media. January 16. <https://www.theguardian.com/environment/2016/jan/16/colorado-grand-junction-persigo-wastewater-treatment-plant-human-waste-renewable-energy>.

Simms, Demetrius. “The Luxury Tourism Market Is Expected to Reach \$82 Billion by 2030, a New Reports Says.” *Robb Report*, 10 Aug. 2022, [robbreport.com/travel/destinations/luxury-tourism-market-expected-to-reach-82-billion-1234737336/](http://robbreport.com/travel/destinations/luxury-tourism-market-expected-to-reach-82-billion-1234737336/).

Srivastava, Ar. Prashansha. 2019. “Effect of Tree Placement on Wind Flow Pattern in Building in Warm and Humid Climate.” *International Journal of Scientific & Engineering Research* Volume 10 (Issue 9): 1659–63. doi:10.14299/000000.

“This Comforter Made from Recycled Plastic Has Thousands of 5-Star Reviews.” 2021. Newsweek. Newsweek. February 3. <https://www.newsweek.com/amplify/this-comforter-made-recycled-plastic-has-thousands-5-star-reviews>.

“U.S. Energy Information Administration - EIA - Independent Statistics and Analysis.” 2022. Biomass Explained - U.S. Energy Information Administration (EIA). Accessed December 13. <https://www.eia.gov/energyexplained/biomass/>.

Underhill, Diane. 2022. “How Fast Does a Wind Turbine Spin?” Nature's Generator. Nature's Generator. September 20. <https://naturesgenerator.com/blogs/news/how-fast-does-a-wind-turbine-spin>.

“Upcycling vs. Recycling vs. Downcycling: The Conscious Consumers Guide.” 2022. Hive Brands. Hive Brands. July 25. <https://hivebrands.com/blogs/news/upcycling-vs-recycling-vs-downcycling>.

US Department of Commerce, NOAA. 2021. “Terlingua Cooperative Precipitation Data.” National Weather Service. NOAA's National Weather Service. February 6. [https://www.weather.gov/maf/cli\\_maf\\_coop\\_annprecip\\_terlingua\\_ranch](https://www.weather.gov/maf/cli_maf_coop_annprecip_terlingua_ranch).

“Vast Energy Value in Human Waste.” 2022. United Nations University. Accessed December 13. <https://unu.edu/media-relations/releases/vast-energy-value-in-human-waste.html>.

“Weather.” National Parks Service, [www.nps.gov/bibe/planyourvisit/weather.htm](http://www.nps.gov/bibe/planyourvisit/weather.htm).

“What Is Renewable Energy?” *United Nations*, [www.un.org/en/climatechange/what-is-renewable-energy#:~:text=Renewable%20energy%20is%20energy%20derived,plentiful%20and%20all%20around%20us](http://www.un.org/en/climatechange/what-is-renewable-energy#:~:text=Renewable%20energy%20is%20energy%20derived,plentiful%20and%20all%20around%20us).

Zaino, Lori. 2022. "15 Best Luxury Wine Hotels & Vineyard Resorts Worldwide."

Winetraveler. August 27. <https://www.winetraveler.com/resorts-hotels/best-luxury-wine-hotels-vineyard-resorts/>.