

The House of the Machine is the Territory

Architecture in the loop



Fig. 1 Diagram (Own illustration 2026)

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EFL STICHTING

The House of the Machine is the Territory
Architecture in the loop

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Graduation Report
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„If the disconnection between the world we live in and the world we live from is really the cause of the disorientation (..), then the remedy is clear: We should find ways to decrease the distance between the two worlds, so as to begin our landing on earth - without crashing“ Bruno Latour, Peter Weibel „Critical Zones“ , Critical Zones (ZKM 2020), p.120.

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Artificial intelligence is commonly framed as immaterial and placeless, yet it depends upon extensive territorial systems of extraction, labour, and water management. This thesis investigates a corridor along the Kemijoki River in Arctic Finnish Lapland, where hydropower infrastructures, mining operations, transmission networks, tourism economies, and emerging data centers converge into a dense layered landscape.

Instead of understanding the data center as an isolated spatial object, the research situates it within a broader set of interdependent ecological and infrastructural processes that reorganize territory through the demand for energy and cooling. Water, in its different states, emerges as the central medium through which these transformations are traced. The climate of the arctic becomes therefore a strategic resource.

Through territorial mapping, fieldwork, media analysis, and research-by-design, the thesis investigates the externalized systems required to sustain continuous computation and explores new territorial synergies between cooling infrastructures, labour and control. These processes typically remain concealed within the abstraction of the black box, while their ecological and spatial consequences materialize across peripheral landscapes.

The thesis argues that the “exclusion zone” (LeCavalier 2019, 54; Young 2019, 10) of the data center is itself architectural. By exposing and spatializing the hidden thermodynamic and ecological dependencies of artificial intelligence, the project proposes new forms of coexistence between human, machine, and non-human systems within the “operational landscapes” (Katsikis and Brenner 2020) of the Arctic.

My interest in this topic is shaped by experiences in the Japanese and Finnish countryside, where landscapes revealed themselves not as untouched nature, but as culturally embedded and continuously maintained environments. In Japan particularly, I encountered territories shaped through ongoing practices of care, where human intervention and natural processes remain closely intertwined. With my family background from Finland, the Finnish countryside has always been a close part of me and I grew up by encountering those as untouched, wild and natural. At the same time, these same landscapes are increasingly transformed by vast amount of automated infrastructures, solar fields, extraction sites, and data centers.

As computational infrastructures expand further into rural regions, not only in Japan and Finland, the question is no longer whether they will arrive, but how they will reorganize the territories into which they are introduced. Contemporary data center developments are often framed through technical solutions such as waste-heat reuse, presenting images of efficiency, circularity, and green technological integration. These approaches risk reinforcing a condition in which broader territorial dependencies and environmental consequences remain obscured.

Ultimately, the thesis is driven by a broader question concerning the territories upon which digital life depends, the narratives of green, renewable and progress surrounding artificial intelligence, and the strategic role of the Arctic in securing the infrastructures of our digital future.

Uncertainty today is often treated as something that must be eliminated. Predictive systems promise clarity, stability and control. Yet the more we attempt to remove uncertainty, the more we lose the frictions that keep us connected to the unpredictable parts of our environment. My fascination with this began with a simple question: *Where do the servers sleep?*

Data centres do not produce predictions. But they are the spatial precondition of a world that has elevated prediction to its organising logic. They store, move and process the data from which models learn and algorithms derive patterns. The abstract promise of calculability materialises here: in energy infrastructures, cooling systems, spatial siting and continuous optimisation. From this observation, the object was crafted. It attempts to reveal the logic of these patterns: the infrastructures that increasingly define European territory, data centres dependent on stable grids, automated rural systems driven by optimisation, and landscapes calibrated for continuous demand. They are the territorial typologies of what we call data, cloud, or AI.

Across Europe, AI factories and gigafactories are not built where research and knowledge are anchored, but where energy is cheap and low-carbon. Their value is measured through electricity, water access, land price and tax incentives. These spatial decisions follow the same logic as the systems they host: efficiency over experience, control over uncertainty. By treating predictability as something that can be engineered, Europe shifts uncertainties elsewhere: ecological pressure moves to the periphery, energy loads concentrate, and landscapes become functional territories. The stability produced remains fragile. This Veduta understands uncertainty not as a failure but as a spatial, ethical and economic condition. The blind spot becomes a productive space: when cracks in patterns of prediction open possibilities, and when architecture can be conceived with, rather than against, uncertainty.

“Doubt is not a pleasant condition, but certainty is absurd” (French: „Le doute n’est pas une état bien agréable, mais l’assurance est un état ridicule“) Voltaire in a letter to Frederick the Great of Prussia in 1770.

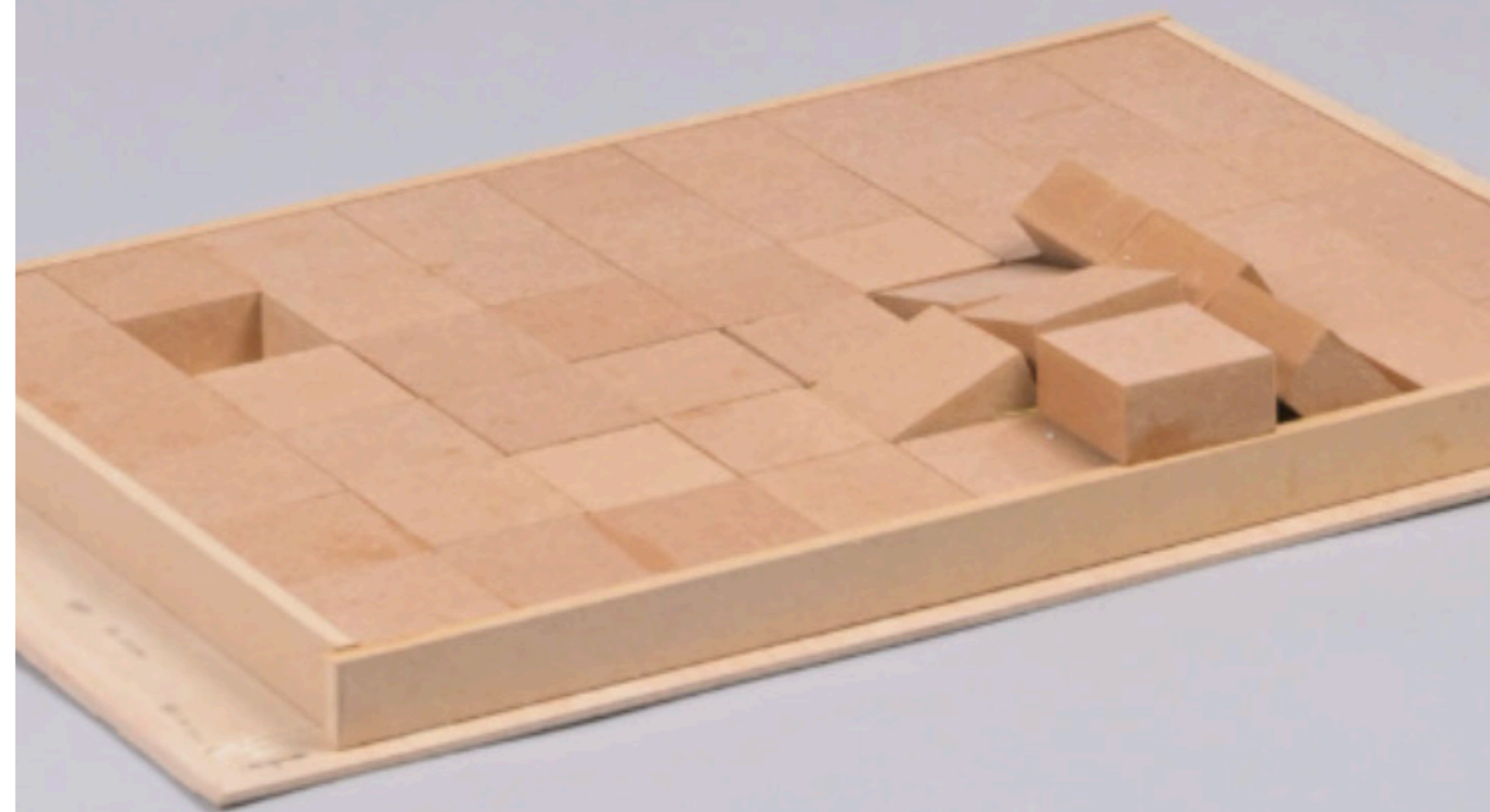


Fig. 2 Veduta (Explore Lab 2025)

The image of the Earth as a singular and unified entity has long shaped contemporary imaginaries of globalization. During the recent Artemis II mission, astronaut Victor Glover reflected on this condition by remarking: “From up here, you also look like one thing: homo sapiens ... we’re all one people!” (Associated Press 2026). On the one hand, seen from space, the planet appears continuous and indivisible; distinctions and borders flatten into a shared planetary surface. On the other hand this image stands in sharp contrast to the ways territory is materially organized on Earth, through borders, infrastructures, local identity and systems of extraction that unevenly distribute resources, labor, and environmental burden. Connected through planetary cable infrastructures of connectivity.

Almost a decade earlier, the research project ENEROPA, developed by OMA, proposed a similarly infrastructural reading of Europe. Rather than understanding the continent through political boundaries, the project reimagined Europe as an operational energy landscape structured through geographically distributed systems of energy production. A similar territorial imagination can already be identified in Herman Sörgel’s Atlantropa proposal, which envisioned Africa as part of a territorially externalized infrastructural system designed to support European modernization through large-scale hydraulic and energy infrastructures — what ARCH+ later described as “Infrastrukturen der Externalisierung” (ARCH+ 2020).

Such planetary and infrastructural abstractions risk concealing the material realities, externalizing their environmental and spatial consequences toward peripheral territories. As Bruno Latour argues, the Earth is not a smooth and continuous surface, but a fragile and contested Critical Zone: “a thin biofilm no thicker than a few kilometers up and down” (Latour and Weibel 2020, 3), in which geological, ecological, atmospheric, technological, and human processes remain inseparably entangled. It is within this unstable zone that contemporary transformations unfold. The apparent coherence of global systems often obscures the localized frictions and environmental disturbances required to sustain them.

While the vision of a borderless energy Europe never fully materialized, another territorial transformation has accelerated across the continent. In recent years, regions such as Finnish Lapland and the Arctic in general have emerged as strategic frontiers within Europe’s green transition. Through initiatives such as the European Union’s Critical Raw Materials Act and the European Green Deal, peripheral territories are increasingly repositioned as sites of extraction and infrastructural expansion (European Union 2024). Finnish Lapland, long shaped by forestry, hydropower, and extraction landscapes for minerals, is now expected to host new mining operations, wind energy infrastructures, solar fields, energy corridors, and data centers.

Where the servers
sleep

This transformation reveals a fundamental contradiction embedded within the contemporary green transition. The infrastructures intended to support ecological futures simultaneously reorganize and degrade the landscapes upon which they depend. Rivers are regulated, forests fragmented, groundwater systems disrupted, and local livelihoods destroyed. The transition toward renewable energy therefore cannot be understood solely through technological efficiency and favourable conditions; it must also be examined through the territorial and environmental transformations it produces.

The same territories that provide renewable energy and critical raw materials are now becoming strategic locations for the infrastructures of Artificial intelligence and Data. As Kate Crawford argues, AI is not an immaterial or autonomous system, but one built upon extraction, energy consumption, logistics, and labor (Crawford 2021). What is commonly described as “the cloud” is in reality a deeply material apparatus “made of rocks and lithium brine and crude oil” (Crawford 2021, 31).

Artificial intelligence is therefore not merely a technological development, but an emerging territorial condition. The cloud has a climate, a geography, a thermal regime, and a water footprint. What appears elsewhere as seamless intelligence materializes here as extracted minerals, cleared land, extended grids, regulated environments, and landscapes part of the “exclusion zone” (LeCavalier 2019, 54; Young 2019,10).

Within Finnish Lapland, these overlapping transformations produce a landscape suspended between residue and emergence. Abandoned workers’ housing, underused buildings, aged hydropower infrastructures, new tourism developments by international investors, extraction sites, transmission corridors, and new data facilities coexist within the same territorial field.

The remnants of previous industrial regimes reveal shifts in labor, governance, and infrastructural dependency, while contemporary investments signal the arrival of new systems increasingly shaped by automation and exclusion.

It is within this unstable and entangled condition that this thesis situates itself: understanding the data center as a territorial machine through which landscapes, climates, labour, and human and non-human life are reorganized.

Contemporary territorial transformations are no longer legible through the traditional distinction between city and countryside. Territories increasingly operate as what Neil Brenner and Nikos Katsikis describe as “operational landscapes”: extended terrains continuously produced and reorganized through infrastructural, ecological, and computational processes (Katsikis and Brenner 2020). Finnish Lapland exemplifies this condition. What appears as remote periphery reveals itself as a strategic node within Europe’s Green Transition.

Climate itself becomes an operational resource: cold temperatures, long winters, water availability, and renewable energy are competitive assets within the development of Data Centers. Yet the environments they live from become unstable themselves, through rising temperatures, changing seasonal cycles, and intensified ecological pressures. The territory itself becomes subdivided into landscapes instructed to behave like a machine, while the environmental consequences remain unevenly distributed across local territories: disrupted salmon migration caused by dam infrastructure, fragmented animal migration through accelerated land clearance, reindeer calf mortality linked to displaced grazing routes and new infrastructural borders, contamination from mineral extraction and construction dust, and increasing pressure on fragile ecological systems already destabilized by infrastructural development and climate change (Fieldwork interviews 2026). Through these infrastructures, Europe becomes simultaneously operationally unified and territorially fragmented (ARCH+ 2020, 53).

These transformations also produce growing socio-spatial asymmetries. While vast amounts of energy are extracted and distributed through global infrastructures, local communities continue to face rising energy costs, demographic decline, and increasing dependency on externally controlled systems. While data centers consume vast amounts of water for cooling during the summer months, groundwater systems already increasingly face pressure from extraction, rising temperatures, and changing seasonal cycles, leaving local communities and ecosystems increasingly vulnerable to infrastructural dependency and environmental instability.

Decisions shaping these territories are increasingly made at distant institutional and corporate scales, while their environmental and social consequences materialize locally. International corporations, like the EU and investment flows from abroad reshape the region through highly automated forms of development that generate limited long-term local employment.

Problem Statement

This thesis argues that the externalized dependencies of the data center on water, energy, and land must instead be understood as architectural and territorial questions. The project therefore asks how new forms of coexistence can emerge between human, non-human, and machine systems, and close the gap between “the land we live in, and the land we live from” (Latour and Weibel 2020, 8).



Fig. 3 The European Arctic (Google Earth 2026)



Fig. 4 Petäjäsoski Powerplant along the Kemijoki River (Google Earth 2026)



Fig. 5 Kemijoki River Aerial View (Museum and Science Centre Arktikum 1960)



Fig. 6 Wind Farm near Sodankylä (Google Earth 2026)



Fig. 7 Snowfarming Ruka Ski resort, Finland (Kangasluoma 2025)



Fig. 8 Kittilä Mine (Google Earth 2026)



Fig. 9 Protests against the opening of the new mine north of Sodankylä (Nilsen 2023)



Fig. 10 Transmission Line cutting through forest (Google Earth 2026)

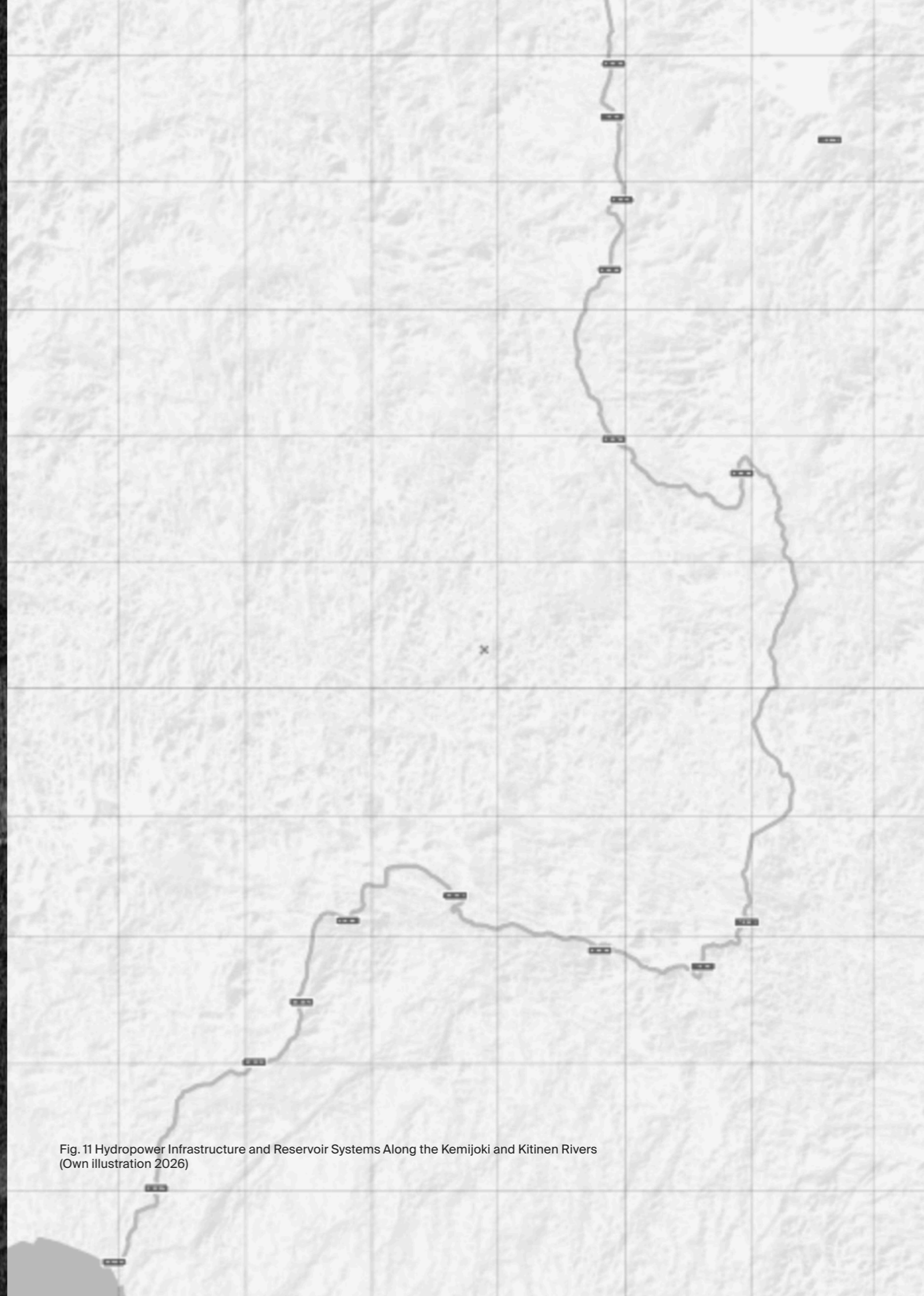


Fig. 11 Hydropower Infrastructure and Reservoir Systems Along the Kemijoki and Kitinen Rivers (Own illustration 2026)

Hyperscale computational development across Northern Europe continues to accelerate, while current regulatory frameworks largely address transparency, efficiency, emissions, and waste-heat reuse without providing spatial protocols for territorial integration. At the same time, contemporary debates surrounding artificial intelligence and data centers remain primarily focused on technological innovation, optimization, or the integration of civic programs within the black box itself. The broader territorial and socio-ecological systems through which these infrastructures operate remain insufficiently addressed at the scale between architecture and urbanism. As argued by Jesse LeCavalier, “our challenge now is to offer suitably seductive responses, to proliferate typological inventions and to generate dispositional modes of practice that see the political problems of logistics as fundamentally architectural” (LeCavalier 2019, 55).

Simultaneously, Keller Easterling describes infrastructure space as operating less through isolated objects than through “repeatable spatial formulas” (Easterling 2014, 9).

Within this condition, architecture risks obsolescence unless it repositions itself as a territorial interface capable of finding new relations rather than merely optimizing isolated buildings.

The thesis therefore argues that the exclusion zone of the data center itself can become architectural. Cooling systems, energy infrastructures, logistics, snow management, and environmental monitoring are not secondary technical questions, but spatial conditions through which planetary computation materializes.

By focusing on Finnish Lapland, the research contributes to emerging discourse investigating how Arctic territories are increasingly repositioned within the future geography of computation and extraction. In doing so, the thesis questions what forms of architectural agency remain possible within landscapes increasingly shaped by automation, infrastructural abstraction, and systems of control.

The contribution of the thesis lies in:

- Reframing AI infrastructure as a territorial and material system

- Positioning water, snow waste, and seasonal thermal cycles as architectural design drivers

- Exploring architecture as a practice operating through friction, exposure, and entanglement

- Investigating how architectural interventions can engage the externalities and operational dependencies of computational infrastructure within the landscape of Lapland

The objective of the thesis is to develop an architectural and territorial framework capable of spatializing these externalized operational dependencies and transforming them into publicly negotiable ecological and socio-ecological relationships. The project explores how architecture can operate within or as part of the exclusion zone by finding new relationships between infrastructure, climate, landscape and local conditions.

Within this framework, water emerges as the central medium. Snow, cooling water, contamination, and seasonal water cycles are understood as interconnected territorial systems capable of generating new architectural relationships.

The thesis does not propose a simplified technological utopia, nor a nostalgic return to a pre-industrial past. Instead, it positions architecture as an active territorial space embedded within the operational systems sustaining artificial intelligence and computation. By working across multiple scales, from territorial infrastructures to localized situated conditions, the research explores how architecture can give space to new relations through which artificial intelligence sustains itself.

It also questions the role of the architect, working in a field that is entangled in Extraction processes itself and can not separate itself anymore from those cycles, supply chains and environmental conditions.

How can architecture engage the territorial externalities of computational infrastructure in Finnish Lapland along the Kemijoki River by redistributing operational systems into ecological and socio-ecological relationships? Research Question

How do operational landscapes reorganize Finnish Lapland as a **strategic resource frontier** for Europe's green and digital transition? Sub-questions

How do **cooling infrastructures of the data center**, local water systems, and snow accumulation **produce new ecological relations, dependencies, and conflicts** across the territory?

How can **the externalized by-products of computation be spatialized and internalized** through new architectural and territorial hybrids?

What forms of **architectural agency** remain possible within landscapes increasingly **shaped by automation and planetary computation**?

The thesis is structured into four sequences moving from territorial systems and processes of computation toward architectural interventions on site. The research focuses on the corridor along the Kemijoki River in Finnish Lapland, between the harbour in Kemi and the mine in Sodankylä. Specifically focusing on a site in Heikkilänranta, Rovaniemi, where a hyperscale data center is planned.

SEQUENCE 01 — Operational Territories

Establishes Lapland not as wilderness, but as an operational landscape shaped by extraction, energy production, logistics, and computation. The chapter introduces concepts such as operational landscapes, environmental blindness, exclusion zones, and water as a political medium within computational territories.

SEQUENCE 02 — Observatories

Situates the research physically within the Kemijoki corridor through fieldwork, interviews, and photographic observations. The chapter translates the territory into situated territorial conditions and identifies local realities, and potential spatial synergies for architectural intervention.

SEQUENCE 03 — Layered Landscape

Investigates the local infrastructural networks, frictions, and data center processes surrounding the chosen site. The chapter identifies territorial synergies between water, snow, energy, and landscape, while exploring alternative systems of coexistence between the data center and the local territory.

SEQUENCE 04 — The House of the Machine is the Territory

Proposes architecture as the territorial support system of computation through hybrids between human, machine, and non-human systems, entangled within cycles of cooling, snow accumulation, meltwater, and heat reuse across the territory.

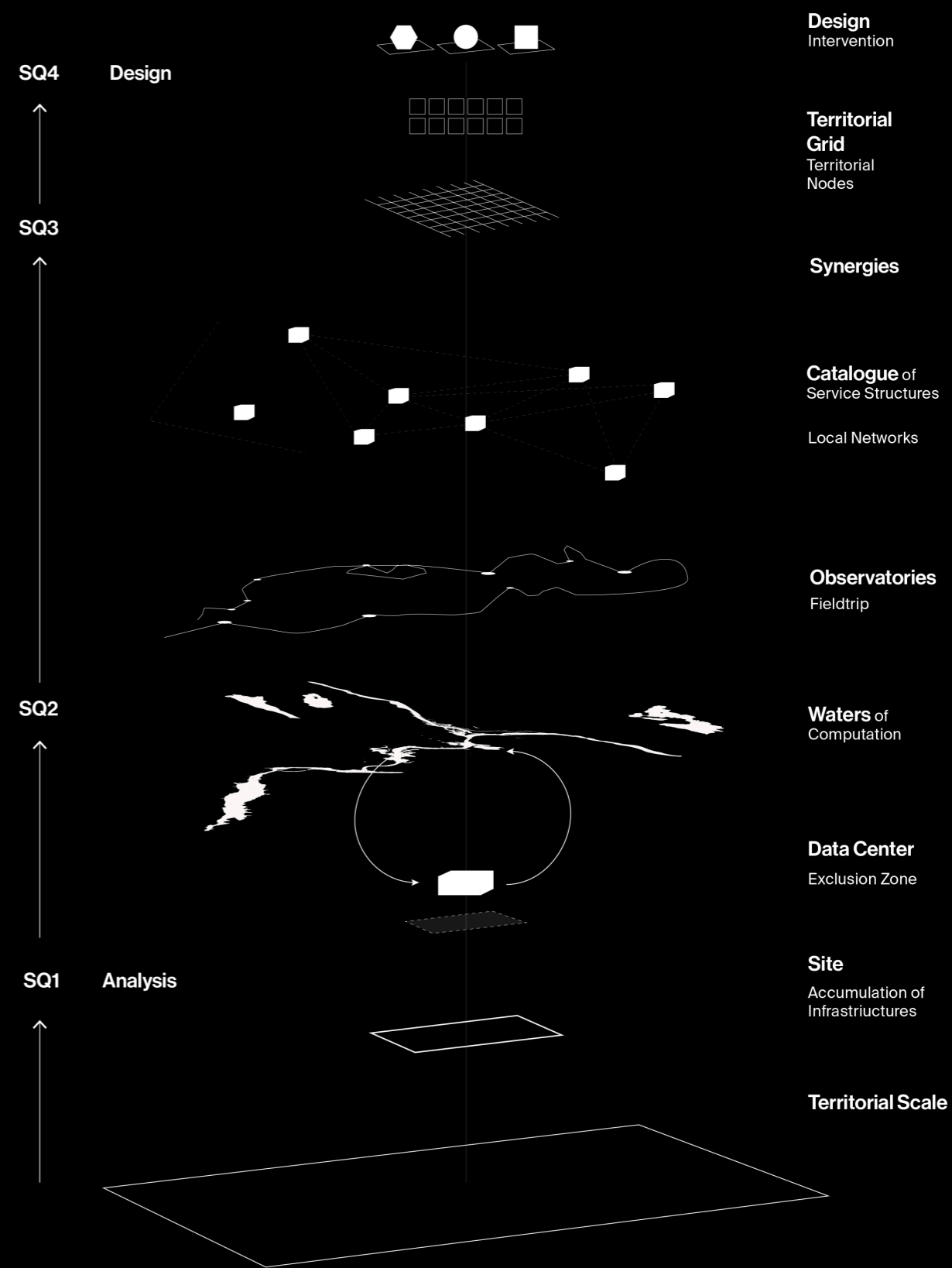


Fig. 12 Diagram Methods (Own illustration 2026)

Approach

The research combines multiple methods that operate across scales and forms of knowledge production. The project positions itself as a form of critical disclosure, making visible the material dependencies, externalities, and frictions that underpin seemingly immaterial digital systems. This process allows the project to move between territorial scales and architectural positioning.

1. Mapping

Mapping serves as a primary analytical tool to understand the territory as a system of overlapping infrastructures, resource flows, and ecological processes. This method allows me to identify sites of accumulation that become relevant for architectural intervention and understand the positioning of the data center in the wider territorial frame.

2. Topological Analysis of Water

Water is examined as both material and territorial medium, ranging from the dam to the server. Within this framework, snow waste is understood as a thermal resource that forms a synergy between local waste streams and cooling demand of the data center.

3. Media Analysis

A qualitative media analysis of the regional newspaper Lapin Kansa (2024–2026) was conducted with Atlas.ai to identify recurring narratives, concerns, and conflicts related to infrastructural development in Lapland.

Environmental impacts of data centers and industrial expansion

- Pressures on local ecologies and livelihoods

- Energy transition and resource extraction

- Demographic and economic transformation

This method allows the thesis to examine how territorial transformations are represented and debated within the local discourse.

4. Fieldwork and On-Site Observation

A field trip conducted along the Kemijoki corridor (Rovaniemi–Sodankylä) provides further knowledge from within the territory. On-site documentation through photography, observation, and archive materials captures conditions that remain invisible in abstract datasets and planning documents. This empirical engagement allows the project to confront theoretical assumptions with lived realities. Additionally it informs the design part programmatically.

5. Interviews

Semi-structured interviews were conducted during the fieldwork with actors from environmental organizations, local administrations, cultural institutions, universities, planning agencies, and reindeer herding communities. They contribute perspectives on the cumulative impact of large-scale infrastructural developments in the past and present.

Methodology

6. Typological Fragment Catalogue

During the fieldwork, recurring architectural and infrastructural typologies on a local level within the Kemijoki corridor were documented and analyzed through photographic cut-outs, and spatial observations. These included community houses, gas stations, water towers, worker housing, snow logistics infrastructures, industrial sheds, roadside services, and maintenance facilities.

7. Territorial Design and Architectural Interventions

Architectural interventions emerge directly from territorial analysis. Design acts as a way to translate territorial research into spatial design. The architectural interventions and territorial design emerge from local networks, and local systems already present within the territory.

Operational Landscapes / Extended Urbanization

This thesis understands Finnish Lapland not as a peripheral wilderness, but as an operational landscape produced through overlapping systems of extraction, logistics, energy generation, and computation. Following Neil Brenner and Nikos Katsikis, urbanization is no longer confined to the traditional city, but extends through dispersed infrastructural territories that sustain planetary systems of production and circulation (Katsikis and Brenner, 2020).

Landscape as Infrastructure

Within this condition, Pierre Bélanger positions landscape not as scenery or untouched nature, but as an infrastructure holding processes of extraction, hydrology, logistics and waste (Bélanger 2017). Ecology, in this sense, becomes a “constructed ground” (Bélanger 2017, 226). This perspective reframes architecture as a territorial practice embedded within larger ecological and infrastructural relations, identifying synergies between different actors and uses.

Materiality of AI and Exclusion Zone

At the same time, the infrastructures of computation remain largely invisible. Ali Fard describes AI systems as forms of environmental abstraction that conceal their material dependencies behind the image of an immaterial cloud (Fard 2023). Jesse LeCavalier’s and Liam Young’s notion of the exclusion zone, further reveals how logistical systems produce territories organized around automation, efficiency, continuity, and control (LeCavalier 2019; Young 2019). Despite their territorial significance, they remain spatially opaque and politically detached from the landscapes that sustain them. The architectural consequence is the production of the black box: a sealed technical object whose internal operations remain inaccessible while its external territorial effects continue to expand. Against this invisibility, the thesis insists on the materiality of AI. Drawing on Kate Crawford, artificial intelligence is understood not as a virtual system, but as a planetary infrastructure dependent on minerals, labor, electricity, water, and environmental transformation (Crawford 2021).

Environmental Blindness

AI infrastructures operate through processes of abstraction that convert landscapes into operational datasets. Human presence is minimized while environmental processes are translated into operational data. Marina Otero Verzier describes computational infrastructures as environments governed through metrics, prediction, and environmental control (Otero-Verzier 2023). Similarly, Shannon Mattern argues that digital infrastructures often conceal their material dependencies behind narratives of seamless connectivity and technological neutrality, therefore calling for a more situated understanding of infrastructural landscapes (Mattern 2022). Rather than relying solely on visual and operational representations, Mattern examines what such infrastructural systems “leave out” (Mattern 2022, 40) particularly the ecological, sensory, and embodied conditions obscured through processes of abstraction.

Theoretical Framework

Hydro Social Theory

Water is approached in this thesis not as a neutral natural resource, but as a socio-technical and political medium produced through infrastructural intervention. Jamie Linton argues that water does not exist independently from the systems that organize, measure, regulate, and distribute it (Linton 2010). Similarly, Maria Kaika and Erik Swyngedouw demonstrate that hydraulic infrastructures simultaneously reorganize ecological systems and political relations (Kaika 2005; Swyngedouw 2009). Water infrastructures therefore shape not only environmental conditions, but also territorial governance, economic priorities, and social hierarchies.

Entanglement / Contamination / Externalities

The project further rejects binaries between nature and technology, or purity and contamination. Drawing on Anna Tsing’s concept of contamination and entanglement, landscapes are understood as relational environments shaped through continuous processes of disturbance, exchange, and adaptation (Tsing 2015). Contamination here does not only describe toxicity, but conditions of unavoidable contact: between snow waste and cooling systems, rivers and computation, ecological cycles and digital infrastructures. As Tsing argues, contemporary environments are produced through and within “human-disturbed earth” (Tsing 2015, 163). Consequently, the project produces territorial externalities: indirect environmental and spatial costs displaced onto surrounding ecologies and communities (METALOCUS 2025).

Critical Zone

Drawing on Bruno Latour’s concept of the Critical Zone, the territory is ultimately approached as. As Bruno Latour argues, the Earth is not a smooth and continuous surface, but a fragile and contested Critical Zone: “a thin biofilm no thicker than a few kilometers up and down” (Latour and Weibel 2020, 3). Architecture is therefore positioned not as a singular form-making practice, but as a sub-infrastructure operating within entangled metabolic systems.

Internalities

This position resonates with the concept of “internalities” (METALOCUS 2025), developed by Roi Salgueiro and Manuel Bouzas in the Spanish Pavilion at the Venice Architecture Biennale 2025, which argues that architecture should no longer externalize its environmental consequences, but spatialize and expose them. Rather than concealing operational systems behind technological enclosures, the thesis explores how the by-products of computation – cooling, storage, maintenance, sensing, evaporation, waste heat, and logistical support – can become spatial and civic relationships within the landscape.

SEQUENCE 01
The Operational Territory

As we are beginning to understand, territories are no longer defined by borders, but by the infrastructures that traverse them. What appears as remote landscape is in fact already enrolled in vast operational systems. Finnish Lapland no longer exists merely as a political entity, but as an infrastructural project, held together by grids and fragmented through their uneven effects.

Hypothesis

Across Europe's northern peripheries, a new spatial narrative is emerging—one that frames remote territories as simultaneously green, connected, and available. Regions such as Finnish Lapland, long imagined as peripheral wildernesses shaped by forests, snow, and climatic extremes, are increasingly repositioned as strategic sites within Europe's energy and digital transition. Within the context of the European Green Deal and the accelerating demand for digital infrastructures, remoteness is reframed as an asset rather than a limitation: low population densities imply fewer spatial conflicts, vast land availability suggests infrastructural flexibility, and cold climatic conditions promise technical efficiency through reduced cooling demands. Abundant hydropower and expanding fibre-optic connections further integrate these northern territories into global systems of energy and data exchange.

Within this framework, Lapland can be understood less as a coherent geographic entity than as a territory assembled through grids, corridors, energy networks, and systems of extraction. Far from being isolated, the Arctic is deeply embedded within transnational energy infrastructures extending across Northern Europe.

Over the last century, Lapland has gradually transformed into a highly operationalized territory. Forestry and logging infrastructures were followed by large-scale hydropower developments along the Kemijoki River during the 1950s and 1960s, restructuring rivers, settlements, and regional economies around energy production.

Alvar Aalto's regional plan for Lapland in the 1950s reveals how the Lapland region was already conceived through infrastructural systems of energy production, settlement distribution, and territorial modernization during the post-war period. Nature with its rivers and water systems became a spatial driver for this expansion (Svenskberg 2025). Mining infrastructures extended the operationalization of Lapland territories beyond hydrological control toward systems of extraction and resource circulation.

Today, the region is increasingly positioned within Europe's green transition through renewable energy projects, mining developments, and emerging digital infrastructures. Rather than existing outside contemporary urbanization, Lapland has become deeply embedded within planetary systems of energy, extraction, and computation.

In this context, Lapland increasingly functions as what Brenner and Katsikis describe as a territory reorganized through infrastructures of circulation, extraction, and planetary support systems. The hinterland itself becomes operationalized. (Katsikis and Brenner 2020)

Hydropower dams continue to regulate rivers originally transformed decades ago, while transmission networks, mines, wind farms, and fibre-optic infrastructures introduce new territorial demands and spatial hierarchies. In this context, Lapland has become an increasingly attractive site for

Wilderness as a Strategic Asset

Historical Operationalization of Lapland

hyperscale data centers. Cold climates, access to hydropower and renewable energy, and existing integration into the European energy grid transform regions like Lapland into environments for computation.

At the same time, the apparent immateriality of digital infrastructure conceals extensive territorial and ecological dependencies. As Kate Crawford argues, artificial intelligence remains inseparable from the material systems that sustain it: mines, energy grids, labor networks, waste products, and logistical supply chains (Crawford 2021). Crawford and Joler's *Anatomy of an AI System* reveals artificial intelligence not as an end-product, but as an extensive network of different actors and processes. A data center in northern Finland is therefore only a small part in a bigger system. It is never only digital; it is part of a larger network and intensifies existing dependencies and environmental pressures.

As Ali Fard describes these spatial dependencies as “the infrastructural palimpsest at the core of the socio-technical production of planetary platforms” (Fard 2023, 192). Computation therefore does not detach itself from territory, but produces new operational relationships between energy, climate, infrastructure, and landscape. Rather than replacing one another, they accumulate and increasingly depend on one another within the same operational landscape.

On the site in Heikkilänranta, a small village along the Kemijoki River, 10km south of the city of Rovaniemi, this becomes explicitly spatial. The proposed data center site operates as a territorial intersection within the layered operational landscape of Northern Finland, where systems of energy production, logistics, extraction, ecology, and local support networks already converge. Infrastructure here accumulates. The quarry site itself — already extracted, cleared from forest, and zoned for industrial development — reveals that computation does not arrive within untouched wilderness, but inserts itself into landscapes that have long been operationalized through earlier cycles of extraction and infrastructural transformation.

Computation therefore intensifies existing spatial asymmetries between territorial burden and global circulation. While extraction, energy production, and environmental transformation remain territorially concentrated, their economic and computational benefits circulate elsewhere through planetary networks of logistics, capital, and data exchange. Energy generated in northern territories feeds distant urban centers and digital infrastructures, while localized mining, cooling demands, and ecological pressures remain embedded within the landscape itself. As authors such as Lassila argue, regions like Lapland risk functioning as contemporary “sacrifice zones” (Lassila 2025) within Europe's digital and green transition.

Computation and the New Frontier

During fieldwork in Pelkosenniemi, parts of an abandoned village house had been dismantled and relocated into tourist developments elsewhere in Lapland. What remained was less an architectural object than a fragment within a broader landscape of extraction and redistribution. The dismantled house became symptomatic of Lapland's contemporary territorial condition. Continuously reorganized through infrastructures of extraction, from tourism, logistics, to energy and computation. Extraction on all scales.

The data center therefore becomes territorial before it is architectural.

The House without Walls



Fig. 13 The House without walls (Tynkkynen 2024)

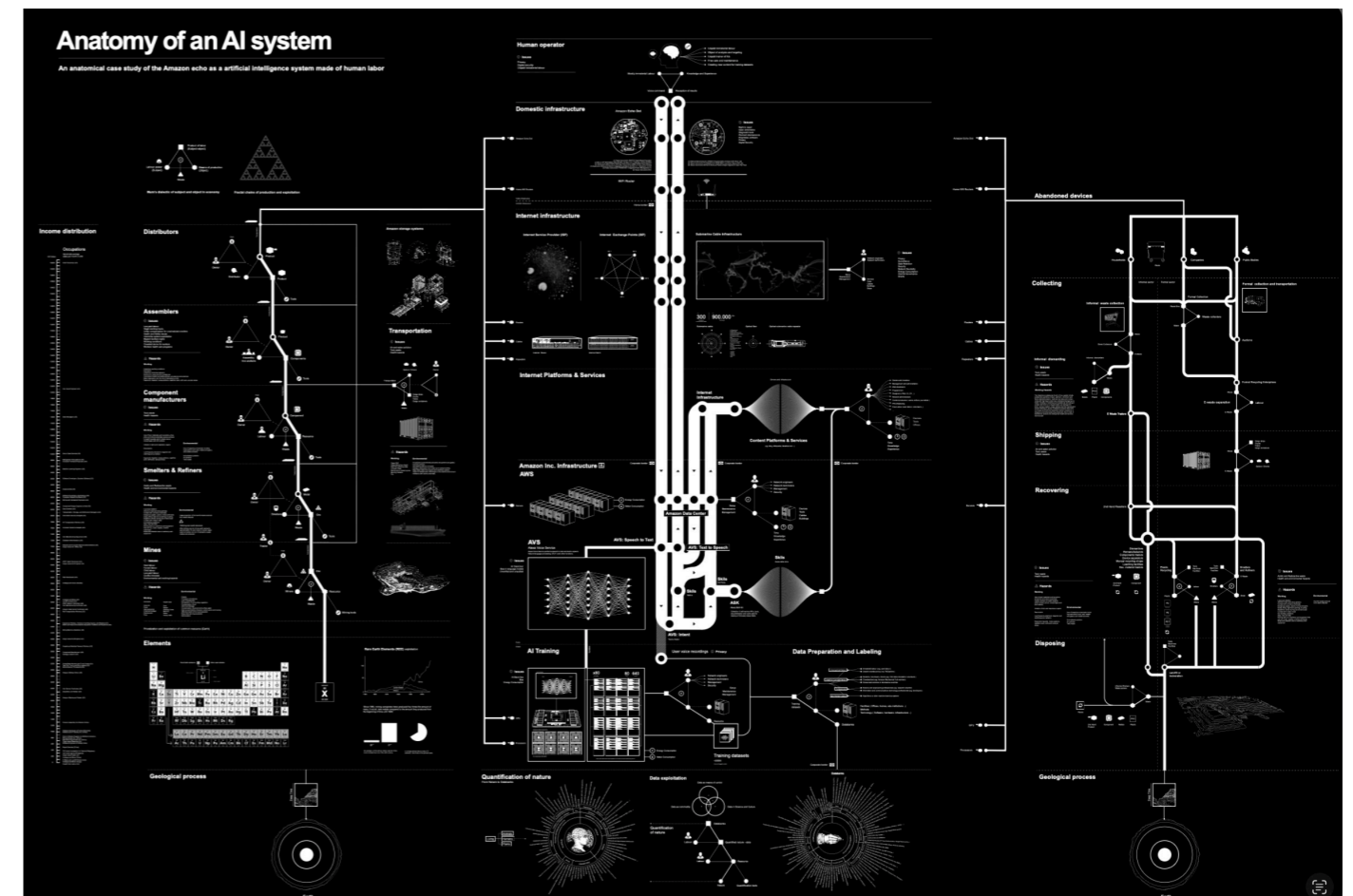


Fig. 14 Anatomy of an AI System – Diagram illustrating the territorial, ecological, and infrastructural systems underlying contemporary artificial intelligence (Crawford and Joler 2018)

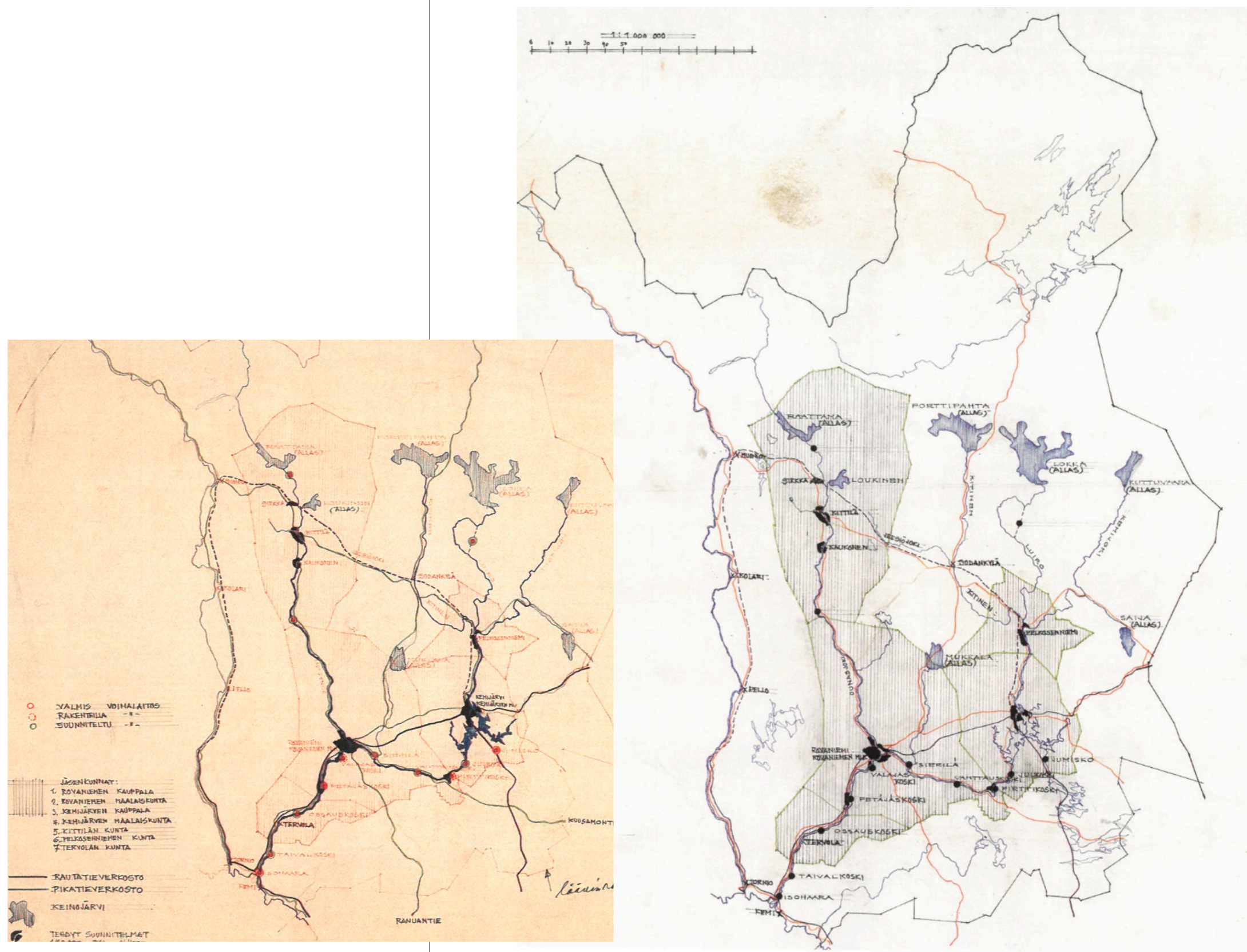


Fig. 15 Lapland Regional Plan – Regional planning drawing by Alvar Aalto illustrating territorial organization along hydropower and settlement infrastructures in Lapland (Aalto 1950s a)

Fig. 16 Nature-based Electricity Production System with Reservoirs and Dams – Territorial energy diagram by Alvar Aalto (Aalto 1950s b)



Fig. 17 Construction Works of the Pirttikoski Hydropower Plant Along the Kemijoki River in 1956 (Museum and Science Centre Arktikum 1956)



Fig. 18 Construction of the Pirttikoski Hydropower Plant During the Late 1950s (Museum and Science Centre Arktikum 1950s)



Fig. 19 Headframe of the Kärvasvaara Iron Ore Mine Near Kemijärvi in 1959 (Finnish Heritage Agency 1959)



Fig. 20 Mining Infrastructures in Kärvasvaara, Kemijärvi – Industrial extraction landscape during the late 1950s (Finnish Heritage Agency 1950s)

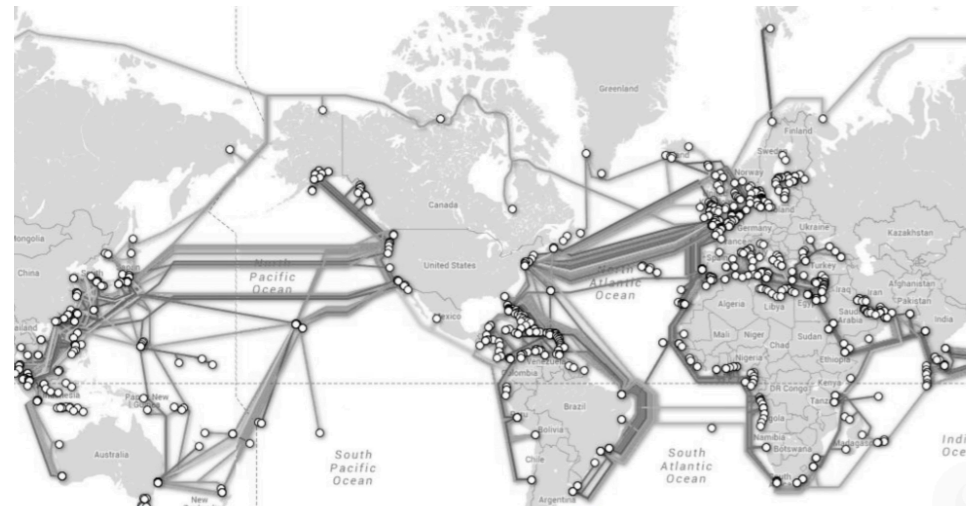


Fig. 21 Global Submarine Cable Network – Map illustrating submarine communication infrastructures (TeleGeography 2024)

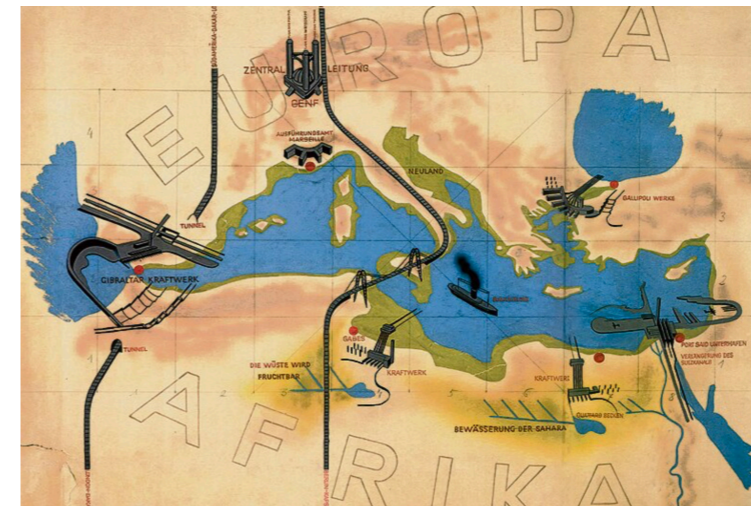


Fig. 23 Atlantropa Proposal — Continental hydropower vision by Herman Sörgel (Sörgel 1932)



Fig. 22 Northern European Transmission Infrastructure Map (ENTSO-E 2024)



Fig. 24 Map of ENEROPA – Territorial energy vision by OMA/AMO (OMA/AMO 2014)

ENERGY GRID AND SETTLEMENTS

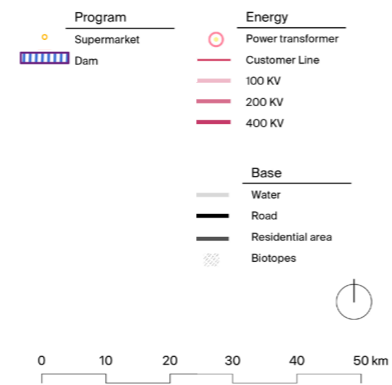
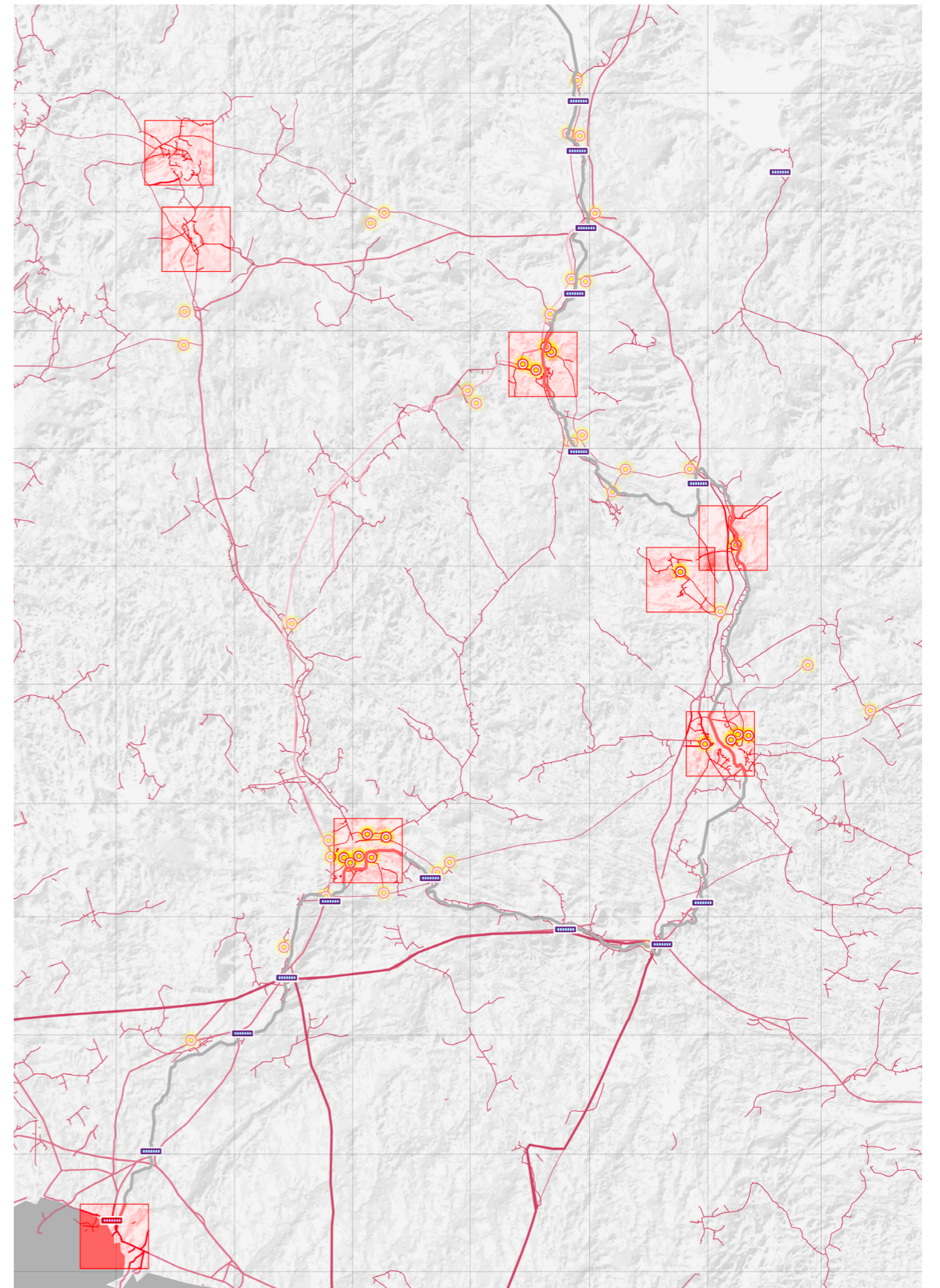


Fig. 25 MAP (Own illustration 2026)



TERRITORIAL
CROSS SECTION

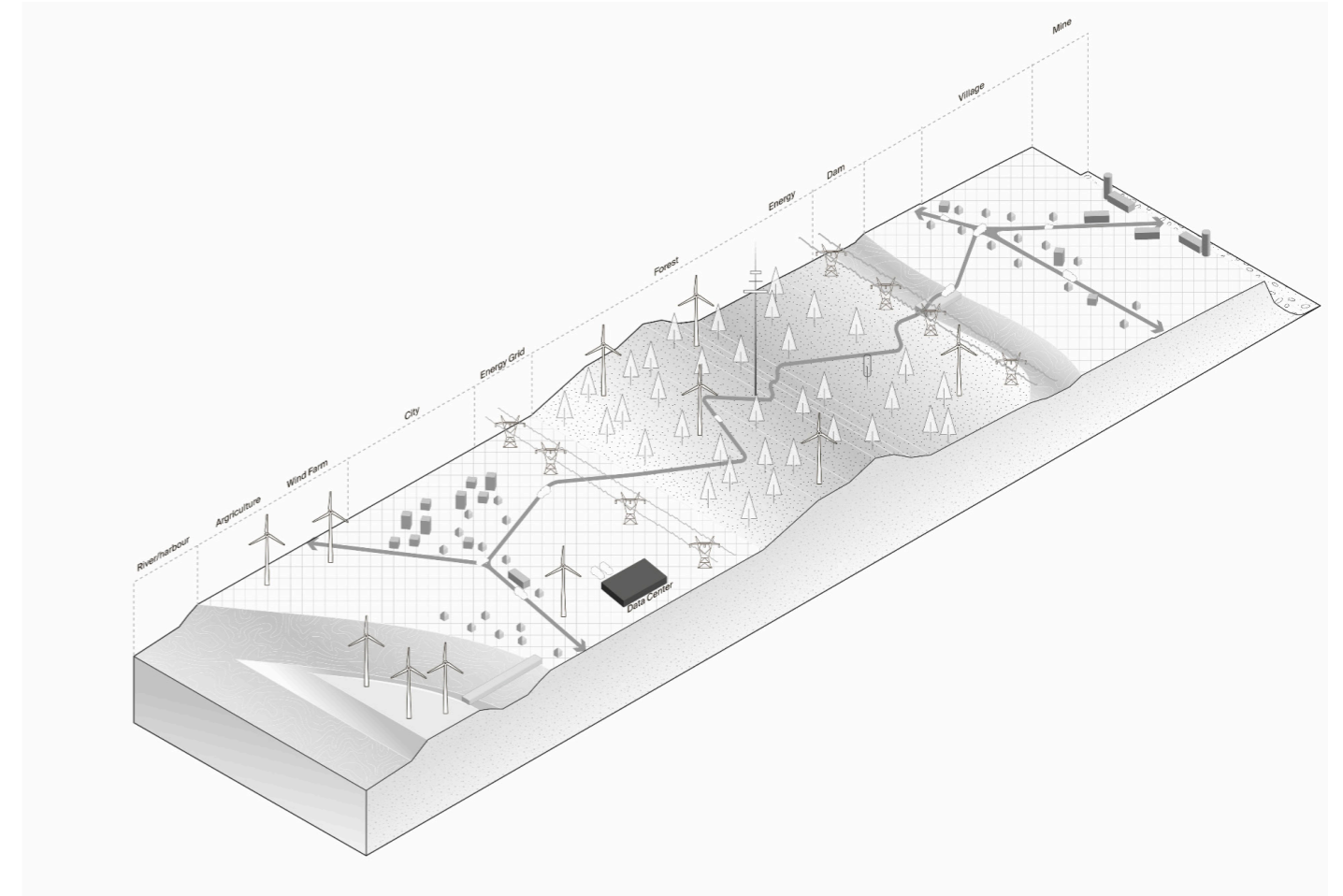


Fig. 27 Territorial Cross Section of Operational Landscapes (Own illustration 2026)

„NO MAN’S LAND“

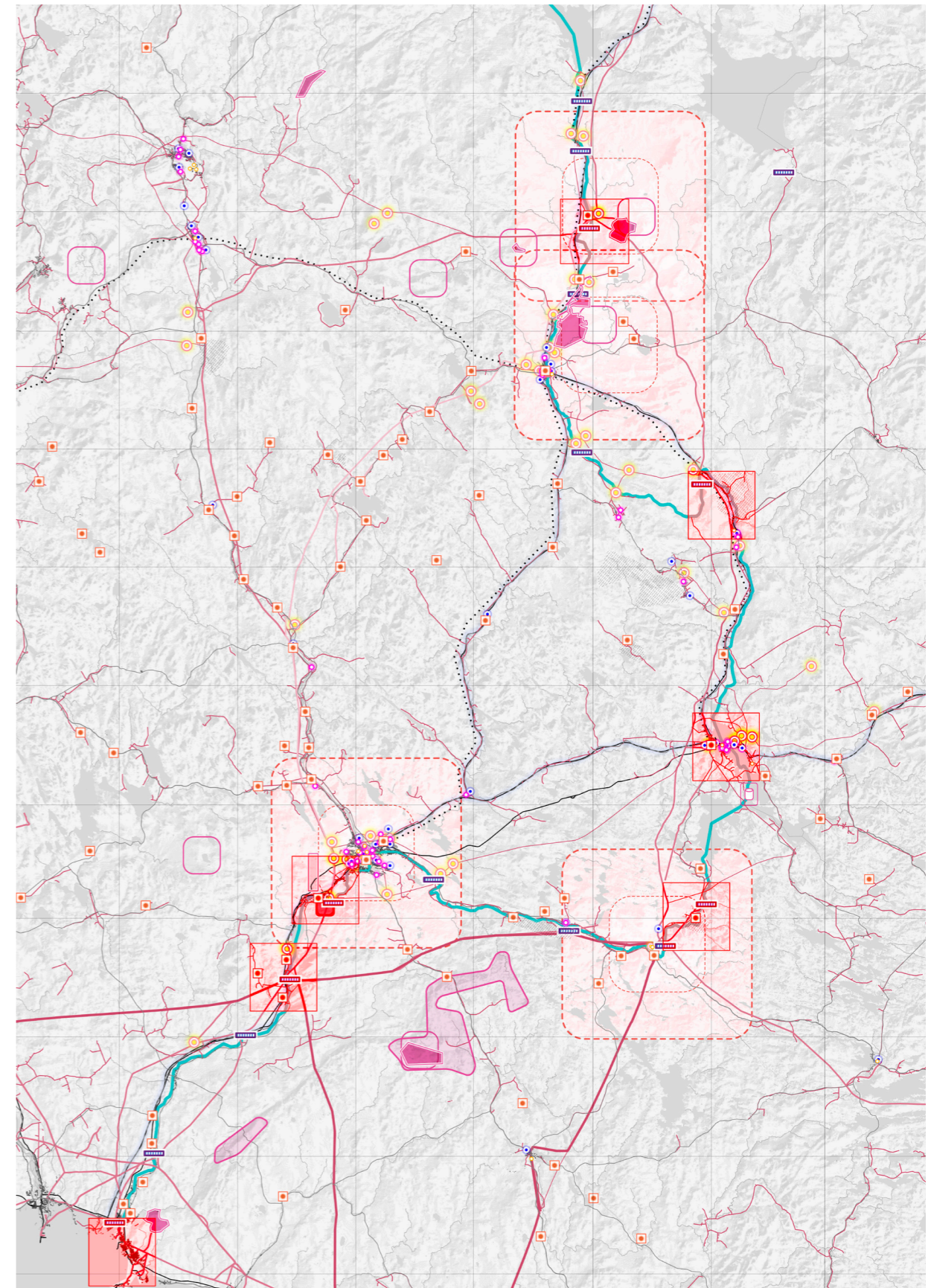
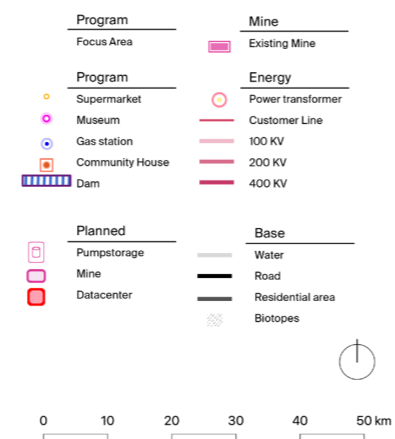
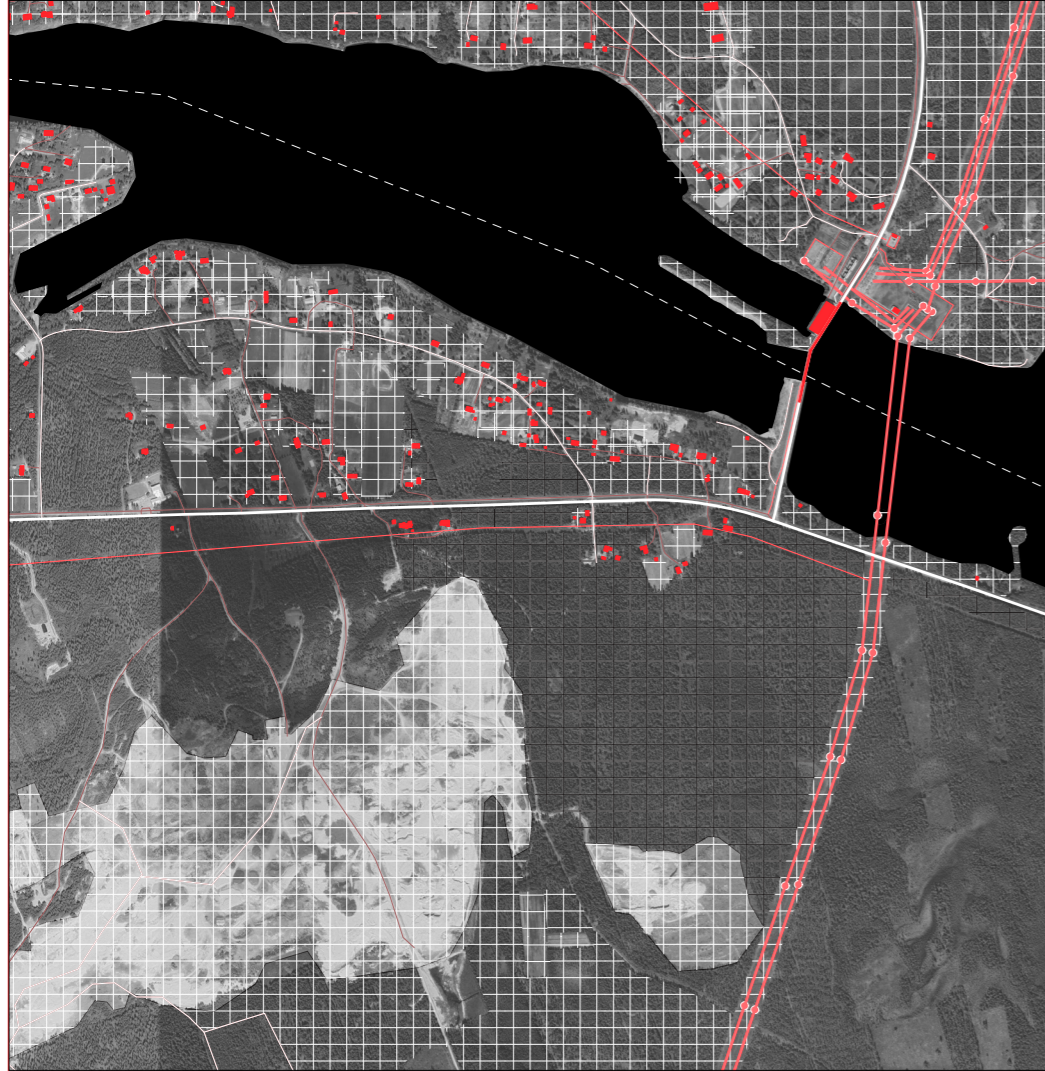


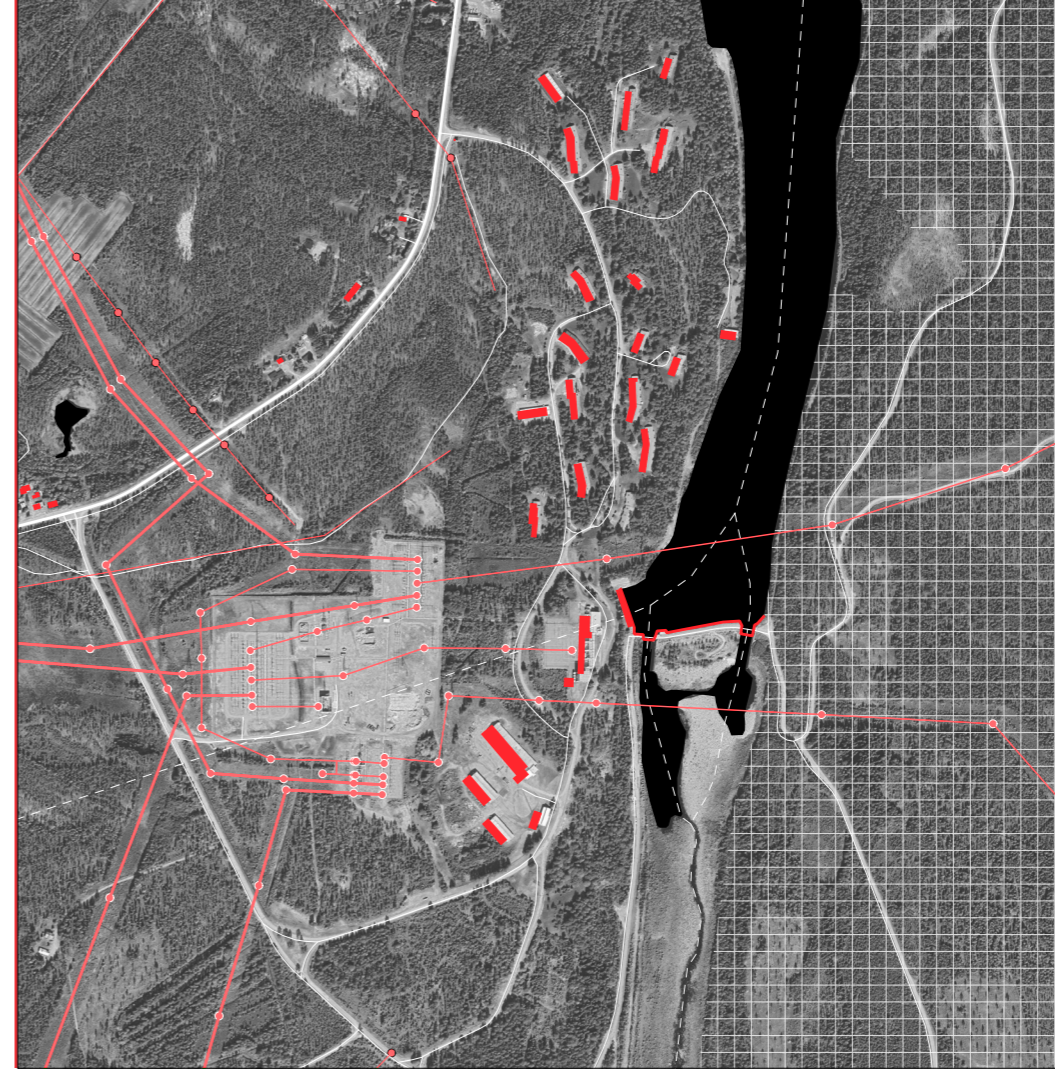
Fig. 26 MAP (Own illustration 2026)

ACCUMULATION OF
INFRASTRUCTURES



Valajaskoski Power Plant,
Rovaniemi

Fig. 28 Site Plan Valajaskoski (Own illustration 2026)



Pirttikoski Power Plant,
Rovaniemi

Fig. 29 Site Plan Pirttikoski (Own illustration 2026)

THE HOUSE OF THE
DATA CENTER -
CHOSEN SITE

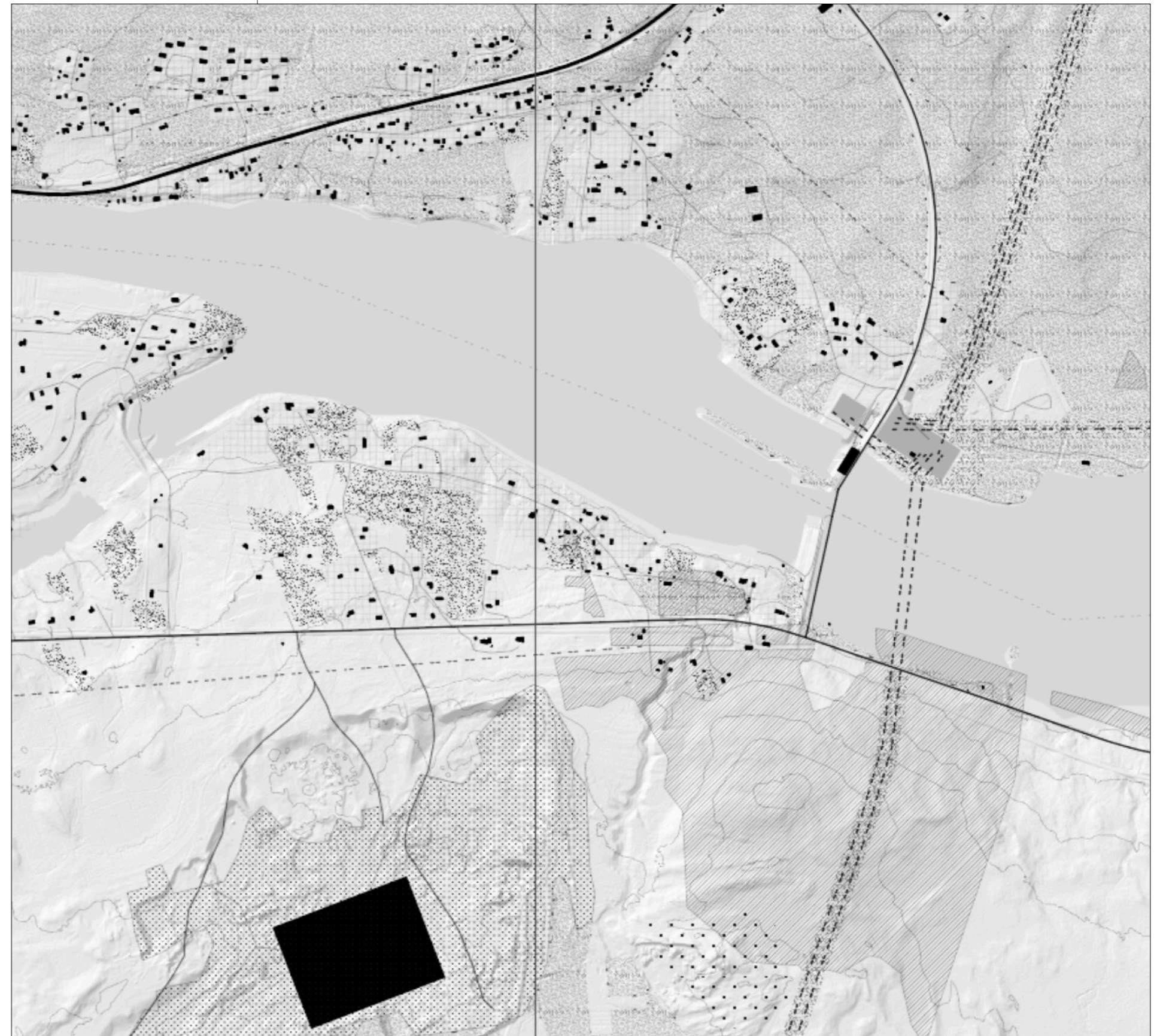
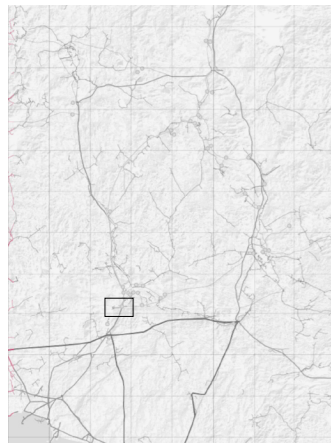


Fig. 30 Siteplan Valajaskoski with planned Data Center (Own illustration 2026)

We are no longer asked to observe landscapes, but to measure them. Sensors replace perception, and data defines what can be seen. What escapes measurement risks disappearing. Yet the more precisely the world is captured, the more it eludes us.

Hypothesis

THE HOUSE OF THE
DATA CENTER -
EXCLUSION ZONE



Fig. 31 Control center of computer rooms' air conditioners (Beyondtech 2016)



Fig. 32 Interior space Hamina Data Center (Beyondtech 2016)



Fig. 33 Colorful Pipes transporting water (Beyondtech 2016)

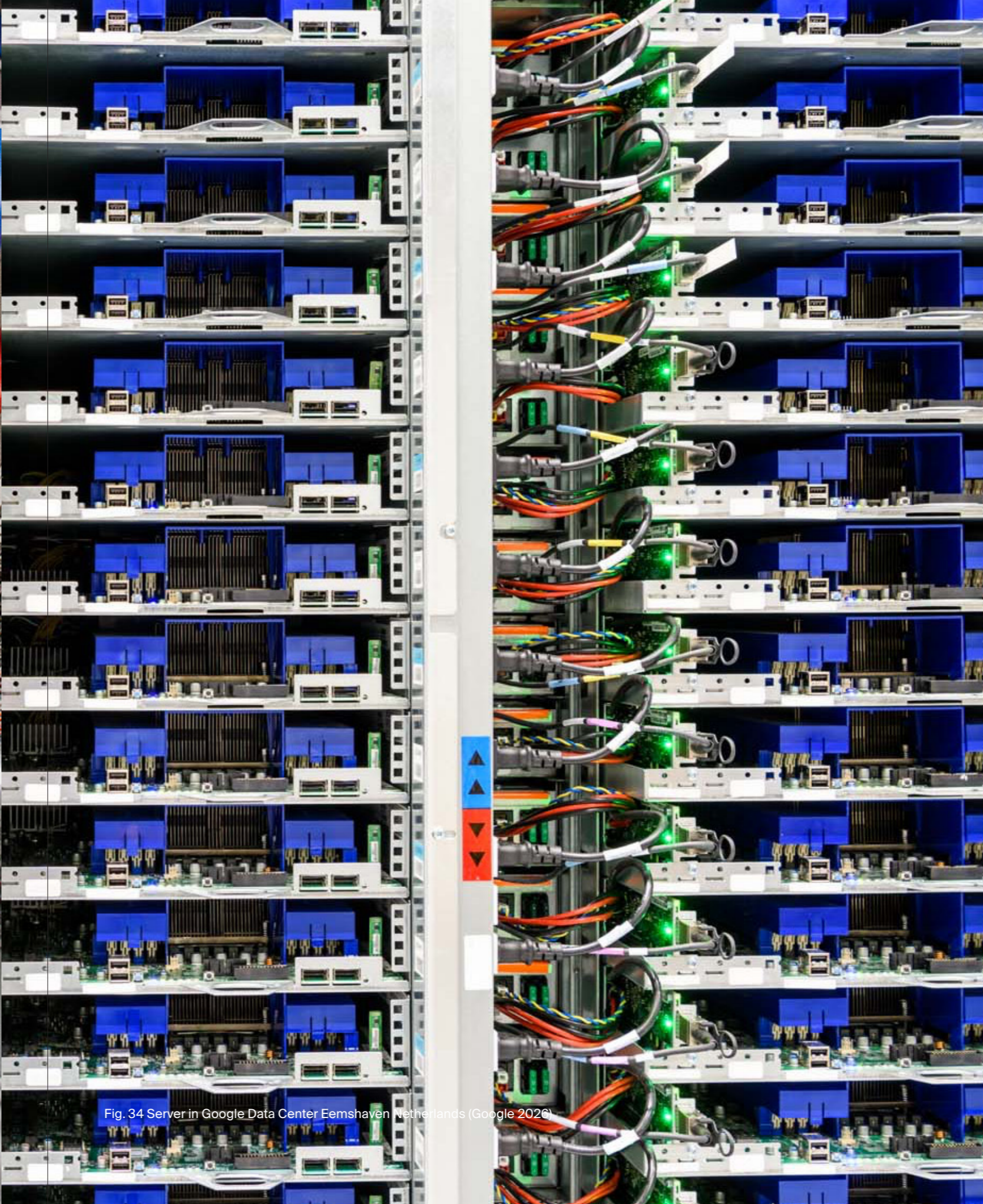


Fig. 34 Server in Google Data Center Eemshaven, Netherlands (Google 2026)

Hidden behind security perimeters, cooling systems, and controlled interiors, contemporary data centers operate as highly regulated environments optimized for continuity rather than human occupation. Their spaces are defined less by thermodynamic stability and infrastructural control. While sustaining everyday digital life elsewhere for the human, these architectures increasingly withdraw from societal visibility.

Infrastructure does not only organize flows in the territory, but also the conditions of their visibility. As Niklas Maak argues, the defining architectures of contemporary society, like the data center no longer appear as collectively symbolic spaces such as churches, stations, or civic institutions, but increasingly withdraw into invisible systems of capital, logistics, and computation (Maak 2022). Data centers on the one hand sustain contemporary everyday life while they on the other hand remain spatially distant from public visibility.

As Jesse LeCavalier describes, contemporary logistical environments increasingly function as exclusion zones: architectures optimized for automation, operational continuity, environmental control, and efficiency rather than human occupation (LeCavalier 2019). Hidden behind security perimeters, cooling systems, and controlled interiors, infrastructures such as data centers, dams, mines, and transmission networks become black-box environments in which human presence becomes secondary to operational performance (LeCavalier 2019). As Liam Young describes, they operate as “a world of information trapped behind a non-disclosure agreement, a formless facade and a security-patrolled fence” (Young 2019, 59).

Yet Data Centers and the cloud cannot be rendered invisible, as Kate Crawford notes, as they are deeply rooted in and running on “the exploitation of human labour” (Crawford 2021, 32). Labeling data, logistics, and the supply chain is in fact deeply human. From truck drivers, to technicians, to workers in India labelling our data to train AI. Or as Jenny Odell puts it into words, they are “deeply fully human at the same time” (Odell 2019, 35).

Next to the conclusion zone, the landscapes these infrastructures live from are no longer experienced directly, but through technologically mediated systems of control, sensing, and prediction. Satellite images, remote sensing technologies, and computational interfaces detach territory from lived experience, reducing complex environmental relations into measurable surfaces and operational datasets.

Bruno Latour describes this condition as a shift from situated perception toward “sliding abstraction” (Latour and Hermant 2006, 9). These operational landscapes are not neutral or purely technical environments, but spatial

The Human
Exclusion Zone

The Control Room /
Landscape as Data

systems structured through specific regimes of governance, management, and control. As Shannon Mattern argues, technical landscapes “index, materialize, and even render perceptible, the logics behind their own organization, management, and use” (Mattern 2022, 39). Their spatial organization reflects not only infrastructural requirements, but also “specific protocols of operation, legal codes, and systems of administration” (Mattern 2022, 39). The territory is framed not as lived thickness, but as a computable surface.

This abstraction is not neutral. As Ali Fard argues this abstraction “is necessary for its representation” (Fard 2023, 134). Environmental blindness is therefore not a flaw but a structural requirement: systems operate by excluding what cannot be measured, standardized, or optimized.

Projects such as Haus-Rucker’s OASE No. 7 reveal an early architectural fascination with technologically mediated environments. Inflatable climate bubbles and artificial atmospheres no longer positioned nature as something directly encountered, but as something technologically filtered and environmentally managed.

Similar spatial logics reappear today within greenhouse infrastructures retrofitted for server heat reuse, insulated tourist interiors, and computational environments optimized through continuous climatic control. Architecture increasingly separates humans from direct environmental exposure while simultaneously simulating intimacy with nature. Furthermore As Marina Otero-Verzier describes, such architectures operate as “Cartesian enclosures” (Otero-Verzier 2023, 115), where buildings become optimized interior climates detached from their territorial surroundings.

Rather than existing as opposites, nature and digital infrastructures become increasingly entangled through systems of sensing, optimization, and environmental management. The landscape itself becomes a controllable climatic medium. While the natural, the artificial, the machine and the human blindfold themselves from each other. What appears stable and optimized within operational models persists on site as seasonal, contested, and continuously shifting. The more precisely the territory is measured, the more it resists complete translation. The more it eludes what cannot be seen, and the more we distance ourselves from reality.

As Shannon Mattern suggests, sensing must occur from within rather than at a distance (Mattern 2022). This requires a shift from abstract monitoring toward local observation.

Artificial Natures
/ Cartesian
Enclosures



Fig. 35 Arctic Houses near Luosto (Own photography 2026)



Fig. 36 Mechanical Turk – Historical automation apparatus exposing hidden human labour (Kempelen 1770 reproduced in Crawford and Joler 2018)

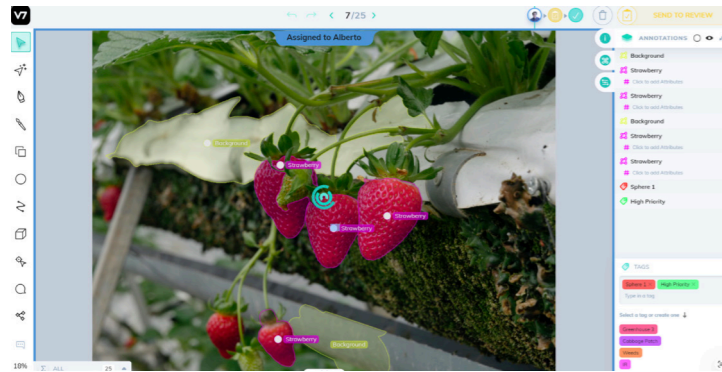


Fig. 37 Collecting and Labelling Data (Augmented AI 2023)

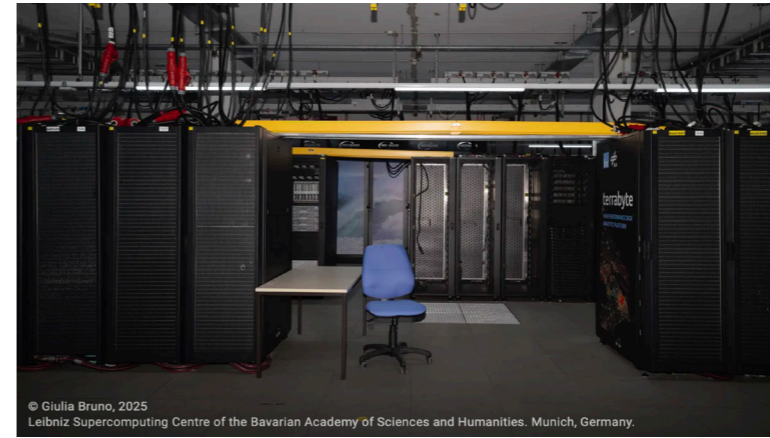


Fig. 38 Leibniz Supercomputing Centre, Munich (Bruno 2025)



Fig. 39 Project Cybersyn, Opsroom, Chile, 1973 (Barco 2021)



Fig. 40 Haus-Rucker-Co, OASE No.7 (1972) (Elephant Media 2022)

ENVIRONMENTAL
BLINDNESS

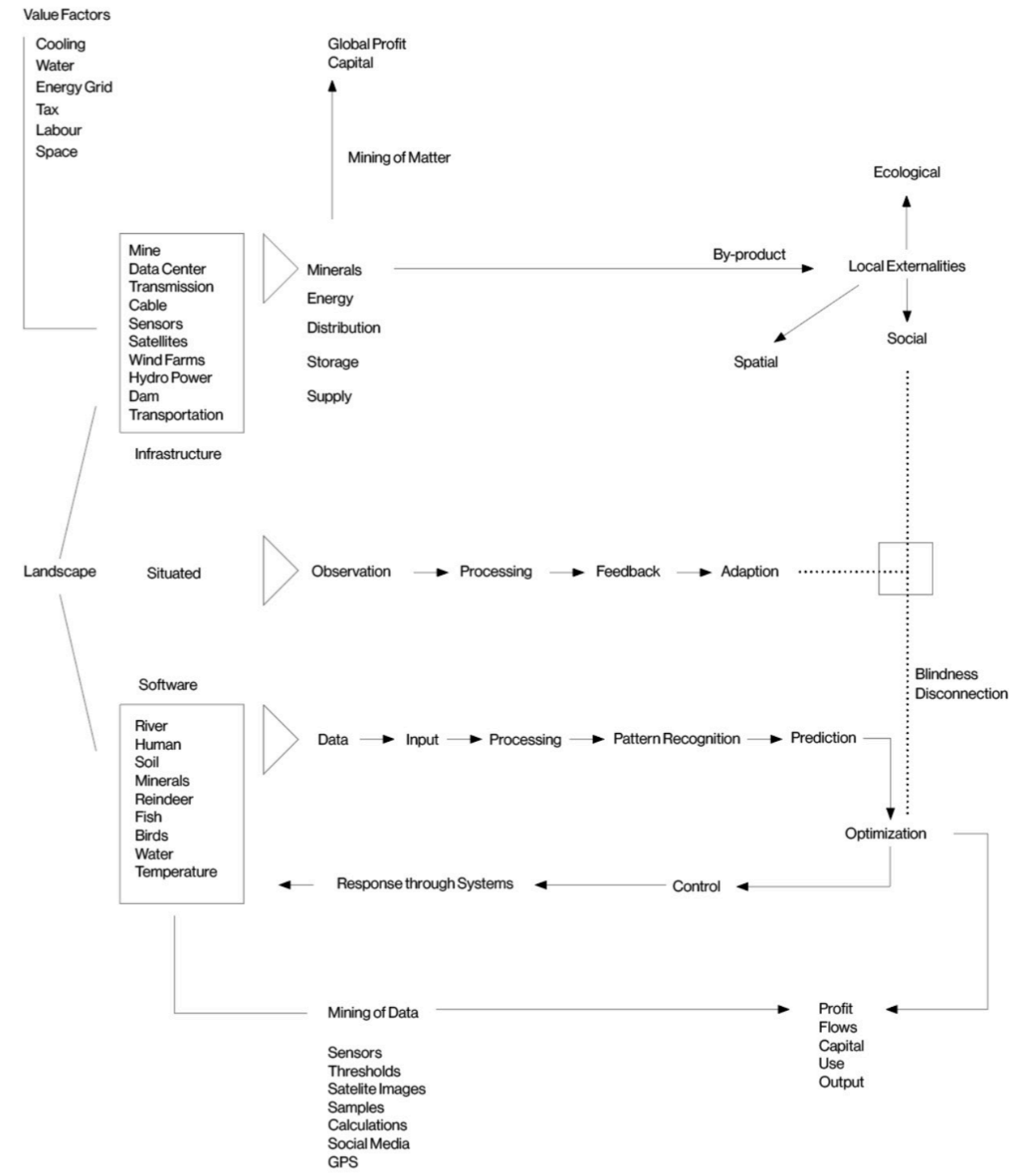


Fig. 41 Environmental Blindness (Own illustration 2026)

COMPONENTS OF THE MACHINE

- Summer**
Increased Water Dependency
Chillers activated
Evaporation increases
Thermal stress rises
- Winter**
Outside Air Cooling
Direct Cold Air Intake

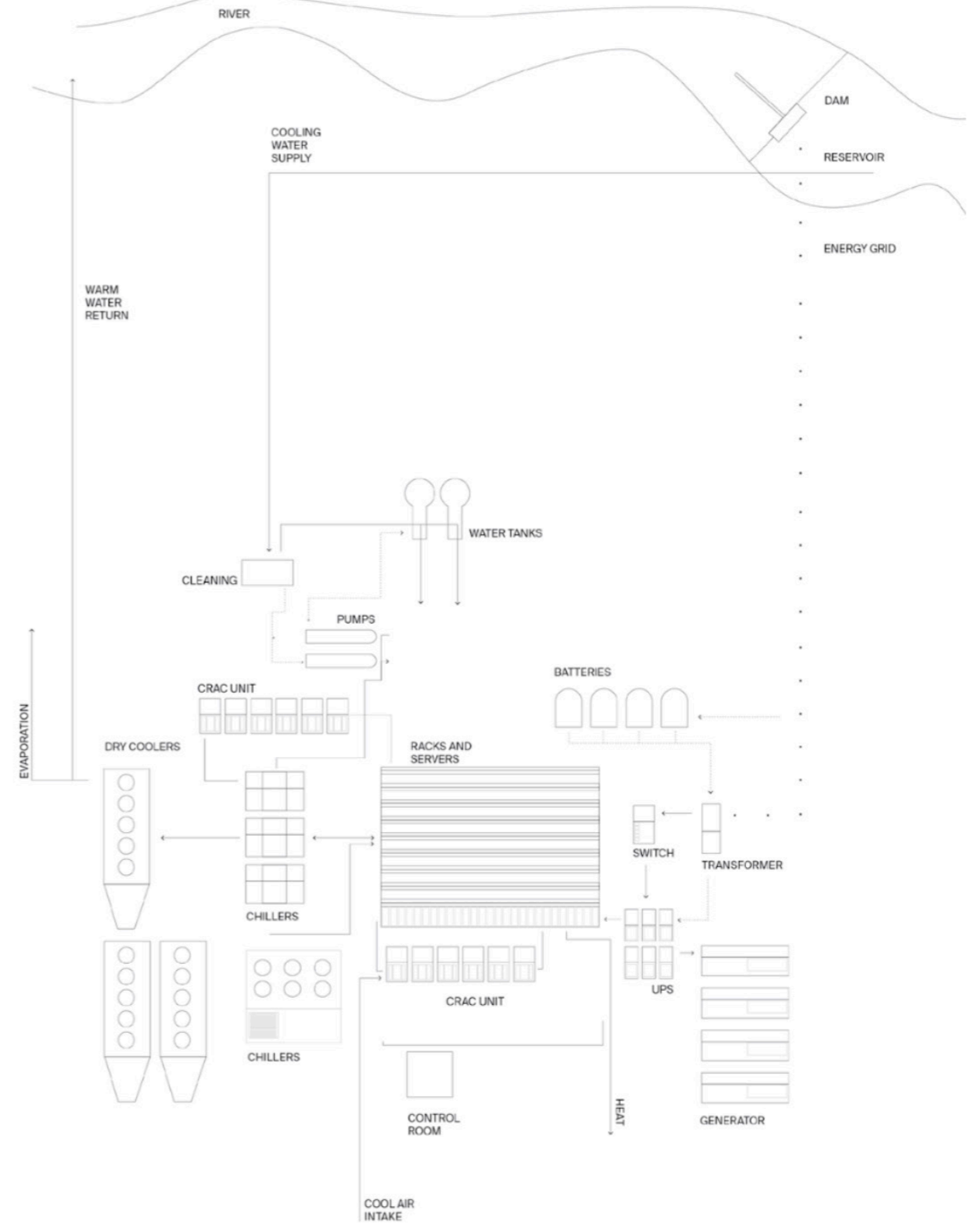


Fig. 42 Components Data Center(Own illustration 2026)

It would be a mistake to think of a river as simply flowing. In Lapland, water is captured, regulated, frozen, stored, and redirected through overlapping systems. From dam to data center, water in its different states no longer operates as part of a natural cycle, but as a medium embedded within infrastructures of energy, cooling, and computation.

Hypothesis



Fig. 43 The World without Water (Den Aardkloot van water ontbloot), 1694 by Thomas Burnet (Crawford 2021, 238)

Rivers become cooling systems, snow becomes a natural cooling medium. In Lapland, computation increasingly integrates itself into an already regulated hydrological landscape.

Water is not simply a natural resource moving through neutral landscapes, but a socio-technical and political medium through which territories are organized. As Jamie Linton argues, water is “what we make of it” (Linton 2010, 9), shaped through cultural, technological, and infrastructural practices. Building on this, Erik Swyngedouw demonstrates how the regulation of water simultaneously regulates access to energy, territory, labour, and ecological stability, unevenly distributing environmental burdens and infrastructural benefits across regions (Swyngedouw 2009). Water therefore operates not outside society, but within systems of governance, extraction, and modernization.

Maria Kaika further argues that rivers are “neither purely natural nor purely a human product; something that is materially produced as a commodity (and thus subject to social relations of production), but socially constructed as part of nature” (Kaika 2005, 53). Rivers emerge as hybrid socio-natural infrastructures shaped through technical intervention, political ambition, and territorial management. Hydropower dams, in this context, become “iconic embodiments of, and shrines to, a technologically scripted image and practice of ‘progress’” (Kaika 2005, 28), transforming rivers into regulated flows of energy while standardizing seasonal variation and displacing ecological consequences territorially.

In Lapland, these transformations remain clearly legible along the Kemijoki River. Throughout the twentieth century, hydropower modernization reorganized river dynamics for national energy production, severing salmon migration routes, increasing flooding, and restructuring settlement patterns across the region. At Pirttikoski, the construction of the dam was accompanied by worker settlements that embedded energy production directly into everyday life through housing, water filtration systems, supermarkets, saunas, and communal facilities. The river therefore operated not only as a geographical feature, but as territorial infrastructure organizing labour, settlement, and social reproduction.

These developments were closely tied to post-war reconstruction and regional modernization. In 1945, Alvar Aalto led the replanning of Rovaniemi and later developed the Regional Plan of Lapland, aiming to integrate industrialization, settlement, infrastructure, and landscape into a coherent territorial vision. Rather than treating Lapland as a remote periphery, Aalto approached it as a connected territory structured along the river and its infrastructural systems (Svenskberg 2025). Nature and infrastructure were not conceived as opposites, but as interdependent components within a

Water Does Not
Simply Flow

broader project of modernization.

Today, many of these infrastructural landscapes persist under changing economic and technological conditions. Media analysis demonstrates that water-related concerns remain central within public discussions surrounding infrastructural development in Lapland. Recurring issues include groundwater contamination, ecological impacts of hydropower regulation, mining runoff, and increasing industrial pressure on freshwater systems. At the same time, settlements once organized around hydropower maintenance have gradually fragmented as labour systems became centralized and increasingly automated. Fieldwork interviews revealed how houses remain vacant throughout winter months, while local services disappeared alongside the workers they once supported.

The river therefore continues to operate as territorial infrastructure, but under new operational logics increasingly shaped by automation, extraction, and environmental management. Within this already regulated hydro-social landscape, data centers introduce a new phase of infrastructural transformation in which rivers, groundwater, and snow become integrated into systems of computational cooling and thermal control.

Contemporary data centers extend rather than disrupt this hydraulic trajectory. The data center requires vast quantities of water and cooling capacity in order to maintain continuous computational operation. Most hyperscale facilities operate through heat-exchange systems in which water absorbs thermal loads from servers before being cooled, filtered, and recirculated through continuous cooling loops. As servers operate continuously, large amounts of heat are generated that must constantly be removed in order to maintain stable computational performance. While winter temperatures allow the use of cold outside air in Lapland, summer peaks increasingly depend on water drawn from already regulated rivers and groundwater reserves.

Water links river, reservoir, grid, and server into a continuous chain.

In many ways, the contemporary data center operates as a new hydraulic monument. Like the dam, it regulates water and depends on continuous environmental regulation and territorial support systems. Yet unlike the monumental visibility and architecture of hydropower infrastructures, computational architectures increasingly withdraw behind controlled interiors and exclusion zones as argued in the previous chapter.

Across the territory, water becomes redirected, delayed, filtered, exposed, stored, and extracted through overlapping systems of environmental management. Within these water topologies, the data center emerges as

The Data Center as
Hydraulic Monument

a parasitic element that attaches itself to inherited hydrological capacities of storage, cooling, and energy production while displacing many of its environmental consequences across the landscape. As Bélanger argues, landscape increasingly functions as a medium through which natural systems are reorganized to support infrastructural processes (Bélanger 2017). The river, the climate, the snow become active parts of the functioning of the data center.

The promise of renewable energy and cold climate conditions in Lapland therefore conceals a more fragile territorial reality. Despite air cooling during winter months, computation still depends on extensive cooling capacities, water extraction, and environmental regulation during warmer periods. The ecological consequences of these dependencies increasingly accumulate across rivers, groundwater systems, and local landscapes.

Snow already functions as a seasonal climatic agent within the cooling logic of Data Centers in northern territories. Stored across winter months, it can operate as a thermal buffer during summer periods. Similar systems have been explored in Japan, where accumulated snow is preserved and reused as a passive cooling medium for data centers, demonstrating how frozen water can function as long-term thermal infrastructure. The Japanese “Yukimuro” technique, for example, uses stored snow to maintain stable low temperatures throughout the year (Government of Japan 2022). More recently, the architecture office Kei Kaihoh has translated this principle into contemporary architectural structures.

Within Lapland, snow accumulation along roads, logistical corridors, and urban edges around Rovaniemi begins to establish new relationships between winter maintenance systems and future computational cooling demands. Snow therefore no longer appears solely as seasonal excess, but as a stored environmental resource capable of redistributing cooling capacity across time. Through its thermal mass and insulating properties, accumulated snow becomes a medium through which seasonal climate, infrastructure, and computation are increasingly interconnected.

Frozen Water - Snow
as Thermal Medium



Fig. 44 Power Plant Along the Kemijoki River, 1960s (Finnish Heritage Agency 1960)



Fig. 45 Savukoski Along the Kitinen River 1930s (Arktikum Science Centre 2026)



Fig. 46 Pirttikoski, Rovaniemi – Photograph by Tauno Stenroth, 1960s.(Arktikum Science Centre 2026)
 Fig. 47 Worker Houses at Pirttikoski Rovaniemi (Own photography 2026)

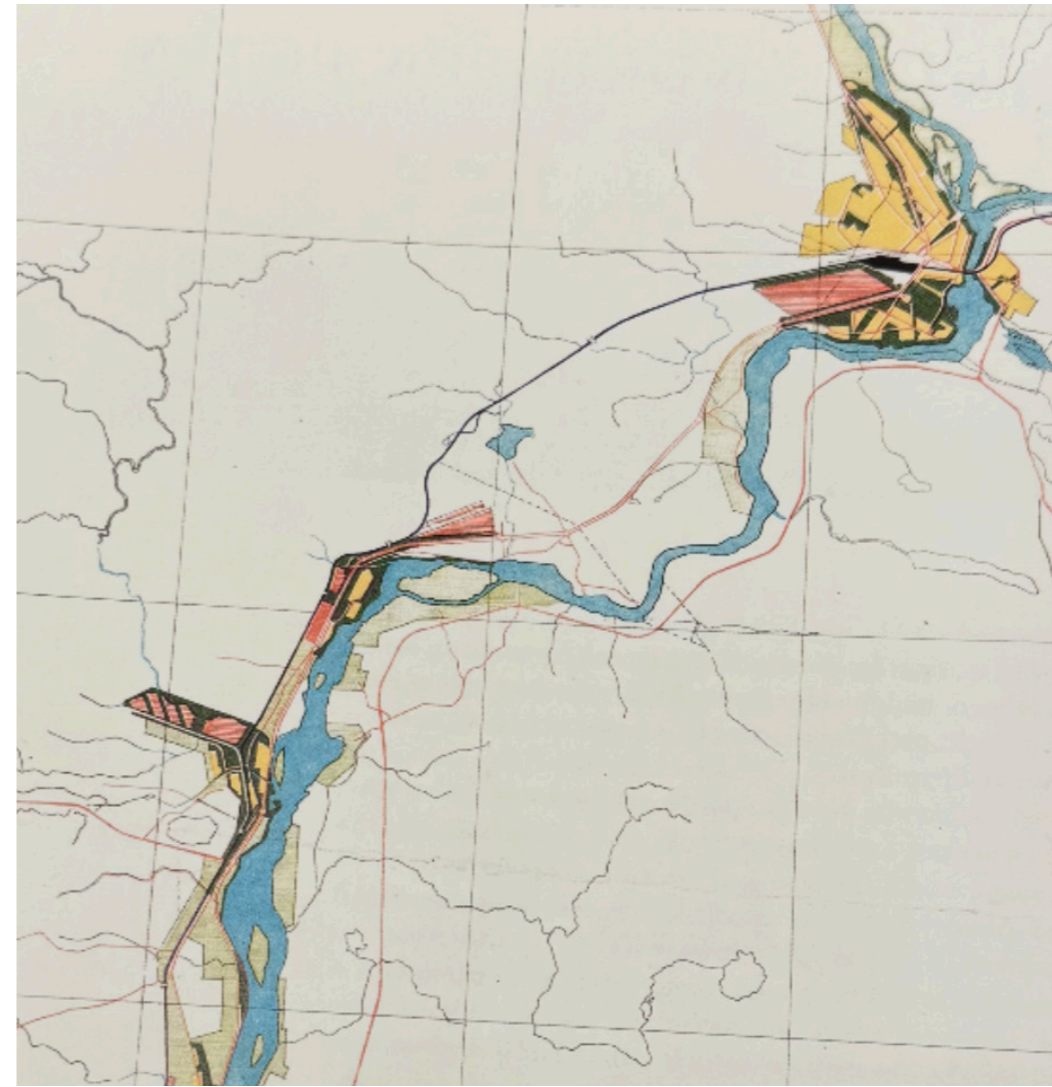
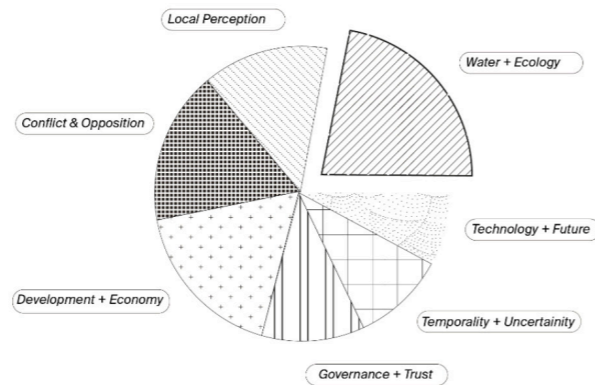
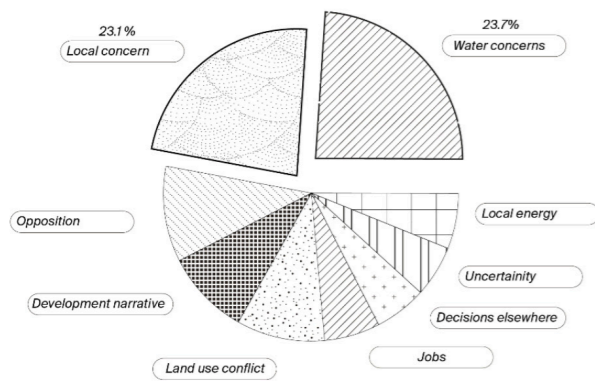


Fig. 48 River Towards Kemi by Alvar Aalto (Aalto 1950s a)

MEDIA ANALYSIS

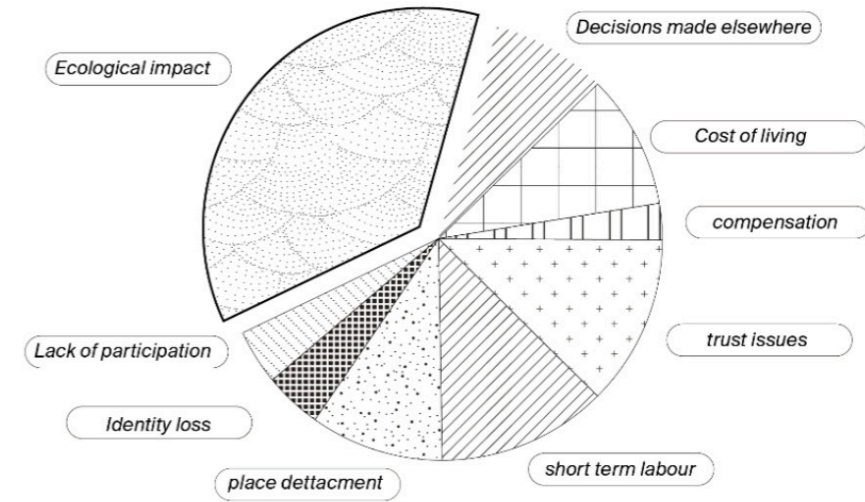
Aim:
Identify how large-scale infrastructures (energy, mining, data, transport) along the Kemijoki corridor are discussed in relation to social impacts, territorial conflicts, perceptions, and everyday life.

Dataset: 150 coded articles
Timeframe: 2021-2026
Source: Regional newspaper Lapin Kansa
Search Topics: Hydropower / Mining / Grid / Road / Data Center / Housing / Labour
2nd Cycle: Focused analysis on *local concerns* and *water concerns*
Method: Qualitative coding and thematic clustering with Atlas.ti



second-cycle coding (Saldana)

Local Concerns
33 codes



Water concerns
34 codes

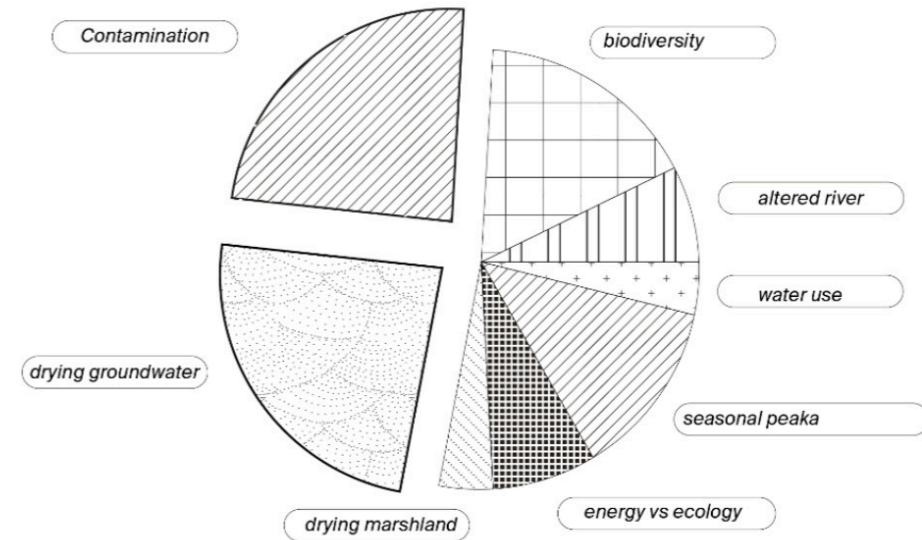


Fig. 49 Media Analysis Diagram (Own illustration 2026)

RIVER AS INFRASTRUCTURE

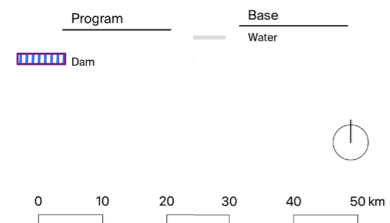
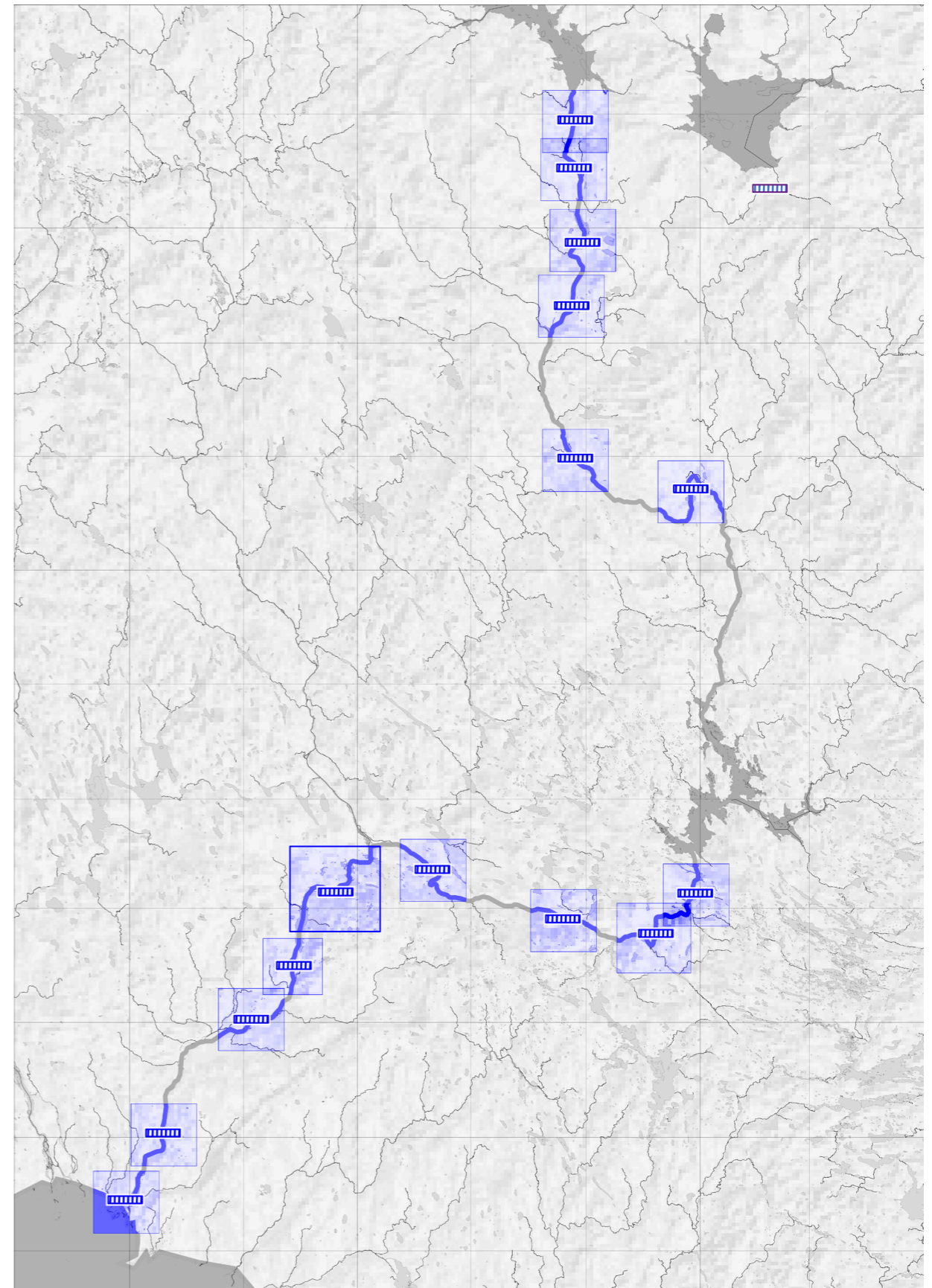


Fig. 50 Hydropower Infrastructure and Reservoir Systems Along the Kemijoki and Kitinen Rivers
(Own illustration 2026)



SNOW WASTE
STREAMS

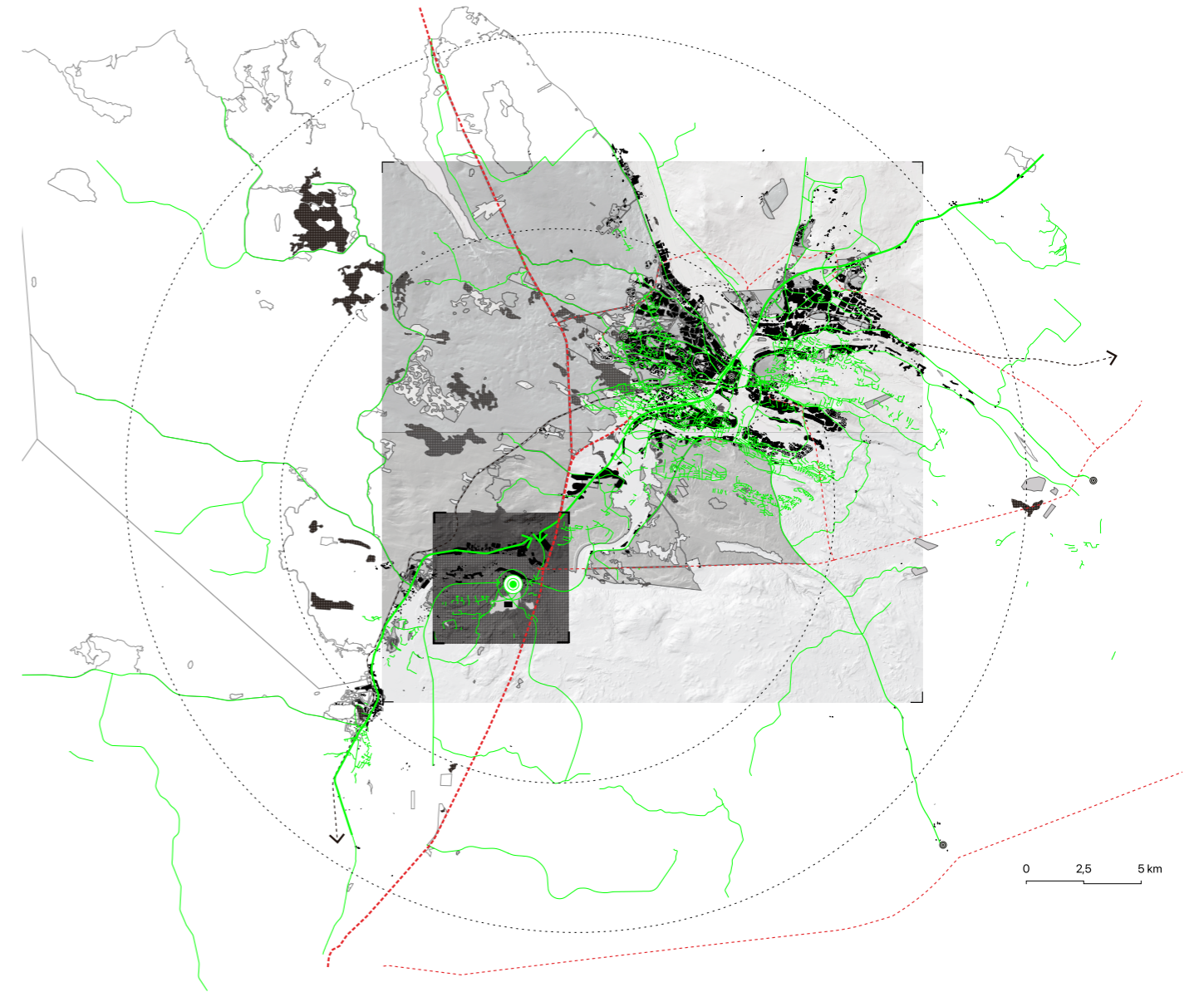
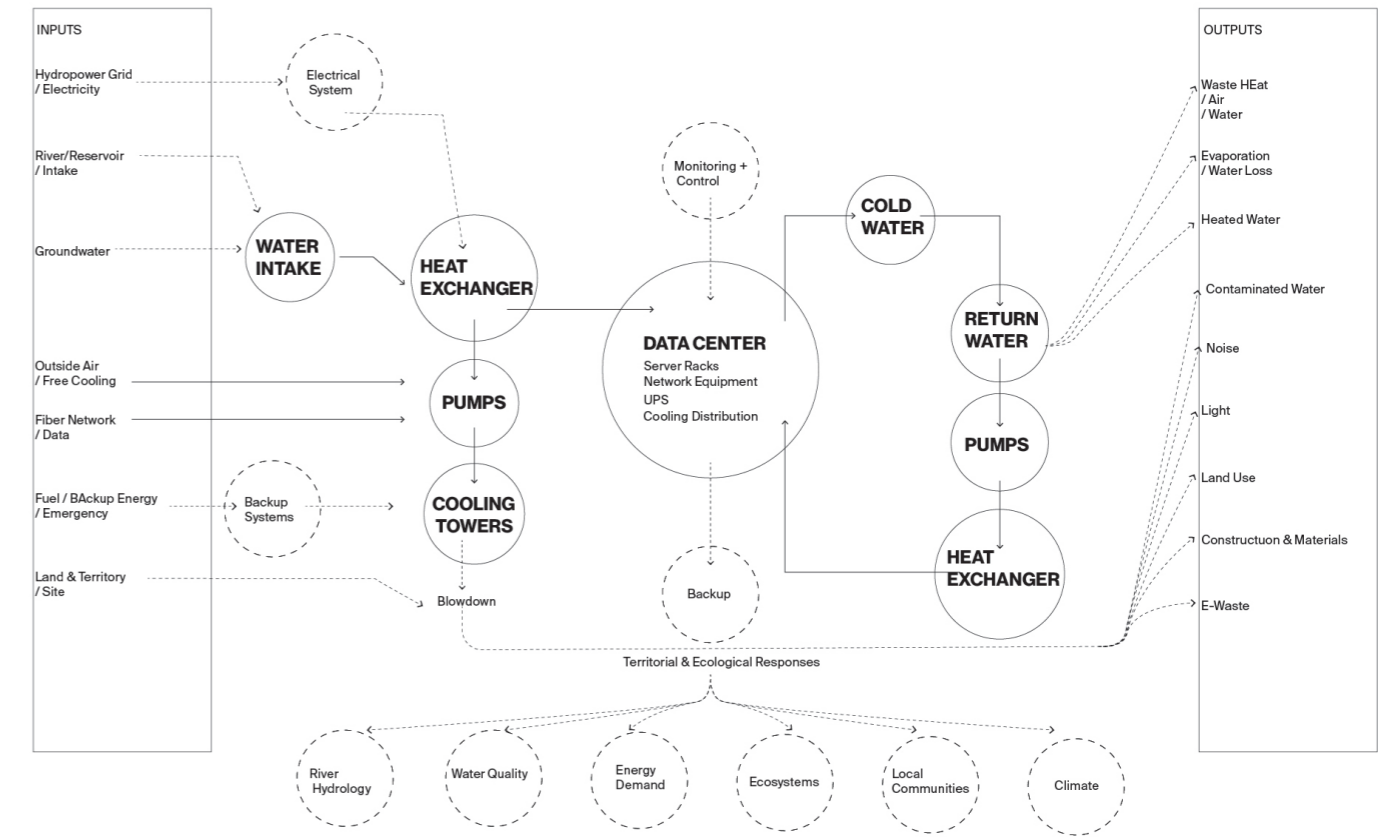
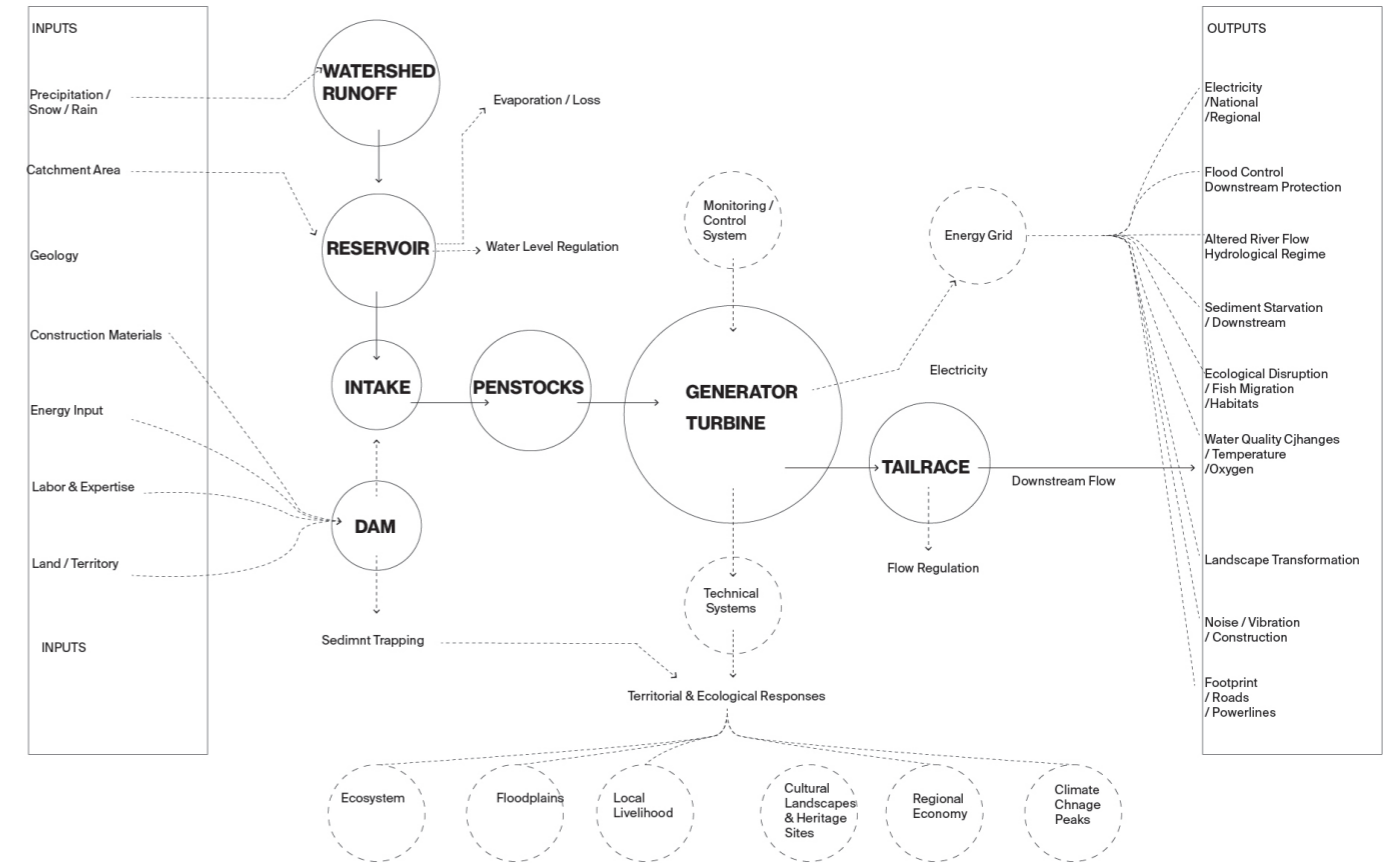


Fig. 51 Rovaniemi Regional Map (Own illustration 2026)

ANATOMY OF THE DAM AND DATA CENTER



○ EXTERNAL SYSTEM
 ○ INTERNAL SYSTEM
 - - - IMPACT
 - - - WATER

Fig. 52 Anatomy of the Dam (Own illustration 2026)
 Fig. 53 Anatomy of the Data Center (Own illustration 2026)



Fig. 54 Snow Storage Interior by Kei Kaihoh (Suizu 2023)



Fig. 55 Snow Storage Exterior by Kei Kaihoh (Suizu 2023)

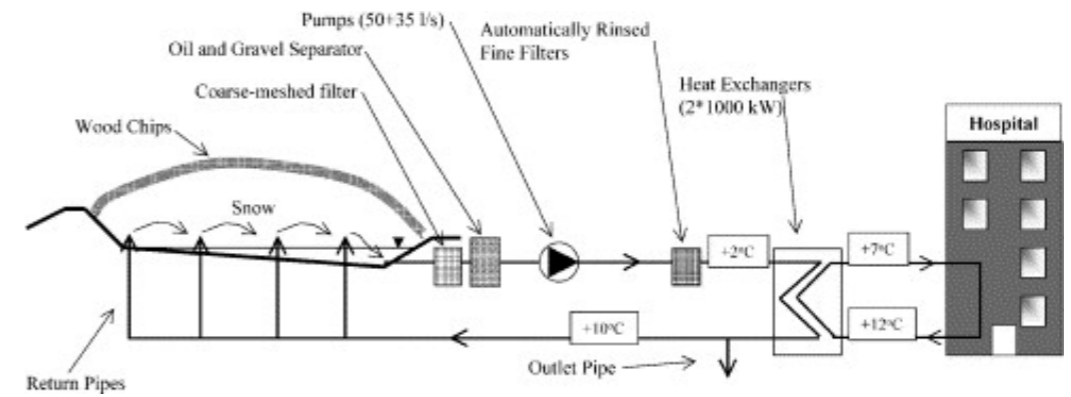


Fig. 56 Schematic drawing of Snow Storage System (Skoksberg 2001)

SEQUENCE 02
Observatories

In order to complement the spatial mapping and media analysis conducted during the initial phase of the research, a field trip to Northern Finland was carried out in March 2026. The journey followed the Kemijoki river corridor from Rovaniemi toward Sodankylä. The field trip aimed to move beyond the position of the architect as a distant observer. Instead of operating from a conceptual control room, the research sought to experience the territory directly through weather, social interactions and distances. Travelling through the landscape revealed aspects that remain invisible within remote analysis alone.

During the field trip, a series of site visits and informal conversations were conducted. These encounters provided insights into how global infrastructural developments intersect with local livelihoods and ecological systems. It became evident how difficult it is to understand all the challenges. The impression was, it can not be seen black and white. While the region is dependent on extraction and new investments as well as tourism, the effect and burden it has on the landscape is clearly visible. Energy peaks, black outs and military presence shaped my visit. The landscape felt like the nexus of our future and today. It was difficult to feel all these different perspectives of the place next to each other. Local memories and tourist stories make the place feel as artificial as it feels real.

Unexpected discoveries, archive images, locally produced maps documenting historic buildings and local resistance, revealed additional layers of the region's spatial history. My observations mainly focused on the local networks and service architectures that make everyday life possible. From coffee place visits to gas station stops, and water towers, the landscape is not only the infrastructures we see from the top and not the tourist arctic safari that is sold on social media. It's this in between that I encountered that makes one layer of all these others and acts as a connector.

Throughout the fieldwork one recurring theme remained present: hope. Despite the many challenges facing the region the people I met expressed a strong commitment to maintaining local culture, community life, and connection to the landscape. "Living here is a choice" (Fieldwork interview 2026). This choice often involves balancing economic opportunities with the preservation of identity, nature, and cultural traditions. Many of the people I spoke with were deeply aware of these tensions and actively searching for ways to navigate them. Maybe the role of the architect may lie in understanding contexts, connecting people, and translating complex systems into spatial possibilities.

Entering the Land

The fieldwork clarified something fundamental: landscapes such as Lapland cannot be understood through a single narrative. Understanding all the layers is the first step towards imagining how future infrastructures might not only extract resources from the region but also contribute to supporting the communities and landscapes that sustain them.

During the trip, I was told that even as an outsider, I had come to understand this place—the people, their lives, and their struggles. And that even if I am the only one whose perspective shifted through this journey, perhaps that alone is already a success. I came with a lot of questions and left with even more. What is this place going to look like tomorrow between climate change, material extraction and energy production? How much is still invisible to me? How can we save places like that with all their richness and at the same time invest into our future?

Together, these materials form an empirical layer of the research that complements the territorial analysis and informs the identification of the program for the architectural intervention. The insights gathered during the journey were documented in the following photobook.

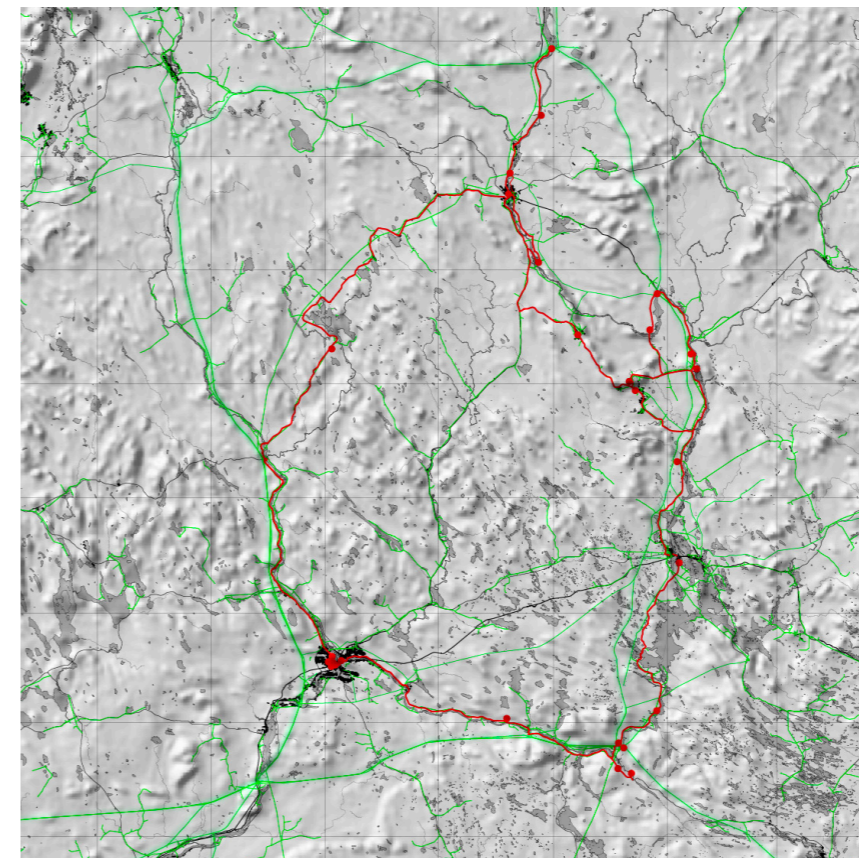
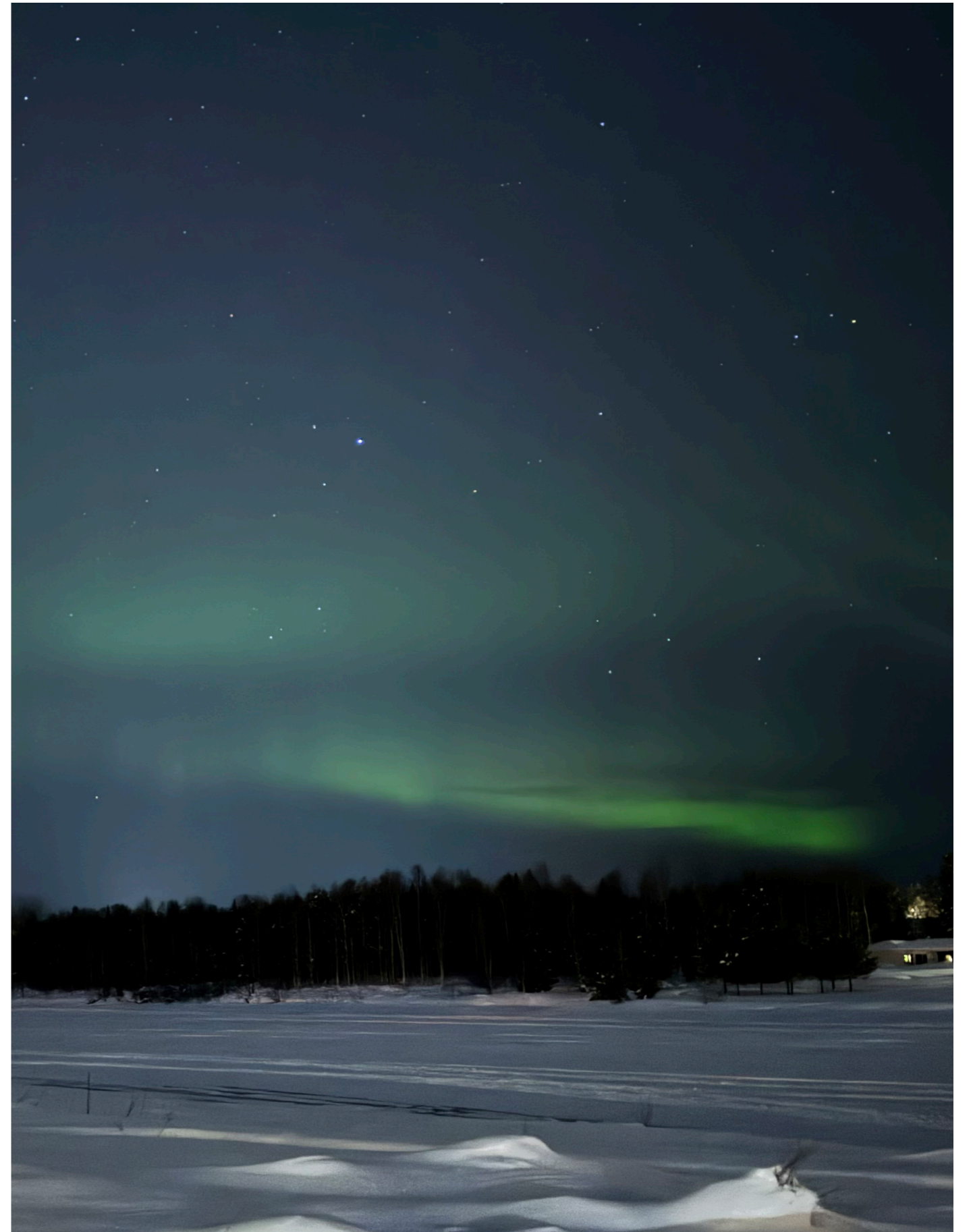


Fig. 57 Map of Fieldtrip (Own illustration 2026)































SEQUENCE 03
Layered Landscape

Behind the apparent automation of energy and computational systems lies a dispersed network of architectures that sustain labour, maintenance, mobility, and everyday life across the territory. Small scale architectures provide functions that make life for the human and non-human possible and that are part of a larger territorial network.

Hypothesis

Along the Kemijoki corridor, a dispersed network of everyday infrastructures supports life within the territory. Roadside gas stations, community houses, antennas, pumping stations, snow trucks, worker housing, and storage buildings form a subtle yet critical layer between large-scale infrastructural systems and local everyday practices. While energy grids, extraction industries, and data infrastructures reorganize the territory at a planetary scale, these smaller architectures sustain forms of maintenance, coordination, repair, and social interaction on the ground. They operate as territorial support systems: spaces where logistical, ecological, and social processes intersect within the everyday life. Individually, these elements may appear disconnected or even mundane. However, when considered in relation to one another, they begin to expose the logic of the local network and their importance.

Local Networks

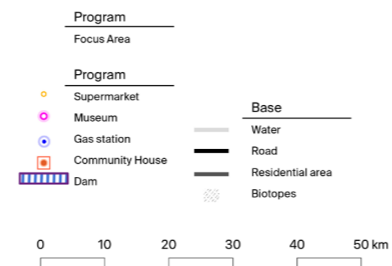
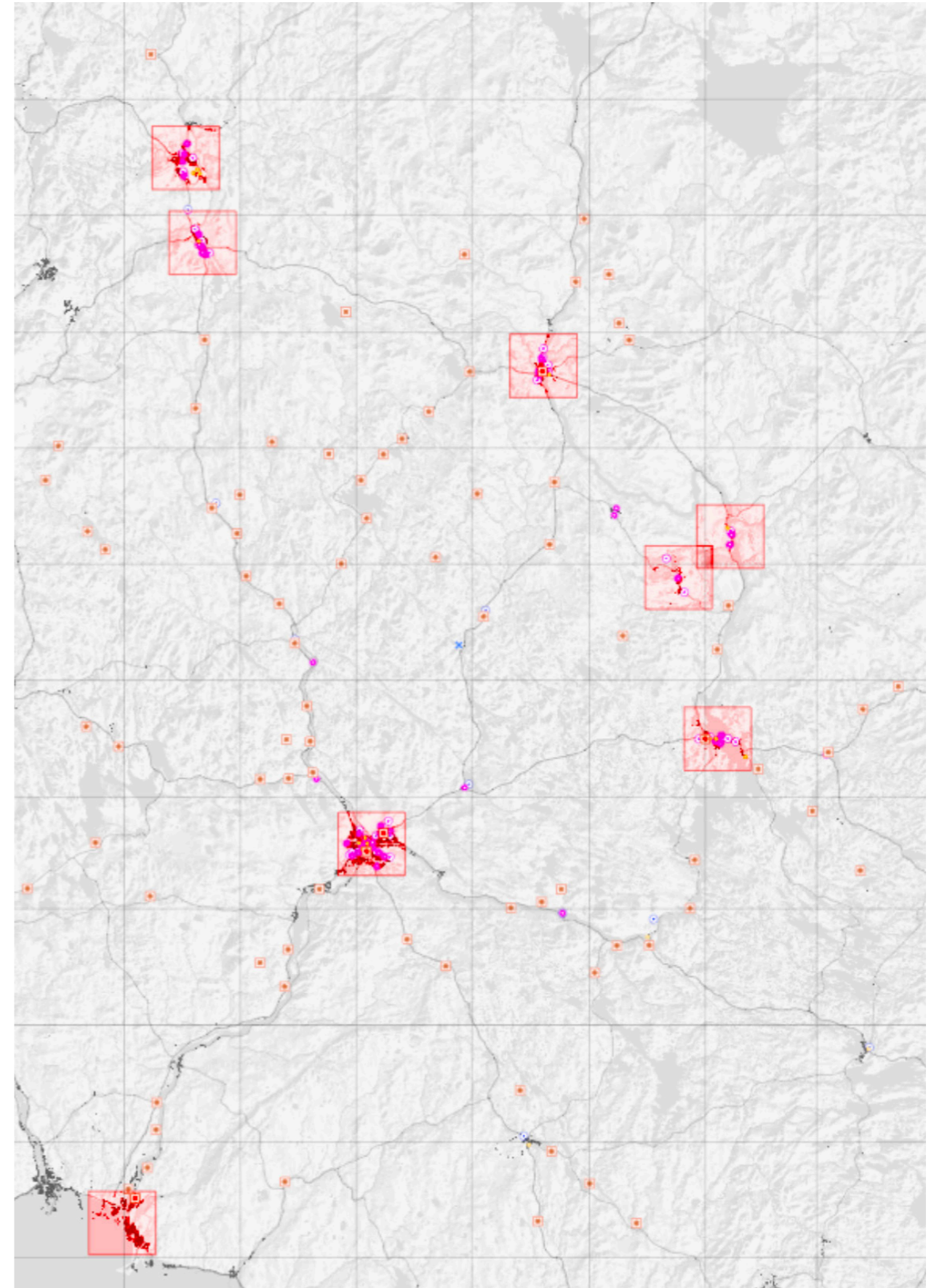
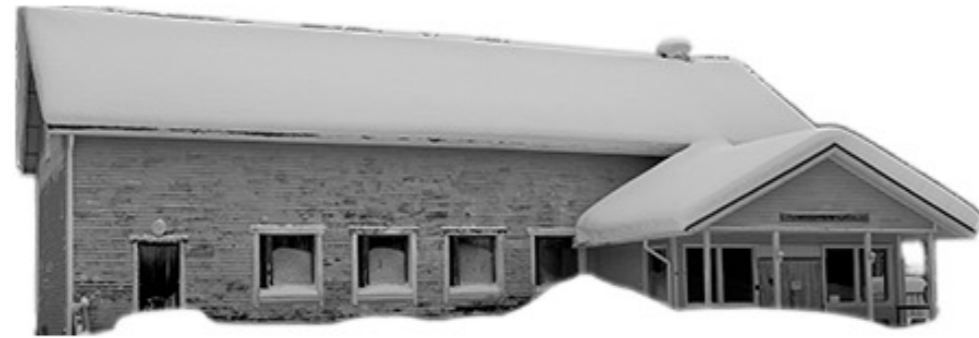


Fig. 58 Local Networks (Own illustration 2026)





KYLÄTALO

Service:
The kylätalo functions as a shared social infrastructure within dispersed rural settlements. Maintained collectively by local associations, it provides space for meetings, celebrations, storage, and emergency support. While modest in architectural expression, its role within the territory is significant. The building operates as a stable social anchor within an otherwise dispersed landscape, supporting forms of collective maintenance and local governance that extend beyond formal institutions. Due to the demographics, old school buildings also get transformed into community houses.

**COMMUNITY
SHELTER**



GAS STATION

Service:
Positioned along long infrastructural corridors, roadside gas stations operate as hybrid nodes of mobility, logistics, and social exchange. They serve truck drivers, tourists, workers, and local residents simultaneously, creating temporary points of interaction within otherwise fragmented territories. Beyond fueling vehicles, these spaces support communication, maintenance, food distribution, and logistics.

**STORAGE
LOGISTICS**



AITTA

Service:

The aitta, a traditional Finnish storage building, reflects a spatial logic of anticipation and seasonal preservation. Historically used for storing food, tools, and harvested materials, these elevated timber structures formed part of a distributed system of storage embedded within everyday rural life.

**STORAGE
AGRICULTURE**

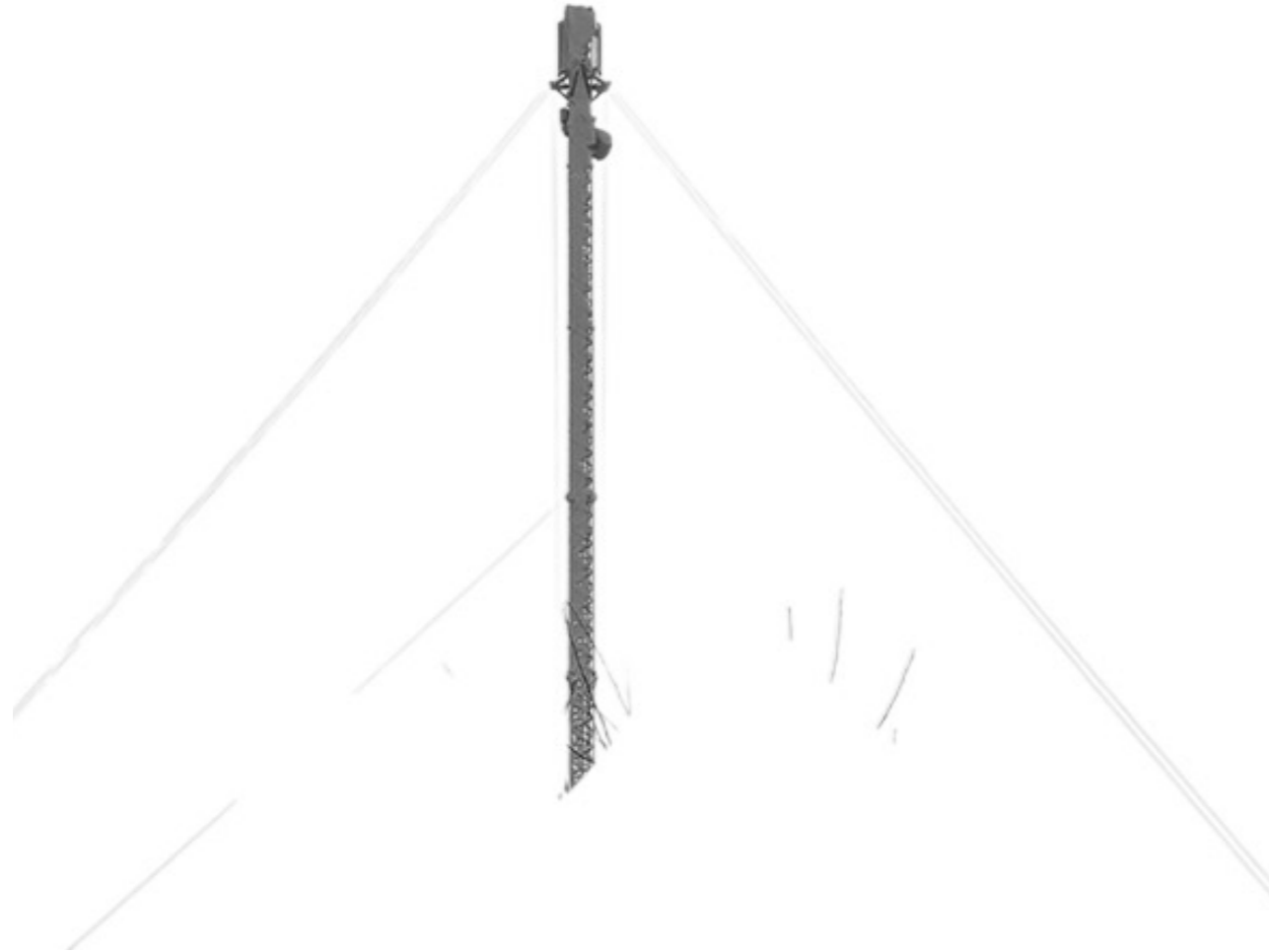


THE SUMMER BARN

Service:

The summer barn represents a seasonal architectural typology. With a pyramidal roof the warm air rises upwards. In spring, when the snow melted, the cows spent their summer nights in the barn, sheltered from mosquitos or other predators. Unlike permanent infrastructural systems optimized for continuous operation, the summer barn operates through seasonal use and thermal responsiveness.

**THERMAL
SHELTER**



ANTENNA

Service: Antennas and transmission towers punctuate the forests and roads of Lapland, connecting remote territories to wider systems of communication, sensing, and data exchange. While highly visible within the landscape, the networks they support remain largely invisible. They operate less as singular objects than as part of a continuous infrastructural field linking climate, logistics, energy, and computation across vast distances.

**CONNECTIVITY
LANDMARK**



WATER TOWER

Service: Many water towers in Lapland were built during the post-war modernization of Northern Finland, supporting new settlements, hydropower developments, and expanding infrastructures. By storing and distributing water through gravity, they enabled everyday life across remote territories. Rising above the forest, they remain visible markers in the landscape.

**HYDRO
STORAGE
LANDMARK**



WATCH TOWER

Service:

Watch towers appear across the forests and open landscapes of Lapland as points of observation and territorial oversight. Elevated above the terrain, they support monitoring, orientation, and maintenance across large distances, revealing how remote landscapes are continuously managed through systems of visibility and control.

OBSERVATION LANDMARK



TRUCKS

Service:

Trucks move continuously across the long infrastructural corridors of Lapland, connecting mines, forests, harbours, energy sites, and dispersed settlements. More than vehicles of transport, they sustain the circulation of materials, food, fuel, and industrial resources across vast territorial distances. Roadside stops, parking areas, and service stations form part of this logistical network, supporting the rhythms of mobility, labour, and maintenance required to keep the operational landscape functioning.

MOBILITY LOGISTICS



SUPERMARKET

Service:

Supermarkets operate as critical nodes of everyday infrastructure within the dispersed settlements of Lapland. Supplying food, materials, and essential goods across large distances and harsh seasonal conditions, they support both local communities and transient workers connected to the region's infrastructures of energy, extraction, and logistics. Beyond their commercial role, they function as spaces where everyday life, mobility, and territorial support systems intersect.

COMMUNITY FOOD



SAUNA

Service:

The sauna is a common social and thermal space in Lapland. Used for washing, heating, and gathering, it forms part of everyday life across homes and communities.

THERMAL COMMUNITY



DRONES

Service:
Drones increasingly operate across the landscapes of Lapland as tools for monitoring, maintenance, and environmental observation. Used for surveying infrastructure, tracking reindeer movement, mapping terrain, and inspecting remote sites, they extend systems of sensing and control across large territorial distances. Through aerial observation, the landscape becomes continuously measured, monitored, and operationalized.

**OBSERVATION
MONITORING
DEVICE**



REFRIGERATOR

Service:
Refrigerators are critical local infrastructures in Lapland. They preserve berries, fish, mushrooms, and meat harvested during the short summer season and other foods, making food storage possible throughout the long winter months. The cold becomes a resource for survival.

**THERMAL
STORAGE**

In Lapland, infrastructures, ecological cycles, and local networks overlap, produces frictions, externalities, and unequal territorial burdens, but also open the possibility for new forms of spatial and ecological relationships.

Hypothesis

“The problem is not only one project. It is the accumulation of many projects in the same landscape.” (Fieldwork 2026)

Entangled
Landscape

Within the operational landscape of Lapland, different systems overlap without fully aligning, revealing a territory that is not smooth or continuous, but fragmented and contested.

What Bruno Latour describes as the Critical Zone becomes directly observable within the landscapes of Lapland. Rivers, infrastructures, ecologies, and local practices no longer operate as separate systems, but continuously shape and depend on one another and are part of the same (Latour and Weibel 2020).

These relationships become particularly visible at territorial interfaces such as dams, transmission corridors, road crossings, extraction sites, and the edges of new developments, where different spatial and environmental logics overlap without fully aligning. Disturbance emerges through „unpredictable encounters” (Tsing 2015, 20) between global systems and local realities. As Anna Tsing argues, disturbance is not simply failure but generative, “realigns possibilities for transformative encounter” (Tsing 2015, 152).

Building on this shift, landscape can no longer be understood as a stable baseline disrupted by external forces. Instead, disturbance becomes the condition of the landscape itself. What constitutes acceptable change for energy production or economic growth may simultaneously represent a new opportunity.

Interviews and local reporting reveal the cumulative pressure produced by overlapping developments including mining, wind energy, tourism, and emerging data center infrastructures. At the same time, they also reveal distributed forms of resilience operating through maintenance, adaptation, and local knowledge. (Fieldwork 2026)

As discussed in previous chapters, the data center functions through the externalization of cooling, energy production, water extraction, sensing, and territorial maintenance. In Lapland, these externalities accumulate spatially through altered river flows, disrupted migration routes, increasing infrastructural energy demands, and waste heat generated by the planned data center. Groundwater pressures, contamination, and the gradual erosion of local ecologies and practices further intensify these conditions.

Externalities to
Internalities

At the same time, these by-products reveal potential spatial relationships between infrastructures, ecologies, and local practices. Pierre Bélanger argues that contemporary infrastructures increasingly operate through synergies between environmental and material flows in order “to generate multifunctionality and interoperability” (Bélanger 2017, 459).

The site in Hietavaara, positioned between the Kemijoki River, the 200kV transmission corridor, the Valajaskoski hydropower plant, National Road No. 4, agricultural fields, forestry operations, and existing industrial zones, condenses many of the frictions and infrastructural relationships identified throughout this research. It appears simultaneously connected and fragmented: deeply integrated into planetary systems of energy, computation, and resource circulation, while remaining spatially dispersed and environmentally segmented at the local scale. Existing infrastructures already establish the territorial logic upon which the proposed data center depends. National Road No. 4 and Road 926 support truck circulation, industrial maintenance networks, and regional connections between Rovaniemi, Tornio, and surrounding settlements. Simultaneously, the transmission corridor cutting through the forest distributes electrical capacity across the territory while producing cleared spatial corridors capable of accommodating additional pipes, cooling infrastructures, and service networks.

Entangled
Landscape

Furthermore, cooling loops from the data center can connect to accumulated snow waste collected from Rovaniemi and surrounding settlements, as discussed in Sequence 01. Waste heat supports localized cultivation and new climatic environments. Greenhouses become new actors within the landscape, responding to increasing demands for regional food production, while monitoring infrastructures overlap with reindeer observation, drone networks, and environmental sensing systems — recurring concerns raised throughout fieldwork interviews conducted during March 2026. Septic fields, groundwater systems, and filtration landscapes become integrated into larger hydrological cycles operating across the site, reducing pressure on river-based cooling systems and limiting contaminated snow runoff entering the Kemijoki River.

This shift from linear extraction toward circular metabolism requires the synchronization of uneven temporal and spatial systems. Industrial infrastructures operate continuously, while ecological and social systems remain seasonal and cyclical. Architecture therefore operates as an interface between these uneven systems, capable of redirecting and synchronizing operational by-products with local ecological and social cycles. In this sense, Bélanger’s spatial imaginaries — where “buildings become batteries, highways rolling warehouses, landfills goldmines, suburbs stormwater sponges, forests carbon sinks, and city coastlines estuarine aprons” (Bélanger 2017, 459) — become less speculative metaphors than territorial design logics.

“The problem is not only one project. It is the accumulation of many projects in the same landscape.”

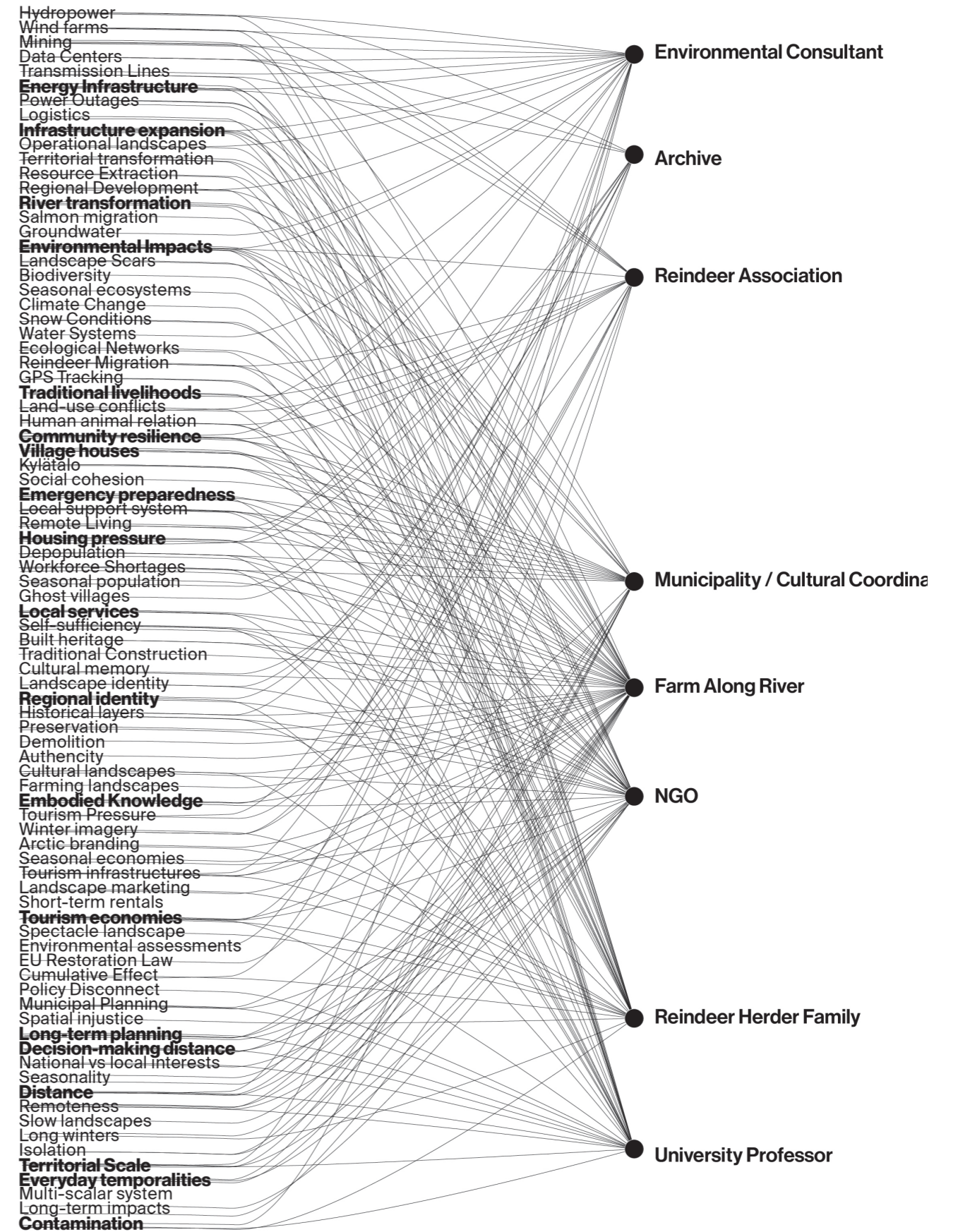
“Lapland is sold as winter and snow, but there is much more here during the rest of the year.”

“A house is not only architecture. It carries the stories and memories of the place.”

“Living here is a choice. You need to understand that it changes your relationship to space and time.”

Quotes from Interviews conducted during the fieldtrip, March 2026

Fig. 59 Interview Analysis (Own illustration 2026)



INTERVIEW
ANALYSIS**Temporal Mismatch**

- long-term thinking missing
- reuse
- heritage
- cumulative impacts over time
- long-term ecological damage
- short-term project cycles
- projects come and go
- mining temporary vs long term effects
- seasonal life vs permanent infrastructure
- seasonal tourism
- fluctuating climate
- unstable economies
- reactive planning^
- 300-year settlement vs 30-year mine
- long-term life vs short-term extraction

Exclusion

- distributed villages
- isolated places
- reindeer routes blocked
- grid lines
- district division
- infrastructure overlap
- land ownership frgamented
- gaps in the grid
- infarstructure cuts landscape
- community divisions
- abandoned housing
- ghost towns
- uneven development
- monofunctional system
- loss of diversity
- river systems broken
- traditions lost
- economic shifts

Externalisation

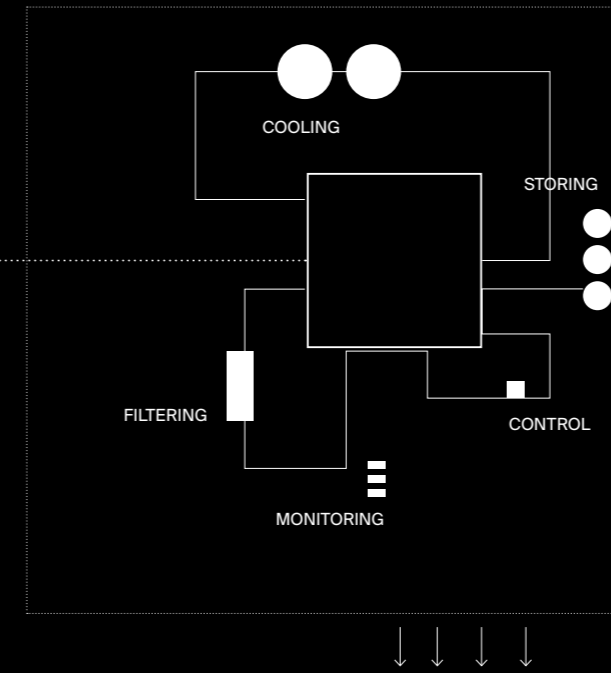
- non-profit driven
- alternative values
- green transition driven
- minerals + energy demand from outside
- local burden
- energy produced locally not used locally
- toursim reshapes identity
- -decisopns driven from elsewhere
- tourism narratives created externally
- energy markets external
- local dependency
- mining economy
- gloabl dependency
- geopolitics
- mining benefits temporary
- damage remains local

Fragmentation

- self-organization
- local initiatives
- autonomy
- resilience
- mediation needed
- negotiation needed
- local adpt, dont decide
- ack of control over development
- uncertainty about decisions
- lack of imagination
- resistance to change
- external decision making
- local knowledge in building
- adaptation over time

OUTSIDE THE EXCLUSION ZONE

EXCLUSION ZONE



DISCONNECTION

LOCAL SEASONAL POLITICAL

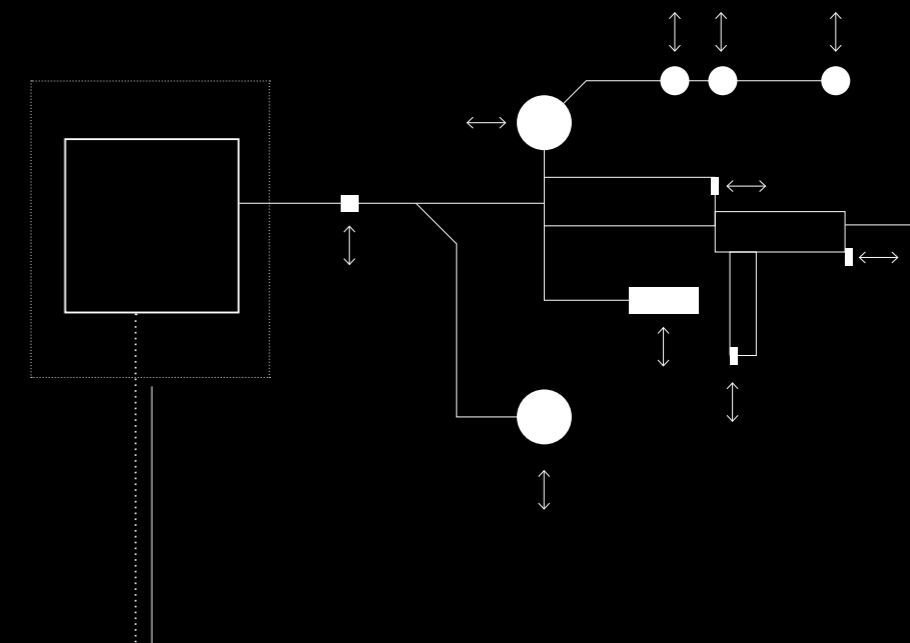


Fig. 60 Outside the Exclusion Zone (Own illustration 2026)

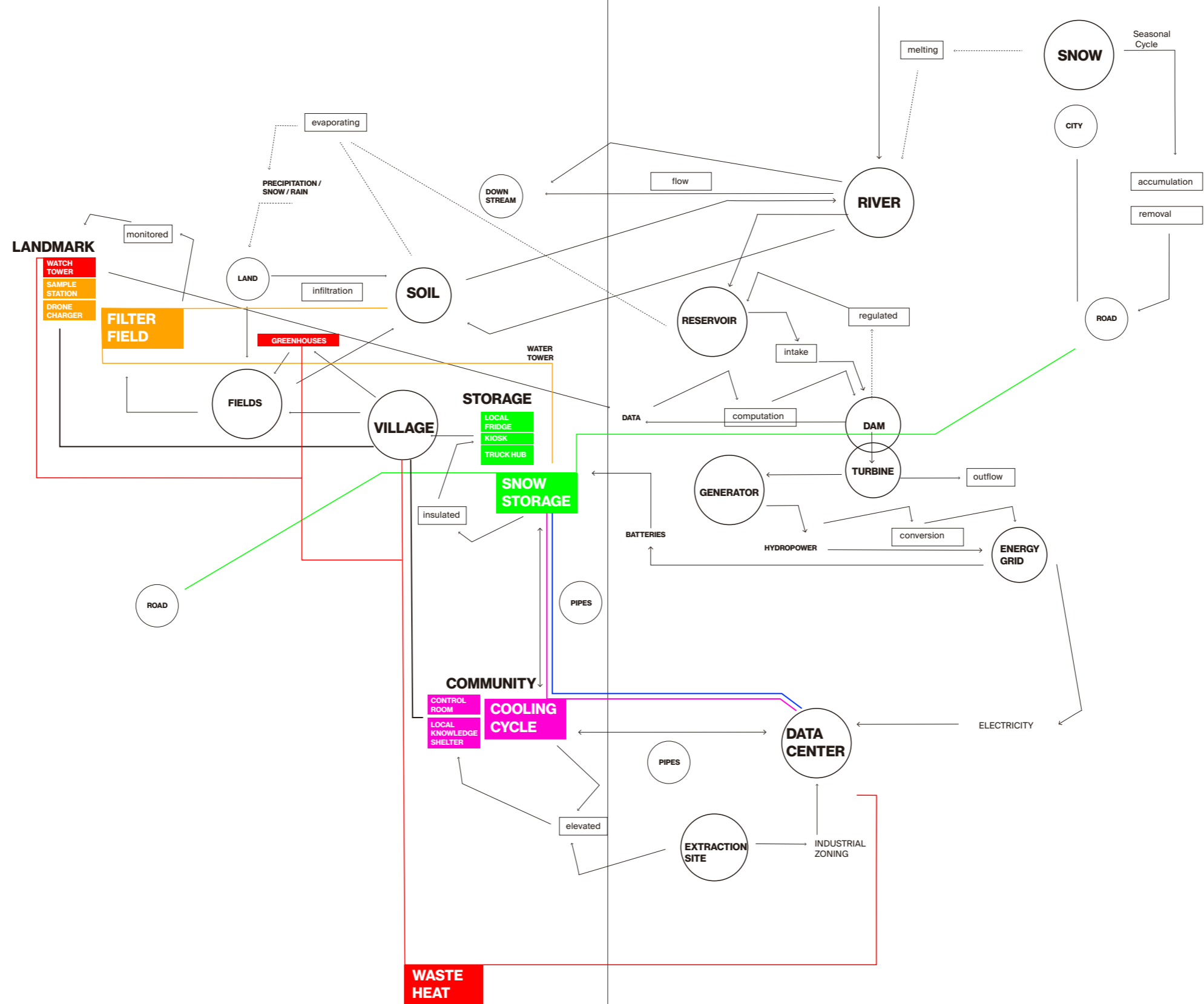


Fig. 63 The Cycles (Own illustration 2026)

SEQUENCE 04
The House of the Machine is the Territory

Drawings all produced by author

Rather than concentrating all operational processes within the exclusion zone of computation, the territorial dependencies of the data center can be redistributed across the landscape, generating new spatial relationships between machine, ecology, infrastructure, and everyday life.

Hypothesis

Built upon the Synergies discussed in Sequence 03, the project approaches the demands of the machine, cooling, monitoring, storage, and environmental regulation as dispersed across the territory, producing hybrid architectures positioned between machine, and human occupation. Infrastructure that behaves like a city but does one thing, keeping the data center alive, but at the same time producing new relationships for the local ecologies. As the system branches away from the data center, it reduces in scale and adapts to human and ecological conditions. In this sense, the project asks whether the machine determines architecture, or whether architecture makes the machine possible in the first place.

The grid begins with the server rack as the smallest spatial unit of computation. A single rack, approximately 0.6 by 1.2 meters, produces not only data processing capacity but also heat, airflow requirements, maintenance access, and energy demand. When racks are arranged in rows, they form hot- and cold-aisle modules. These modules are then aggregated into structural bays, data halls, and larger operational blocks.

In the project, this logic of repetition is scaled beyond the building envelope. The 6 x 6 and 60 x 60 meter grid becomes an architectural translation of the same computational order into the territory. It organizes cooling pipes, snow storage, filter fields, maintenance paths, monitoring towers, and ecological interfaces.

This distributed approach challenges the centralized enclosure of the black box by externalizing operational systems into territorial relations. Architecture thereby becomes an instrument for negotiating the territorial consequences of AI infrastructure and for constructing new relationships between computation, ecology, water, and landscape.

The thesis ultimately argues that the house of the machine is no longer the isolated building, but the territory itself.

Territorial Grid

NATIONAL ROAD

RIVER

SETTLEMENT

AGRICULTURE

ROAD

ENERGY

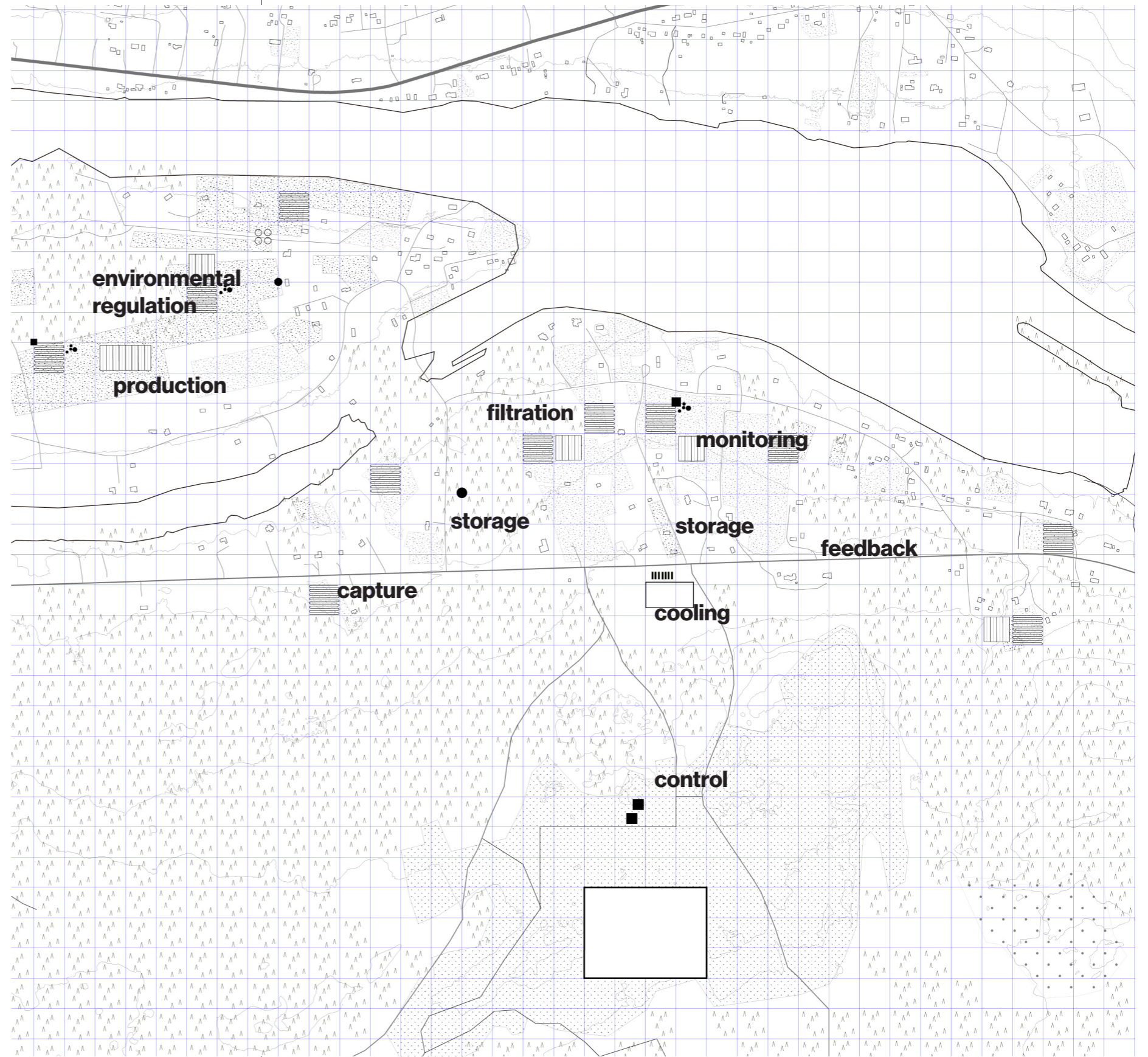
FOREST

EXTRACTION SITE

DATA CENTER



OUT OF THE EXCLUSION ZONE



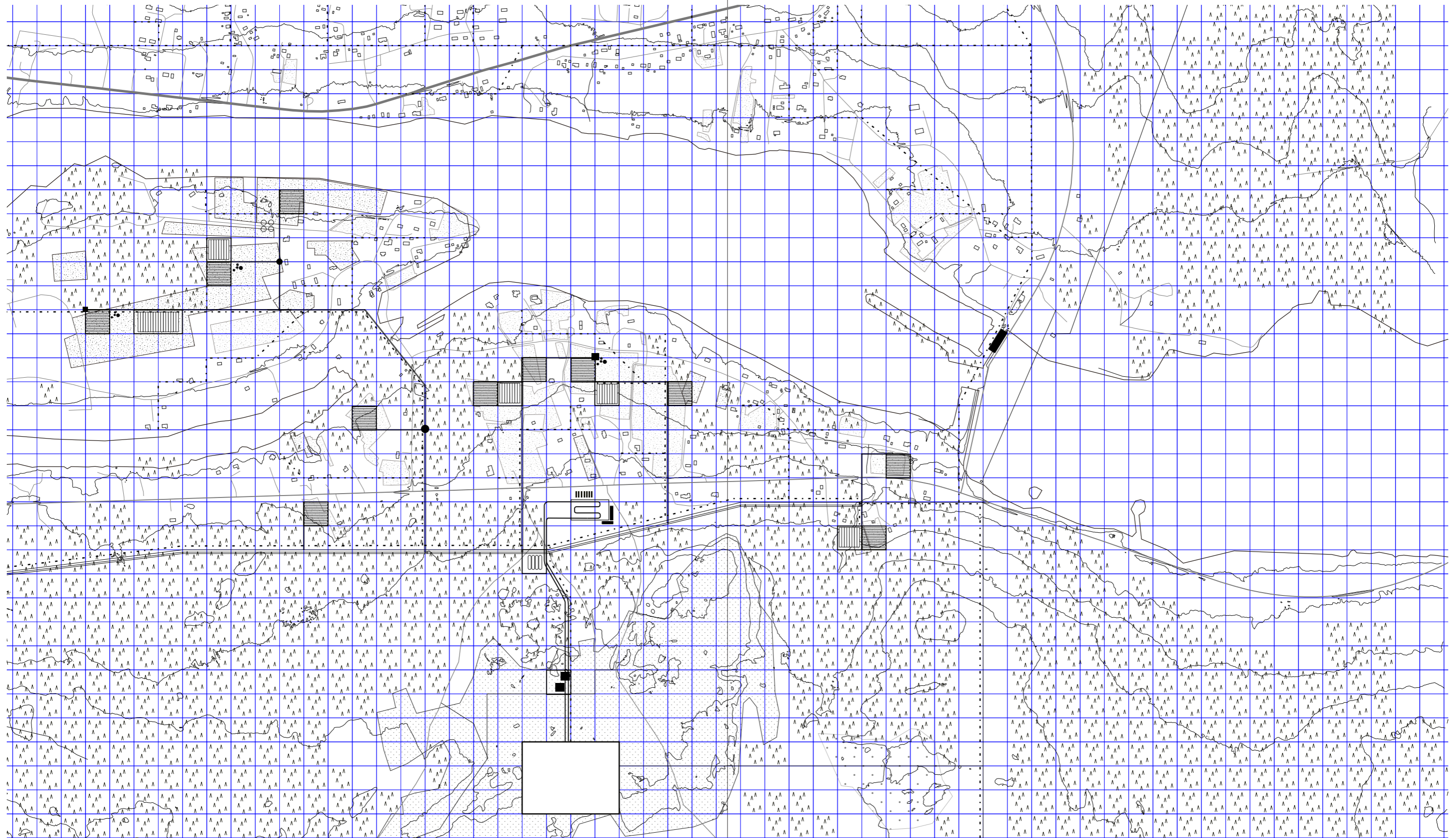
TERRITORIAL
NODES IN THE
CYCLES OF THE
DATA CENTER

Meltwater Cycle

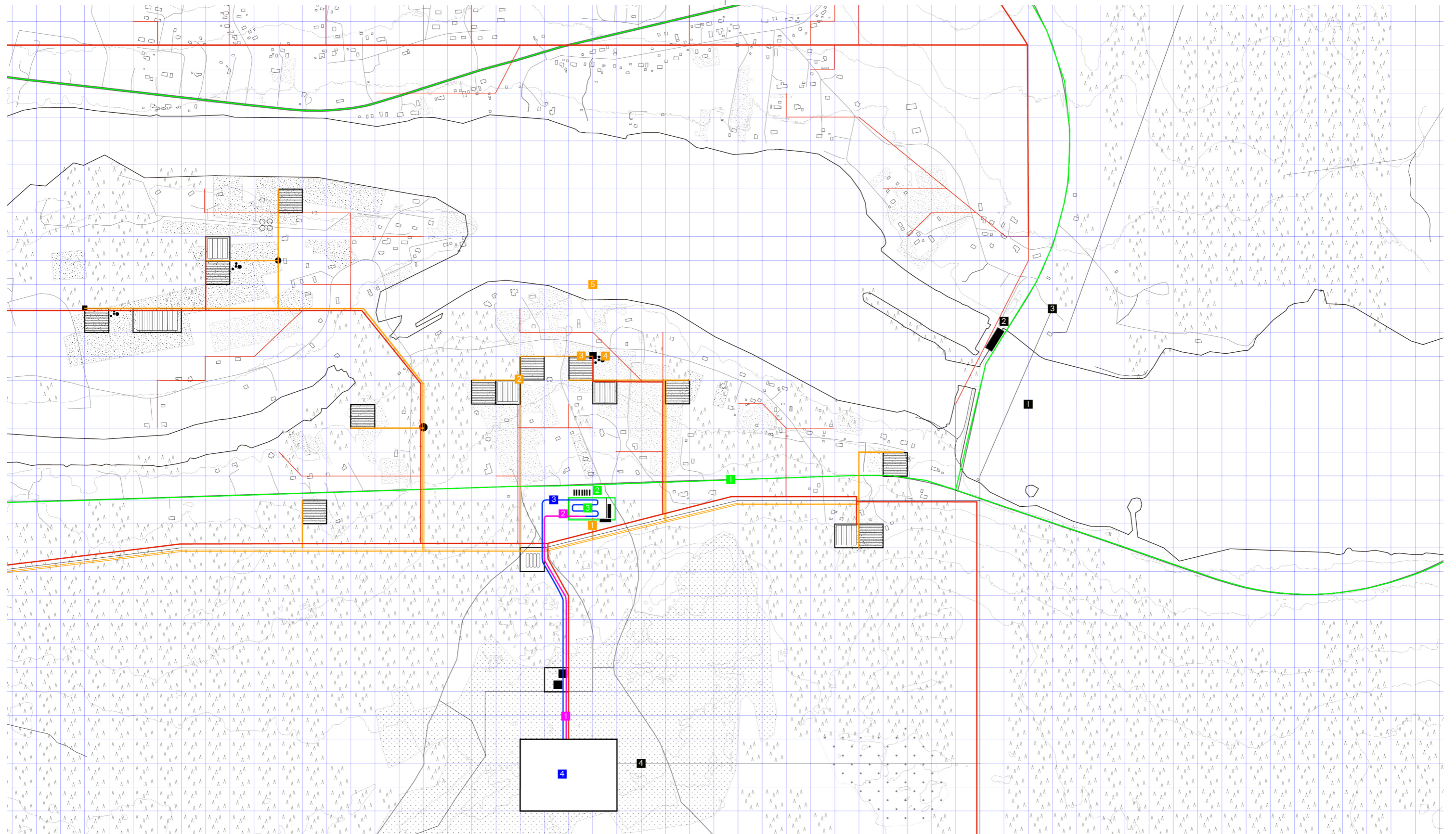
Waste Heat Reuse

Cooling Cycle

| Meltwater Cycle | | | Waste Heat Reuse | | | Cooling Cycle | | |
|---|--|---|---|--|---|---|---|--|
| Septic Field | Sampling Station | Water Tower | Battery Station | Greenhouse | Watch Tower | Snow Storage | Fridge | Pipe Shelter |
| <i>Aim</i> | | | | | | | | |
| Filtration | Testing | Storage | Capture | Production | Observation | Cooling/Reuse | Storage | Exchange |
| <i>Internalities</i> | | | | | | | | |
| Contamination Groundwater pollution | Research Environmental monitoring | Water scarcity Pressure fluctuation | Energy peaks Grid instability | Heat surplus Food insecurity | Territorial monitoring Landscape control | Waste Reuse Snow Logistics | Food preservation Local supply chain | Thermal exchange Maintenance access |
| <i>Programme</i> | | | | | | | | |
| Biological filtration and water treatment | Ecological monitoring and data collection | Water storage, pres- sure regulation | Energy storage and charging infrastructure | Climatic cultivation and heat reuse, food production | Observation, monitoring, territorial feedback | Seasonal snow logistics, thermal commons, hub | Local fridge | infrastructural shelter, thermal commons, community house, kitchen |
| <i>Seasonality</i> | | | | | | | | |
| Summer | Summer | Year round | Continuous | Winter cultivation | Winter Shelter, Drone Port, Summer Testing | Winter Snow Waste Summer Cooling Kiosk | Winter Storage Summer Commu- nity Cafe, Cooling | Winter Shelter Summer Control Room |

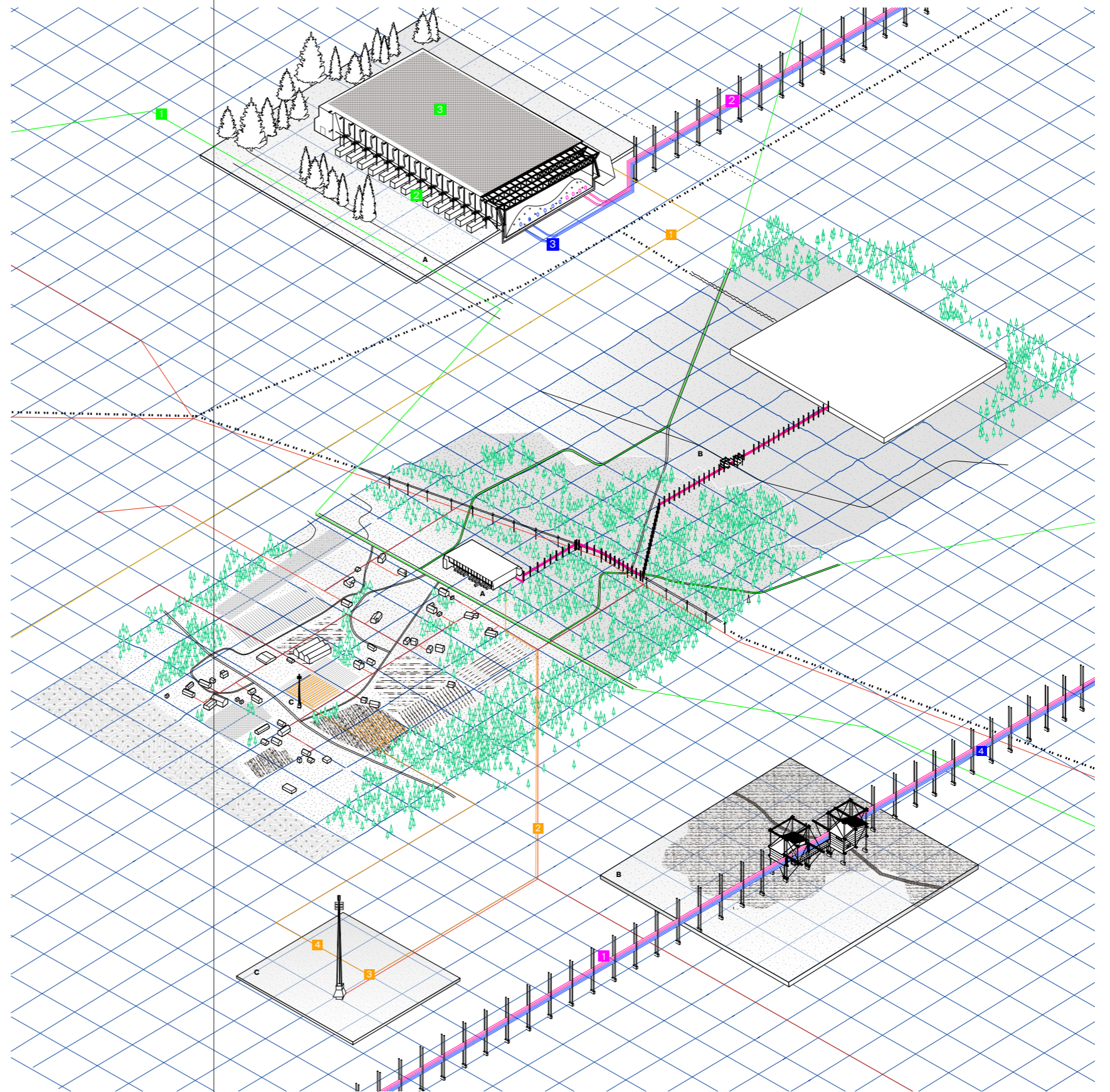


- SEPTIC FIELD
- SAMPLING STATION
- WATER TOWER
- CHARGING STATION
- GREENHOUSES
- WATCH TOWER
- SNOW STORAGE
- LOCAL FRIDGE
- PIPE SHELTER



| | | | | | | | | | | | |
|--------------|------------------|-------------|------------------|-------------|-------------|--------------|--------------|--------------|------------------------|-----------------------------------|-----------------------------------|
| SEPTIC FIELD | SAMPLING STATION | WATER TOWER | CHARGING STATION | GREENHOUSES | WATCH TOWER | SNOW STORAGE | LOCAL FRIDGE | PIPE SHELTER | 1 Snow Waste | 1 Warm Water from Servers | 1 Melt Water from Snow Storage |
| | | | | | | | | | 2 Arrival at Hub | 2 Pipes towards Snow Storage | 2 Pumped to Filter Fields |
| | | | | | | | | | 3 Storing of Snow | 3 Heat Exchange with Snow | 3 Sampling Station at Watch Tower |
| | | | | | | | | | 4 Cold Water to Server | 4 Redistribution on Septic Fields | |

THE HOUSE OF THE MACHINE IS THE TERRITORY



- A** Snow Storage
- B** Pipe Shelter
- C** Watch Tower and Sampling Station

- Snow Waste Cycle
- Cooling Cycle Cold Water
- Cooling Cycle Warm Water
- Waste Heat Reuse
- Melt Water Cycle
- - - Energy Grid

- | | | |
|--|--|---|
| 1 Snow Waste | 1 Warm Water from Servers | 1 Melt Water from Snow Storage |
| 2 Arrival at Hub | 2 Pipes towards Snow Storage | 2 Pumped to Filter Fields |
| 3 Storing of Snow | 3 Heat Exchange with Snow | 3 Sampling Station at Watch Tower |
| | 4 Cold Water to Server | 4 Redistribution on Septic Fields |

If architecture once framed the world from a distance, it can no longer do so. It is already inside the systems it seeks to address. The task is not to design objects, but to intervene within flows of energy, water, and material without assuming control over them. Perhaps architecture's role is not to resolve these systems, but to make their tensions visible.

Hypothesis

The project focuses on three nodes within the territorial design. The snow storage, the Pipe Room and the Filter Field + Watch Tower. All three interventions function on the concept of thermal storage and redistribution.

Interventions

Architectural logic:

Logic 01: Insulation

Logic 02: Elevation

Logic 03: Observation

Thermal logic:

Logic 01: Skin

Logic 02: Pipe

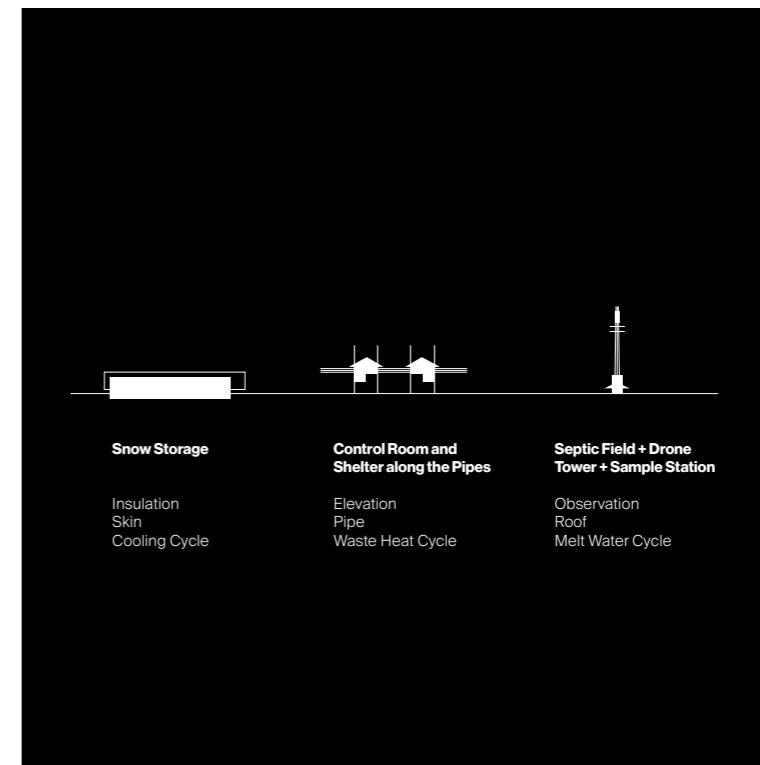
Logic 03: Roof

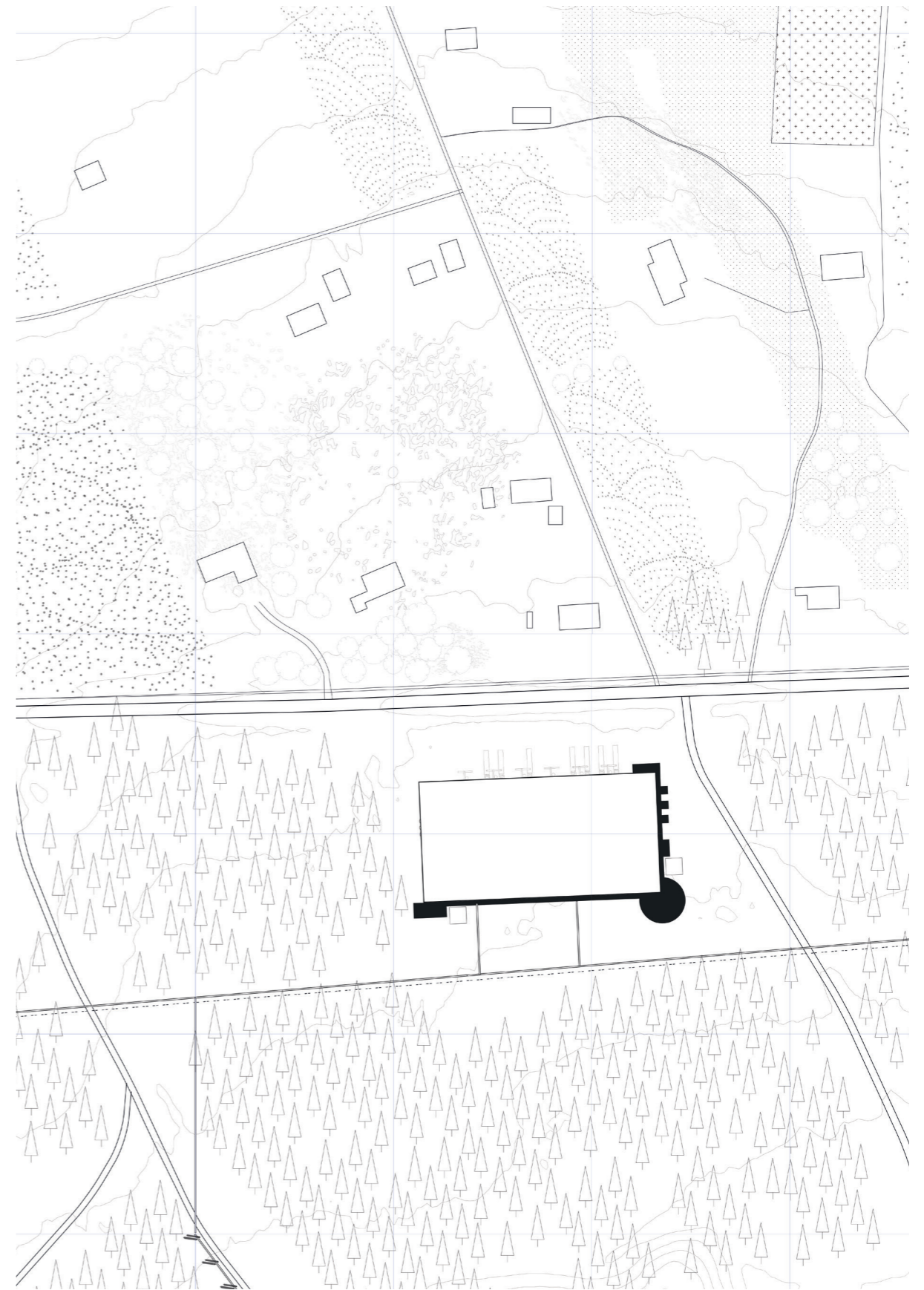
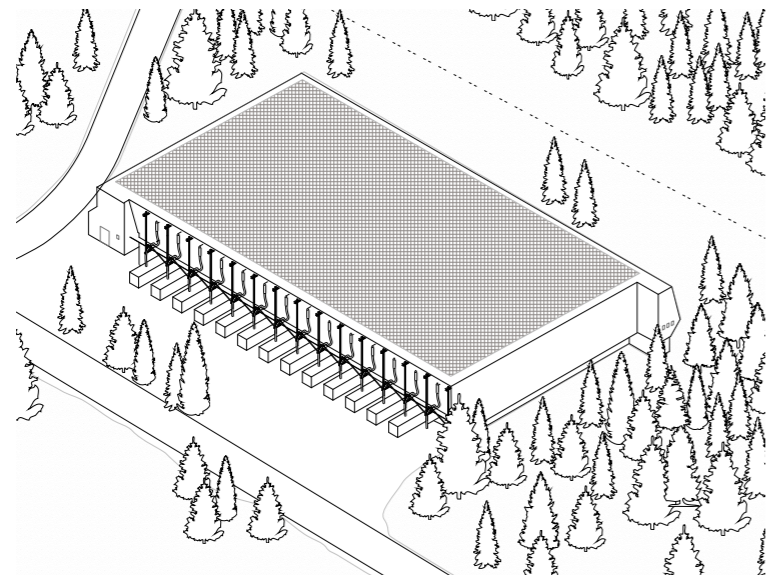
Three Cycles

Cycle 01: Cooling Cycle

Cycle 02: Waste Heat Cycle

Cycle 03: Melt Water Cycle





Snow is collected from Rovaniemi's winter street clearance and transported to a large storage volume near the road and data center. A smaller storage typology is positioned near settlements and local roads.

Operational role:

In winter, snow is accumulated as a distributed reservoir.

In summer, it melts gradually and provides approximately 1.4 GWh of thermal cooling capacity under compacted-snow assumptions.

Architectural argument:

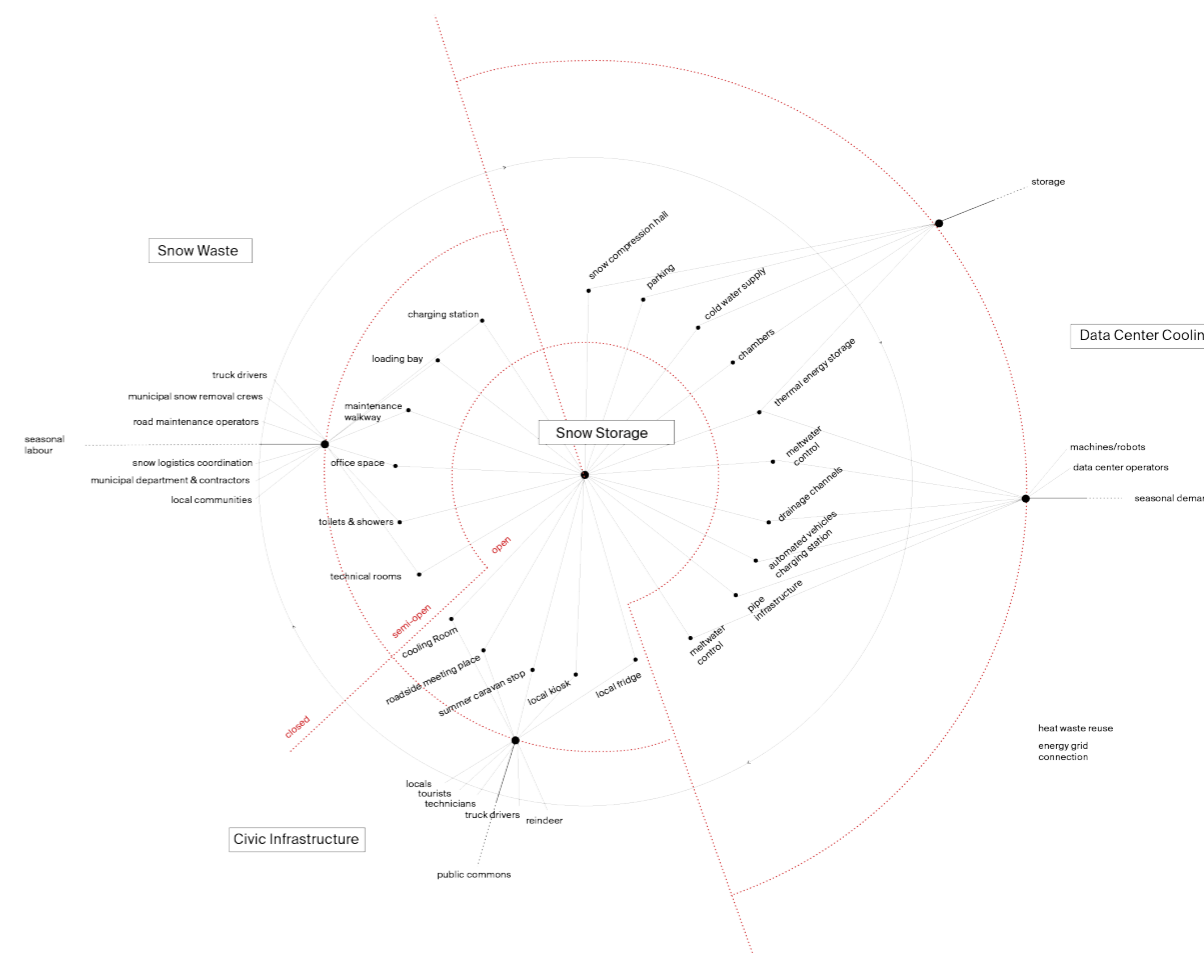
The snow storage acts as an artificial seasonal interruption: it delays meltwater, reorganizes local water availability, and transforms snow waste into shared thermal infrastructure rather than a resource appropriated only by the data center.

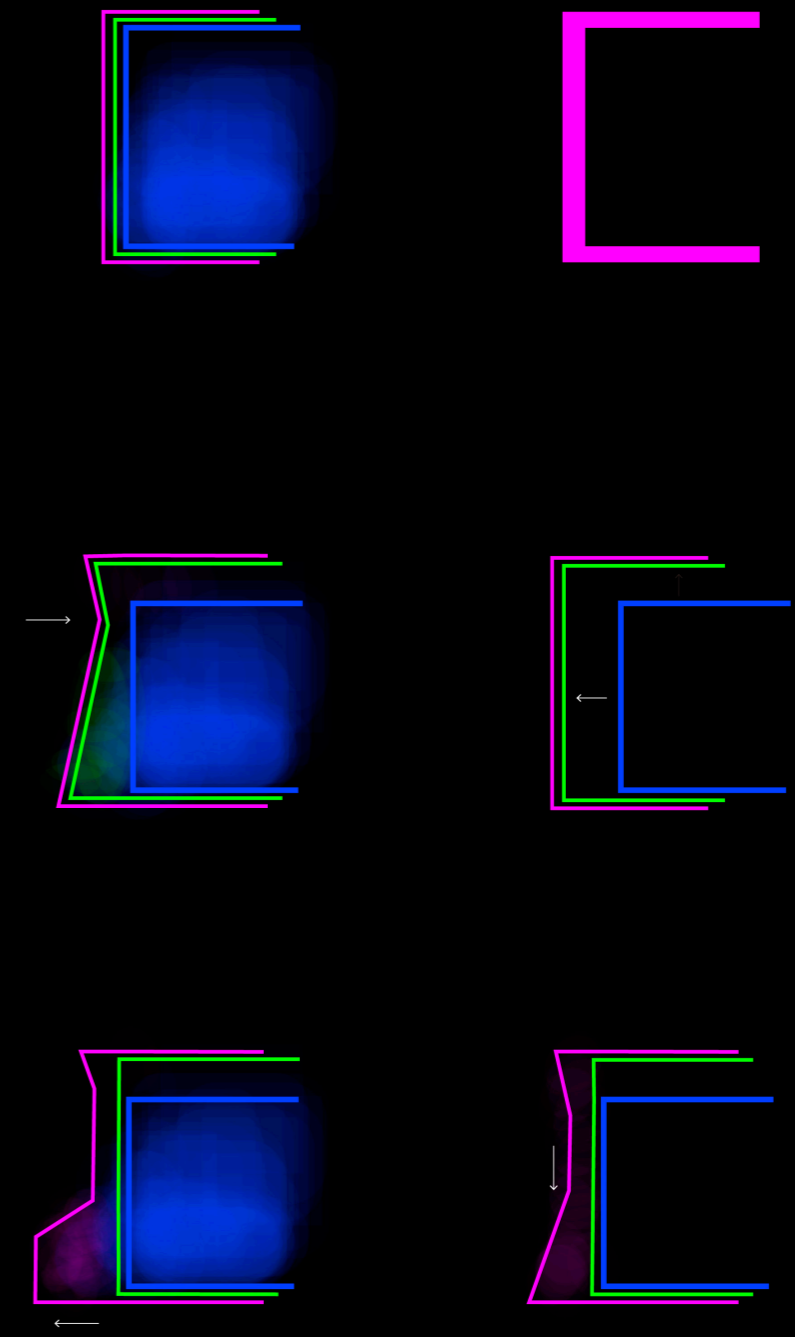
Winter Condition

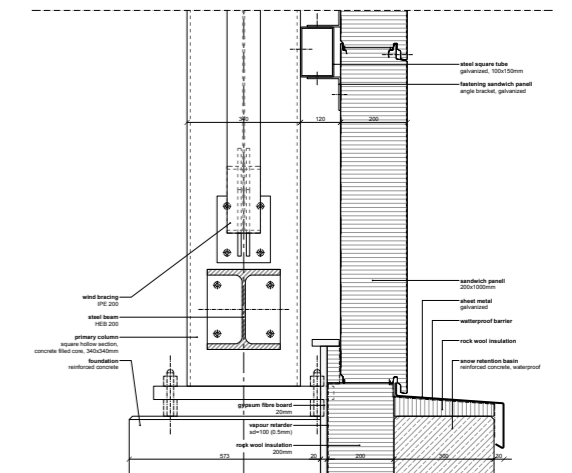
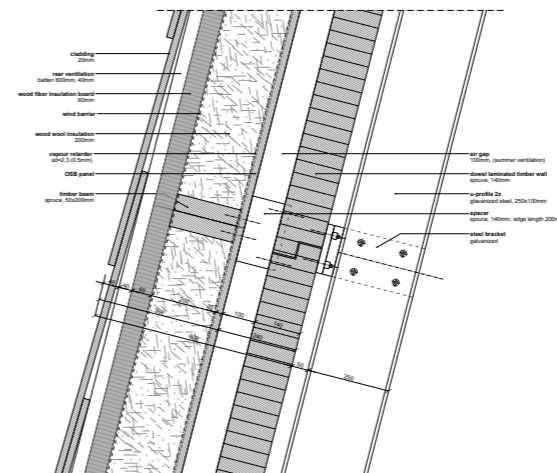
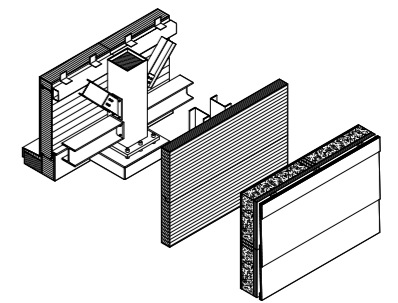
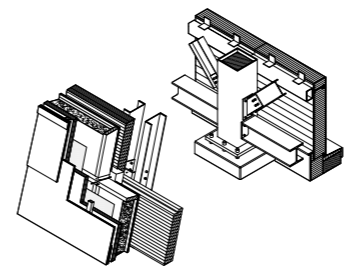
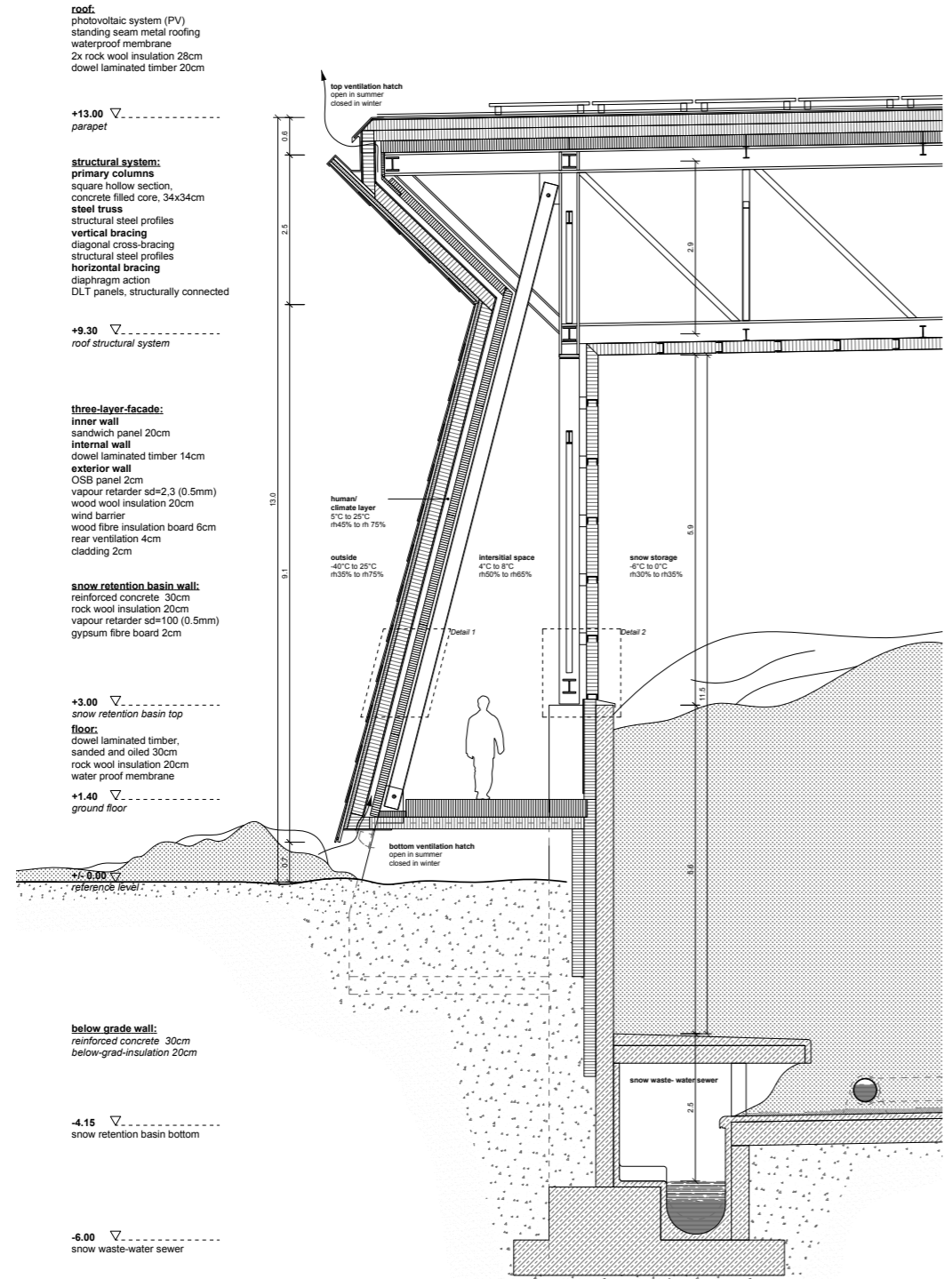
During winter, snow collected from territorial snow logistics is deposited and compacted inside the storage volume. While exterior temperatures drop to approximately -30°C, the insulated envelope creates a thermal buffer that maintains the refrigeration spaces at approximately -6°C without active cooling. A inbetween layer is creted by pushing the three walls apart. The Corridor becomes a zone of approximately 6-8°C. Through occupation and thermal accumulation, the outer layer with the café space stabilizes at approximately 15°C to 18°C. Snow waste is operationalized as a shared thermal resource and local infrastructure.

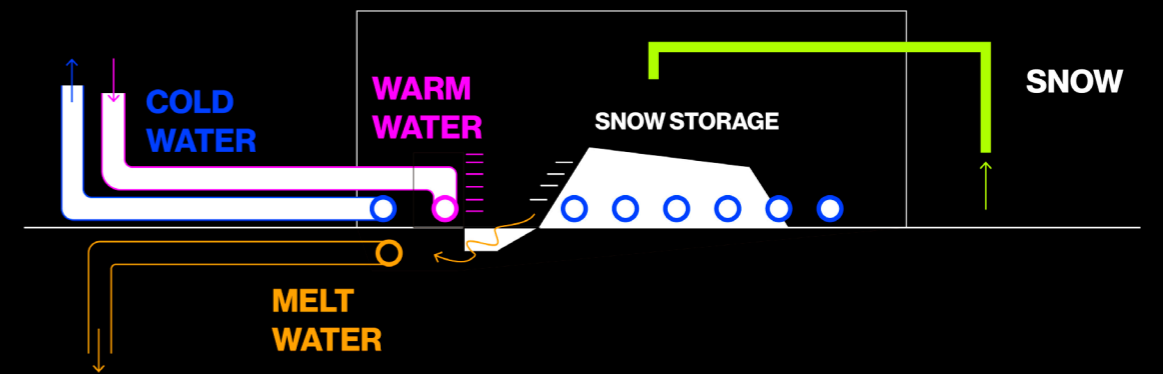
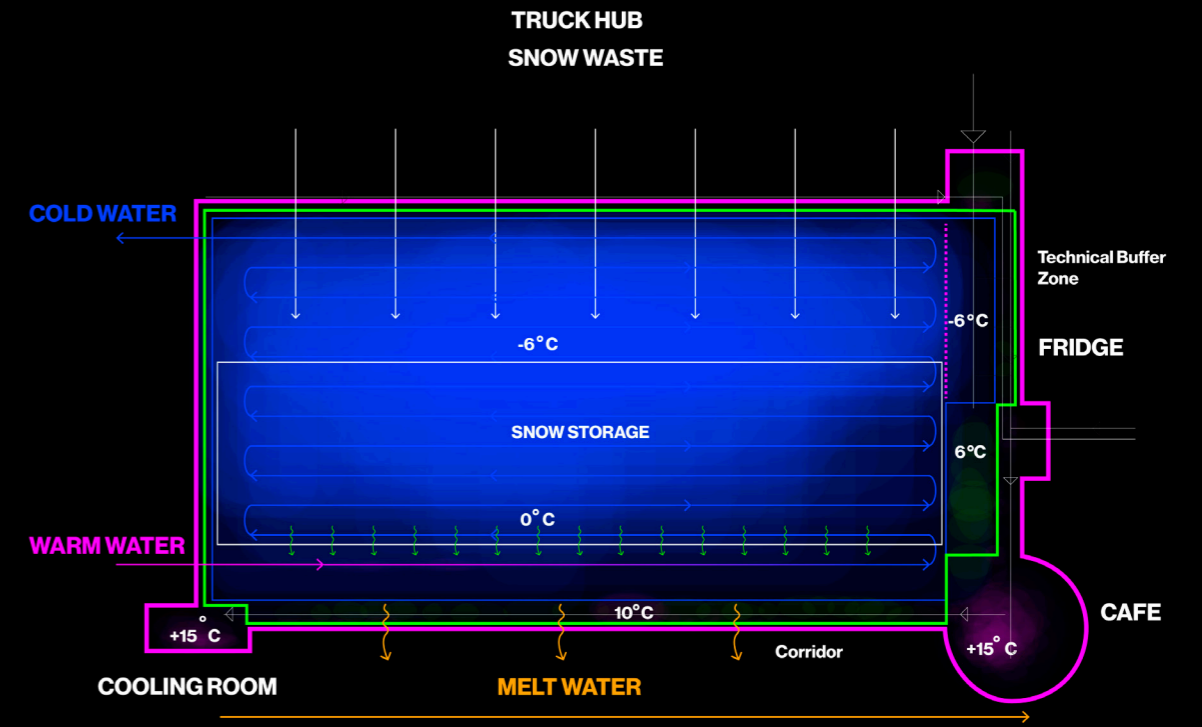
Summer Condition

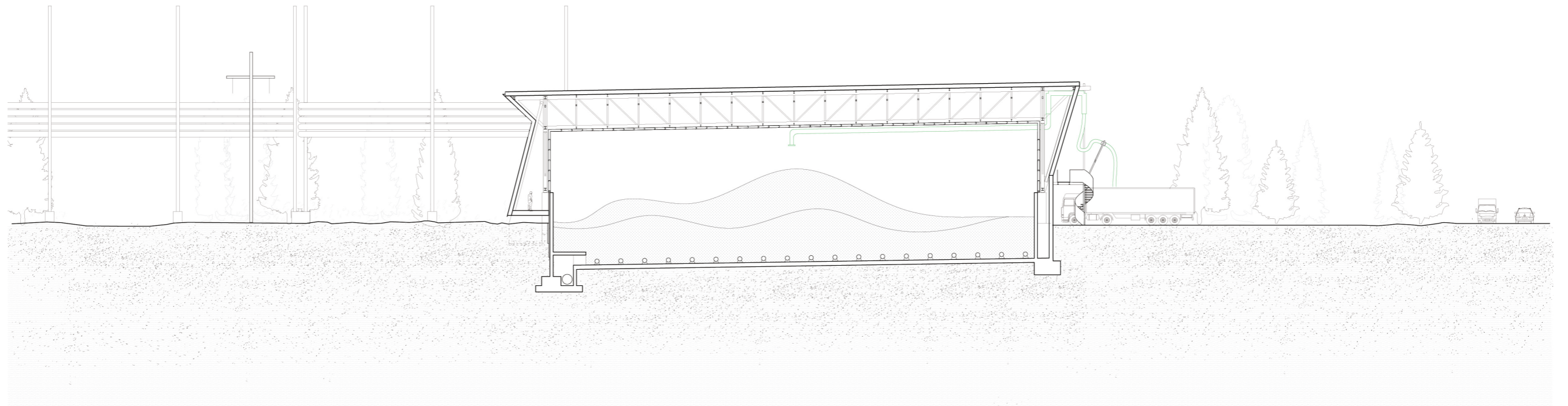
The snow storage operates as part of the data center cooling cycle. As external temperatures and cooling demands increase, meltwater generated from the stored snow cools the circulating liquid through a continuous exchange process. The cooled medium is redirected back toward the data center, establishing a cooling loop. Meltwater is transported through visible pipe infrastructure toward filtration and redistribution systems. Simultaneously, the storage supports local seasonal activities, including berry picking, food production, and reindeer herding, through refrigerated storage facilities.



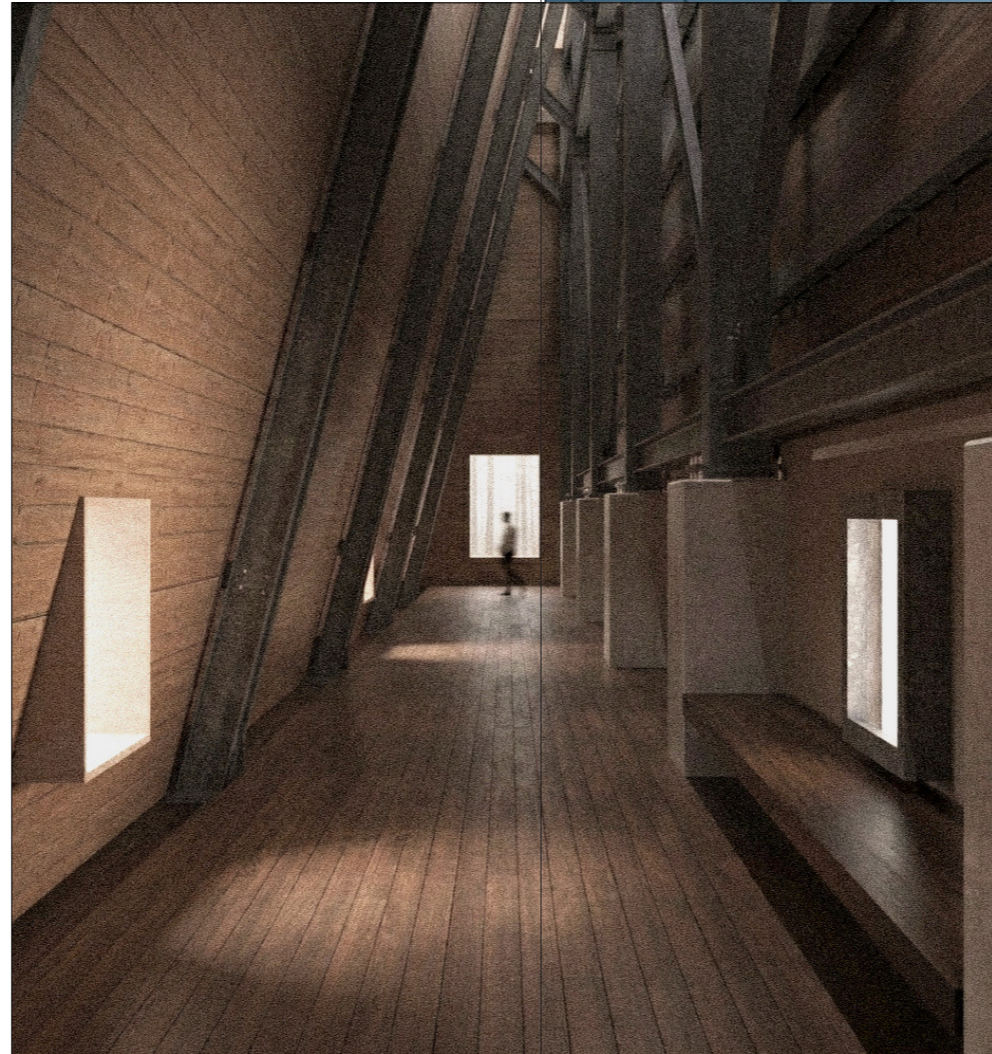


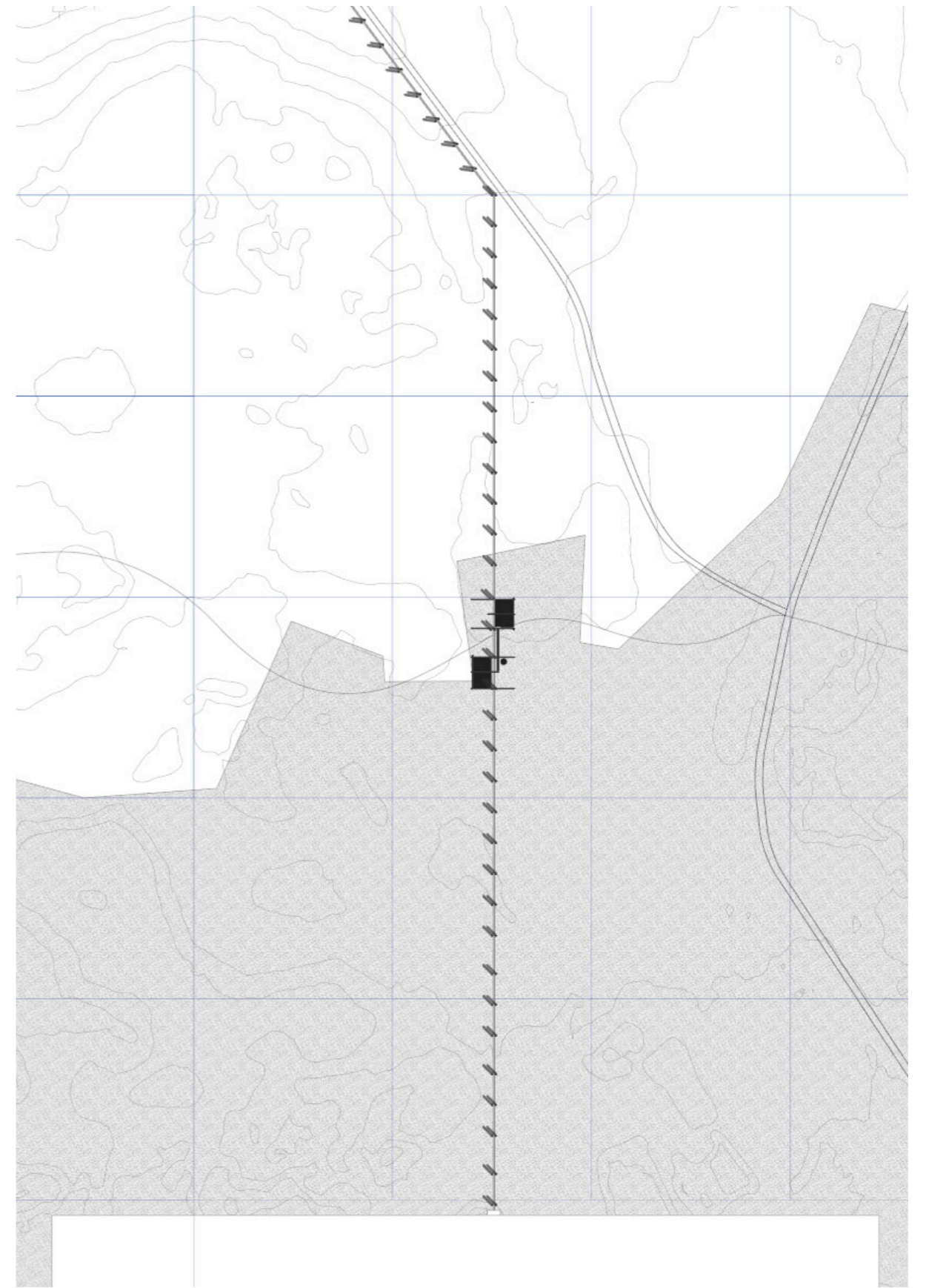
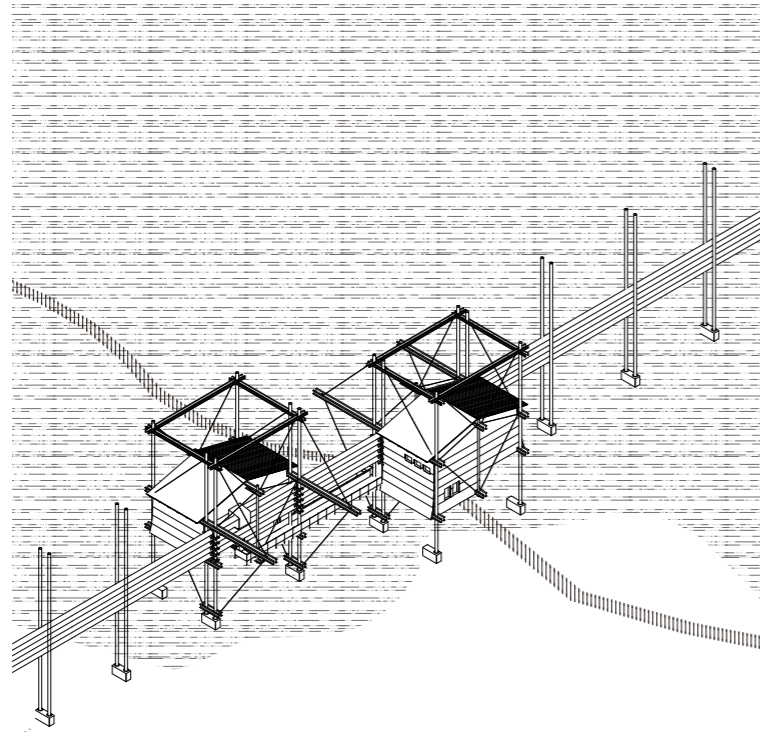


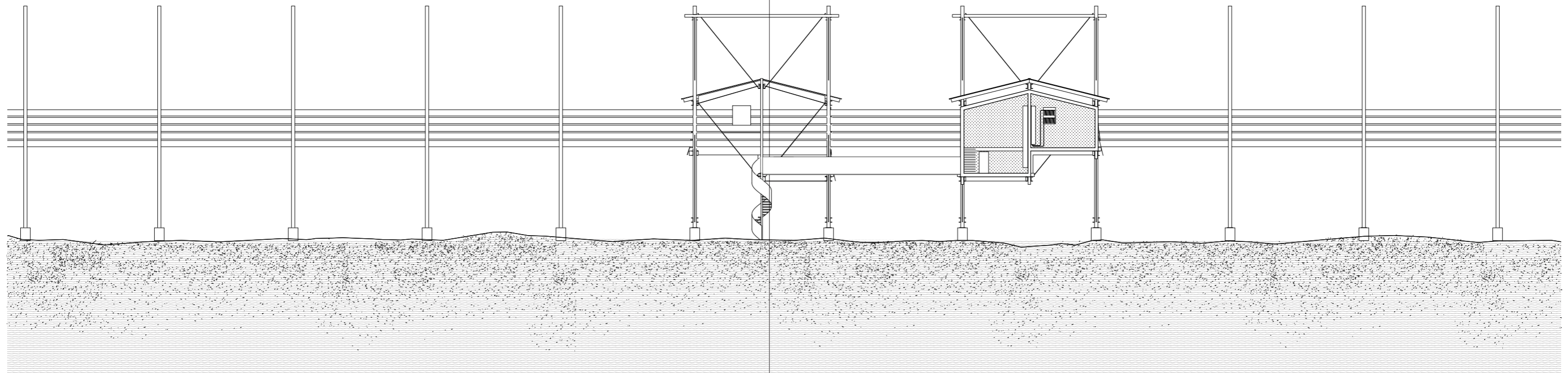












Positioned within the extraction landscape of the quarry, the Control Room spans next to the pipe infrastructure and responds to elevation differences, groundwater conditions, and reindeer movement corridors. The project combines hydrological monitoring and a community shelter into a shared territorial node between local knowledge, scientific instrumentation, and computational forecasting.

Attached directly to the warm pipe systems, the building captures the heat from the cooling cycle to a secondary one.

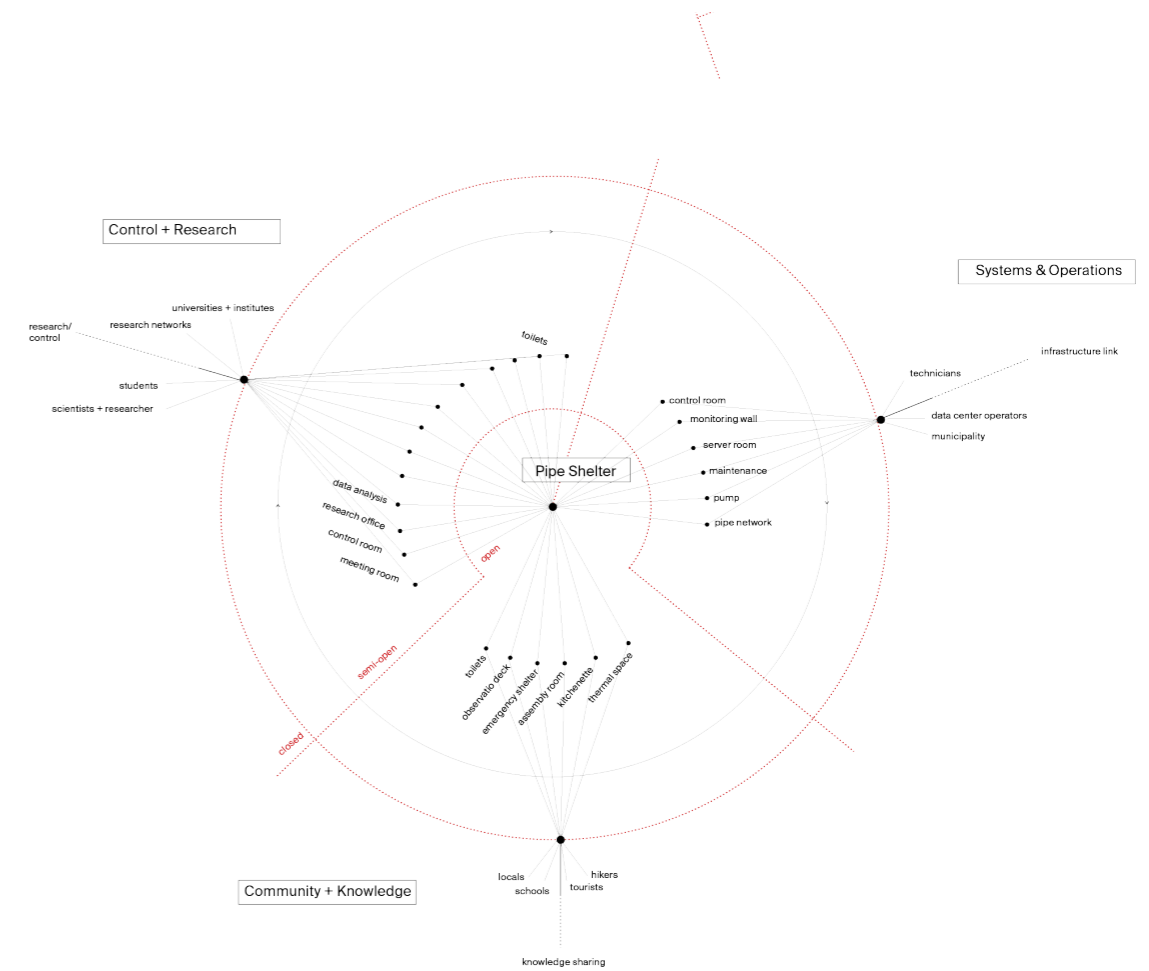
Winter Condition

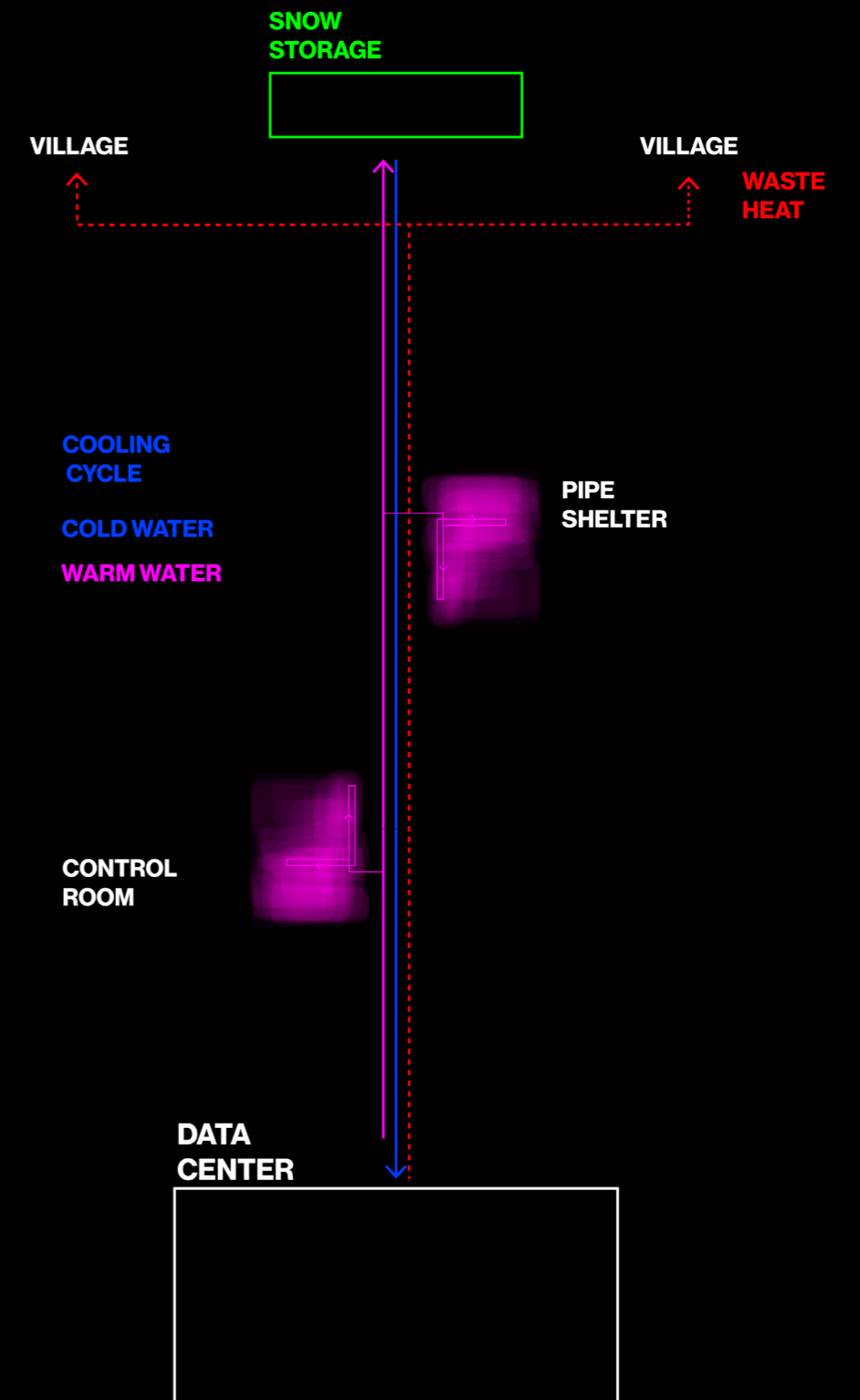
During winter, warm return pipes from the data center provide passive heating for the shelter interior through a secondary radiator system. The building operates as a heated observatory and resting space along the infrastructural corridor for maintenance workers, hikers, tourists, and local residents. Positioned along the elevated pipe route, the shelter establishes a continuous winter program within the open landscape.

Summer Condition

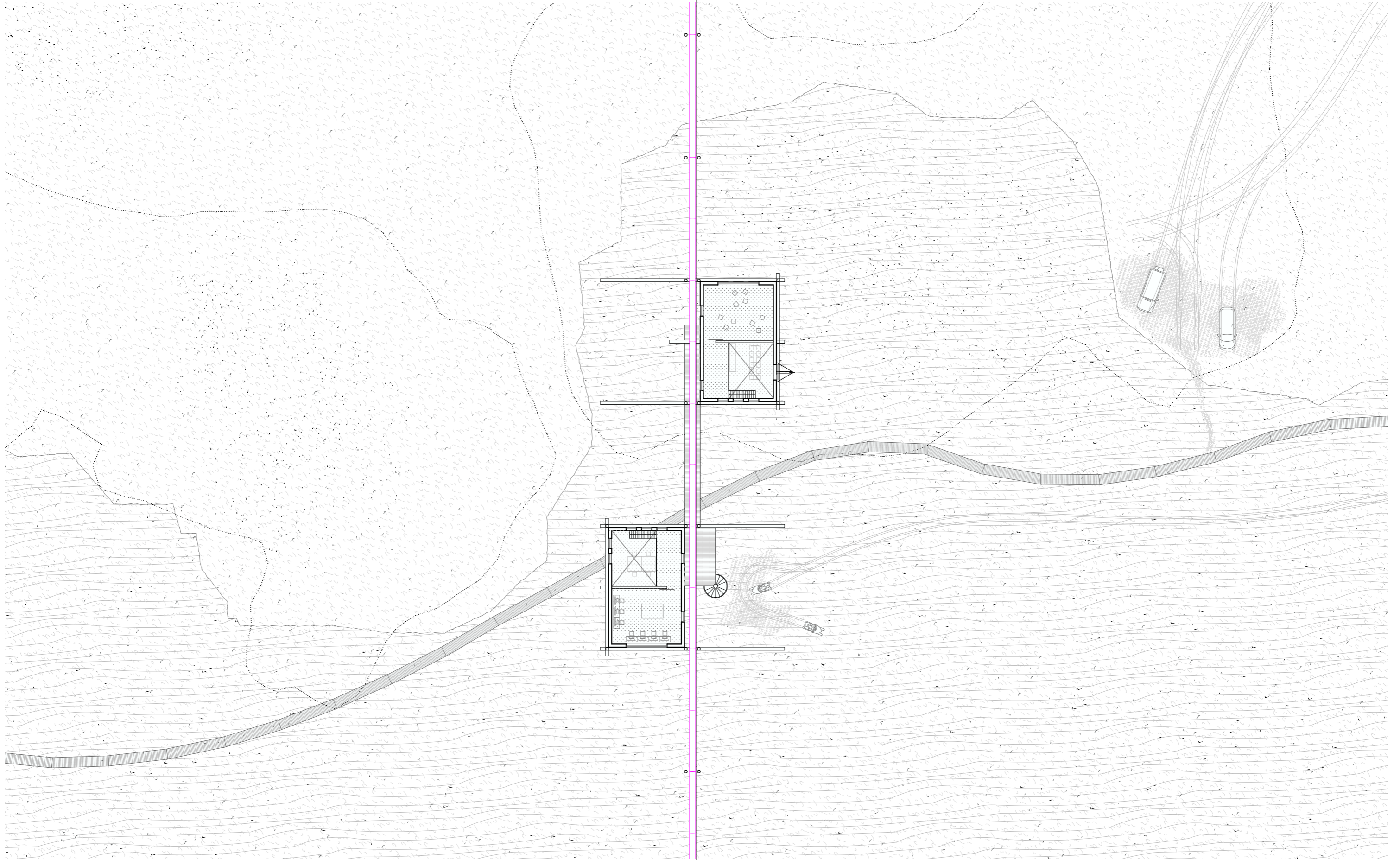
The building becomes a node within the landscape, used by hikers, observers and monitoring workers. The shelter simultaneously functions as an observation point for monitoring seasonal landscape changes, hydrological flows, and animal movement.

Program

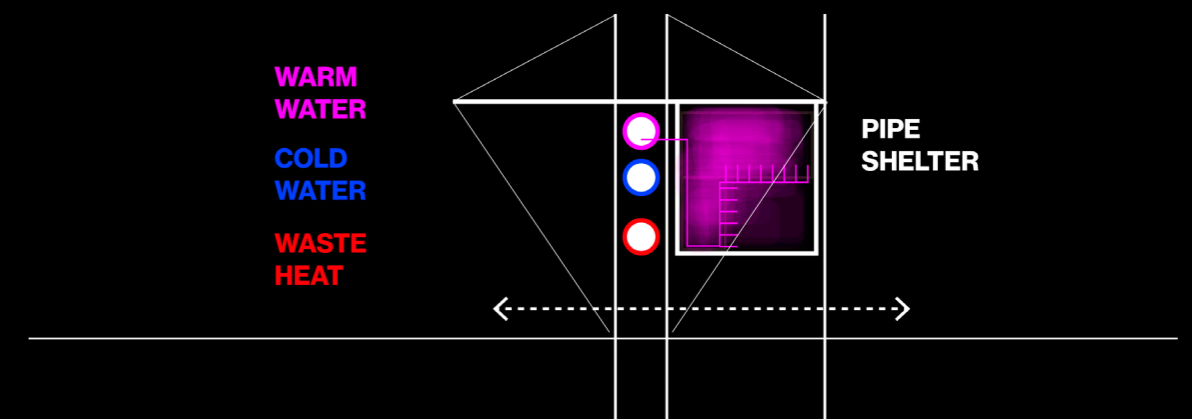
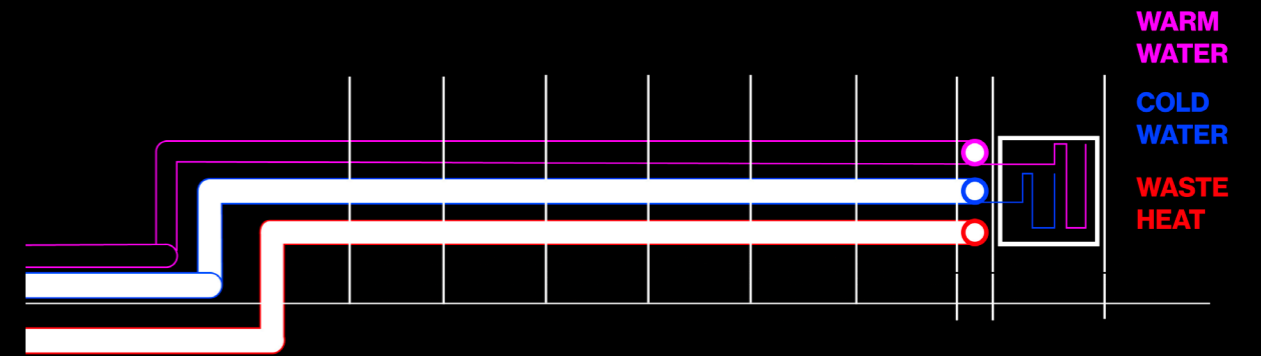
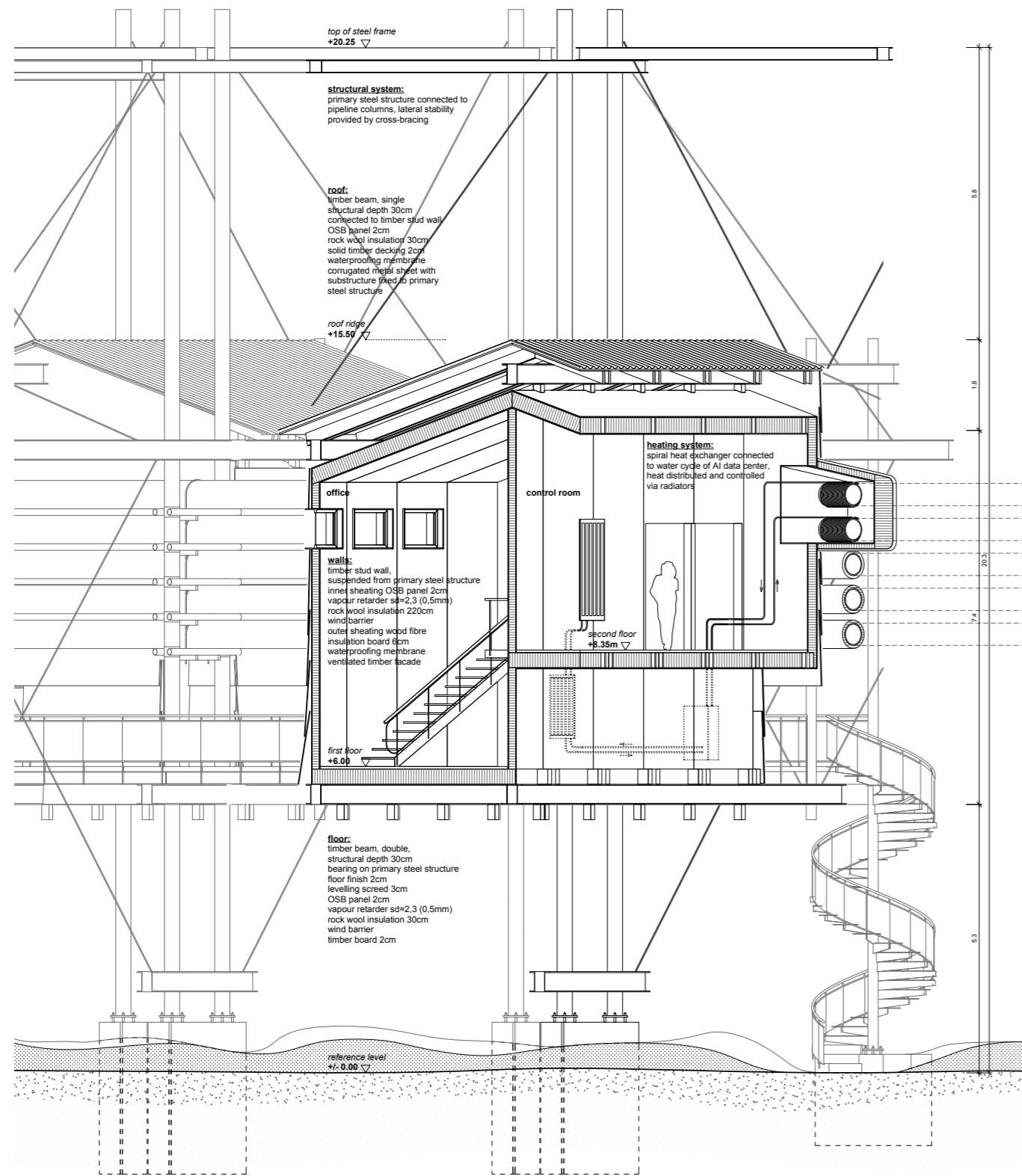




Cooling Cycle







The Pipe Radiator



Meltwater from the snow storage is redirected through a distributed field system where water is slowed, filtered, and reabsorbed into the ground. Operating similarly to a septic landscape, the fields address runoff and contamination through ecological integration. Over time, new vegetative conditions emerge through changing moisture and nutrient concentrations, producing a distinct local ecology linked to the seasonal water cycle.

Above the fields, the Drone Tower establishes a vertical feedback infrastructure connecting local observation with larger territorial and planetary systems. The tower responds to demographic shifts, environmental monitoring, and increasing demands for local agriculture. Human occupation, sensing technologies, and automated observation systems are integrated into a single territorial landmark. At the base of the tower, a small sample station allows researchers to monitor soil conditions, water quality, vegetation growth, and landscape transformation.

Environmental data becomes a relational feedback system between the landscape it senses and the ecology and community it lives on.

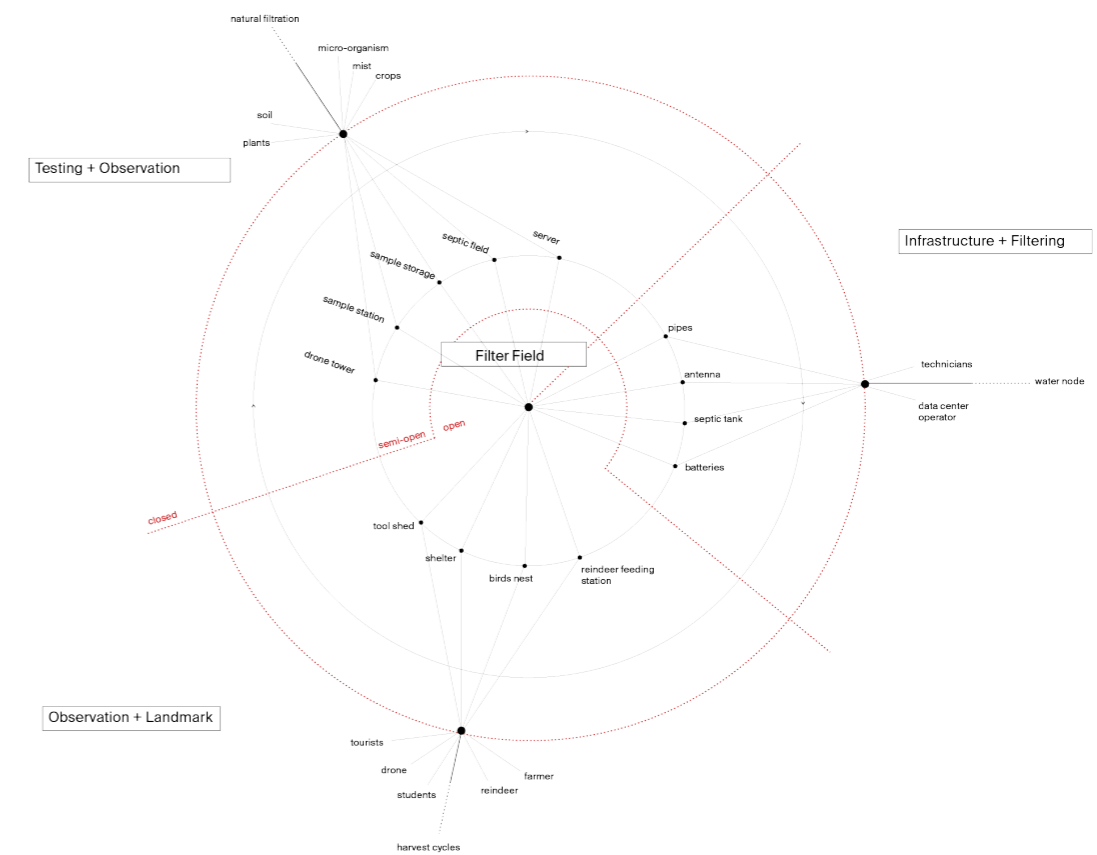
Winter Condition

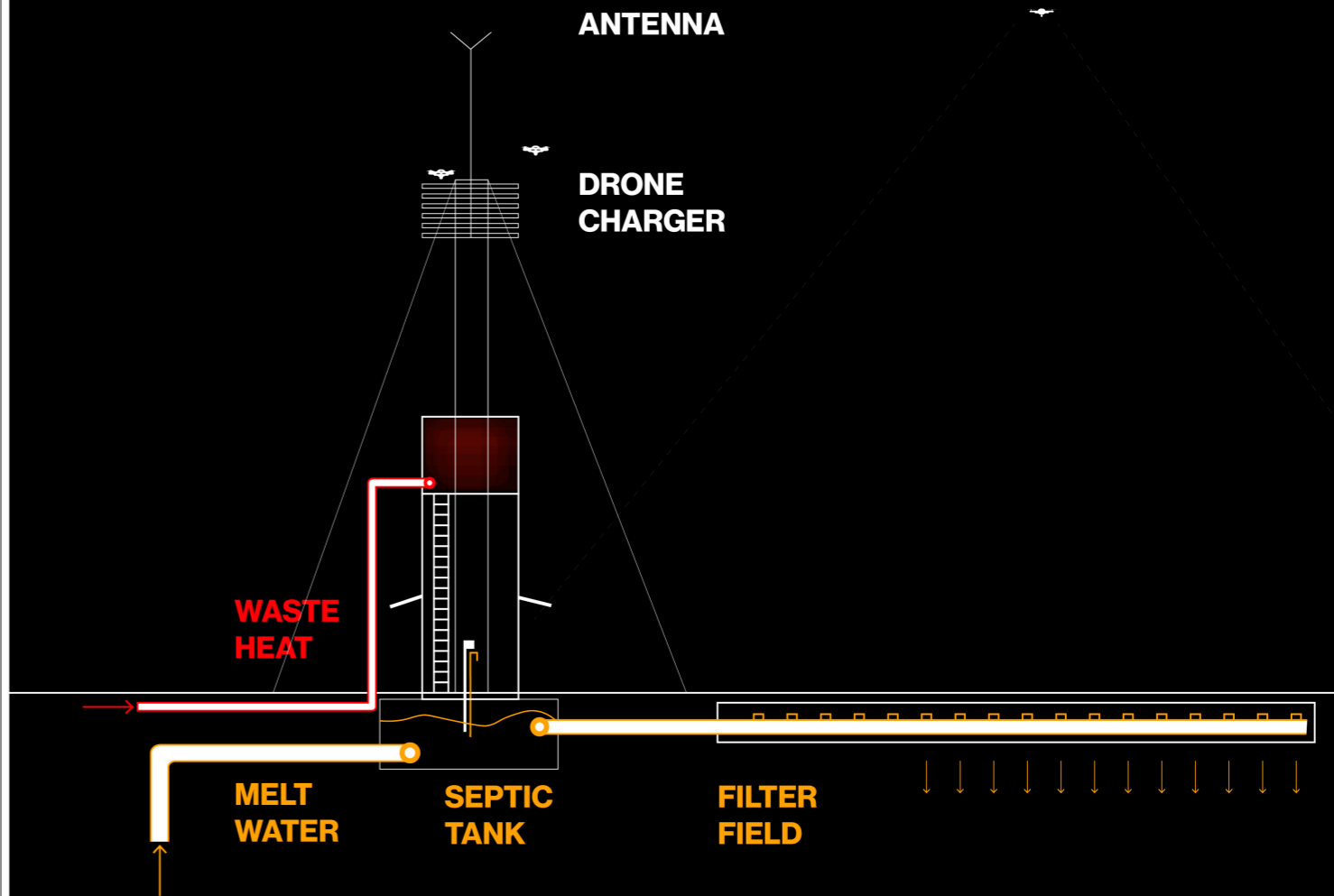
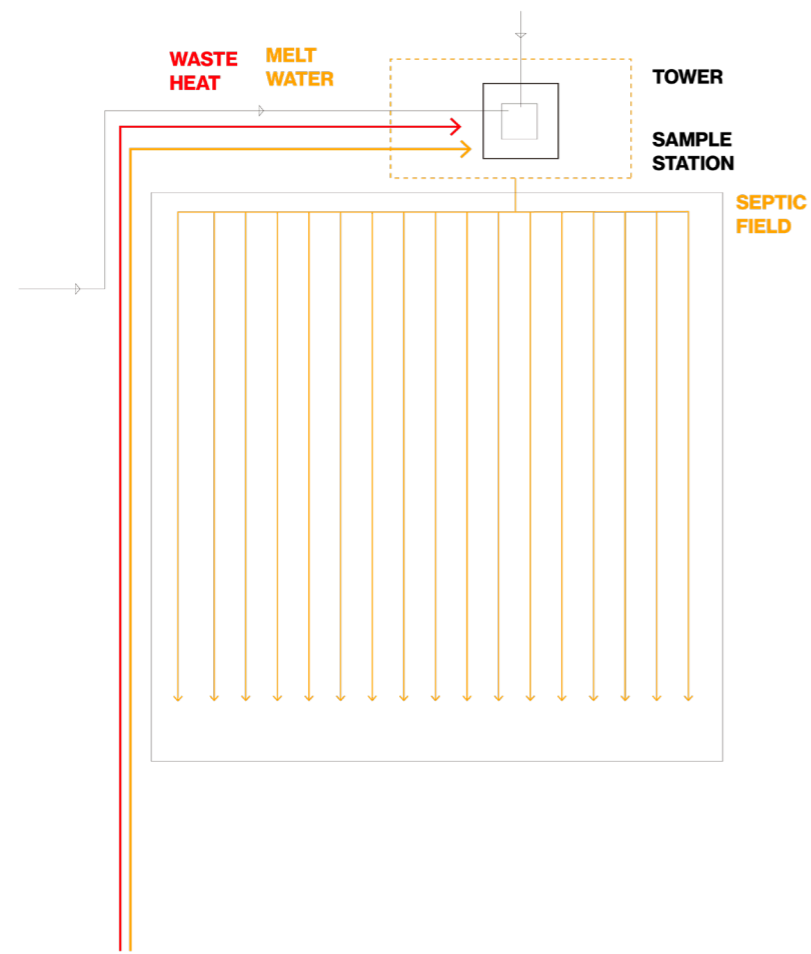
During winter, the tower operates as a landmark and observation point within the snow-covered landscape. Connected to the waste heat cycle, the structure provides a temporary warm shelter for researchers. Warm air accumulates within the upper section of the tower, creating a thermally protected interior for seasonal monitoring and observation activities.

Summer Condition

During summer, the tower supports agricultural and ecological monitoring activities. Drones operate across the surrounding fields to document reindeer movement, vegetation growth, landscape changes, and human activity. Researchers collect soil and water samples from the surrounding septic fields to monitor long-term environmental transformations and contamination levels.

Program





The Watch Tower



Conclusion

When I began this research, I believed I was looking at the data center and Artificial Intelligence itself: its architecture, imagery, and promises of technological progress and how prediction shapes tomorrow. Gradually, however, it became clear that the data center is not the singular object of the project, but only one manifestation of a much larger territorial condition.

The project has dissected the data center and formed a set of research hypotheses on how it can be understood outside the black box and how to incorporate it into our entangled landscapes.

The point is not to romanticize a past that does not exist anymore or to critique the data center on itself. It is about looking at a future in which the human, the non-human and technology can coexist. With the increasing use of AI, and data in our everyday lives, hidden infrastructures make us unaware of their spatial materialities and implications.

Along the Kemijoki River these relations become materially visible, even if these systems of computation did not yet arrive, the systems they depend on are already there. A territory increasingly reorganized through infrastructural systems of extraction, regulation, and computation. Within this condition, architecture can no longer operate solely through isolated objects or bounded sites. The architectural question shifts from the design of the building toward the spatial consequences of infrastructural organization itself. The “house of the machine” is therefore not the data center alone, but the territory that sustains it.

The project consequently reframed landscape itself as infrastructure, drawing from Pierre Bélanger’s understanding of landscape as a constructed and metabolically active ground (Bélanger 2017). Water, snow, reservoirs, soils, and seasonal cycles were treated not as passive backgrounds, but as operational mediums through which computation becomes materially embedded within the territory. Snow was reconsidered as thermal storage; meltwater became part of a fields; the warm pipes of the cooling cycle were connected to localized spatial programmes; and monitoring infrastructures became territorial interfaces rather than hidden technical systems. These interventions attempted to spatialize the externalities of AI infrastructure and reposition them as civic and ecological relations rather than concealed by-products.

The architectural proposal responded to this condition by dispersing the “black box” of the data center into a network of territorial nodes. Instead of concentrating computation within a sealed exclusion zone, thermal, hydrological, and logistical processes were redistributed across the landscape. Drawing from Jesse LeCavalier’s notion of infrastructural exclusion zones, the thesis identifies how contemporary automated systems

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displace their environmental and social burdens outward while concealing operational complexity behind abstraction and enclosure (LeCavalier 2019). Water became central within this framework. Building on the political ecology of water developed by Kaika, Swyngedouw, and Linton, the thesis understood water not as a neutral resource, but as a socio-technical medium shaped through infrastructures of regulation and control (Swyngedouw 2009; Kaika 2005; Linton 2010). Along the Kemijoki River, hydropower systems have already transformed rivers into operational landscapes governed through reservoirs, energy production, and seasonal management. The emergence of AI infrastructure extends this historical logic into the computational era, where rivers, snow, atmospheric conditions, and cooling systems become integrated into digital economies. These systems remain dependent on ecological processes, labour, maintenance, and local territorial conditions, even when computational infrastructures present themselves as abstract and immaterial.

At the same time, the thesis recognizes that such visibility remains partial. As Kate Crawford has argued, AI is fundamentally material, yet its territorial consequences remain difficult to spatially perceive because they are distributed across vast planetary networks (Crawford 2020). Architecture alone cannot fully represent or resolve these systems. The project therefore does not claim that architecture can counteract the planetary metabolism of computational capitalism. Instead, it proposes a more limited but necessary role: to construct spatial frameworks that interrupt abstraction and reintroduce situated relationships into territories to rethink our co-existence between human, non-human and technology.

Following Anna Tsing, disturbance is not treated solely as destruction, but as a condition through which new and often unstable assemblages emerge (Tsing 2015). The architectural interventions operate within these disturbed landscapes. They acknowledge that Lapland is already profoundly transformed by extraction and infrastructure that traverses it, and that AI infrastructure represents another layer within this longer history of territorial reorganization. The architectural proposal remains intentionally incomplete. It is conceived as an open territorial framework capable of adaptation, extension, and transformation across seasonal and infrastructural cycles. The disturbance that these infrastructures generate cannot be fully understood.

Rather than offering definitive answers, the project argues that architecture must continue to operate precisely within these uncertainties.

The implications of this thesis extend beyond the specific case of Lapland. The project suggests that architecture must increasingly engage with infrastructures that are planetary in scale yet locally situated in their environmental and social consequences. Following theories of operational

Implications /
Recommendations

landscapes, landscape infrastructure, and political ecology, the thesis positions the architect less as an autonomous form-maker and more as someone operating within complex territorial systems. This requires architectural practice to engage with resource cycles, environmental externalities, and infrastructural governance as spatial questions. At the same time, the thesis recognizes the limits of architectural agency.

Contemporary computational infrastructures are largely planned through technical standards and engineering logics that exceed direct architectural influence. The project therefore does not propose a technological solution, but rather a spatial design capable of revealing, redistributing, and negotiating infrastructural relationships that are otherwise rendered invisible.

Instead of providing a framework that can be easily copied elsewhere the project is a situated response to emerging data centers in Lapland, replication needs specific understanding of the context in order to understand how to find synergies with existing local ecologies. Especially in fragile contexts such as Lapland and the Arctic in general, also with the eye on the indigenous population which I did not touch as part of my research, as they are more in the north, requires significant understanding of their perspectives and challenges in order to respond to this sensitive area.

The Arctic will be one of the most interesting territories of tomorrow, and requires a sensitive understanding of the local identity and ecologies that are already embedded in the context there.

The methodological framework of the thesis combined territorial mapping, fieldwork, interviews, media analysis, and research-by-design in order to investigate AI infrastructure as a spatial and territorial condition rather than a purely technical system. Mapping served as an analytical tool to identify relationships between hydropower systems, transmission networks, extraction sites, settlements, roads, reservoirs, and emerging computational infrastructures along the Kemijoki corridor. However, mapping alone risked reproducing the same abstraction through which operational systems are often represented. The project therefore relied on fieldwork and situated observation to complicate these infrastructural readings.

Travelling through the territory fundamentally shifted the understanding of the project. The Media Analysis gave me already a first impression on the local concerns. Infrastructure appeared as layered and unevenly experienced through everyday maintenance, tourism pressure, ecological vulnerabilities, housing conditions, and local dependencies. These observations challenged the initial technological framing of the project and redirected the thesis toward a more situated understanding of infrastructural landscapes. Conversations with local actors revealed conflicts surrounding cumulative infrastructural

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Methods

impacts, energy reliability, and ecological fragmentation. These discussions repositioned the architect less as an external expert and more as a translator between territorial systems and local knowledge.

The design process increasingly focused on operational fragments and infrastructural by-products such as snow logistics, cooling systems, pipe networks, maintenance spaces, heat exchange, monitoring devices, and water redistribution. Starting without a fixed programme or architectural typology allowed the project to remain adaptive and iterative throughout the process. The focus on snow as thermal infrastructure became a decisive architectural direction that connected territorial ecologies with computational systems.

At the same time, the project exposed the limitations of architectural representation. Many of the systems addressed within the thesis remain invisible and difficult to spatialize. The proposal therefore necessarily relied on abstraction and speculation. While sections, systemic drawings, mappings, and infrastructural diagrams made relationships between water, energy, logistics, maintenance, and ecology spatially visible, they could not fully represent the operational complexity of AI systems themselves.

The project risks aestheticizing infrastructure or overestimating the transformative capacity of spatial interventions. The proposed architectures remain dependent on the same extractive and computational systems they attempt to critique. Architecture does not exist outside planetary infrastructures; it is implicated within them.

Ultimately, the project transformed the understanding of architecture from a discipline centered on form-making toward one operating through relations. The architect increasingly becomes a translator between the machine, the human and the non-human. Between social, ecological and technical processes. This role remains uncertain and incomplete because it operates within systems that architecture alone cannot control or understand. This complexity requires a team with expertise in different fields to fully comprehend and represent. Its value lies not in offering definitive solutions or highly technical models, but in constructing spatial frameworks capable of making new territorial relations discussable and imagining a future within the emerging landscapes of computation.

“If we accept that automation has a technological momentum that will work to shape the built environment to its own expedient end then, rather than stepping aside to let technology run its course, there is an opportunity to treat this as an architectural issue, or at least a spatial one (...) architecture has always been a machinic landscape.”

— Jesse LeCavalier (Human Exclusion Zones, Machinic Landscapes, AD, 2019)

This graduation project would not have been possible without the support, guidance, and generosity of many people.

I would first like to thank my tutors, Angela Rout and Nikos Katsikis. Angela Rout continuously provided clarity, critical reflection, and careful guidance throughout the process. Nikos Katsikis challenged me to think territorially and across scales, opening up new perspectives on infrastructure and architecture that became central to this thesis.

I am deeply grateful to all the people I met during my fieldwork in Lapland, who welcomed me openly and shared their experiences, stories, and knowledge of the region. Their perspectives fundamentally informed this research. I would also like to thank the Van Eesteren-Fluck & Van Lohuizen Stichting for financially supporting the fieldwork that made this research possible.

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Finally, I would like to thank my parents and my sister for their constant support throughout my studies, and Andy, for his patience, and continued belief in me.



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Plan Overview

A Data Management Plan created using DMPonline

Title: Where do the servers sleep? Architecture in the loop.

Creator: Sinja Reichenbecher

Affiliation: Delft University of Technology

Template: TU Delft Data Management Plan template (2025)

Project abstract:

This thesis investigates how the rapid expansion of artificial intelligence infrastructure is reshaping remote resource landscapes and their local socio-ecological systems. Focusing on the Kemijoki corridor between Rovaniemi and Sodankylä in Northern Finland, the project examines how hydropower dams, energy grids, mining operations, transport networks, and emerging data infrastructures are becoming interconnected within a new territorial logic of extraction, computation, and optimization.

Rather than understanding AI as an immaterial or placeless technology, the research frames it as a spatial and metabolic system that depends on energy, water, minerals, land, and labor. These infrastructures produce a range of externalities: heat, ecological fragmentation, water stress, maintenance burdens, and spatial disconnection.

Through multi-scalar mapping, field research, and speculative design, the project conceptualizes the corridor as a closed operational loop in which historical resource infrastructures evolve into a distributed landscape of computation. Within this context, the architectural proposal explores how localized and small-scale spatial interventions can capture, repurpose, and find opportunities of infrastructural externalities. These typologies form a counter-infrastructure that reconnects global digital processes with situated ecological knowledge and local experience.

By positioning architecture within the territorial metabolism of AI, the project proposes spatial strategies that address the growing disconnection between digital life and its material impacts, and that support more accountable, place-sensitive futures for fragile landscapes.

ID: 197128

Start date: 10-11-2025

End date: 18-06-2026

Last modified: 20-02-2026

Where do the servers sleep? Architecture in the loop.

0. Administrative questions

1. Provide the name of the data management support staff consulted during the preparation of this plan and the date of consultation. Please also mention if you consulted any other support staff.

The DMP has been shared with my thesis supervisor Rout Angela via DMPonline, and reviewed by them on 20th of February, 2026

2. Is TU Delft the lead institution for this project?

- Yes, the only institution involved

I. Data/code description and collection or re-use

3. Provide a general description of the types of data/code you will be working with, including any re-used data/code.

| Type of data/code | File format(s) | How will data/code be collected/generated? <i>For re-used data/code: what are the sources and terms of use?</i> | Purpose of processing | Storage location | Who will have access to the data/code? |
|--------------------------|---|---|--|------------------|--|
| Geospatial data (public) | Shapefile (.shp), GeoPackage (.gpkg), GeoJSON (.geojson), raster files (.tif), CSV (.csv), Illustrator (.ai) and PDF (.pdf) for visual outputs. | <ul style="list-style-type: none"> • National Land Survey of Finland (NLS) • OpenStreetMap (ODbL license) • Finnish Environment Institute (SYKE) • Geological Survey of Finland (GTK) • Copernicus / Sentinel satellite data (EU open data) • Finnish Meteorological Institute and other public monitoring platforms • All data will be used in accordance with open-data licenses and properly cited. | Territorial analysis, multi-scalar mapping, infrastructure analysis (energy, mining, hydropower, transmission, land use), and spatial visualization for research and design. | SURFdrive | Sinja Reichenbecher and academic supervisors. Final processed maps may be published in the thesis and academic presentations. |
| Quantitative interview | Notes (.docx, .pdf), | Informal expert conversations with professionals, researchers, and institutional representatives. Participation is voluntary. No sensitive personal data will be collected. If requested, contributions will be anonymized. | Contextual understanding of regional infrastructure development, governance, and local impacts to support research interpretation. | SURFdrive | Sinja Reichenbecher and academic supervisors. Personal identifiers will not be published without explicit consent. Selected content may be selected for final booklet. |

| | | | | | |
|--|--|--|---|-----------|---|
| Field documentation (photos, observations) | Photographs and videos (.jpg/.mov) | Material collected during site visits in public space. No identifiable individuals will be documented without consent. | Documentation of landscape conditions, infrastructure presence, and spatial context for analysis and visual representation. | SURFdrive | Sinja Reichenbecher and academic supervisors. Selected images may be included in the thesis. |
| Field documentation | field notes (.pdf/.docx) | Material collected during site visits. No identifiable individuals will be documented without consent. | Documentation of landscape conditions, infrastructure presence, and spatial context for analysis and visual representation. | SURFdrive | Sinja Reichenbecher and academic supervisors. |
| Qualitative coding (Atlas.ti) - Qualitative text and visual analysis | Text documents (.docx, .pdf), field notes, interview notes (if applicable), images (.jpg, .png), Atlas.ti project files. | Researcher-generated material (field notes, literature excerpts, policy documents, local newspaper, expert input). All external documents are publicly available or used for academic research under fair-use and proper citation. | The software supports the identification of themes such as infrastructural externalities, spatial conflicts, and governance patterns. | SURFdrive | Sinja Reichenbecher and academic supervisors. No sensitive personal data will be processed. |
| AI-assisted image analysis (Deep Learning / image segmentation) | Satellite imagery and photographs (.tif, .jpg, .png), processed outputs (.tif, .png), Python scripts (.py). | Open-source satellite imagery (e.g., Copernicus Sentinel, publicly available aerial imagery) and researcher-generated field photographs. All imagery will comply with open-data licenses and be properly cited. | Used for identifying landscape features and infrastructure patterns, classify land cover or spatial elements, support territorial analysis and visualization. The method supports spatial interpretation and does not involve facial recognition, biometric analysis, or identification of individuals. | SURFdrive | Sinja Reichenbecher and academic supervisors. Selected processed visualizations may be published in the thesis. |
| Report/thesis | .pdf | Serves as record of the process as well as documentation | Long-term | SURFdrive | Sinja Reichenbecher and academic supervisors. |

II. Storage and backup during the research process

4. How much data/code storage will you require during the project lifetime?

- < 250 GB

5. Where will the data/code be stored and backed-up during the project lifetime? (Select all that apply.)

- SURFdrive

III. Data/code documentation

6. What documentation will accompany data/code? (Select all that apply.)

- Data - Methodology of data collection

IV. Legal and ethical requirements, code of conducts

7. Does your research involve human subjects or third-party datasets collected from human participants?

If you are working with a human subject(s), you will need to obtain the HREC approval for your research project.

- Yes - please provide details in the additional information box below

I have applied for ethical approval from the Human Research Ethics Committee on [date] with HREC application number [#12345].

8. Will you work with personal data? (This is information about an identified or identifiable natural person, either for research or project administration purposes.)

- Yes

9. Will you work with any other types of confidential or classified data or code as listed below? (Select all that apply and provide additional details below.)

If you are not sure which option to select, ask you Faculty Data Steward for advice.

- No, I will not work with any other types of confidential or classified data/code

10. How will ownership of the data and intellectual property rights to the data be managed?

For projects involving commercially-sensitive research or research involving third parties, seek advice of your Faculty Contract Manager when answering this question

This is an internal TUD MSc thesis project.

11. Which personal data or data from human participants do you work with? (Select all that apply.)

- Proof of consent (such as signed consent materials which contain name and signature)

12. Please list the categories of data subjects and their geographical location.

The data subjects include the following categories:

- Local residents living in the Kemijoki corridor (Rovaniemi-Sodankylä region)
- Professionals and stakeholders involved in infrastructure and land use, such as representatives from energy companies, hydropower operators, mining companies, data center operators, and municipal authorities
- Researchers and experts working on environmental monitoring, infrastructure, or regional development
- Local practitioners and land users (e.g., forestry workers, tourism operators, or reindeer herding representatives where relevant)

All participants are located in Northern Finland, specifically within or around the Kemijoki river corridor, including the municipalities of Rovaniemi, Sodankylä, and surrounding areas.

13. Will you be receiving personal data from or transferring personal data to third parties (groups of individuals or organisations)?

- No

No personal data will be received from external organisations or transferred to third parties. Personal data (e.g., names and contact details for interview scheduling) will be collected directly from participants and will be used solely for the purpose of this research at TU Delft. Interview data will be anonymised and will not be shared outside the research context.

16. What are the legal grounds for personal data processing?

- Informed consent

Personal data will be processed based on informed consent. Participants will receive an information sheet explaining the purpose of the research, the type of data collected (e.g., interview recordings and transcripts), how the data will be stored and used, and their rights, including the right to withdraw at any time without consequences.

Written or recorded consent will be obtained prior to participation. All interview data will be anonymised or pseudonymised and used solely for academic research purposes within the TU Delft graduation project.

17. Please describe the informed consent procedure you will follow below.

Potential participants will be contacted individually by email or through professional networks. Prior to the interview, participants will receive a digital participant information sheet explaining the purpose of the research, the voluntary nature of participation, the type of data collected (e.g., audio recordings and notes), how the data will be stored and used, and their rights, including the right to withdraw at any time without consequences.

Participants will be asked to provide informed consent before the start of the interview. Consent will be obtained either through a signed digital consent form (for online interviews) or through written consent (for in-person interviews). If written consent is not feasible, verbal consent will be recorded at the beginning of the interview.

Participants will also be asked whether they agree to audio recording. If they do not consent to recording, only written notes will be taken.

All collected data will be anonymised or pseudonymised and used solely for academic research purposes within the TU Delft graduation project.

18. Where will you store the physical/digital signed consent forms or other types of proof of consent (such as recording of verbal consent)?

The proof of consent (digital copy of signed document) will be preserved on the TU Delft Project Data Storage (U:) drive.

19. Does the processing of the personal data result in a high risk to the data subjects? (Select all that apply.)

If the processing of the personal data results in a high risk to the data subjects, it is required to perform a Data Protection Impact Assessment (DPIA). In order to determine if there is a high risk for the data subjects, please check if any of the options below that are applicable to the processing of the personal data in your research project.

If any category applies, please provide additional information in the box below. Likewise, if you collect other type of potentially sensitive data, or if you have any additional comments, include these in the box below.

If one or more options listed below apply, your project might need a DPIA. Please get in touch with the Privacy team (privacy-tud@tudelft.nl) to get advice as to whether DPIA is necessary.

- None of the above apply

The research involves a small number of voluntary interviews with adult professional stakeholders. No sensitive or special category personal data will be collected. Data will be anonymised or pseudonymised and used solely for academic purposes. The study does not involve automated decision-making, systematic monitoring, large-scale data processing, or vulnerable populations. Therefore, the

processing of personal data does not pose a high risk to data subjects.

23. What will happen with the personal data used in the research after the end of the research project?

- Anonymised or aggregated data will be shared with others

Only anonymised and aggregated data will be shared in the final thesis and related academic outputs. Personal identifiers (such as names, organisations, or specific positions where identification is possible) will be removed or generalised. Interview quotations may be included in anonymised form (e.g., "energy sector stakeholder" or "municipal expert").

Raw personal data (e.g., contact details, recordings, and non-anonymised transcripts) will not be shared and will be stored securely for research purposes only.

24. For how long will personal research data (including pseudonymised data) be stored?

- Personal data will be deleted at the end of the research project

25. How will your study participants be asked for their consent for data sharing?

- In the informed consent form: participants are informed that their personal data will be anonymised and that the anonymised dataset is shared publicly

V. Data sharing and long term preservation**27. Apart from personal data mentioned in question 23, will any other data be publicly shared?**

Please provide a list of data/code you are going to share under 'Additional Information'.

- All other non-personal data/code underlying published articles/reports/theses

29. How will you share research data/code, including those mentioned in question 23?

Select all that apply and provide additional details below.

- I am a Bachelor's/Master's student at TU Delft and I will share the data/code in the body and/or appendices of my thesis/report in the TU Delft Repository

30. How much of your data/code will be shared in a research data repository?

- 100 GB - 1 TB

31. When will the data/code be shared?

- At the end of the research project

32. Under what licence(s) will the data/code be released?

- Other - please explain below

The research outputs will be shared as part of the Master's thesis, which will be published through the TU Delft Repository and is subject to standard copyright.

The thesis will include anonymised and aggregated research results, spatial analyses, maps, diagrams, and design outputs. No separate datasets or software will be released, and no personal data will be shared.

VI. Data management responsibilities and resources**33. If you leave TU Delft (or are unavailable), who is going to be responsible for the data/code resulting from this project?**

My supervisor Angela Rout, Assistant Professor in the Department of Architecture at the Faculty of Architecture and the Built Environment at TU Delft

34. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

Research data are only shared within the MSc thesis: no additional resources are required.

35. Which faculty do you belong to?

- Faculty of Architecture and the Built Environment (ABE)



Course: Explore Lab Graduation Studio - AR4EX310
Project: MSc Graduation Project - Where do the servers sleep? Architecture in the loop.
Research Team: Sinja Reichenbecher
Project Date: 20.02.2026

Dear Participant,

You are being invited to participate in a Master's thesis titled: *Where do the servers sleep? Architecture in the Loop*. This study is conducted by Sinja Reichenbecher at TU Delft (Faculty of Architecture and the Built Environment).

The purpose of this research is to investigate the spatial impacts of emerging infrastructures related to energy, extraction, and digital technologies. The interview will take approximately 20-45minutes. The data will be used for academic research and analysis for the Master's thesis, which will be published in the TU Delft Repository with public access. Anonymised insights may also be used for academic presentations or future research publications.

During the interview, you will be asked about your professional experience, perspectives, and knowledge related to infrastructure, land use, environmental impacts, and regional development in the study area.

As with any digital communication, a minimal risk of data breach exists. To protect your privacy, all information will be treated confidentially. With your permission, the interview may be audio-recorded to ensure accuracy. Recordings and notes will be stored securely on password-protected devices and TU Delft-approved storage. Personal identifiers such as your name, organisation, or specific position will be removed or generalised.

Any quotations used in the thesis will be fully anonymised and cannot be traced back to you. Only anonymised and aggregated information will be included in publicly available outputs. Raw recordings and identifiable data will not be shared and will be deleted after completion of the research project.

Participation in this study is entirely voluntary. You may withdraw at any time without giving a reason and are free to skip any questions. You may request removal of your data up to two weeks after the interview, after which the data may have been anonymised and integrated into the analysis.

There is no financial compensation for participation.

If you have any questions about the study, please contact:
 Sinja Reichenbecher
 Master's Student, TU Delft

Angela Rout,
 Assistant Professor, Department of Architecture, TU Delft

By agreeing to participate (or by signing the consent form or confirming verbally before the interview), you confirm that you have read and understood this information and consent to the use of your anonymised data for the purposes described above.



Explicit Consent points

| PLEASE TICK THE APPROPRIATE BOXES | Yes | No |
|--|--------------------------|--------------------------|
| A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICIPANT TASKS AND VOLUNTARY PARTICIPATION | | |
| 1. I have read and understood the study information dated [DD/MM/YYYY], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction. | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. I understand that taking part in the study involves: Participation involves a one-time semi-structured interview of approximately 20-45 minutes about your professional knowledge and perspectives related to infrastructure, land use, and regional development in the Kemijoki corridor. With your permission, the interview will be video or audio-recorded to ensure accuracy. If you do not consent to recording, written notes will be taken instead. Audio recordings will be transcribed into text for analysis and then securely stored and deleted after the completion of the research project. All information will be treated confidentially. Personal identifiers (such as your name, organisation, or specific role) will be removed or generalised, and only anonymised information or quotations may be used in the thesis and related academic outputs.^ | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. I understand that the study will end upon completion and assessment of the Master's thesis at TU Delft (expected June 2026) | | |
| B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION) | | |
| 6. I understand that taking part in the study involves the following risks: minimal risk, including the time required for participation and the possible sensitivity of sharing professional opinions. I understand that these risks will be mitigated by ensuring voluntary participation, the right to skip questions or withdraw at any time, and by treating all information confidentially and using only anonymised data in the research outputs. | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. I understand that taking part in the study involves collecting limited personally identifiable information (PII), such as my name, professional role, organisation, and contact details for communication purposes, as well as associated research data (PIRD) from the interview about my professional knowledge and opinions. I understand that there is a small potential risk of re-identification or professional reputational impact if identifiable information were disclosed. This risk will be mitigated by removing or generalising personal and organisational identifiers, securely storing the data, and using only anonymised information and non-attributable quotations in the thesis and related academic outputs. | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. I understand that no sensitive personal data as defined under GDPR (such as data on health, religion, political opinions, ethnicity, or criminal records) will be collected or processed as part of this study. The research focuses solely on professional knowledge and perspectives related to infrastructure and regional development. | <input type="checkbox"/> | <input type="checkbox"/> |

| PLEASE TICK THE APPROPRIATE BOXES | Yes | No |
|--|--------------------------|--------------------------|
| 9. I understand that the following steps will be taken to minimise the risk of a data breach and protect my identity: personal data will be collected only where necessary and stored securely on password-protected devices and TU Delft-approved storage with access limited to the researcher (and supervisors if required). Video and Audio recordings will be transcribed and then deleted after the completion of the project. Personal identifiers such as names, organisations, or specific roles will be removed or generalised, and all research outputs will use anonymised or aggregated information only. | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. I understand that personal information collected about me that can identify me, such as name, profession, will not be shared beyond the study team. | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. I understand that the (identifiable) personal data I provide will be destroyed after the completion of the Master thesis. | <input type="checkbox"/> | <input type="checkbox"/> |
| C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION | | |
| 12. I understand that after the research study, the de-identified information I provide will be used for academic purposes, including the Master's thesis, which will be published in the TU Delft Repository with public access. De-identified insights and anonymised quotations may also be used for academic presentations, teaching, or potential future research publications. The results will contribute to research and design strategies related to infrastructure, environmental impacts, and regional development. No identifiable personal information will be published, and any quotations or examples will be fully anonymised and non-attributable. | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. I agree that my responses, views or other input can be quoted anonymously in research outputs | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. I agree that my real name can be used for quotes in research outputs | <input type="checkbox"/> | <input type="checkbox"/> |
| D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE | | |
| 16. I agree that only anonymised and aggregated results will be included in the publicly available Master's thesis in the TU Delft Repository. Raw interview data (recordings, transcripts, and notes) will not be archived and will be deleted after completion of the research project. | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. I understand that access to this repository is open via the TU Delft Repository. No separate research dataset will be stored or made available. | <input type="checkbox"/> | <input type="checkbox"/> |

Signatures

Name of participant [printed] Signature Date

[Add legal representative, and/or amend text for assent where participants cannot give consent as applicable]

I, as legal representative, have witnessed the accurate reading of the consent form with the potential participant and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness [printed] Signature Date

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Researcher name [printed] Signature Date

Study contact details for further information: *[Name, phone number, email address]*

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