Sentience of Site

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In
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Abstract

A contemporary understanding of site is integral towards the proper implementation of an architectural intervention which reconciles itself amongst the landscape.

This thesis is situated at the convergence of technology and nature, investigating a constructive engagement of site in order to inform an architecture embedded into rural Appalachia.

An integration of drone avionics, advanced imaging and sensing technologies, and traditional means of site-observation fosters the opportunity for a more holistic understanding of place. The corresponding architectural intervention thus manifests itself as a contemporary rendition of the fire tower, a US Forest Service outpost monitoring changing wildlife populations and behaviors within the George Washington and Jefferson National Forests. Dubbed *The Aviary,* the construct functions as a wilderness drone-port, supporting a large, integrated network of conservation-drone activity over the vast surrounding mountain-scape.

Sentience of Site

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General Audience Abstract

This thesis investigates the role of our built environment in relation to concurrent trends in drone technology and wildlife conservation. The thesis is broken up into two parts, the first exploring new methodologies of site-investigation, and the second exploring architecture as tool for ecological conservation and preservation. The architectural site-exploration process is redefined using drone mapping and data visualization, in hopes of achieving a more holistic understanding of our rural and wilderness landscapes, with the goal of further utilizing this understanding to inform an architecture that resides harmoniously within it's "place." The eventual designed construct can be viewed as a modern reinterpretation of the American fire-tower, a declining typology traditionally used to safeguard our natural and wilderness resources and landscapes. This new construct takes a dynamically different approach, and functions as a wilderness drone-port that facilitates a fleet of unmanned aerial vehicles to monitor the changes of behaviors and populations in Virginia's wildlife, advancing our methodologies of local conservation and ecological studies.

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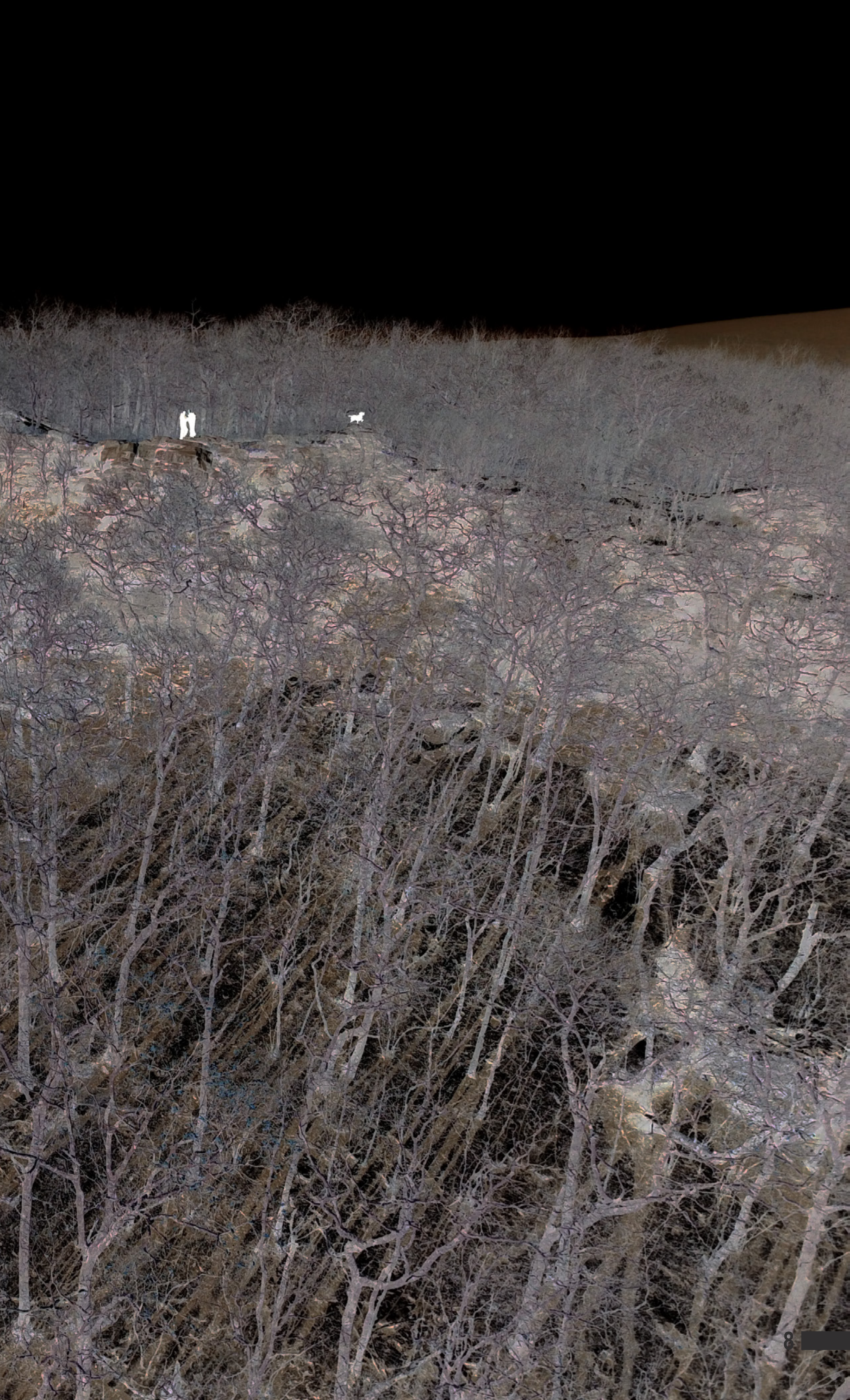
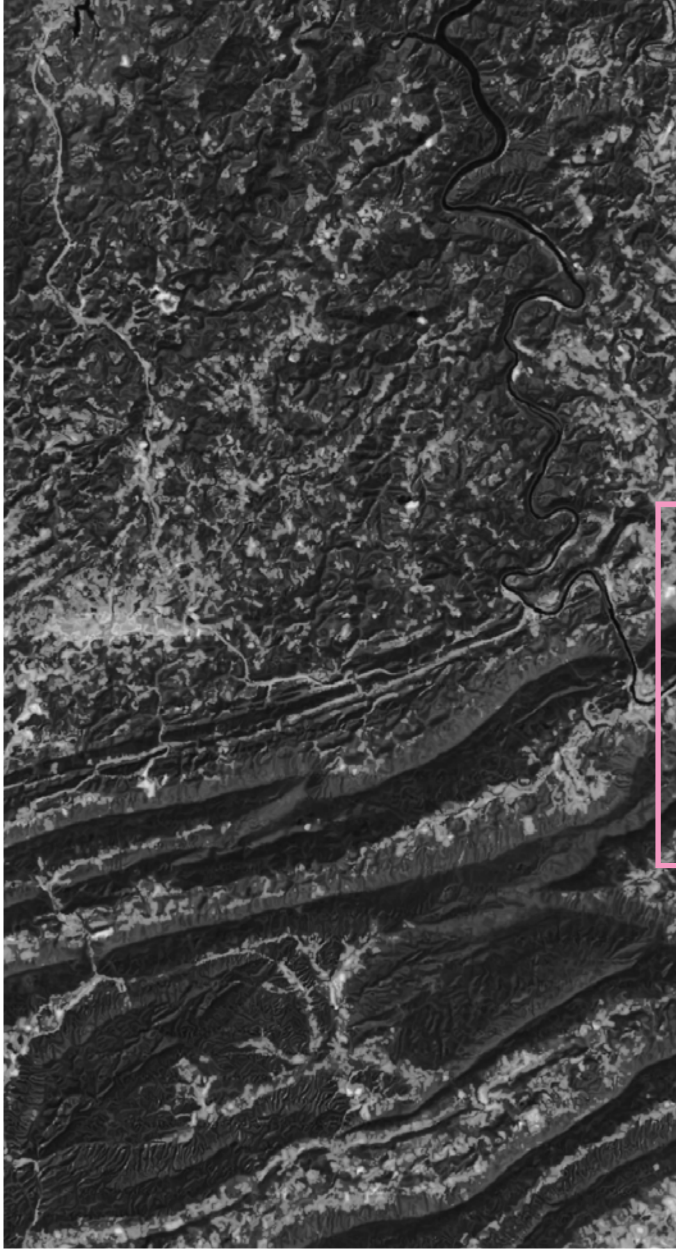
(Right) Raw site: Maybe the most traditional means of analyzing a site involves simply living on it. Three nights we're spent hiking and camping the proximal wilderness, in order to understand the place in a more experiential sub-context. Common concepts of scale and time are different in these natural settings. What contributes to the metaphysical *feeling* of a site?

(Right) Raw site: An aerial image recorded while documenting the site of inquiry in Giles County, VA. Captured using one of Virginia Tech's DJI Mavic Pros. Living on the site only sparked further curiosity; I needed an understanding of place beyond its qualitative properties, and turned to contemporary trends in drone avionics and sensing technologies to began documenting deeper measures.

(Right) The same aerial image, but visualized across an infra-red spectrum. How does an enhanced or varied spectrum of visibility shape our understanding of the places we occupy?





Greater Context

(Clockwise, from Top left) A site without borders. Precession in scale, from the US Atlantic seaboard, to the Appalachian Ridge and Valley geo-region, and further to an isolated stretch of ridge-line within the George Washington and Jefferson National Forests. True borders of a natural site exist only in the physical formations and features of the landscape.

Imagery courtesy: Apple Maps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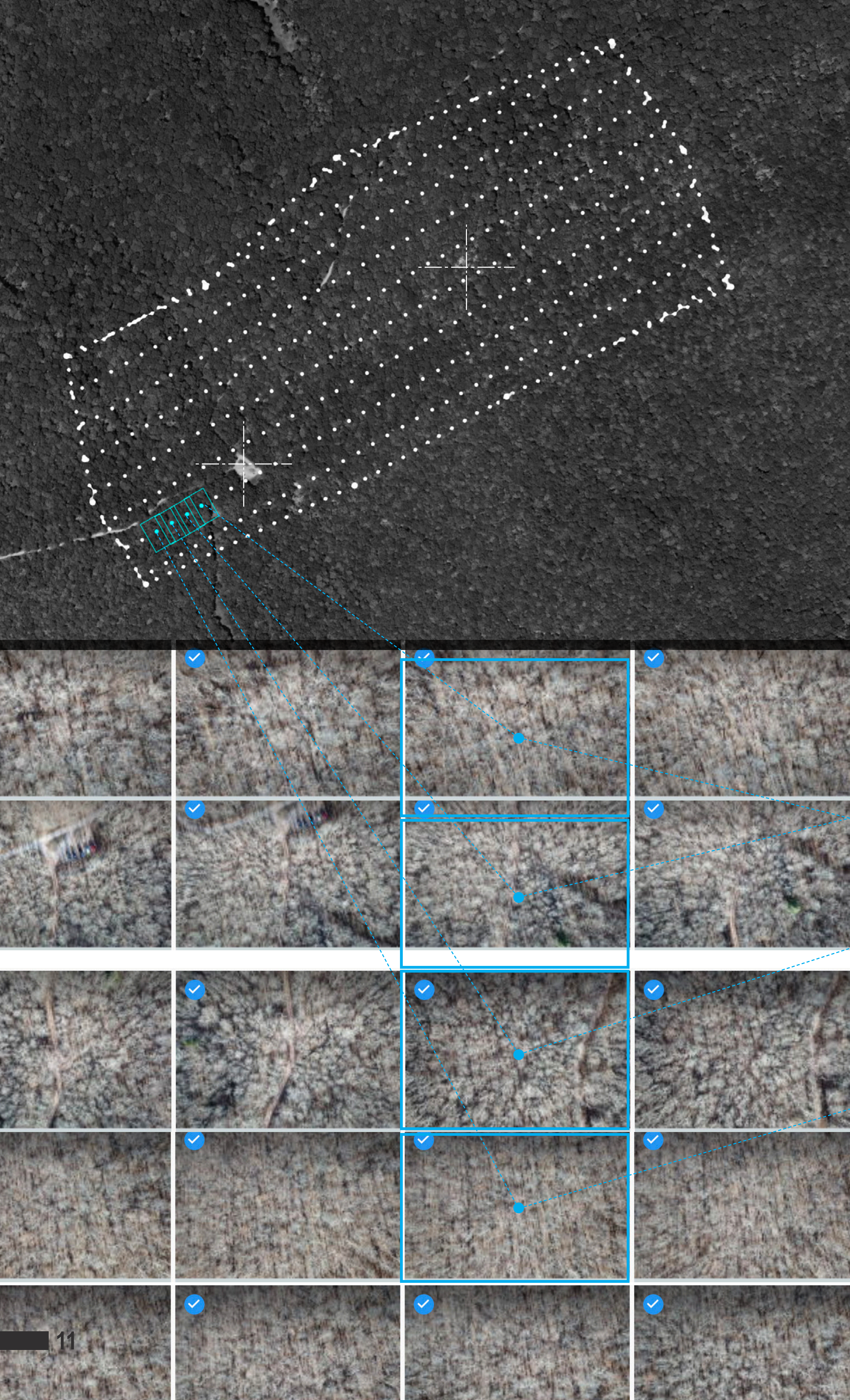


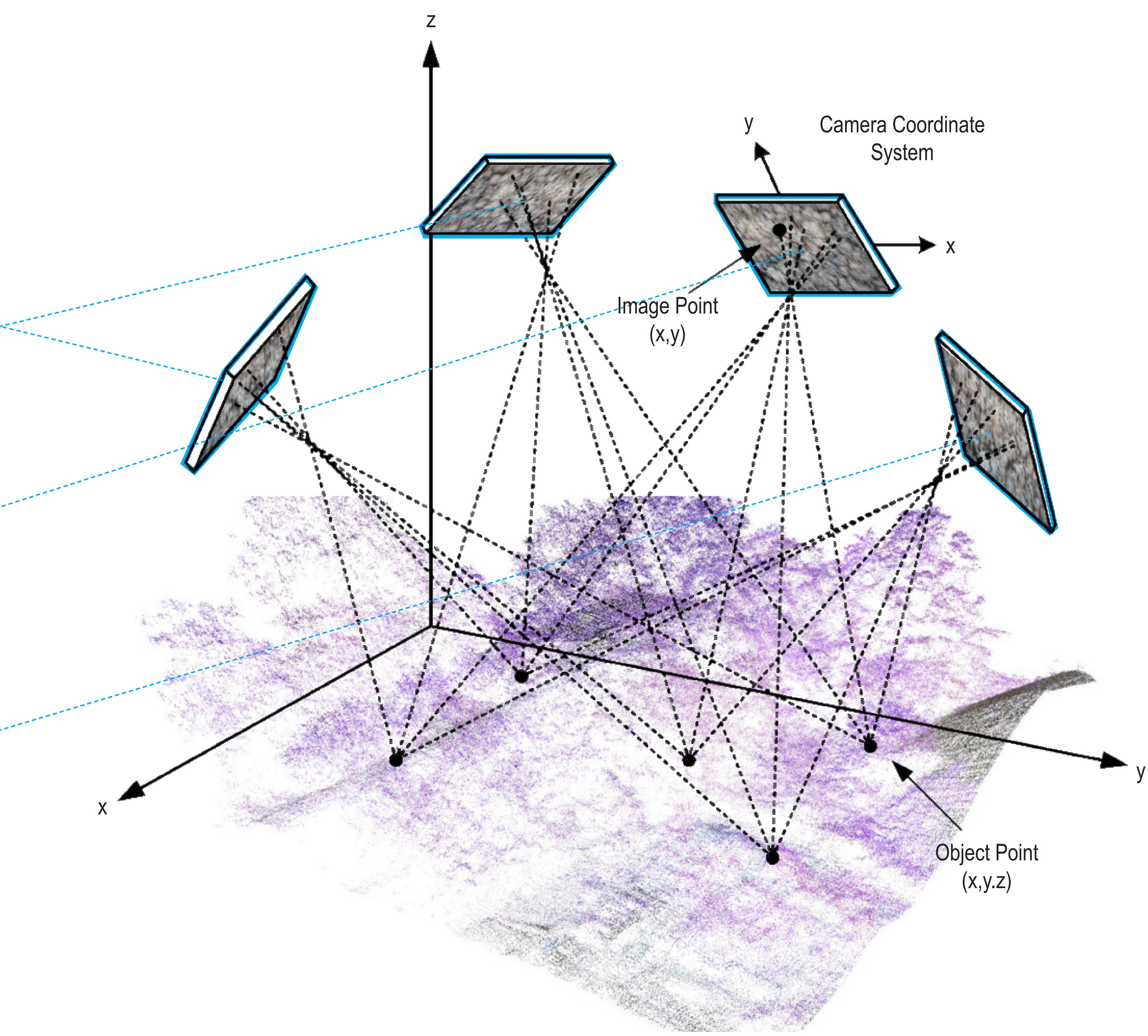
Data Collection, Processing

I used a Virginia Tech owned *Mavic Pro* drone in unison with *Drone Deploy* for a majority of the data collection and processing, taking advantage of a contemporary surveying technique known as Photogrammetry. The process goes as follows:

(*Top left*) A flight path was created and executed via *Drone Deploy* to facilitate the drone movement and photography across the landscape; each dot corresponds to a picture and relative GPS coordinate. *Imagery source: Apple Maps*

(*Bottom left*) The hundreds of images were then fed into a photogrammetry processing algorithm (*Drone Deploy*) that uses common landscape features within boundaries of image-overlap to stitch together a high resolution digital representation of the site.

(*Bottom right*) A visual display of the method by which the algorithm uses to stitch the images and generate the digital representations of the data.

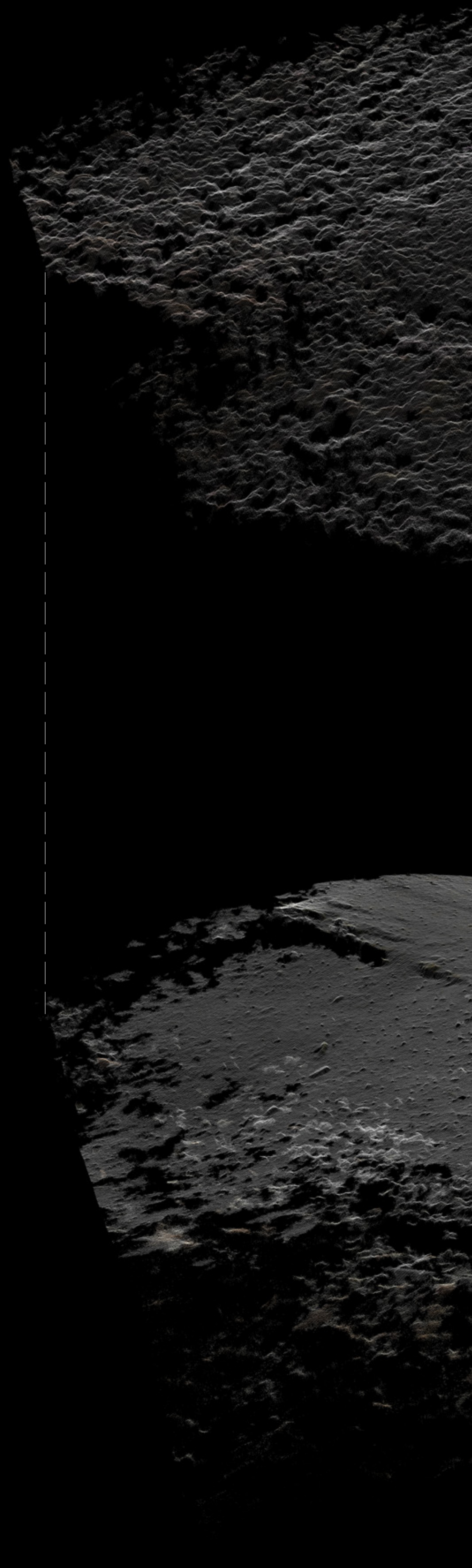


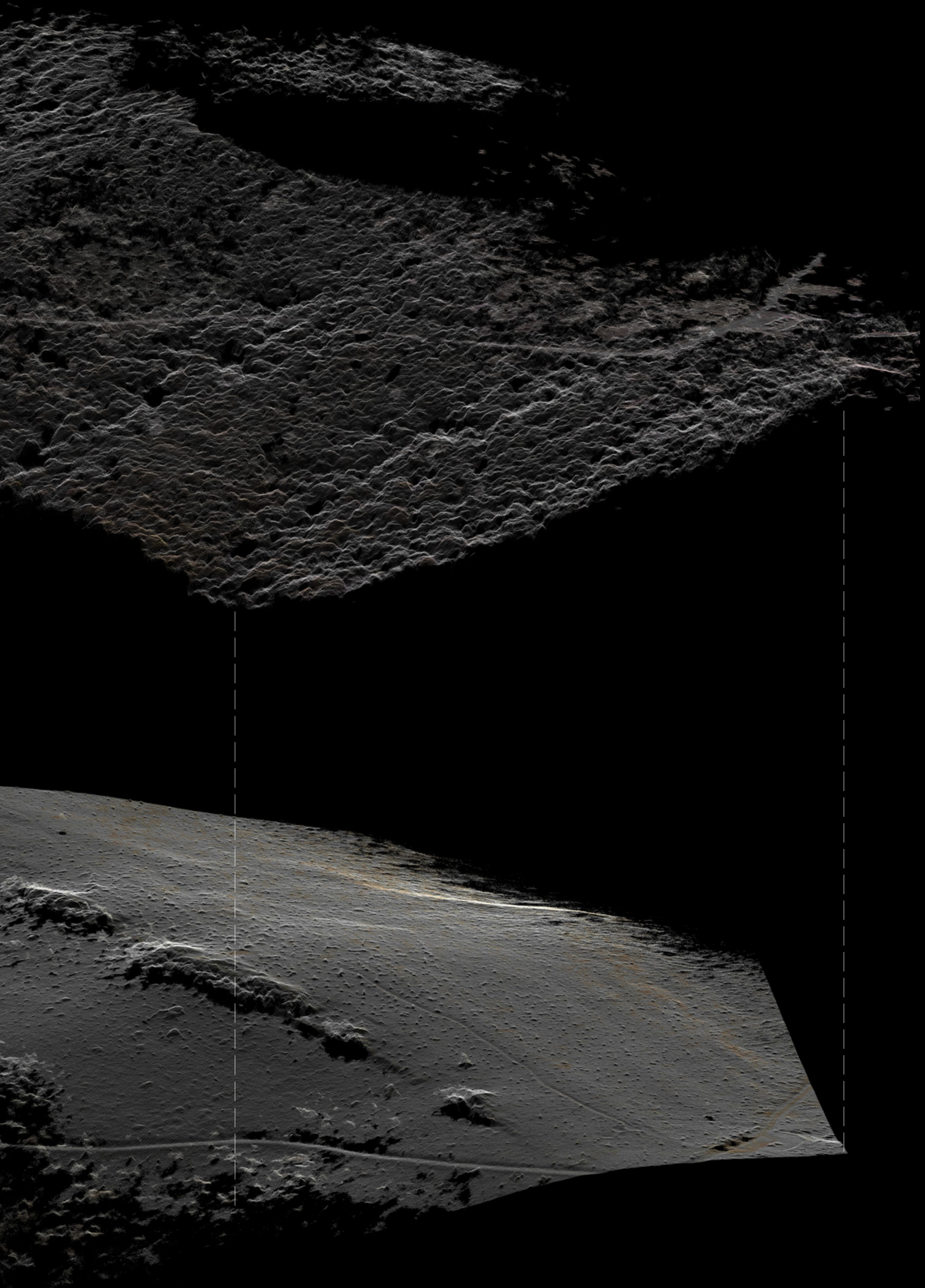
Representing Data

Multiple drone flights were conducted across multiple seasons in order to obtain a more holistic representation of the landscape, which are represented by the point-clouds (*right*).

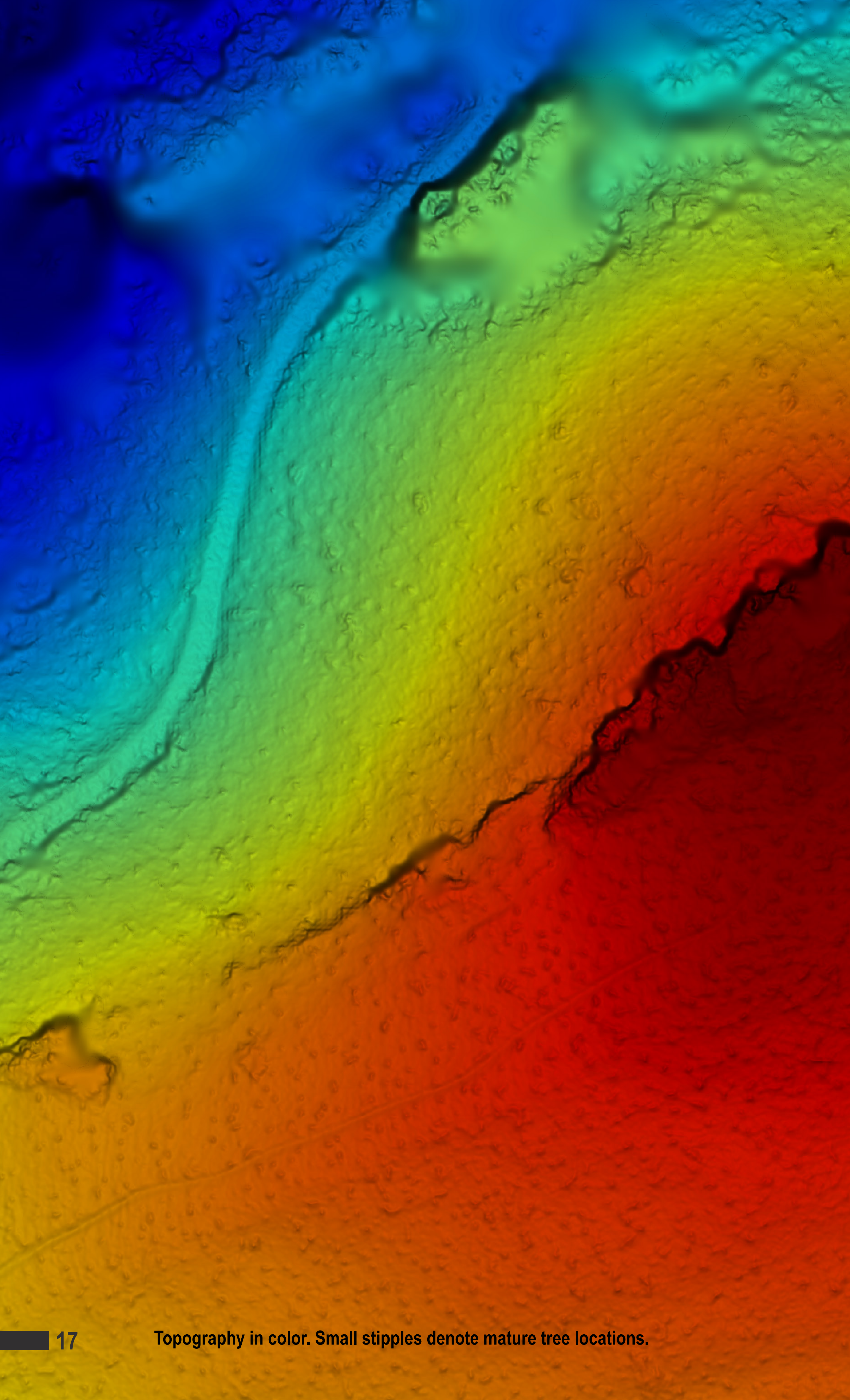
The canopy was collected on a fall day where the trees retained their foliage, while the ground was collected at a later date in winter, when transparency of the trees allowed the drone to peer past the canopy to the ground. Thus, a detailed physical readout of site was acquired, revealing roads, human and animal foot paths, and even landscape features such as tree and boulder sizes and locations.

The point cloud is just one medium by which the processed drone data is represented. The following pages highlight additional methodologies of representation, offering new clues into the intensive measures of the landscape.

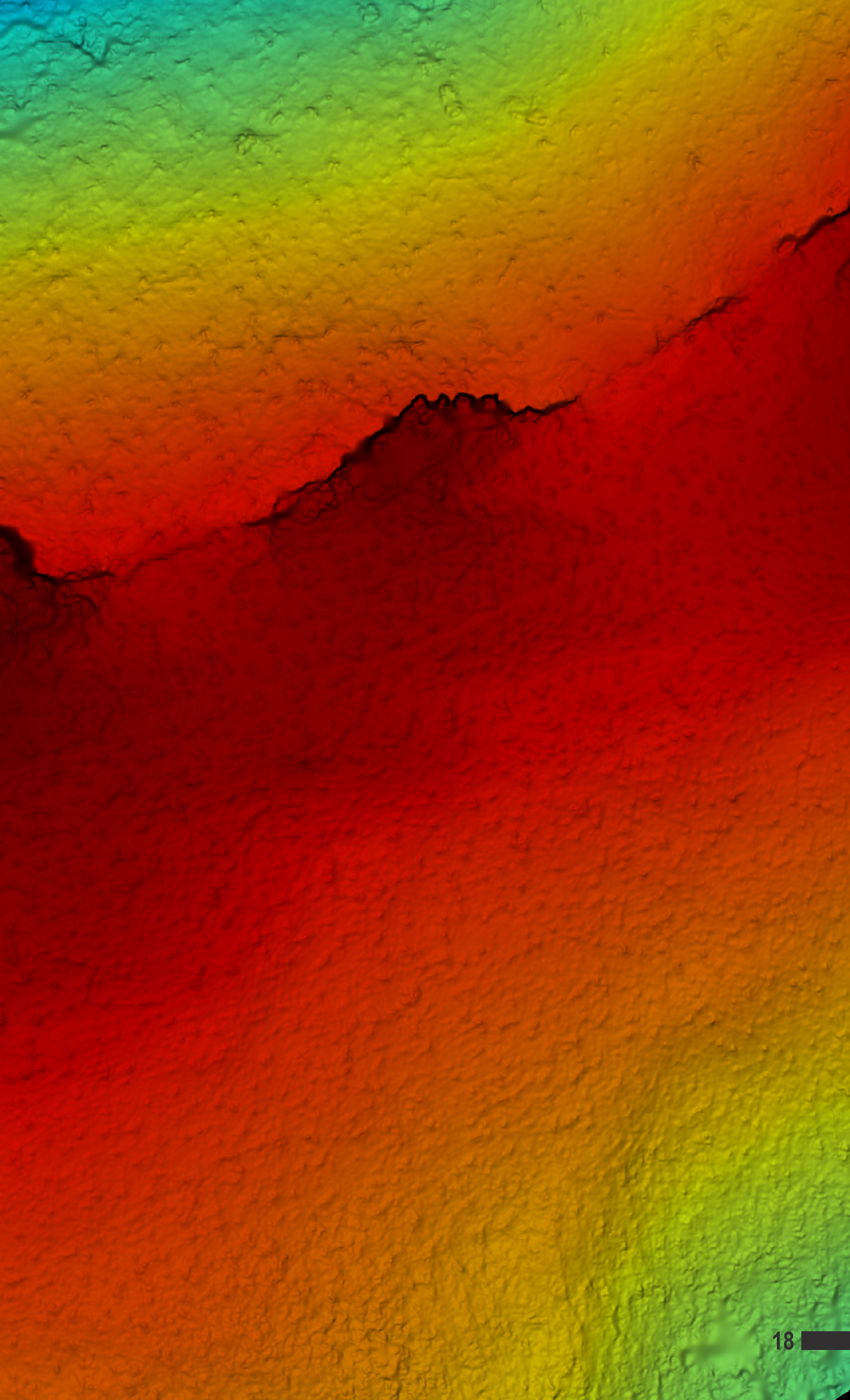


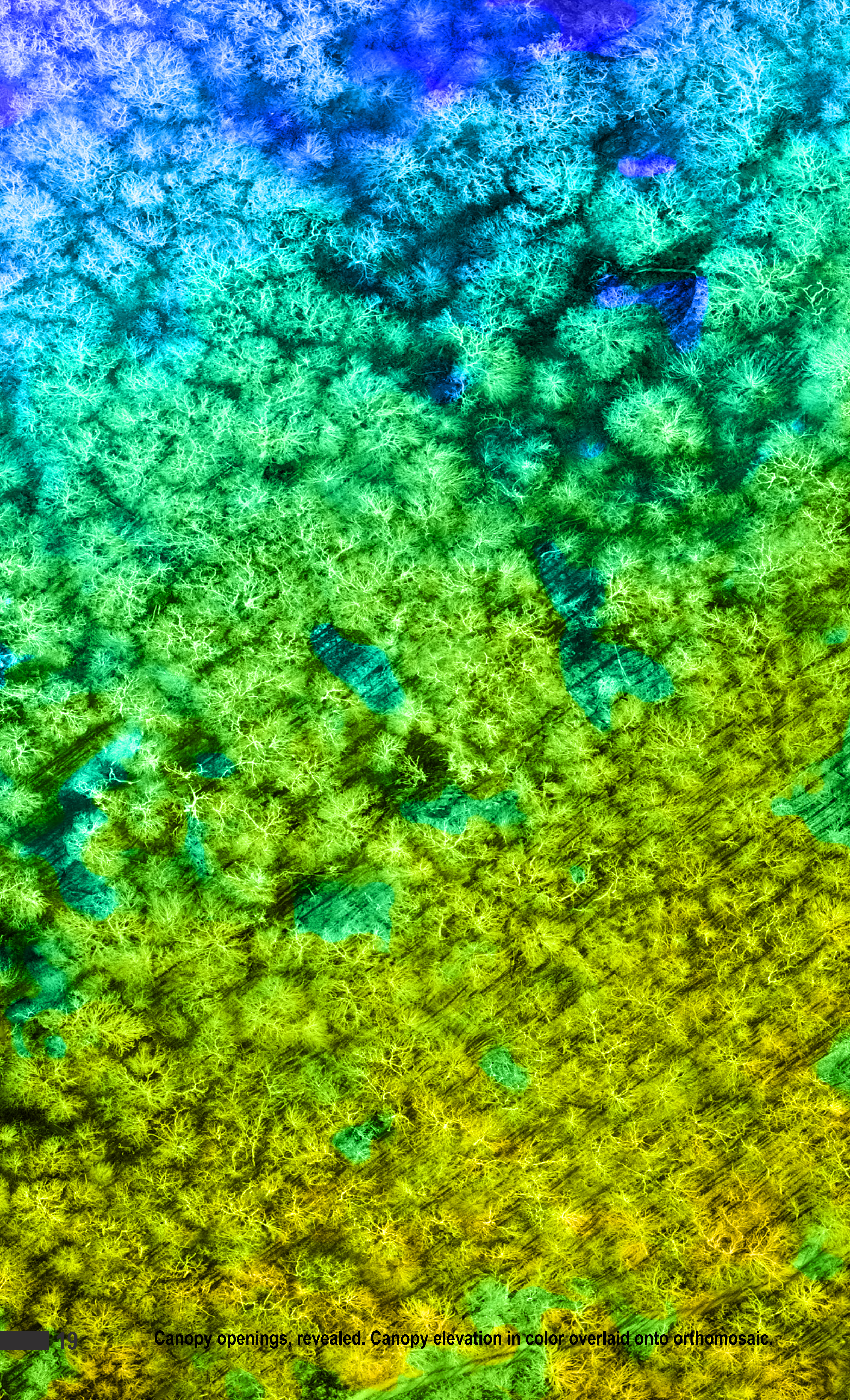


Compiled Orthomosaic Map, ~3cm /pixel resolution.

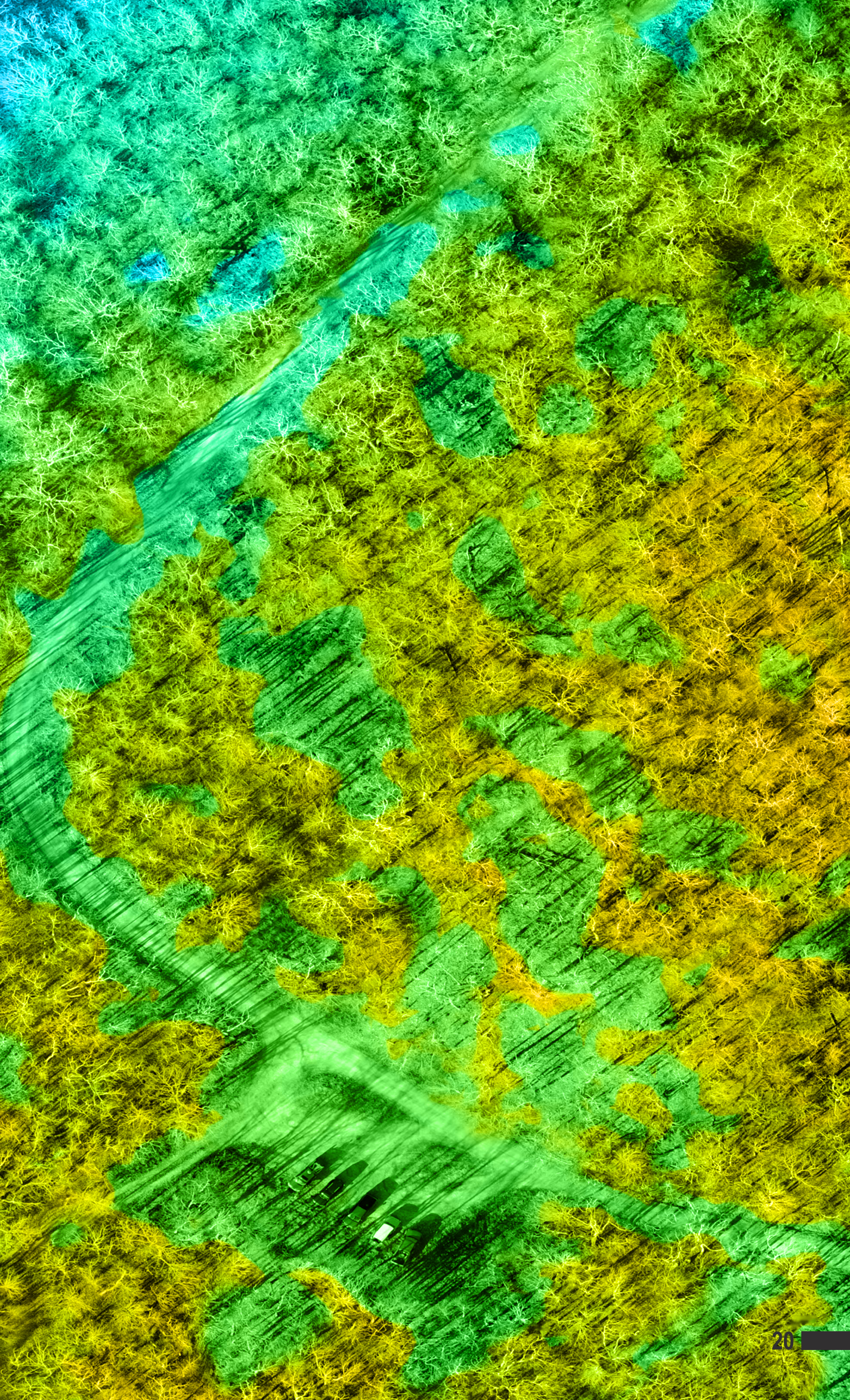


Topography in color. Small stipples denote mature tree locations.





Canopy openings, revealed. Canopy elevation in color overlaid onto orthomosaic.



Data and Site, takeaway

Data, in its raw form, is relatively meaningless. Its the creative medium by which we represent it that can connect data to reality. The following five points were deduced to support the relevance of drones and data to site investigations within the architectural practice:

1. Enhanced Spatial Engagement with Site
Topographic clarity, enhanced visual access

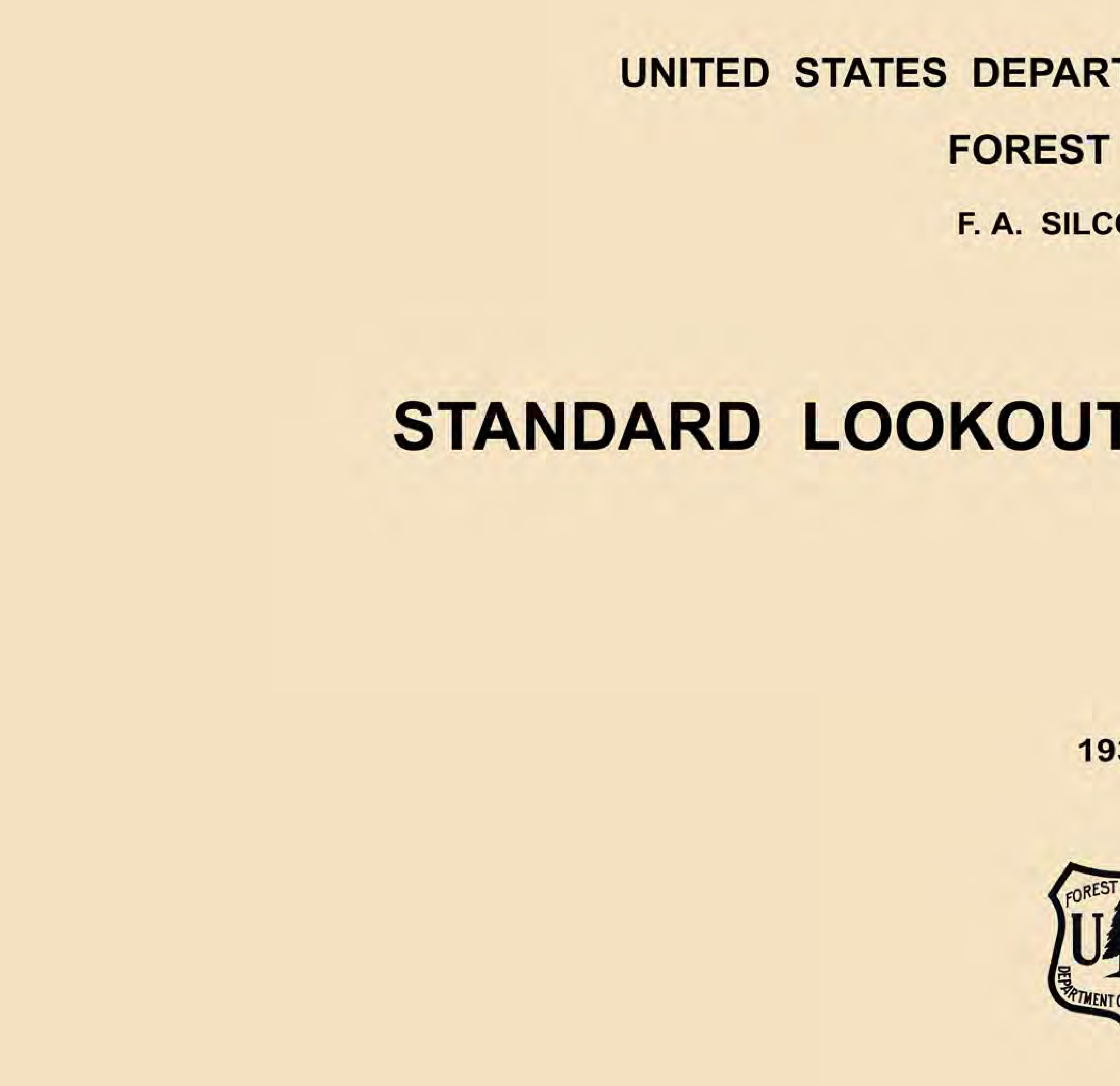
2. Atmospheric Qualities
Changes in light, air across time

3. Extensive Measures
Revealing a deeper context, the systems outside of frame

4. Intensive Measures
The internal, invisible, layered qualities of a place revealed

5. Generative Aspects
Enhanced constructive engagement and communication

The data collected, interpreted using these five points, can now more usefully inform an architectural intervention of the site.


UNITED STATES DEPART
FOREST
F. A. SILC
STANDARD LOOKOUT
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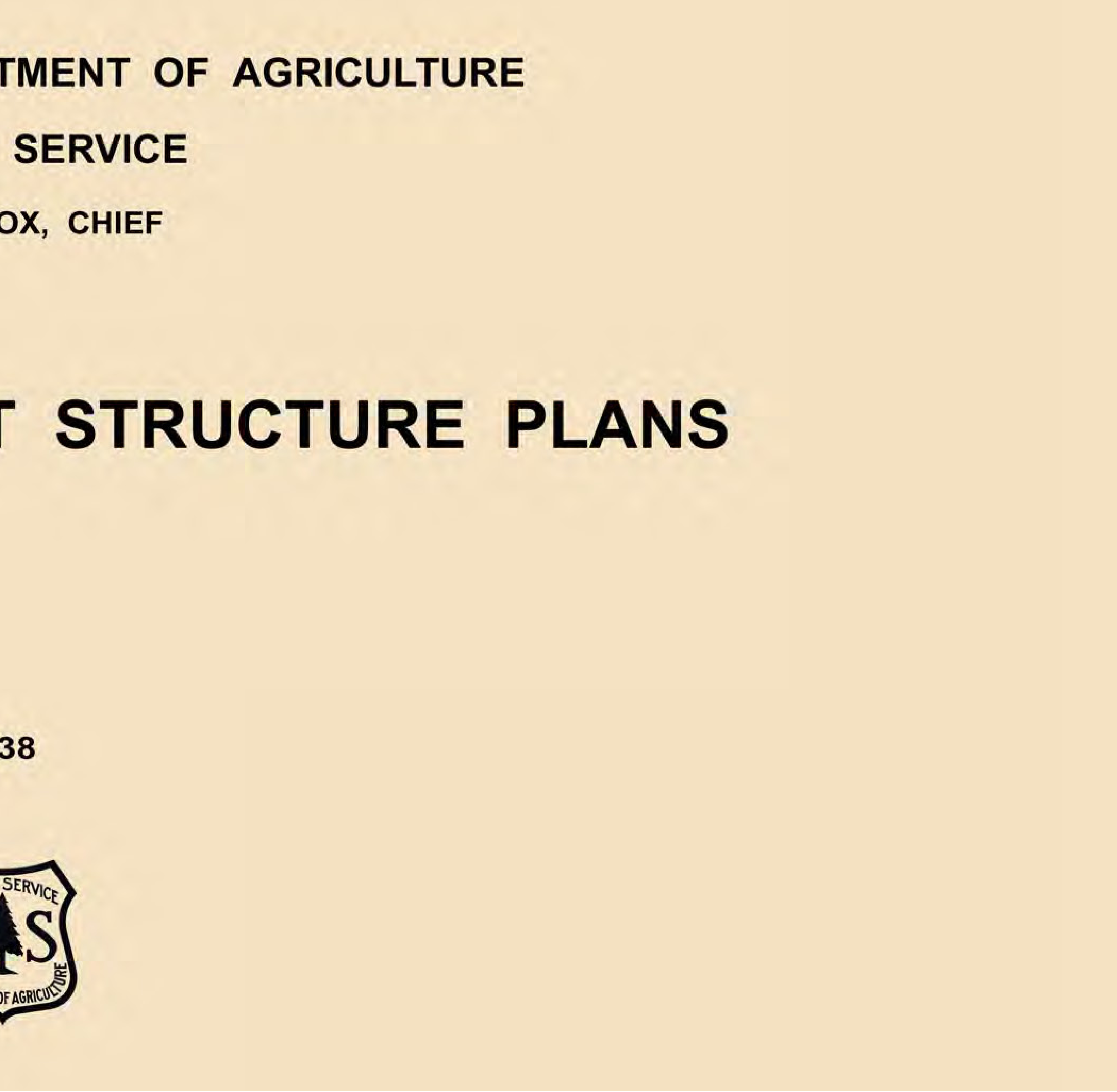
The Life, Death and Re-birth of the American Lookout

Images Courtesy: USDA Forest Service

The site reveals almost no evidence of human intervention other than a thin gravel road and a lightly-used stretch of the Appalachian Trail. Ten-years ago, however, this place hosted the US Forest Service's Stony Creek Lookout Tower, which monitored the proximal valley for resource protection.

I am troubled by the continual reckless expansion of the human footprint, and the unfortunate growing cost of the loss of our natural local habitats. The fire tower used to have a meaningful purpose in our society, to humbly protect our country's great wilderness. But it seems our wilderness has fallen to the bottom of our civil priority, and as our natural world disappears, so does the need for protection, rendering the lookouts of today's world almost null.

Architecture must play a role in the continual protection of our natural world. How could the Fire Tower be re-invented, I wondered, to re-assume the role of protecting, not our natural resource but instead our natural world, through the lens of environmental conservancy.


TMENT OF AGRICULTURE
SERVICE
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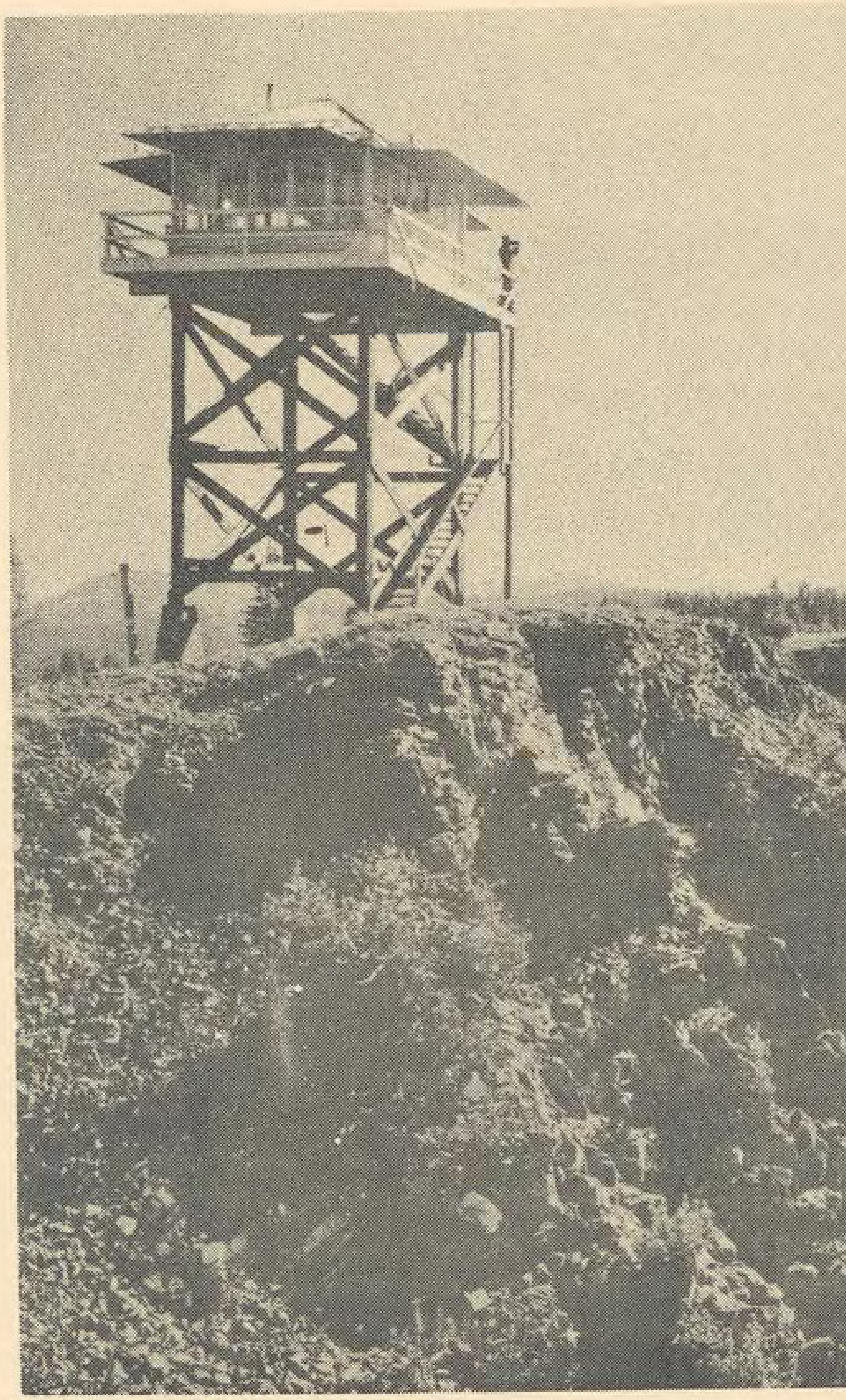
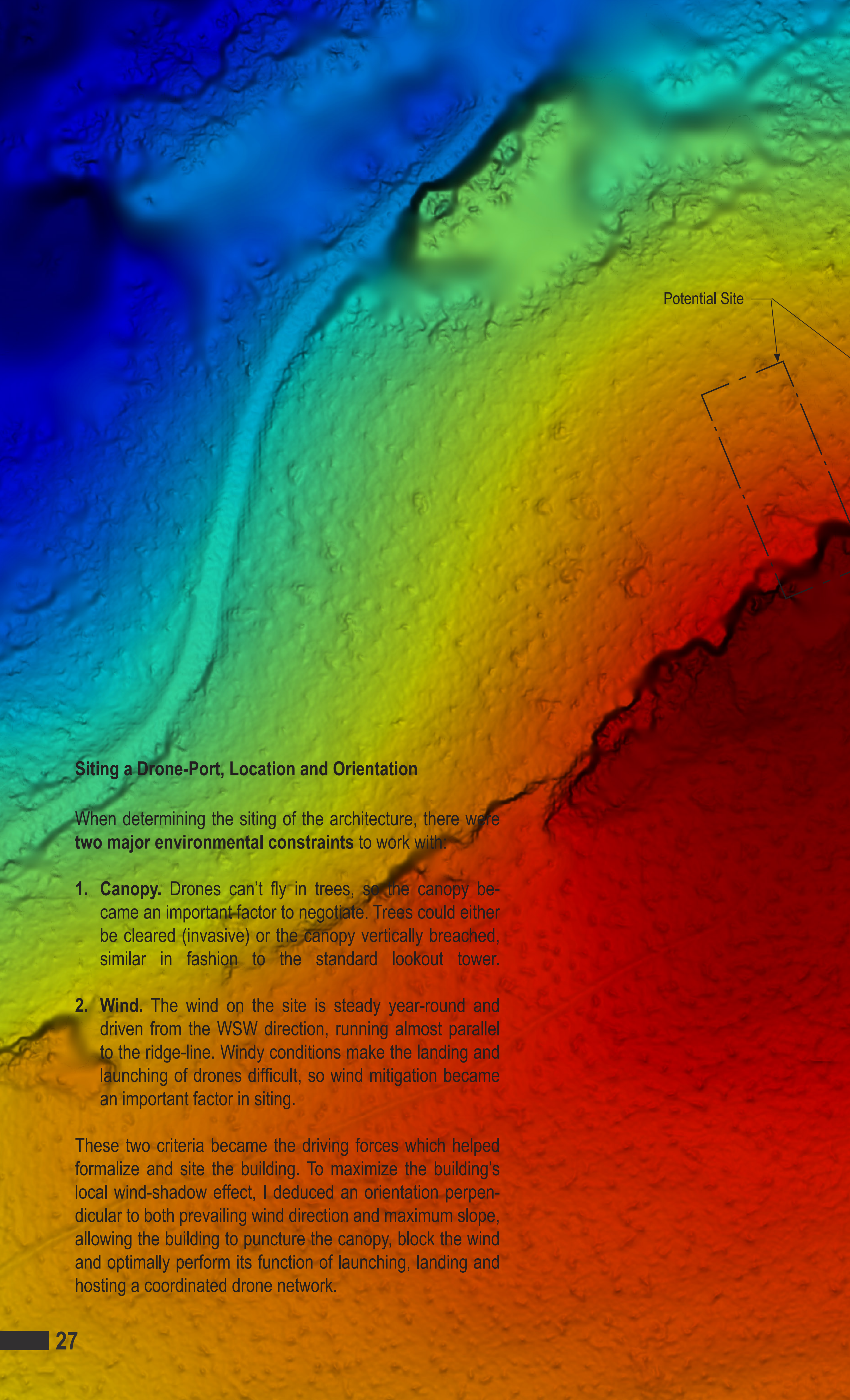
T STRUCTURE PLANS
38

A contemporary lookout began to take shape. Instead of a tower supporting the use of our eyes and ears to monitor our directly observable world, this construct would support an integrated network of the same drone-sensing technology I used to document the site to maintain a live awareness of the ebbs and flows of wildlife across the region, deriving a holistic sentience of the surrounding natural world.

The construct would function as a wilderness drone-port, facilitated by the US Forest Department, which could use these advanced technologies to monitor the populations and behaviors of the surrounding wildlife, without any real human impact. The facility would be responsible for the launching, landing, charging and maintenance of the drones, as well as an upload / processing station for the large streams of data involved in such an operation. In addition to housing technological program, the construct would have to provide operations and residency spaces for the rotation of Forest Rangers whom manage the station. Once again it seemed the forest had protection, by humans and technology, from humans and technology.



On Guard!



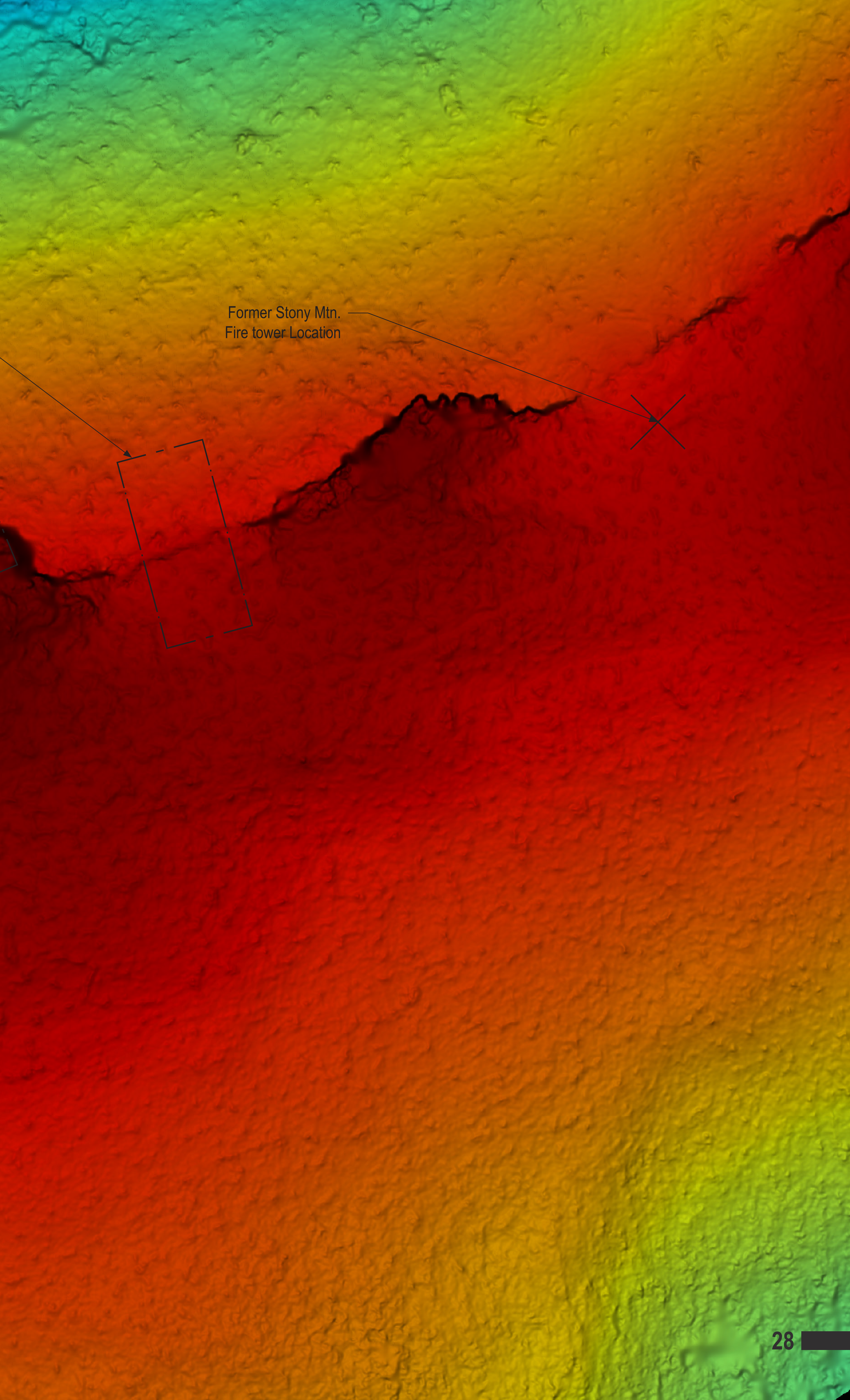
Siting a Drone-Port, Location and Orientation

When determining the siting of the architecture, there were **two major environmental constraints** to work with:

1. **Canopy.** Drones can't fly in trees, so the canopy became an important factor to negotiate. Trees could either be cleared (invasive) or the canopy vertically breached, similar in fashion to the standard lookout tower.

2. **Wind.** The wind on the site is steady year-round and driven from the WSW direction, running almost parallel to the ridge-line. Windy conditions make the landing and launching of drones difficult, so wind mitigation became an important factor in siting.

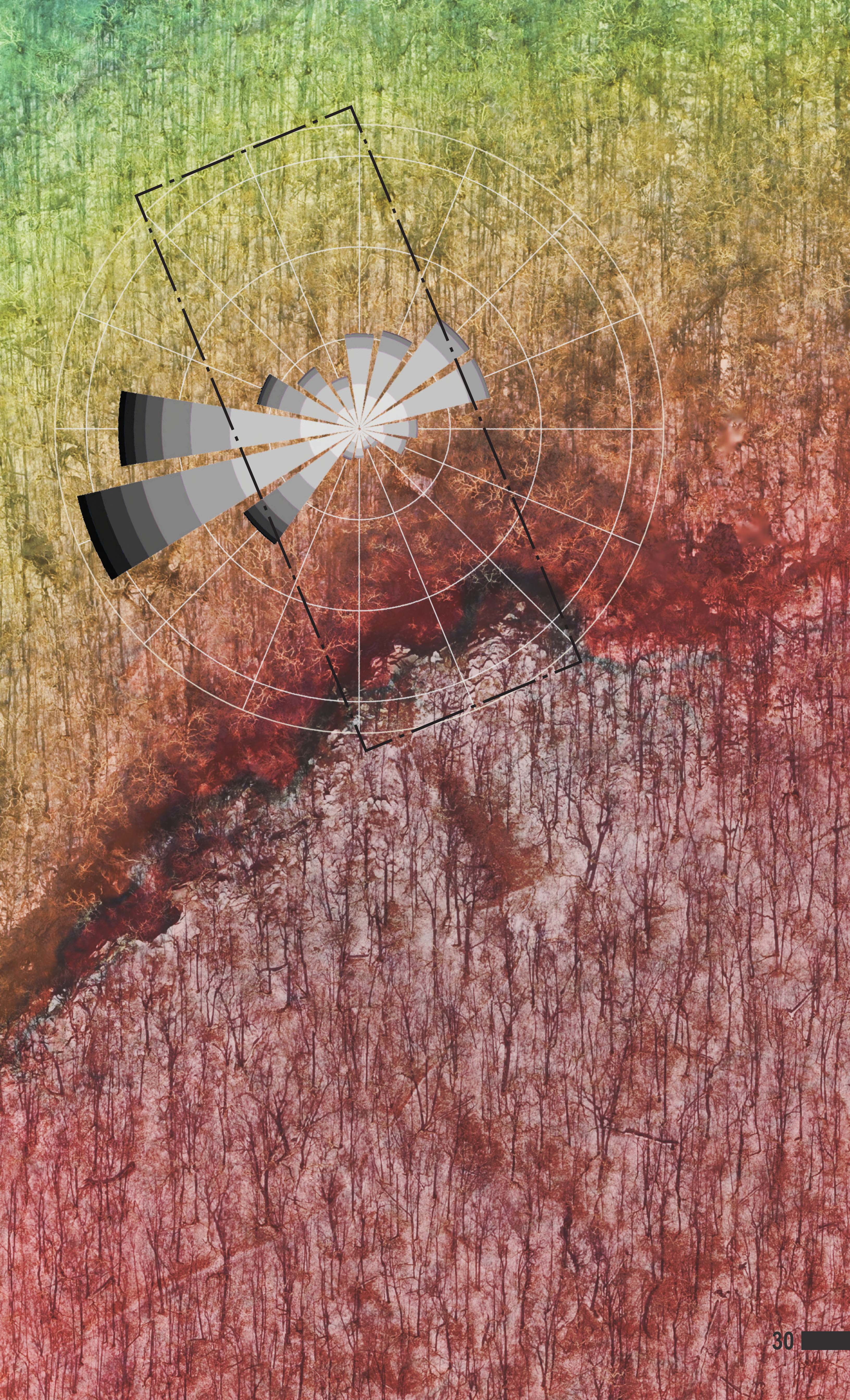
These two criteria became the driving forces which helped formalize and site the building. To maximize the building's local wind-shadow effect, I deduced an orientation perpendicular to both prevailing wind direction and maximum slope, allowing the building to puncture the canopy, block the wind and optimally perform its function of launching, landing and hosting a coordinated drone network.


Former Stony Mtn.
Fire tower Location

Siting a Drone-Port, Prevailing Winds

This specific site was chosen as it removes itself from the ridge-line as a measure of protection; the ridges often host our most sensitive ecosystems.

The wind rose visualizes local wind conditions, representing both prevailing direction and intensity. on the site is steady year-round and driven from the WSW direction, running almost parallel to the ridge-line. Windy conditions make the landing and launching of drones difficult, so wind mitigation became an important factor in siting.

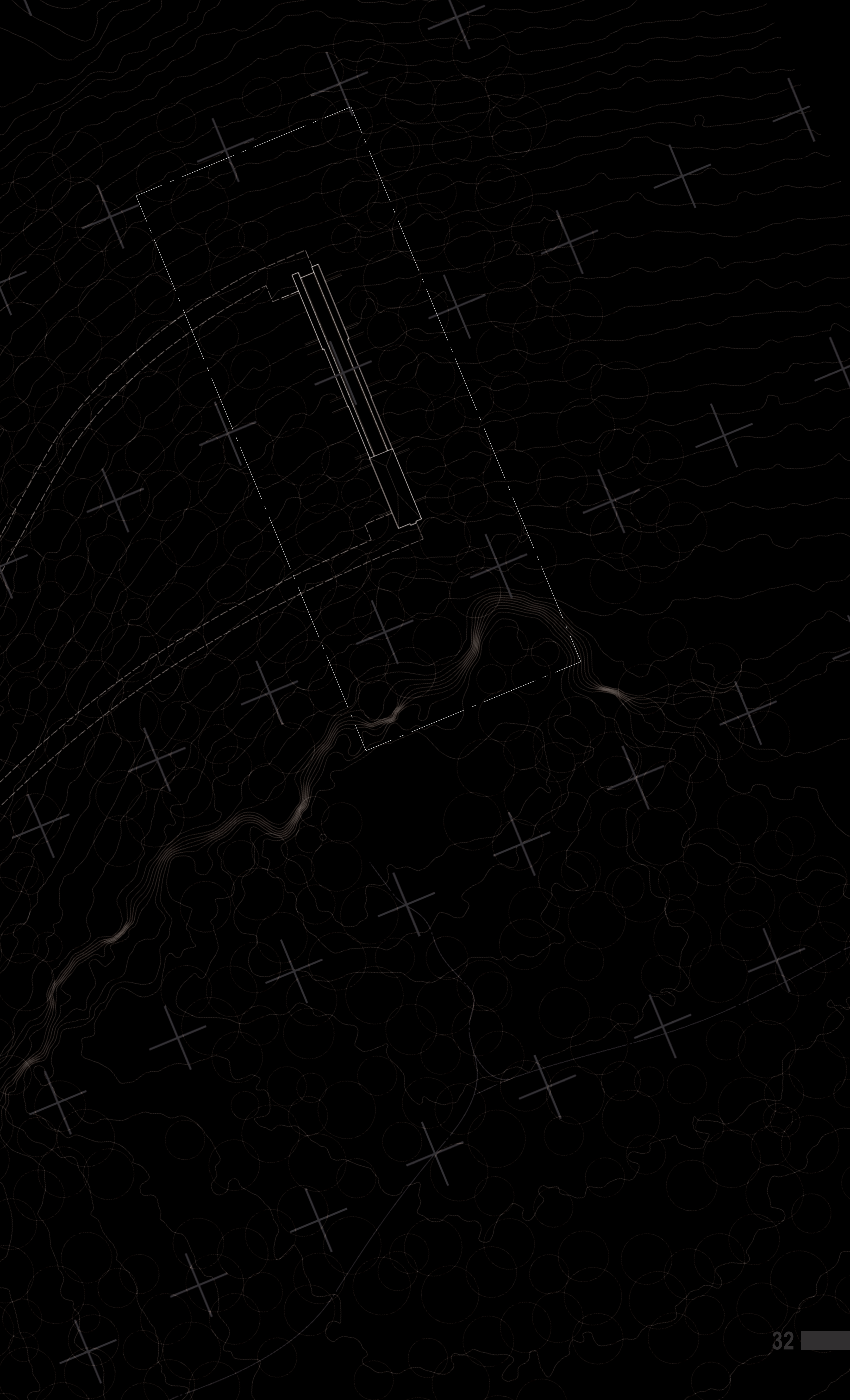


Defining a Form

The building manifested itself as a towering “wall” of program, breaching the canopy in a non-obtrusive manner and protecting against prevailing winds, manipulating the airflow to create wind-shadows, or calm air-space, on the North East edifice for the drones to safely land and launch.

The wall’s interstitial space would house programmatic necessities of both the drones and their biological operators. Adequate program is dedicated to the launching, storing, charging, and data off-loading of the drone fleet, though the structure also hosts a humble portion of conditioned spaces. The steep grade required two dramatically different elevation points of entry; a loading-lift on the low end, and a personal lift / stairwell on the high end.

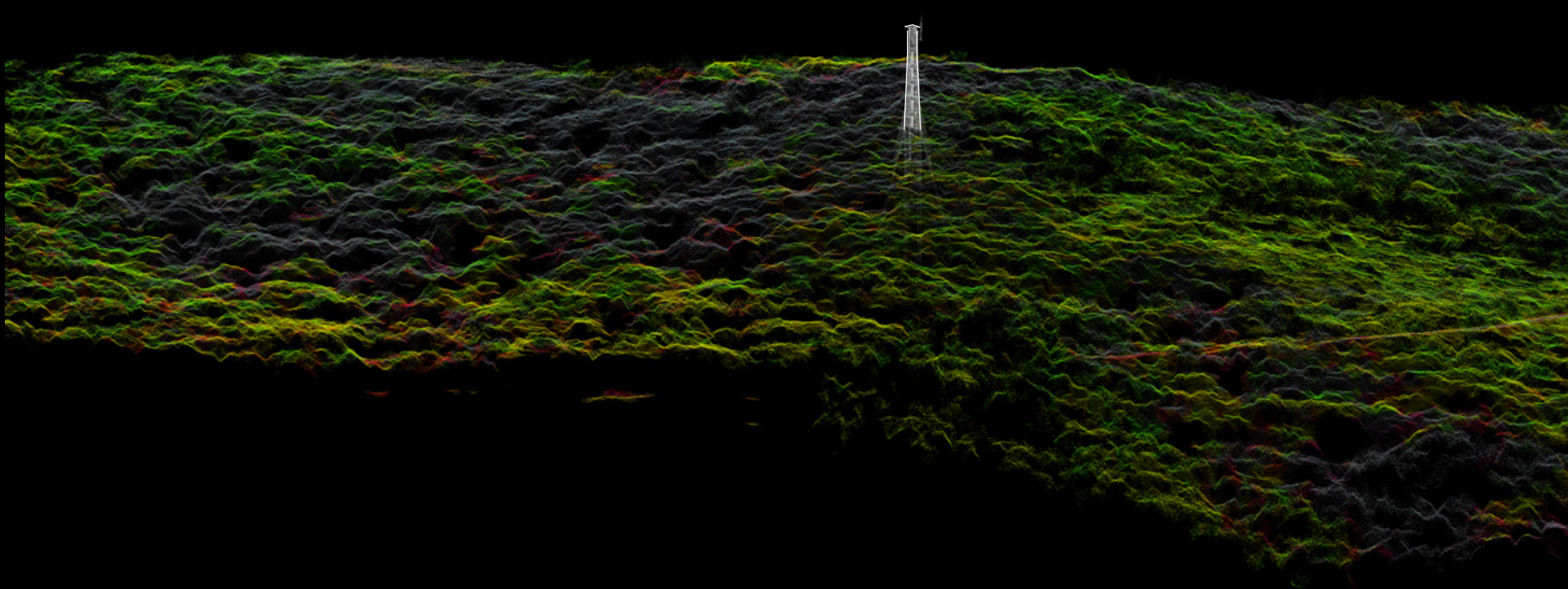
All displayed topographical data, including contours, tree locations, and road locations, were generated from the drone-data collected on site.

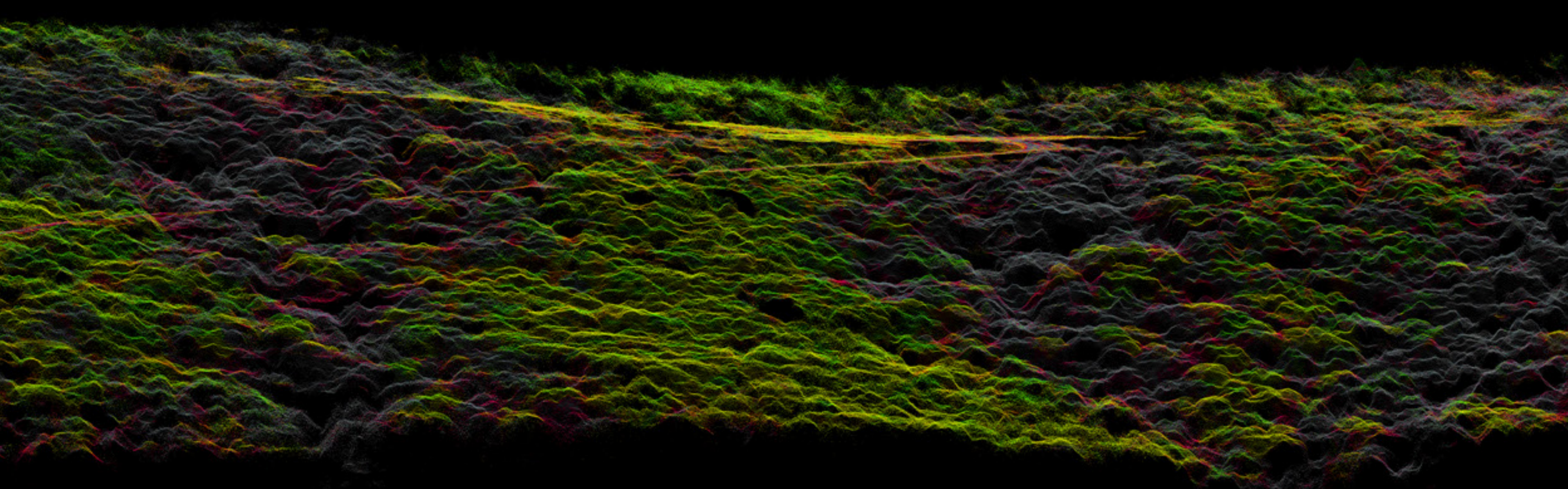


Defining a Form

The cross-sectional quality of the structure reveals a slenderness similar to that of the traditional fire tower.

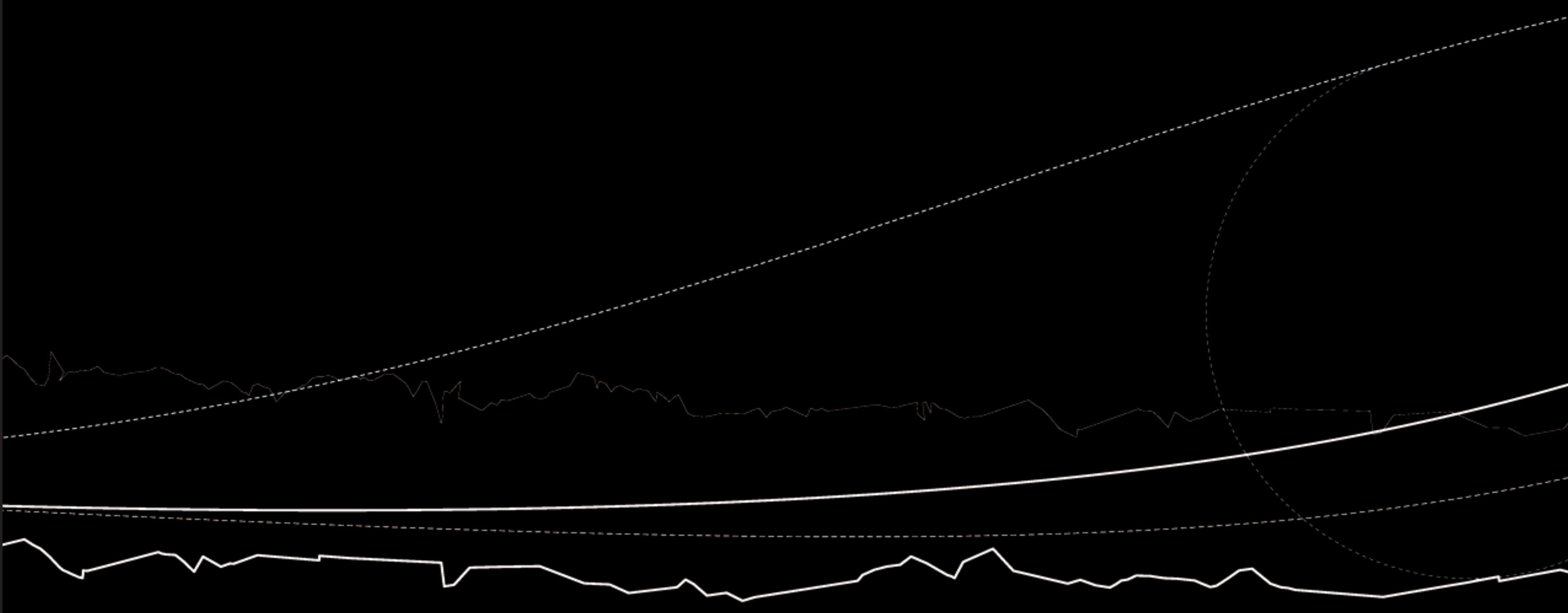
Having the ability to build off of the data provided useful in many ways, such as the tower's juxtaposition within the canopy, assuring an optimal elevation for the control lookout. This site section represents some of the extensive measures informed by the data, allowing us to see the architecture in relation to a context much than whats traditionally available in the common building elevation.

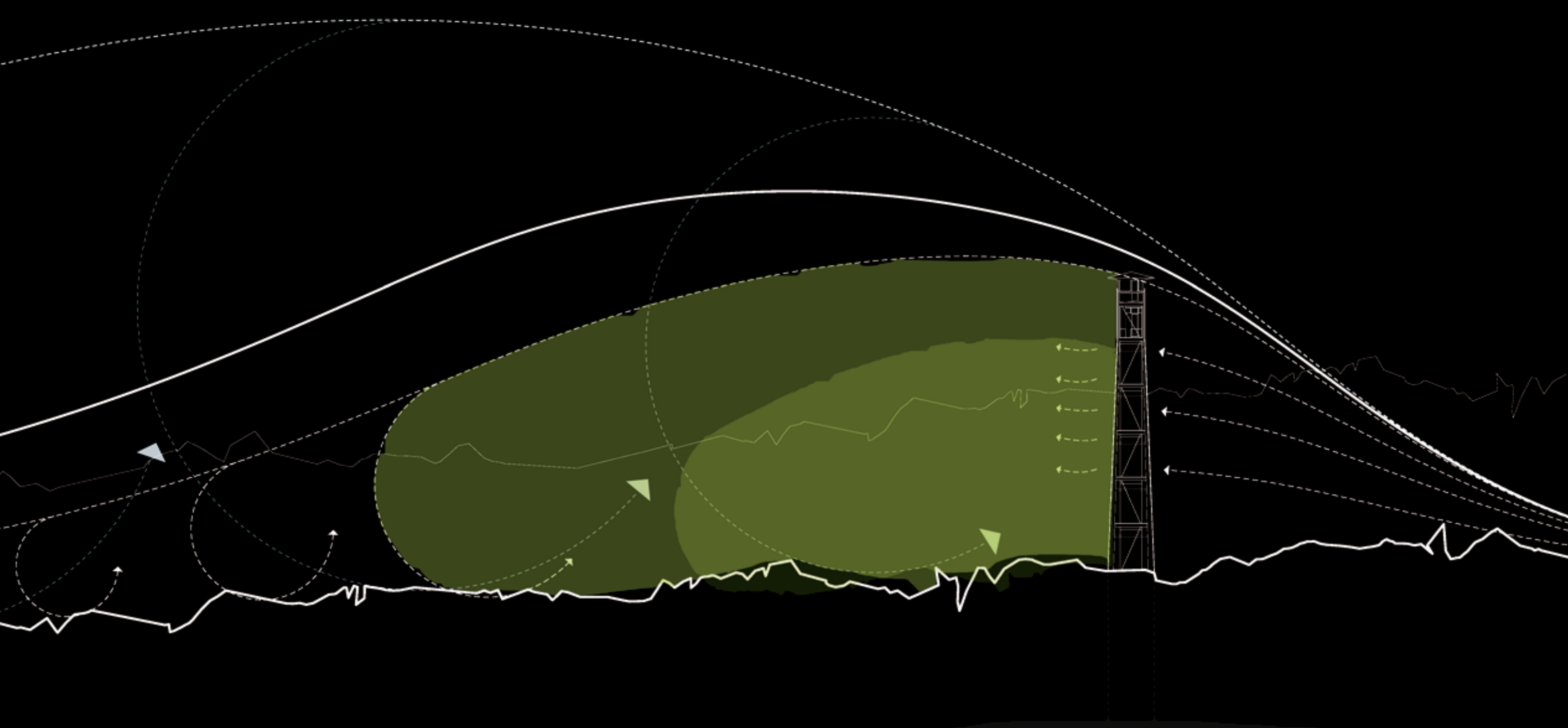




Form and Fluid Dynamics

Conceptually, the “wall” is an open-air, porous steel structure, which uses it’s formal condition to manipulate air movement as it passes over, around and *through* the building. The titanium paneled envelope is roughly 60% porous, allowing the diffusion of air pressure as it builds across the building face. This porosity prevents the turbulent back-flow of wind generally caused by large obstructions in the air, fostering an appropriate wind shadow for the drones to operate safely and efficiently across the down-wind face.





External Measures

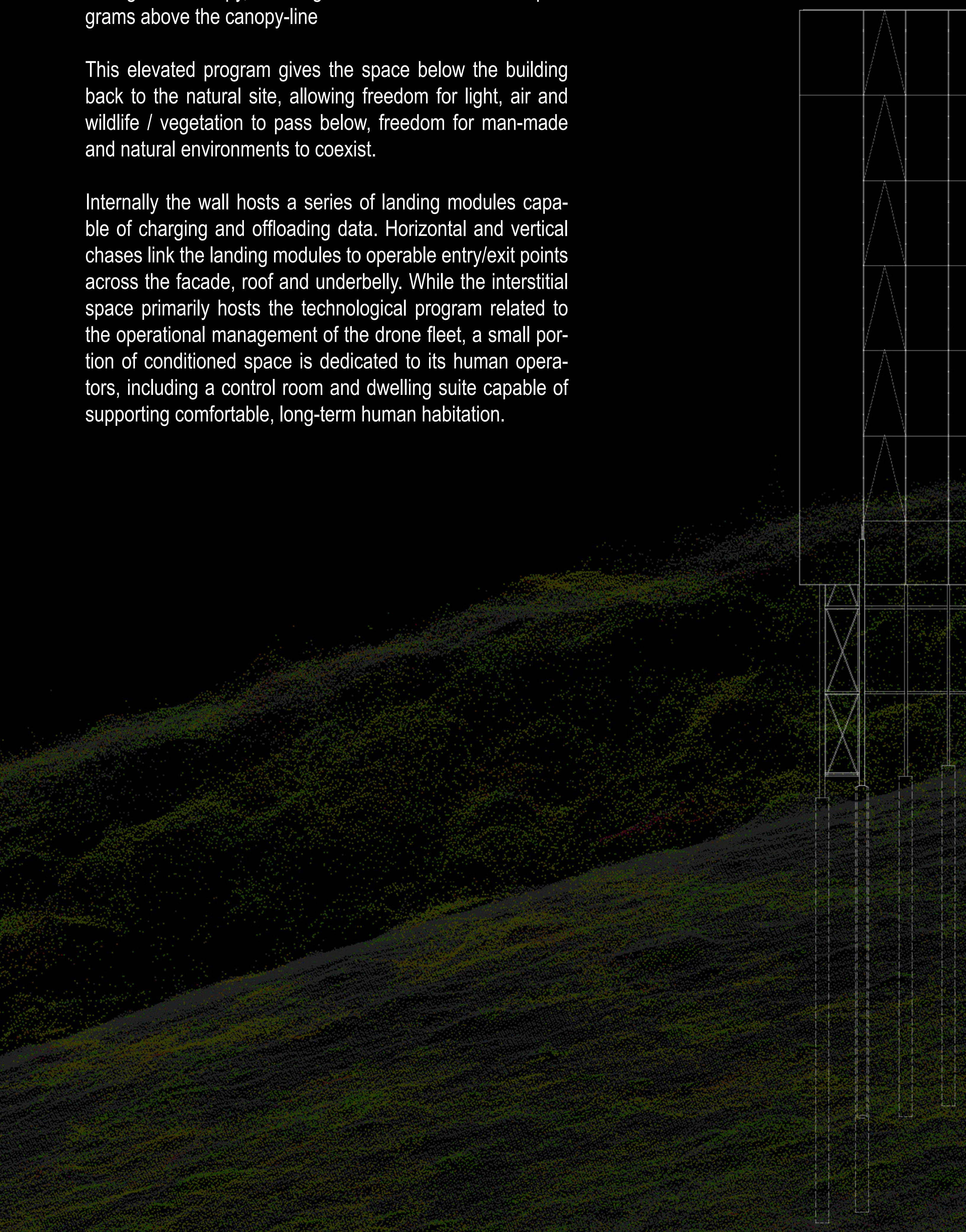
Bird's eye, looking west. The drone allowed access to context beyond the immediate frame of the site, allowing nearly any view from any point within or above the site, helping in understanding the building's juxtaposition within its wild and natural context. The envelope offers transparency and subtle reflectivity, weaving the rising form back into the landscape.

Technical Development

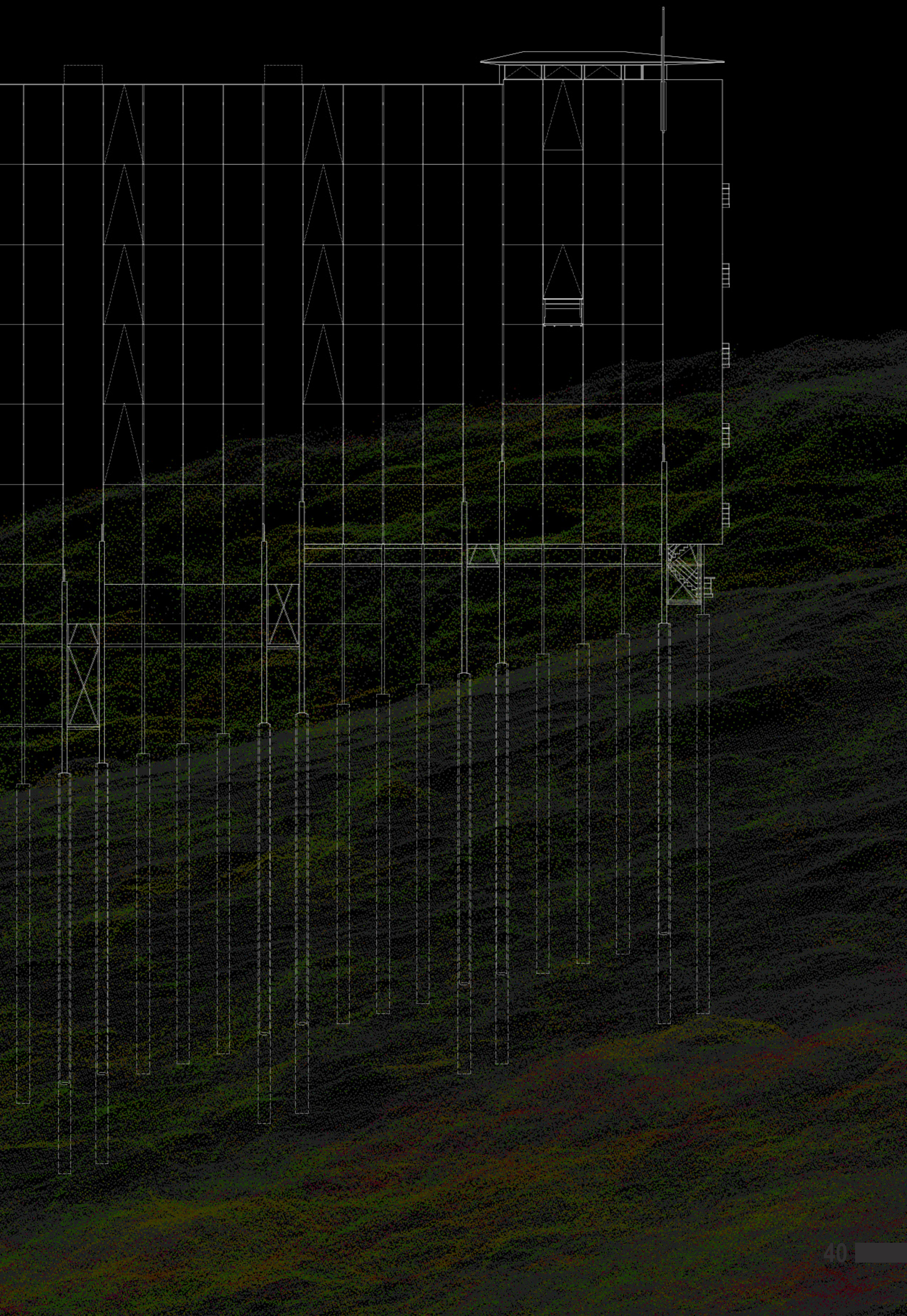
The building utilizes a “root” system similar to a tree, embedding itself into the mountain using a distributed arrangement of deep-ground piles. The structure rises upward and through the canopy, situating its internal drone-related programs above the canopy-line

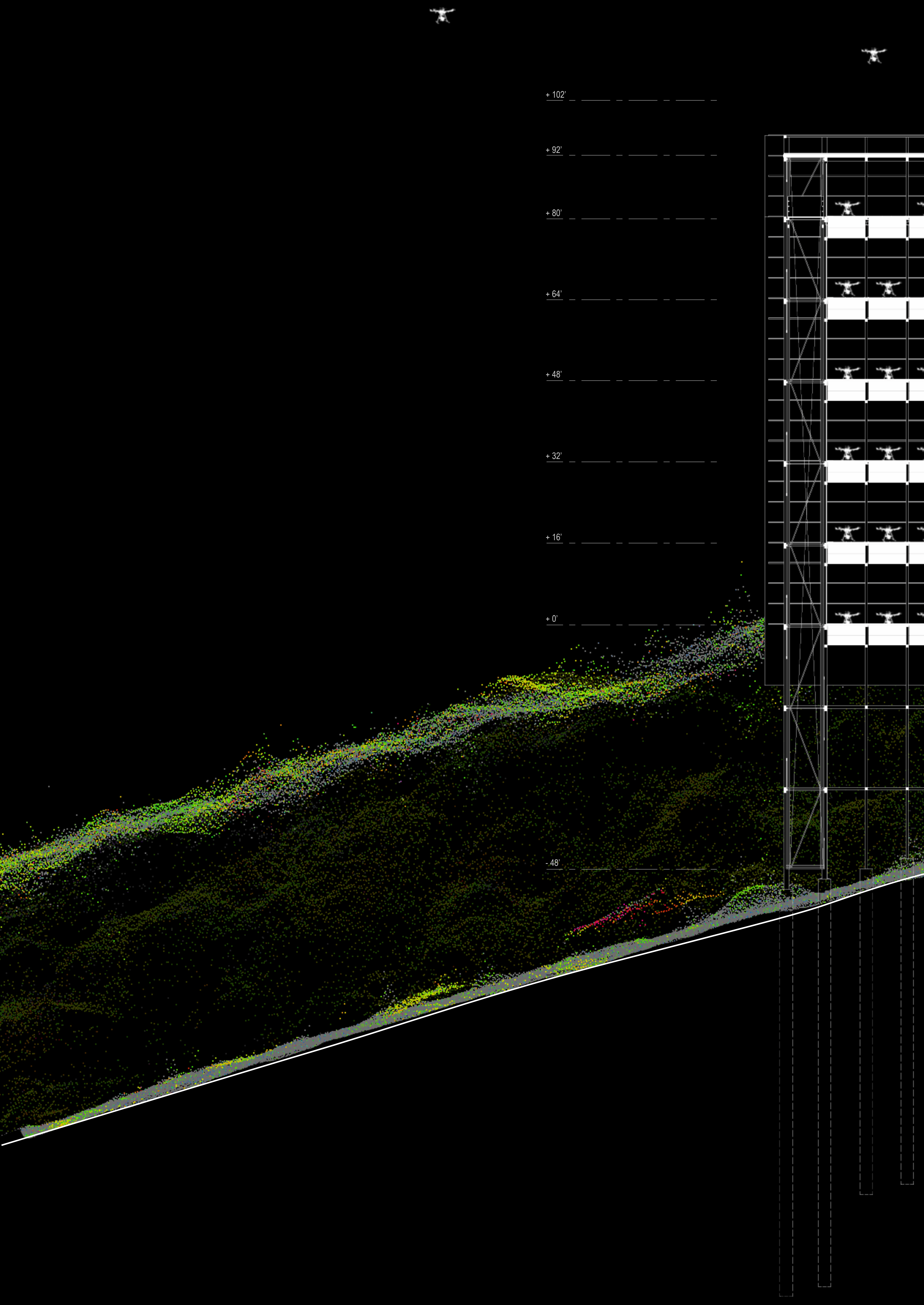
This elevated program gives the space below the building back to the natural site, allowing freedom for light, air and wildlife / vegetation to pass below, freedom for man-made and natural environments to coexist.

Internally the wall hosts a series of landing modules capable of charging and offloading data. Horizontal and vertical chases link the landing modules to operable entry/exit points across the facade, roof and underbelly. While the interstitial space primarily hosts the technological program related to the operational management of the drone fleet, a small portion of conditioned space is dedicated to its human operators, including a control room and dwelling suite capable of supporting comfortable, long-term human habitation.

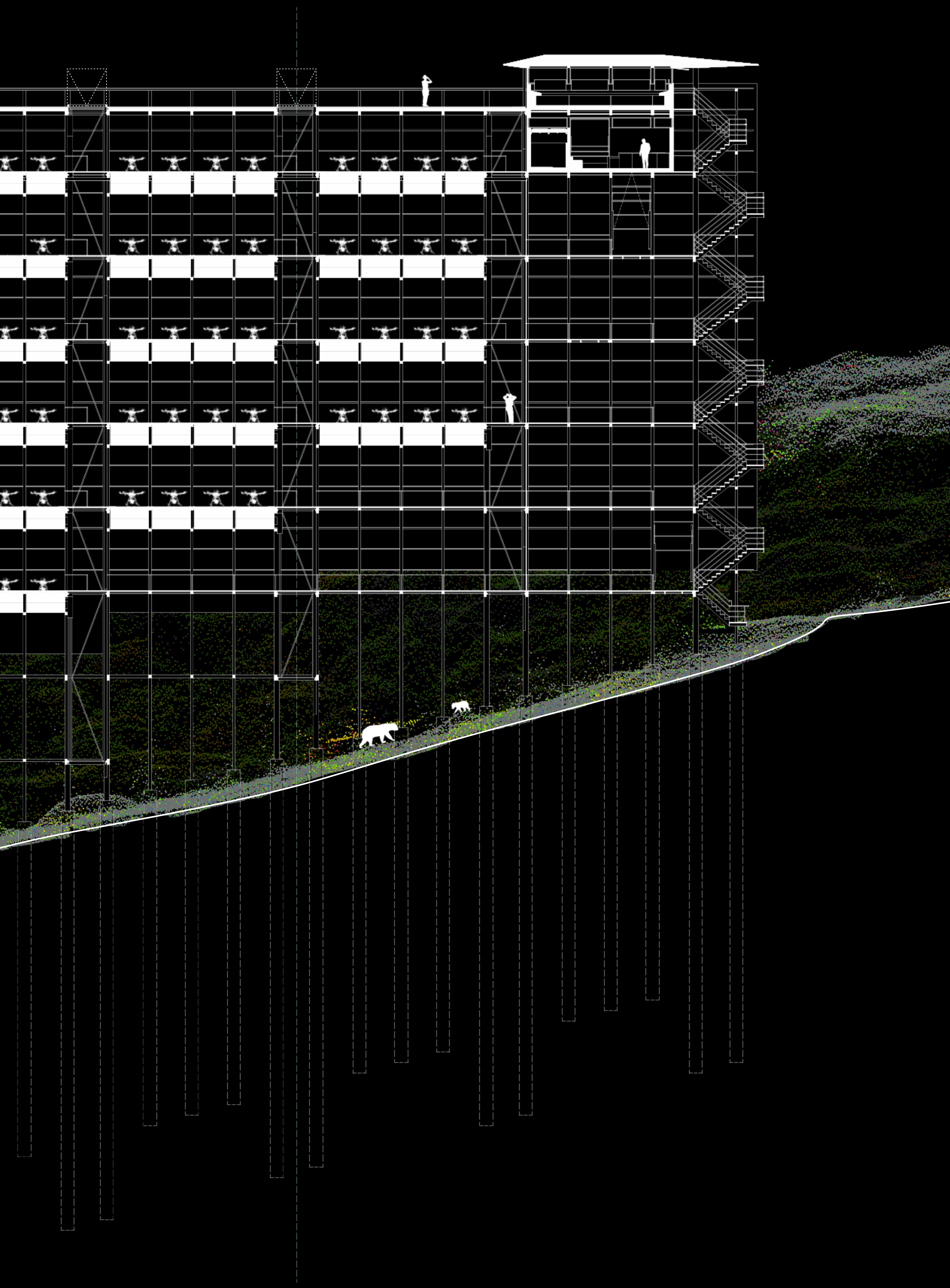


Elevation - Side

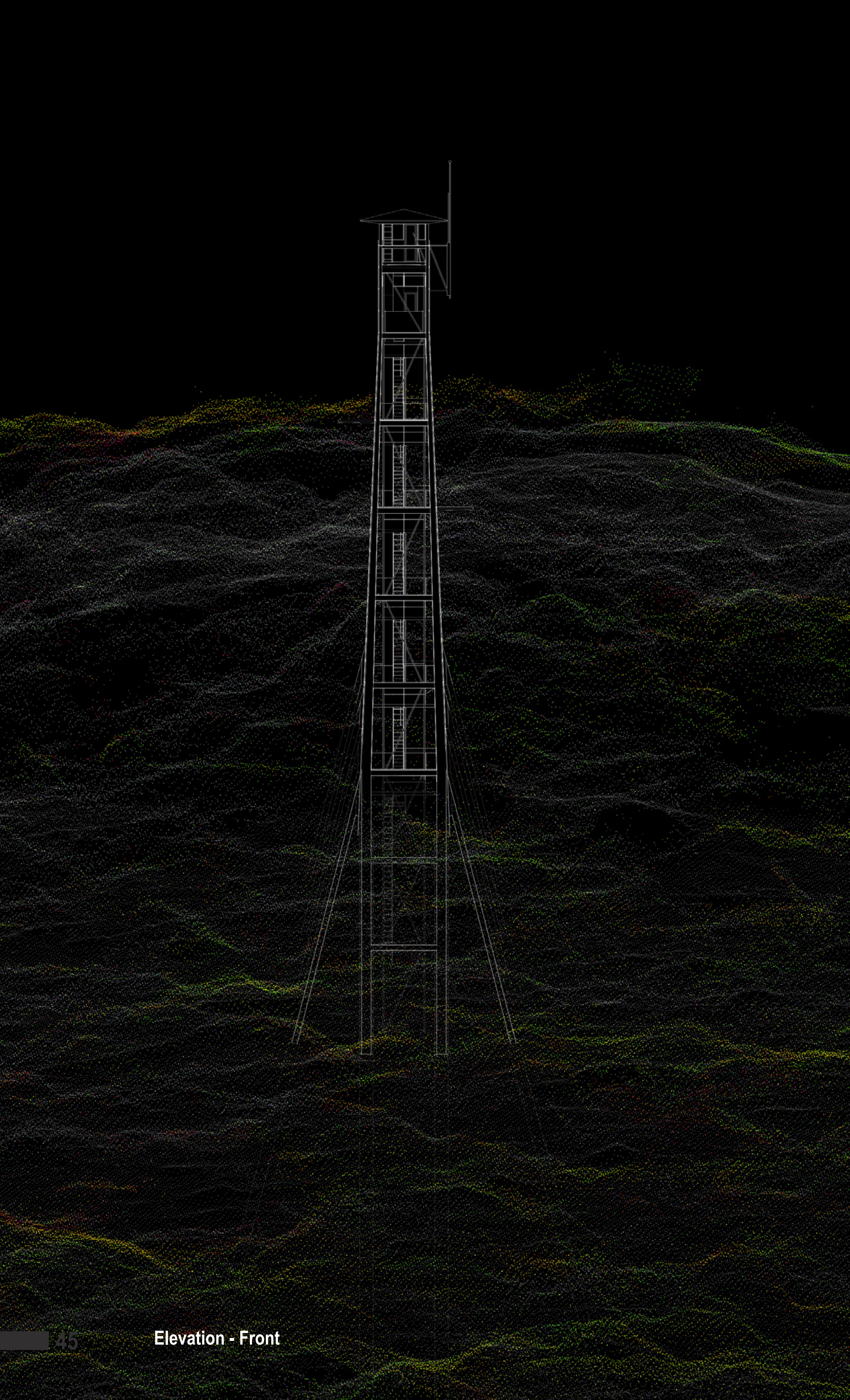




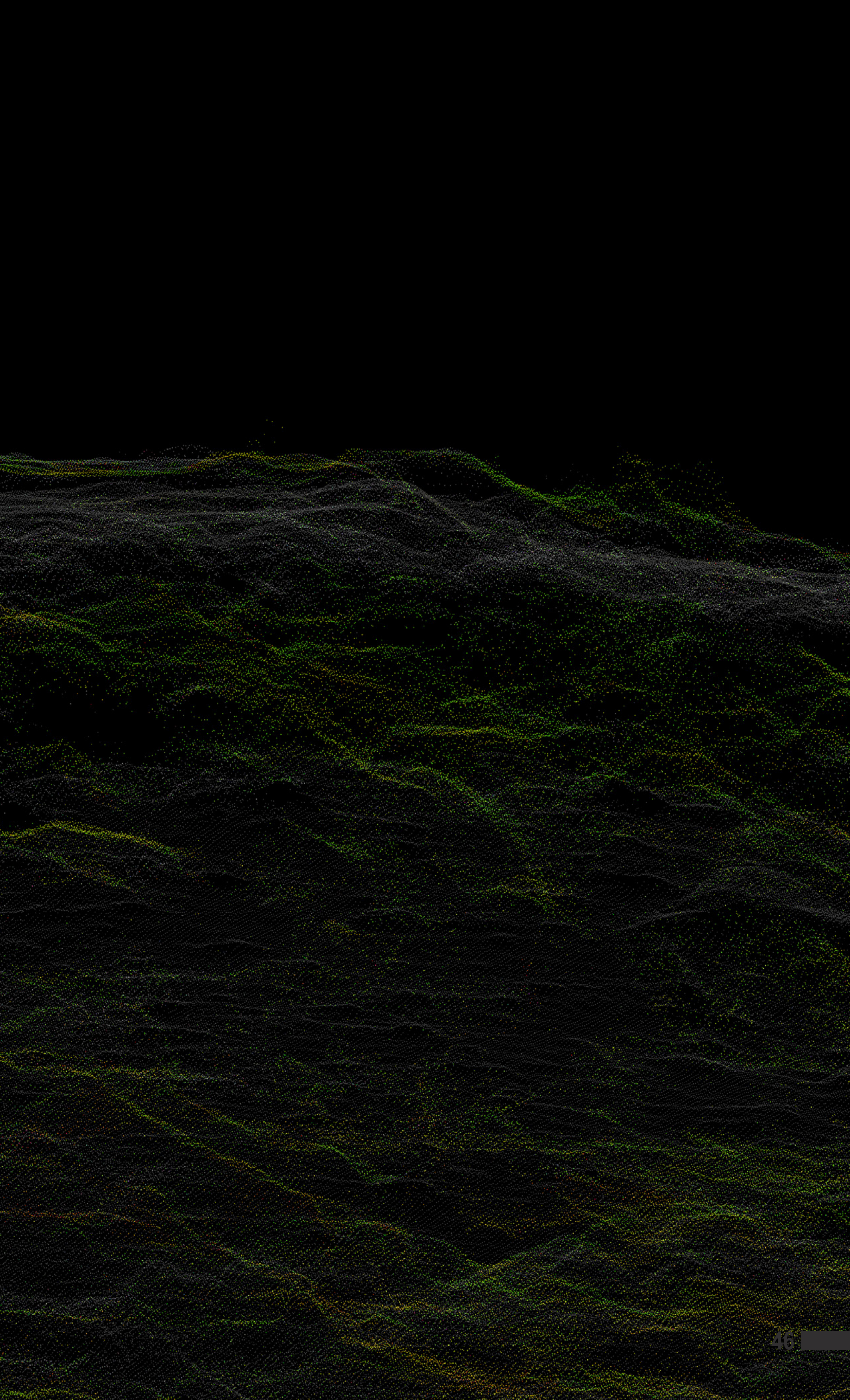
Section - Longitudinal

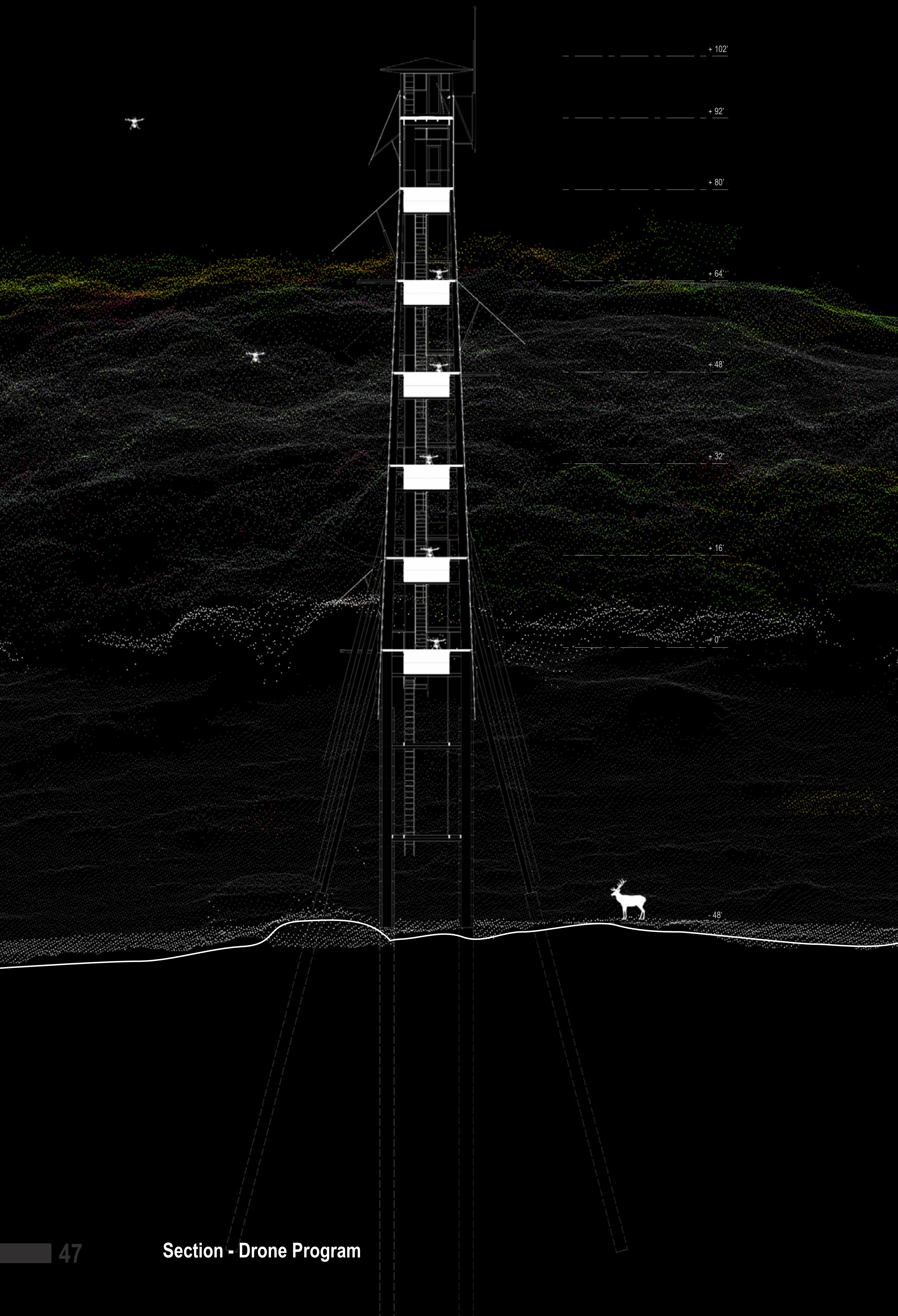


Interior, Landing Level 4

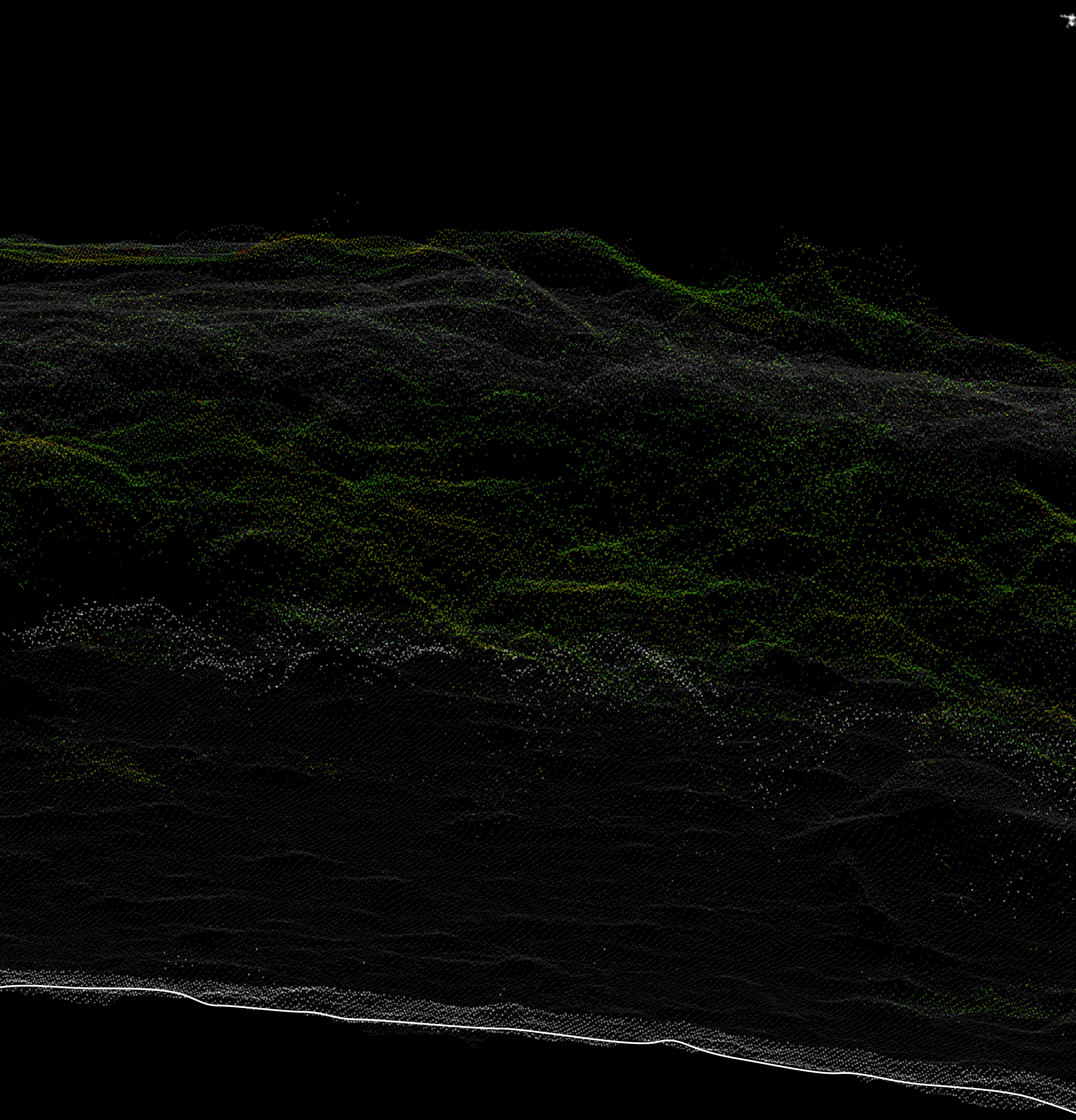


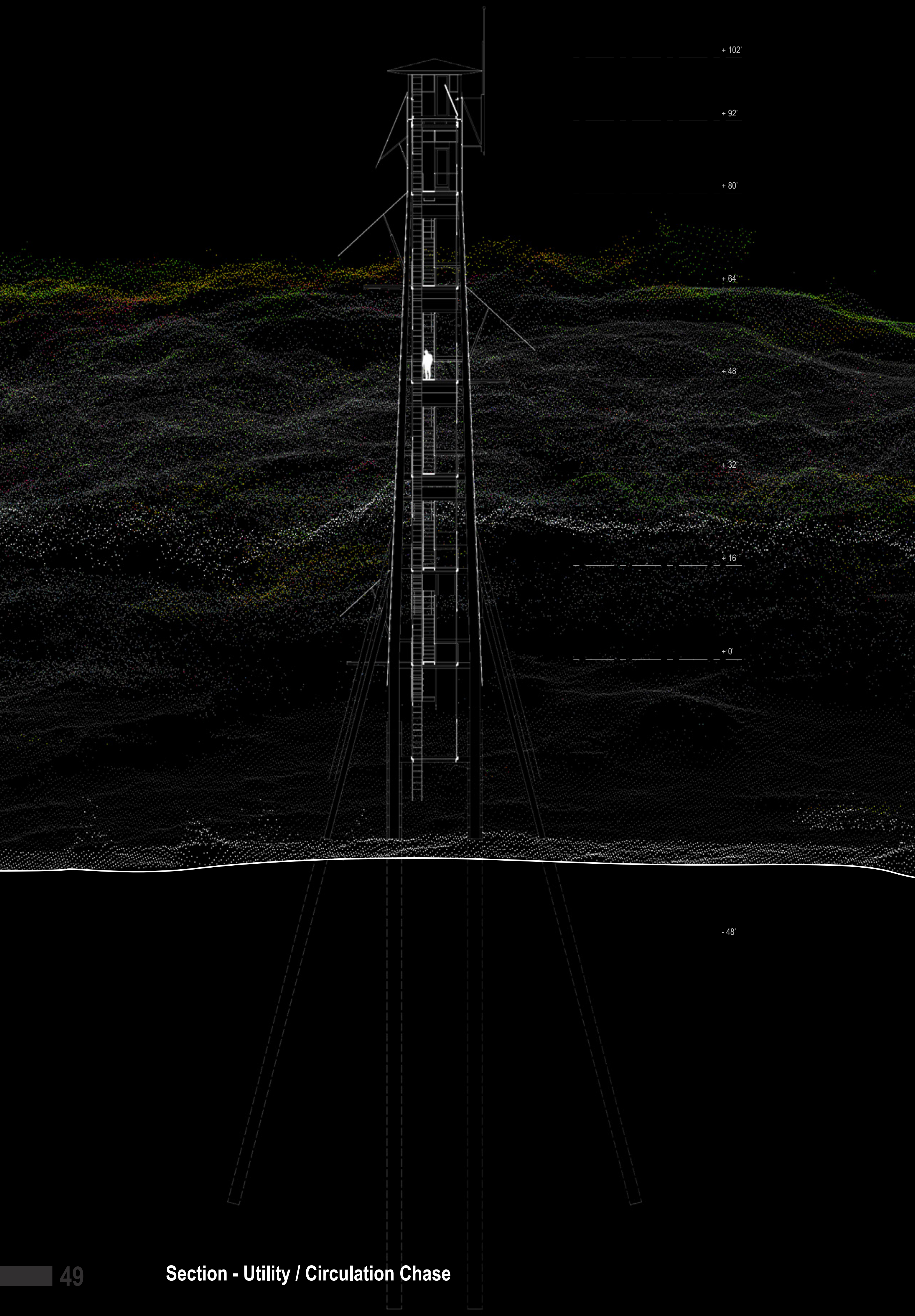
Elevation - Front



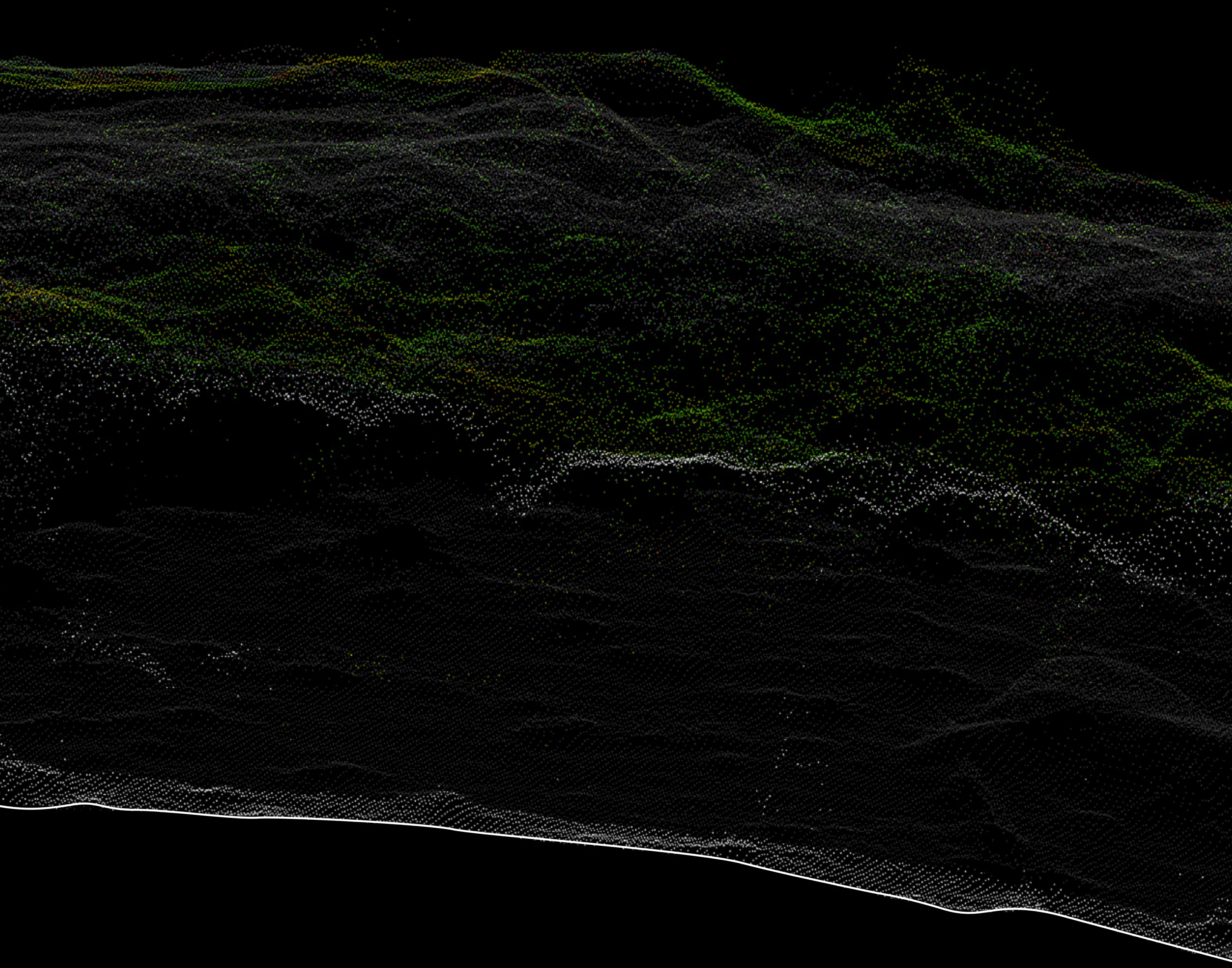


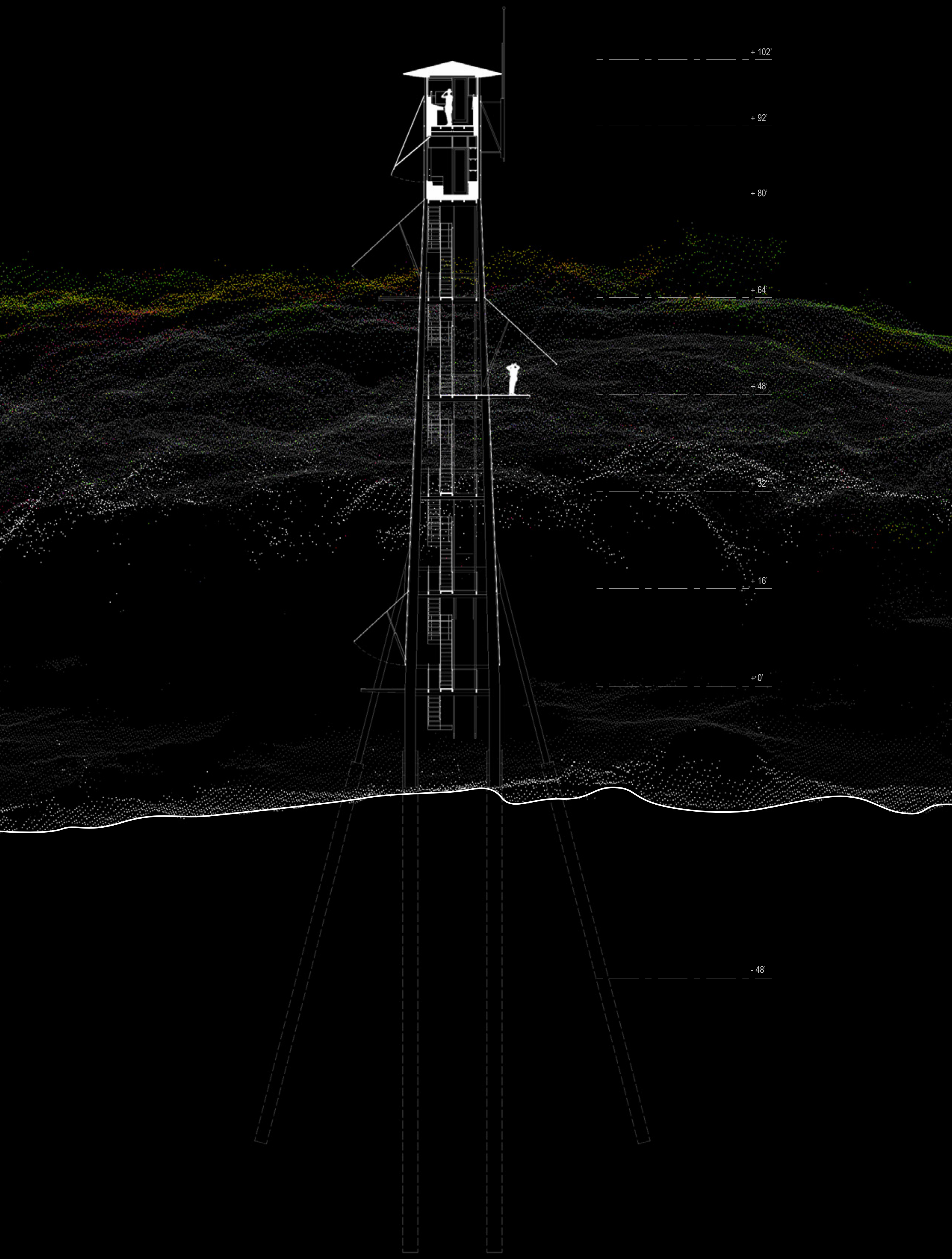
Section - Drone Program



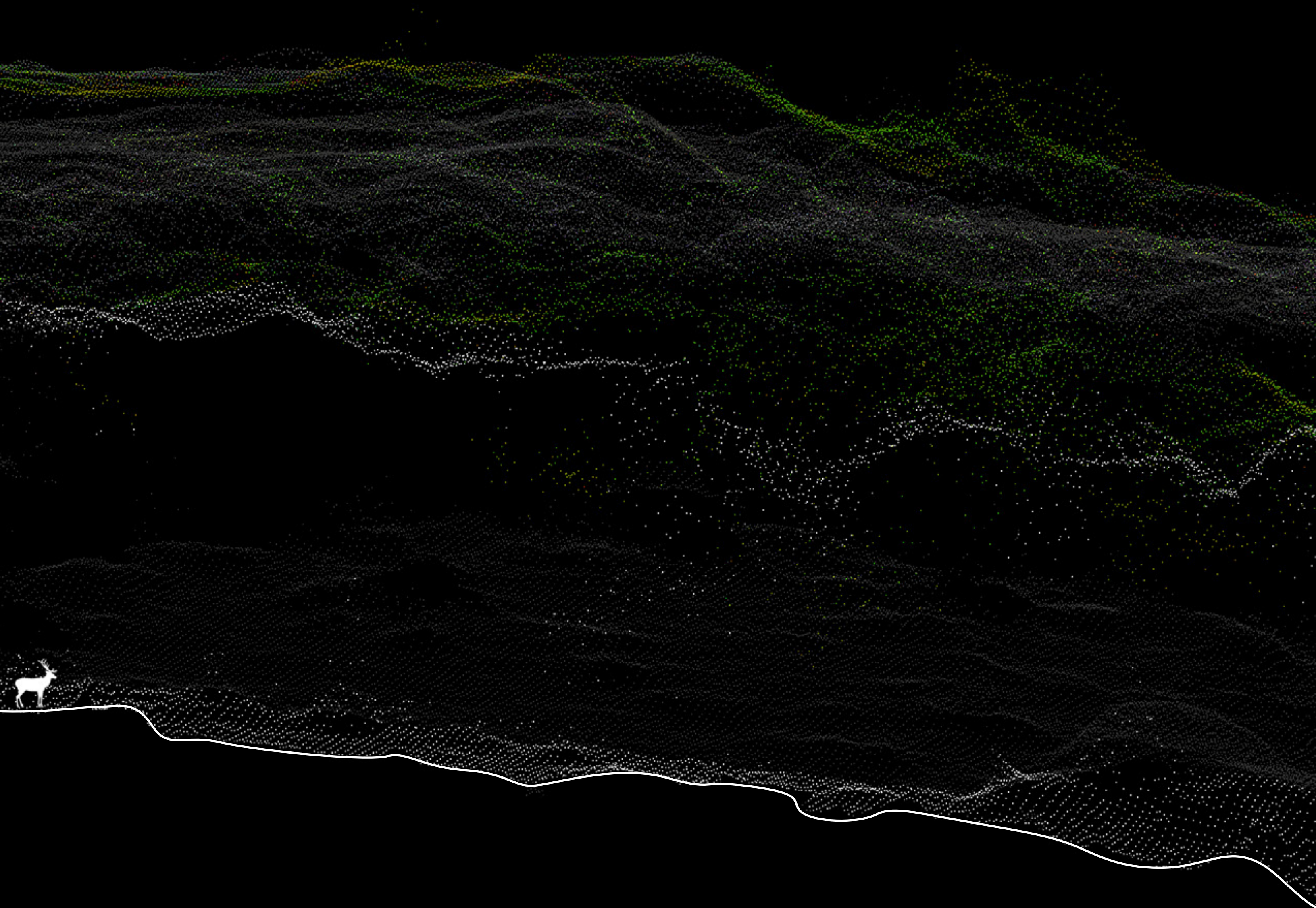


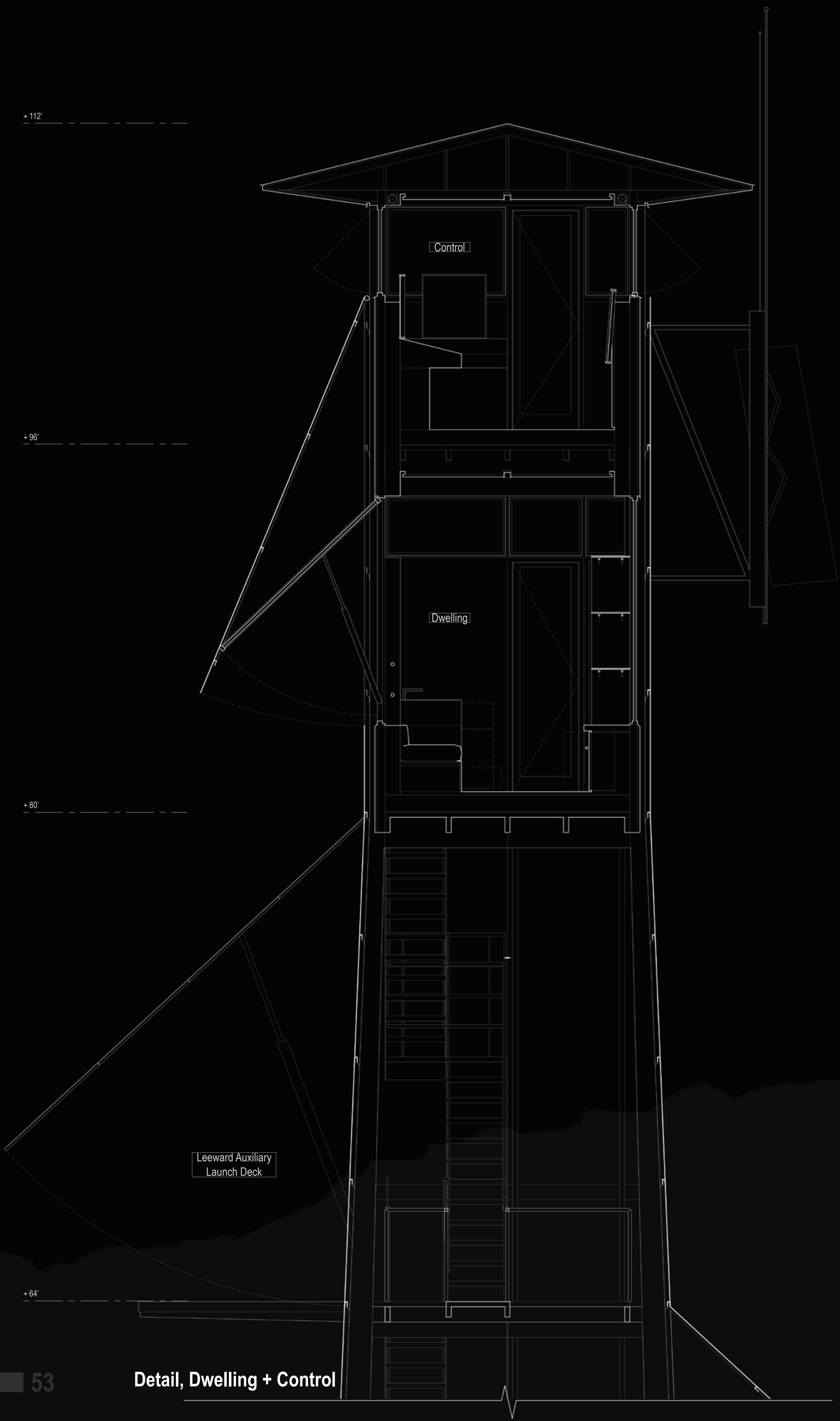
Section - Utility / Circulation Chase



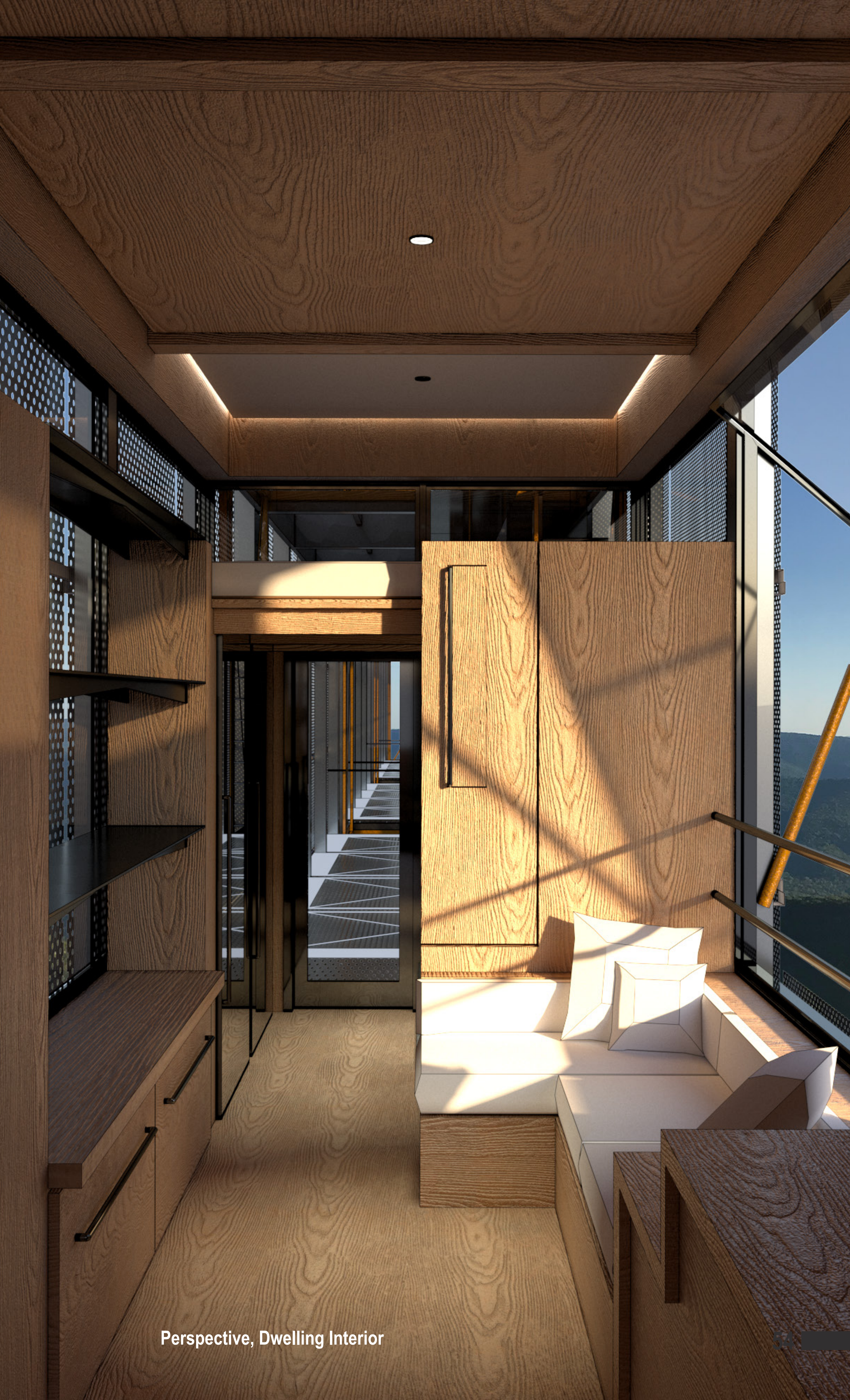


Section - Human Program

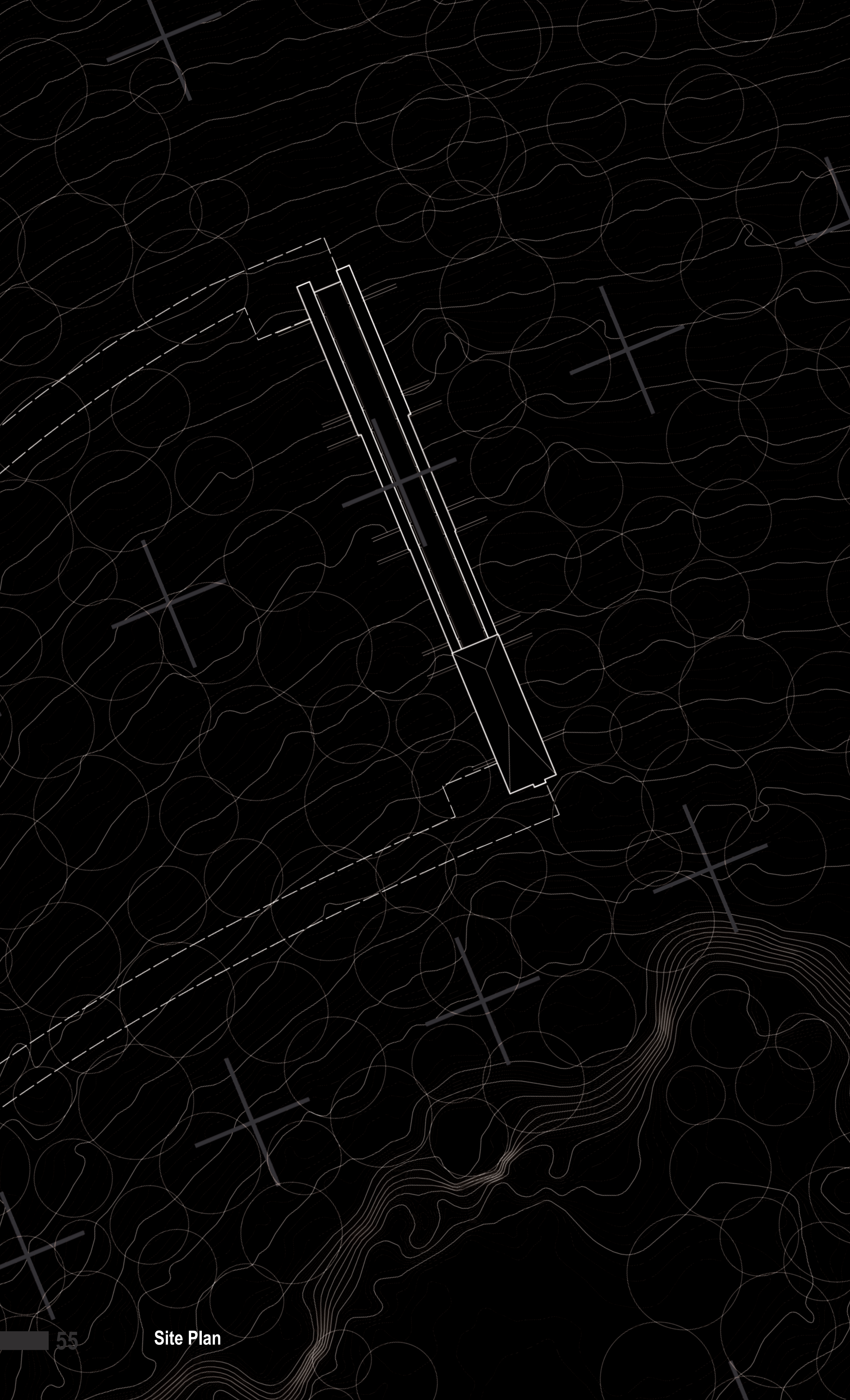




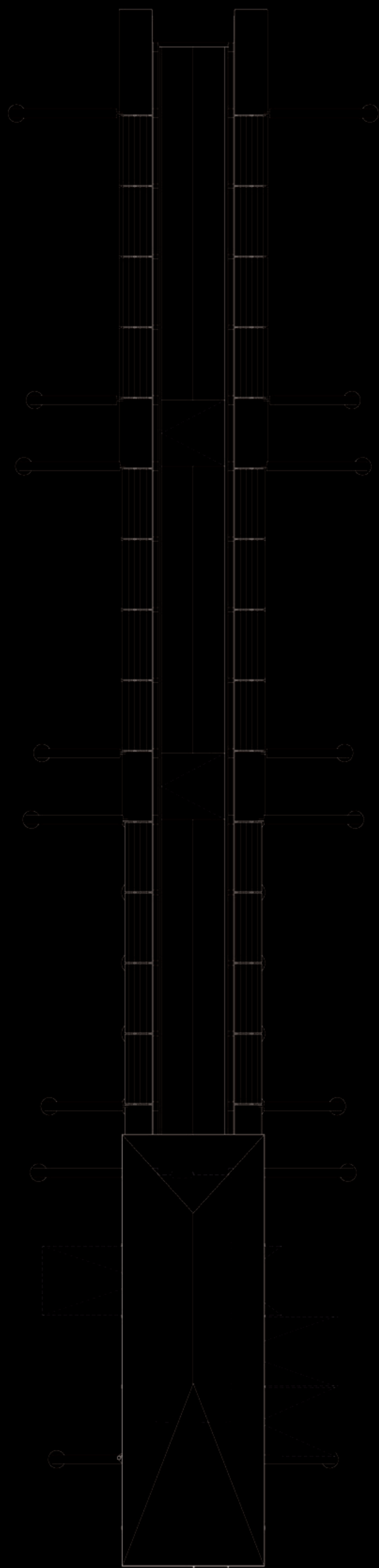
Detail, Dwelling + Control



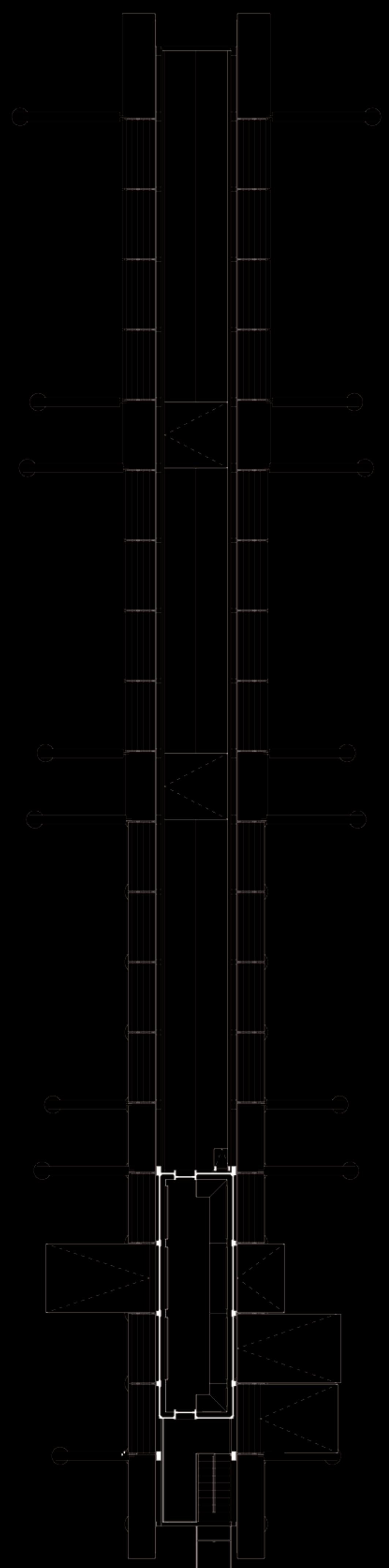
Perspective, Dwelling Interior



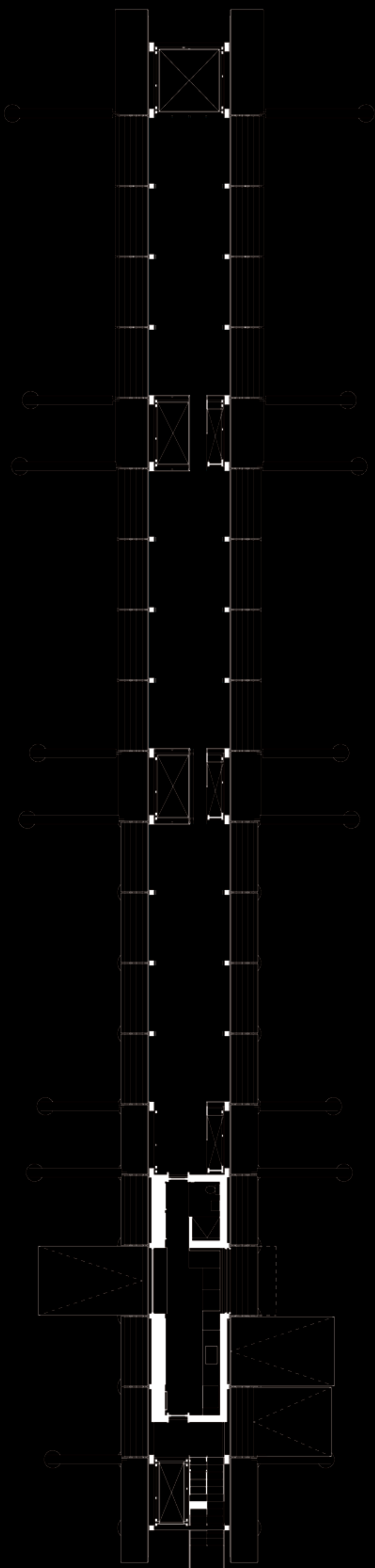
Site Plan



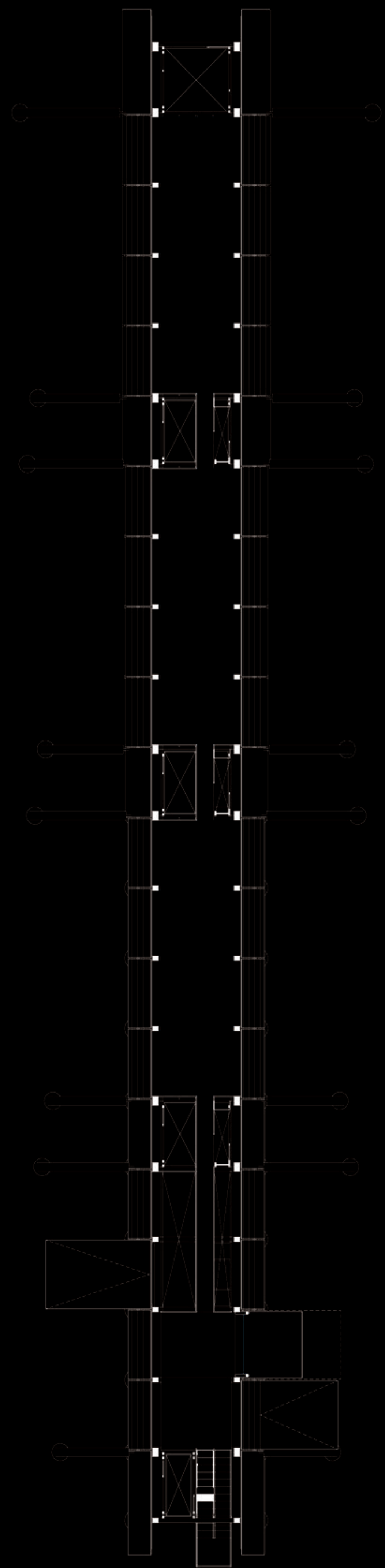
08 - Roof Plan

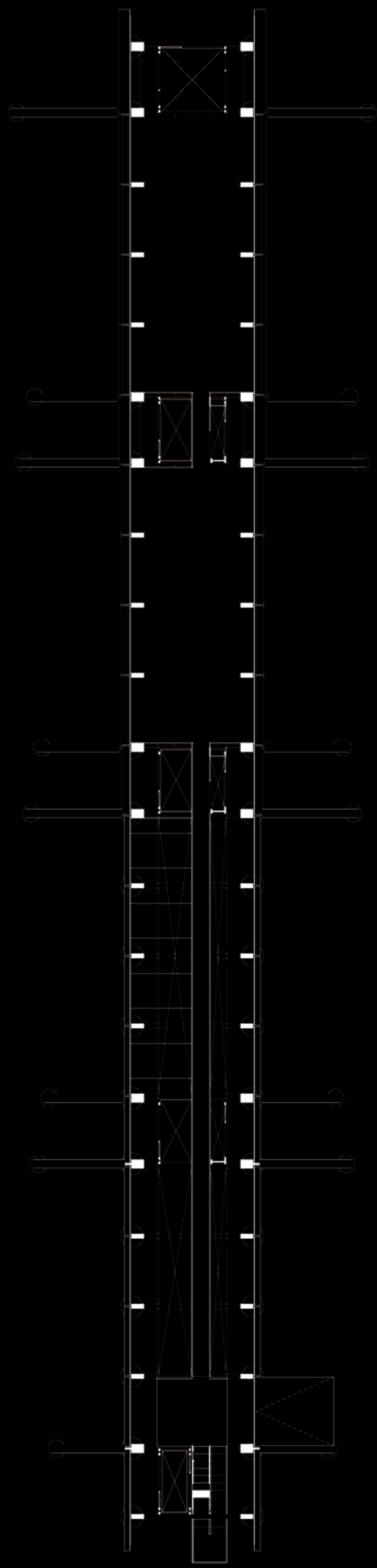


07 - Control Deck

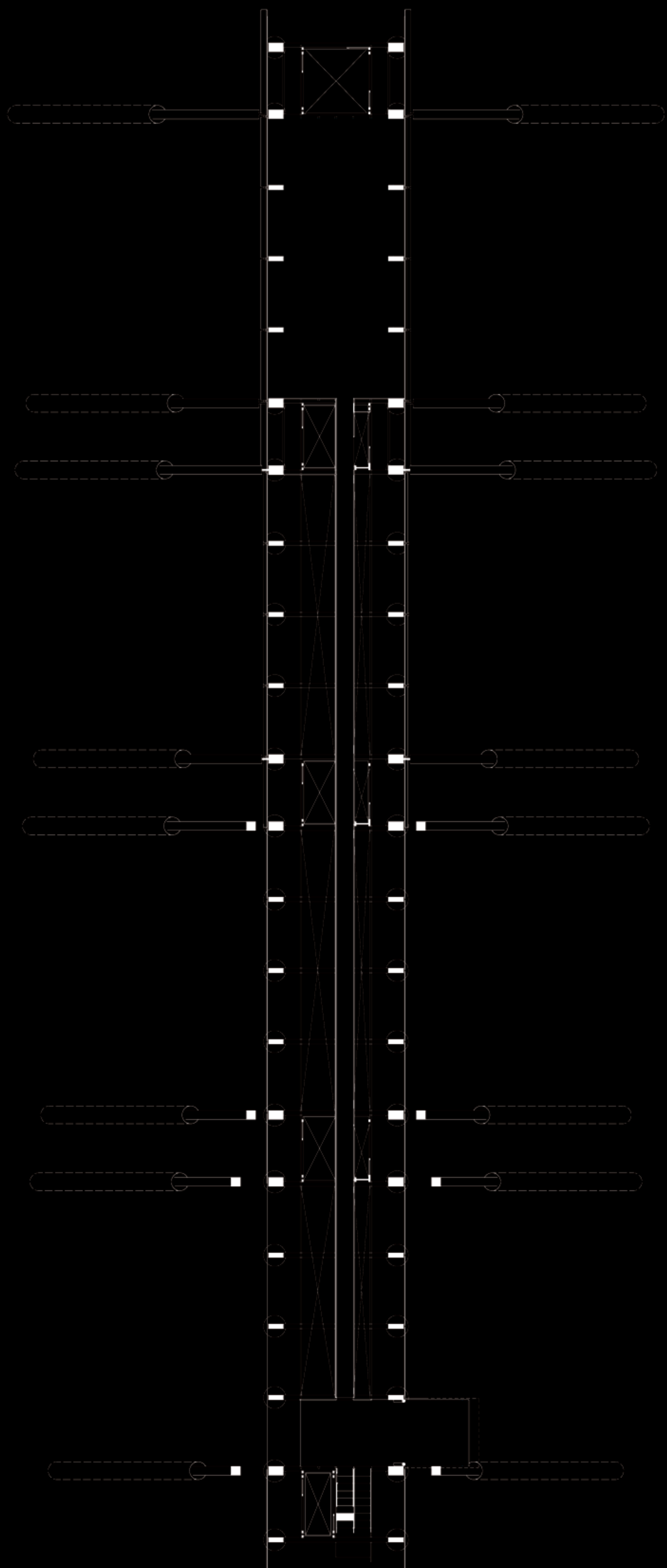


06 - Dwelling Deck

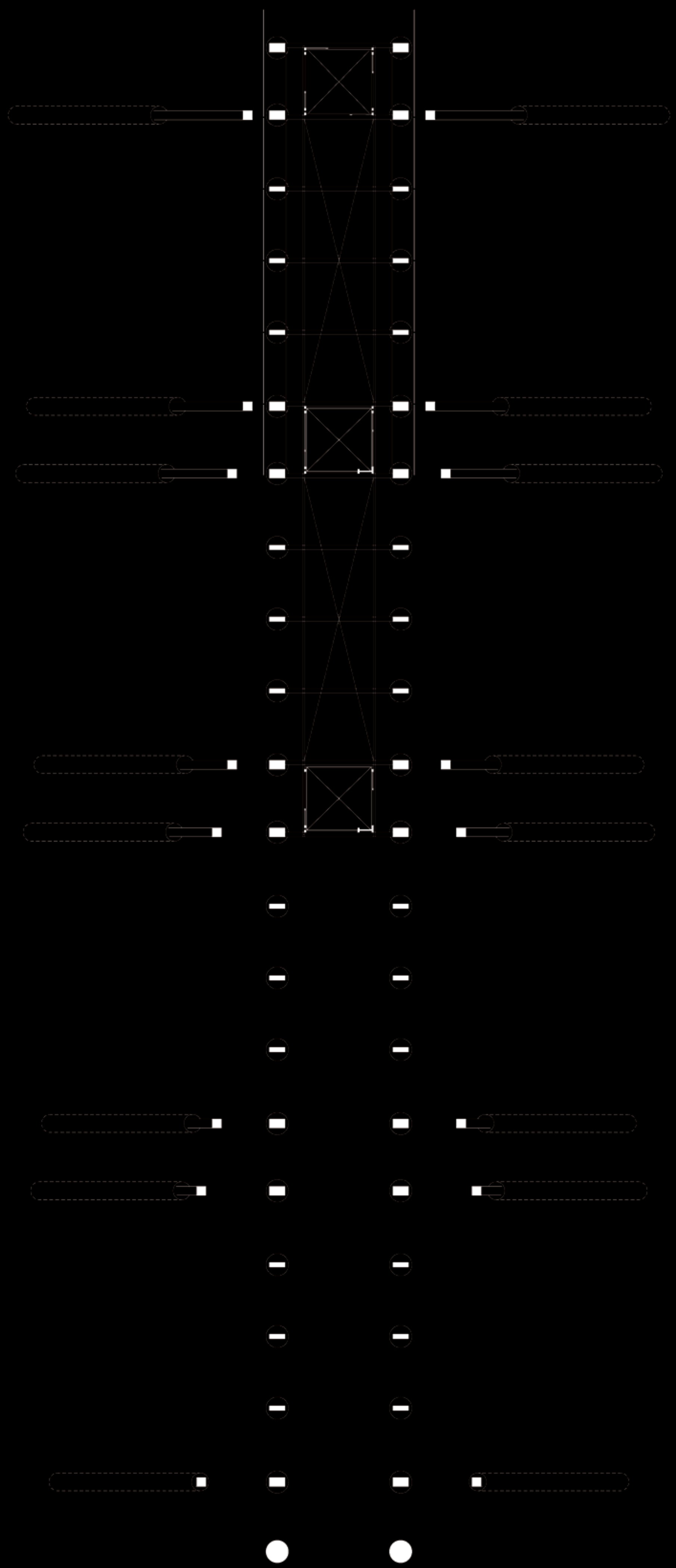




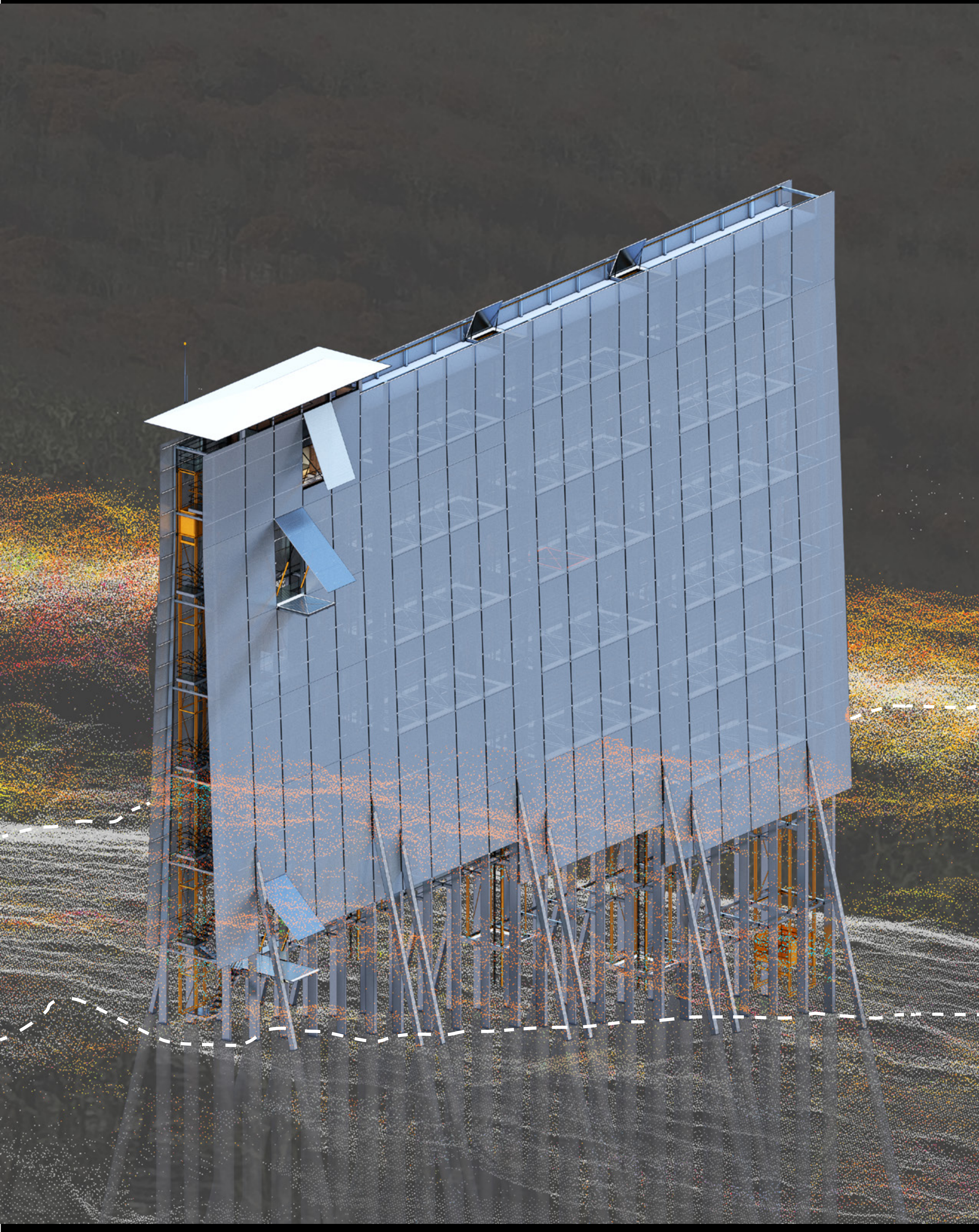
03 - Landing Deck



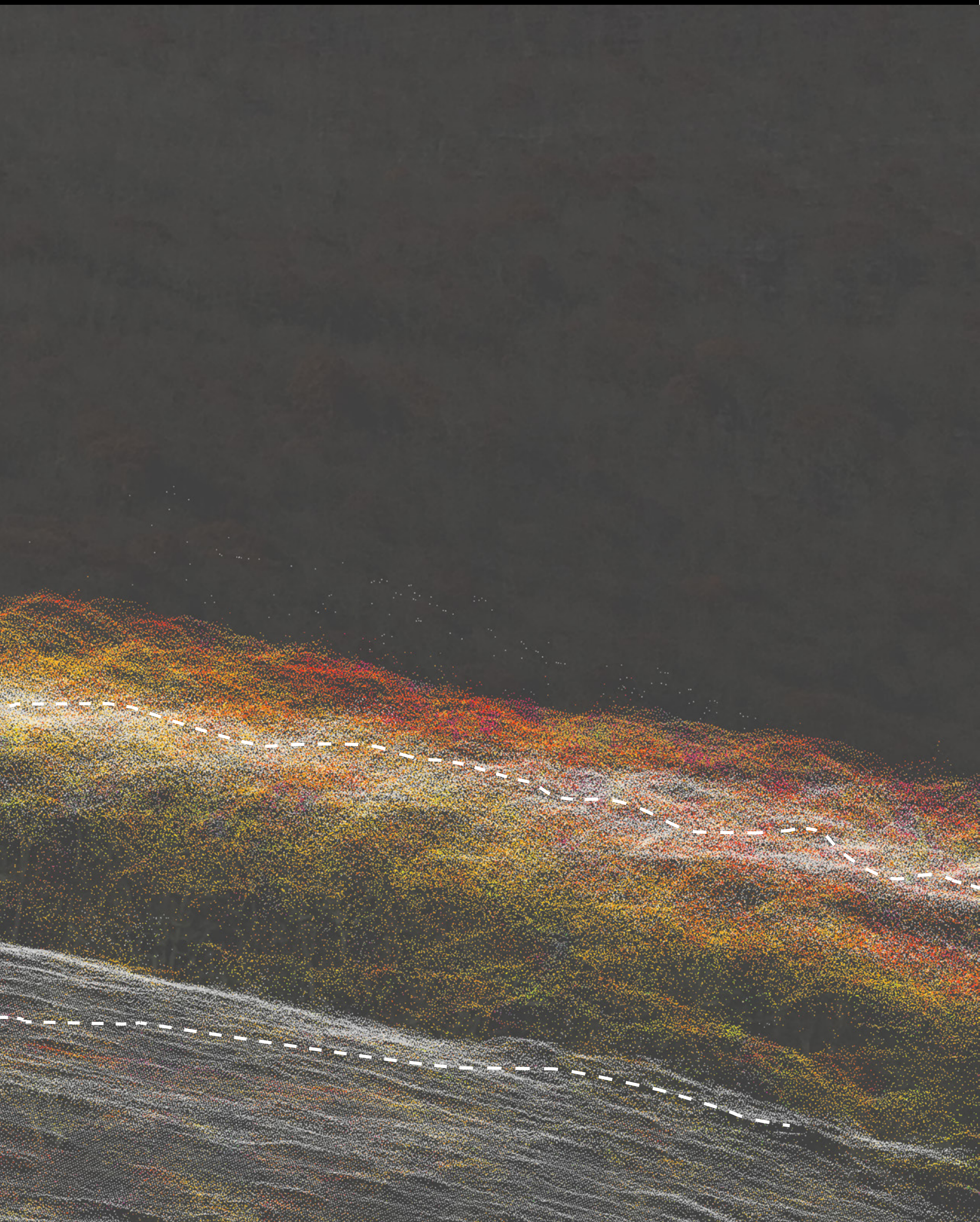
01 - Landing Deck / Pedestrian Entry

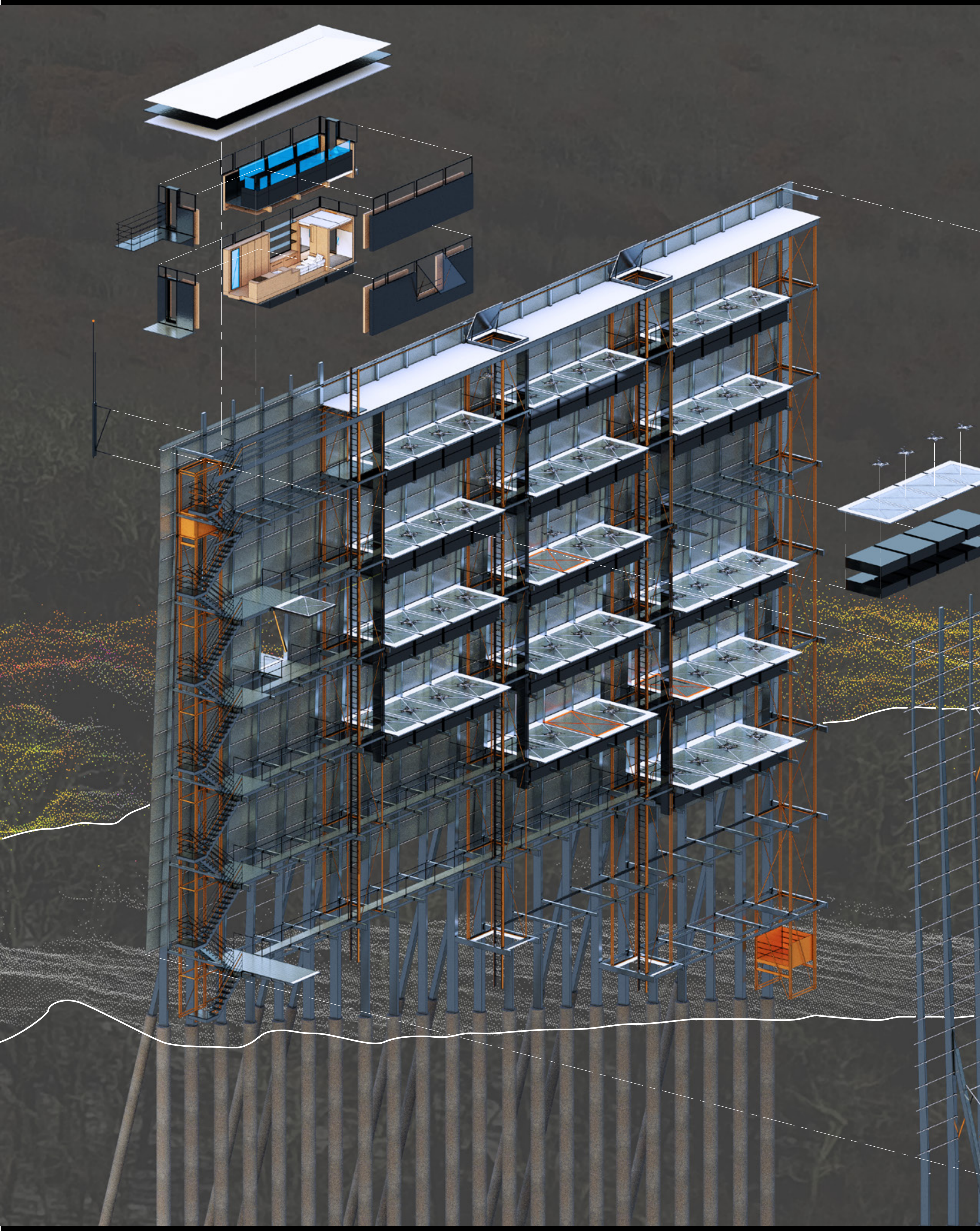


00 - Loading Level

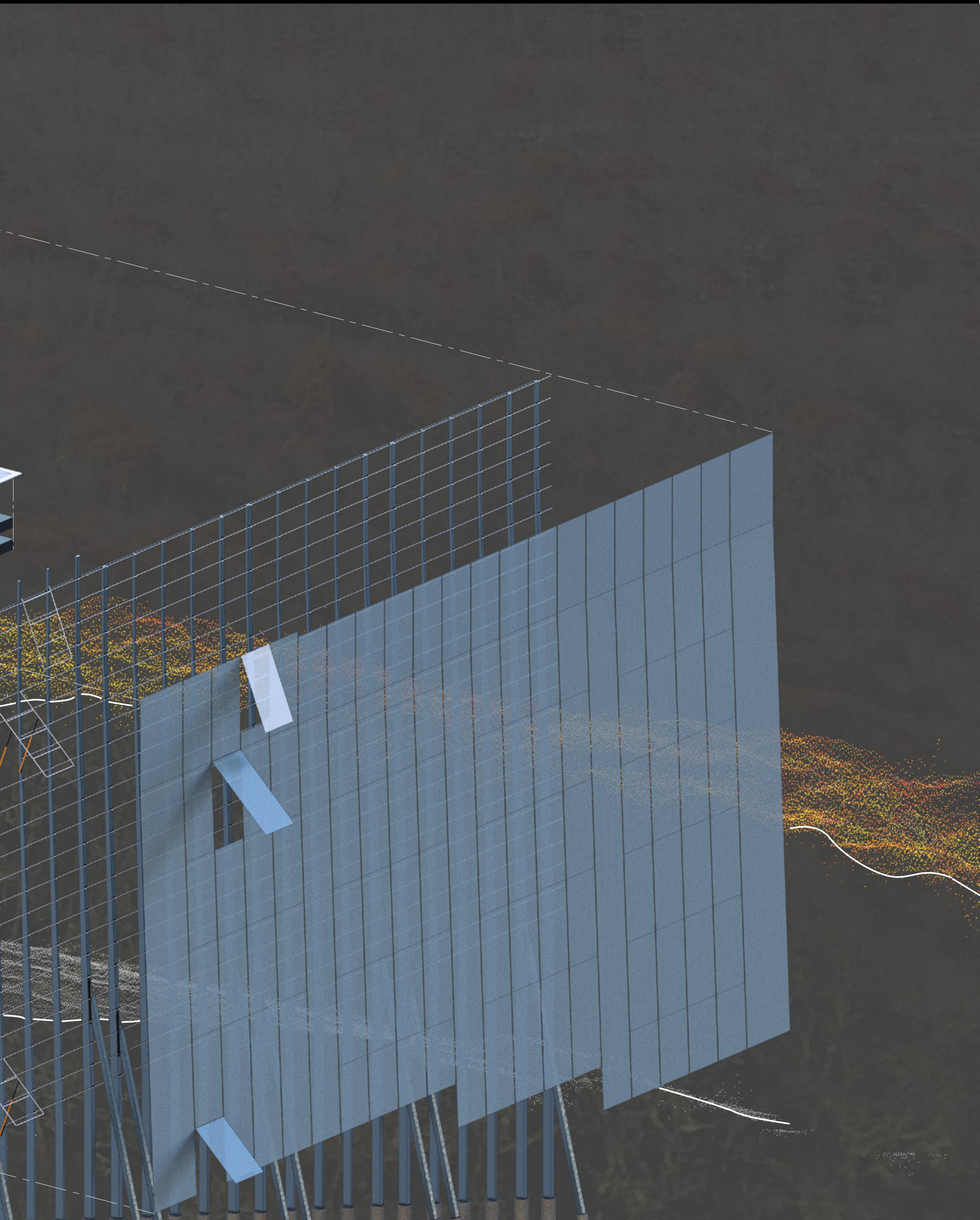


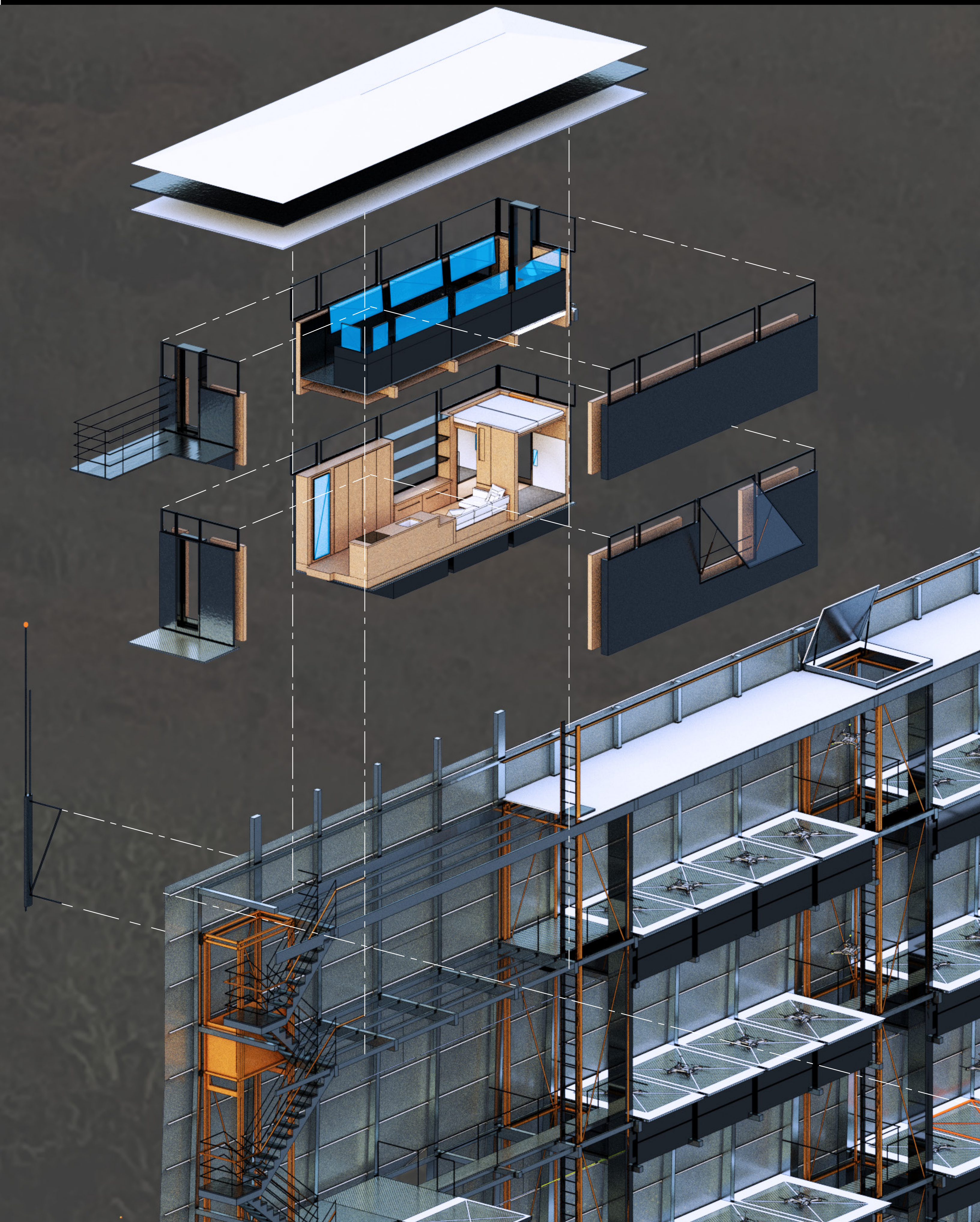
Isometric - Rear



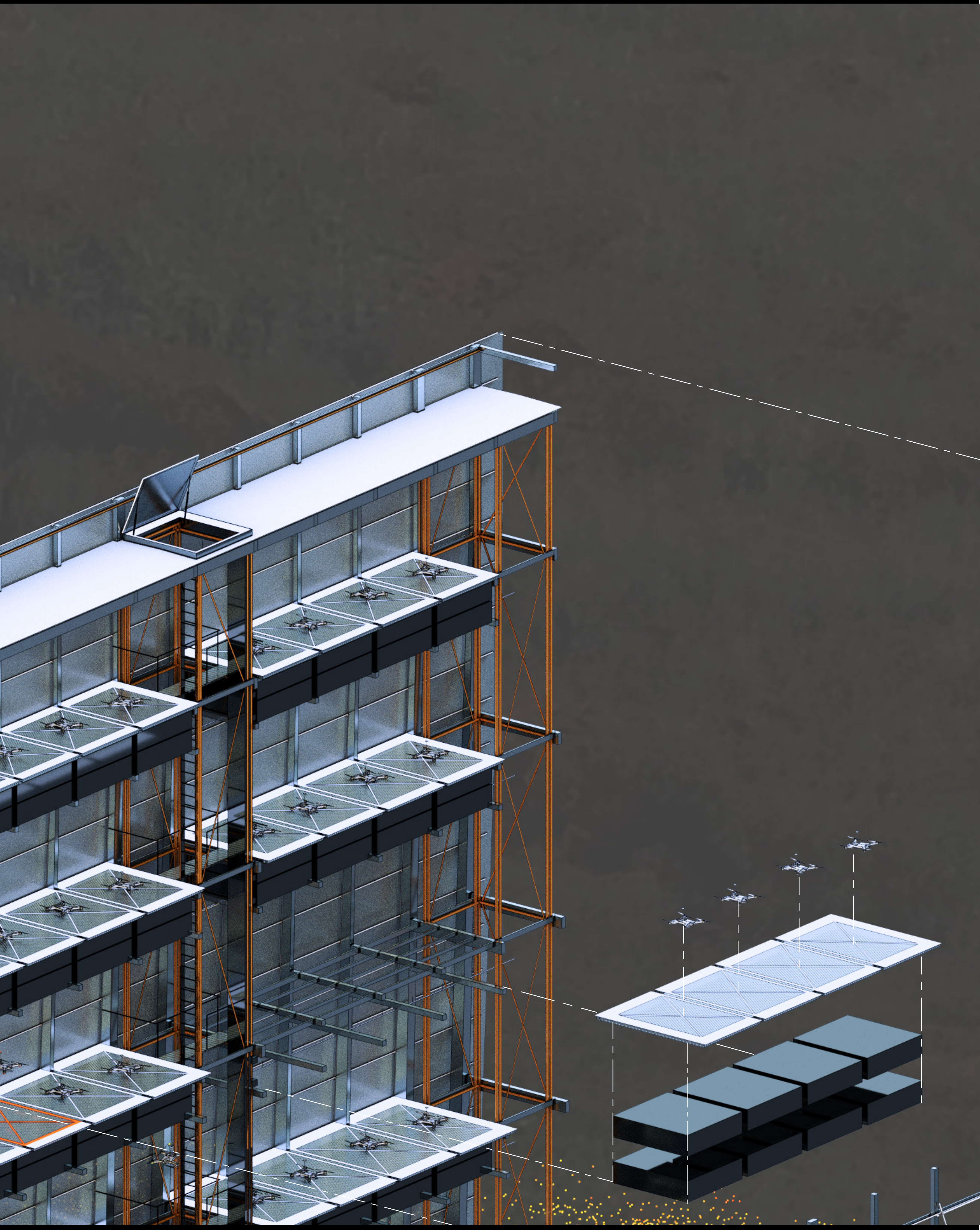


Isometric - Exploded





Isometric - Exploded



Perspective, looking East

Perspective, looking North West

Conclusion

I'm hopeful that architecture can continue to serve a role in protecting what sacred spaces remain in our world.

Overall, the true nature of a place is so much more than creative visualizations of information, regardless of resolution, and data will only go so far as to inform an architecture. These are ephemeral snapshots of a place within time, and are only representations of our real world, as is all architectural documentation, and I don't think any amount of data visualization can reproduce the reality of a first-hand experience of a place. Frank Lloyd Wright was correct when he noted that "True study is a form of experience."

It's instead about tying data back to our experience of reality. Our ability to process such a vast amount of information at scales far beyond what our brains and bodies allow is certainly an advantage to the architect. While the data and the information generated holds no true meaning in its raw form, it's the anomalies and patterns we find hidden within the data that offer us clues towards a more holistic understanding of our natural and built environments.

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Iteration is the key towards a successful project development. That being said, the end of the process is almost unrecognizeable in comparison to the start.

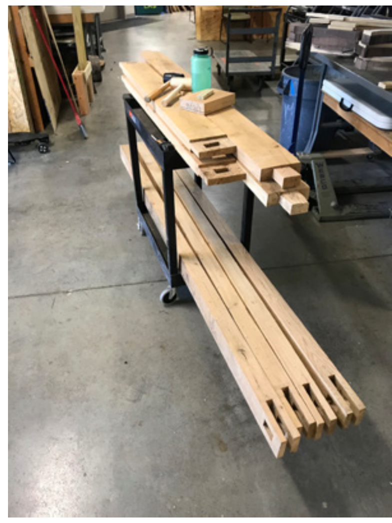
The following compilation of imagery represents the journey of creative work that eventually led to the finalized thesis project.

(Right) Early in the Fall semester I took time to explore traditional Japanese wood working, which informed the design and construction of a White Oak wedding arbor for a close family friend. The process was completely hands-on and made possible through Virginia Tech's Building and Construction School wood shop.











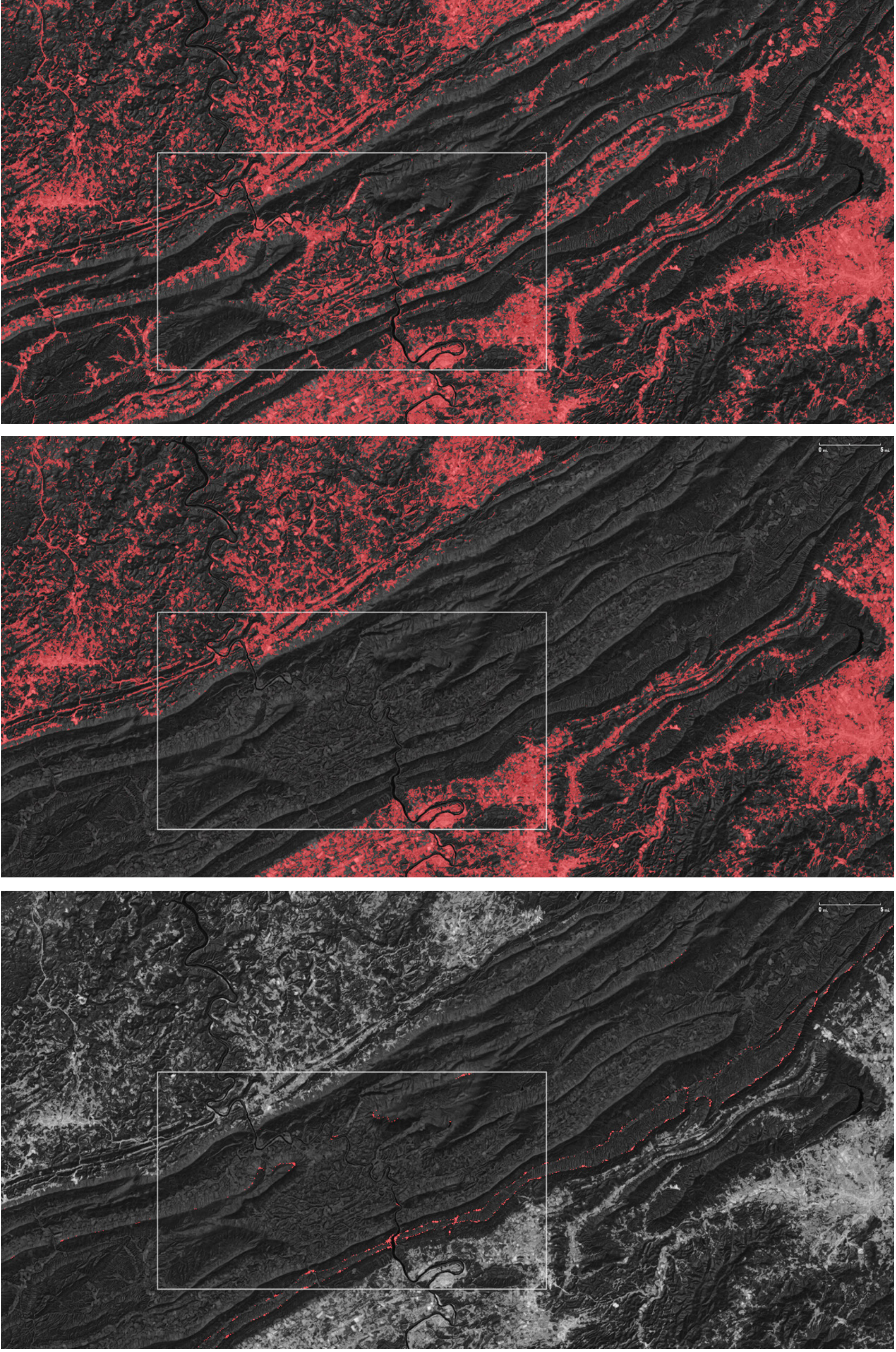




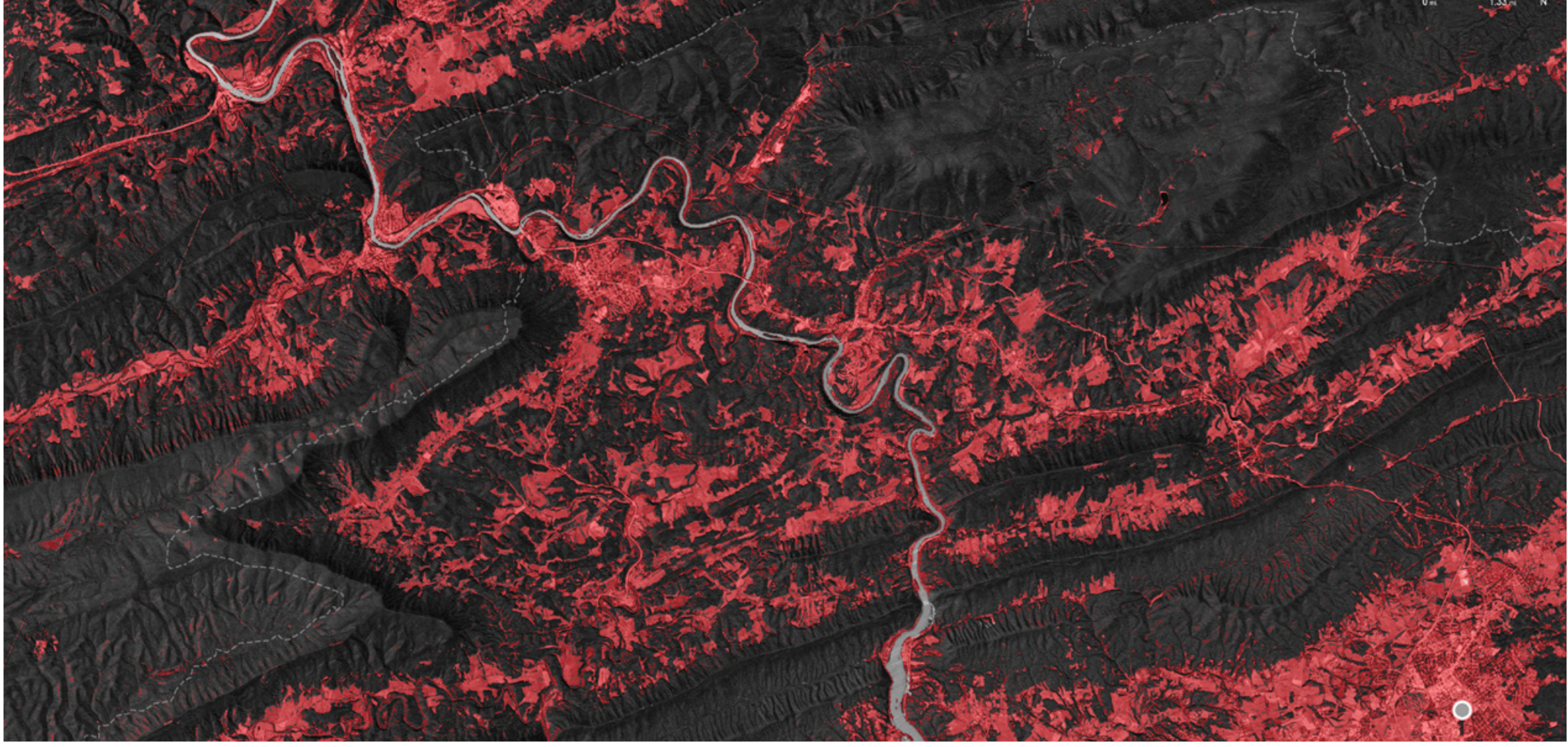


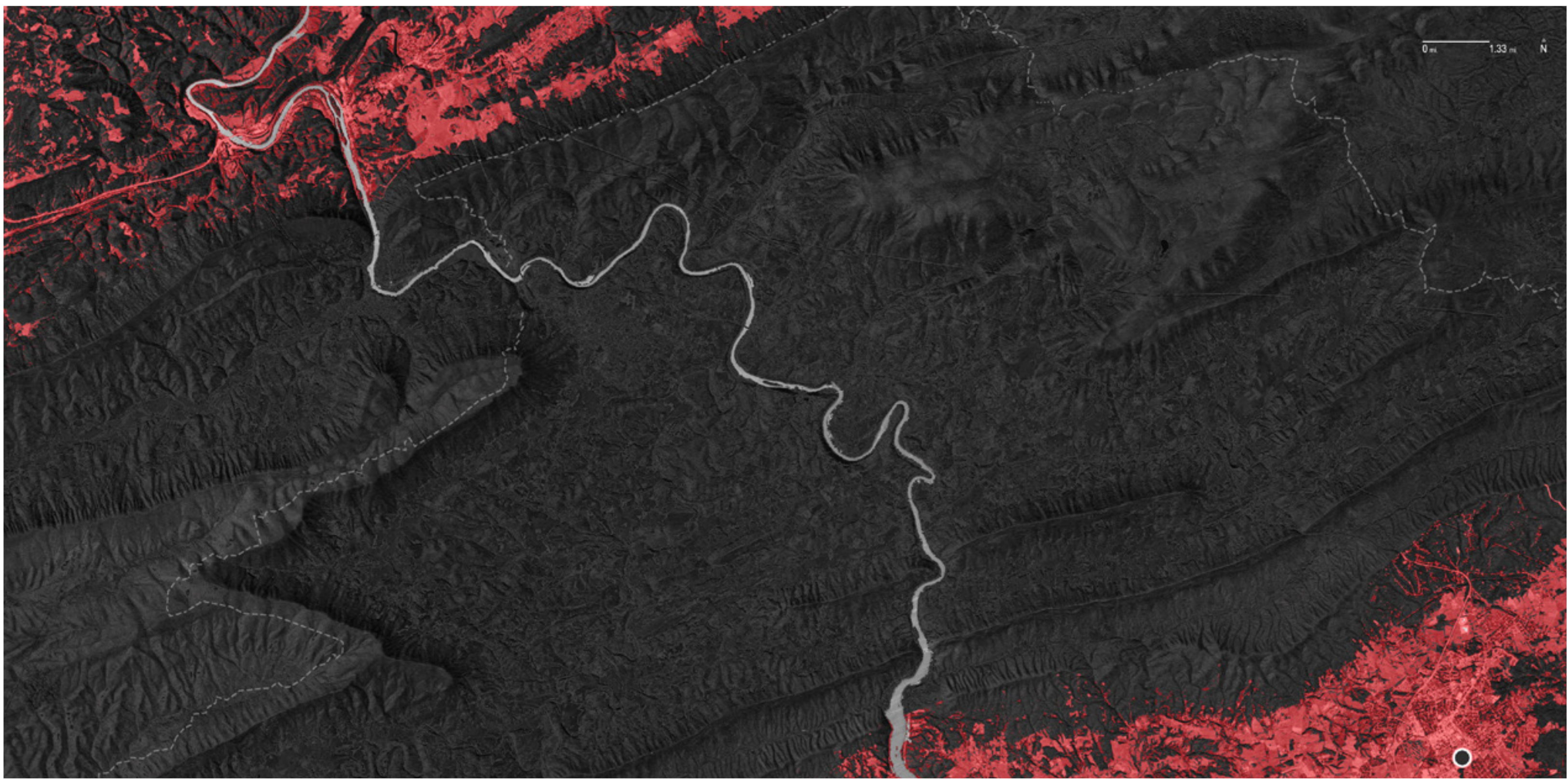
(Below) Initially I was curious about patterns of human settlement, and the borders that have come to exist between city and nature. Our contemporary city typically undergoes a murky transition from urban to suburban to rural; these photo-collages represent a new urban condition, hard pressed to the natural world.

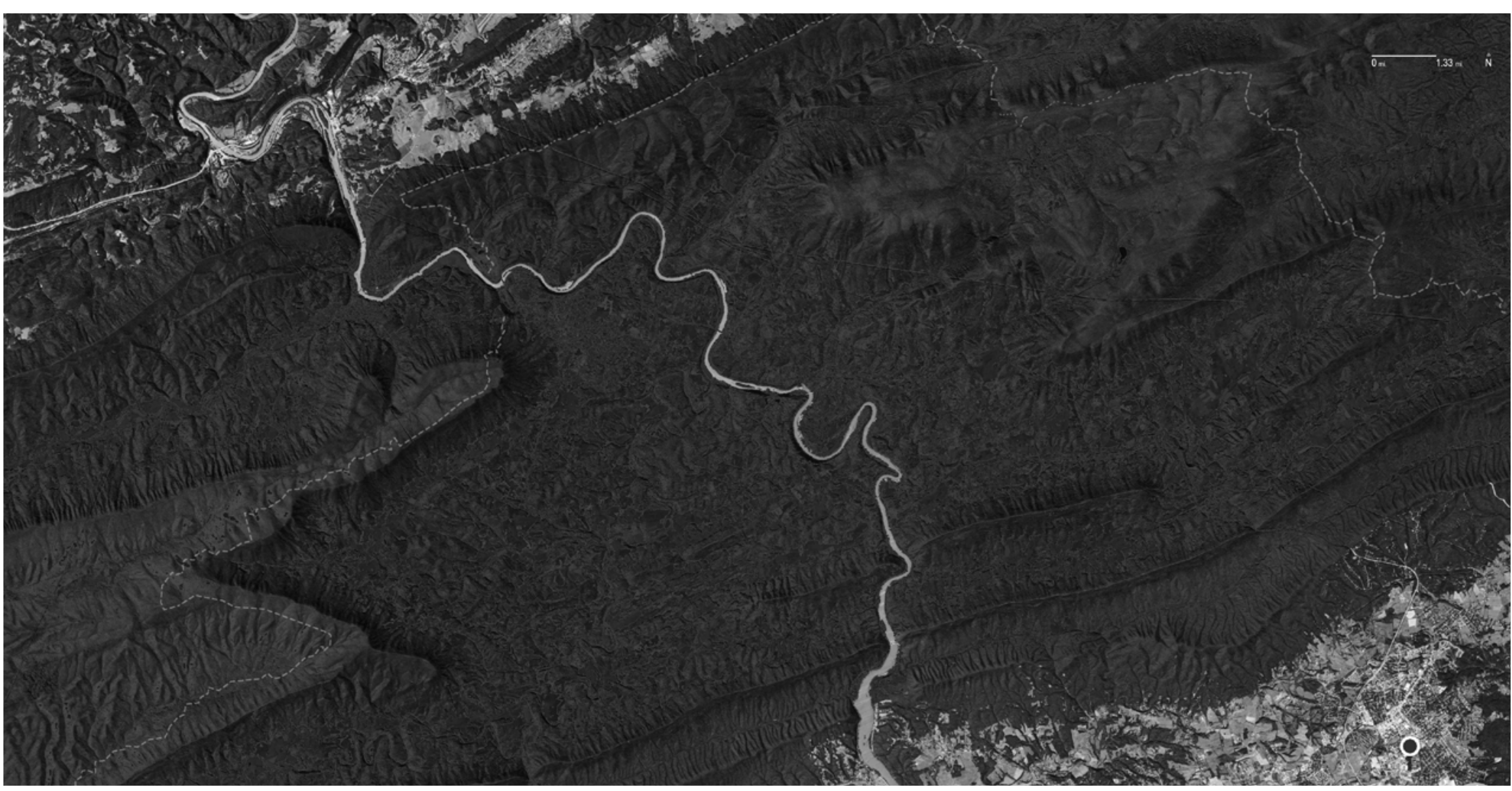

Atlantic
SPORTS MEDICINE
Vitamin Shoppe



(Above) I began rethinking ways in which we can settle (and unsettle) our world, and began visualizing large-scale transformations of developed world into wilderness corridors, returning large portions of land back to an old-growth, natural state.

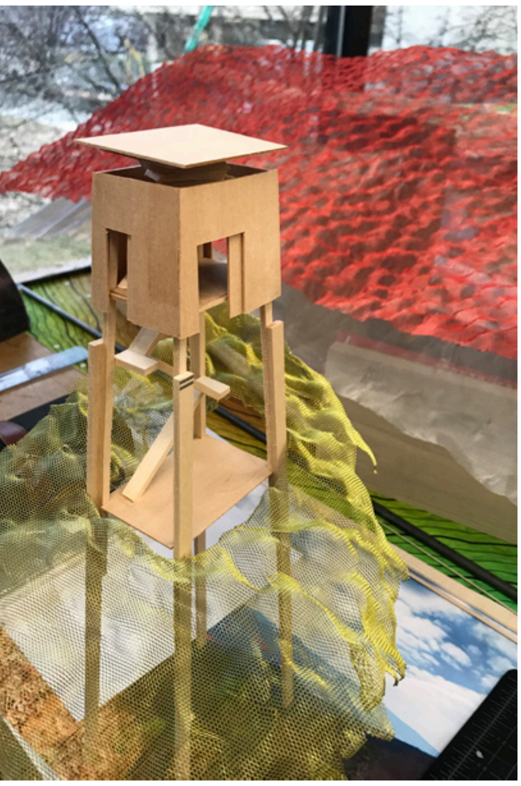


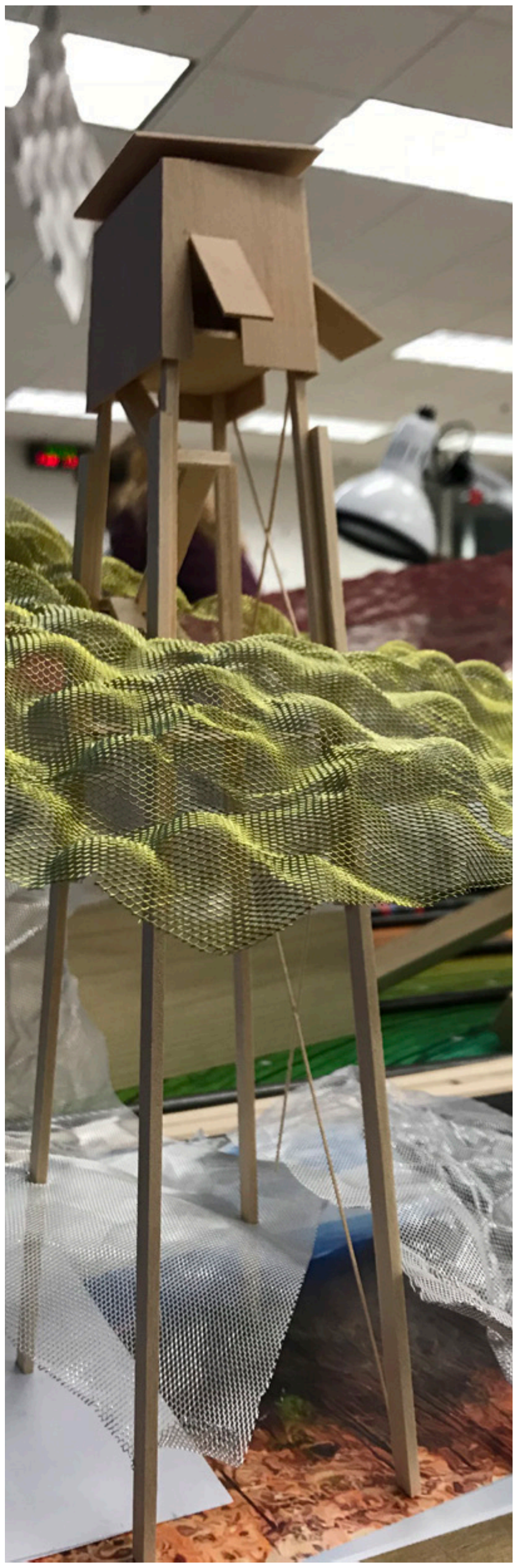


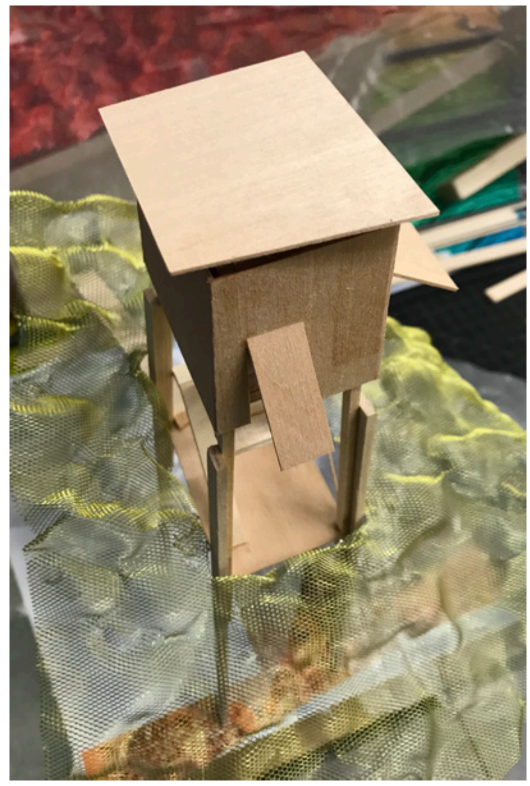


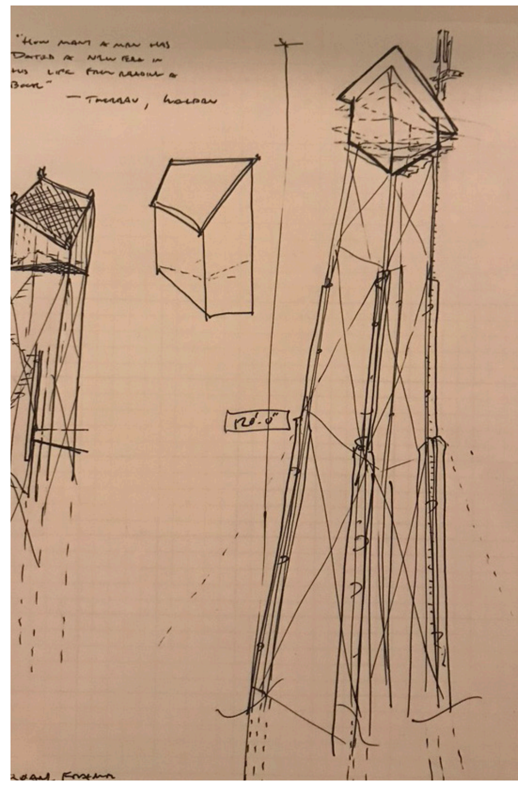
Giles County, VA. Base Imagery courtesy of Apple Maps

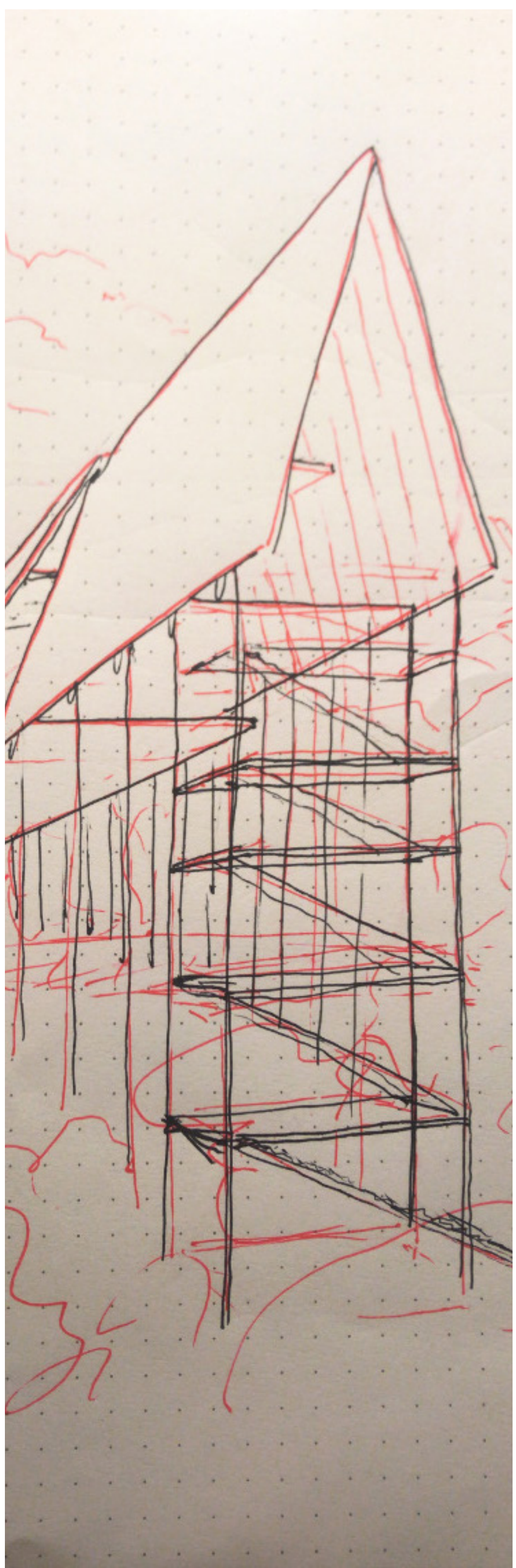
(Below) Study models began to take form, exploring relationships between program and canopy.

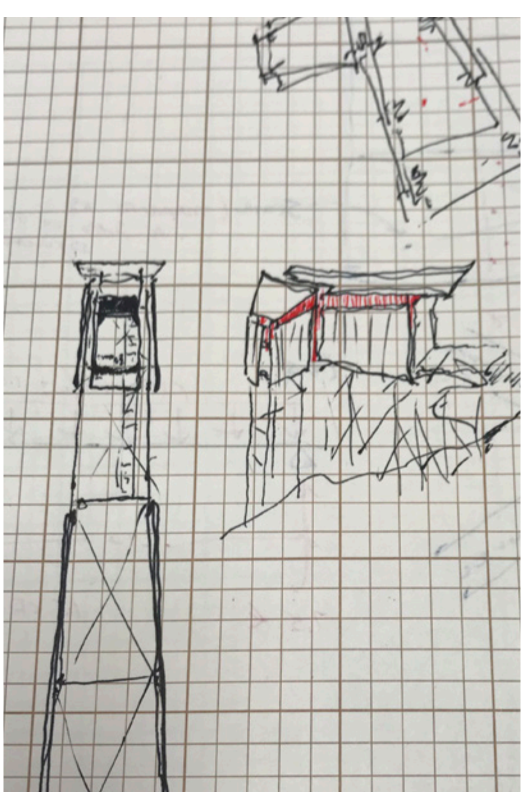


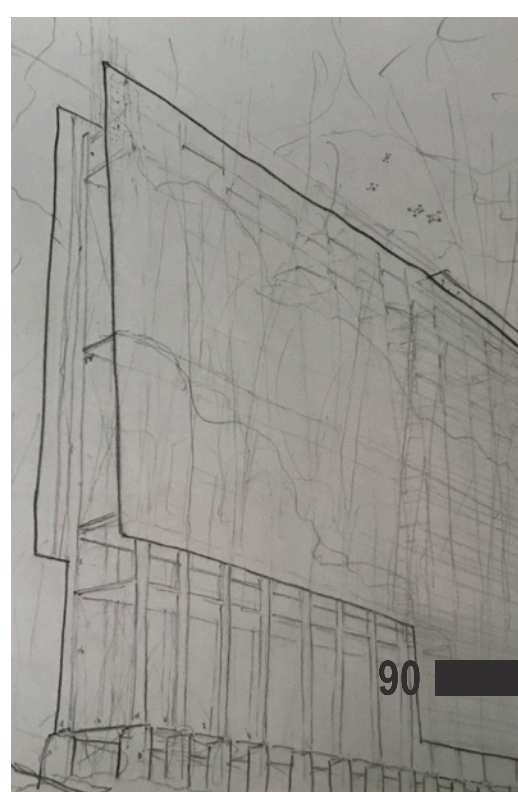


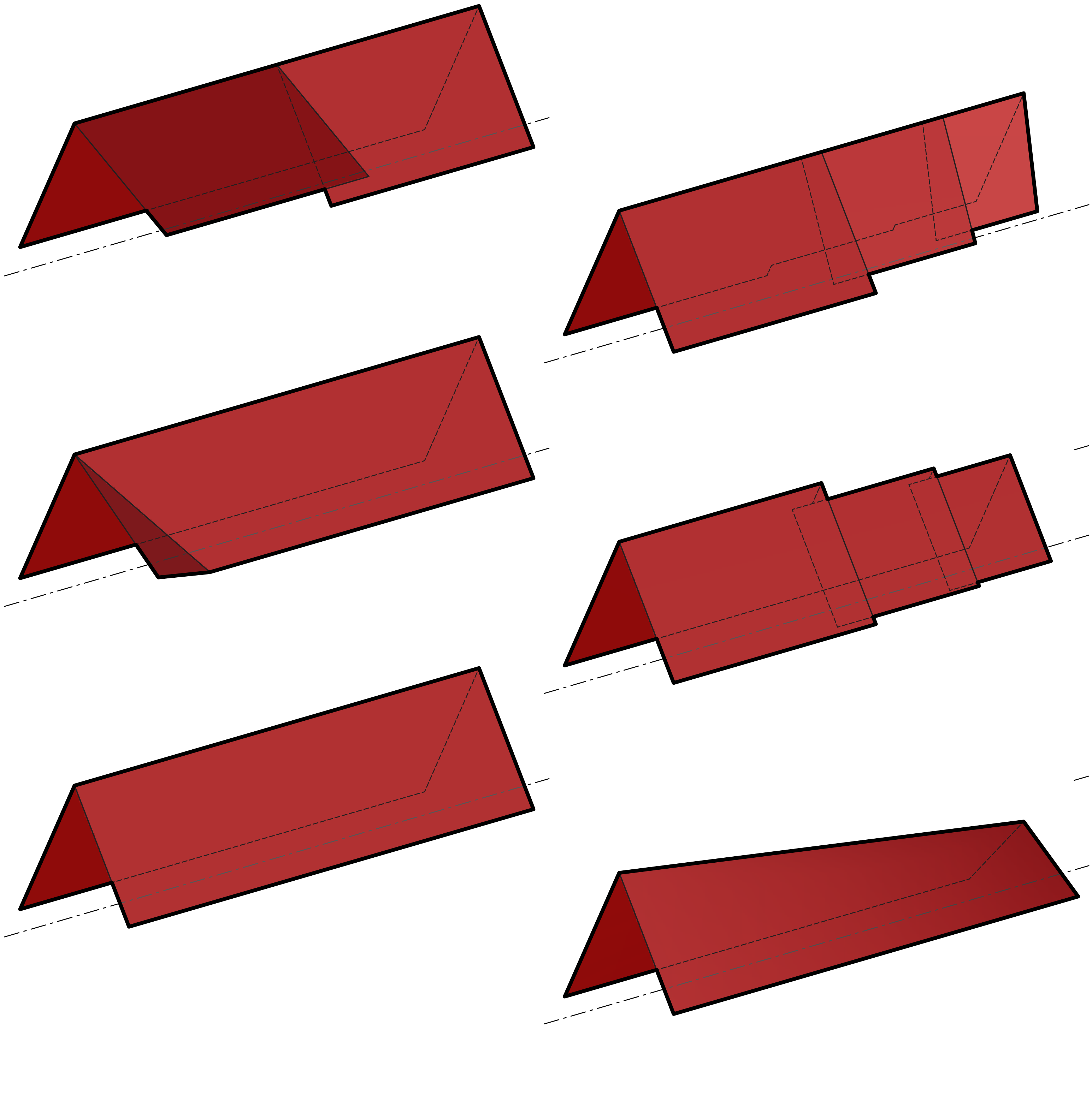



"How many a man has
dated a new era in
his life from reading a
book"
— Thoreau, Walden

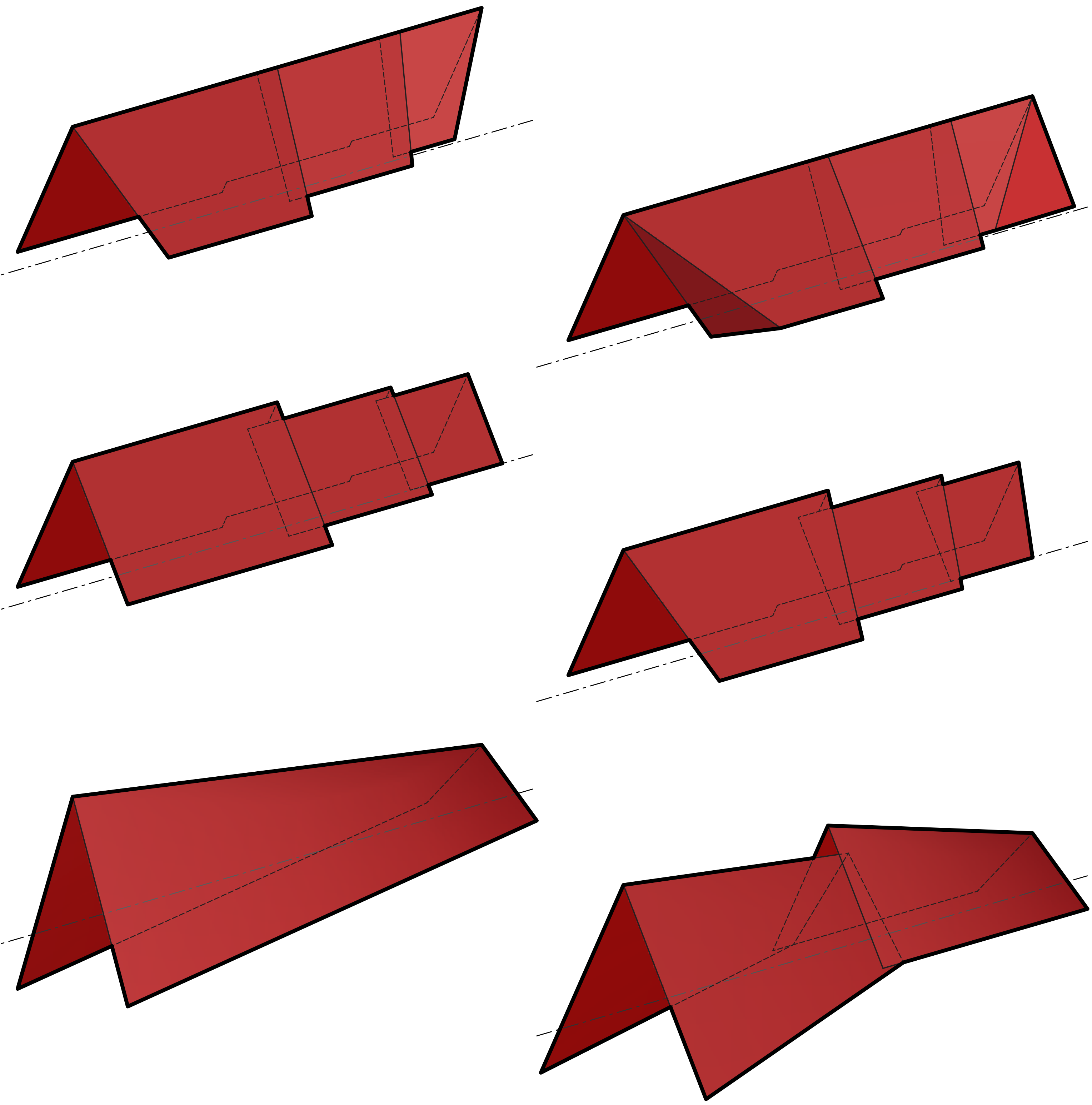


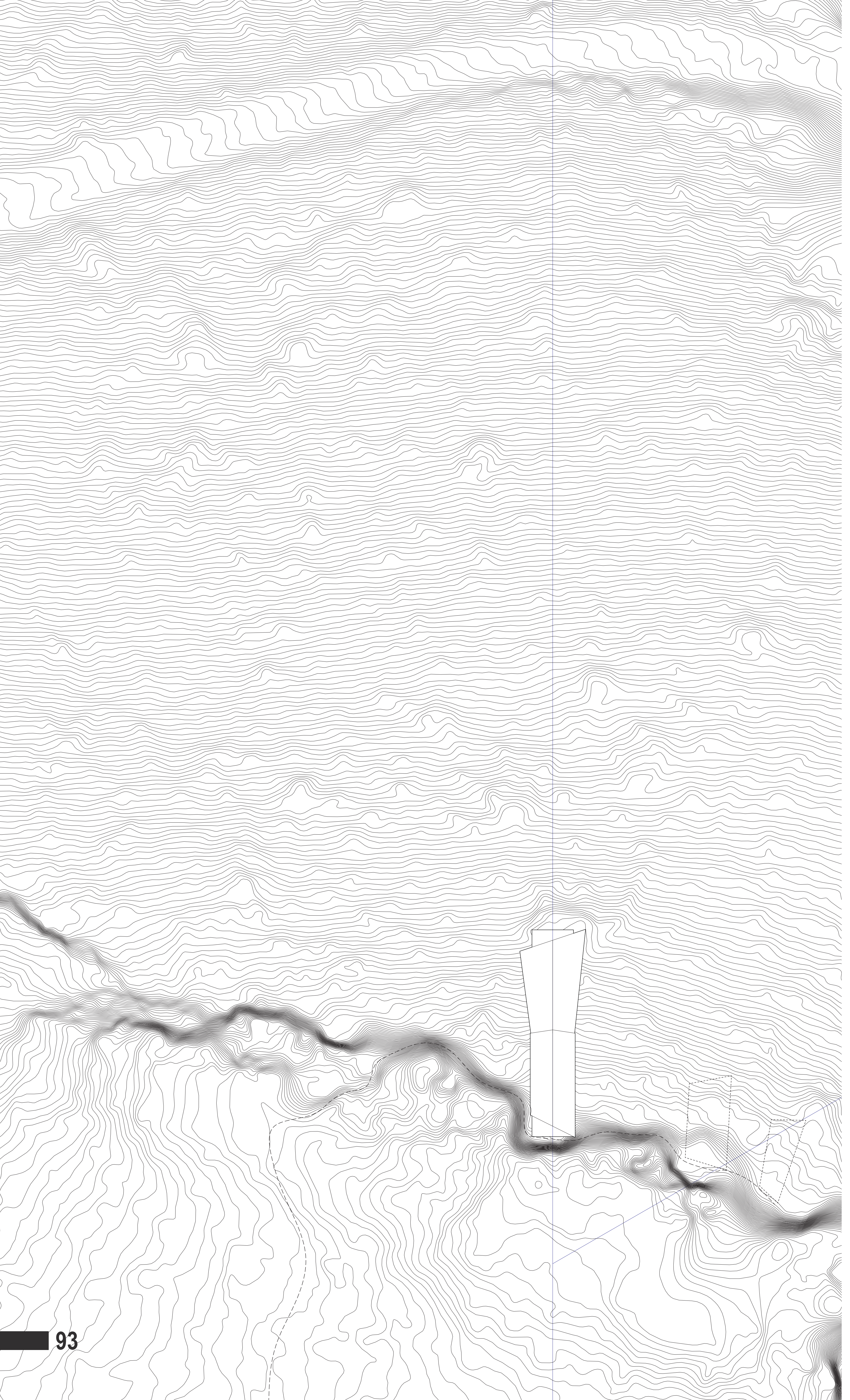


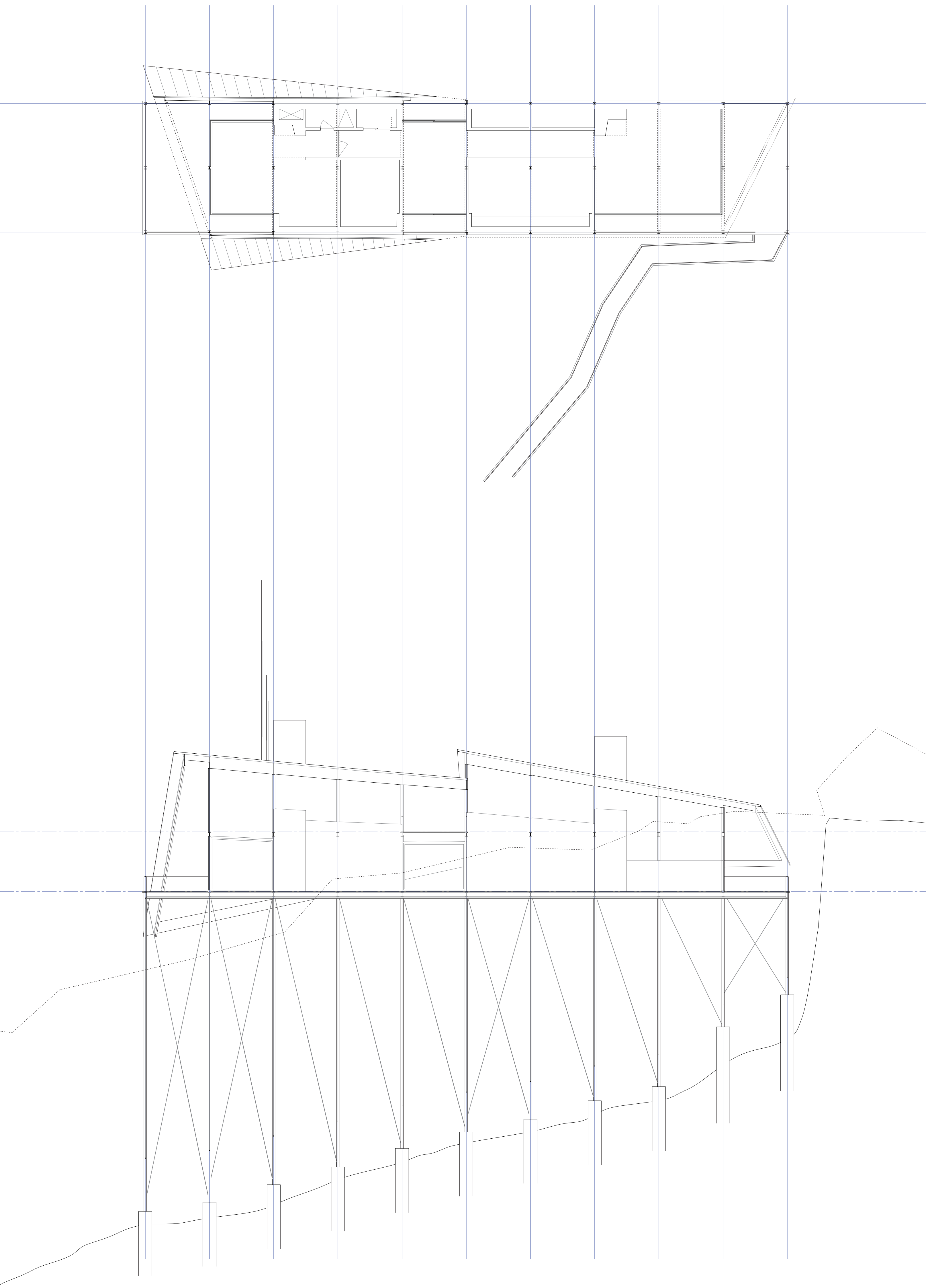


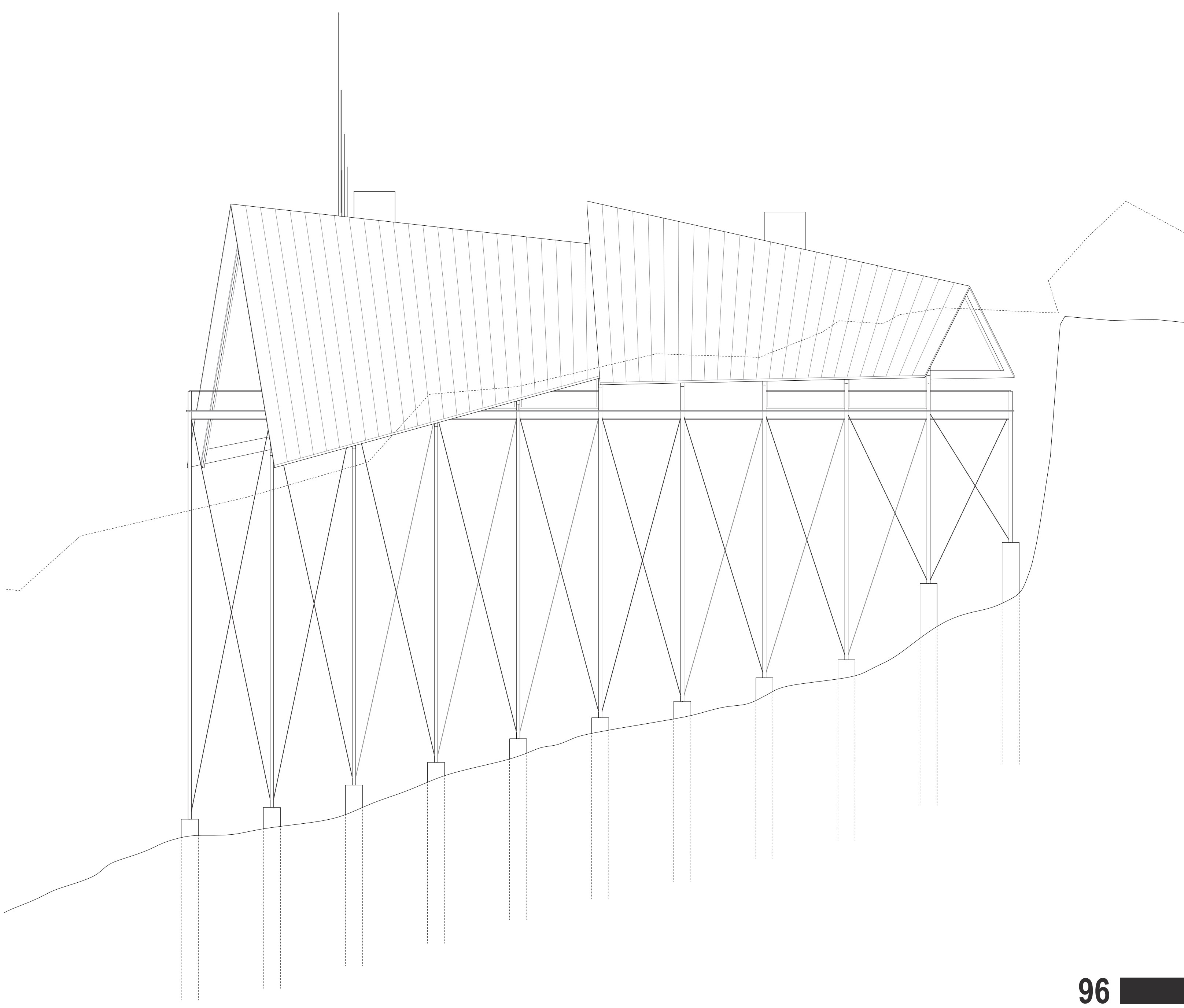


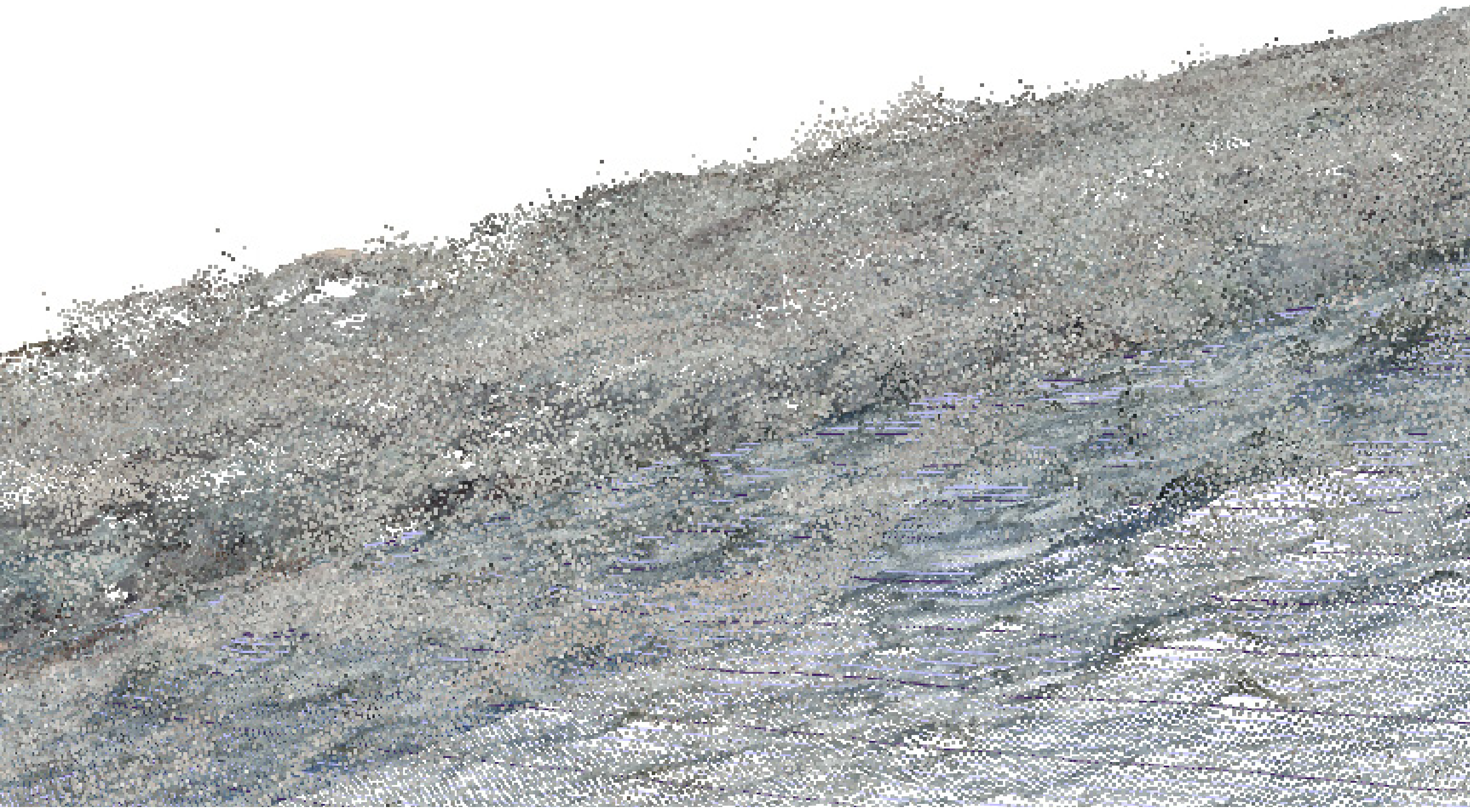
(Above) The Fifth Facade, a study exploring formal configurations of a canopy-breaching roof form.

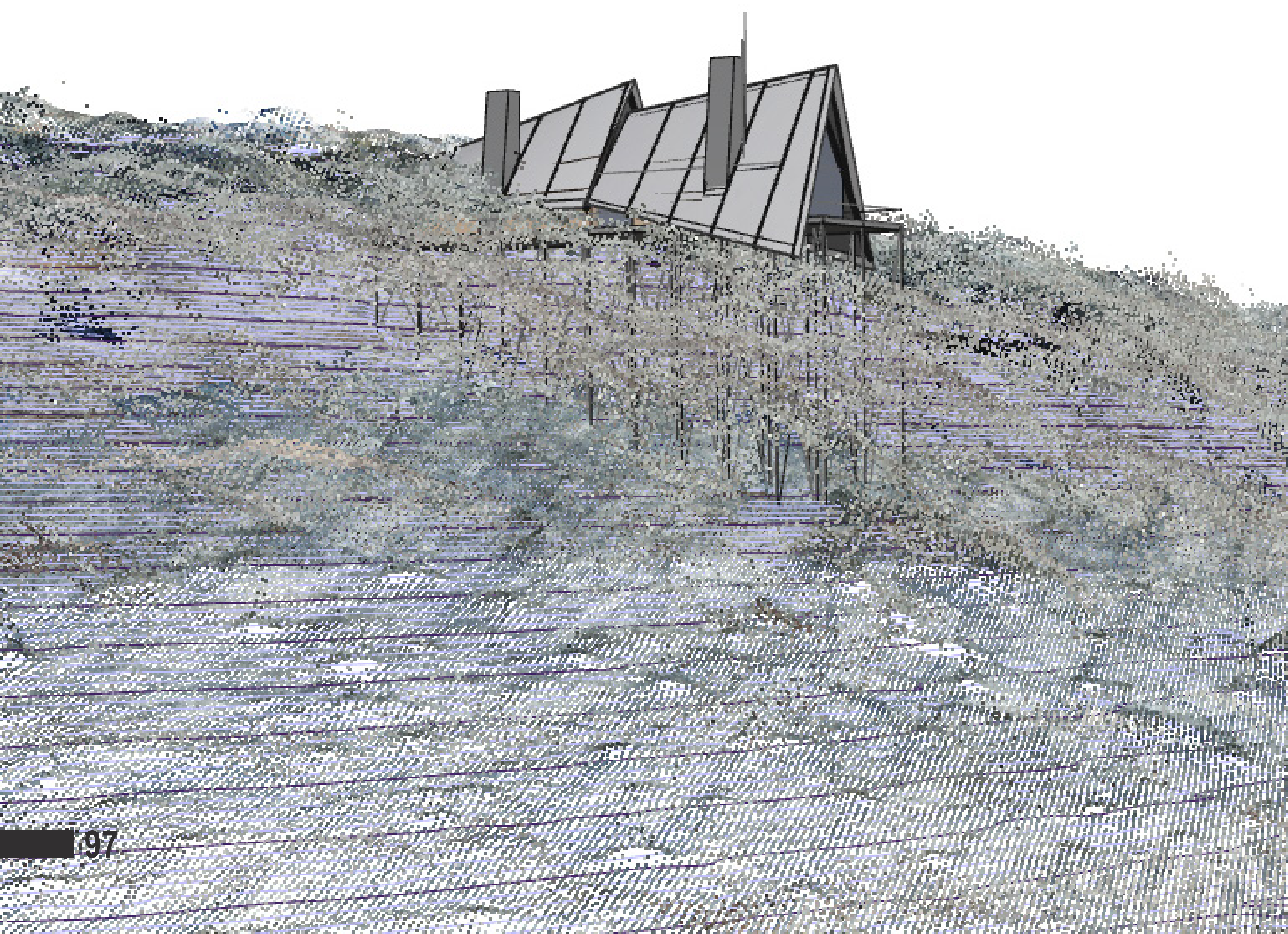


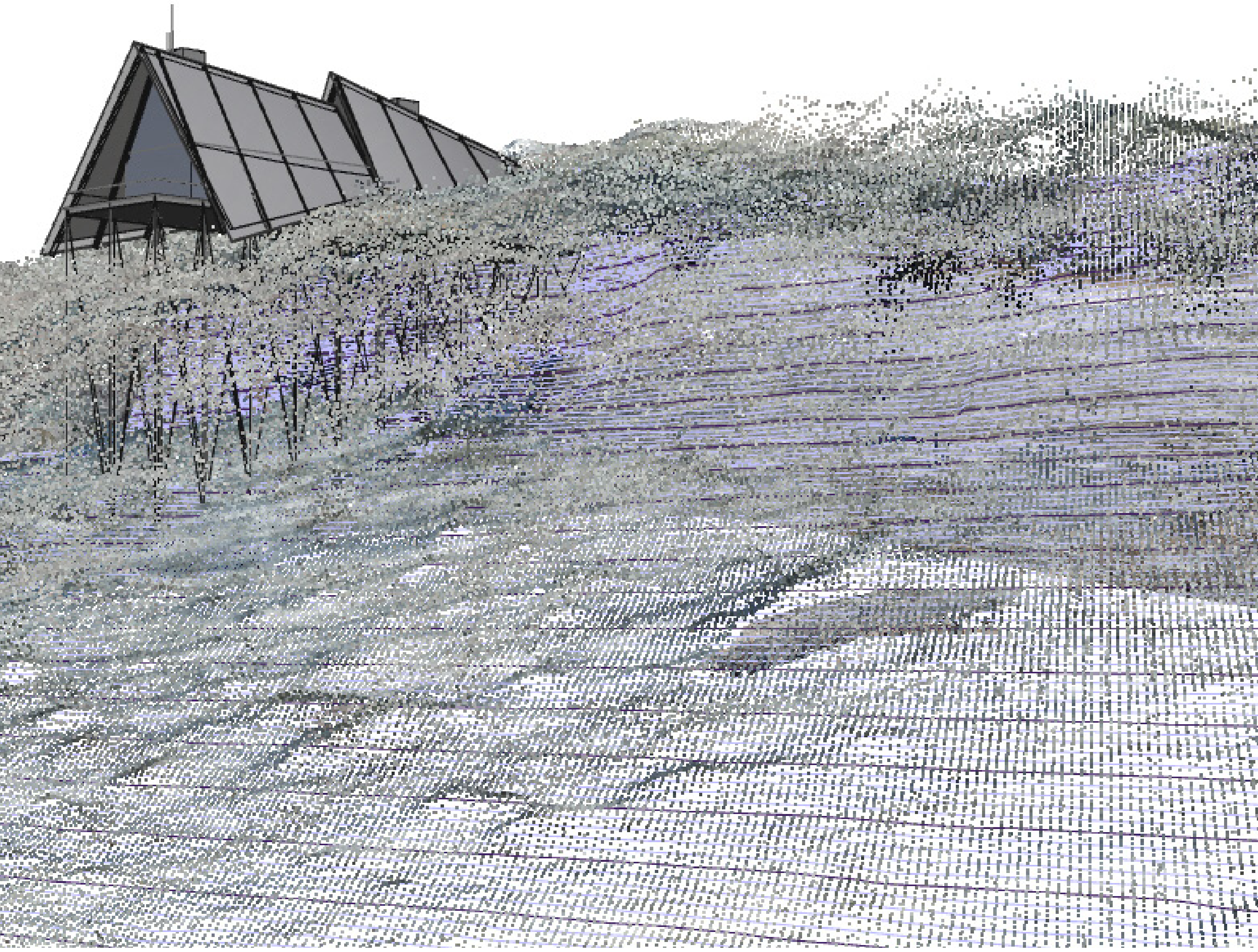


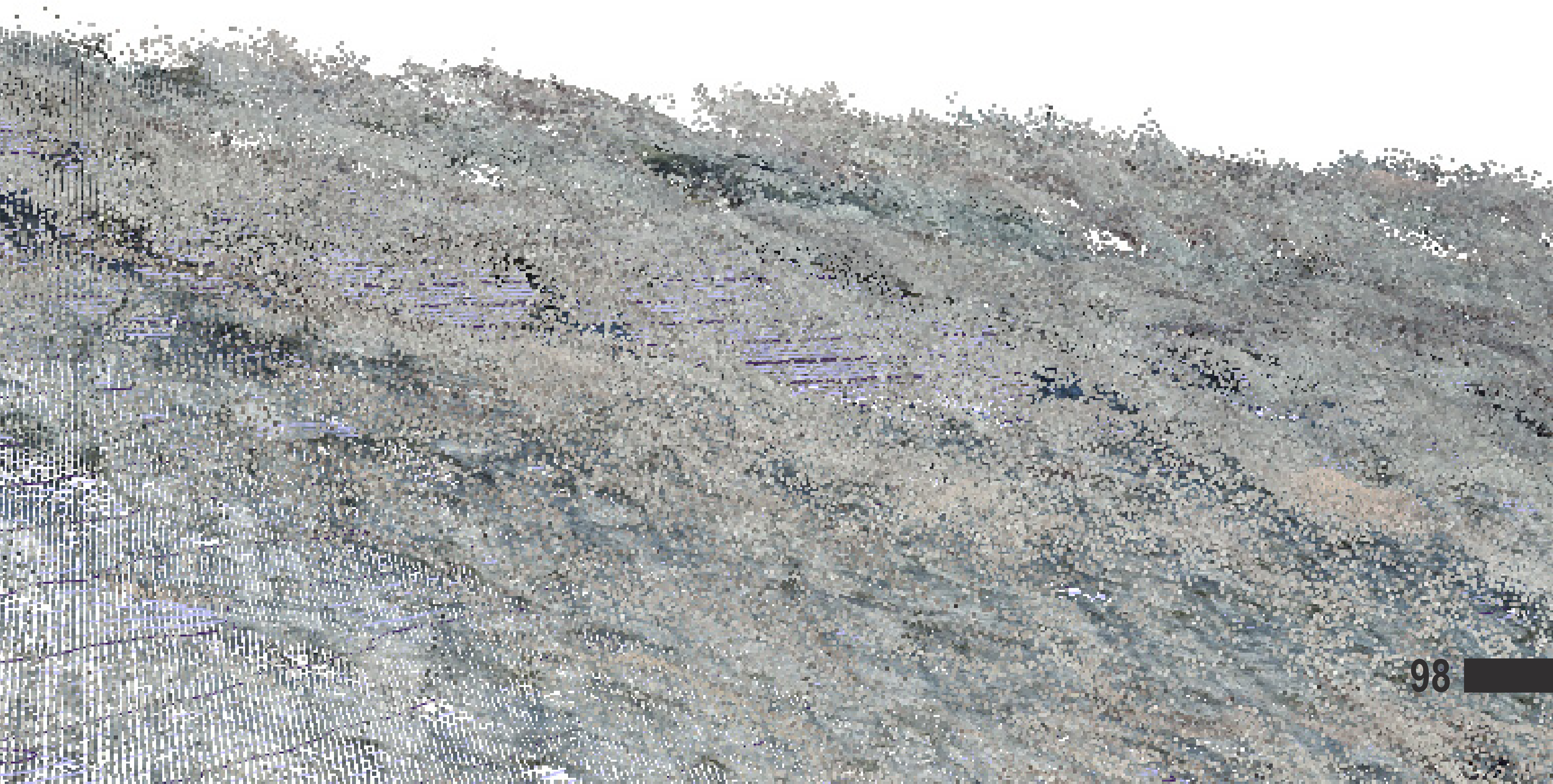




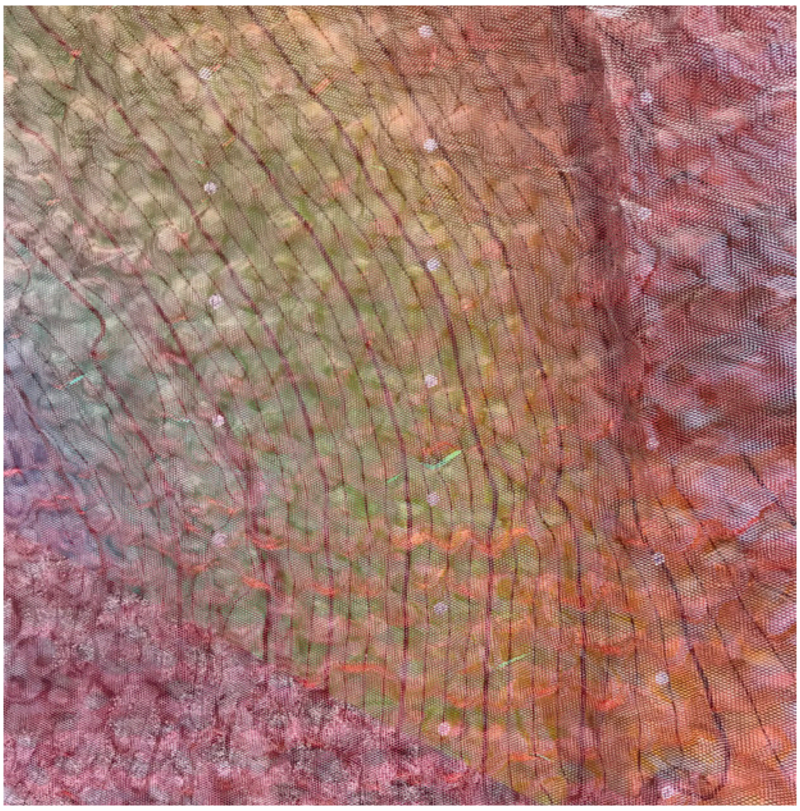


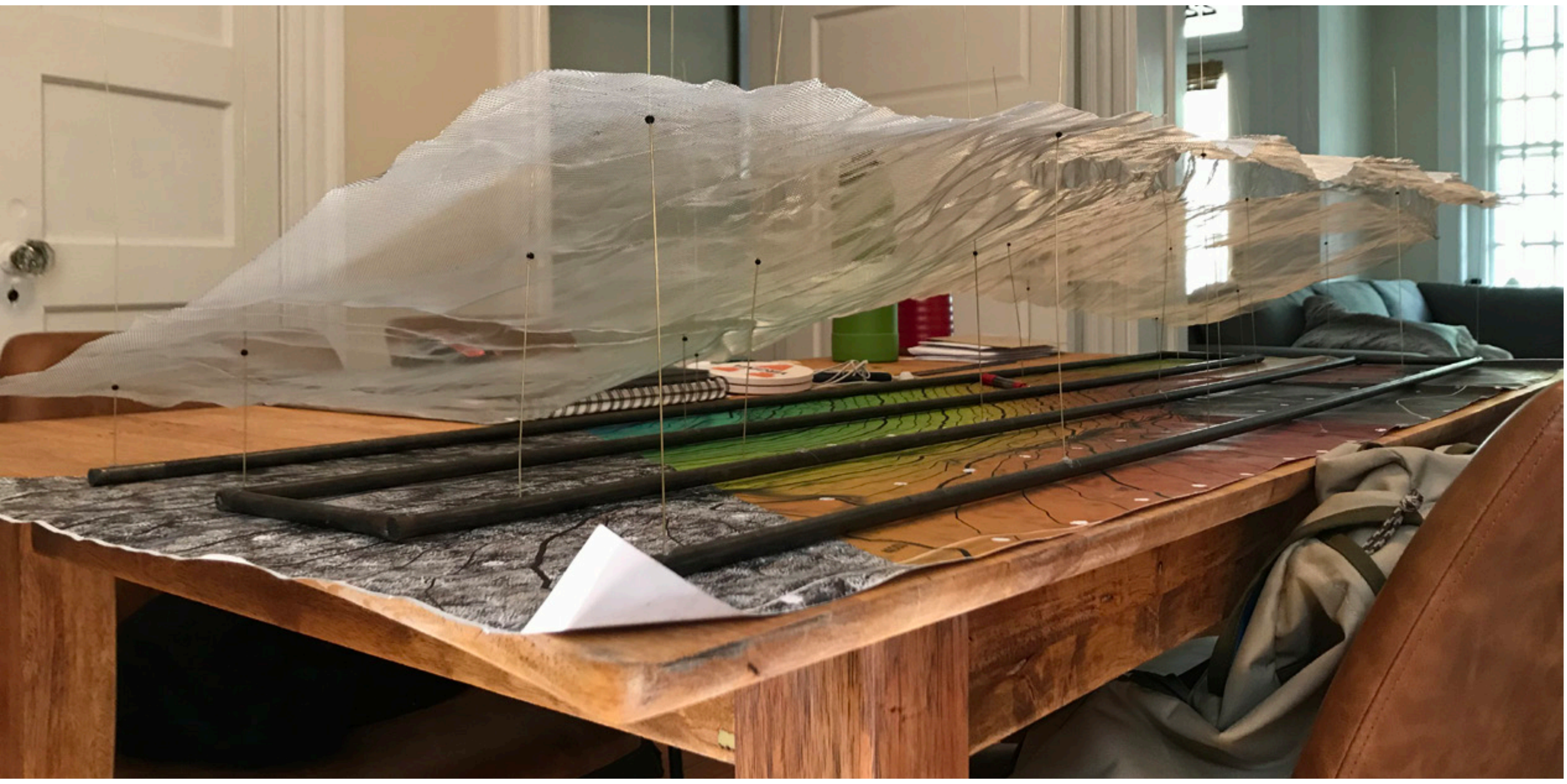


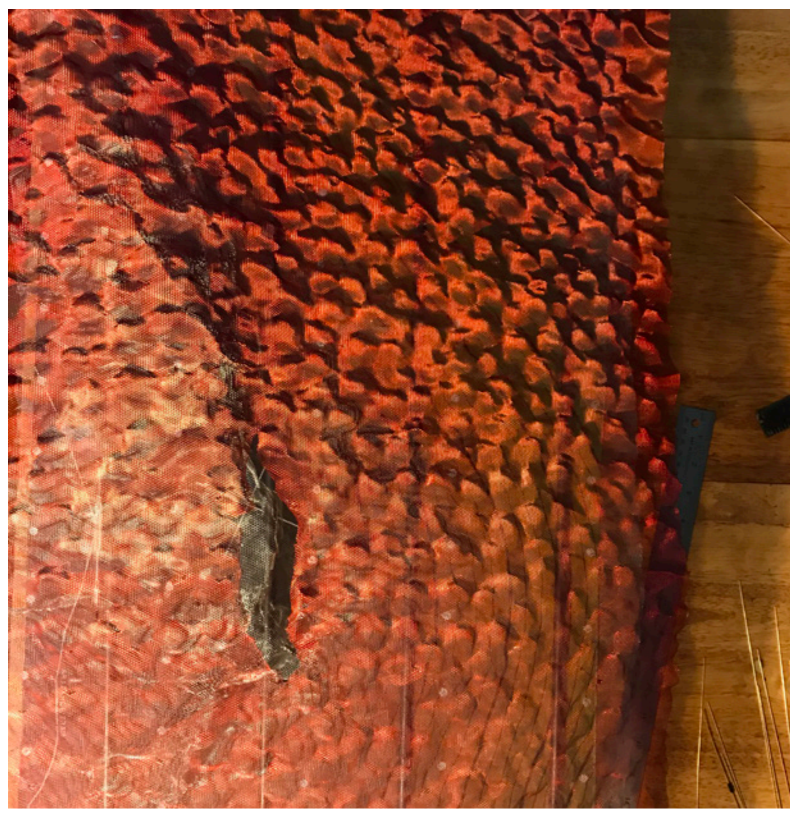




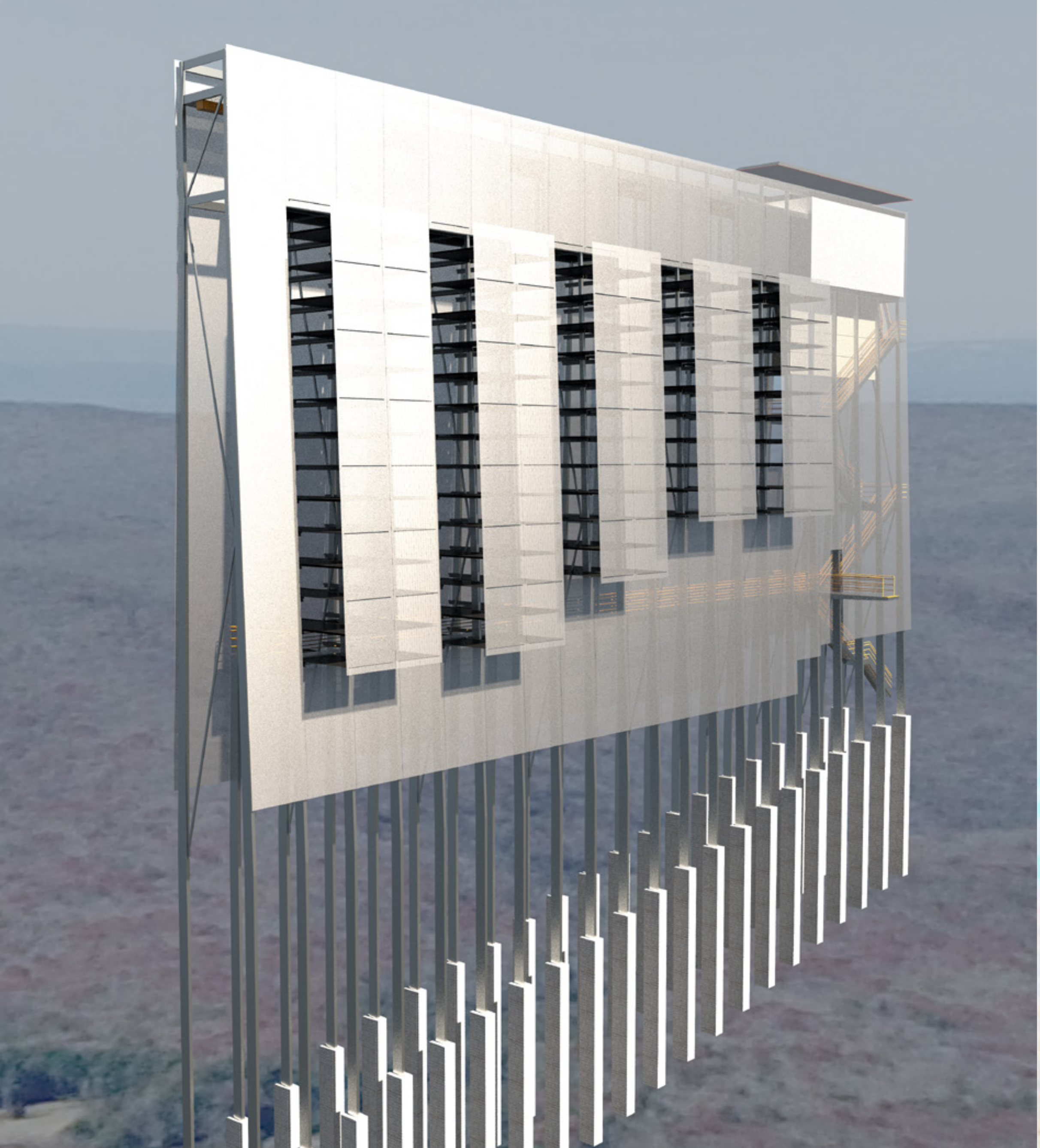
(Below) Site model development; the primary medium used was expanded-aluminum mesh, which was hand-molded to roughly match the topography generated from the data.

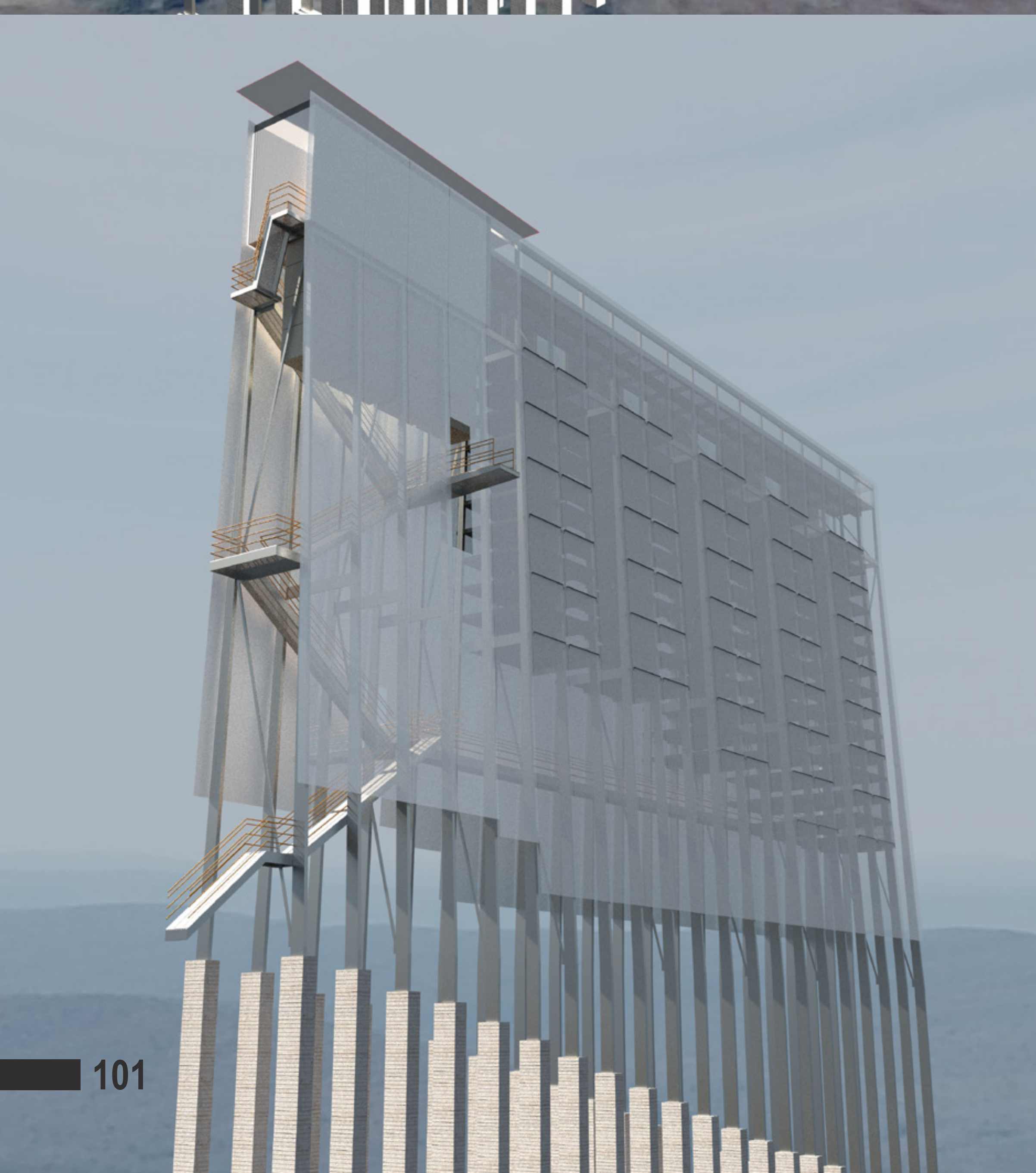







Architecture





(Below) Early renditions of the drone-port explored the operability of the facade in relation to the launching and landing of the drones.