A NEW WILDERNESS LOOKOUT:
Reimagining the Fire Lookout for Ecological Stewardship and Community Engagement

by
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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

ABSTRACT

Canada is steward to 10% of the worlds' forests. They play a global role in producing oxygen and sequestering carbon. Nationally timber is a major industry that is an integral part of Canada's economic strategies. Climate and ecological change threaten the survival of the ecologies we have grown accustom to using for recreation, inspiration and harvesting as a resource. Rising temperatures are accelerating and widening the spread of insects, disease, and forest fires.

This thesis explores how ecological sensing could be coupled with recreation and public engagement and be facilitated by a network of architectural interventions. The fire lookout serves as an inspirational intersection of an identifiable cultural symbol that became a fixture of wilderness and conservation culture as well as a tool for investigating and managing ecologies. An optically functional architecture that spatially frames the act of diligent surveillance and stewardship over vast landscapes. They operate individually in the landscape as landmarks, viewpoints, touristic destinations and simultaneously as a network of architectural instruments for registering the subtle and violent changes that characterize these changing ecosystems. The lookouts also represent a place for fostering an embodied and personal relationship with the landscape to those who occupy or visit them.

Through the design, the fire lookout is reinterpreted with today's broader understanding of what constitutes a forest ecology linking modern methods of ecological monitoring, remote sensing and field sampling to a grounded architectural manifestation that recognizes the importance of public participation and experience of the landscape if wildlands and ecologies are to maintain societal relevance beyond simple resource extraction sites.

ACKNOWLEDGMENTS

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This thesis is affectionately dedicated to my partner and to my family

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“Before, the anguish that nature caused us came from the fact that we were too small, and nature was immense. Now we are the same size, we influence how the Earth behaves. And it is disorienting “

Bruno Latour,
The Feeling of Losing the World is Now Collective,
an Interview with Bruno Latour

INTRODUCTION

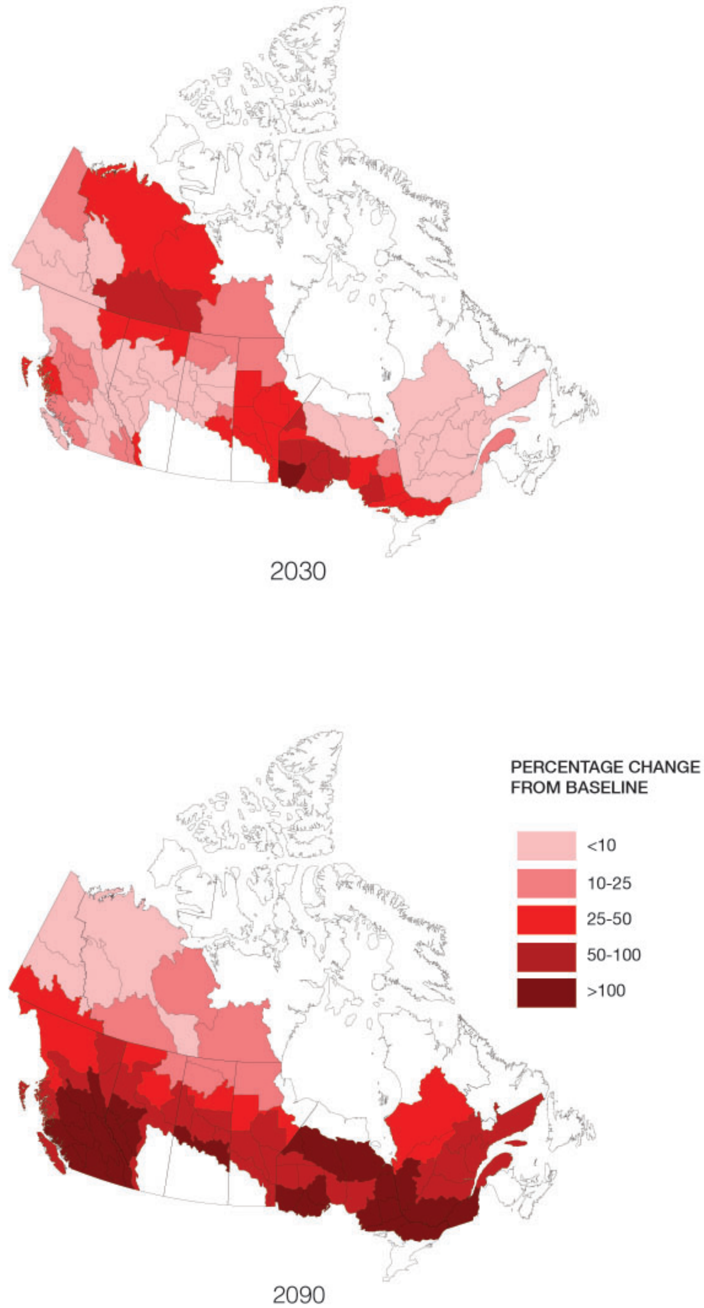

Figure 1.1 *Projected Increase in Annual Number of Fires*

In an ever-worsening ecological crises it seems imperative that we foster more responsibility and care for the natural environments that are so important to our economic and cultural interests. Many forms of cultural engagement with wilderness such as recreation are non-extractive and can be managed in a sustainable way: with the potential to engender a more reciprocal relationship with the environment. For example, Norway has designated eighteen highways through the country as National Tourist Routes gradually developing a set of activities, dining, sale of local arts and goods and natural experiences along them and showing massive investment in the idea of a cultural infrastructure with the idea that it would showcase the country's greatest assets, its natural beauty. The touristic routes are some of the most beautiful in the world and provide an array of services and activities as well as architectural devices for viewing the famous landscape. The Nordic concept of "allenmannsretten", declares the right of public access to the wilderness a basic human right. This freedom to roam is inextricably tied to the public conscience, standing resolute and unquestioned as a cultural constant without being codified into modern law until 1957.[1] It is this attitude of everyone's right to experience public lands and the investments made in its name that has given rise to such valuable cultural infrastructures such as this set of touristic highways peppered with architectural gems. A similar example of societal investment in furthering engagement with landscape is Fogo Island, Newfoundland. The natural beauty of the island was largely unknown until the design and construction of the inn and the several artists residences scattered about the island. Now it is a highly sought-after tourist destination, that brings massive benefit to the community through jobs and tourism dollars. The residents and the world benefit from the artistic initiative, seeing the island through the eyes of the resident artists and bringing its landscape and culture into the light of the public eye. Largely the effect of these new and innovative infrastructures for cultural engagement has been more appreciation and prominence on the world stage for these unique island communities.

1 Pekka Tuunanen and Markus Tarasti, *Everyman's Rights and the Code of Conduct on Private Land*, 5en ed. (Ympäristöministeriö, 2015).


Figure 1.2 *Reiulf Ramstad Architects Trollstigen Viewpoint, Norway*

Figure 1.3 *Squish Studio, Fogo Island, Newfoundland*

Figure 1.4 *French River Visitor Centre by Baird Sampson Neuert Architects, Capreol Ontario*

Figure 1.5 *Centre d'interpretation du Bourg de Pabos by Atelier Big City, Gaspé, Quebec*

Two interpretive centres, the French River Visitor Centre and the Centre d'interpretation du Bourg de Pabos are prime examples of sites where cultural history, landscape and environment are elucidated by architectural intervention. In these projects the architecture is designed as a machine for seeing and learning about each particular site, often through the engagement of the building itself in its landscape. In Ontario, the French River Visitor Centre by BSN marks the transition into the geological region of the Canadian Shield. The centre serves to interpret the cultural landscape and history of the French river from its use as a trade route for Indigenous Peoples and settlers to its depictions by the Group of Seven and provide an architectural interpretation and engagement with the geological and ecological particularities of the region. The building and site have various zones, termed " islands" depicting messages of stewardship and building services and how they integrate into the environment such as bio-filtering systems to deal with the building's use of water and sewage and rainwater collecting cisterns to manage stormwater and reduce erosion to the sites minimal soil layers.[2] The project accomplishes the daunting task of weaving together narratives and histories of the region while providing the opportunity for visitors to also understand the how the building itself engages with the landscape formally, with its series of shifting planes of rock and glass echoing the jagged landscape of granite, and in terms of its environmental impact and the steps taken to mitigate it. The Centre d'interpretation du Bourg de Pabos in Gaspé, Quebec by Atelier Big City is built on the site of a major 18th century fishing establishment and displays some of the over 16 000 artifacts retrieved from the site.[3] The linear building straddles the site including a large open air display of perforated panels layering the historical interpretation visually onto the landscape. The architecture acts as an instrument for viewing and understanding site rather than simply a container for the interpretive material.[4] The historical and cultural information is revealed through a procession through the site and building, visitors interacting with the rotating interpretative panels, texts, artifacts and discussions with guides. This creates an experience of developing a personal understanding of the cultural and physical history of the site discovered in the movement through architectural space and landscape. The interpretive centres represent ways in which architecture can be used to create engaging experiences on site that elucidate their place in broader contexts of cultural history and ecology inviting visitors to produce their own experiences as they move through a metaphorical and physical landscape of ecology, geology, history and culture. It is sites like these that point to how we could engage the landscape and its patrons in a more holistic way going forward. They offer a place for visitors to experience the physically experience the landscape while providing interpretation of historical, cultural, geological and ecological information, ideally leading to connections between the embodied experience of landscape and the greater contexts in which it is situated.

2 Nico Saieh, "French River Visitor Centre / Baird Sampson Neuert Architects," ArchDaily (ArchDaily, June 1, 2010), https://www.archdaily.com/62175/french-river-visitor-centre-baird-sampson-neuert-architects.

3 "Interpretation Center," Bourg de Pabos, accessed August 24, 2020, https://bourgdepabos.com/en/interpretation-center/.

4 Anne Cormier, "Centre D'interpretation Du Bourg De Pabos ," Canadian Competitions Catalogue, n.d., https://www.ccc.umontreal.ca/fiche_laureat.php?lang=en&pId=77.

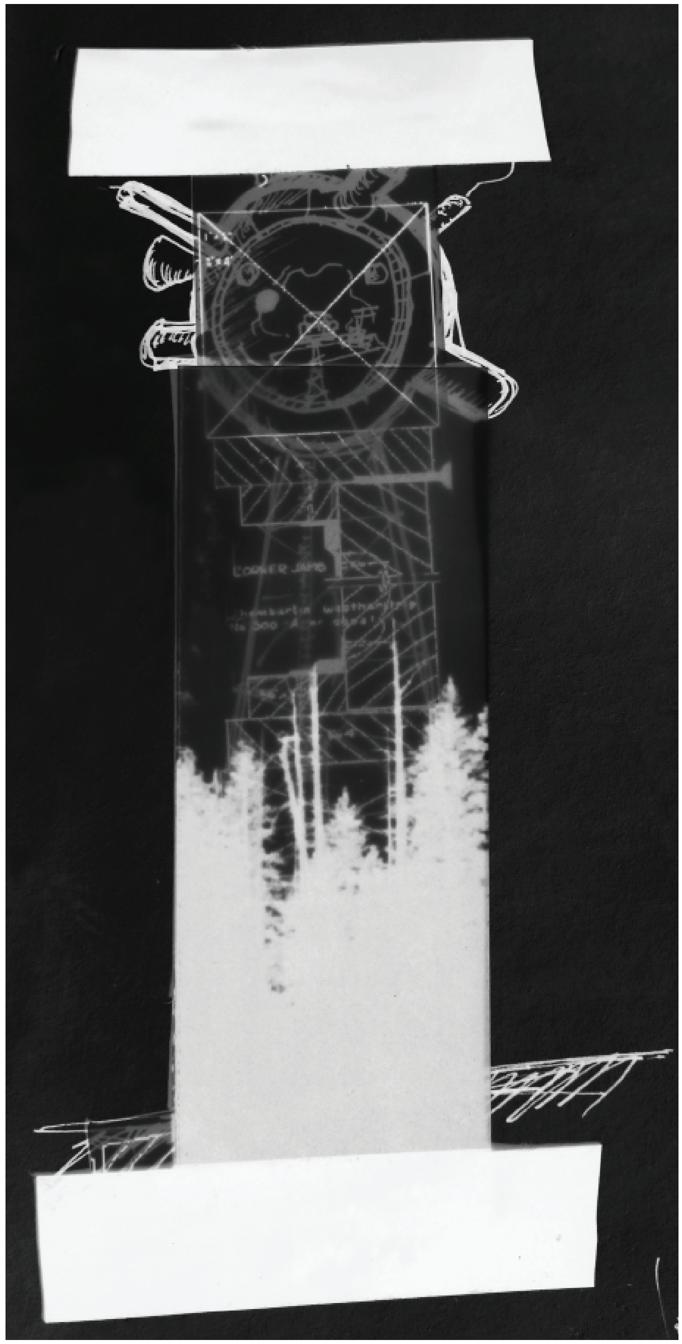

Figure 1.6 *An Architectural Instrument for the Perception of Landscape, multimedia collage*

The North American fire lookout embodies many issues relevant to our time. Its history tells the story of colonial society's attempt at surveillance and control over vast forested landscapes and the eventual rebound of fire as an unstoppable force of nature in the wilderness. Lookouts can be further interpreted as a network of early ecological monitoring stations, tracking both meteorological factors and fires on a continental scale. Perhaps most importantly but more elusively the imprint on our culture that the lookouts have had through the work of their occupants and their depictions in the cultural milieu. This hints at where a similar model may contribute to the future of both the study and experience of wilderness. The lookout represents a model that may begin to address multiple factors involved in the scientific and cultural understanding of our relationship with the wilderness. The historical fire lookout network is viewed as a vast ecological monitoring network which used the technology and understanding of its time to monitor the landscape on a continental scale. which is now beginning to be replicated with modern methods of remote sensing. The lookouts were occupied throughout fire seasons which addresses the need for ground-truthing of data gathered by even current technologies. For fire detection the context given by a human observer still cannot be fully replaced by cameras and sensors. The human observer or experiencer of the wilderness embodies the irreducible experience of physical presence and the effect that has on the individual and through the individual, on culture. For the observers in lookout it was the deeply personal relationship that they formed with the wilderness they occupied that kept many coming back year after year. Their job was to observe, to notice, and one might go as far as to say their job was to meditate on the forest and landscape before them for the entire fire season. In their free time they walked the land, to survey and maintain the tiny human outpost amongst the trees. Though we now know the U.S. Forest Service's policies ultimately had detrimental effects on forest ecologies through their failure to acknowledge the ecological roles of wildfire, the observers who considered it their job to protect and serve the forest cultivated a personal stewarding relationship with the land they were responsible for.

A BRIEF HISTORY OF FIRE LOOKOUTS

Figure 2.1 *Desolation Peak Lookout, North Cascades National Park, U.S.A.*

Forest fires have been a dominant disturbance regime in Canada since the end of the last ice age, around 10,000 years ago.[1] Humans have long had an influence on the dynamics of the landscape, even with the use of fire as a tool. Mary Huffman writes about elements of traditional fire knowledge, traditional practices by which humans used or controlled fire to affect change in their environment, from indigenous populations in 27 countries on all 6 continents finding that even in distant and isolated populations there were many commonalities in the way fire was managed.[2] In Canada, dendrochronological studies reaching back 700 years on British Columbia coastal islands strongly suggest indigenous populations periodically conducted low intensity burns theorized to be for the purpose of opening dense forest, thereby increasing berry patches, growing grass for wild game and creating more open hunting ground.[3]

The North American fire lookouts have their origin with the beginnings of the U.S. Forest Service, roughly coinciding with the cultures and technologies of the Canadian Forest Service. Chronically underfunded since its formation in 1905, the U.S. Forest Service received an outpouring of public support and funding in the wake of a series of devastating forest fires, notably The Great Fire of 1910. The Great Fire of 1910 burned nearly 3 million acres in the Northwestern United States and Southeastern British Columbia killing 87 people and destroying several towns.[4] However, most of the land burned was slated for logging and mining where estimates put the losses in timber alone at a billion dollars. Prior to this, the Forest Service was opposed by timber and mining companies for their conservationist attitudes. There was much debate at the time around the natural origin of forest fires and with industry arguing they should be left to burn rather than waste resources fighting them. This debate quickly evaporated in the face of the massive losses. The Forest Service budget was doubled, firefighters were depicted as national heroes, memorials were erected solidifying the heroism of the Forest Service and instilling new attitudes demonizing forest fires in the name of conservation that would persist for most of the 20th century. The forest services took on fairly extreme policies toward the control of fires on public lands epitomized in the so called “10 am policy’ which stated that any fire on public land was to be extinguished by 10am the day following its report.[5] Logically because of the expenses and dangers involved in fighting large fires, prevention and early detection was the focus.

1 Mary R. Huffman, “The Many Elements of Traditional Fire Knowledge: Synthesis, Classification, and Aids to Cross-Cultural Problem Solving in Fire-Dependent Systems Around the World,” *Ecology and Society* 18, no. 4 (2013), https://doi.org/10.5751/es-05843-180403.
2 Ibid.
3 Kira M. Hoffman, Ken P. Lertzman, and Brian M. Starzomski, “Ecological Legacies of Anthropogenic Burning in a British Columbia Coastal Temperate Rain Forest,” *Journal of Biogeography* 44, no. 12 (2017): pp. 2903-2915, https://doi.org/10.1111/jbi.13096.
4 *The Big Burn*, n.d., https://www.pbs.org/wgbh/americanexperience/films/burn/.
5 Ibid.

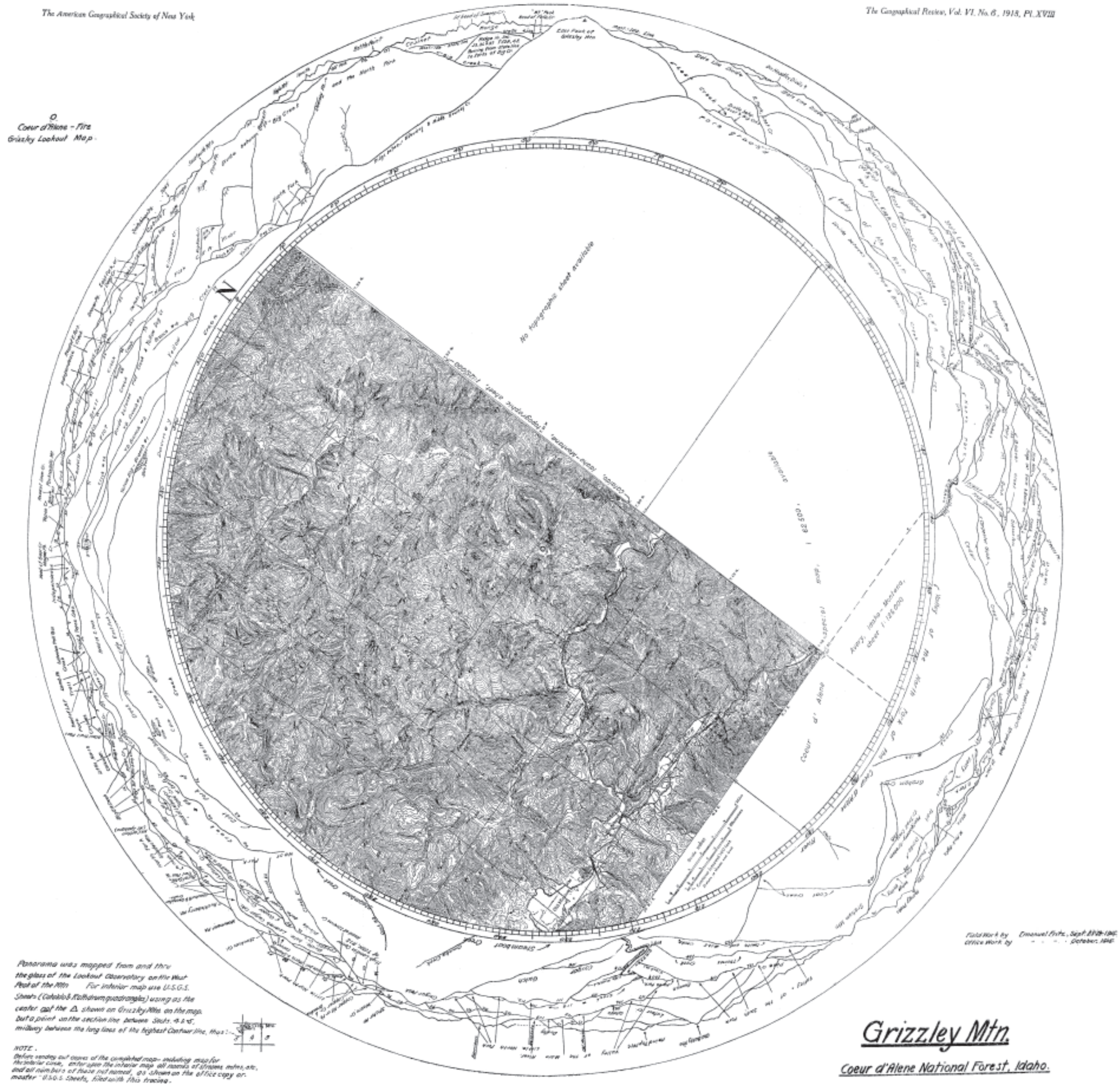

Figure 2.2 *Combined Map and Panorama For Orientation from Lookout Stations*

Prior to 1910 most lookouts were temporary outposts, tents and encampments on hilltops and ladder accessible platforms built directly into a tall tree. As the Forest Service gained funding, they were able to build the permanent lookouts needed for constant surveillance of the forest during fire season. North American lookouts have since come in a variety of forms. Western lookouts, generally able to take advantage of the mountainous terrain are often simply a cabin placed on or near a peak. These cabins contained both workstation and living space for the observer addressing the need for near constant observation especially during dry spells and lightning storms. In 1914 Coert Dubois wrote in a handbook how the lookout's cabin should be arranged for constant surveillance of the surrounding landscape.

"The lookout man's dwelling, office and workroom should be centered in one house, on one floor, and in one room. The room can not be less than 12 feet square, and must be so constructed that at any moment of the day, with the turn of the head, he can see his whole field. He must be fixed so that while he is cooking, eating, reading, writing, dressing, washing his clothes, walking about, or sitting down, he can not help but be in the best position to see."[6]

The lookouts are constructed at the highest elevation available to achieve the farthest view and where there is not sufficient topography to achieve a view over the trees they are built atop a tower. For the lookouts to identify the location of a fire they would need at least two observers to give the compass bearing from their station to triangulate the position of the smoke. Early on, communication was done by heliograph and later by radio or telephone.[7] This system required every lookout to be within sight of at least one other lookout to triangulate fires within their area. Each lookout would be fitted with an Osborne Fire Finder for the purpose of identifying compass bearings by lining up the sights. All had the local topography for orientation and sometimes unrolled elevations so the observer could better understand the various hills and peaks surrounding them. See Figure 2.2. William Osborne even developed a photo-transit device that took panoramic photographs from these towers that now provides stunning images of the forests both before fire suppression policies and afterwards.[8] See Figure 2.6.

Observers work 7 days a week and up to 16 hours a day depending on the fire risk.[9] Most of this time is spent observing but their other duties included daily radio check-ins, documenting meteorological measurements and performing maintenance on the tower as well as the daily rituals of preparing food and water. The general public was also allowed to visit active towers and meet the observers personally. This is still the case in some states that still use human observers and historically in Ontario there were guestbooks in each tower encouraging adventurous visitors who dared climb the tower to sign them, with the books collected in Toronto each year.

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6 Coert Dubois, *Systematic Fire Protection in the California Forests* (Government Printing Office, 1914).

7 Joe Fleming, "The Osborne Firefinder," THE OSBORNE FIREFINDER (United States Department of Agriculture Forest Service, October 2003), https://www.fs.fed.us/eng/pubs/html/03511311/03511311.html.

8 John F Marshall, "The Osborne Panoramas," Wildland Northwest, accessed August 16, 2020, https://www.wildlandnw.net/osborne-panoramas-historic-and-modern.

9 Jennie Russell and Charles Rusnell, "Union Says Unstaffed Wildfire Lookout Towers Leading to Undetected Fires | CBC News," CBCnews (CBC/Radio Canada, June 6, 2019), https://www.cbc.ca/news/canada/edmonton/alberta-wildfire-lookout-employment-laws-government-1.5164036.

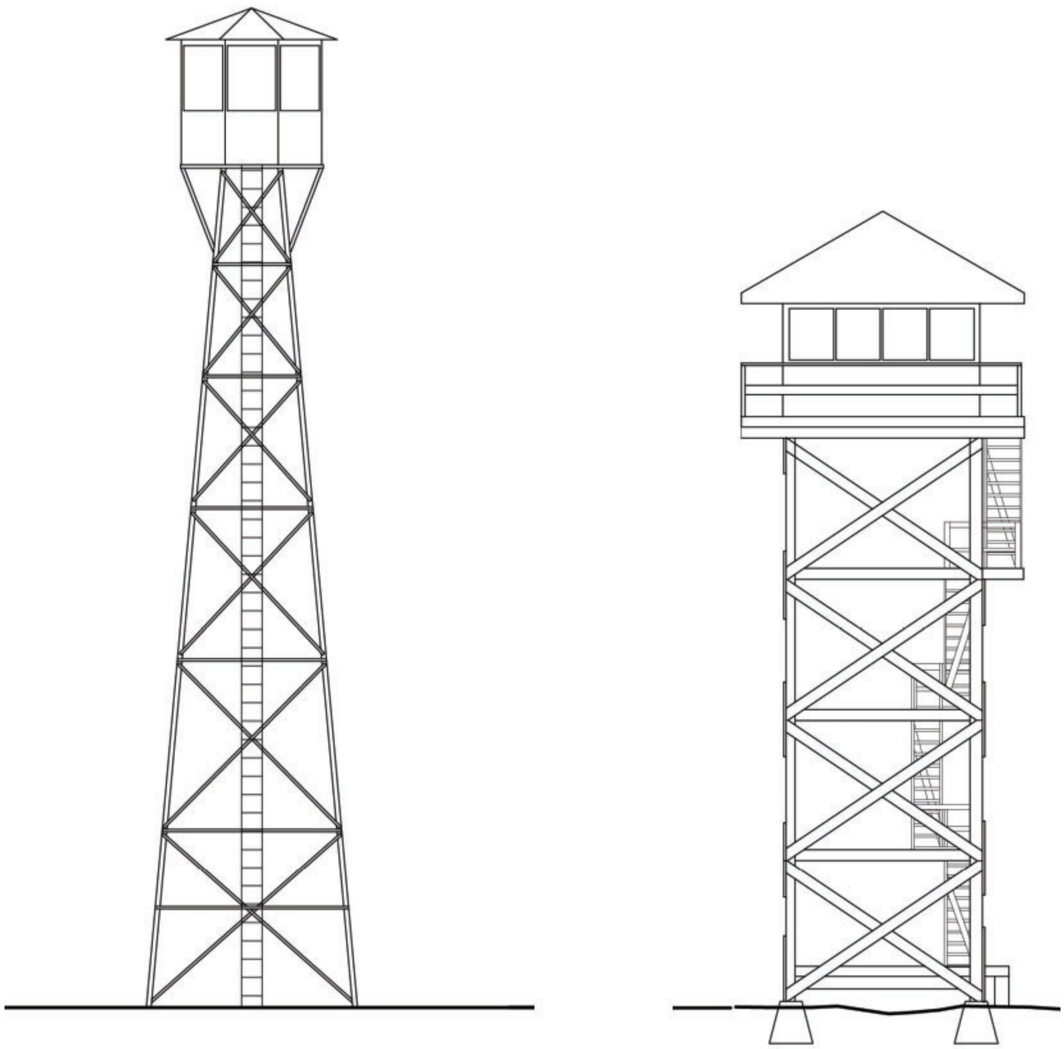

Figure 2.3 *1:100 18m (60') Steel Tower (left), 1:100 12m (40') Wood Tower (right)*

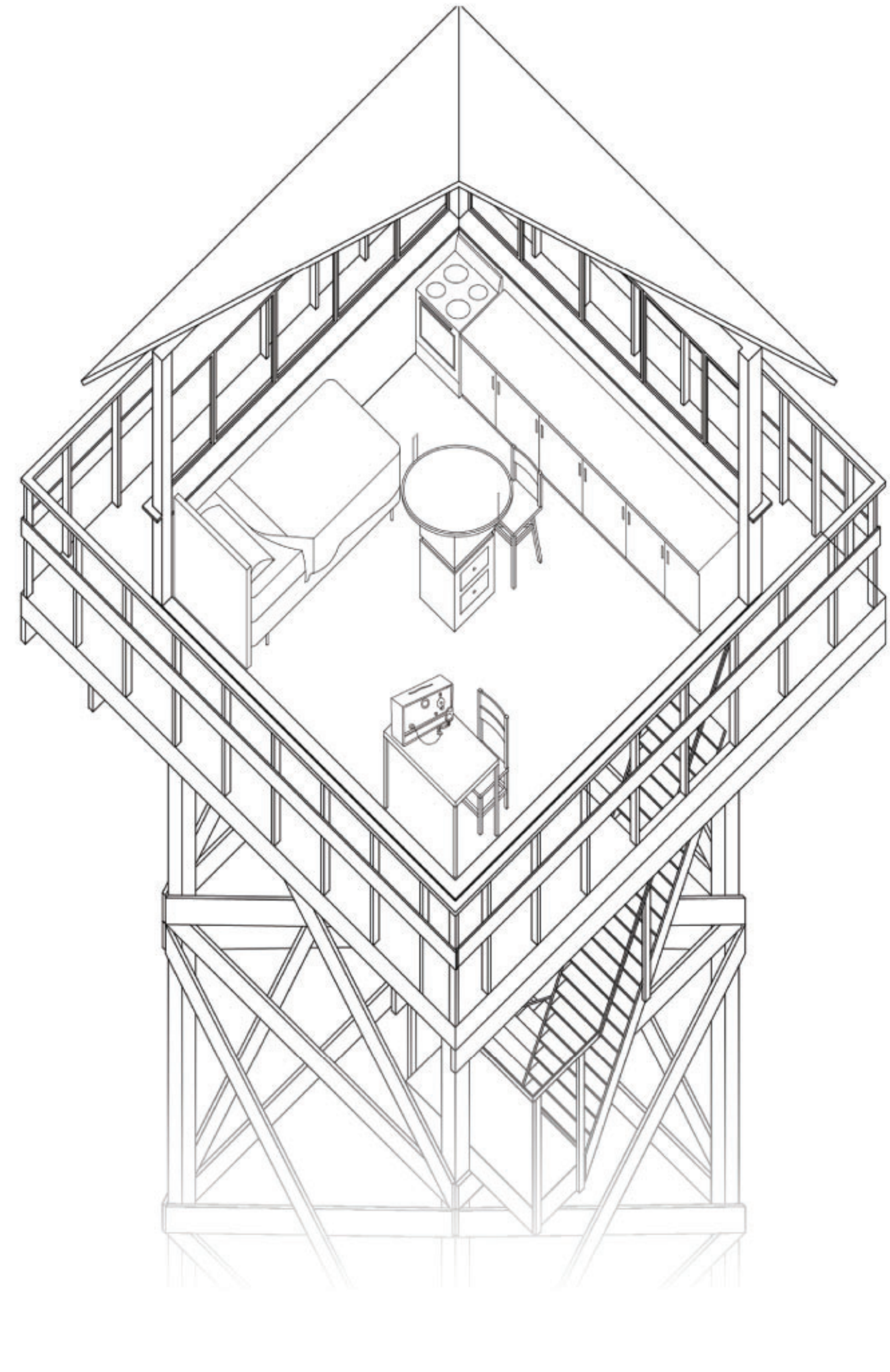

Figure 2.4 *1:50 Wood Tower Axonometric*

Figure 2.5 *Lookout Near Minton, AB*

The lookouts were fixed in the popular culture by many writers and creatives that took work as observers; Gary Snyder, Edward Abbey, Phillip Whalen and Jack Kerouac to name a few. The job as an observer seemed perfect for many aspiring writers and poets, with the isolation providing ample time for writing and contemplation. Many saw it as the most convenient paid writing retreat. Though the absolutist attitudes of control and suppression were the impetus for the often watchtower-esque lookouts, time spent as an observer often had a different effect on the person. Many of their occupants formed deeply personal relationships with the surrounding ecology and natural world during their lengthy isolation within it. Gary Snyder for instance was heavily influenced by his time as a lookout, recognizing the primacy and valuable diversity in the environment, he wrote:

"The treasure of life is the richness of stored information in the diverse genes of all living beings. If the human race, following on some set of catastrophes, were to survive at the expense of many plant and animal species, it would be no victory. Diversity provides life with the capacity for a multitude of adaptations and responses to long-range changes on the planet." [10]

While human occupied lookouts have several functional advantages over aerial and satellite detection the staffing costs are primarily what has led to their disuse. Many places with an intact network of lookouts have outfitted them with remote cameras that are monitored by human observers from a central location allowing one observer to watch many towers at once. Further, image recognition technology is improving such that the detection may be entirely automated in the future. The cost of a camera is paid for by just a few weeks of a human observer's pay. Oregon has replaced staffed lookouts with cameras for the past several years and uses ForestWatch, an automated system of cameras and pattern recognition software.[11]

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10 Gary Snyder and William Scott. McLean, *The Real Work: Interviews & Talks, 1964-1979* (New York: New Directions Publishing Corporation, 1980).

11 Amanda Peacher, "Oregon Officials Replace Human Lookouts With Cameras To Spot Wildfires," October 6, 2015, https://www.npr.org/2015/10/06/446370883/oregon-officials-replace-human-lookouts-with-cameras-to-spot-wildfires.

Figure 2.6 *Remote Camera on Lookout*

RESEARCHING ECOLOGIES

Figure 3.1 *Lodgepole Pine Burn Mosaic*

A wildfire in the boreal forest represents the start of a massive regenerative cycle. Trees that burn release nutrients that were otherwise locked up in their bodies, laying the foundations for the new growth of grasses and pioneer tree species adapted to full sun environments including black spruce, aspen, birch. The warm dead wood is the perfect breeding ground for wood-boring insects which in turn draw many bird species, particularly the woodpeckers that feed exclusively on these insects. Fresh growths are also a favorite of deer and caribou species, drawing them to now wide-open hunting grounds for their predators. More frequent wildfires tend to prevent more destructive and intense fires by removing fuel before it can build up. Wildfires alter the spatial character of the forest creating natural breaks in the canopy which limit the spread of wildfires, diseases, and insects. Each fire and site vary incredibly in the intensity and conditions. At the end of *Managing Forests After Fire* the authors describe the need for more information because of this complexity.

> "Each large wildfire presents an opportunity to implement local studies and expand our knowledge about postfire management… each place is truly unique. In fact, ecology is often described as a 'science of place' because even though the processes may be the same from site to site, the way they play out can't typically be predicted very well."[31]

Thinking of ecology as a 'science of place' reinforces the uniqueness and often incomprehensible complexity of each site even after natural 'disasters, which are only termed so because they represent a disaster to the anthropocentric worldview. Our perceptions of what constitutes 'nature' and functioning ecologies are further challenged by recent work on "novel ecosystems" or "emerging ecosystems", defined as "lands without agricultural or urban use embedded within agricultural and urban regions".[32] Areas which have been heavily affected by human activity but are no longer under direct management, often considered 'degraded', have been revealed to sometimes allow for their own ecosystemic processes to that operate more efficiently than their 'pristine' counterparts. These novel ecosystems are not without their costs, and result in net loss of biodiversity in some cases but they cannot be completely discounted either. They need to be considered on the basis of their own merits without a nostalgic pining for a 'pristine' and static ecosystem, an oxymoron, from a privileged point in time. This is only to say that as in art, there is no bad subject for ecological study. Even environments considered ruined or devastated are each unique in their diversity, even if this diversity hinges on how exactly they were destroyed. All of these environments represent potential for the continuation of the processes that have been changing constantly for millions of years.

31 Cynthia L Miner, "Managing Forests After Fire," *PNW Science Update*, no. 15 (2007).

32 Emma Marris, "Ecology: Ragamuffin Earth," *Nature* 460, no. 7254 (2009): pp. 450-453, https://doi.org/10.1038/460450a.

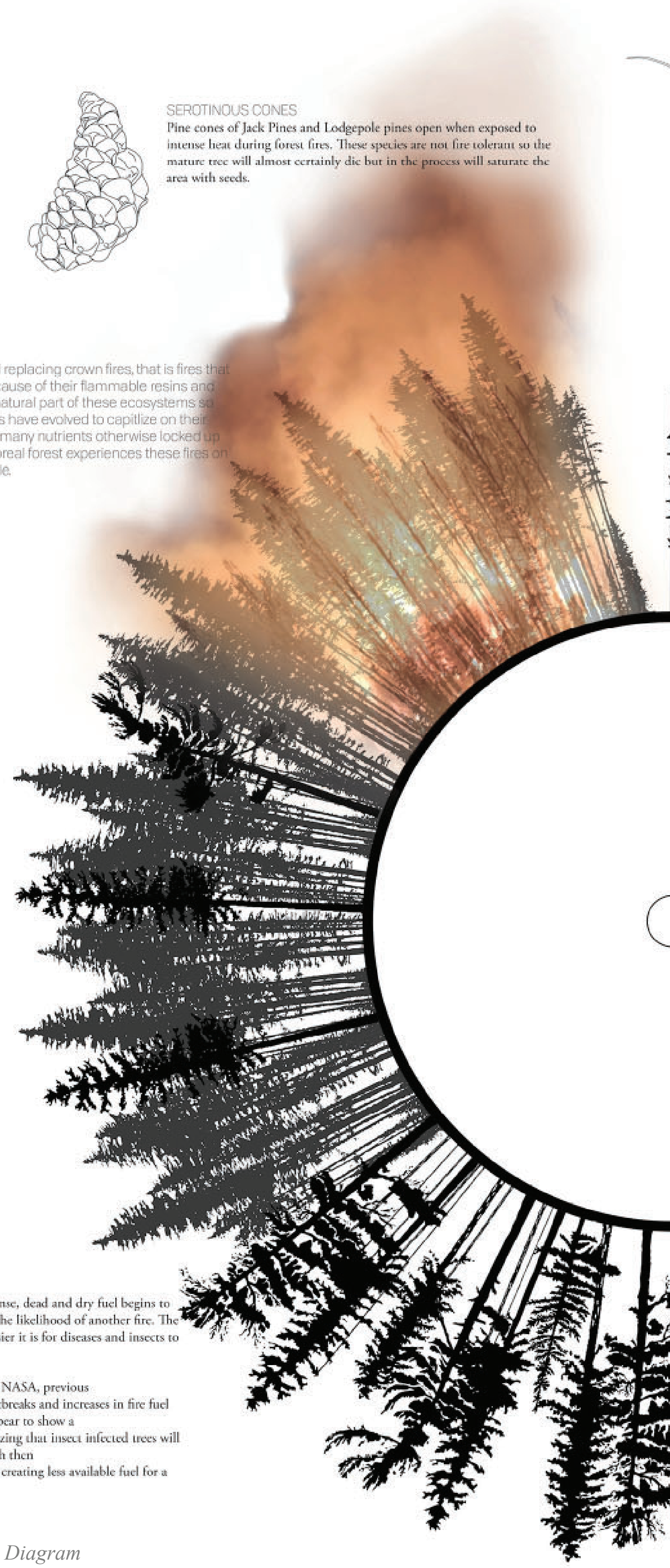
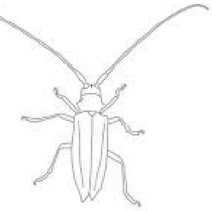


Figure 3.2 *Fire Cycle Diagram*



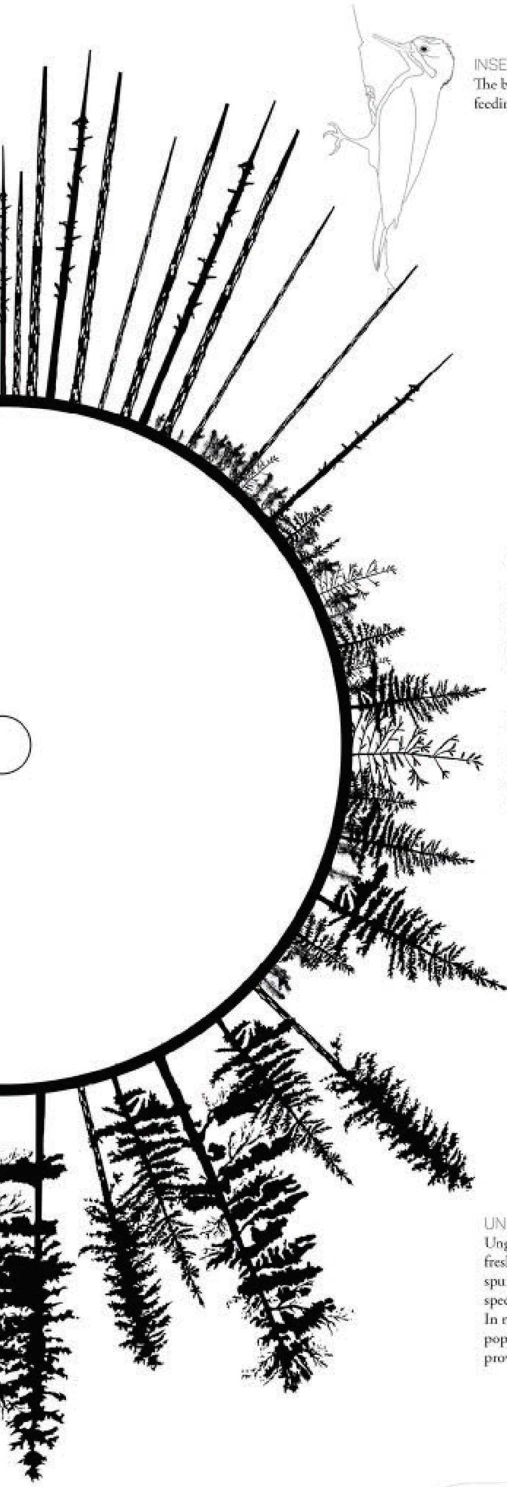
WOOD BORING INSECTS

Insects such as the White-spotted sawyer and other beetles have evolved to exploit the results of frequent forest fires. They thrive in recently burned areas where there is an abundance of dead or dying wood. The explosion of insects after a fire cascades up and down the food chain as they accelerate the decompositions of valuable energy stored in trees and are consumed by many bird species.

Their presence has also been shown to be beneficial to increasing available nitrogen through microbial activity.

INSECTIVORES / WOODPECKERS

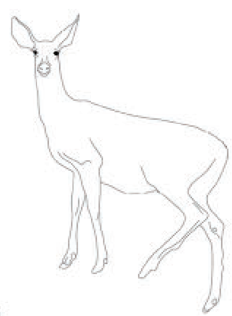
The black-backed woodpecker in particular is a burned forest specialist, feeding mostly on the post-fire outbreaks of wood-boring insects.



PIONEER SPECIES

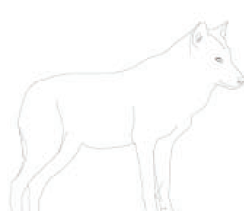
Vegetation such as fireweed and willow quickly colonize and are replaced by the longer lived open sun forest species.
Once seeds are dispersed in the now nutrient rich soil of the post-fire landscape , the once shaded forest is flooded with sunlight. Species such as Jack and Lodgepole pines, Aspens and birch which all require full sun are able to thrive unhindered.

Aspens and birch are both able to sprout from stumps and can within as short a period as 30 years form mature trees. Aspens aren't fire resistant do not burn as well as conifers, tending to keep the fire low intensity and on the ground. Their rhizomatic root structure is able to survive most firest and allows for quick regeneration.



UNGULATES

Ungulates such as deer and moose gain most of their nutrients from fresh growth and saplings in the growing season. The fresh growth spurred by forest fires consitutes an abundant food source for these species.
In response their populations grow, and in turn support the predator populations that also keep them in check. The mostly open forest provides an easily visible hunting ground for predators.



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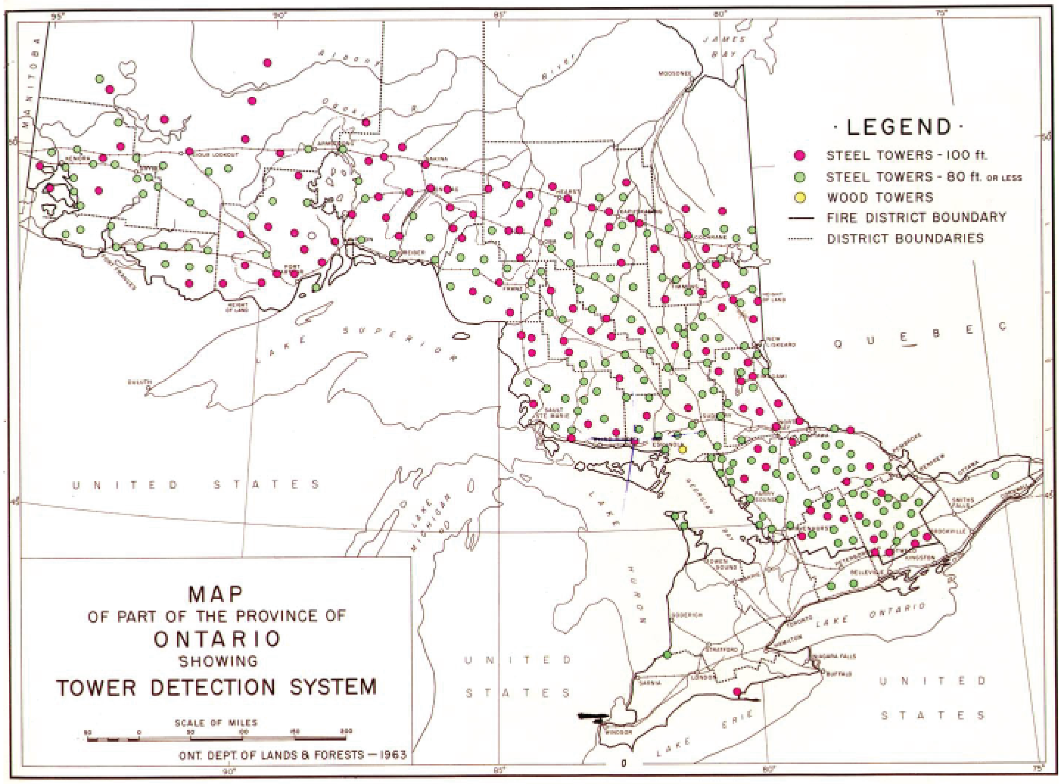


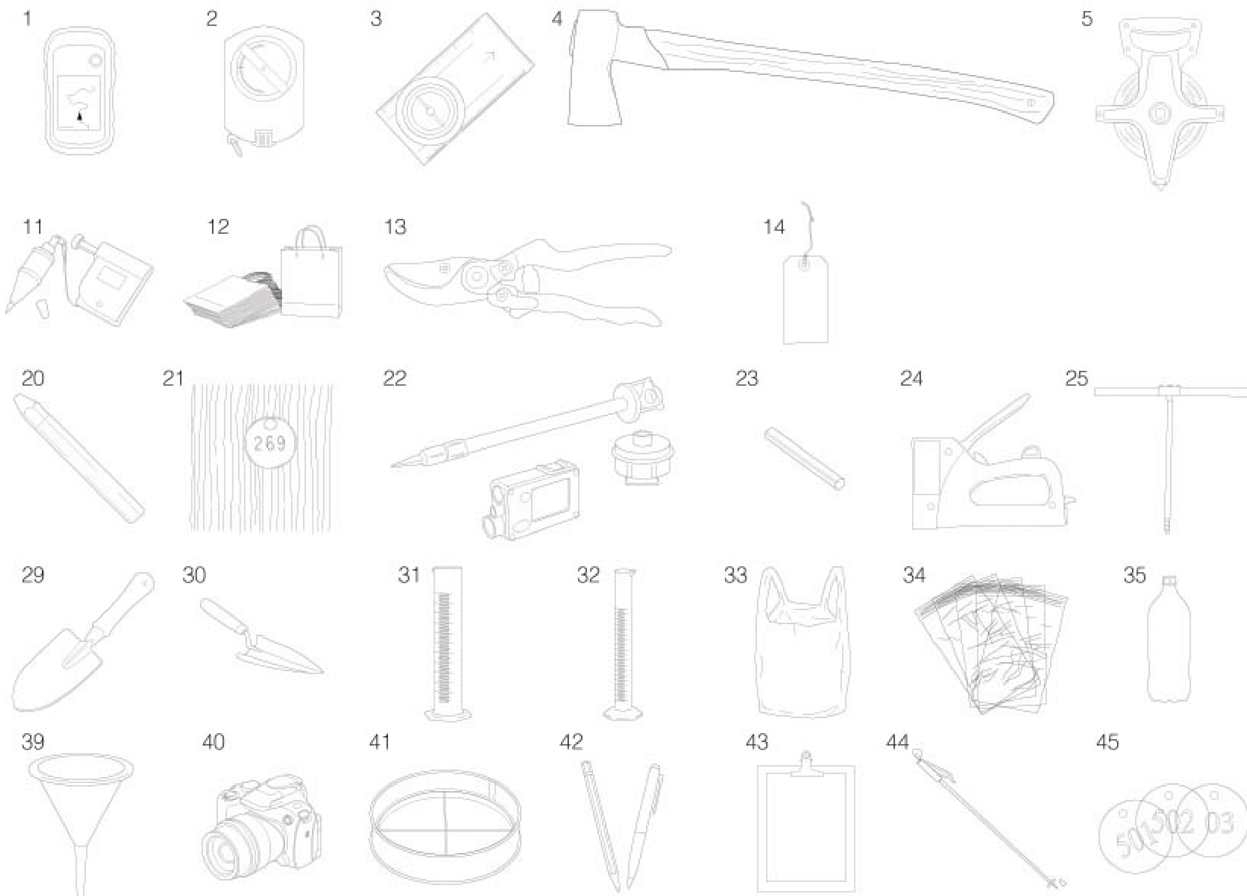
Figure 3.3 *Map of Fire Lookouts, Ontario 1963*

To study the complex dynamics in these changing ecologies data is gathered through a combination of remote sensing and complemented by field research. To study it's forests on a broad scale Canada has established the National Forest Inventory in the early 2000's which monitors Canada's forests by sampling plots from a 20 x 20km grid across the country. Each plot on the grid is 2 x 2km, most of which are sampled by satellite, while a smaller percentage by aerial photography. Ground plots, representing 1% of all plots, are sampled from a confidential location within the 2 x 2km plot by field researchers every 1-10 years.[33] This program has begun the process for a very broad scale analysis and sampling of Canada's forests. Most plots which are sampled at a low resolution and rely on interpretation and estimates to determine the ecological qualities of the plot, focusing primarily on the characteristics of trees in the forest such as species composition, age, total biomass.[34] These estimates are further informed by field research conducted at ground plots but are sampled as infrequently as once a decade at the most remote sites. Field researchers at ground plots can measure a wider range of information at finer detail and including measurements of woody debris of various sizes, soil samples and make notes on changes from previous photographic records of factors like crown density. Though this information is useful and certainly must be part of the strategy going forward, its limitations are clear in the infrequency of ground plot sampling and the ungrounded nature of the majority of data collection. "The increasingly interconnected nature of human and natural environments… demand new and often interdisciplinary and international approaches to address emerging global challenges."[35] Sampling at a single point in time every decade will not capture the change in seasonal norms as the baselines in temperature and climate generally subtly shift over time.

Since the NFI's inception there have been new developments and initiatives in ecological sensing that propose to fill the gaps that programs like the NFI leave. Aerial and satellite data are just one set of tools for the remote gathering of ecological data, allowing programs like the NFI to survey very large swaths of land, albeit narrowly, and gather considerable aggregate data. There are however limitations to what can be gathered by these methods which point toward site-based remote sensors which can gather their own distinctive data sets, more closely measuring the diverse conditions on the ground. There are many programs internationally that are in the process of building this very infrastructure such as the Czech Republic's National Climate Program and the National Ecological Observatory Network (NEON), in the United States. These programs are focused on the development of research infrastructure that they consider necessary to for understanding the impacts of local and global change, "The research at CzechGlobe ranges from short-term observations of plant photosynthetic processes taking place in a matter of seconds and at sub-leaf level (e.g., metabolites and photochemical reactions) up to the regional-level ground-based and remote sensing-based observations of processes taking place over years and decades"[36]

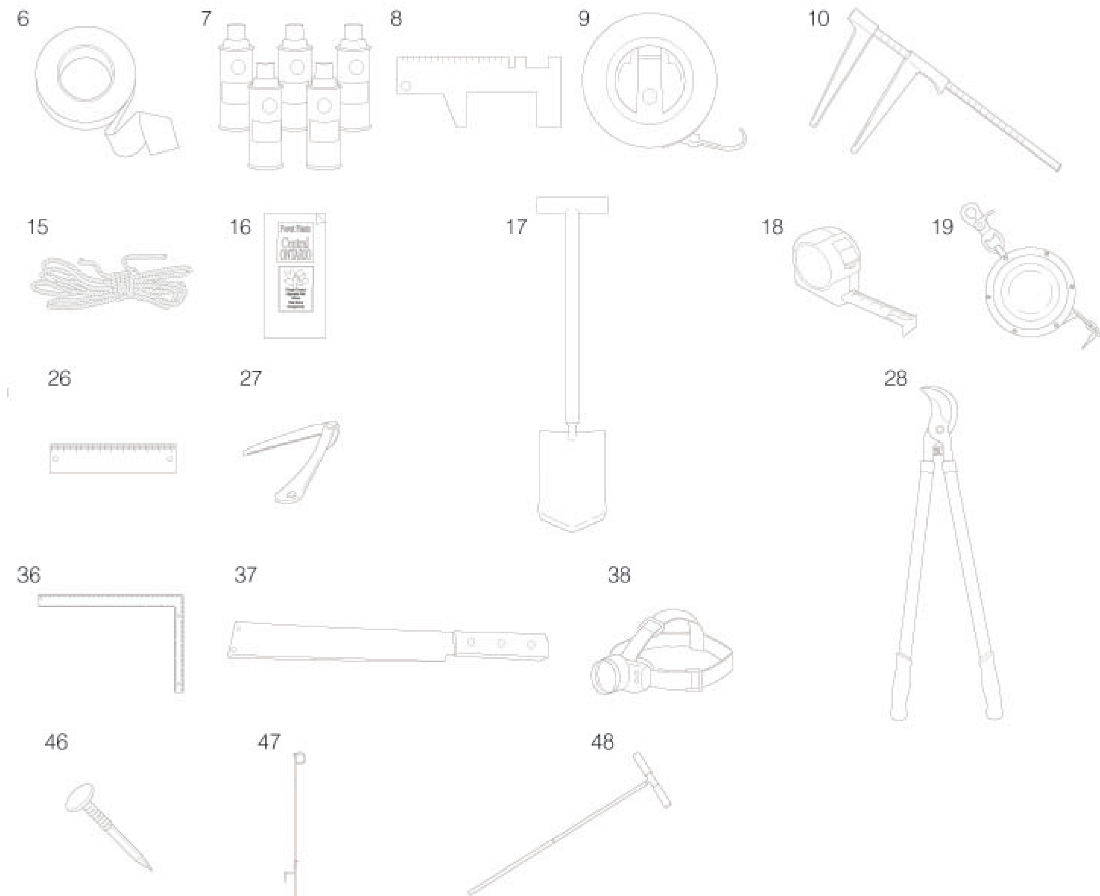
Programs such as CzechGlobe and NEON also recognize the need for in-situ fieldwork. The remote sensors, aerial and satellite imagery that we have are often seen as a pure factual description of the territory. However they are much narrower visions of the world than we typically understand and when attempting to measure something such as ecology, so multivariate and diverse in scales of space and time, it's important to recognize that looking through any one of these methods is akin to viewing the world through

34 Steen Magnussen and Glenda Russo, "Uncertainty in Photo-Interpreted Forest Inventory Variables and Effects on Estimates of Error in Canada's National Forest Inventory," *The Forestry Chronicle* 88, no. 04 (2012): pp. 439-447, https://doi.org/10.5558/tfc2012-080.



1. GPS
2. CLINOMETER
3. COMPASS
4. LARGE AXE
5. TAPE
6. FLAGGING TAPE
7. LOGGING PAINT
8. GO-NO-GO TOOL SMALL WOODY DEBRIS
9. DIAMETER TAPE
10. CALIPERS
11. PLUMB BOB
12. PAPER BAGS
13. HEAVY DUTY FIELD SCISSORS
14. SAMPLE LABELS
15. PRE-MEASURED ROPE 0.56m
16. PLANT ID GUIDE
17. LARGE SPADE
18. TAPE MEASURE
19. LOGGERS TAPE
20. LUMBER CRAYON
21. METAL TAGS
22. VERTEX HYPSOMETER
23. LARGE DIAMETER STRAWS
24. SMALL STAPLER

Figure 3.4 *National Forest Inventory Field Kit*



25. INCREMENT BORER
26. SMALL RULER
27. FOLDING HAND SAW
28. HEAVY DUTY CLIPPERS
29. WIDE TROWEL
30. NARROW TROWEL
31. 1L GRADUATED CYLINDER
32. 100mL GRADUATED CYLINDER
33. 5mm PLASTIC BAGS
34. 10mm PLSTIC BAGS
35. 2L BOTTLE OF 3mm GLASS BEADS
36. 20x20cm ALUMINUM TEMPLATE
37. SHARP FIELD KNIFE
38. HEADLAMP
39. SMALL PLASTIC FUNNEL
40. DIGITAL CAMERA
41. SOIL SIEVE
42. PENS AND PENCILS
43. FIELD CLIPBOARD
44. BREAST HEIGHT POLE
45. PRE-NUMBERED TAGS
46. ALUMINUM NAILS
47. PIGTAIL PINS
48. EXTENDABLE SOIL PROBE

Figure 3.5 *Example of Representative Photo of NFI Ground Plot*

Figure 3.6 *Example of Overhead Photo NFI Ground Plot*

a straw. Laura Kurgan says of maps in *Close Up at a Distance* “rather than interpretations of information that they are, we too often see them simply as representations and descriptions of space” and the image taken from a distance “tells only a story, not the story of what is going on”[37] The plethora of sensors we have, advanced as they are only tell limited single variable stories on their own. It is the assemblage of these many variables and the field work to supplement and verify them that can begin to give us something like a complete picture. Regular ground truthing of remote sensing data is necessary to ensure the accuracy of said data as well as to provide the ability to detect novel changes remote sensors are not tuned to pick up. In addition to regular testing and calibration of the equipment. There are many datapoints that have yet to be collectable or measurable on a remote and automated basis in themselves. Biological sampling of insects, ticks, diseases, and genetic diversity can only be sampled by human hand. All this points strongly to the perpetual necessity of human presence to study and cultivate a greater understanding of dynamic ecologies. As limited as our own endogenous sensing apparatuses are, they are still invaluable in ascertaining truth.

In addition to trained field workers and scientists visiting sites to verify and take new measurements, communities also have a role to play in the collective work of understanding the environment in which we live. The concept of paired plots is one that weaves the necessity of fieldwork with the advantages of local knowledge. The strategy involves sampling two areas, one kept away from the public access solely for trained researchers, and one with a publicly accessible path by which the general public can participate in the gathering of data and ecological study generally.[38] Community plots add a non-technological layer of community participation to the ongoing research into ecologies. The model provides an opportunity for those who have previous experience and knowledge of the land to integrate their valuable contributions with the scientific method. Ideally creating a framework for other ways of knowing to be included and broaden the collective understanding of the land. The National Research Council recognizes the usefulness of communities and states as one of its major goals for environmental science, “by supplying resources so that the community can deploy additional sensors, measurements, experiments and learning opportunities.”[39] These frameworks can be augmented over time as new discoveries are made and conditions change, to ensure the system is relevant well into the future. The longer the system can remain applicable and modernize with new developments the better use the data will be with a long history of comparable baseline.

37 Laura Kurgan, *Close up at a Distance Mapping, Technology, and Politics* (New York: Zone Books, 2013).
38 Kristi Skebo, Sarah Quinlan, and Brian Craig, eds., *EMAN: Monitoring Biodiversity in Canadian Forests* (Environment Canada, n.d.).
39 National Research Council, *Grand Challenges in Environmental Sciences* (Washington: National Academy Press, 2001).

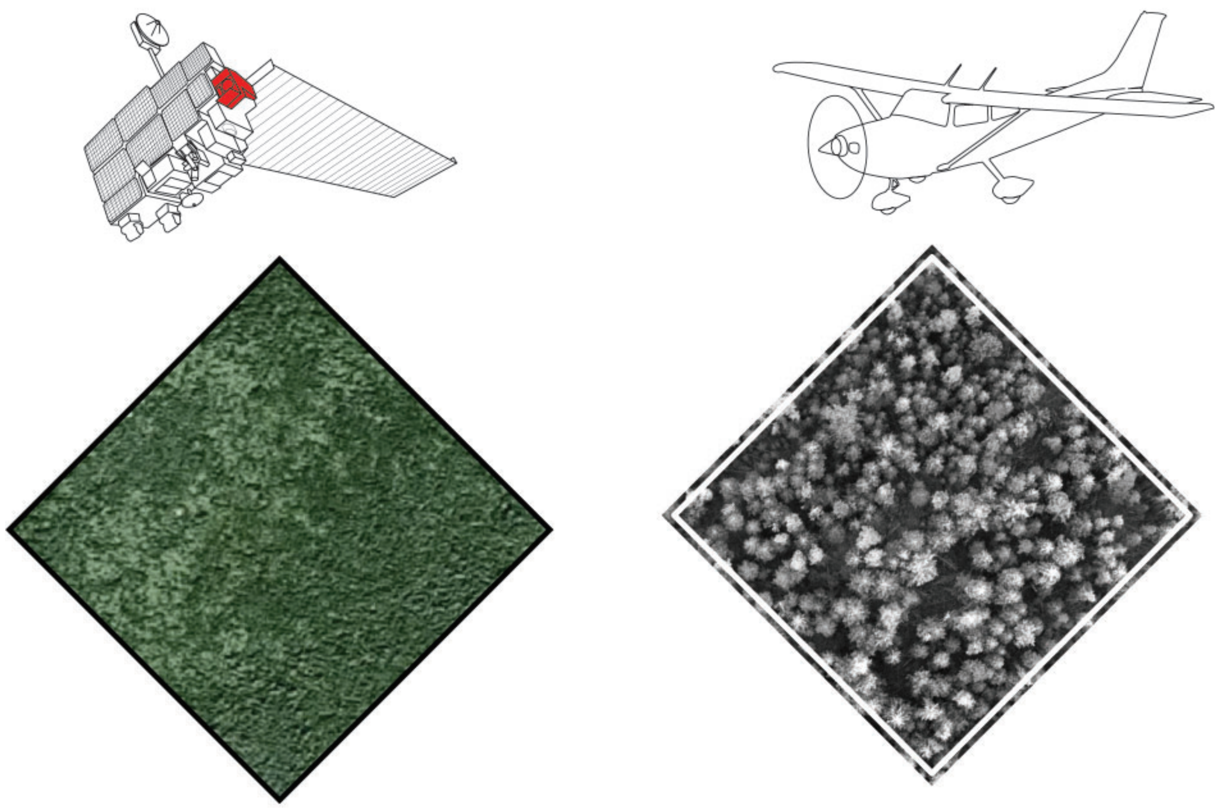
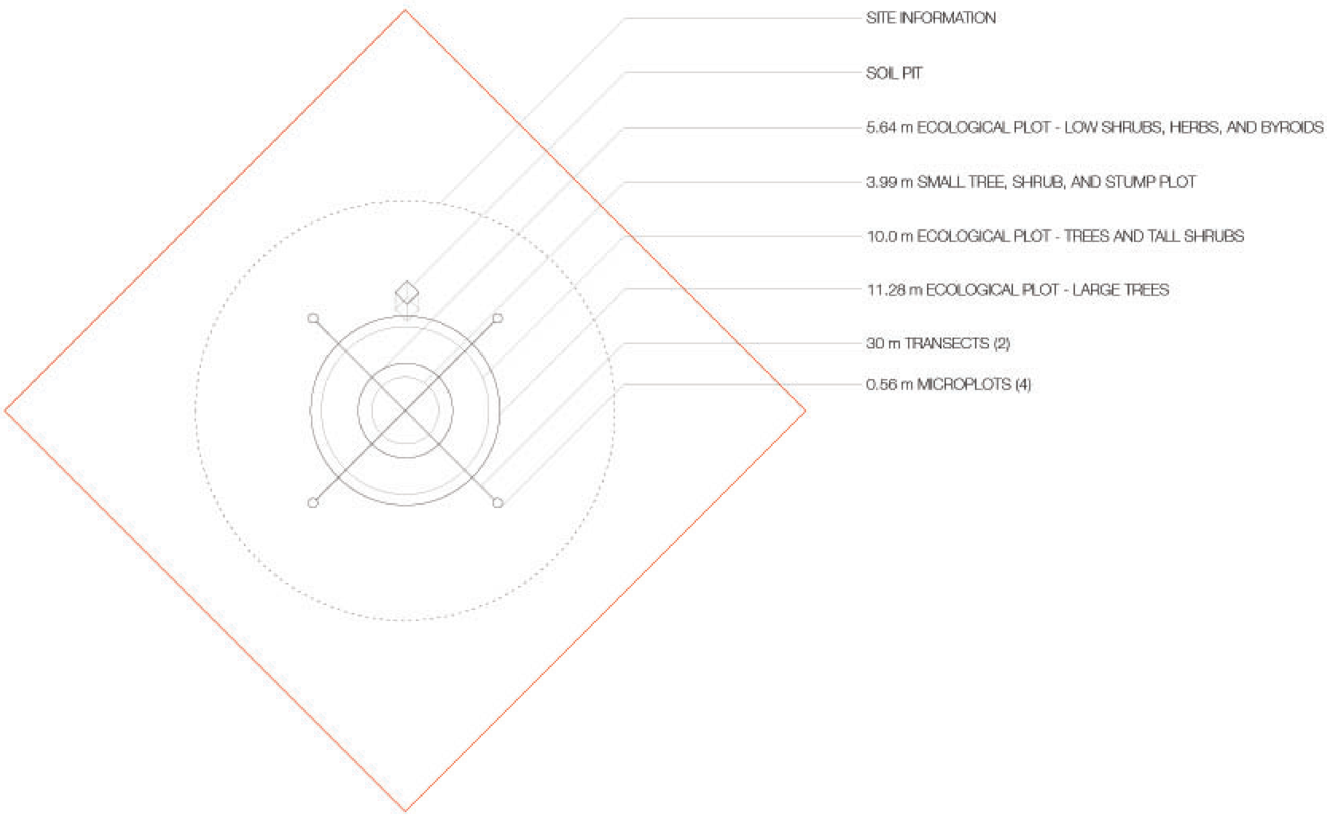


Figure 3.7 *NFI Plot Diagram (left to right) Satellite Plot, Aerial Plot, Ground Plot*


SITE INFORMATION
SOIL PIT
5.64 m ECOLOGICAL PLOT - LOW SHRUBS, HERBS, AND BYROIDS
3.99 m SMALL TREE, SHRUB, AND STUMP PLOT
10.0 m ECOLOGICAL PLOT - TREES AND TALL SHRUBS
11.28 m ECOLOGICAL PLOT - LARGE TREES
30 m TRANSECTS (2)
0.56 m MICROPLOTS (4)

CULTURE AND LANDSCAPE

Figure 4.1 *Panoramic Comparison of Bethel Ridge, Washington 1936-2012*

According to Jakob von Uexkull we perceive our "umwelt", or perceptual world, as landscape of meaningful signals for action.[42] Looking at our historic use of landscape as economic resource, as a culture we have been trained to perceive our landscape as one that is full of useful materials to be extracted. It is much more difficult for us to perceive the whole of these ecosystems and even the effects that our short-term extraction has on the ecosystems over time. Humans do not live long enough or visit these places often enough to experience the kind of ecosystemic change that occurs on the scale of hundreds of years. For example, The Mountain Legacy Project and John F Marshall, through panoramic photographs of the same landscape many decades apart show powerfully the change in the physical and spatial nature of the ecosystem on that land. (see Figure) Many of our attitudes are shaped by seeing nature as 'out there' and protecting or shielding ourselves from it. Perhaps it is the vestiges of the "small and isolated communities surrounded with a physical or psychological "frontier," separated from one another"[43] as elucidated by Northrop Frye, but as we wade deeper into the Anthropocene it only becomes more obvious that there is no difference between 'out there' and us. It is one continuously flowing territory in which everything is interrelated and nothing can happen without the ripples being felt elsewhere. Despite the fact that we feel more distant from nature than ever before we are only coming to realize ever more distinctly our inextricable connection with even the most remote wilderness. Like the microplastics found in the most pristine of mountain summits[44], our humanity, good or ill knows no bounds. An alternative framework for understanding our modern relationships with the natural world is proposed by Bruno Latour in the redirection from the term "nature" which tends to encompass the entire physical world, the universe, physics, to what he terms the 'Terrestrial' defined as "the-nature-as-process" that takes place in the thin habitable membrane between the Earth's crust and the vacuum of space.[45] "We need a term that encompasses the stupefying originality (the stupefying longevity) of this agent. Let us call it, for now, the Terrestrial". It is this conceptualization of nature-as-process that begins to relate the scientific understanding of ecology to a cultural framework.

42 Jakob von Uexküll, *A Foray into the Worlds of Animals and Humans: with a Theory of Meaning* (Minneapolis: Univ. Press, 2010).

43 Northrop Frye, *Bush Garden: Essays on the Canadian Imagination* (Concord,Ont.: House of Anansi Press, 1995).

44 Steve Allen et al., "Atmospheric Transport and Deposition of Microplastics in a Remote Mountain Catchment," *Nature Geoscience* 12, no. 5 (2019): pp. 339-344, https://doi.org/10.1038/s41561-019-0335-5.

45 Bruno Latour, *Down to Earth: Politics in the New Climatic Regime* (Cambridge, UK ;Medford, MA: Polity Press, 2018).

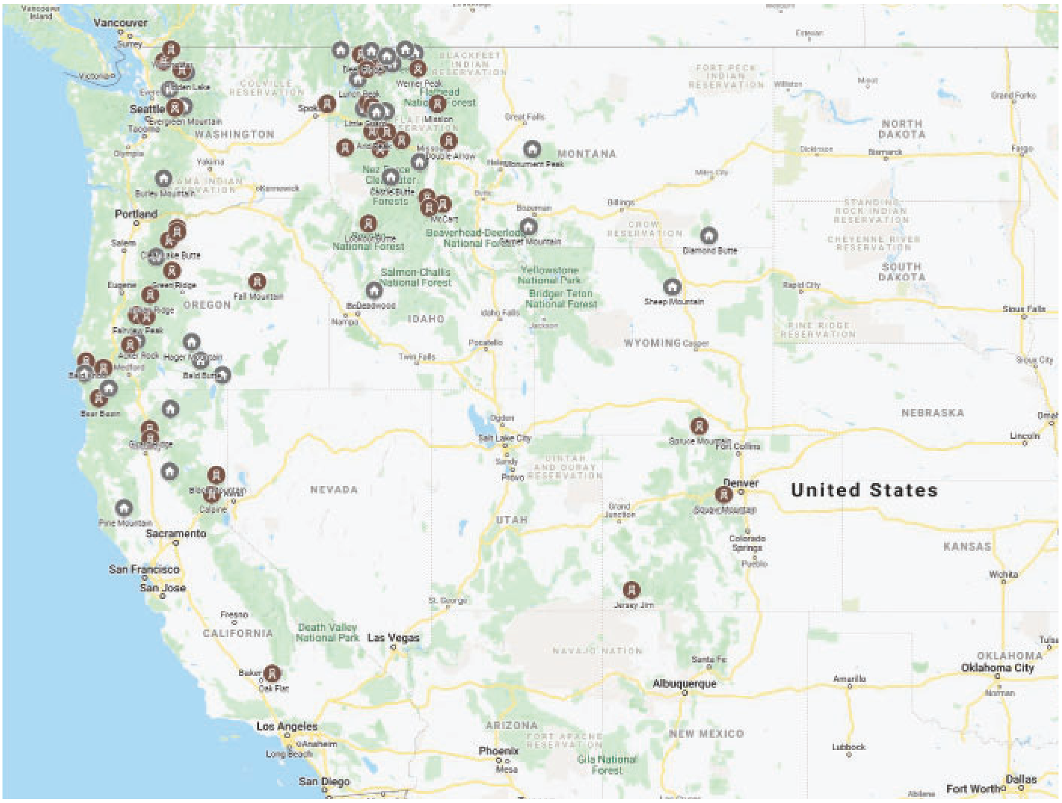


Figure 4.2 *Map of Western Lookouts for Rent by various Park Services*

Figure 4.3 *Volunteers Posing atop Restored Eagle Pass Lookout, BC*

The public enjoyment and use of the available natural resources is an important part of effectively managing the landscape. Without the culture's direct connection to the landscape and its value it's unlikely that the correct care and funding would be attributed to properly manage it. In *Sustaining Wildlands: Integrating Science and Community in Prince William Sound*, the authors make an argument that while a conservational case is often made for restricting humans access for the benefit of the environment, there is good evidence that, for the ongoing stewardship of valuable ecosystems, a human presence is actually imperative and must be accounted for and managed.

"when done well, community engagement can help managers learn to develop scientifically defensible plans that are inclusive of a diversity of users. This allows wildlands to have a better chance of maintaining societal relevance" [46]

Forestry infrastructure has a long history of coincidence with other uses, particularly recreation. Today, many fire lookouts have been restored into landmarks and viewpoints for tourists, ex. Dorset Lookout Tower, as well as camping accommodations managed by park services or USFS in the United States.[47] During their period of intensive use, ending in the 1970's, in Ontario each tower had a guestbook which adventurous hikers could sign that were collected each year in Toronto. In wildland areas where recreation is common, jurisdictions generally increase their fire prevention efforts in the area, for example BC kept fire lookouts operational where recreational use of the land was high and Manitoba expects to increase their infrastructure as recreational uses grow.[48] ATV associations and other recreational interest groups often volunteer time and money to aid maintenance of the environments which they use. Often having a members fee that goes towards upkeep in exchange for information and access. In British Columbia a number of historical lookouts have been adopted by local ATV associations which have put money and volunteered labour to restore and maintain these historical landmarks. In turn they are used as accommodations and destinations on trips and remain open to the public. The Four Wheel Drive Association of BC has adopted three historical lookouts while the province neglects to maintain the majority of them.[49] Logging roads are another opportunity for these recreationalists to access the landscape. Associations work with timber companies to ensure user safety by communicating which roads are in active use at any particular time as well as when and if any of them become inaccessible or are designated 'use at own risk'. These areas which have already been affected by much larger equipment and incursion are a perfect place for these motorized recreationalists to explore without worry of negatively affecting more intact ecologies.

DESIGN METHODOLOGY

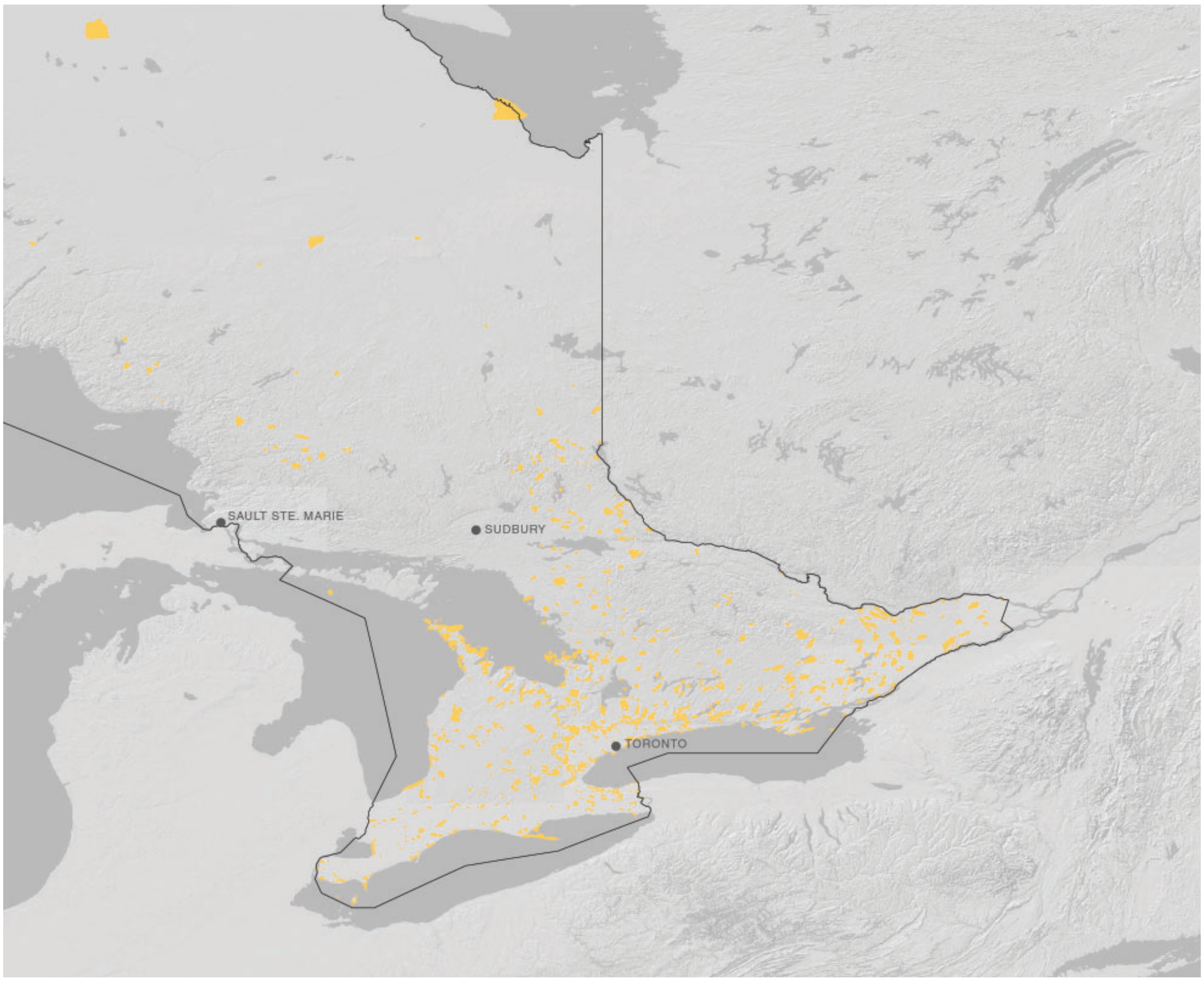


Figure 5.1 *Areas of Natural and Scientific Interest, Ontario.*

Site Selection

Ontario has multiple strategies and designations for identifying important ecosystems and conserving them. This prerogative is partly accomplished with the parks system and conservation areas. While these protections cover a patchwork of land across Ontario, another designation, ANSI, Areas of Natural and Scientific Interest, was created due to the amount of private lands and crown forests that are promised to industrial interest for the purposes of identifying and protecting "the best representative sites that do not occur within national parks, provincial parks, or conservation reserves"[48]. There are both life science and earth science ANSI's, due to the nature of forest ecosystems, life science ANSI's are focused on here.

Life science areas are representative of the biodiversity of the areas and its landscapes, including indigenous plants and animals, forests, praries, savannahs, wetlands and bodies of water. (map of ANSI in Ontario), (map focusing on cluster) A Cluster of life science ANSI areas that currently in the process of approval is identified (map) as with many ANSI designated areas they are surrounded with human activity. They are also in close proximity to major population centers and the area around them is hemmed in on three sides by major highways (see map). The ANSI zones are on regular crown land parcel that has seen logging over the years. The general area is full of existing recreational activities, including camping, hiking, canoeing, hunting, fishing, ATV and snowmobile trails, that can be accessed by the regional highways that surround it and perhaps less commonly by the web of recreational and forest service roads throughout the region.

One ANSI area, the Nemi Lake Forest and Lowlands, was chosen as the focus for its proximity to access by highway and a link into nearby provincial parks via canoe route as well as access by the network of logging roads/atv trails in the area. This is just one site of many that would constitute a suitable location. There are so many sites such as this that have identifiable scientific interest and adjacency to pathways of recreation. There are paired 2kmx2km plots on the site mimicking the standard size for NFI plots, one solely for trained research use and the other for community data gathering and trained. The lookout tower and its sensors are situated as part of the community plot as to facilitate more community participation and exposure of the methods of study for these ecologies.

48 *Natural Heritage Reference Manual*. Toronto, ON: Ontario Ministry of Natural Resources, 2010.

Figure 5.2 *Distance and Population Map*


SUDBURY
Population: 164 689
5 h
TORONTO
Population: 2.9 million
8 h 45 m

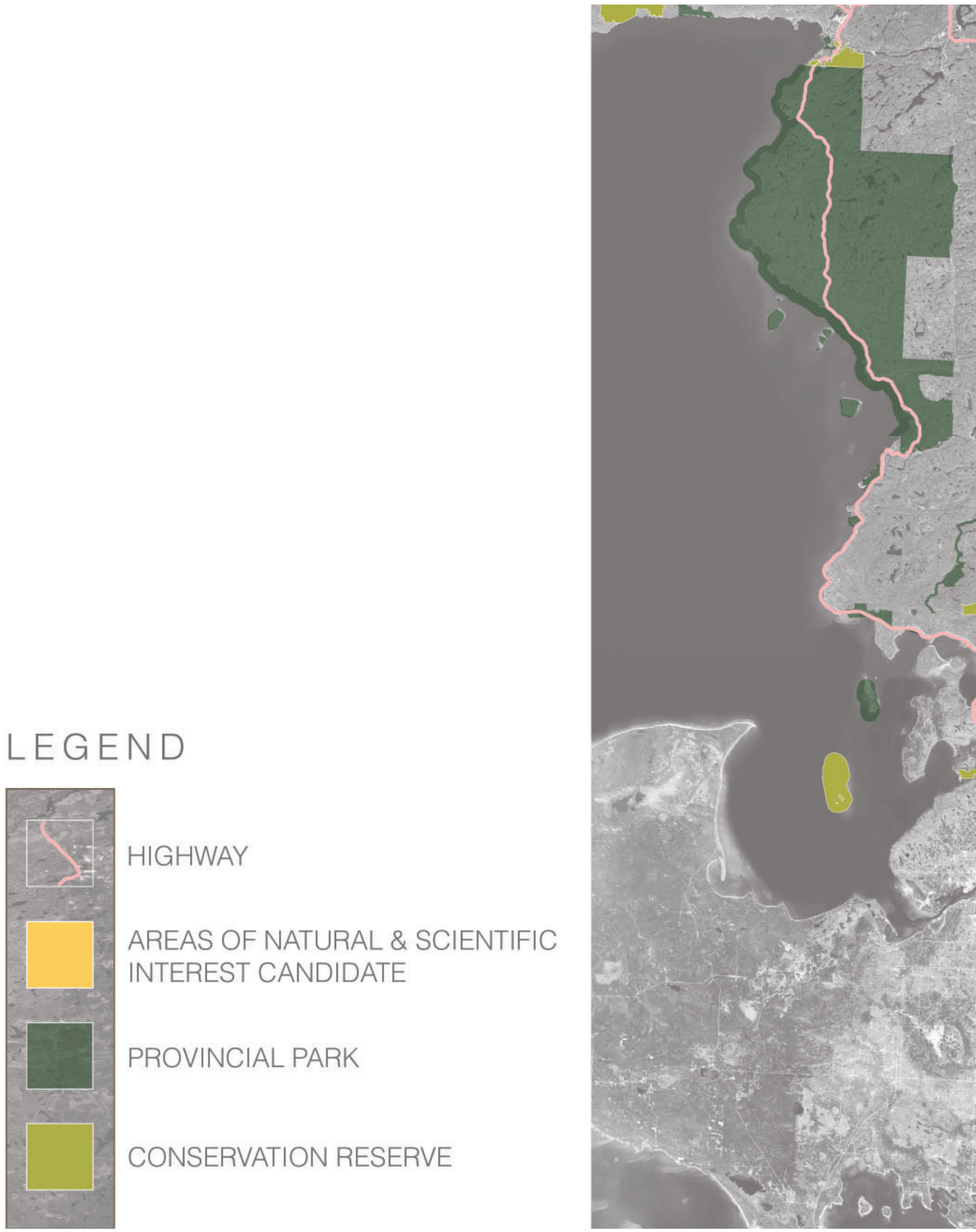
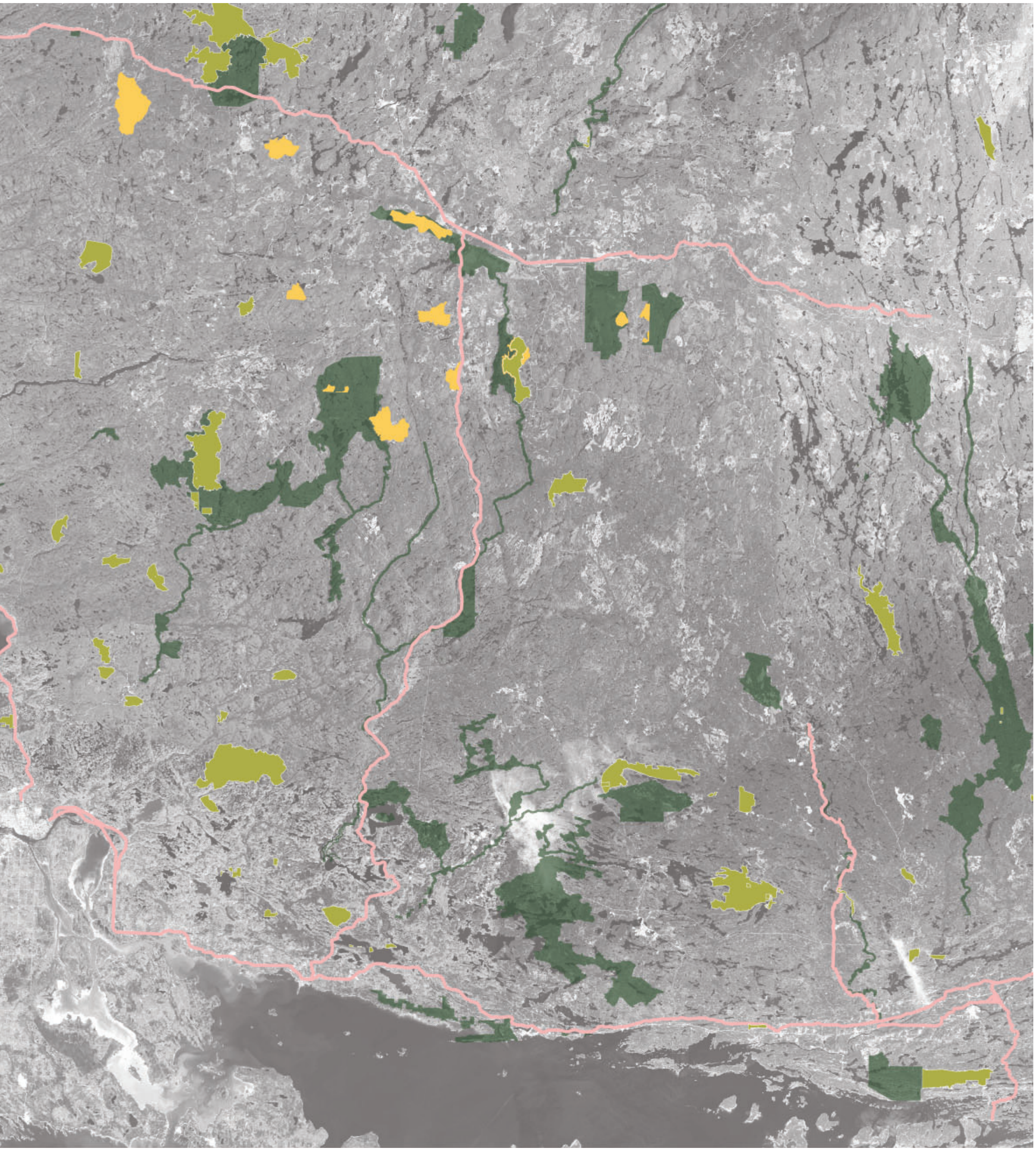


Figure 5.3 *Provincial Parks, Conservation Areas and Areas of Natural and Scientific Interest (ANSI)*



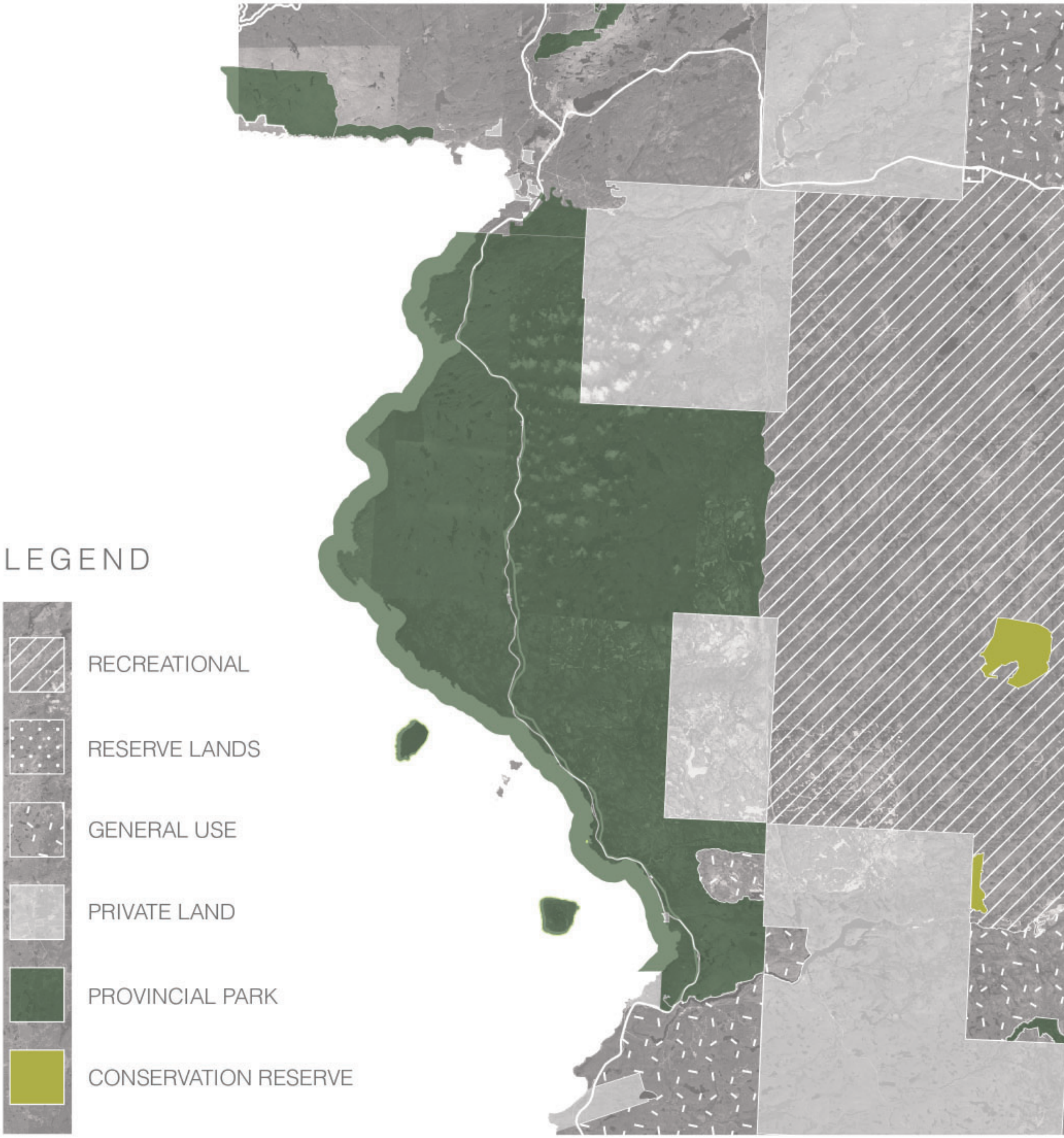
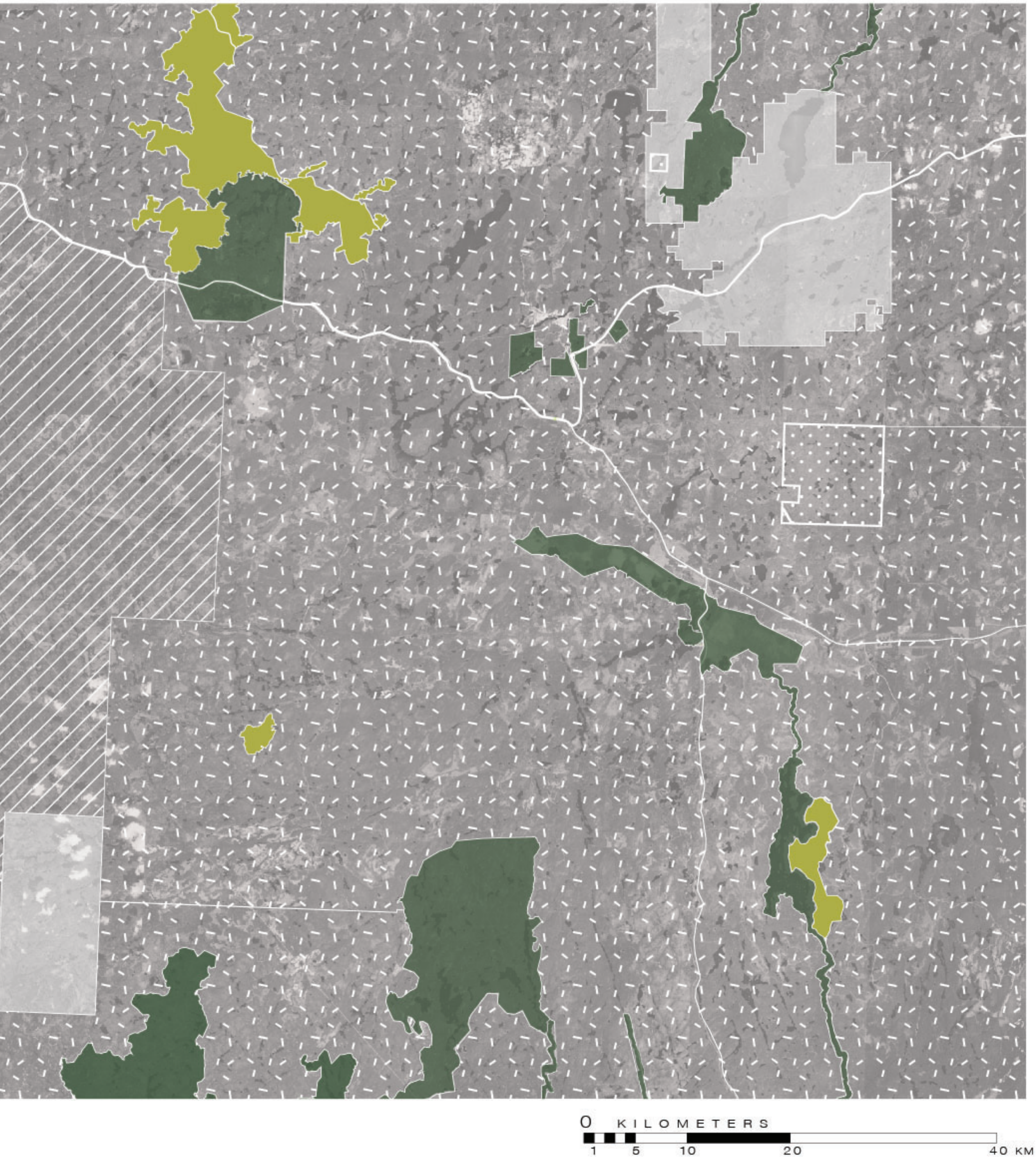


Figure 5.4 *Crown Land Use Policy Map*


0 KILOMETERS
1 5 10 20 40 KM

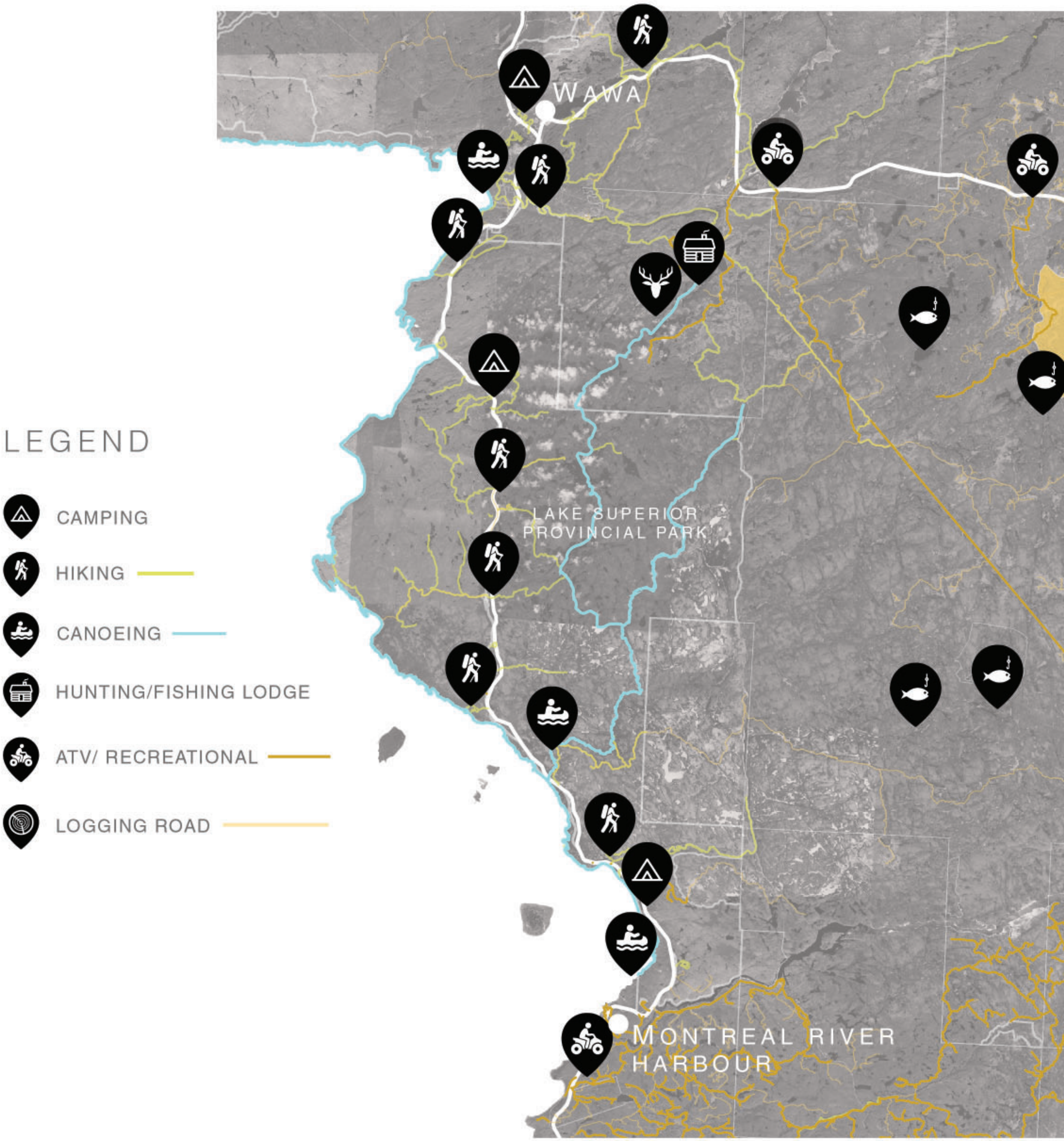
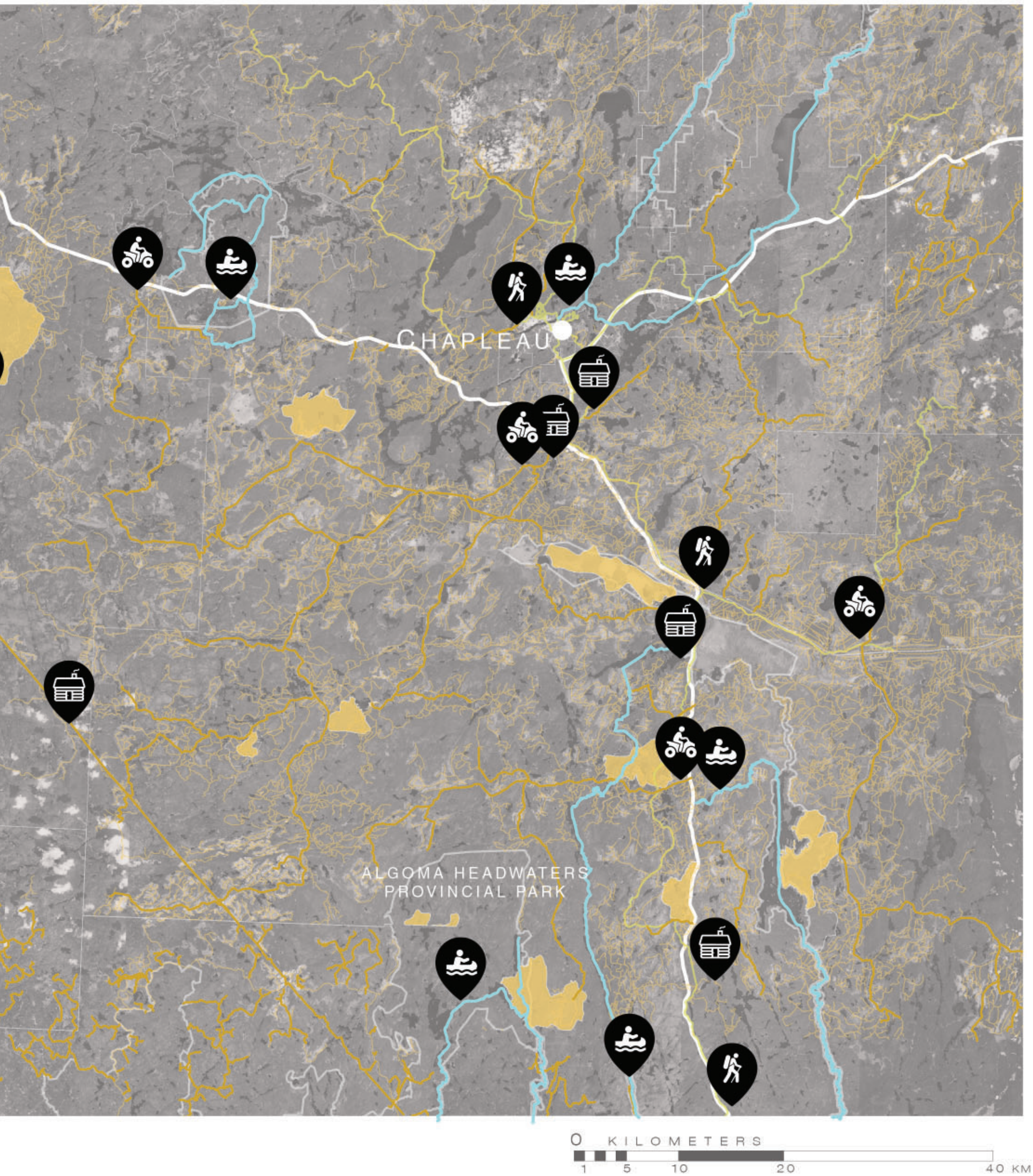


Figure 5.5 *Recreational Activities and Routes Map*


CHAPLEAU
ALGOMA HEADWATERS
PROVINCIAL PARK
0 KILOMETERS
1 5 10 20 40 KM

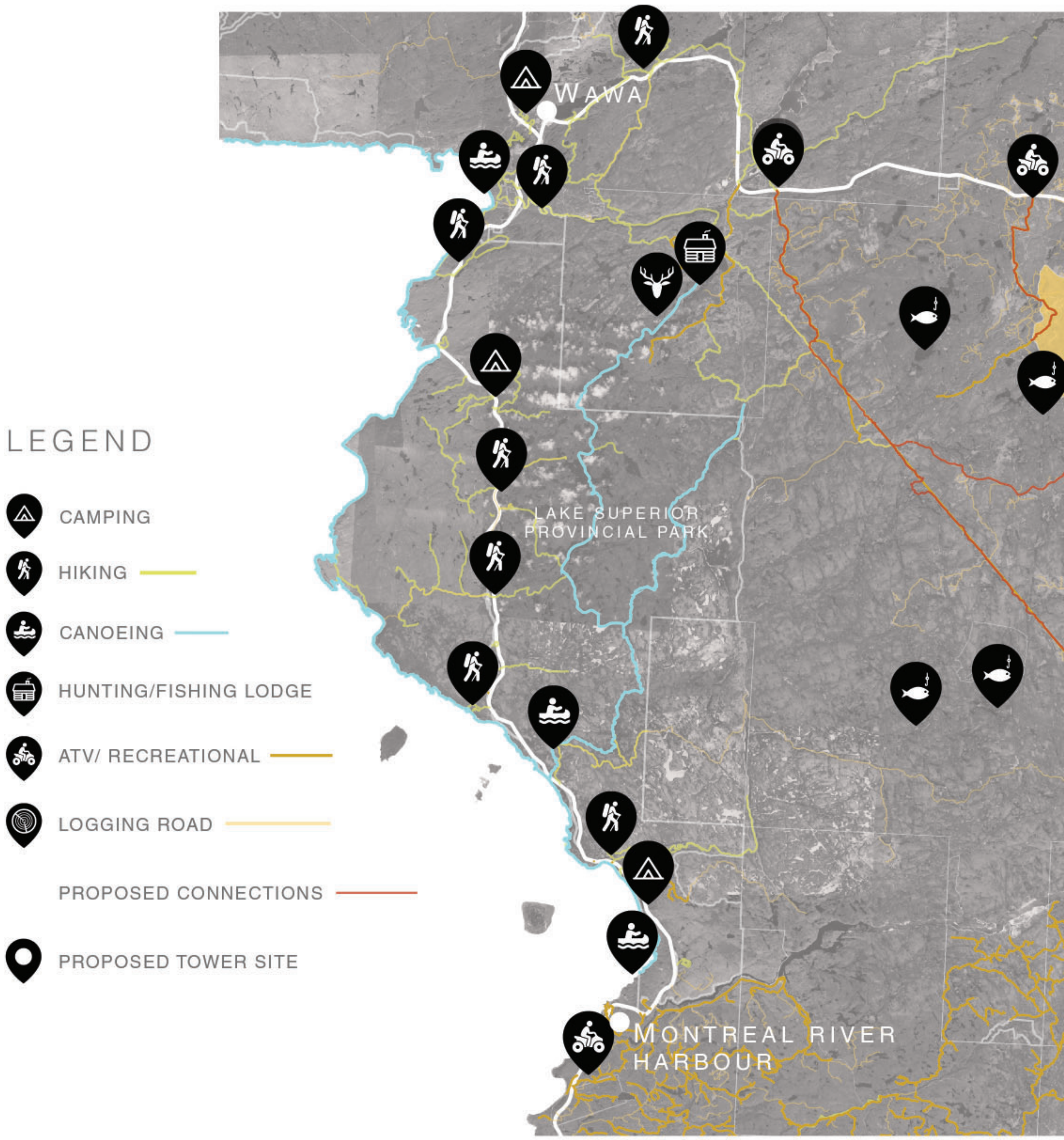
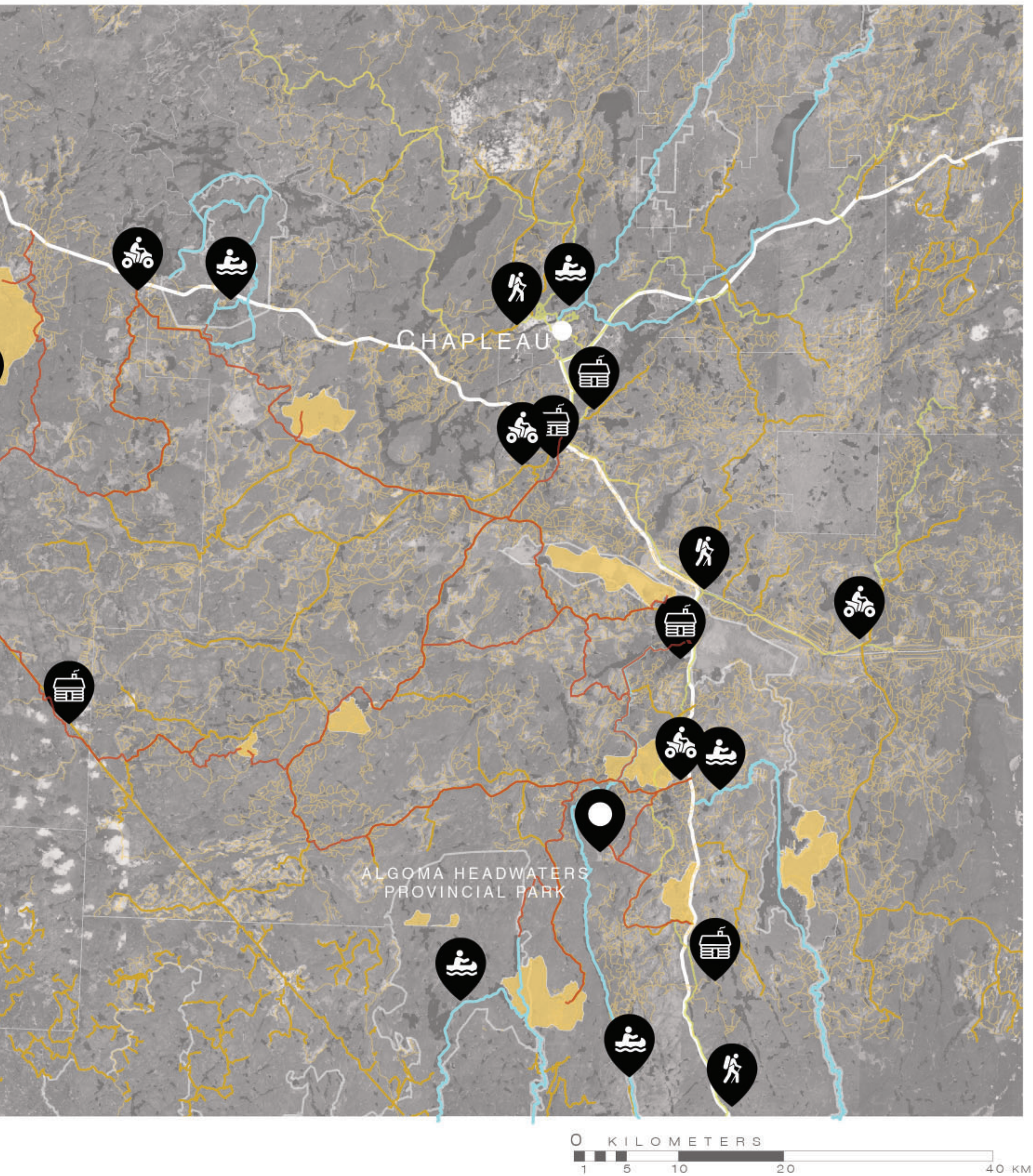
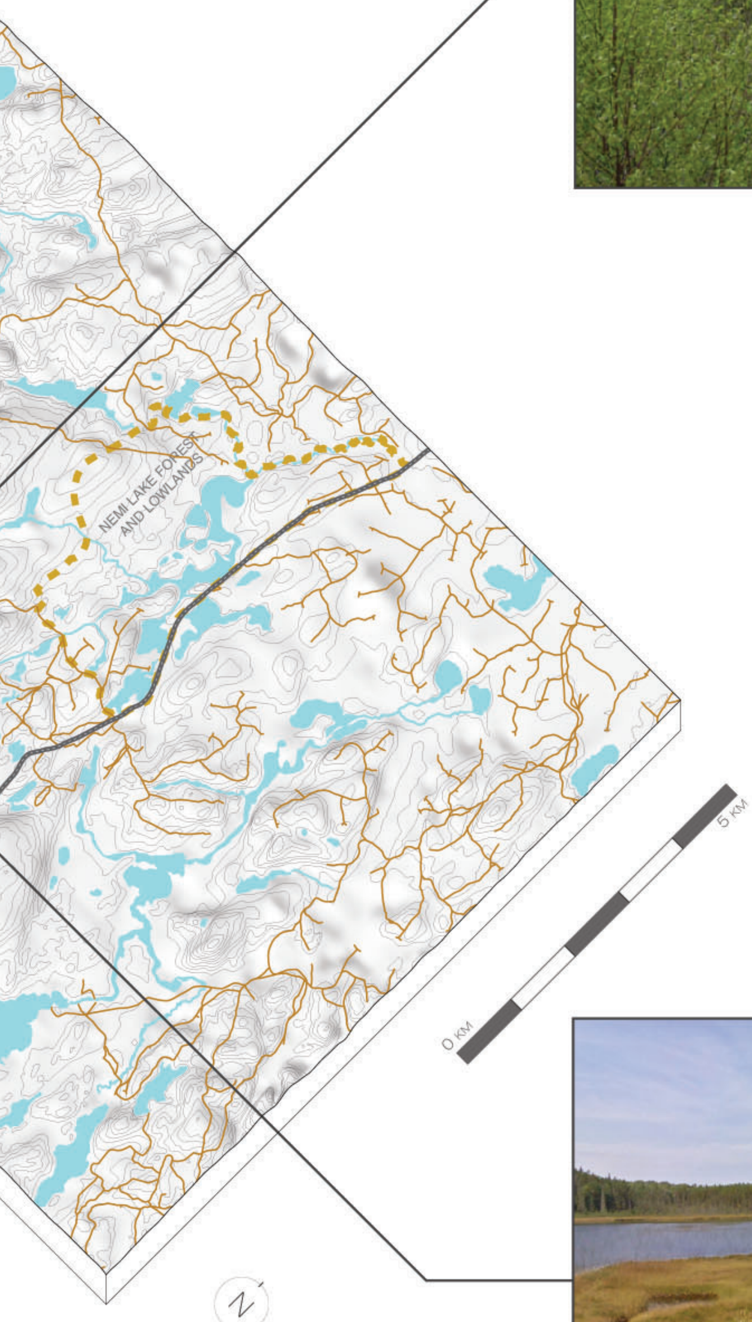


Figure 5.6 *Recreational Activities and Routes Map with Proposed Routes and Site*



CHAPLEAU
ALGOMA HEADWATERS
PROVINCIAL PARK
0 KILOMETERS
1 5 10 20 40 KM

Figure 5.7 *Axonometric Route Conditions*


NEMI LAKE FOREST
AND LOWLANDS
0 KM
5 KM
N


ON-129

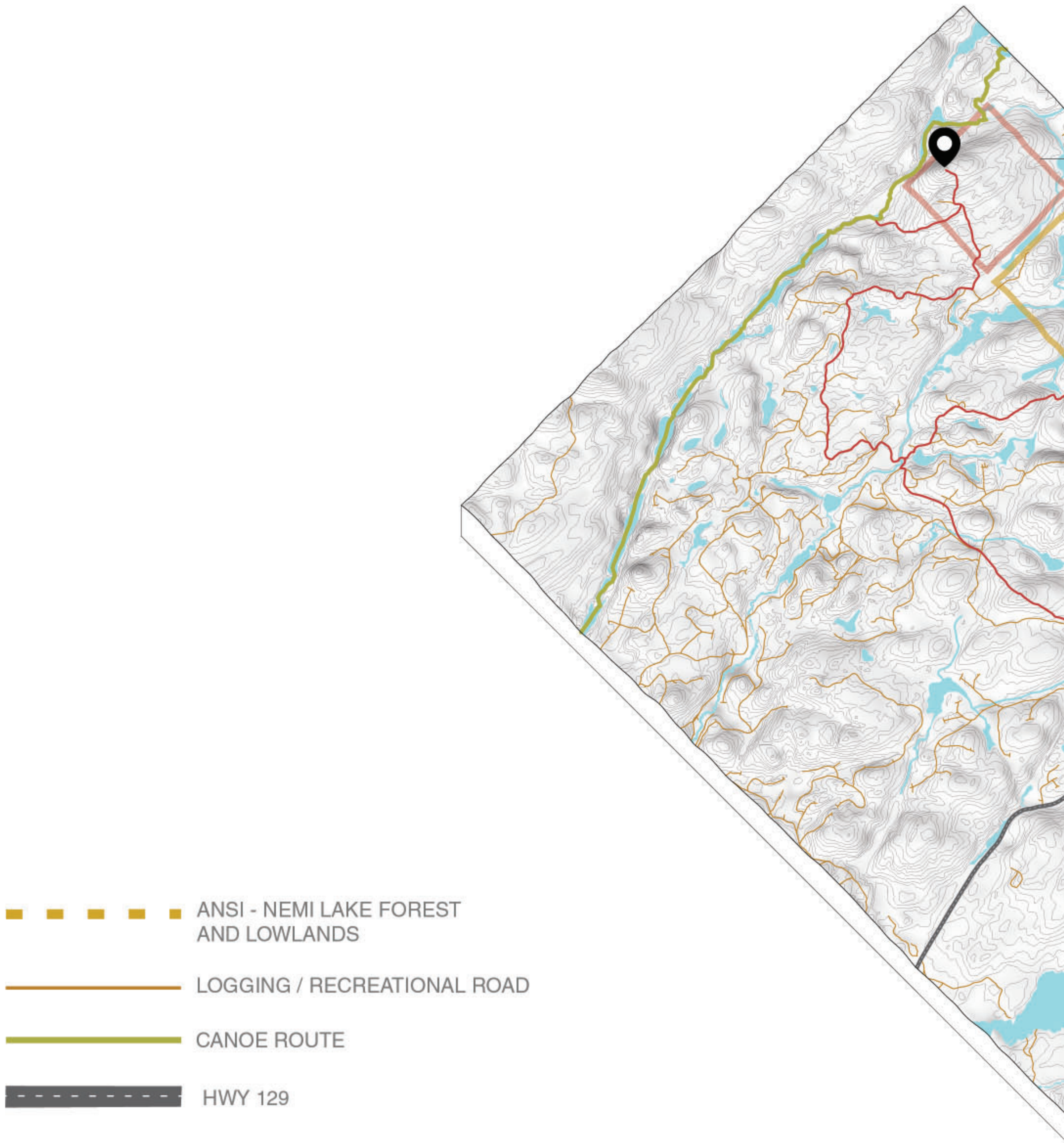


Figure 5.8 *Axonometric Site*

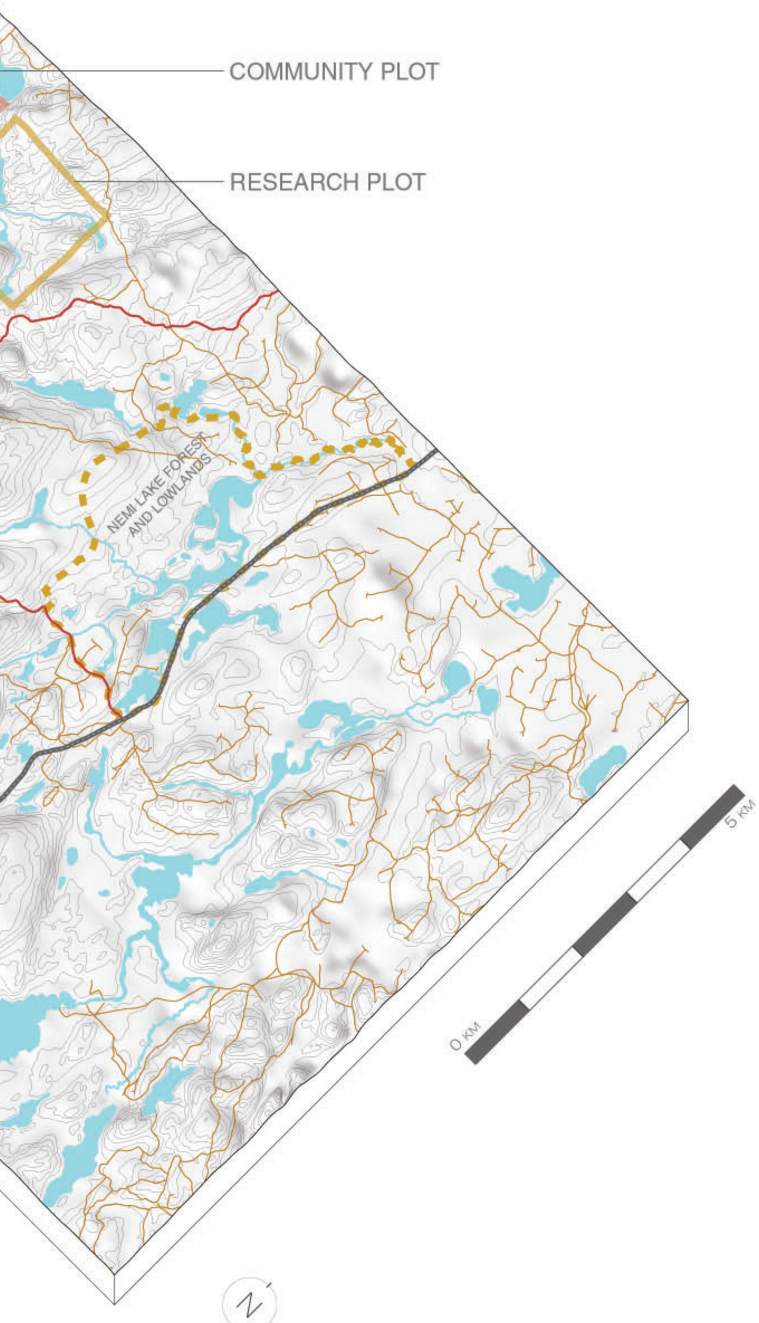

COMMUNITY PLOT
RESEARCH PLOT
NEMI LAKE FOREST
AND LOWLANDS
0 KM
5 KM
N

Figure 5.9 *Axonometric Site Context*

Figure 5.10 *Axonometric Site Highlighted*

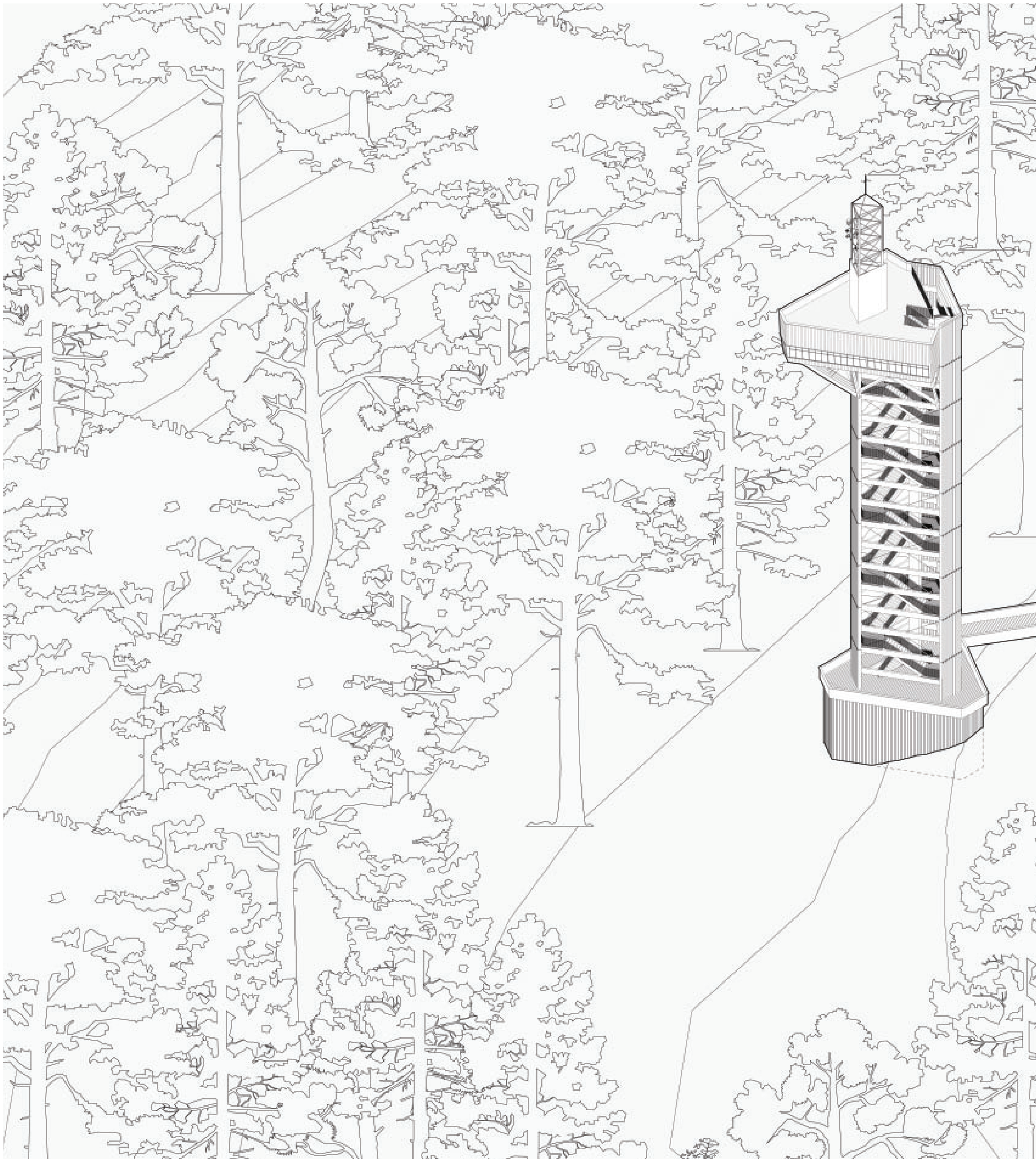
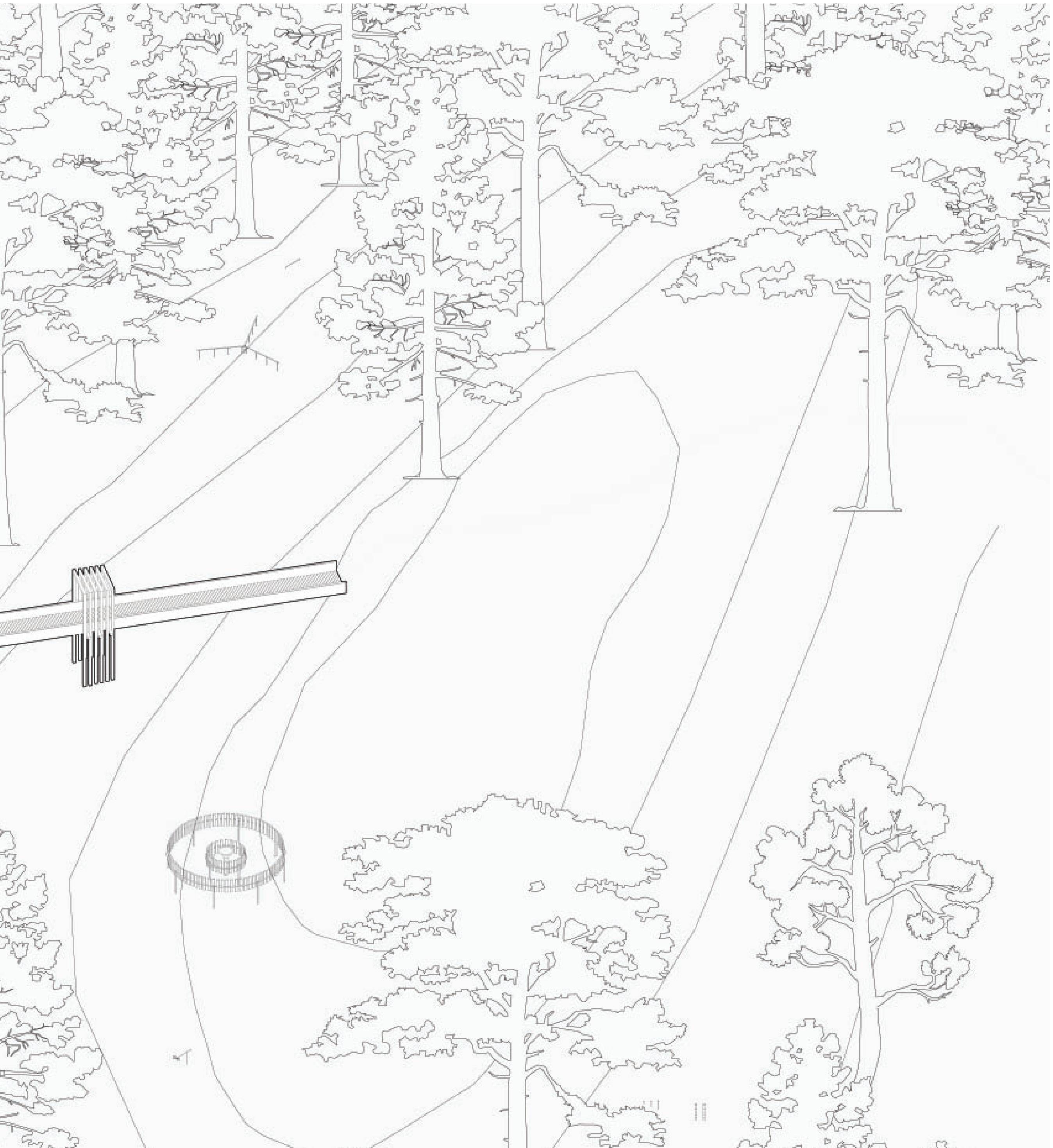


Figure 5.11 *Axonometric Site*



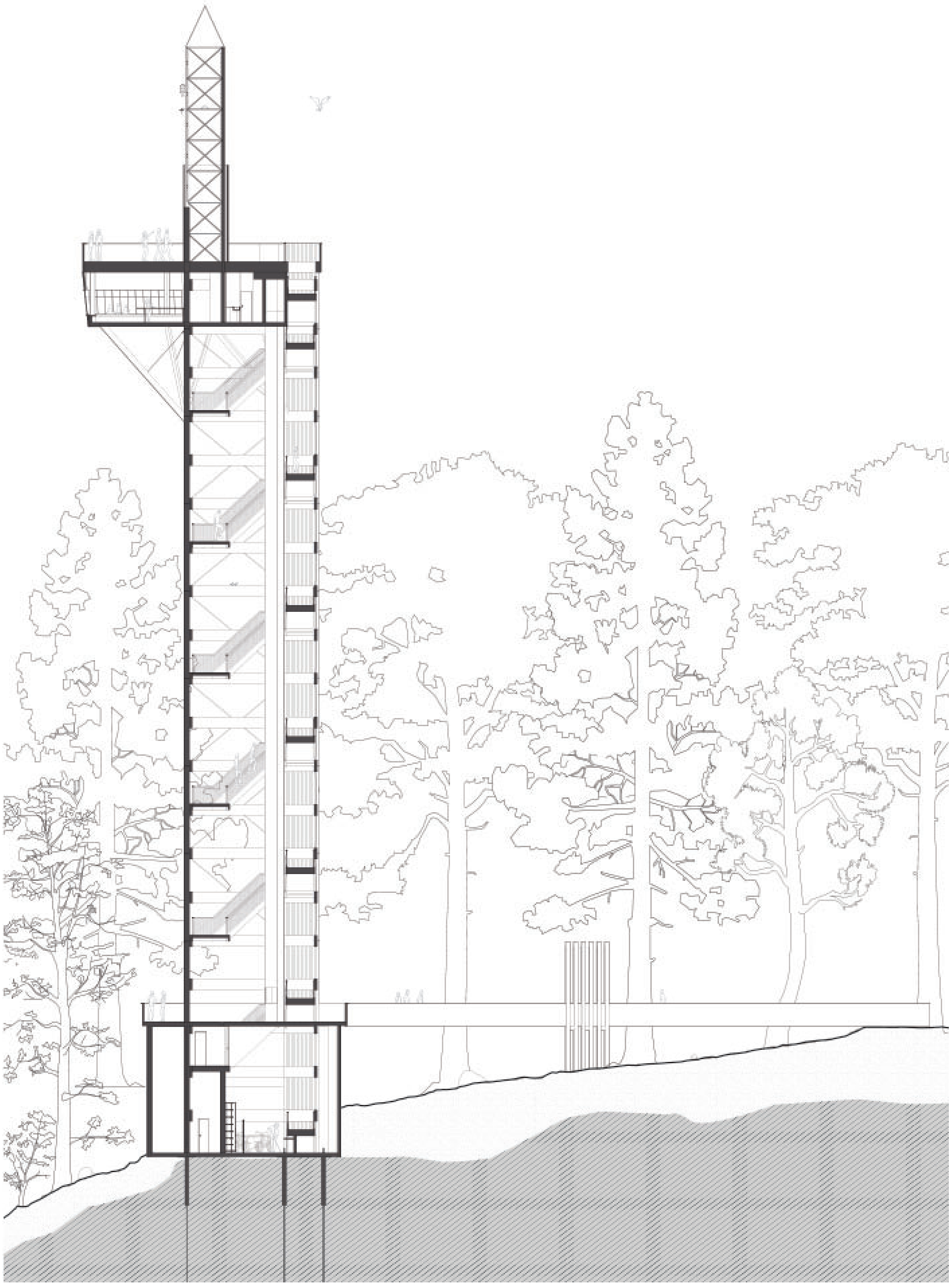


Figure 5.12 *Section A*

The lookout tower proposal is developed for a single site and is intended to represent a protype for what could be an expanded network of towers with a variety of different amenities. This design demonstrates a high level of investment and services in order to engage with the considerable recreational programming endemic to the area, representing the most substantial of an imagined set of towers. Designs of the most substantial towers could afford to be more intimately tailored to each site, providing the opportunity to engage and interpret the ecological, geological, and cultural aspects particular to each site for visitors. The imagined other towers would provide lower impact options that, stripped of most amenities could be placed in the remotest areas to gather data while still providing a landmark and destination to visit and climb for the most adventurous wilderness recreationalists. The lightest and smallest version in this set could be temporary, light enough to demount and relocate to collect new data sets periodically. Mid-way between the lightest and most substantial is a tower of reduced size and scope (See Figure 5.13 Tower B). This prototype utilizes a similar aesthetic and construction to the principle design, at a reduced scale, limiting materials and impact. The tower still serves the same scientific purposes and includes the viewing deck at the peak to entice visitors. Modest accommodations are included but are located at ground level to reduce structure.

Situated on one of the highest peaks in the area overlooking a canoe route in the passing river, the lookout tower rises 50 meters above the ground to allow for a 360° unobstructed view from the cabin, viewing deck and for the associated sensors. The lookout tower is composed of three main parts, a basement, entry level deck and at the top of the stair structure an enclosed shared accommodations area with viewing deck above.

The basement contains space and storage for field equipment and samples, and houses the mechanical and electrical services that serve the sensors and the rest of the tower including data storage, backup generator and power storage. The larger main space is accessible by both stairs from the entry level and a side door with vestibule. It contains a large open area in front of an overhead garage door for storing all terrain vehicles used by field researchers to access remote sites and carry gear and samples. This area also contains ample shelving storage for the extensive field kits required to properly sample forest ecologies as well as refrigerated storage for biological sampling and a workbench area for collective workstations.

The three corners of the triangular base house rainwater collection tanks for use throughout the tower which also serve a structural purpose, their weight concentrated at the edge of the major vertical structural members adding the stability of the tower. Visitors to the tower enter from the walkway at grade onto the first platform. The platform has generous space to accommodate groups of students who visit for educational purposes. Stairs accessing the upper and lower portions of the tower and a small elevator for transporting heavy gear to the accommodations level at the top.

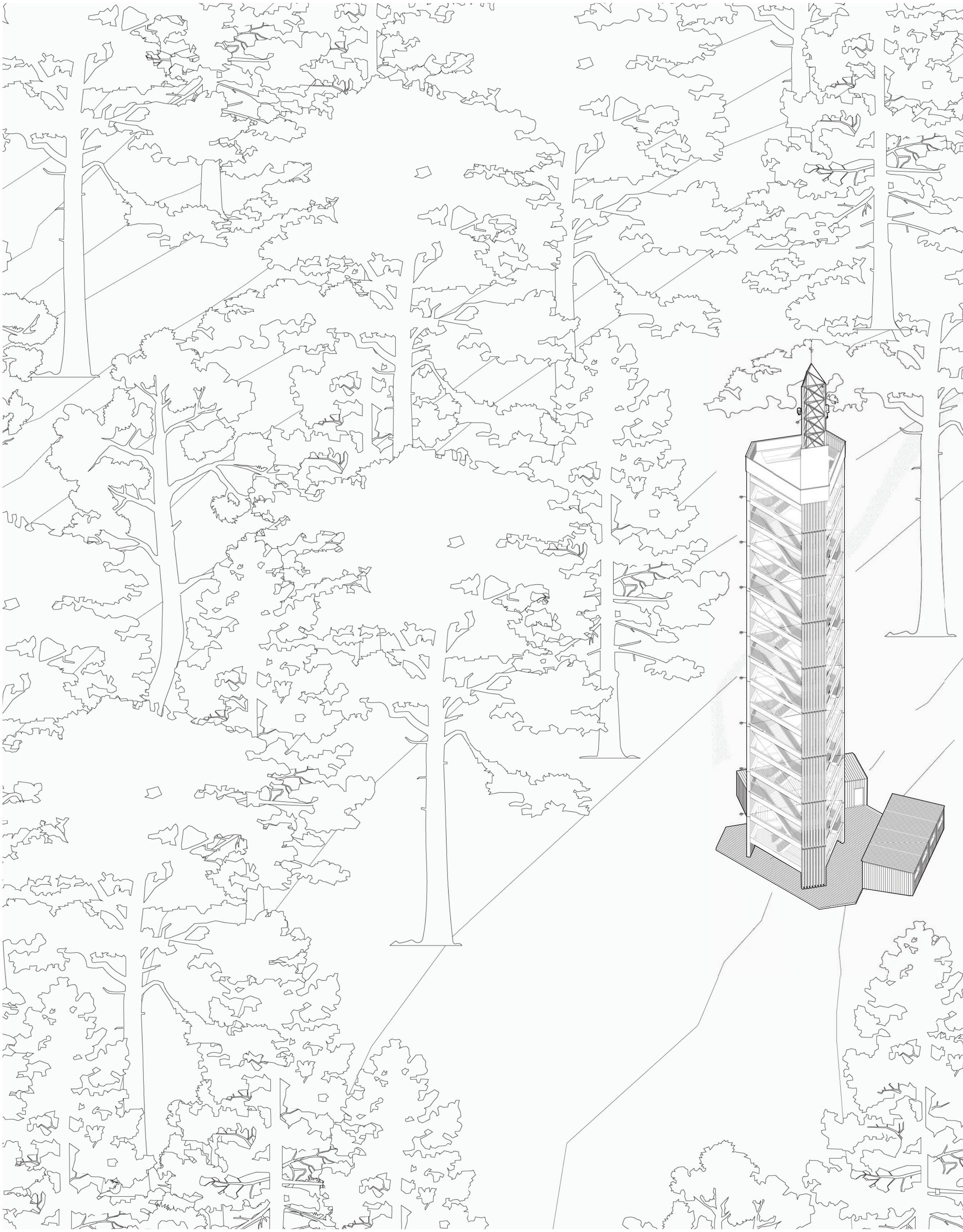


Figure 5.13 *Tower B*

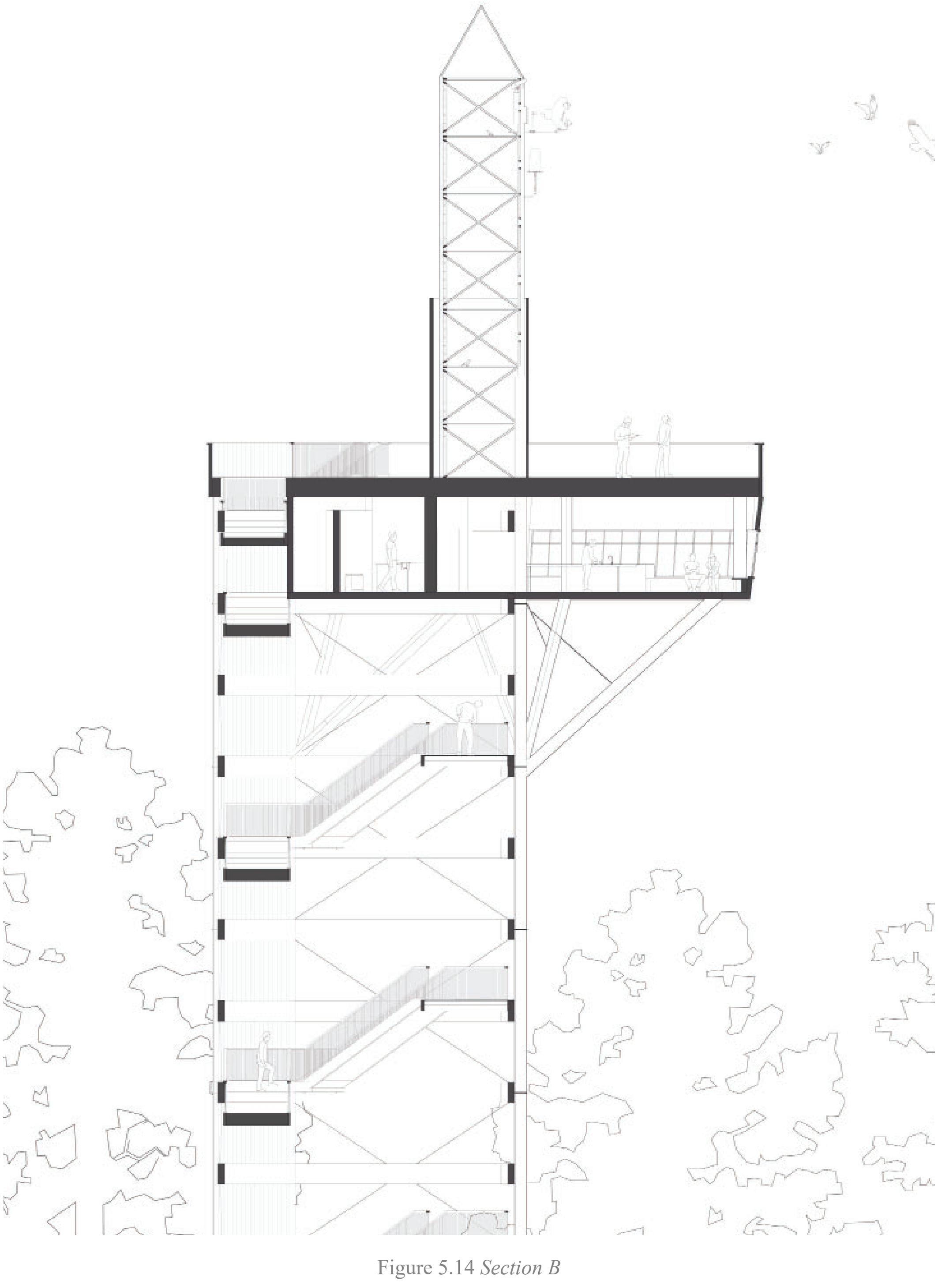


Figure 5.14 *Section B*

Each run of stairs spans a single side contributing to the lateral stability of the structure. The stairs are two meters wide with generous landings to accommodate the ability to pass other visitors traversing up or down.

The upper level contains separated accommodations which are accessible for both the general public and visiting researchers. Each room consists of an entranceway with storage and hangers for clothes and gear, a bunk bed, and a wide bench at the base of a large window with operable sections for daylight and ventilation. The rooms open to a hallway which surrounds a central area which contains the top of the gear elevator, electrical services run, and a single bathroom.

Prominent at the front of the accommodations is the communal dining also surrounded at the perimeter with glazing with benches and counters at the base. At the center of the room is a single dining table encouraging occupants to share a table and experiences and knowledge of the surrounding area. The roof viewing deck above is accessible for complete 360 degree views of the landscape with the spire in the center containing the aerial remote sensors. The lookout is outfitted with a wide range of remote sensors designed to record at a high frequency, accurate data about the multitude of currently measurable ecological factors.

Most of the tower's structure is open except for the very top and base to both provide a more open experience of the environment and to lessen the disturbances it creates that would affect the sensors measuring atmospheric factors

The structure is primarily glu-laminated wood construction, the triangular form. Base is primarily composed of rock anchors and steel plates for the base of the vertical members, the rainwater storage also rest on this and contribute their weight to counter and stabilize the height of the tower. The vertical members are groupings of glulam posts, visually the posts emphasize the verticality of the tower , drawing the eye up. Steel cables form cross bracing between the ring beams to account for lateral loads. The staircase also contributes to the lateral loads forming diagonal bracing on consecutive sides. The structure is sized such that the structural members could be transported on a typical logging truck, the same method by which the very same trees from this area would be carted out returns them for new purpose.

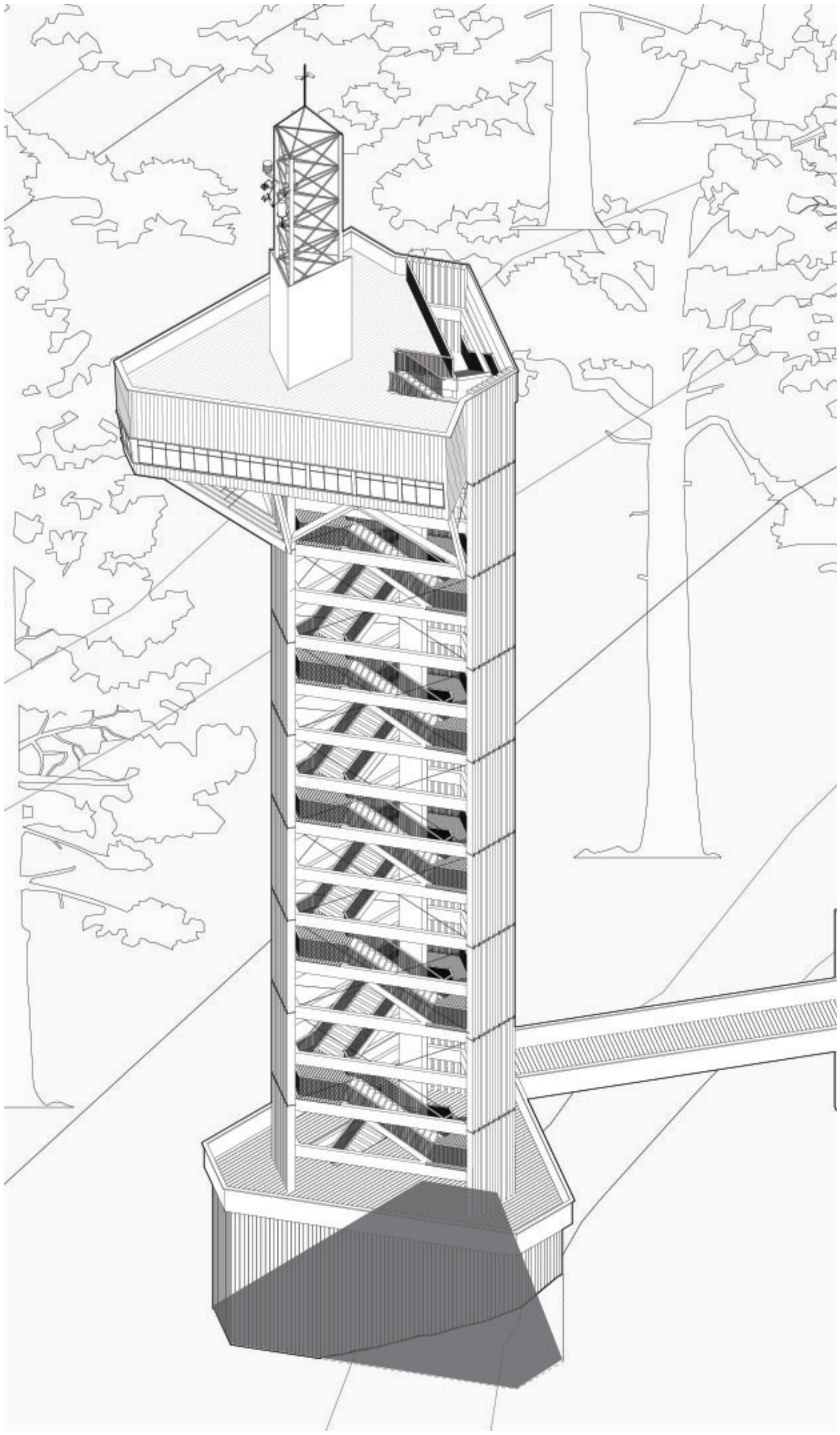


Figure 5.15 *Axonometric Reference: Basement*

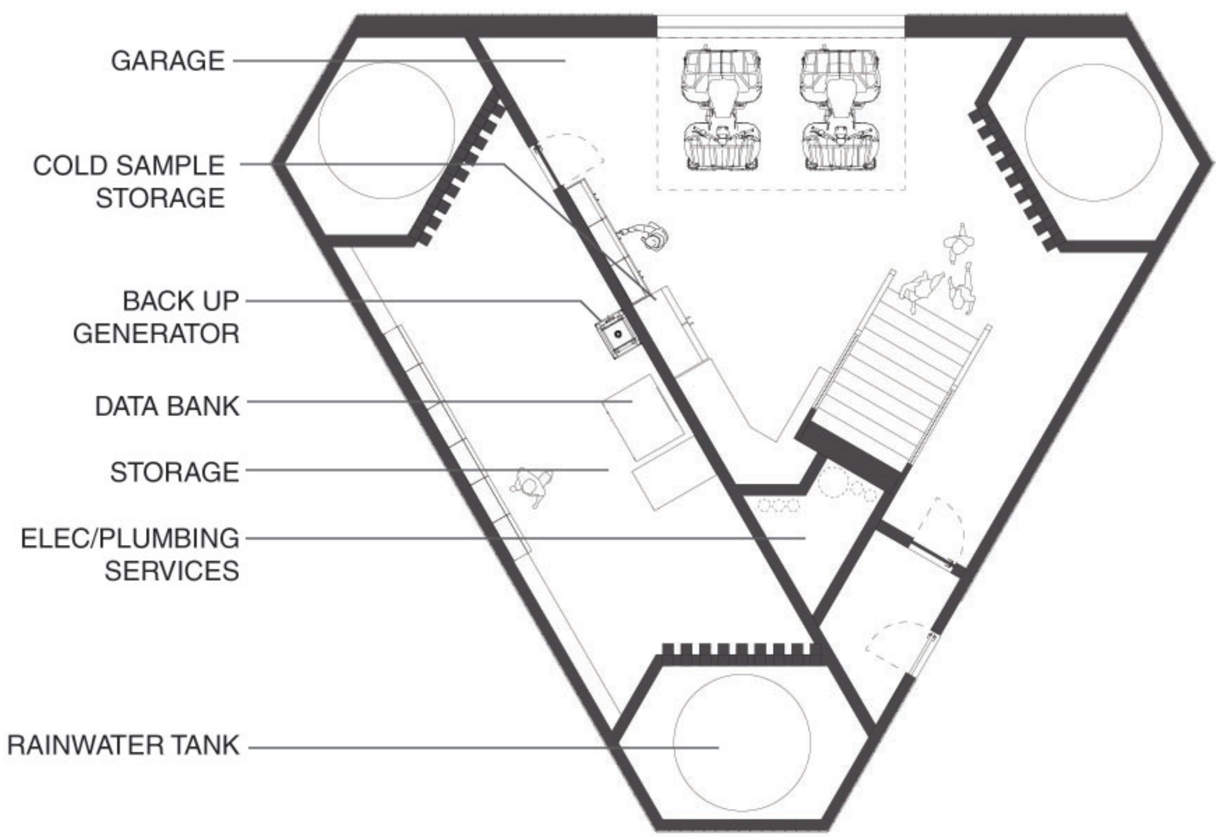


Figure 5.16 *Field Research Basement Plan*

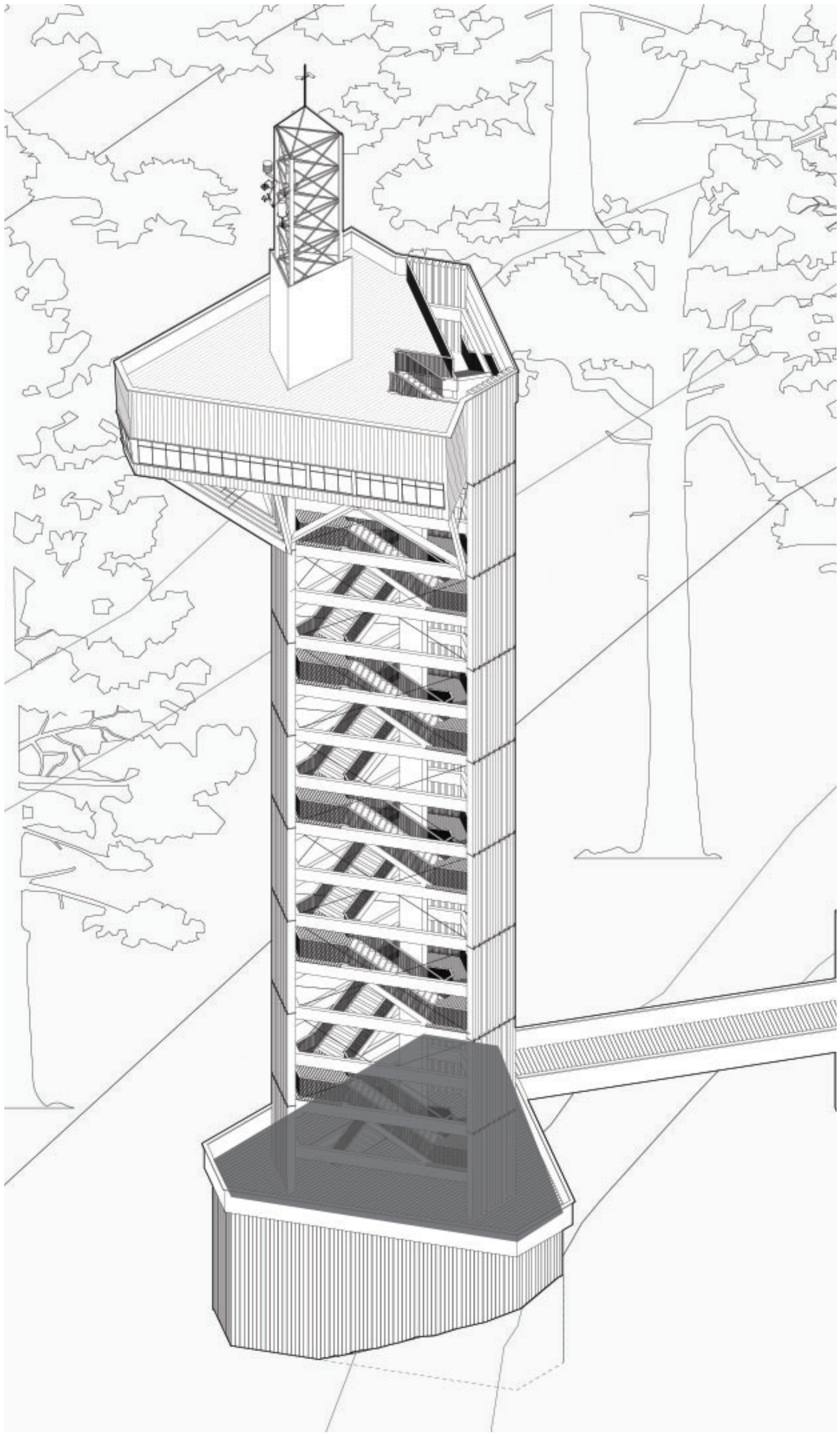


Figure 5.17 *Axonometric Reference: Entry Deck*

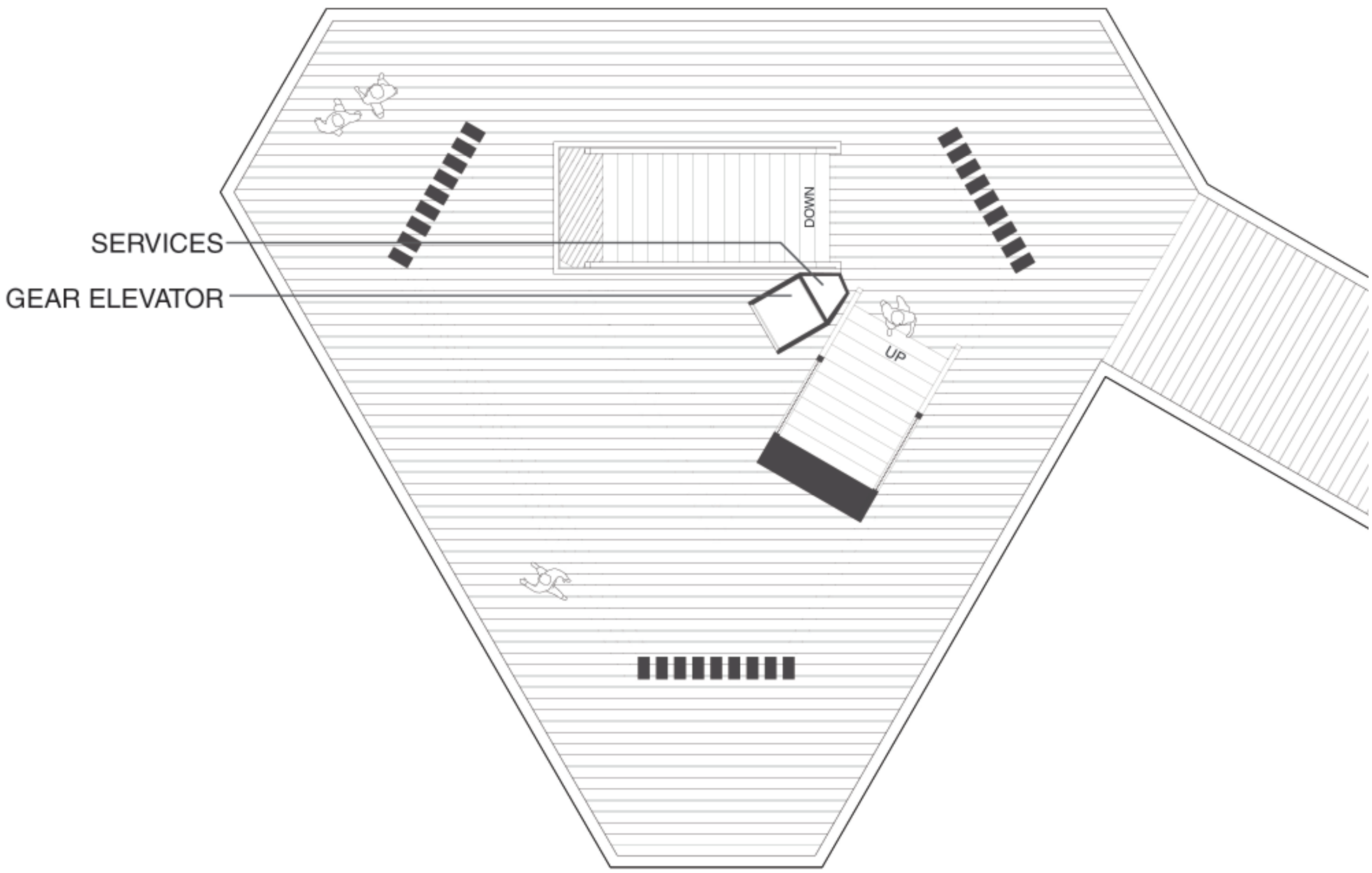


Figure 5.18 *Entry Deck Plan*

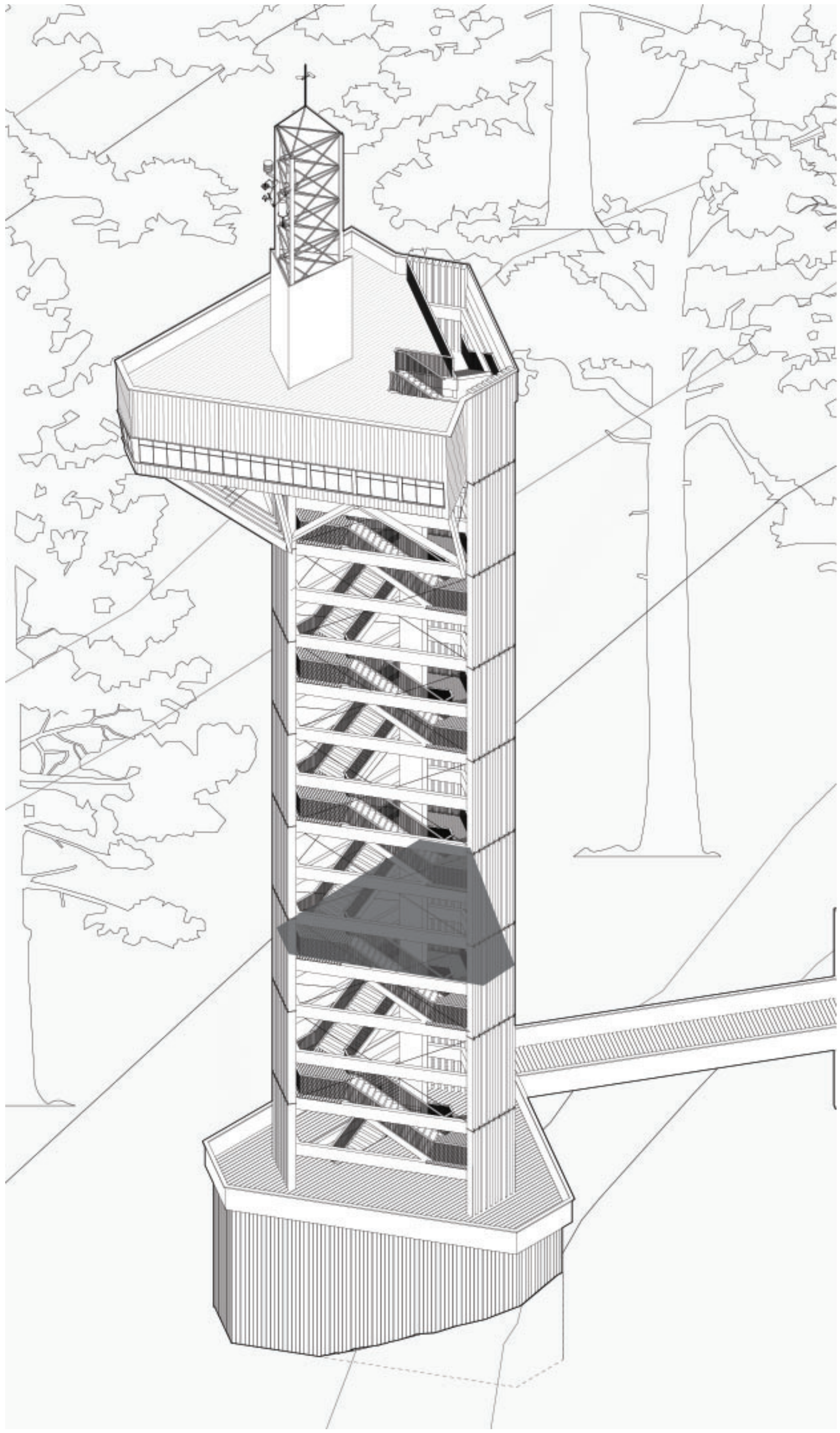


Figure 5.19 *Axonometric Reference: Stairway*

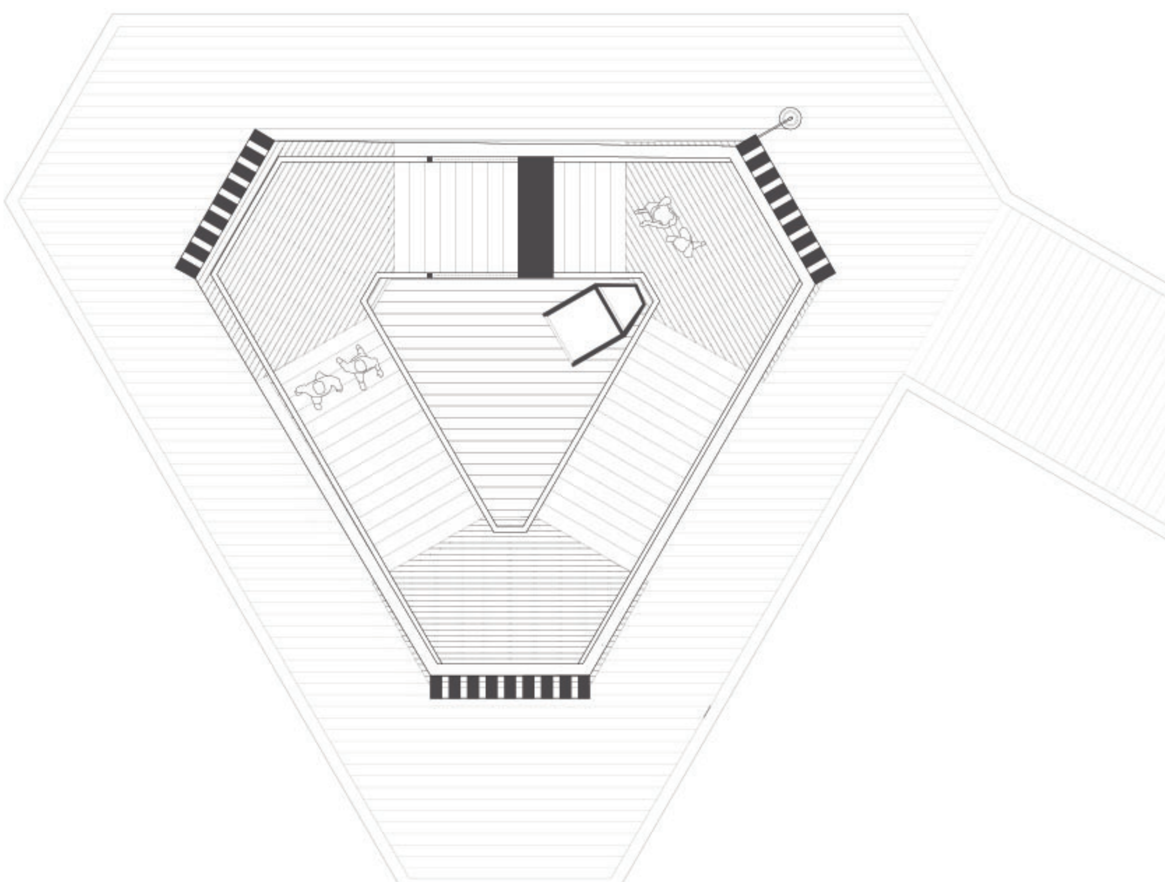


Figure 5.20 *Stairway Plan*

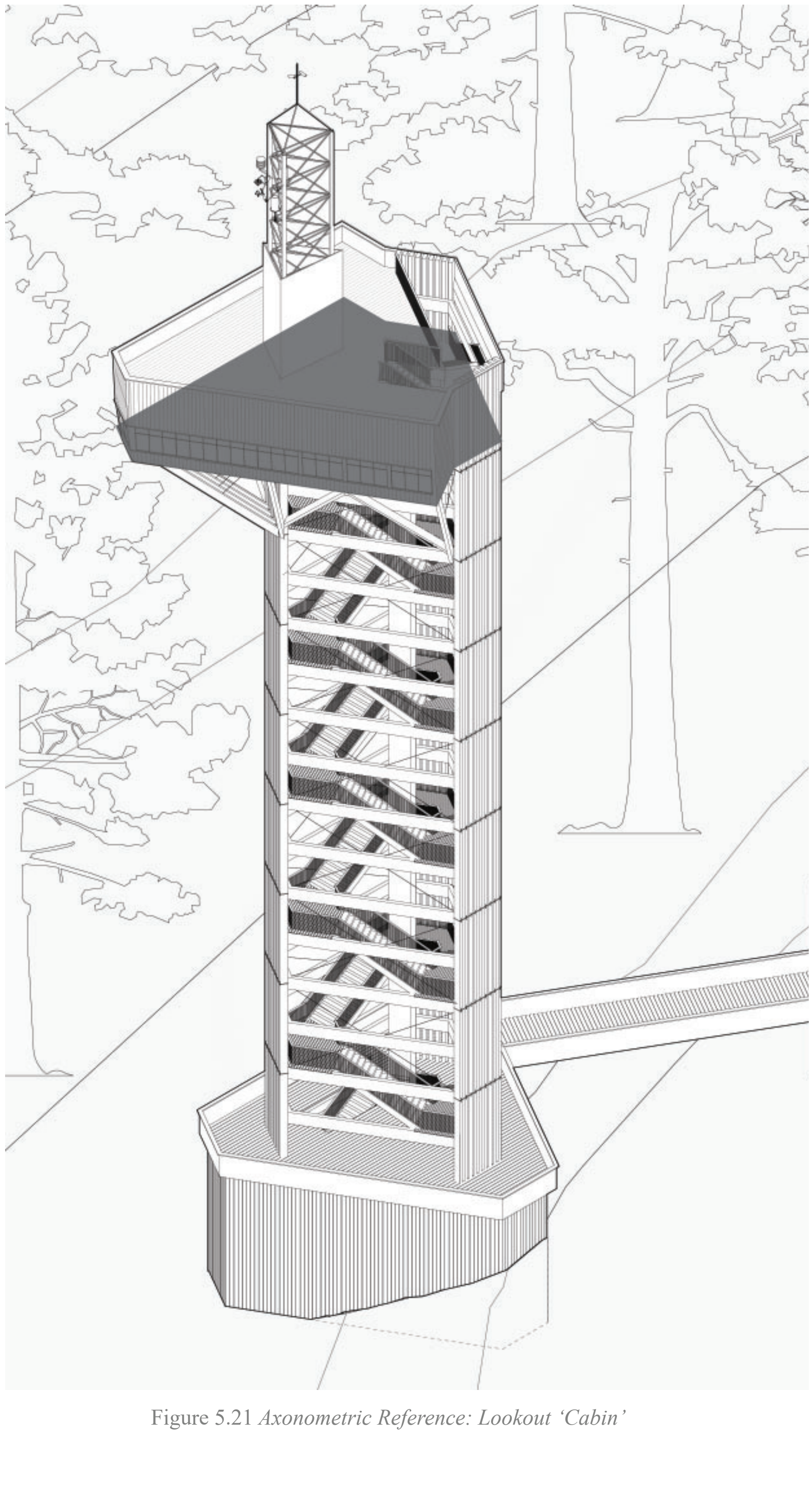


Figure 5.21 *Axonometric Reference: Lookout 'Cabin'*

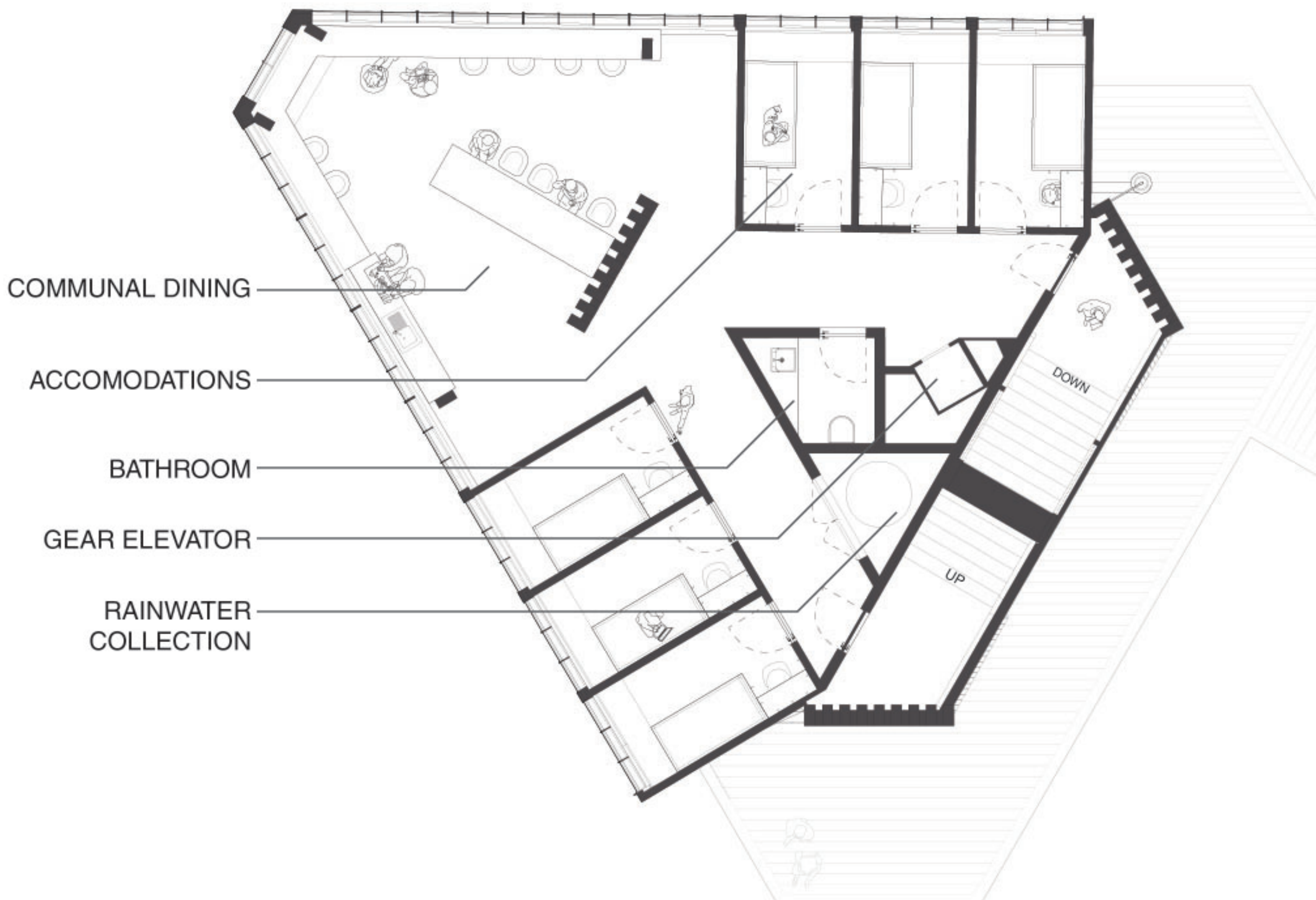


Figure 5.22 *Lookout 'Cabin' Plan*

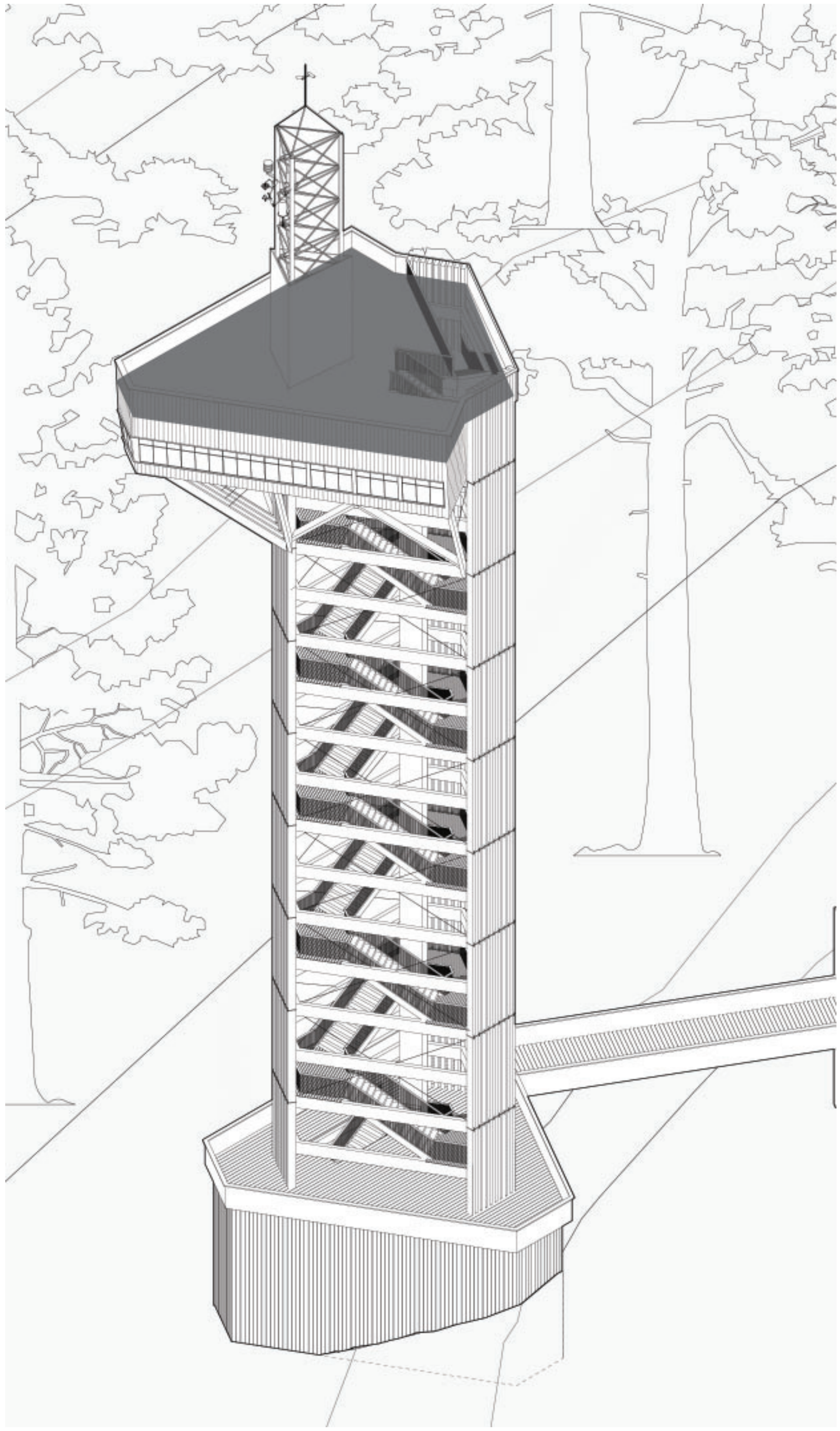


Figure 5.23 *Axonometric Reference: Viewing Deck*

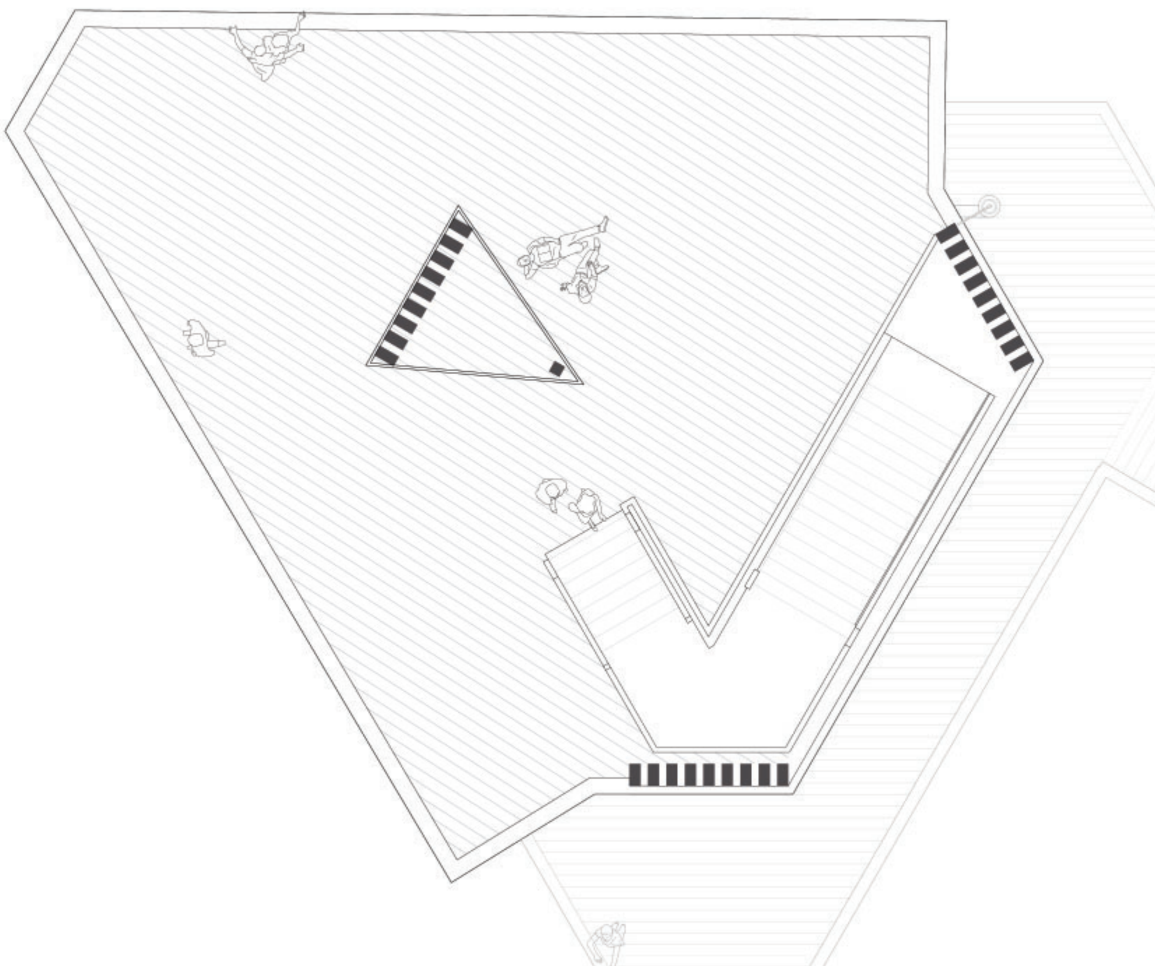


Figure 5.24 *Viewing Deck Plan*

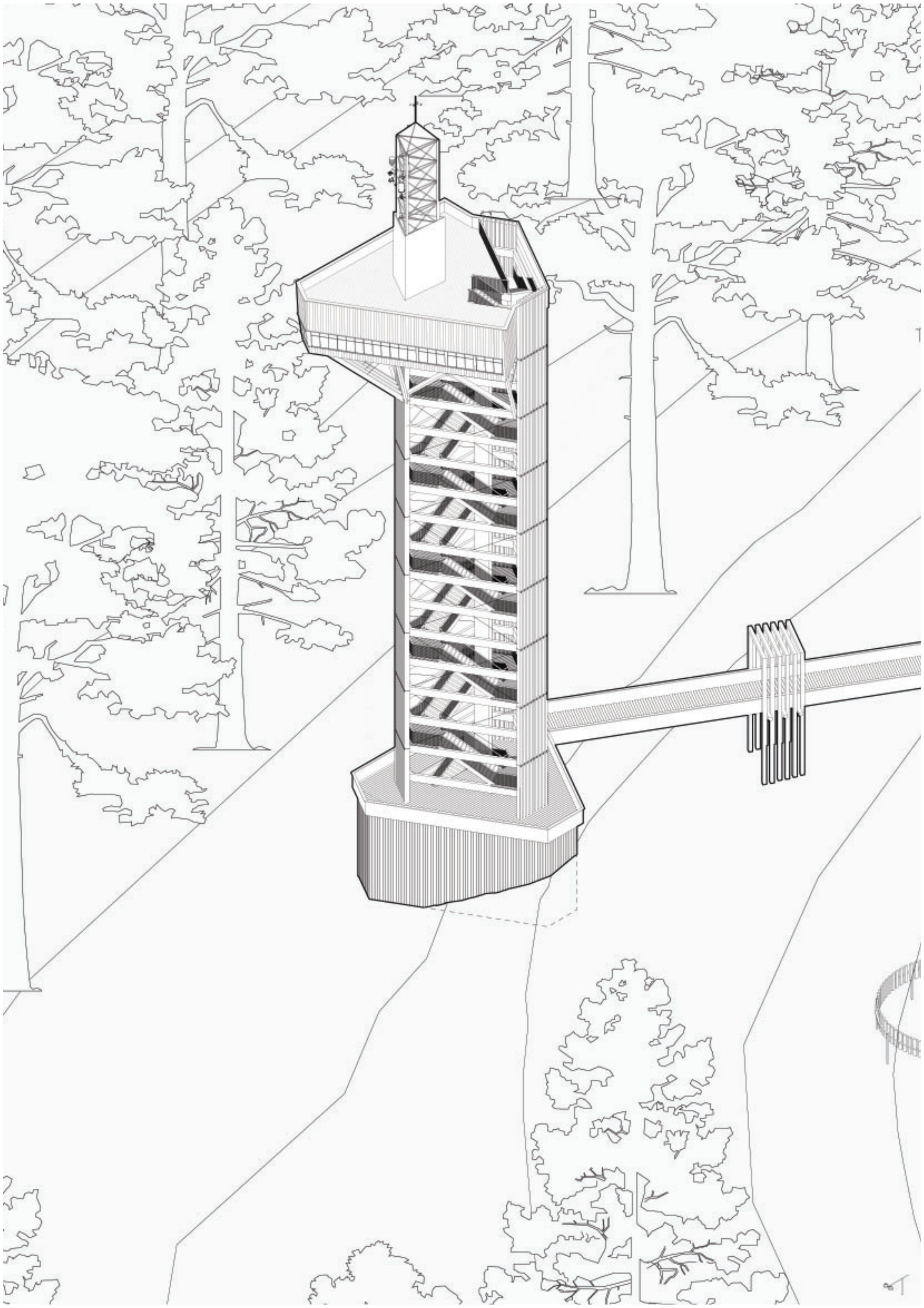


Figure 5.25 *1:500 Axonometric*

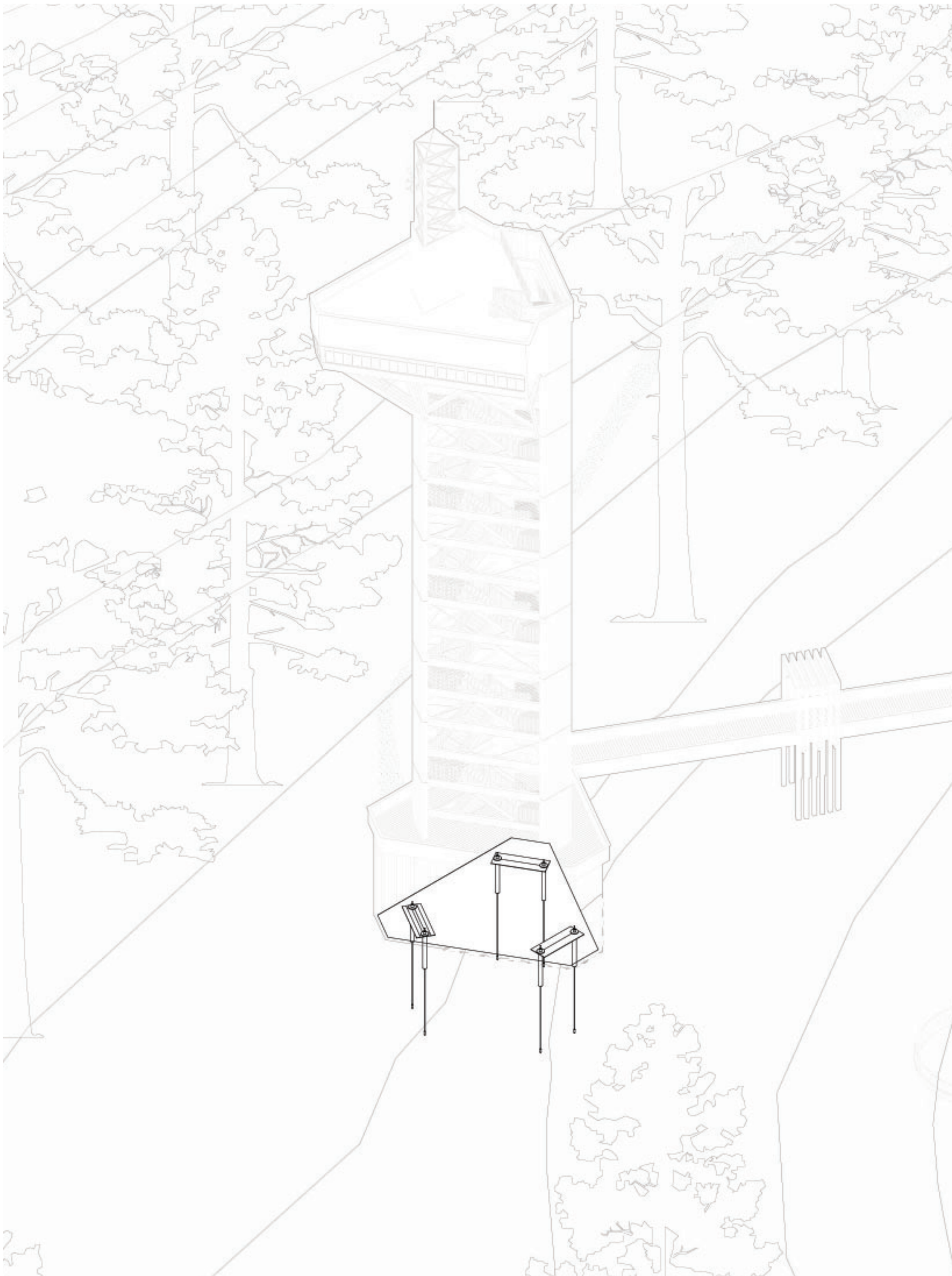


Figure 5.26 *Structural Diagram: Rock Anchoring*

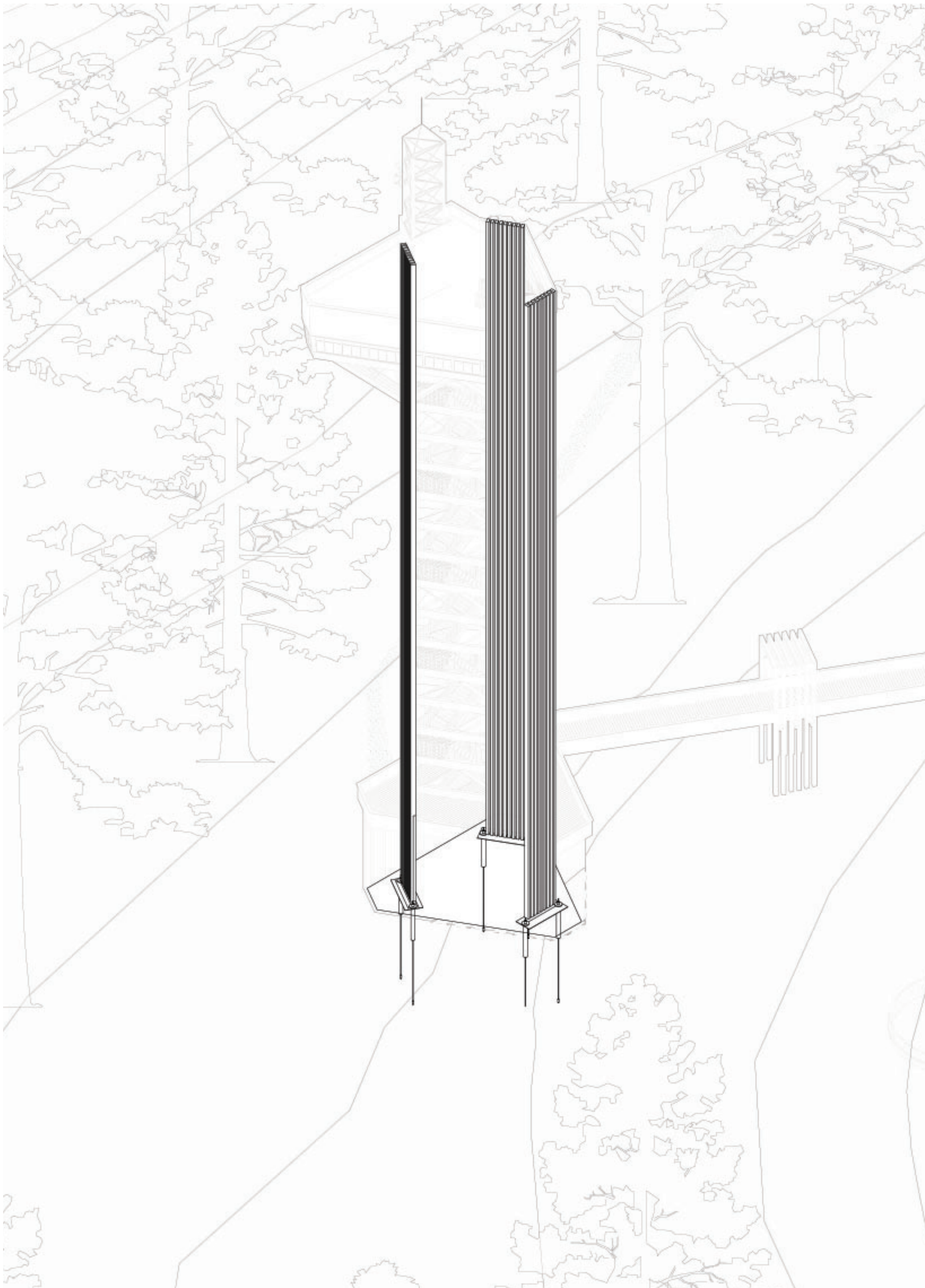


Figure 5.27 *Structural Diagram: Glu-lam Posts*

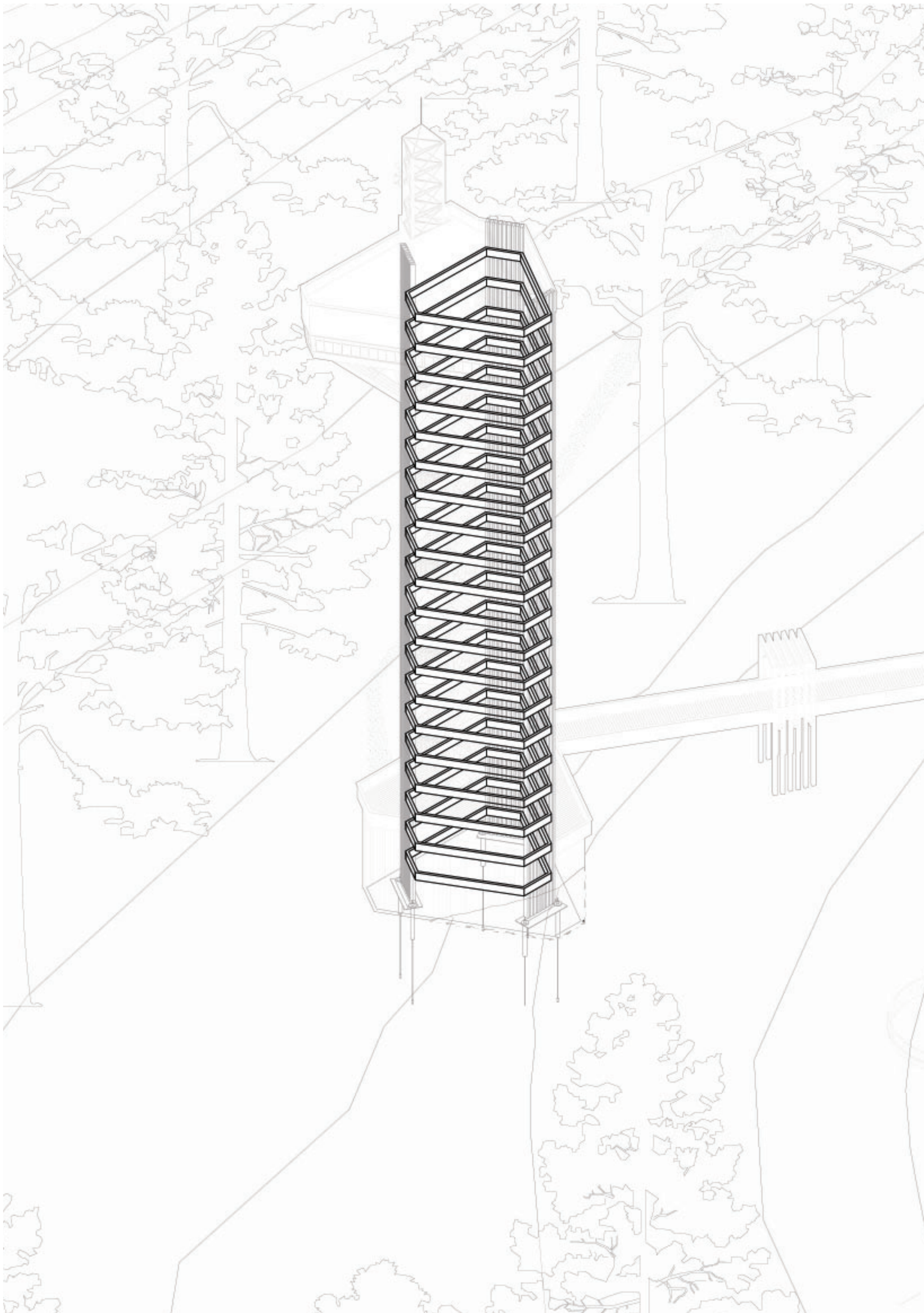


Figure 5.28 *Structural Diagram: Glu-lam Ring Beams*

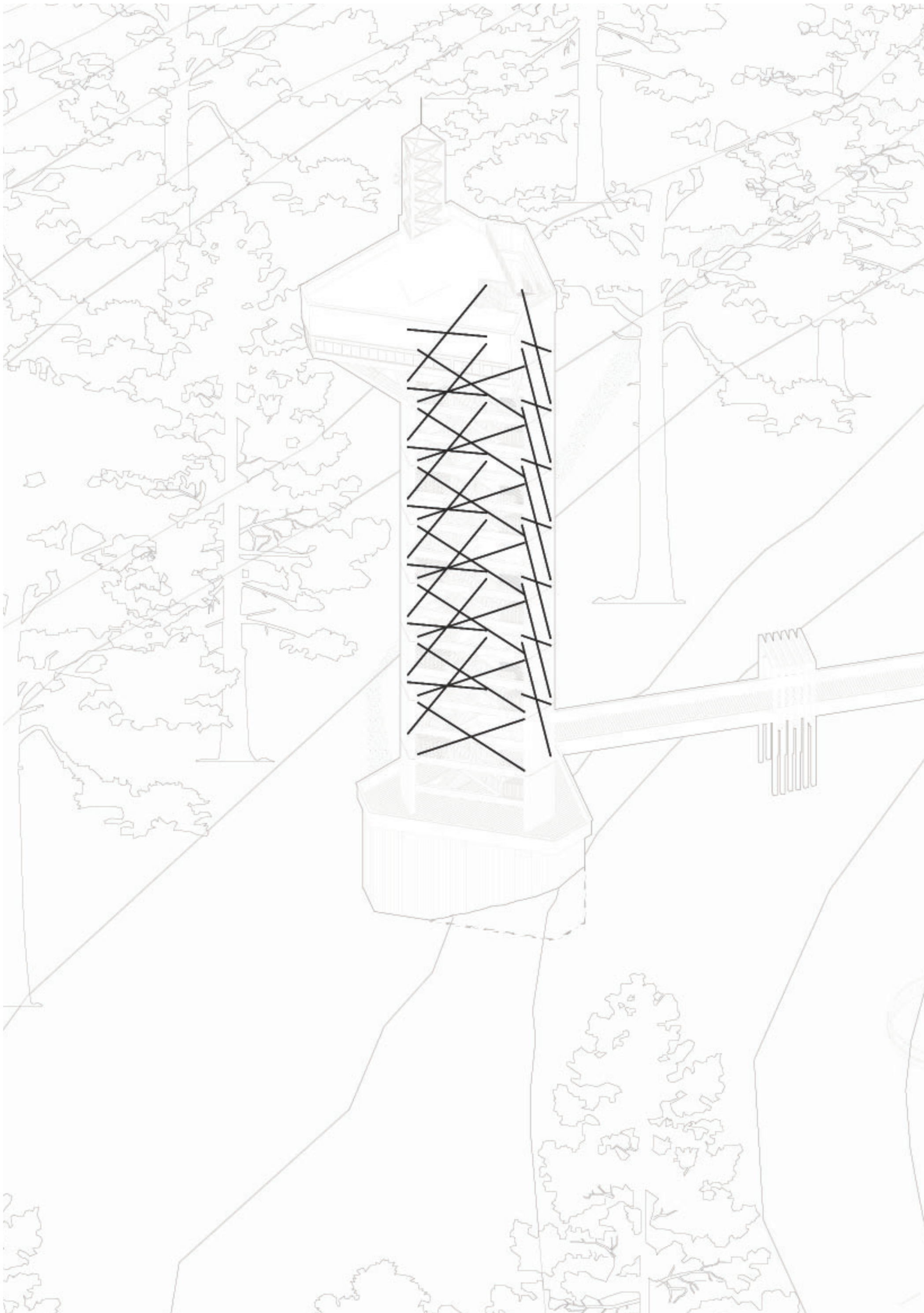


Figure 5.29 *Structural Diagram: Steel Cable Cross Bracing*

Figure 5.30 *Structural Diagram: Stairway*

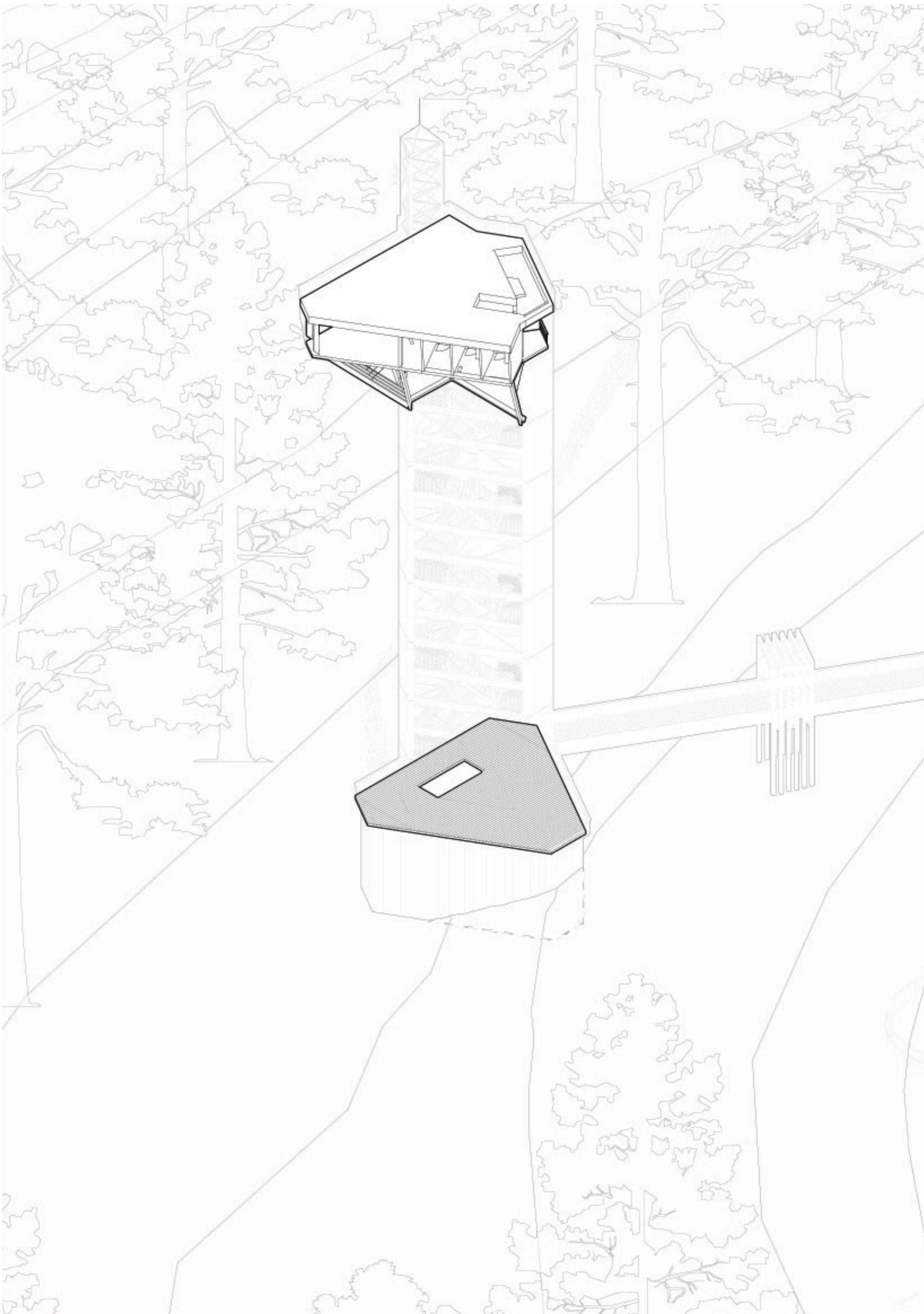


Figure 5.31 *Structural Diagram: Platform Decks*

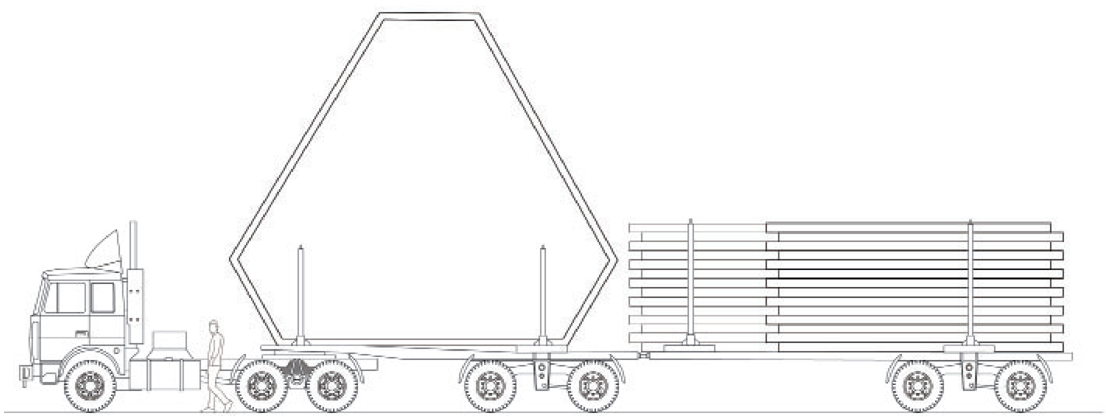


Figure 5.32 *Structural Diagram: Logging Truck Carrying Structural Members*

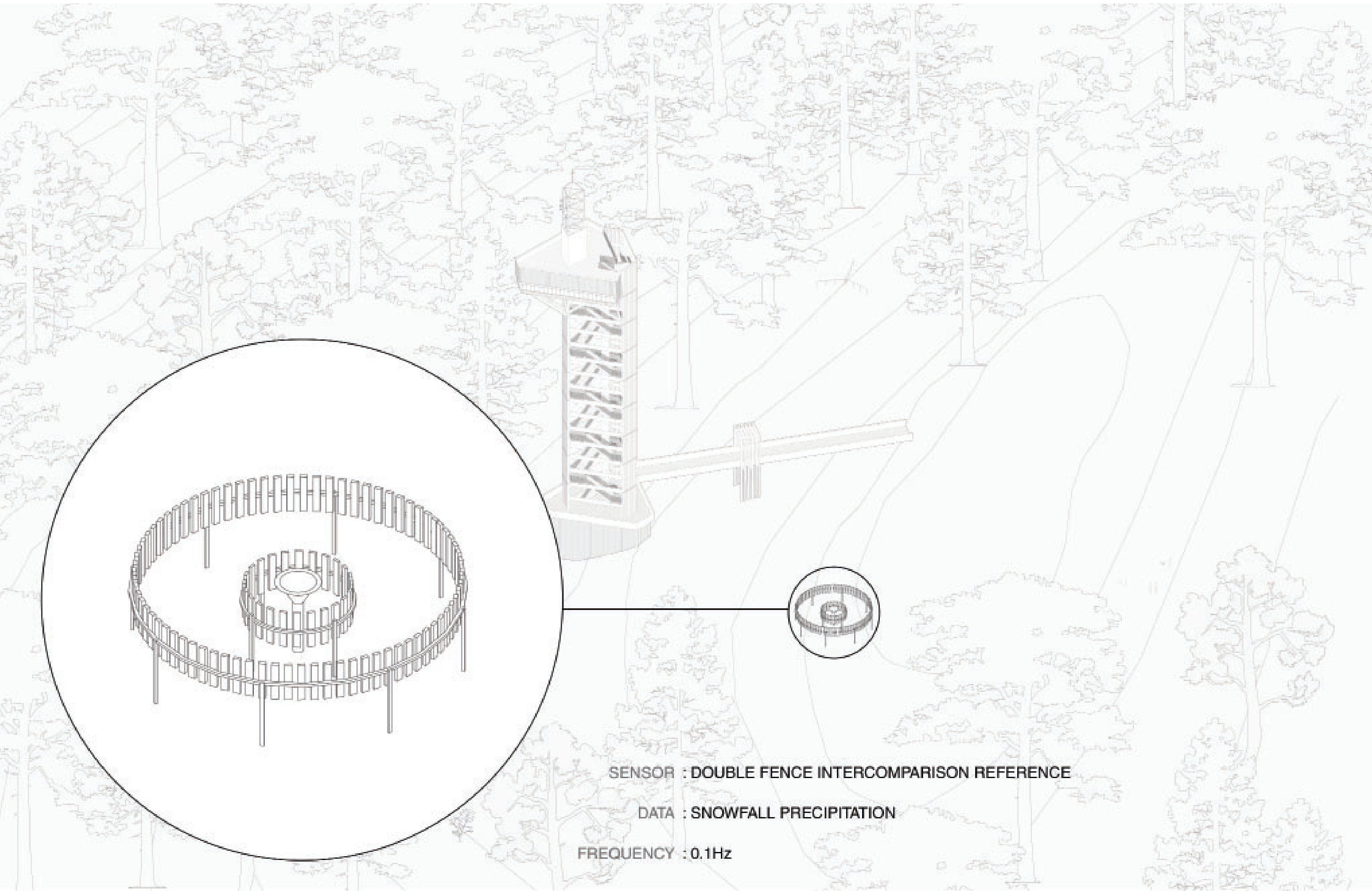


Figure 5.33 *Remote Sensors: Double Fence Intercomparison Reference*

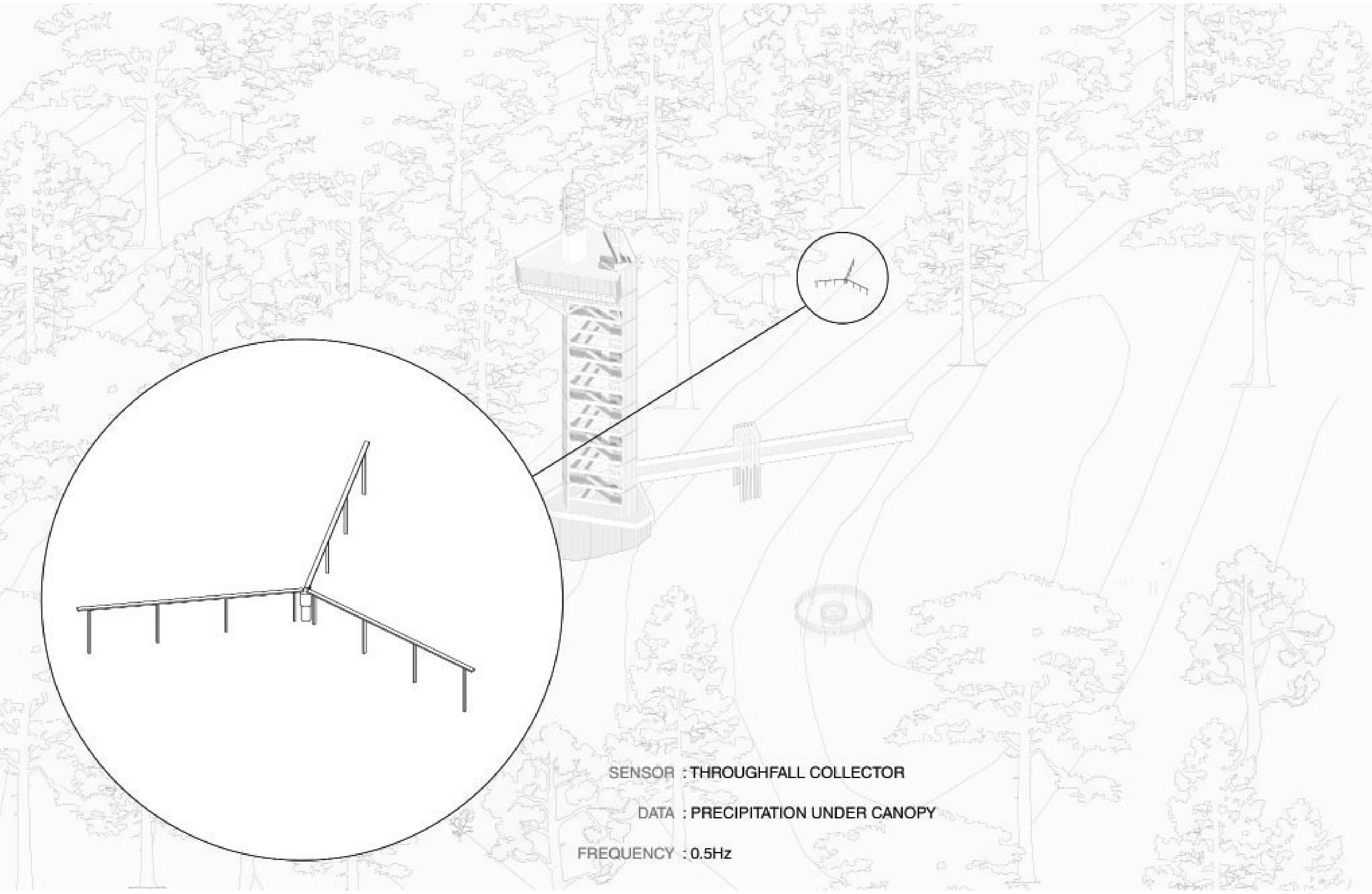


Figure 5.34 *Remote Sensors: Throughfall Collector*

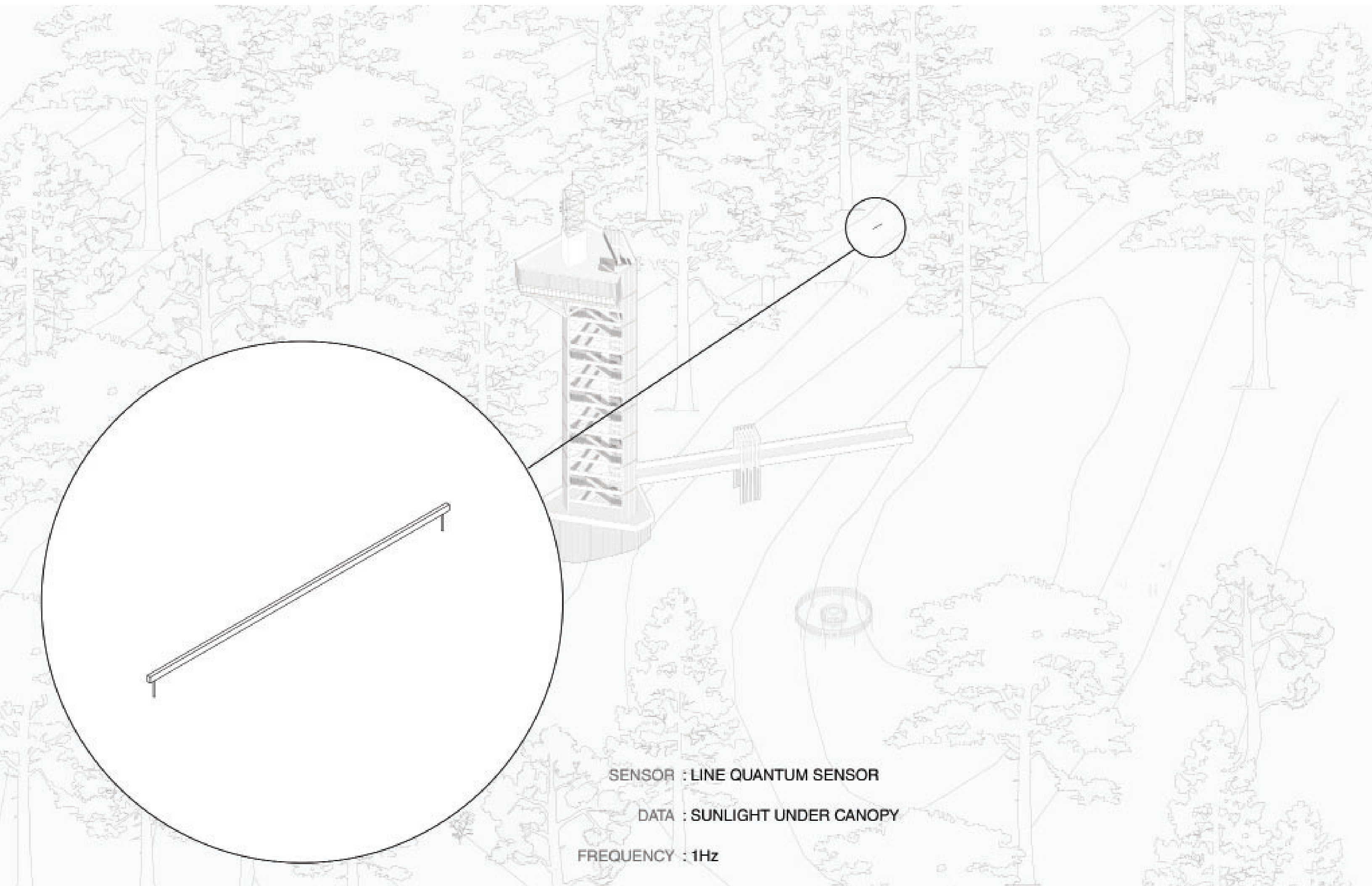


Figure 5.35 *Remote Sensors: Line Quantum Sensor*

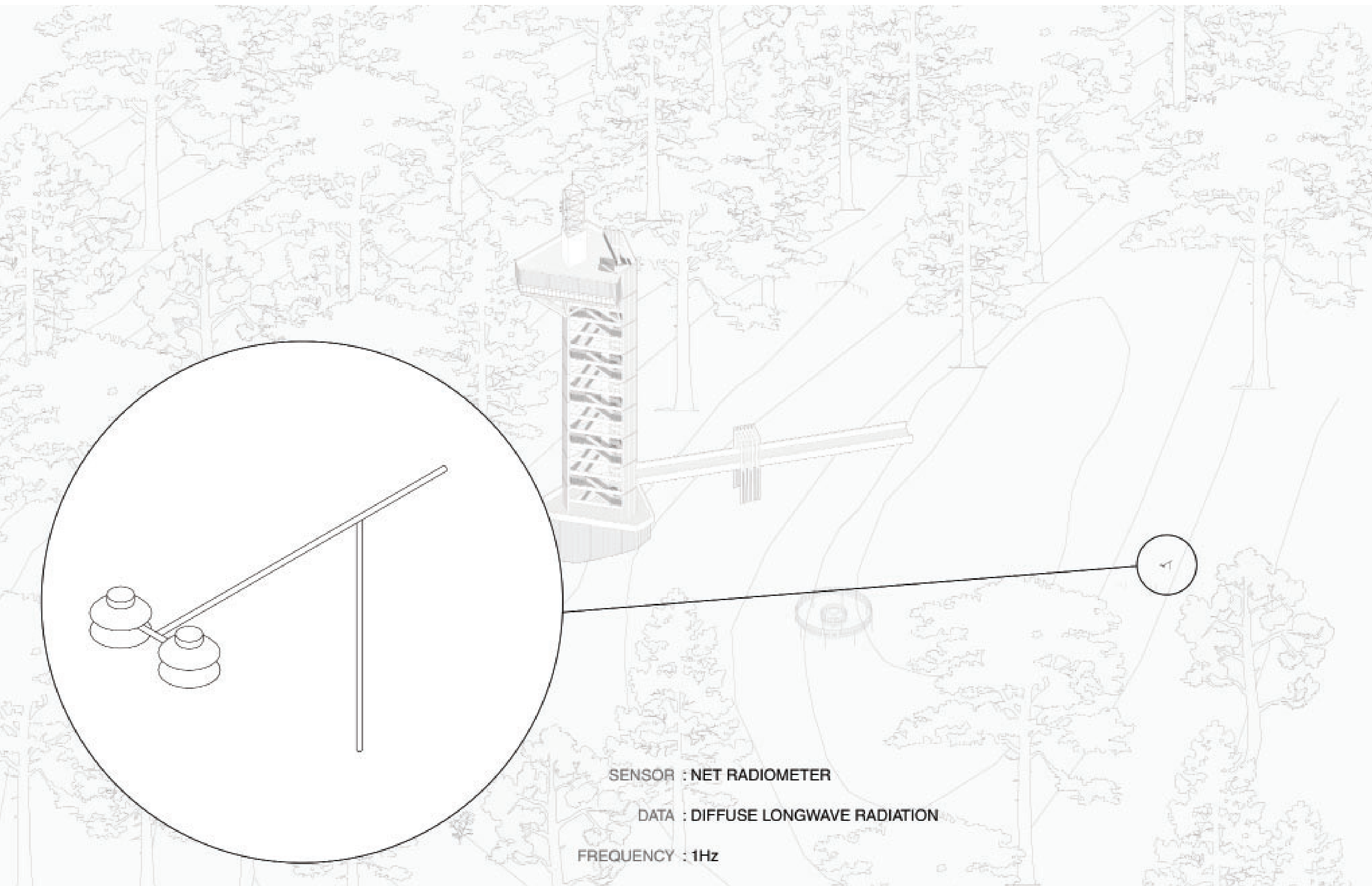


Figure 5.36 *Remote Sensors: Net Radiometer*

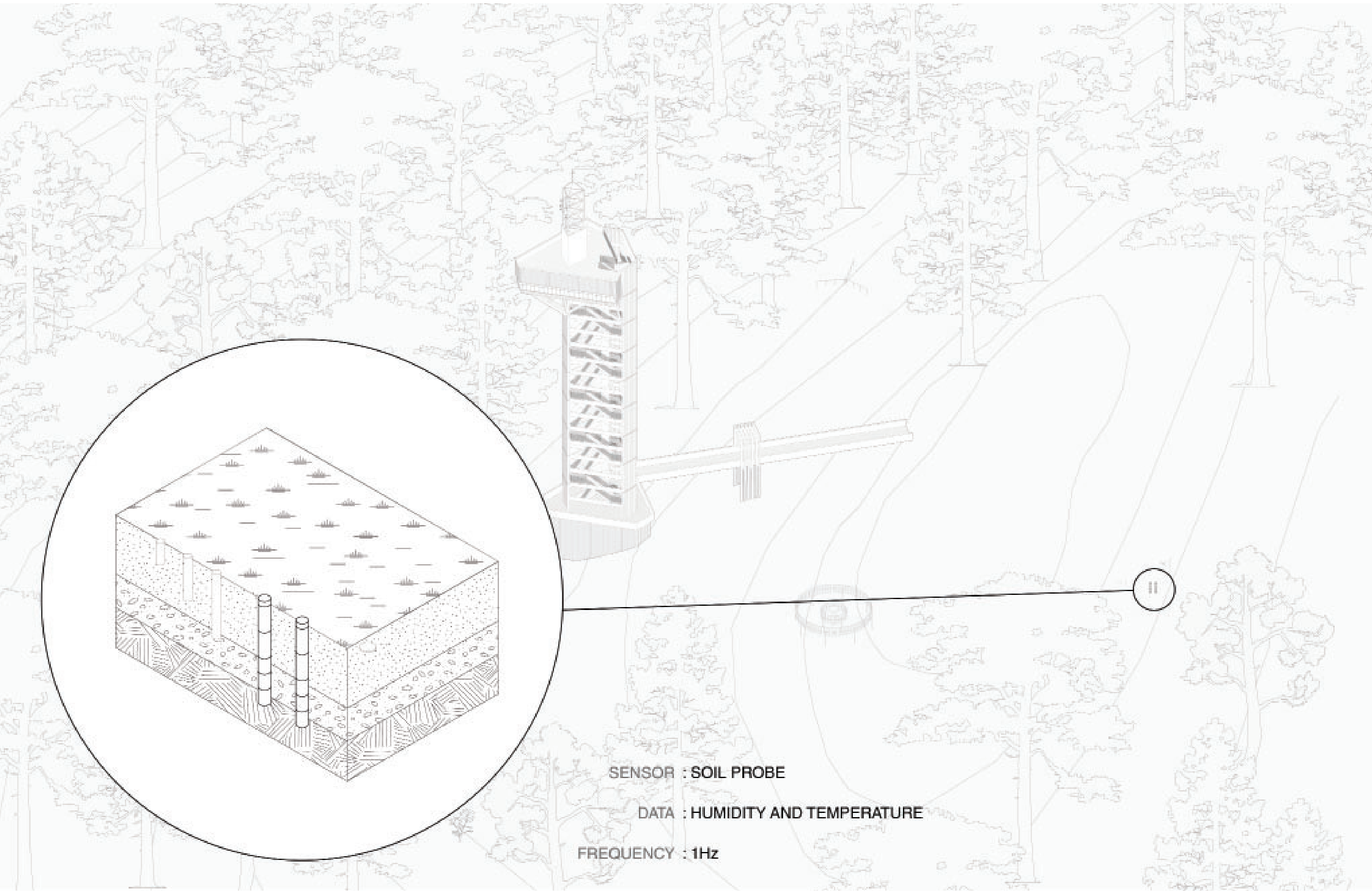


Figure 5.37 *Remote Sensors: Soil Probe*

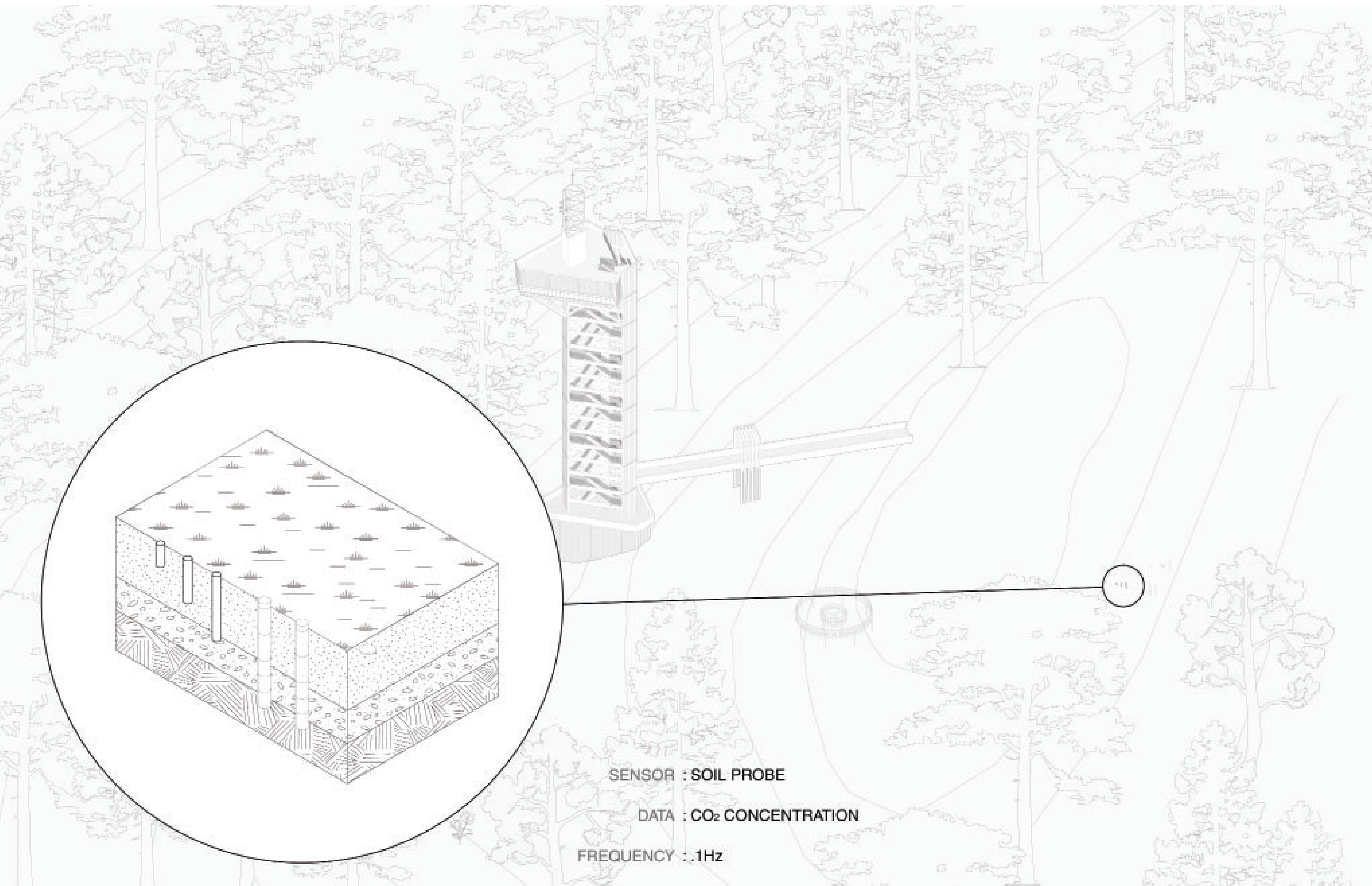


Figure 5.38 *Remote Sensors: Soil Probe*

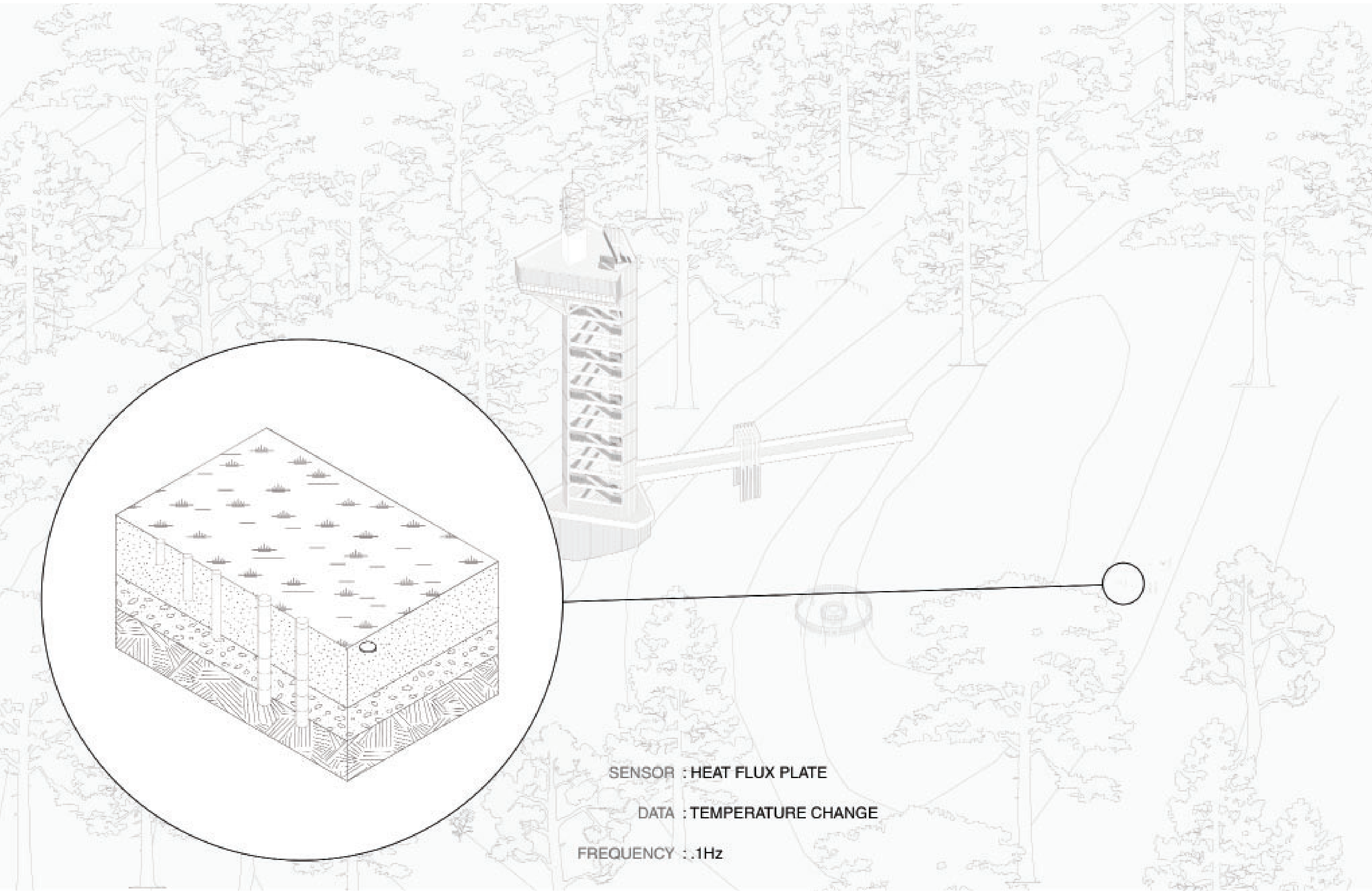


Figure 5.39 *Remote Sensors: Heat Flux Plate*

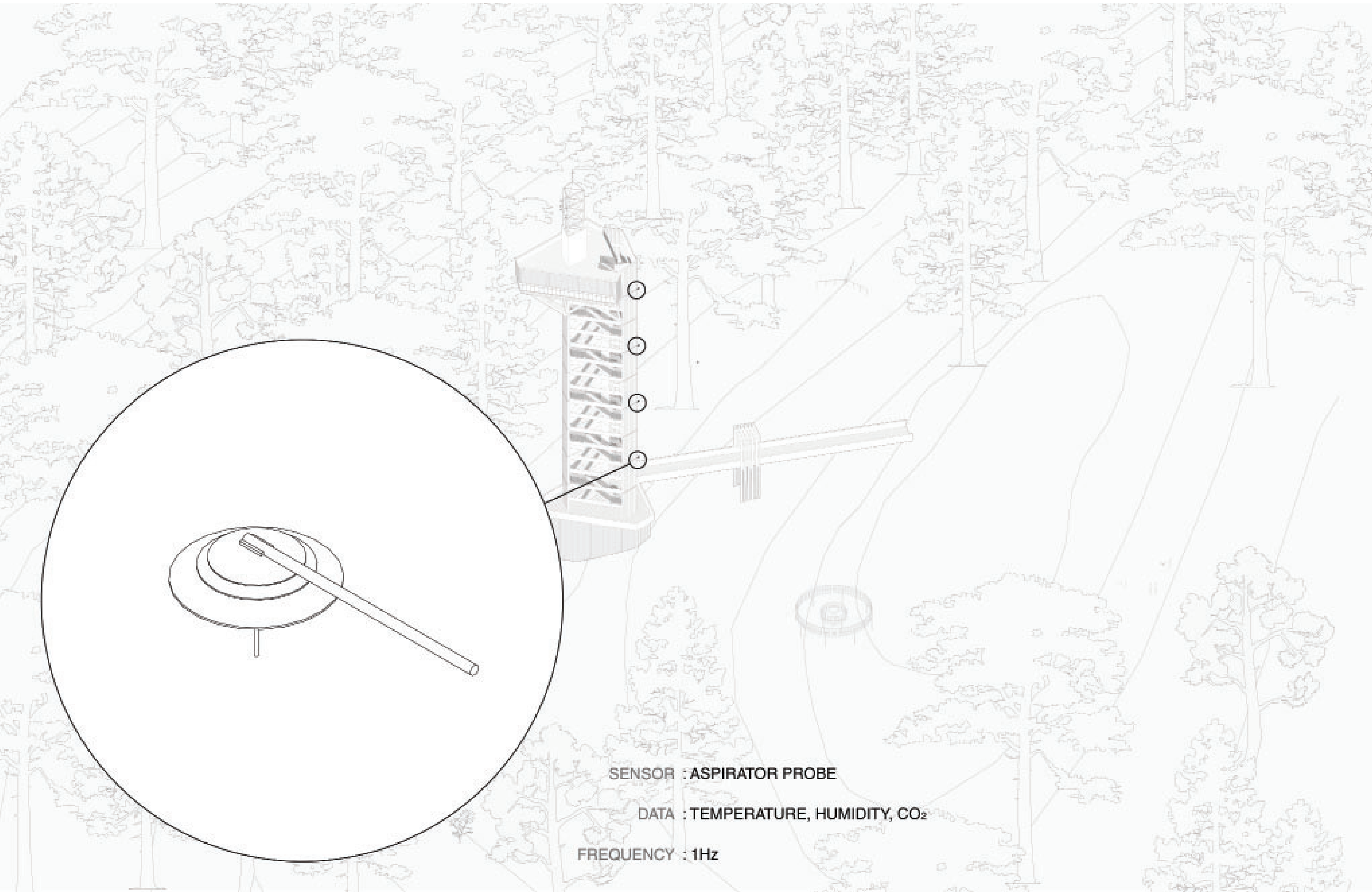


Figure 5.40 *Remote Sensors: Aspirator Probe*

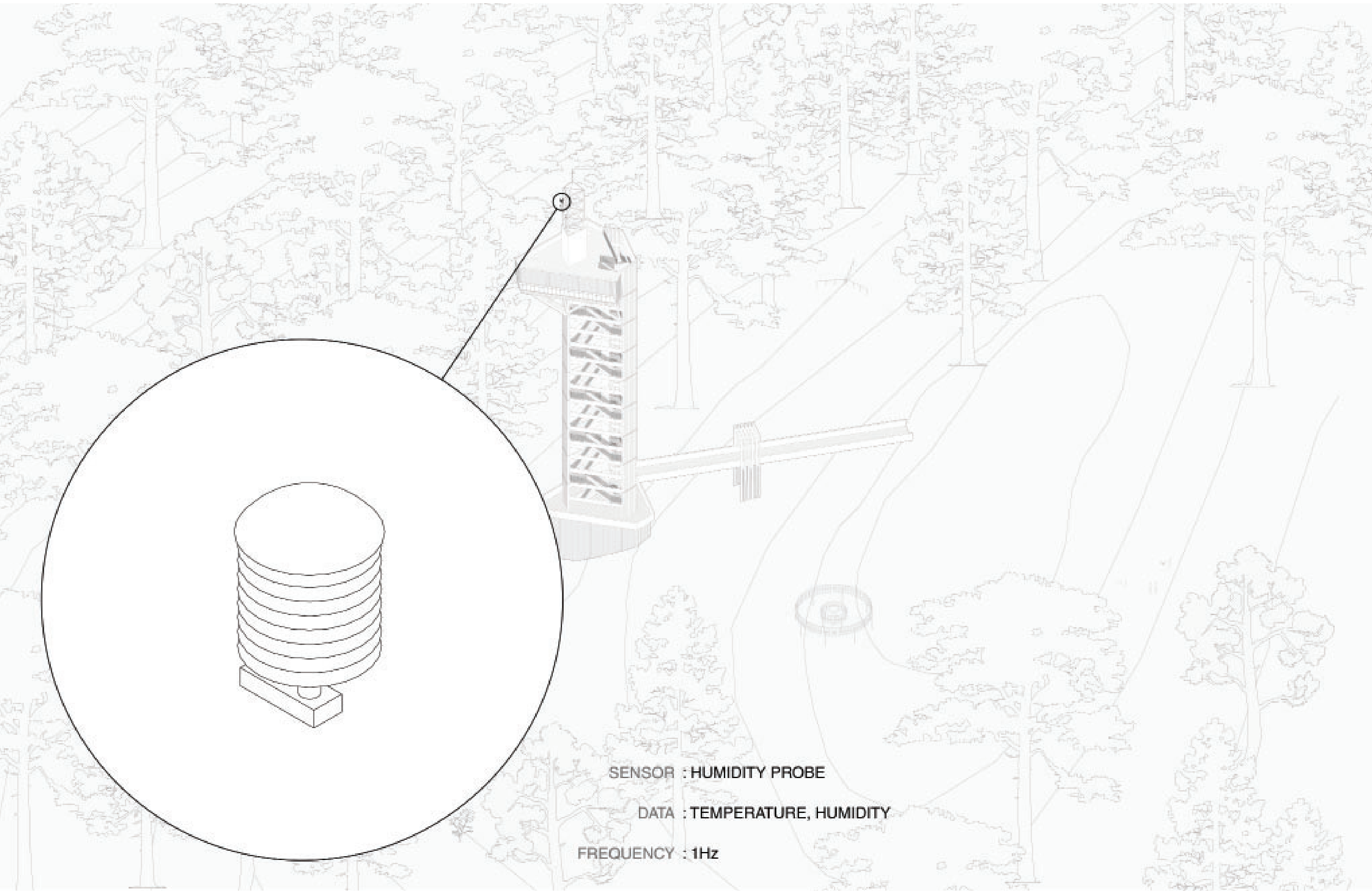


Figure 5.41 *Remote Sensors: Humidity Probe*

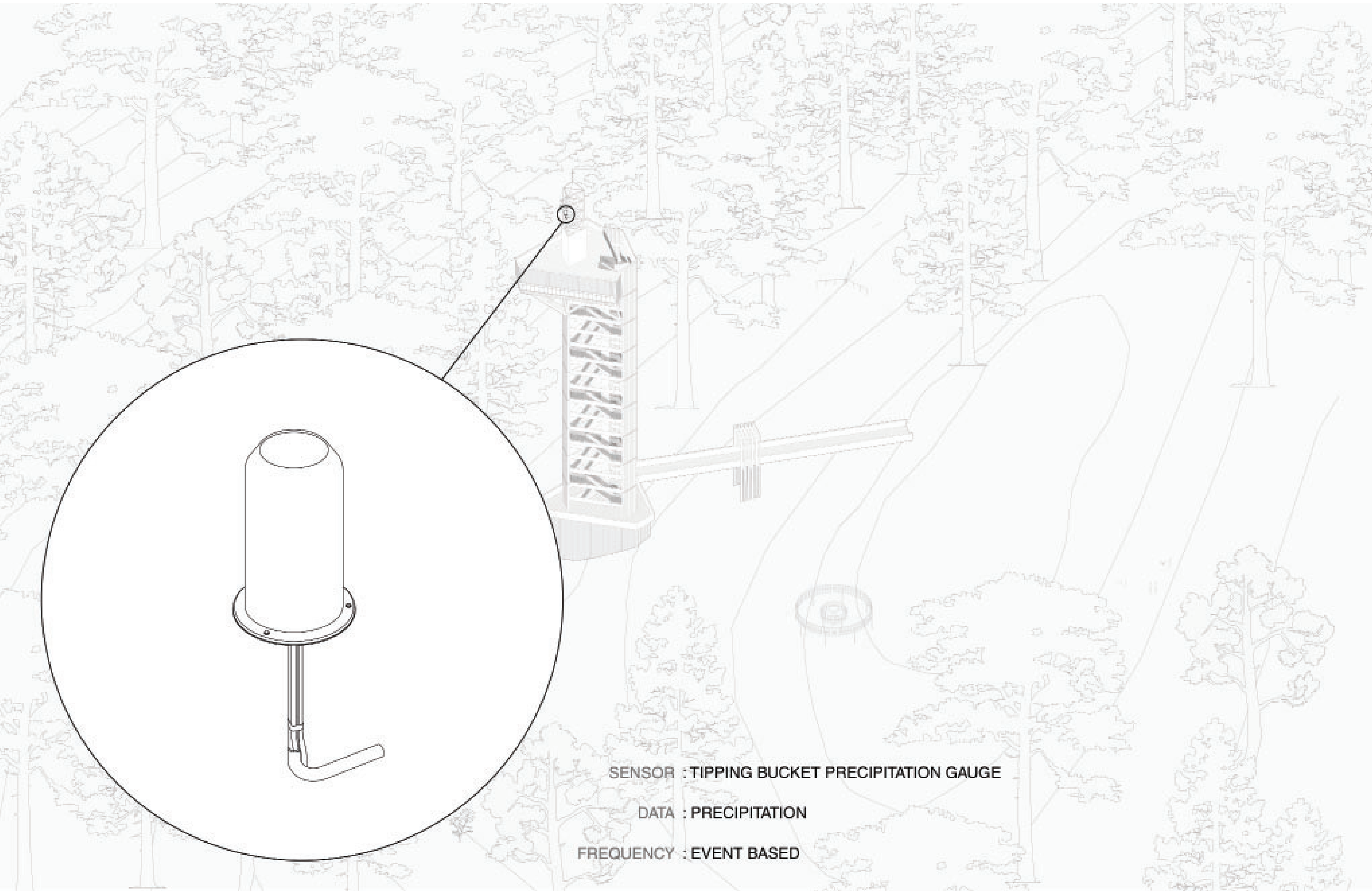


Figure 5.42 *Remote Sensors: Tipping Bucket Precipitation Gauge*

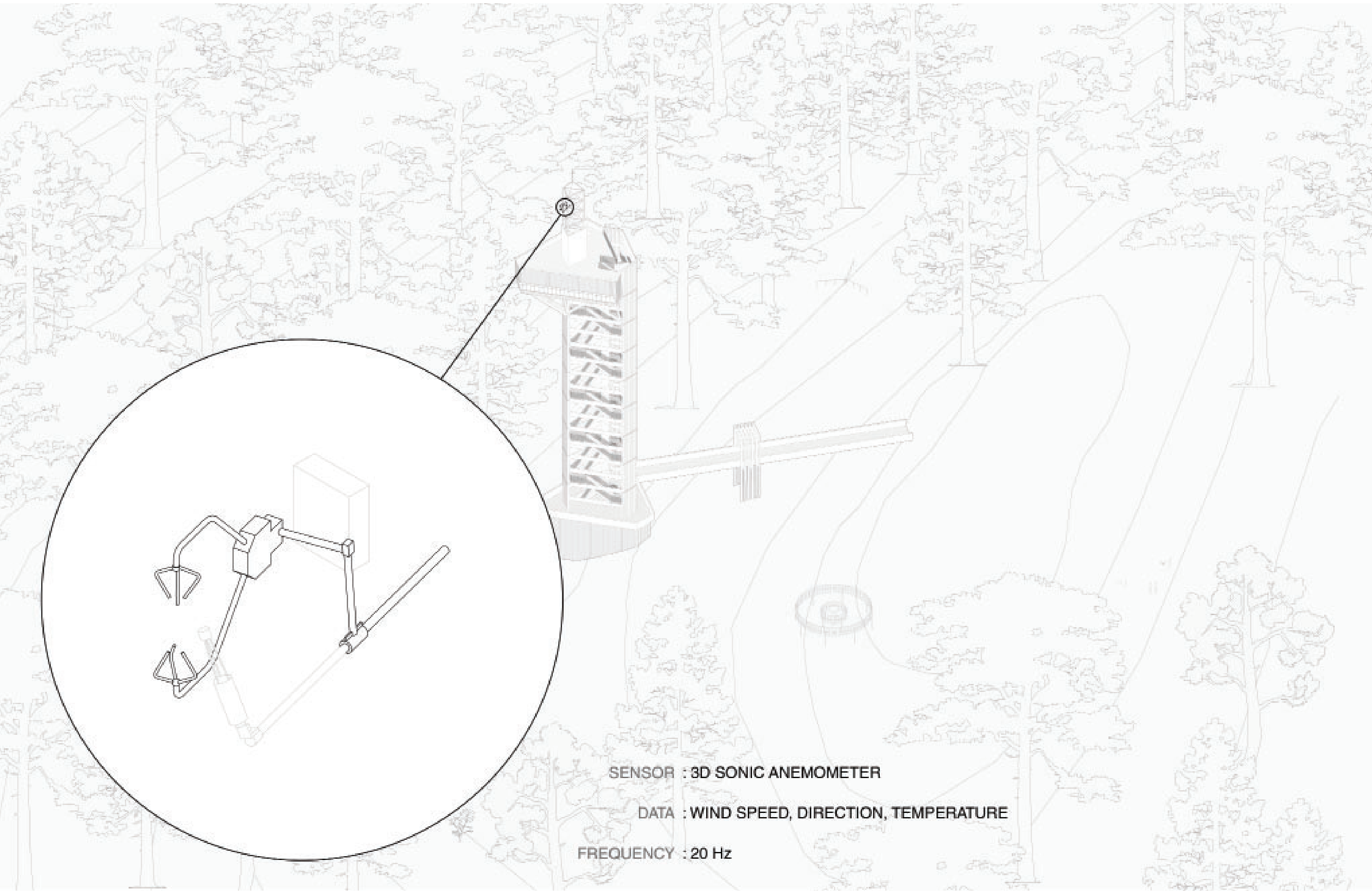


Figure 5.43 *Remote Sensors: 3D Sonic Anemometer*

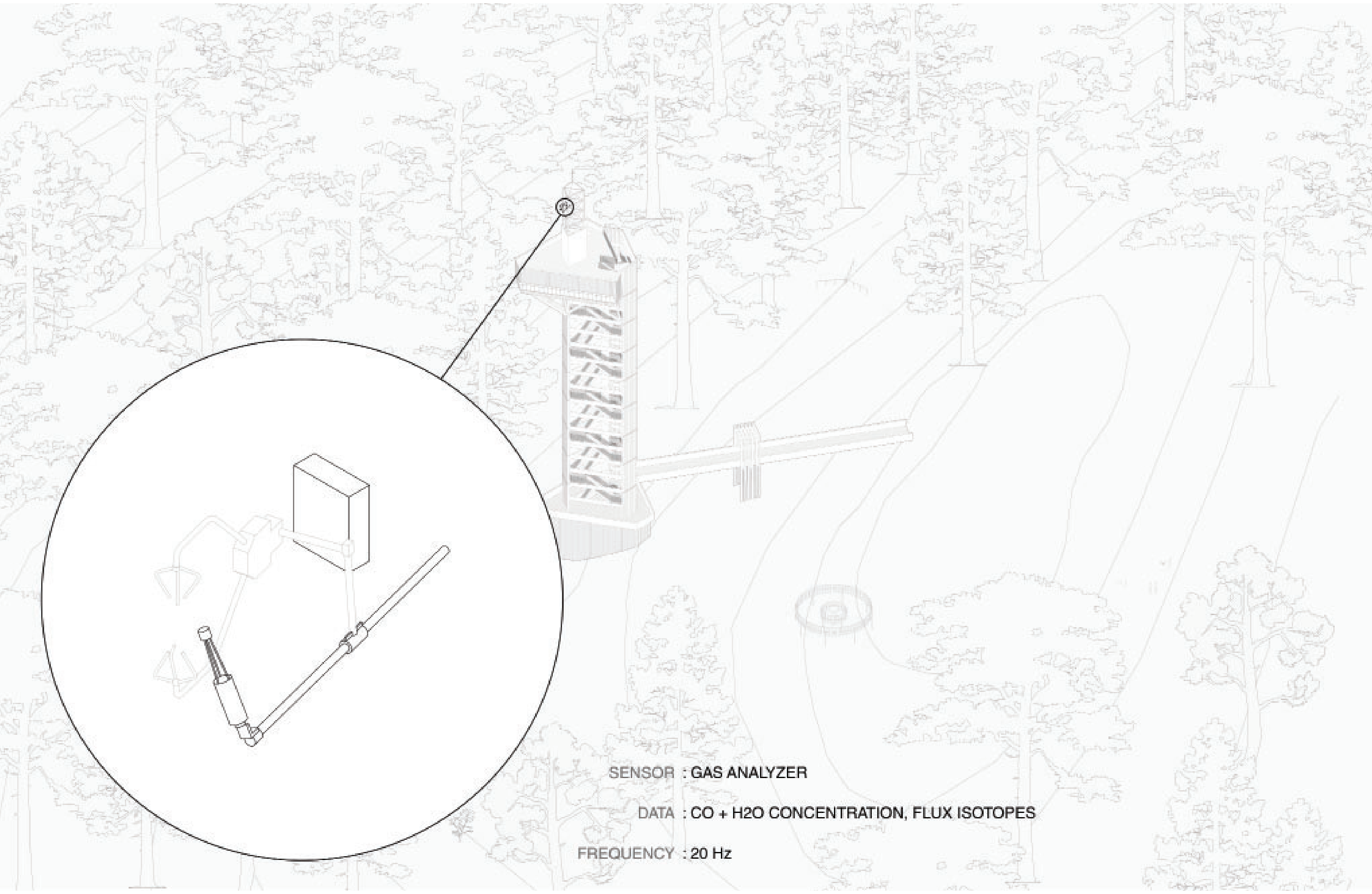


Figure 5.44 *Remote Sensors: Gas Analyzer*

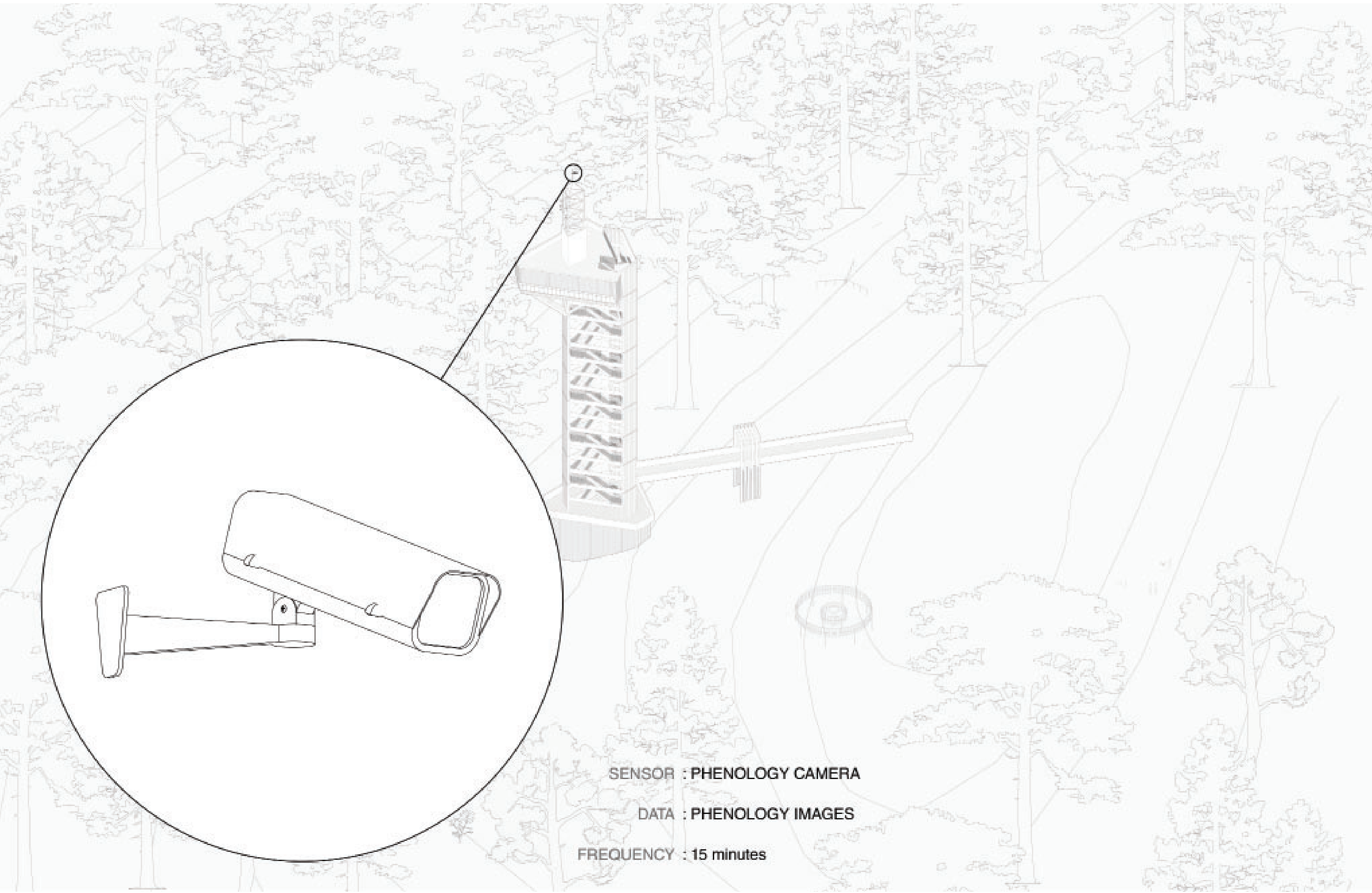


Figure 5.45 *Remote Sensors: Phenology Camera*

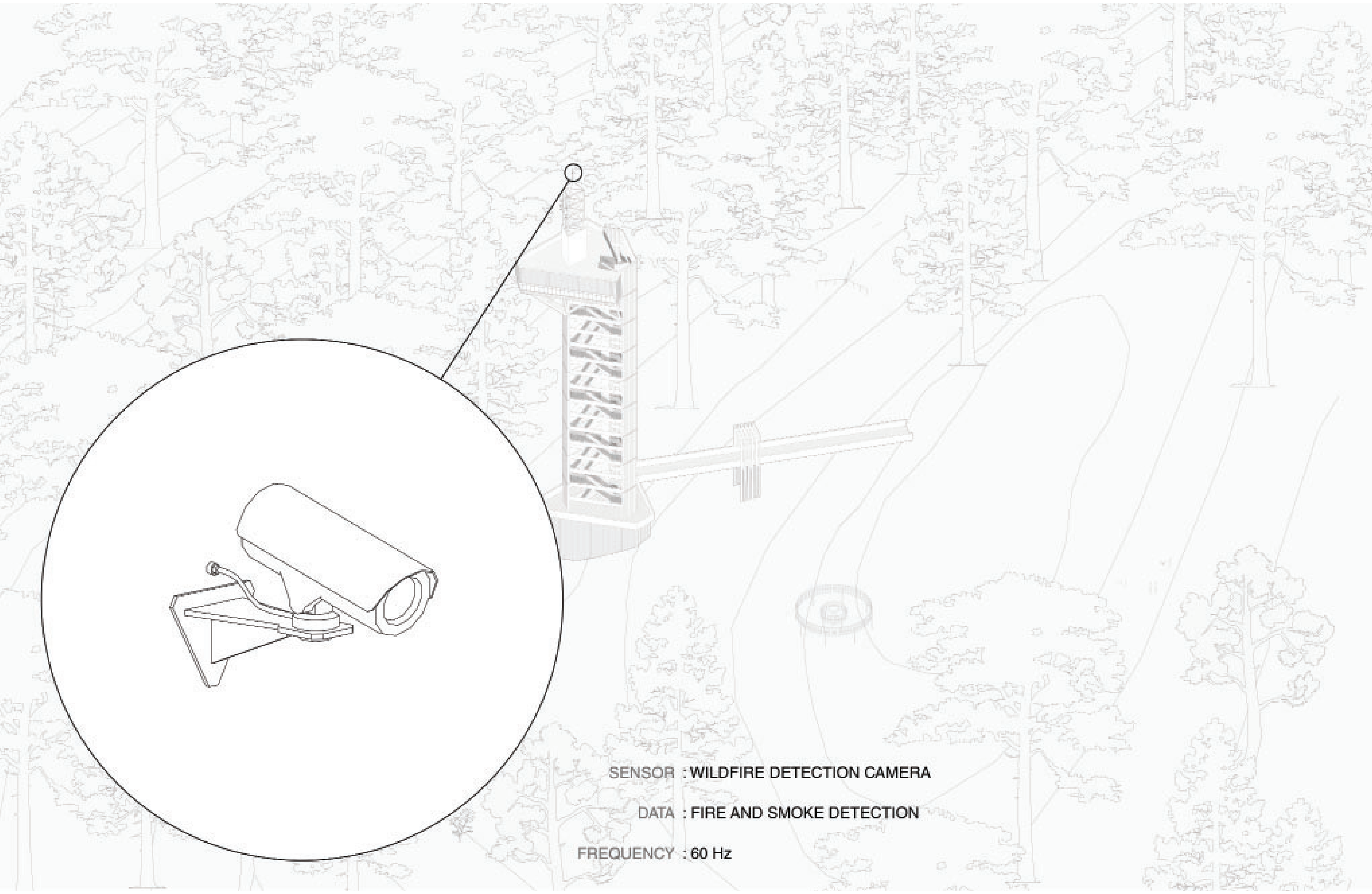


Figure 5.46 *Remote Sensors: Wildire Detection Camera*

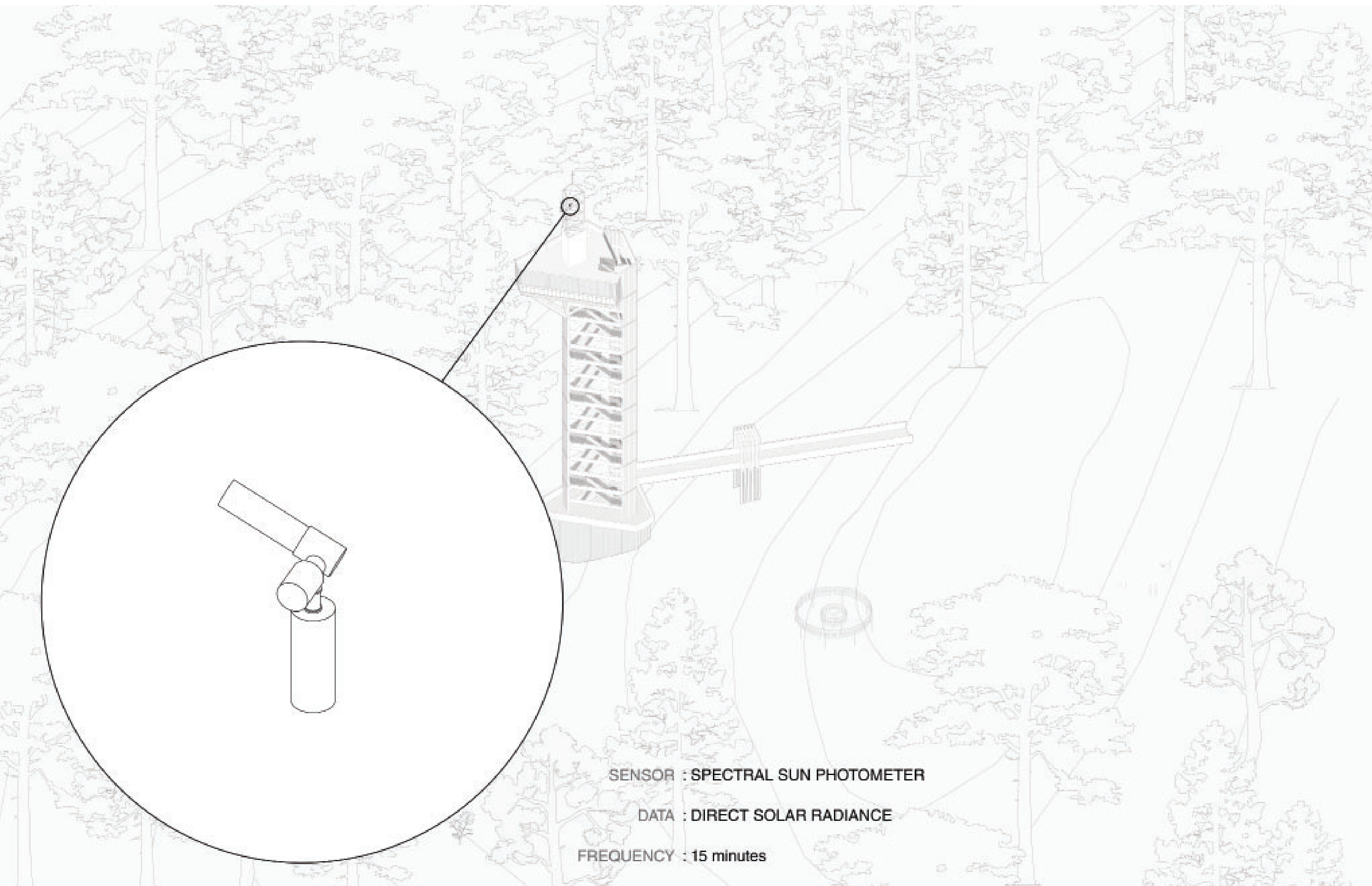


Figure 5.47 *Remote Sensors: Spectral Sun Photometer*

CONCLUSION

This thesis proposes a project that aspires to nurture engagement and a sense of stewardship of the collective gift of our wilderness. This proposal offers a different vision of an interpretive centre type. The French River Visitors Centre and the Centre d'interprétation du Bourg de Pabos and centres like them are often to accessed directly by automobile, offer ADA accessibility, curated displays, and cafés drawing many visitors who would not otherwise experience canoeing through the French River first hand, providing them a chance to understand the landscape through the building and its exhibits. The towers integrate with existing pathways and modes of recreation, attracting different sets of users with interests in the direct experience of the wilderness through activities like backpacking, canoeing and camping. They invite the personal experience and interpretation of the landscape while revealing the ongoing interpretation and research by scientists taking place, elucidating the process of interpretation and gathering of knowledge as it goes on. The towers, providing viewpoints from which to view and reflect on the landscape, aspire to similar goals of interpretation and informed experience of the environment in which they are placed. Visitors are situated in a broader interpretative framework where the entire experience of getting to the tower becomes part of the information with which guest weave their own narratives into that of the landscape. The journey itself is not a singular experience but a multiplicity of possibilities as different users can access by varied paths and methods, encouraging the creation of unique encounters that can be shared at the destination. The preamble of getting to the site is an immersive experience that culminates in views of the landscape recently traversed. The interpretation is partly left to the experience of the landscape itself; the tower offering a place to gather, rest and reflect, echoing the journeys of the fire lookout observers who, upon reaching their station at the end of a long trek would settle into their work, to be still and observe the changing landscape before them. Through the use of a neglected cultural touchstone the design initiates a dialogue for how, as a society, we may come to fully understand our place in the ecosystems on which we rely. The design at the level of a network presents the prospect of a coordinated and fieldwork supplemented data set on a vast scale within and between ecosystems. One example of a kind of toolkit of ecological sensing apparatuses that would register the flowing landscape of ecological processes over vast spans of time. At an individual level the lookout represents a destination, a landmark, a cultural enterprise for kindling an informed connection with the wild places we love.

It is hoped that through increased exposure and enjoyment of these places that, as a culture, we will engender more consciousness and care towards them as with the prominent lookout writers of the 50's and onward. With both recreation and research in mind, the sites would be uniquely situated to collect data on the immediate and long-term effects of human activity. By the overlap of these two programs users will interact, share experiences, stories and knowledge between weekend campers, backcountry trekkers, researchers, students or tourists. The different user groups are actually not so different, they all have shared interest in the same place after all. Ultimately this thesis is about creating more opportunities for everyone to experience the wilderness in an educated way and hopefully nurture the seeds of that same sense of stewardship which arose in the near extinct lookout observers. As we develop new methods and technologies that reveal more about our shared landscape and increase our scientific understanding, we must not forget the value in access and presence in these in places. Not just for the ground truthing and field work necessary to supplement the technological portals that narrowly survey but for the ongoing societal relevance of the natural world and to engage and be able to participate in the collective process of understanding it our and affects on it.

"you should really know what the complete natural world of your region is and know what all its interactions are and how you are interacting with it yourself. This just part of the work of becoming who you are, where you are."[51]

51 Gary Snyder and William Scott. McLean, *The Real Work: Interviews & Talks, 1964-1979* (New York: New Directions Publishing Corporation, 1980).

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APPENDIX