Transitioning Energy (and) Landscapes

Exploring infrastructural, architectural + landscape symbiosis

Infrastructure | Brora, Sutherland

Transitioning Energy and Landscapes
Exploring infrastructural, architectural + landscape symbiosis

Project Booklet Part 1

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Transitional Territories Studio 2018-2019
North Sea: Landscapes of Coexistence

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III Existing Condition

Landscape analysis

The project becomes systemised through the selection of the most promising scenario, namely scenario C from the previous booklet. Moreover, the project zooms into the next scale of intervention: the infrastructural landscape scale. Brora was chosen, due to Loch Brora and its surrounding high topography; the latter creates the potential for pumped electrical storage; as previously mentioned, storage is key in ensuring infrastructural performance.

The receiving landscape's site-specific potentials and constraints are mapped out in the following pages; site-specificity is key to highlighting useful criteria. By understanding the geographical constraints and potentials of the site - its topographic qualities and its water infrastructure - the landscape morphology can be used as an integral part of a subsequently proposed infrastructural and architectural design.

A future climate change scenario of severe winter flooding and summer droughts is used to create a temporal stress on the project. This challenges the design process to question its performance in the most extreme of scenarios. In turn, the project will then endeavour to identify key physical properties of the electrical infrastructure that have architectural potential: design criteria become evident. Issues of **scale**, **embeddedness**, **isolation**, **concentration** and **diffusion** are essential design criteria in achieving an effective and embedded landscape infrastructure with qualitative value. As such, a dialogue between the infrastructure's functionality and the landscape is established.

This scale of analysis begins to investigate the cultural landscape of the locality. By understanding the local industries, the project's architectural agency, in relation to the infrastructure it is situated within, can begin to be considered and realised. To reiterate, the aim of this project is to achieve a symbiosis between infrastructural space, landscape and habitable architectural space. The latter draws its agency from the existing practices and industries of the locality. This project does not wish to intervene into the site with a new programme; rather, it aims to articulate how this site-specific symbiosis can buttress both an existing condition and the larger infrastructure that serves it.

Zooming into an area within this scenario, Clynelish has been chosen for the site of the architectural intervention for this project (this will be expanded upon in booklet 3).

Site Analysis

Brora and its surrounding settlements - including Clynelish - is coincidently nicknamed the 'Electric City'. This name is owed to the fact that this small industrial village was in fact the first place in the north of Scotland to have electricity thanks to its thriving wool industry. The first buildings in the parish of Clyne to have electric light were the Wool Mills, Clyenlish Distillery and the Station Hotel, through a coal plant that was installed between 1903-5. The village's public supply started in 1913 by Captain T. M. Hunter, of Brora Wool Mills, under the name of the Brora Electric Supply Company. The Clynelish Distillery still exists within the community, as one of its most established trades.

As mentioned, this area was chosen due to its rich geographical quality. Clynelish lies in the shadow of 200-300m high hills. This altitude is sufficient to introduce a high level reservoir that connects to Loch Brora, introducing pumped electrical storage into the electrical infrastructure. There is a natural dip between two high points in the topography that is a well-suited location of a reservoir. Another topographical benefit of the site is the flat at the bottom of the hills, an ideal location for a community-owned, medium-sized wind farm. This wind farm could act as a decentralised RET for Brora and Clynelish. This flat is ideally located between the area's existing sub-station and the potential base of the reservoir.








Topography

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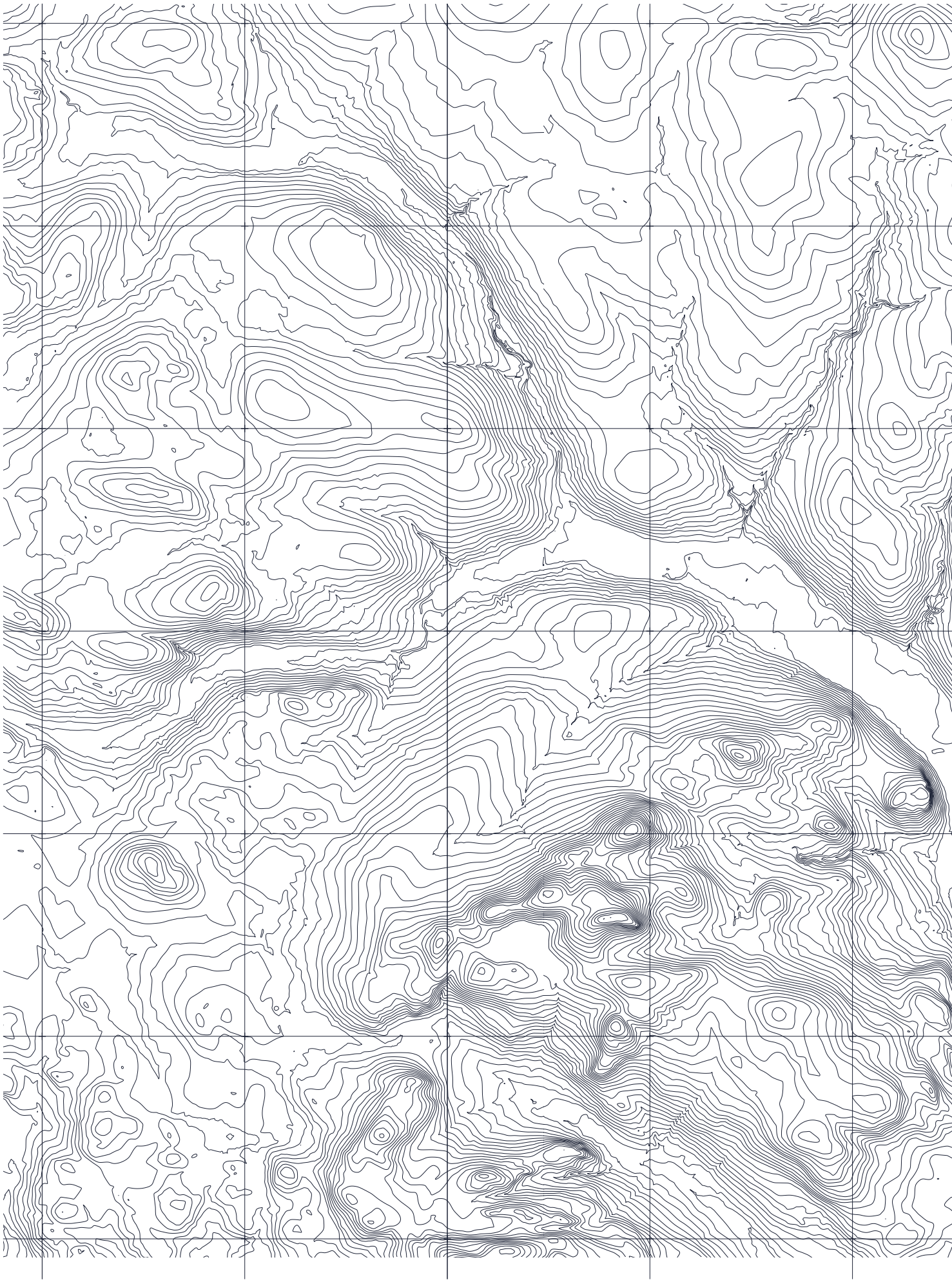
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Water infrastructure

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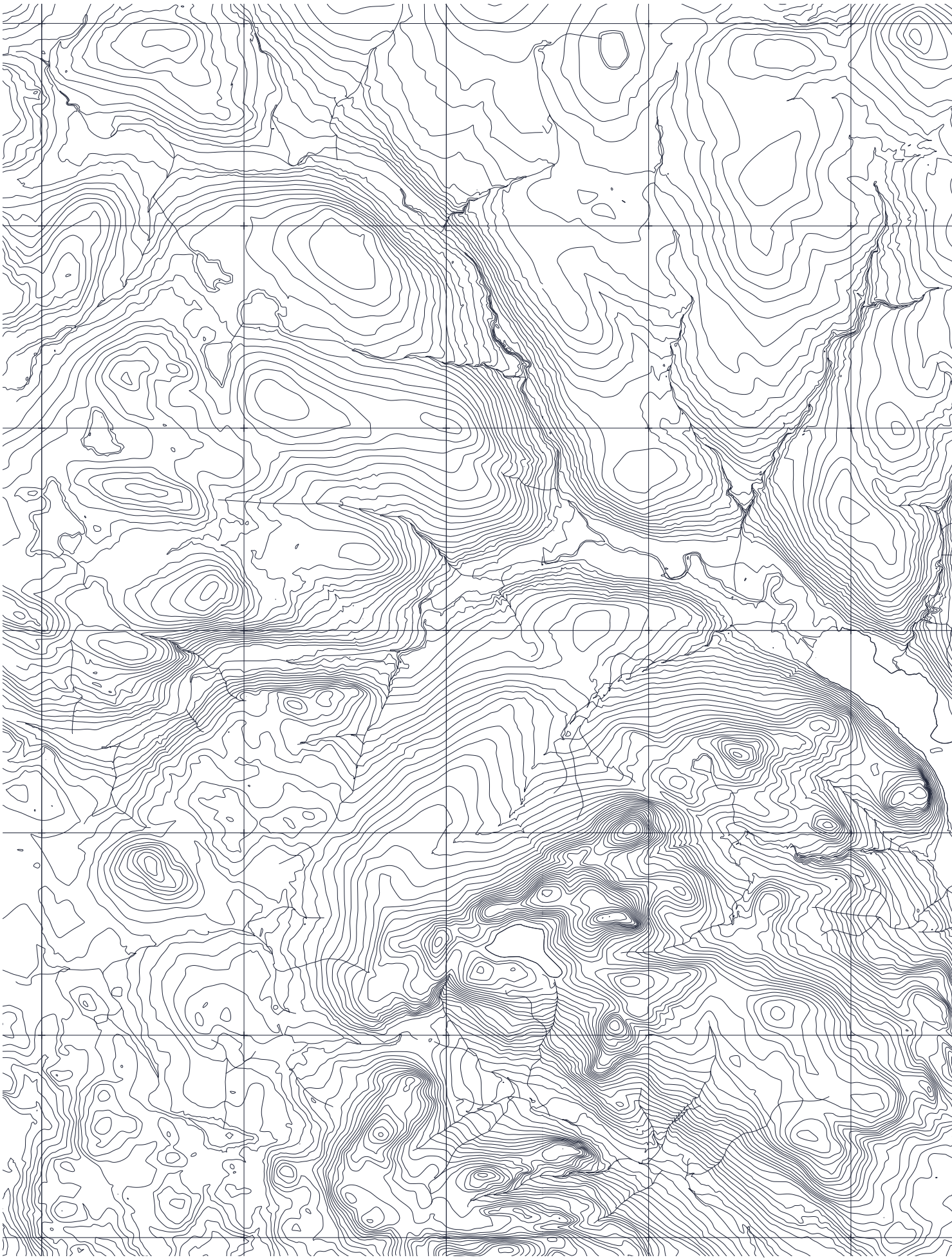
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Soil types

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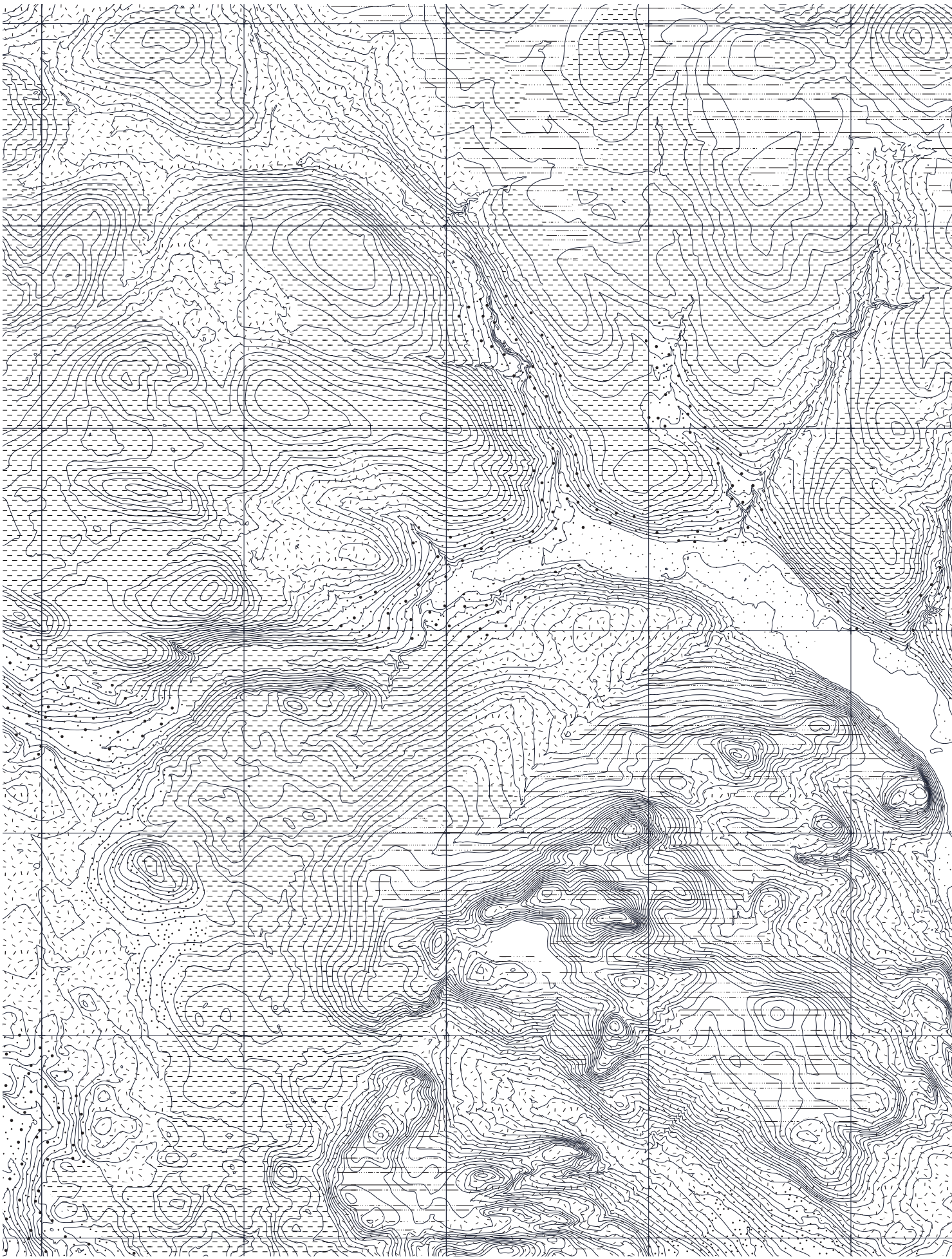
- immature soils
- humus-iron podzols
- alluvial soils
- brown earths
- peaty podzols
- peaty gleys
- peat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Synthesis image

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III.I Climate Scenario

Flooding + drought

In order for the infrastructure to be resilient to temporal stresses, it is also important to consider potential shifts in climatic conditions. During the making of the Atlas, research suggested that the north of Scotland is likely to experience increased rainfall and flooding in winter, while suffering more droughts in summer. Indeed, increasing rainfall and changes in rainfall patterns mean that the country's rivers are likely to flood more often. Since 1961, the north of Scotland has see a 67-69 per cent rise in precipitation. The increasingly severity of the Scottish climate may also impact power distribution, as seen in the damage caused by extreme weather events such as floods and flash storms in he past decade. This is has resulted in an increasing trend of 'undergrounding' - relocating overhead electricity transmission and distribution lines underground.[1]

Summer water shortages, on the other hand, are a threat to many rural farms and one of Scotland's most loved and lucrative industries - whisky production. The area is filled with such industries, whereby the latter accounts for one quarter of the UK's total food and drink exports, generating almost £4 billion a year for the UK economy. Moreover, the whisky industry employs more than 10,000 people, many of them in economically deprived areas since they are often located in peri-urban and rural areas.[2] With this in mind, multi-functionality can be introduced into the infrastructure through storm-water capture in the reservoir, easing the severity of winter flooding and acting as a water store for summer when droughts occur.

Loch Brora
View from Gordon's Bush

III.II Problem Statement + Research Question

Problem Statement

Many industries and trades in Brora, including dairy farms, the heritage Brora Distillery and Clynelish Distillery, rely on the area's availability of fresh water. This is particularly true for the distilleries, which use water from the naturally occurring Clyne burn in their whisky production. In light of the emerging and speculative temporal stresses caused by increasing flooding and droughts, how can architecture's agency evolve alongside its contextual infrastructures in respond to these climatic threats? Rather than seeing architecture as the building of object-space entities, its agency my be improved if interpreted as an enabler within an infrastructure: a space-time discipline?

If architectural agency is to advance and aid in achieving a symbiosis between landscape, infrastructure and social/cultural needs, what qualitative knowledge systems can architect's employ play in this transition? Can we use our design skills to ameliorate our landscapes' morphology and our urban morphology ? Keeping the project's infrastructural objectives in mind, the architectural agency of this project aims to exemplify how design can become a bridge between an infrastructure's multi-functionality and a locality's needs. Architecture can afford the development of a system that already exists. In order for architecture to bare agency within the emergence of energy landscapes, the role of the architect must ensure the qualitative transformation of our urbanised landscapes. In order to achieve this, the following two sub-themes, or design lenses, were emphasised and will be explored.

Architecture as an Enabler

The project seeks to respond to the ever-fluctuating relationships between society and natural processes. This stems from the understanding of cities and urban landscapes as complex systems, which are rooted in a temporal dimension. As previously mentioned, rather than seeing architecture as the building of forms in space, this project seeks to establish its architectural agency as being an enabler of urbanisation processes and infrastructures.

Infrastructure + Landscape + Architecture; Symbiosis

Through the process of hybridisation, the morphology of the urban fabric seeks to improve the quality of the infrastructural network itself: it will be energy sensitive. As such, the new agency of the building is to create a symbiotic relationship between the technical system's architectural requirement, the landscape's ecological constraints and the social environment's habitable needs, culminating in an example of a new cultural, energy landscape. The architect's role in designing the transition is exemplified through this project, highlighting the need for qualitative input in this transition to ensure the amelioration of our landscapes.

Architectural Scale Design Question

Can new architectural agency can be established within the electrical infrastructure itself, particularly at the delivery point, and within the consumer building itself, to buttress existing industries?

Sub-questions

i. Can the issue of scale between infrastructure and building be bridged through landscape infrastructures?
ii. By grafting infrastructural delivery into a building's functionality, can a new distillery typology emerge?

Disjuncture

Manipulated image
J.M.W. Turner, 1796

IV Proposed Design

Generation, storage, transmission

The Infrastructural Proposition

The project will focus on the schematic design of the electrical infrastructure in Brora, as well as a fully-resolved design of an offshoot of the electrical infrastructure that serves Clynelish, namely Brora Distillery.

Beginning with the predicted climatic shifts, that is increased rain fall in winter and droughts in summer, the area has already began to experience shortages of free-flowing water in its burns (streams). This is effecting the locality's whisky and farming industries. As such, this project aims to be a 3-edged sword:

Electrical Infrastructure

By introducing a reservoir above Loch Brora, the issue of electrical storage within the decentralised electrical infrastructure is tackled with pumped storage. Moreover, predicted water-storages in summer droughts is also addressed with the reservoir, as it would also act as a storm-water reservoir and ease flooding risks in the area over the winter. When the area's peak demand exceeds renewable generation, water is released from the reservoir and passes the turbines, that are attached to generators, at the hydro-station at the loch. Electricity is fed into the grid and the water can either be directed into the loch or into the proposed infrastructure.

Landscape Morphology

Electrical cables and water from the hydro-station are fed into an infrastructural viaduct, connecting the loch to Brora sub-station, past the Brora distillery. This viaduct would be integrated into the site's topography where possible, in the form of 'embedded walls'. The electrical cables will be protected from harsh weather conditions and avoid the need for undergrounding. As such, the viaduct is both topographically responsive and multi-functional. The system would then branch off at delivery points, in this project's case Clynelish. This would require localised networks of step-down sub-stations and cisterns that will store water for the distilleries, farms and the town of Brora .

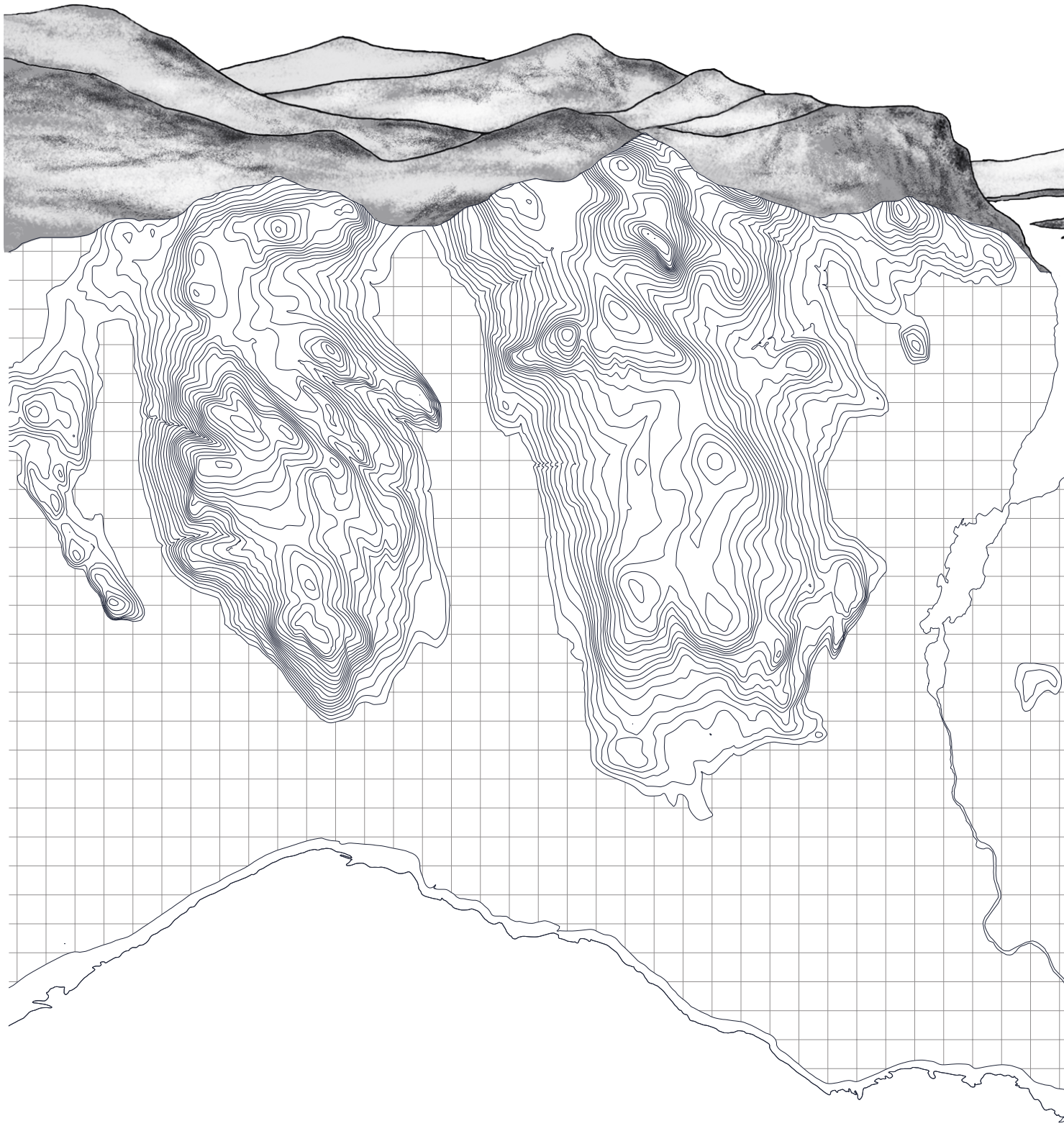
Architectural Design

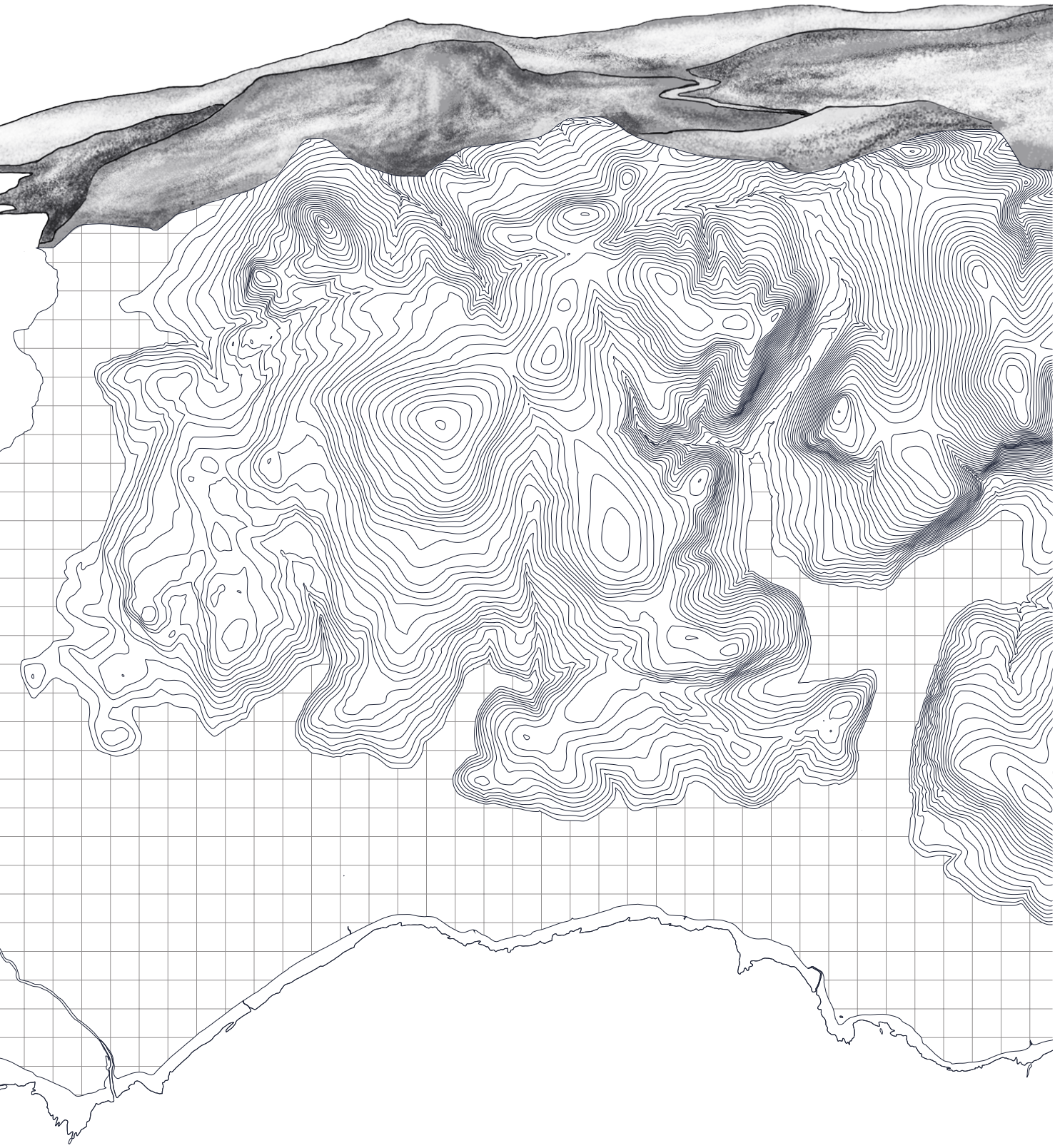
This scale of the project includes the schematic design of the overall infrastructure through the production of a design syntax. The latter establishes a dialectic relationship between selected elements of the infrastructure and the site-specific landscape conditions it will pass through.

Salvataggi di Centri Storici Italiani (Italia vostra)
Superstudio

IV.I Ground Zero

Superimposition 200m down





The indicated delivery points consist of industrial sites, including farms and distilleries. It also includes larger settlements, including the town of Brora. Lastly, a water intensive golf course is also fed by the infrastructure.

Delivery points

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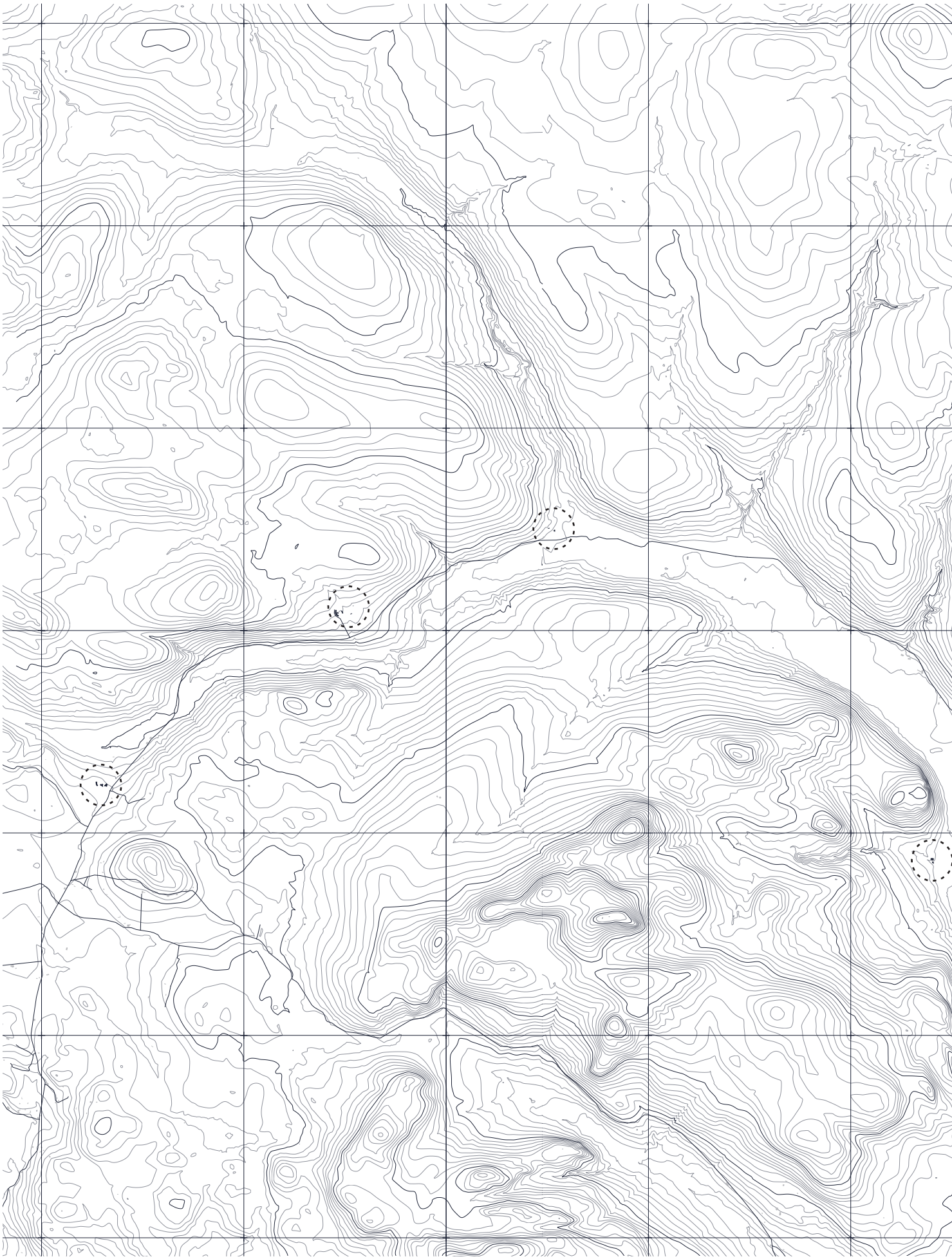
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The highlighted sites are areas of cultural significance to Brora. Firstly, Brora Distillery was founded in the 19th century and was one of the first buildings in the area. It is now a heritage site.

The two brochs remains are some of Scotland's best examples of the ancient monolithic stone structures. These vernacular constructions have been used for architectural inspiration in the aqueduct design.

Cultural sites

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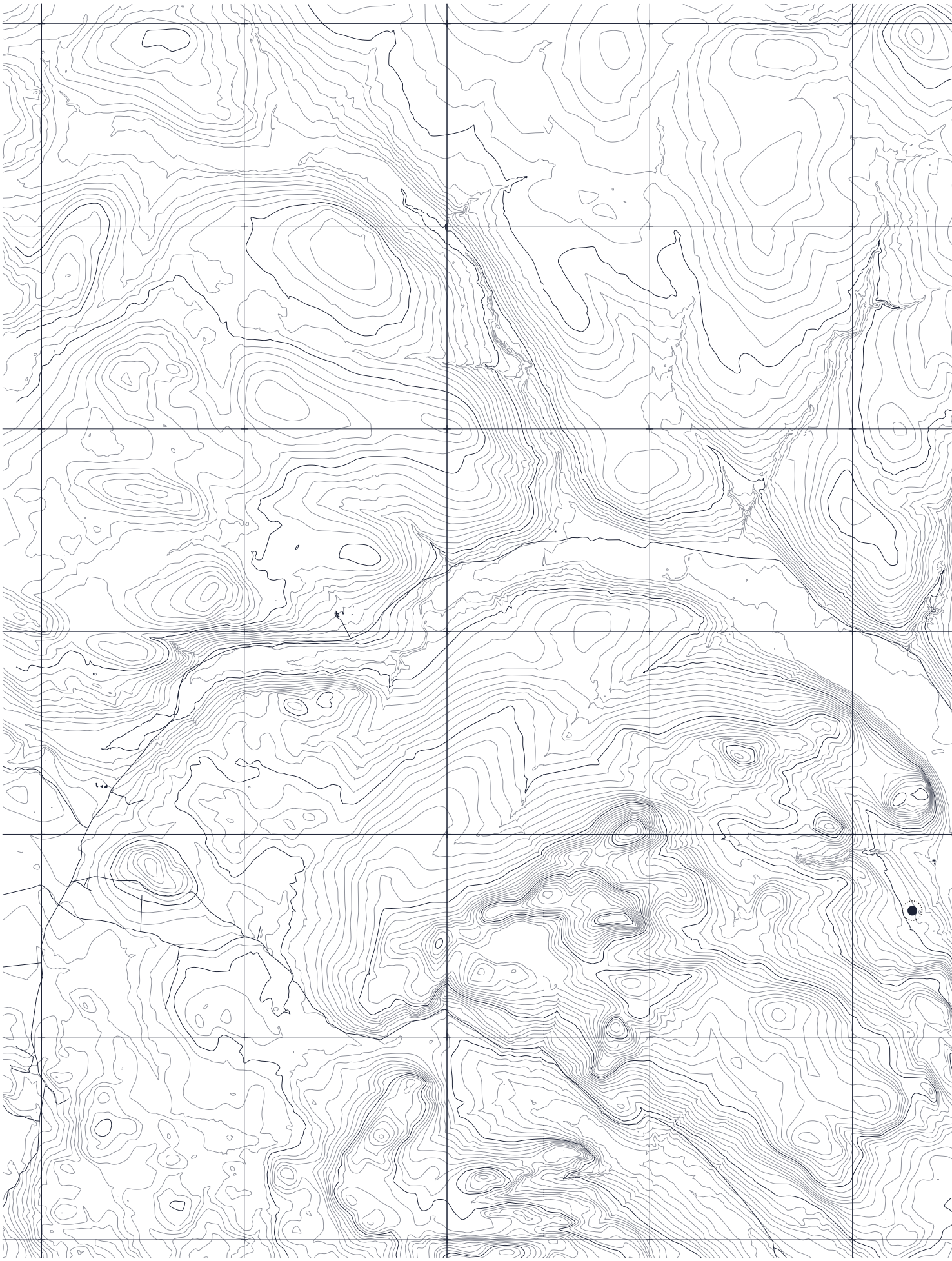
- Brora distillery
- Broch Carn Liath
- Carrol Broch



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Infrastructure map

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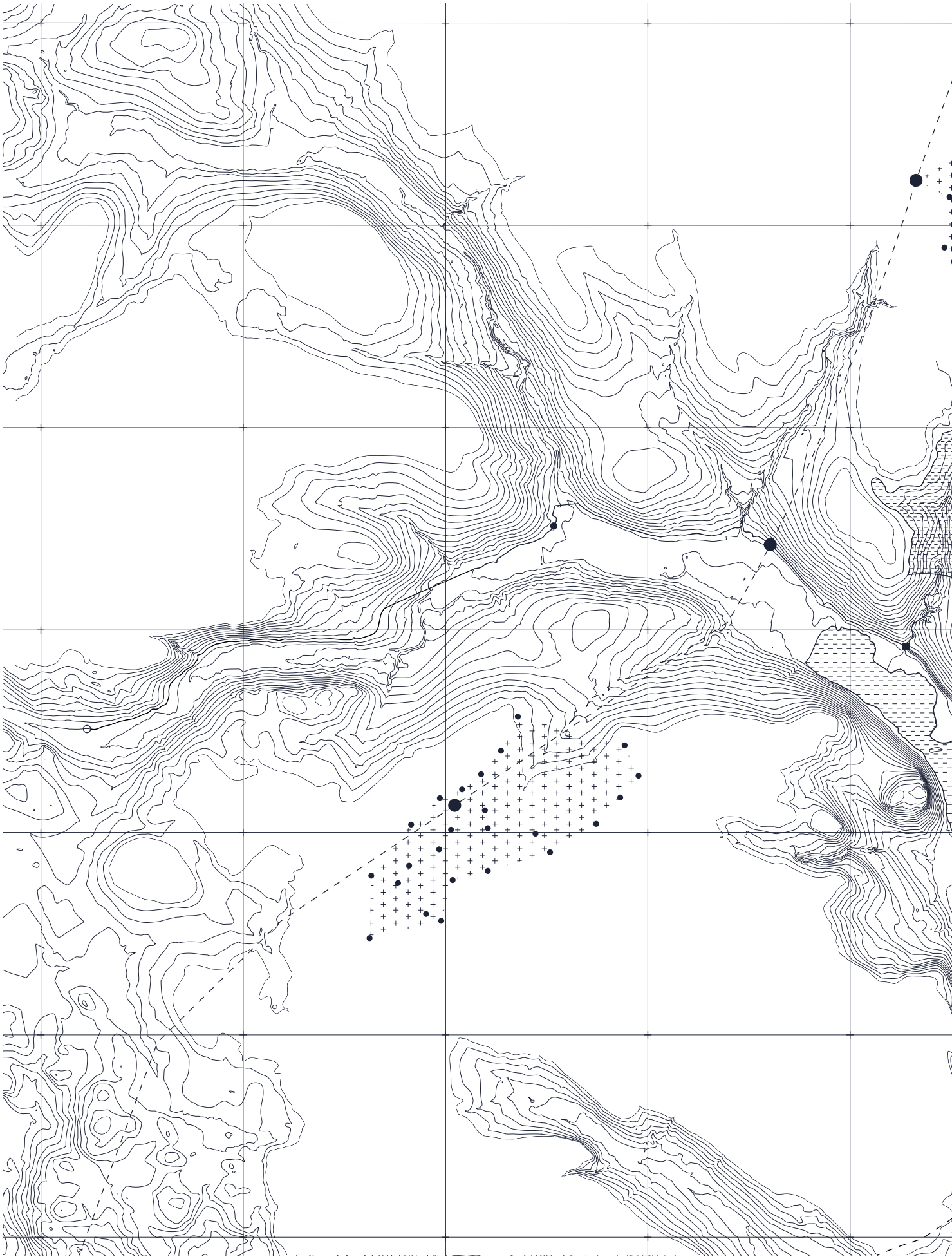
- pumped electrical storage
- onshore wind farm
- hydro sub-station
- sub-station
- sub-station + cistern
- existing transmission lines
- proposed distribution viaduct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Synthesis | Temperature + Flooding

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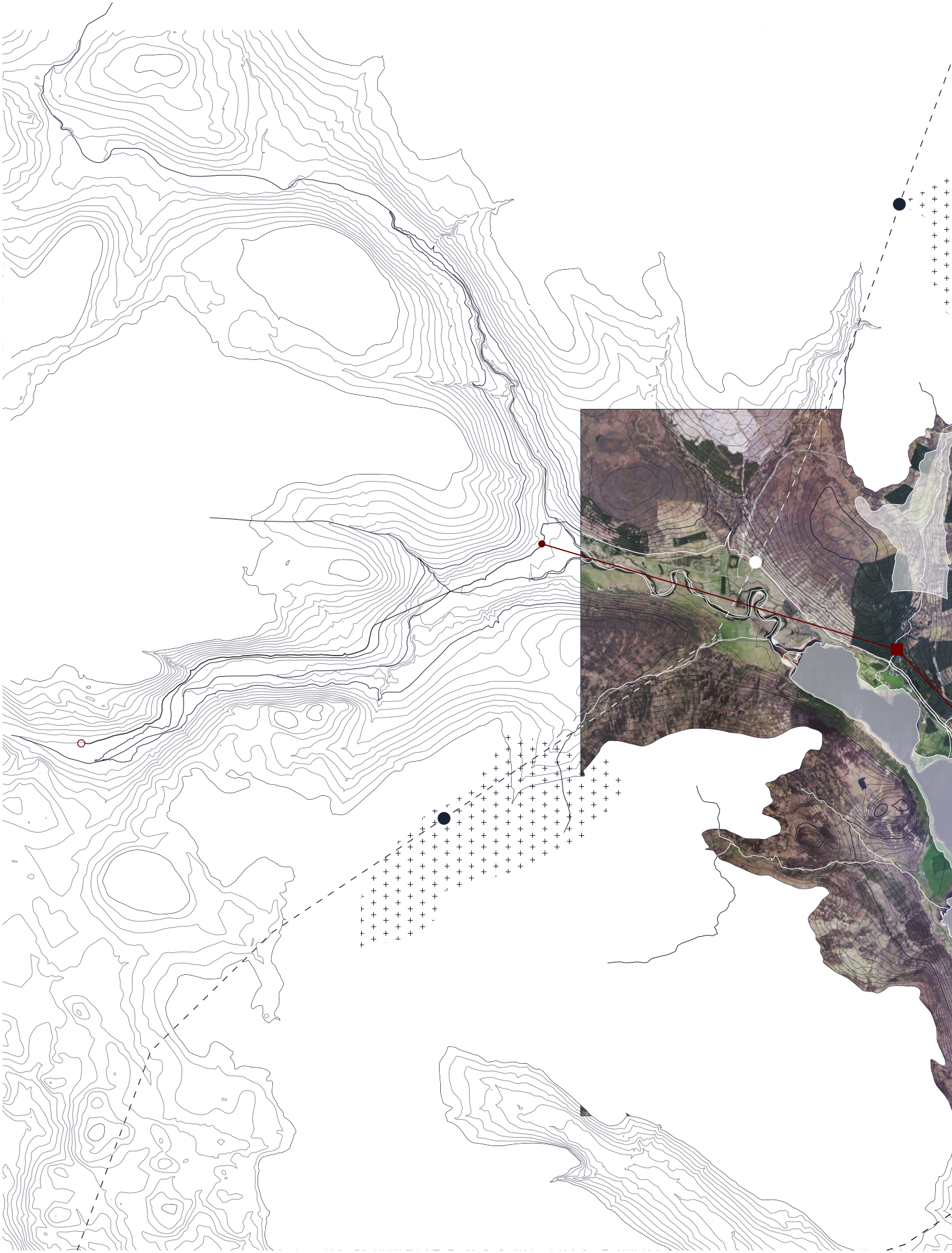

Synthesis | Drought

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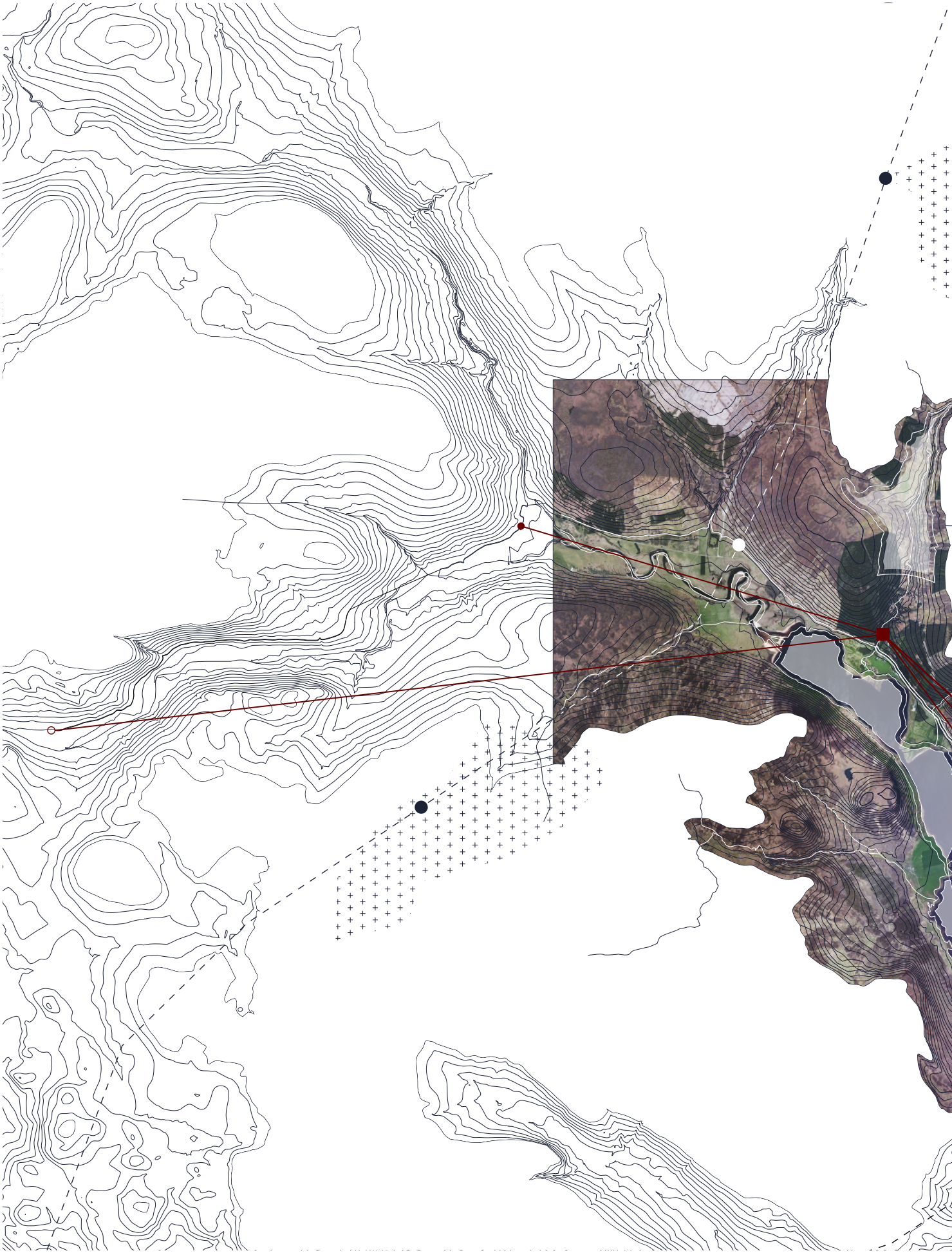
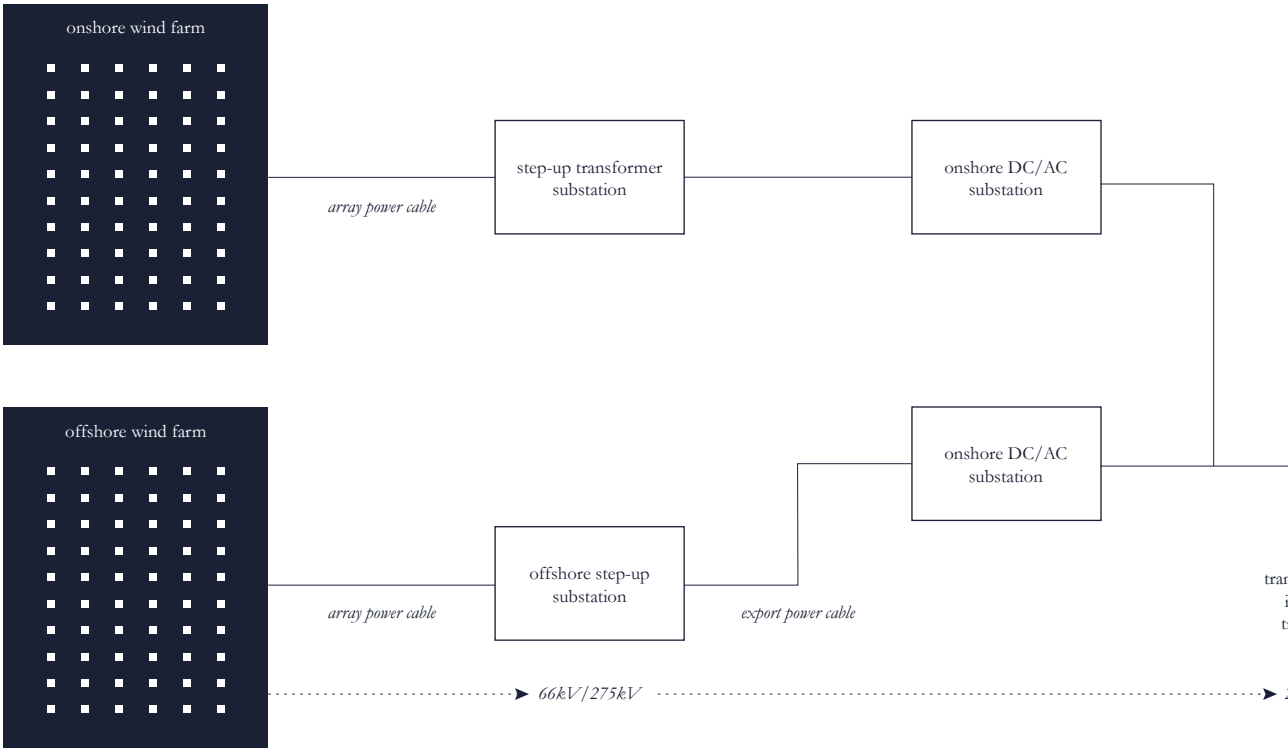
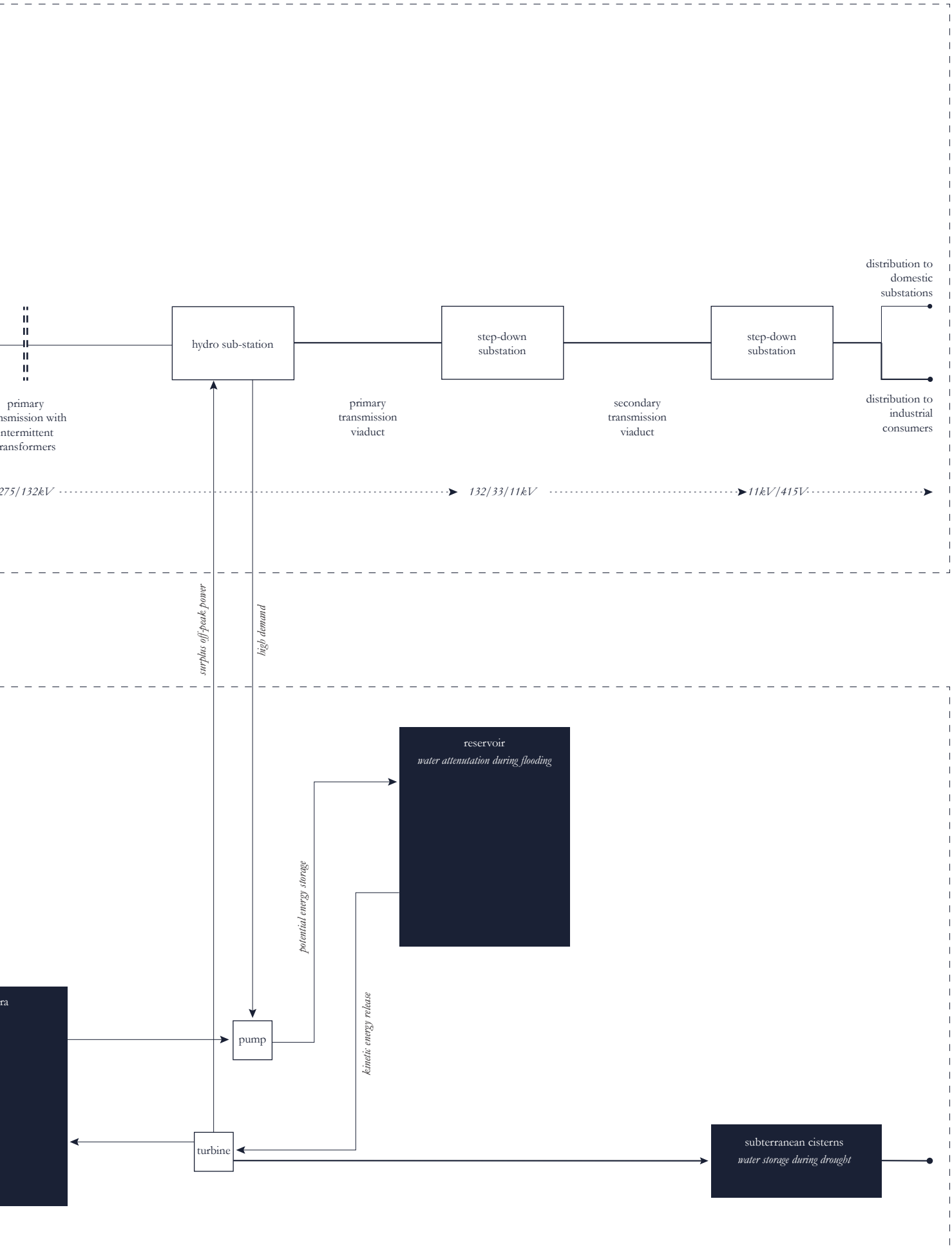


electricity

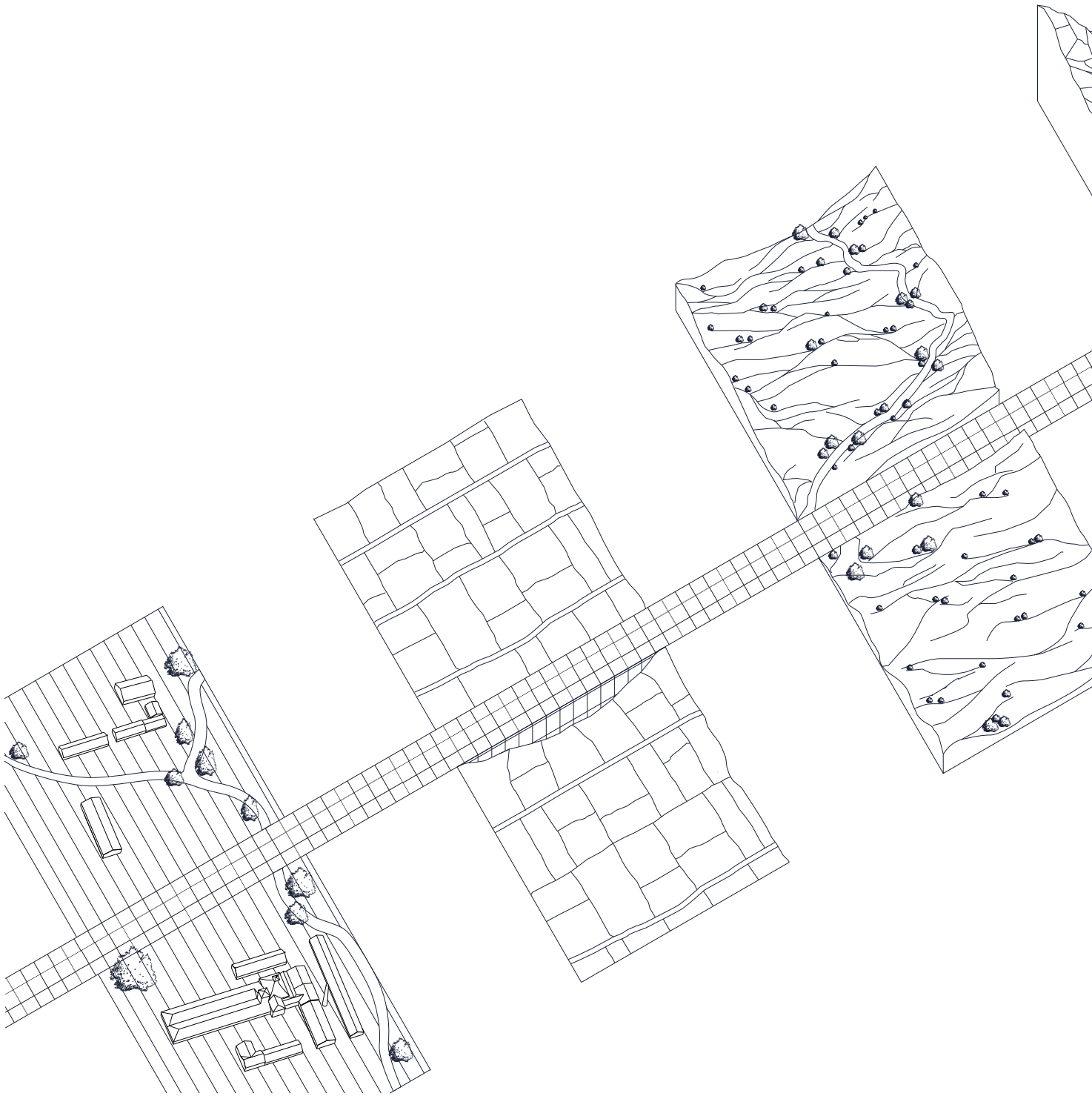


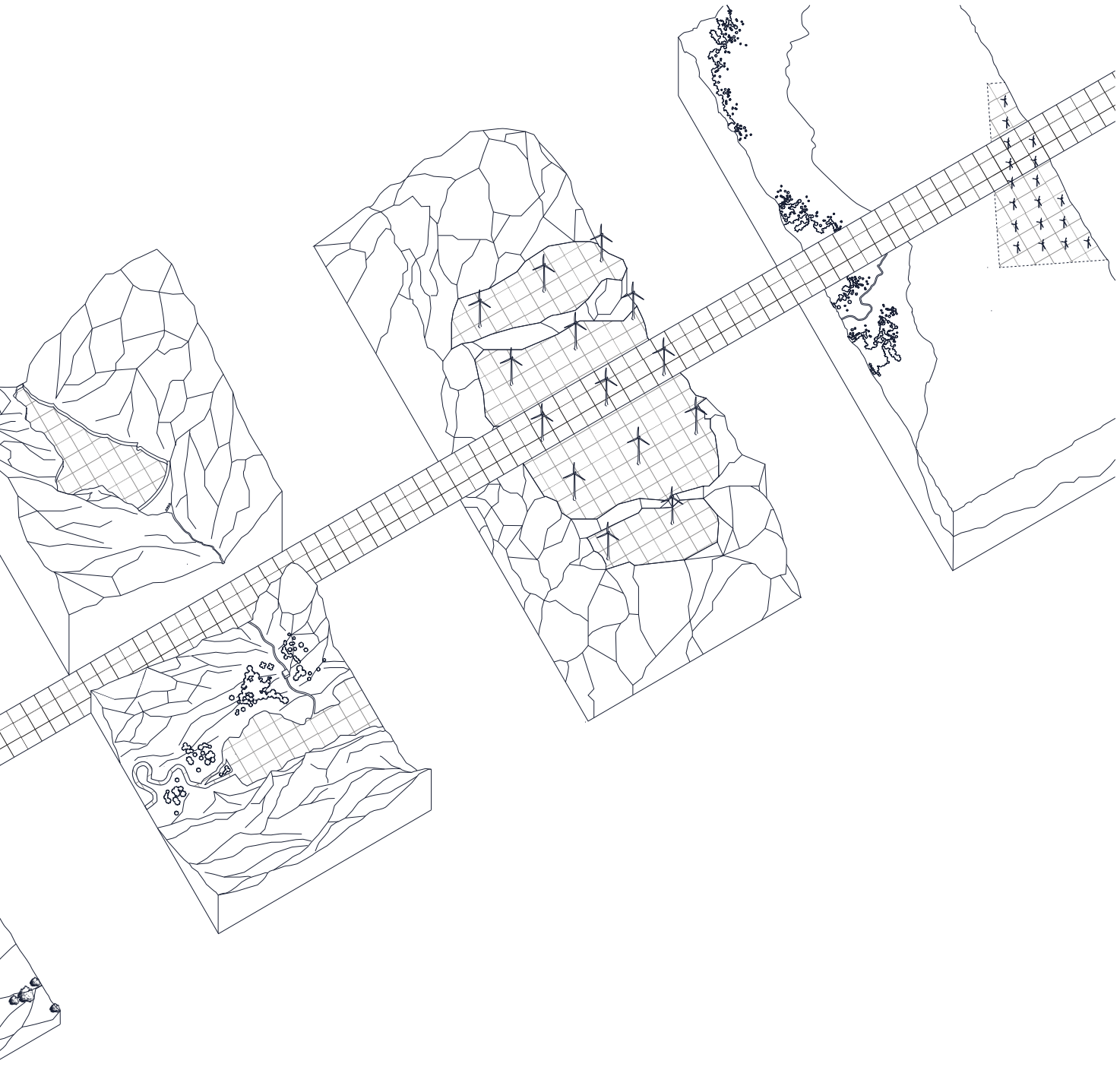
water

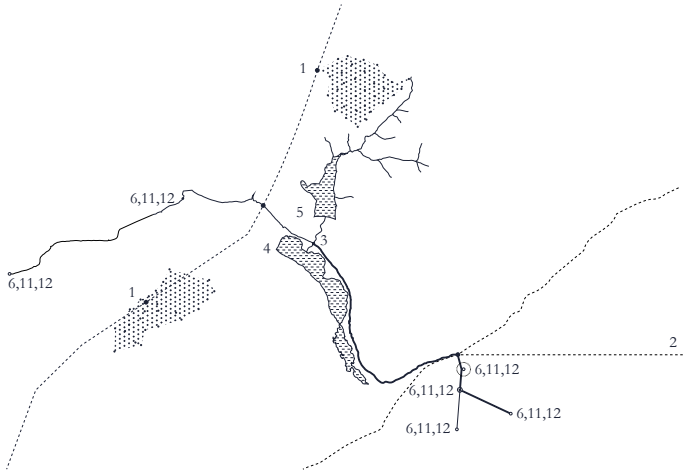

distribution to domestic substations
hydro sub-station
step-down substation
step-down substation
primary nsmission with ntermittent ransformers
primary transmission viaduct
secondary transmission viaduct
distribution to industrial consumers
275/132kV
132/33/11kV
11kV/415V
surplus off-peak power
high demand
reservoir
water attenuation during flooding
potential energy storage
kinetic energy release
ra
pump
turbine
subterranean cisterns
water storage during drought

IV.II Syntactic Design

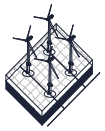
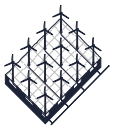
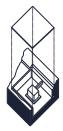
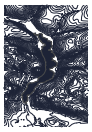
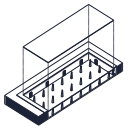
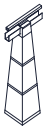
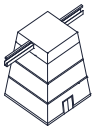
Landscape as infrastructure

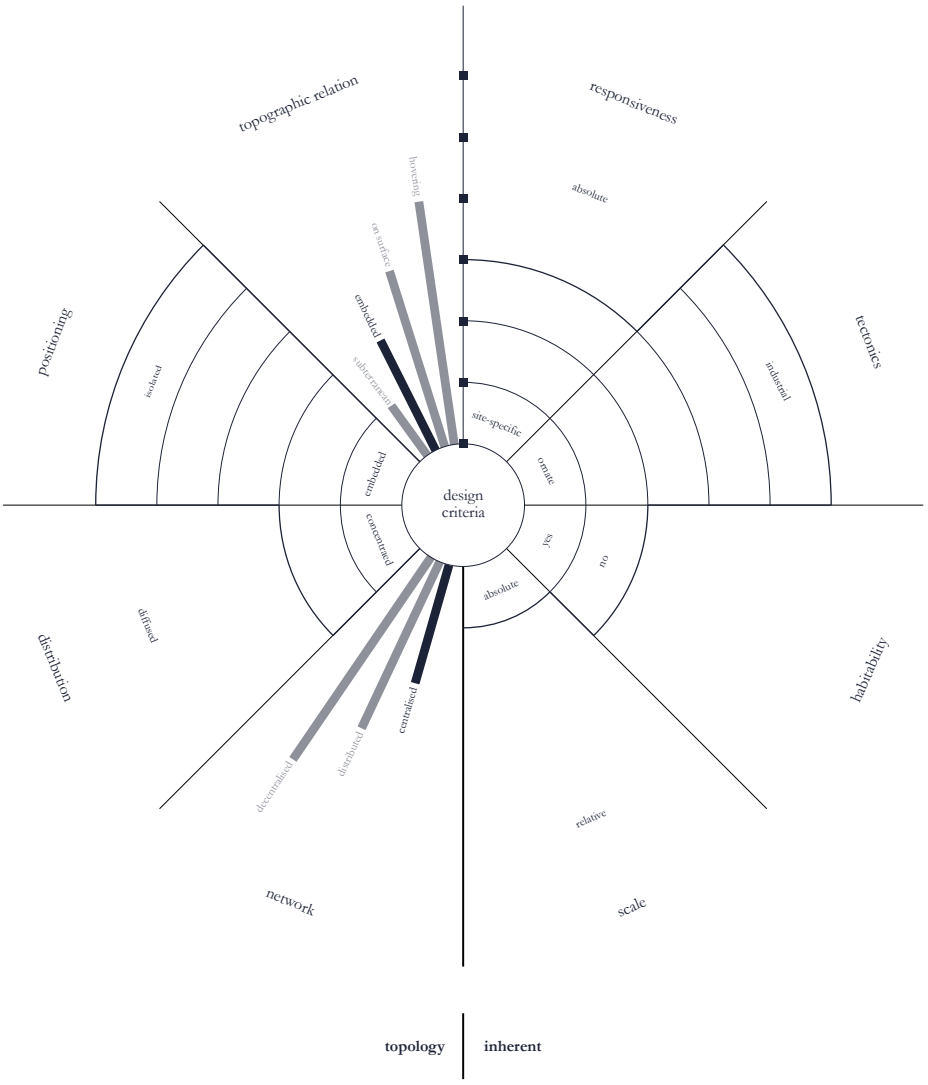




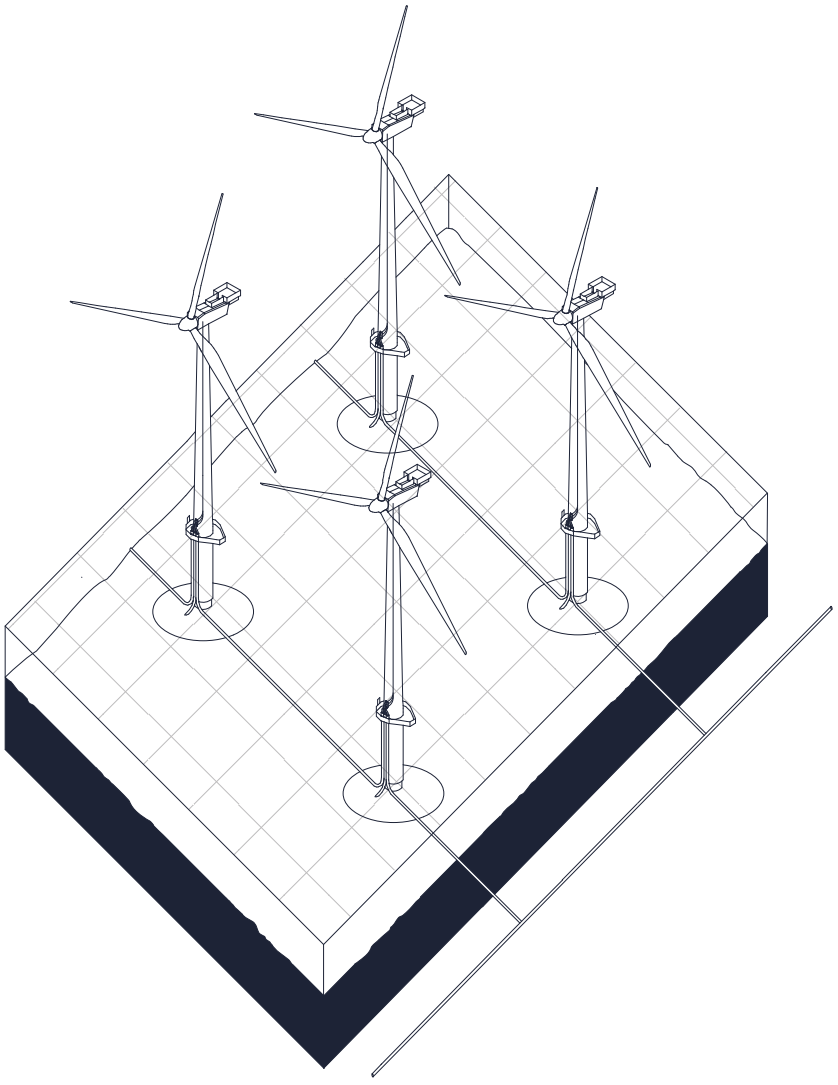


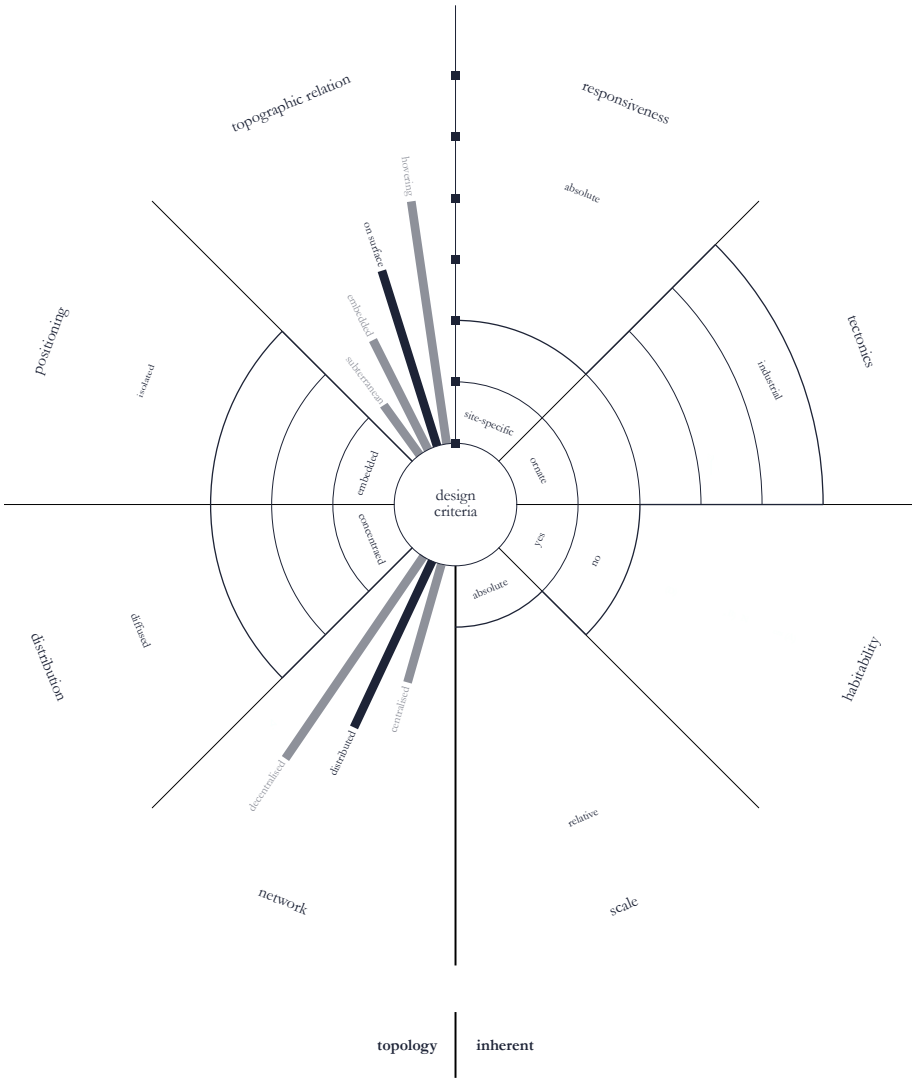
Material strategy + design syntax

		element group	topographical relation	material
1		electrical generators + transformers		fibre glass
2		electrical generators + transformers		fibre glass
3		electrical generators + transformers		concrete
4		vessel		organic
5		vessel		concrete
6		vessel		tile-lined concrete / puddled clay
7		conduit		stainless steel conduits stone wall
8		conduit		stainless steel conduits stone/concrete wall
9		conduit		stainless steel conduits stone/concrete wall
10		auxiliary structure		stainless steel conduits stone/concrete wall
11		auxiliary structure		stainless steel conduits stone/concrete wall
12		auxiliary structure		stainless steel conduits stone/concrete wall

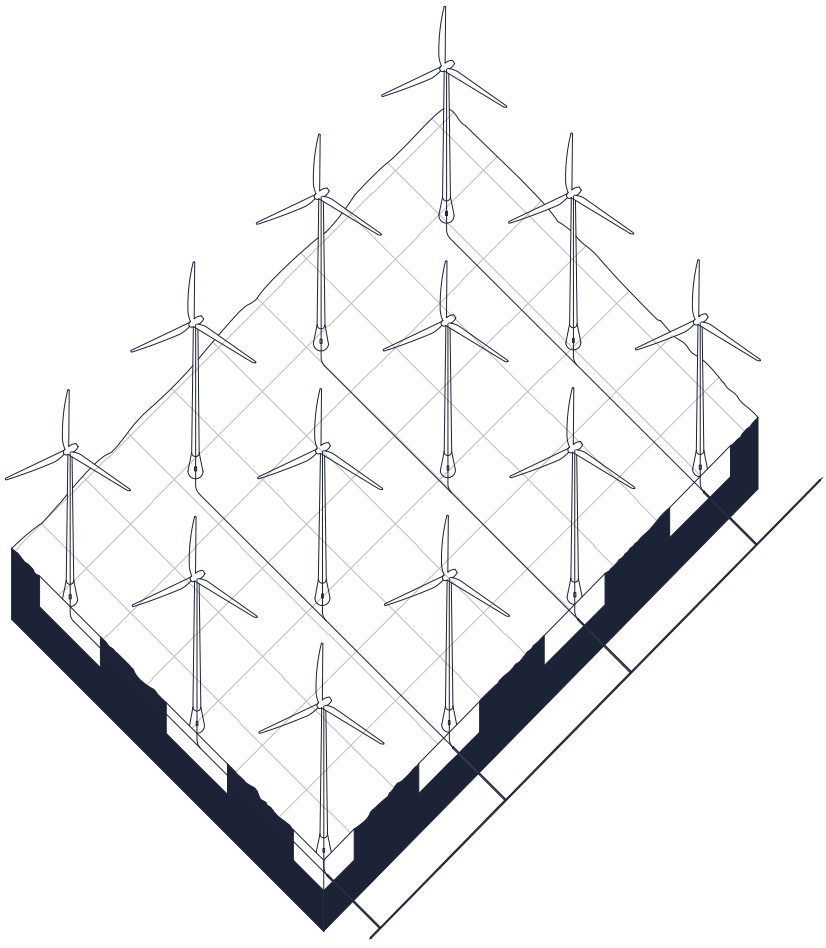


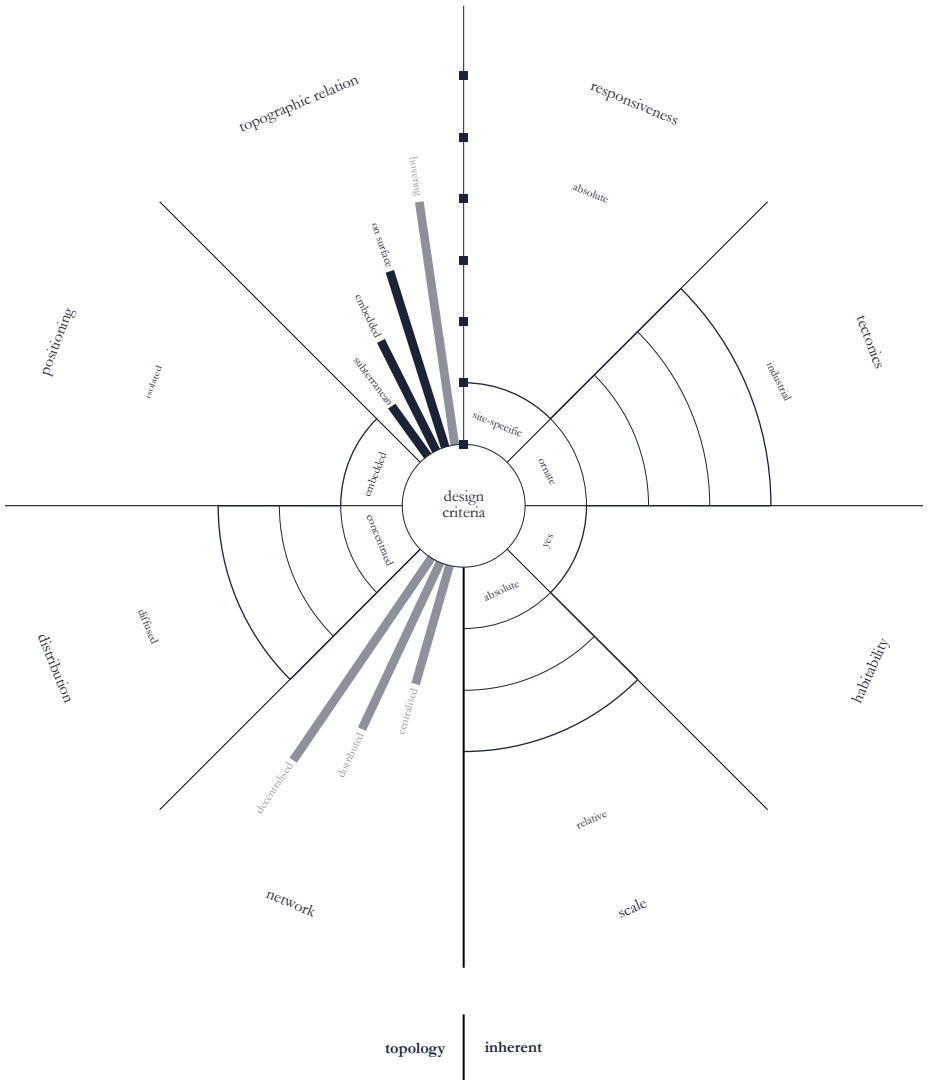
Offshore wind farm
electrical generator + transformer



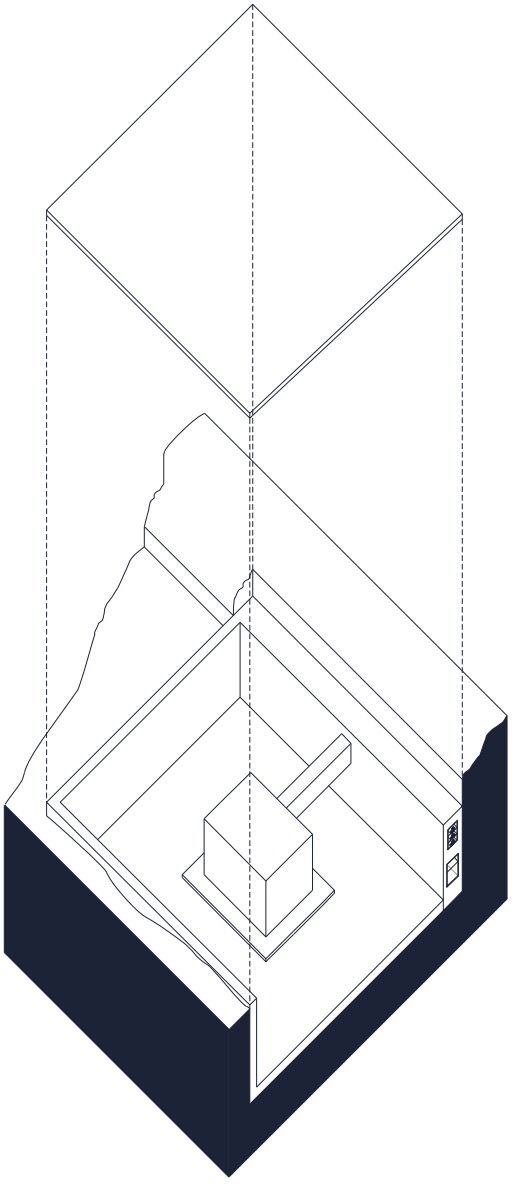


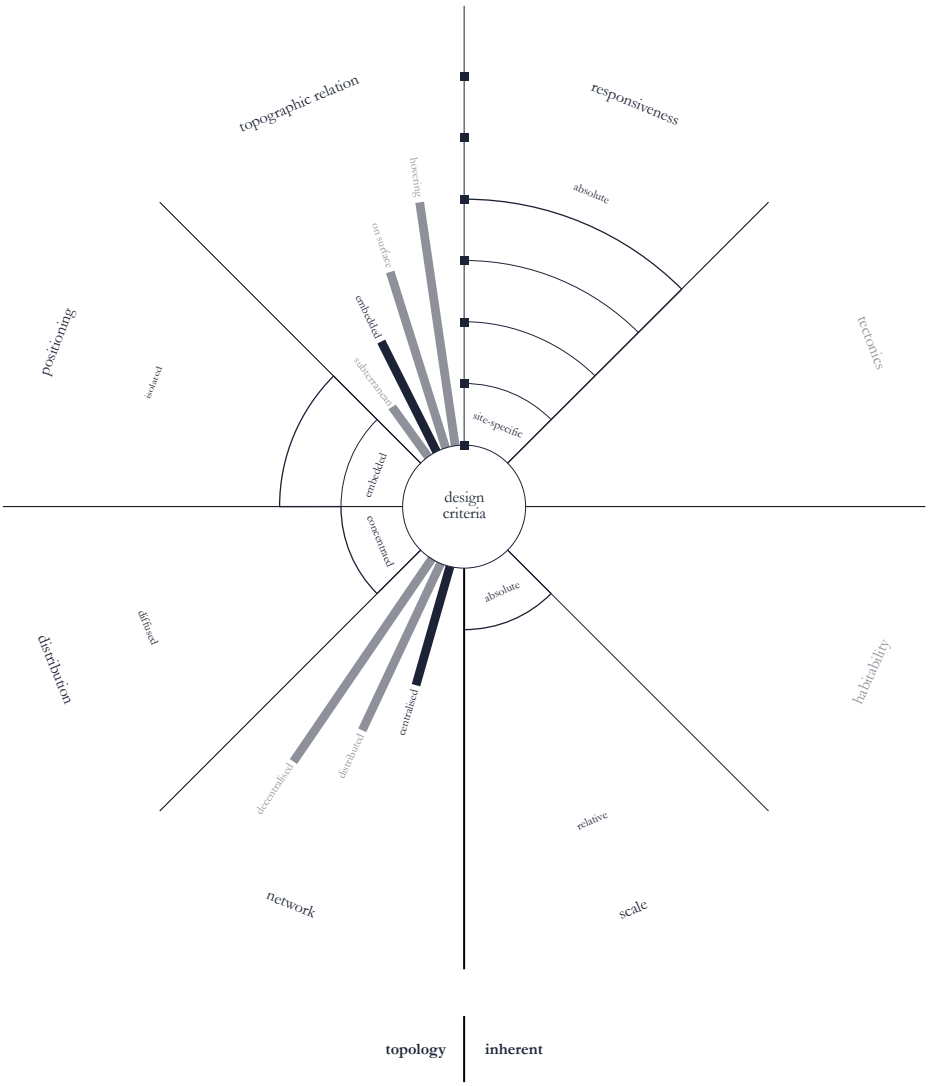
Onshore wind farm
electrical generator + transformer



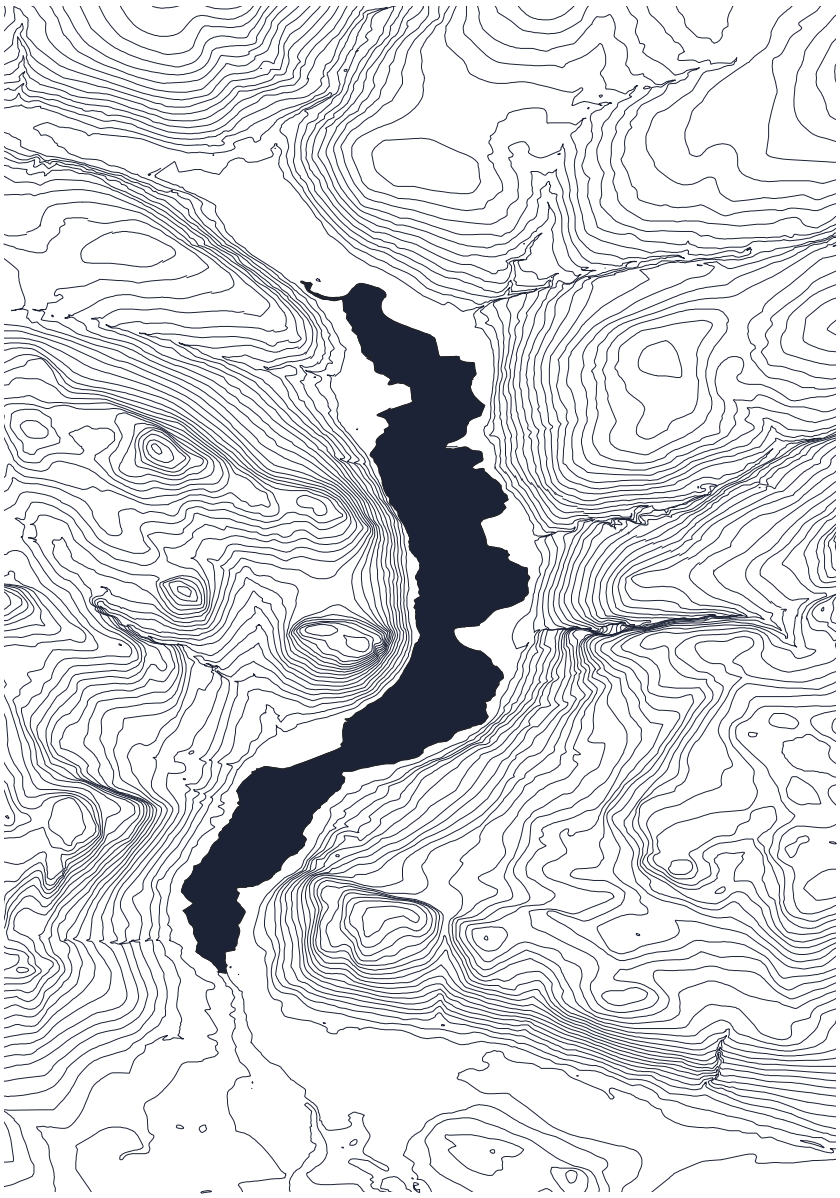


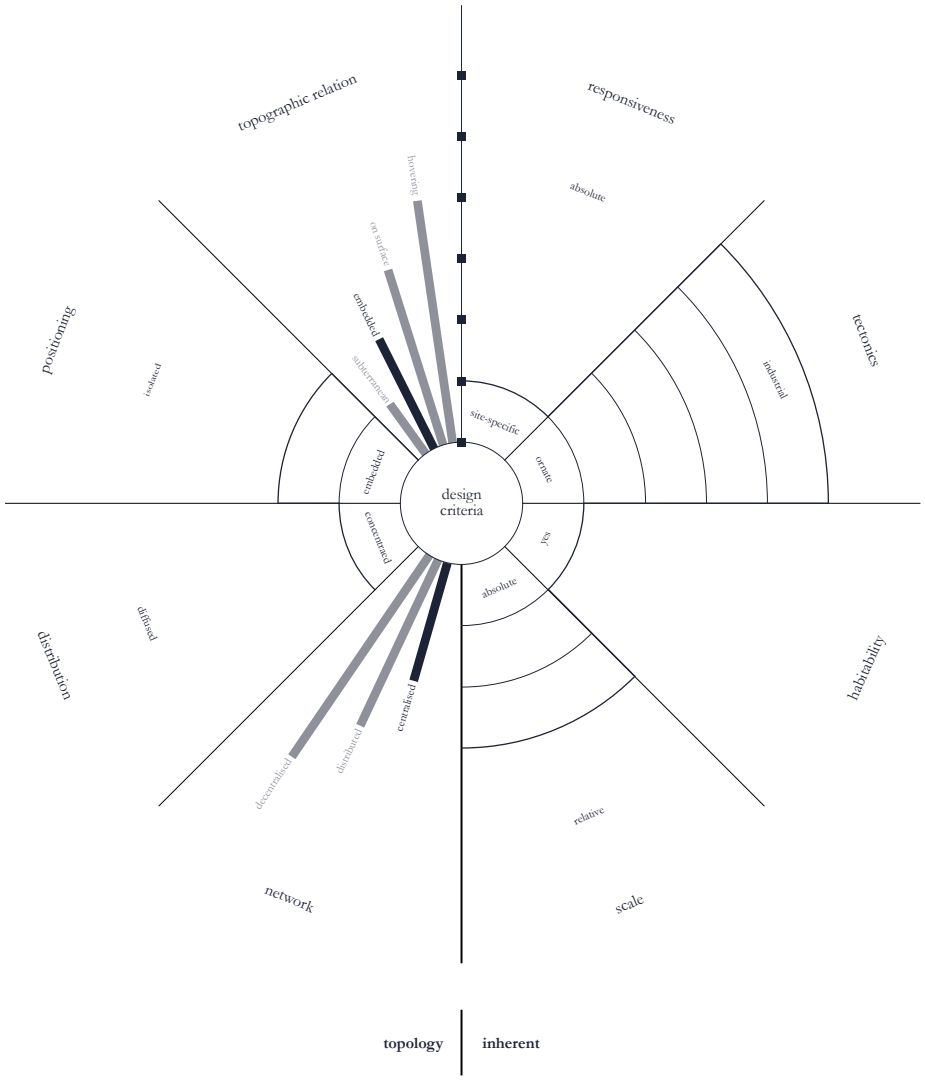
Hydro sub-station
electrical generator + transformer



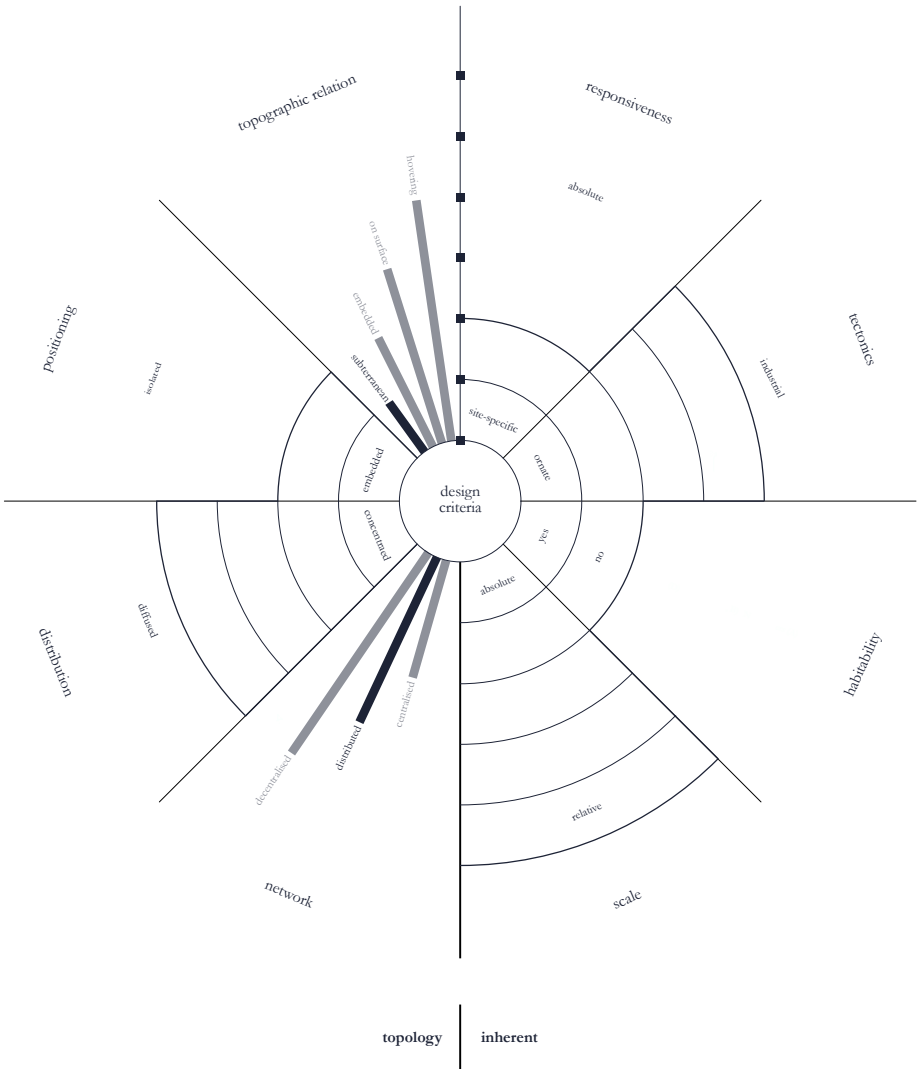


Loch Brora
vessel | pumped electrical storage

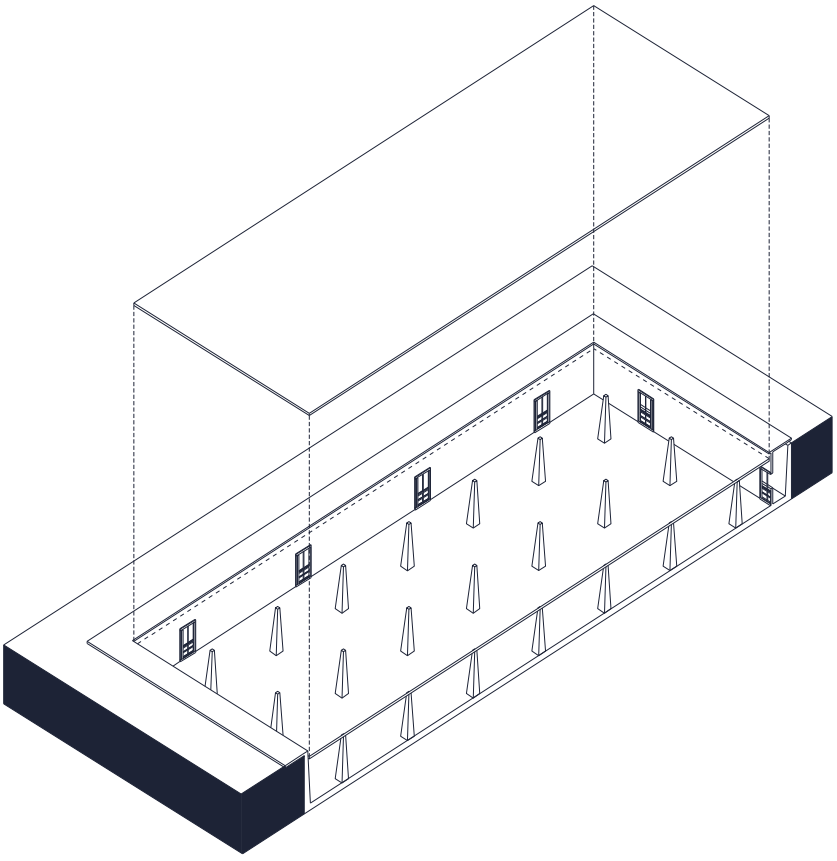


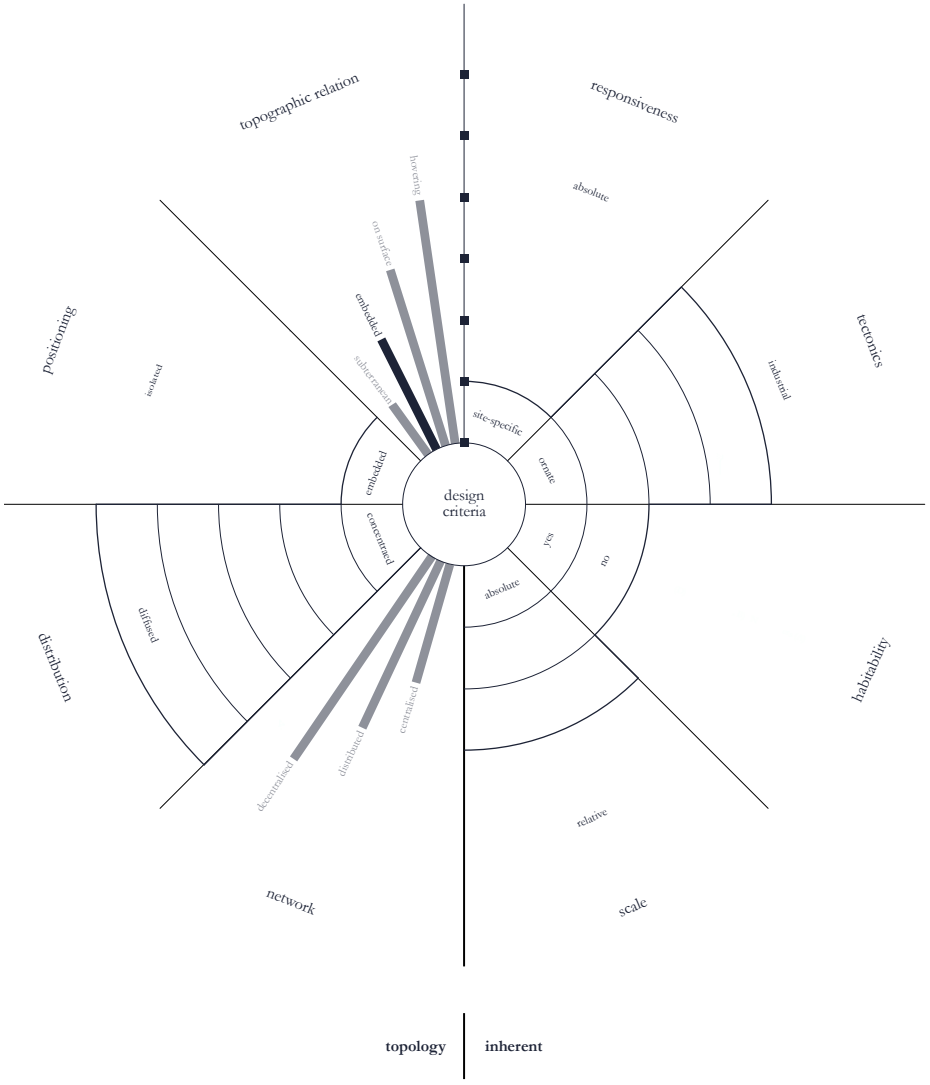


High-level reservoir
vessel | pumped electrical storage + water storage

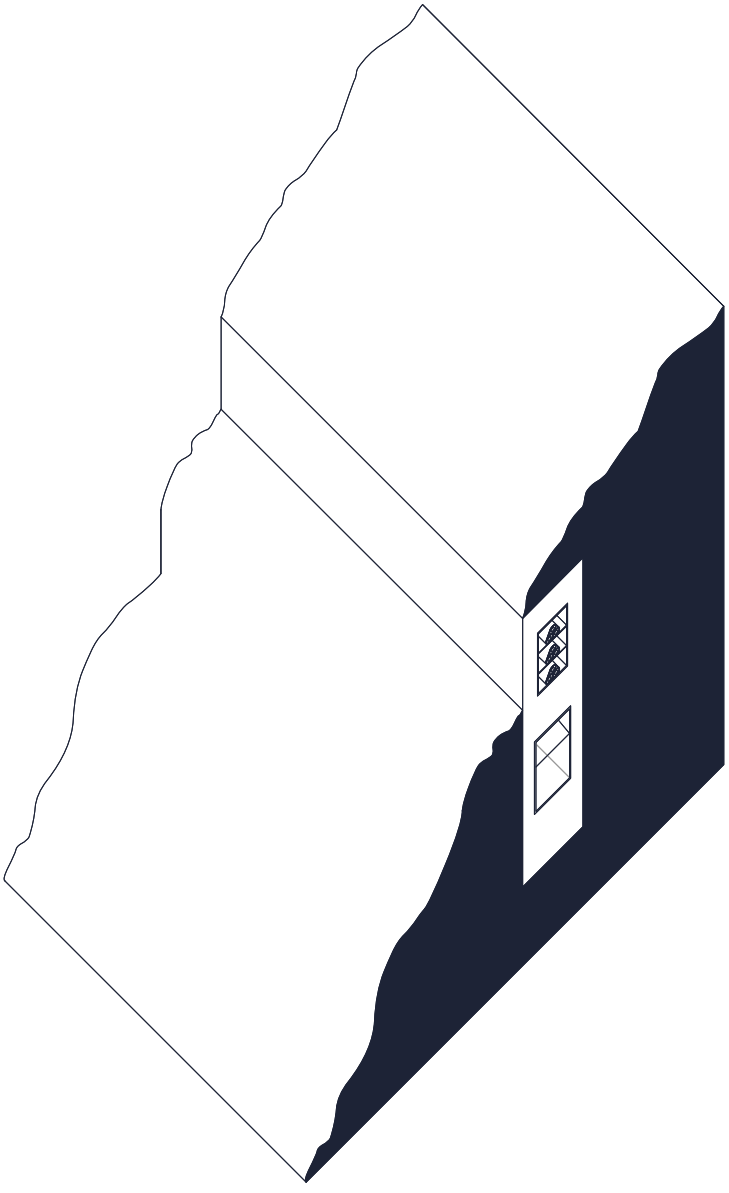


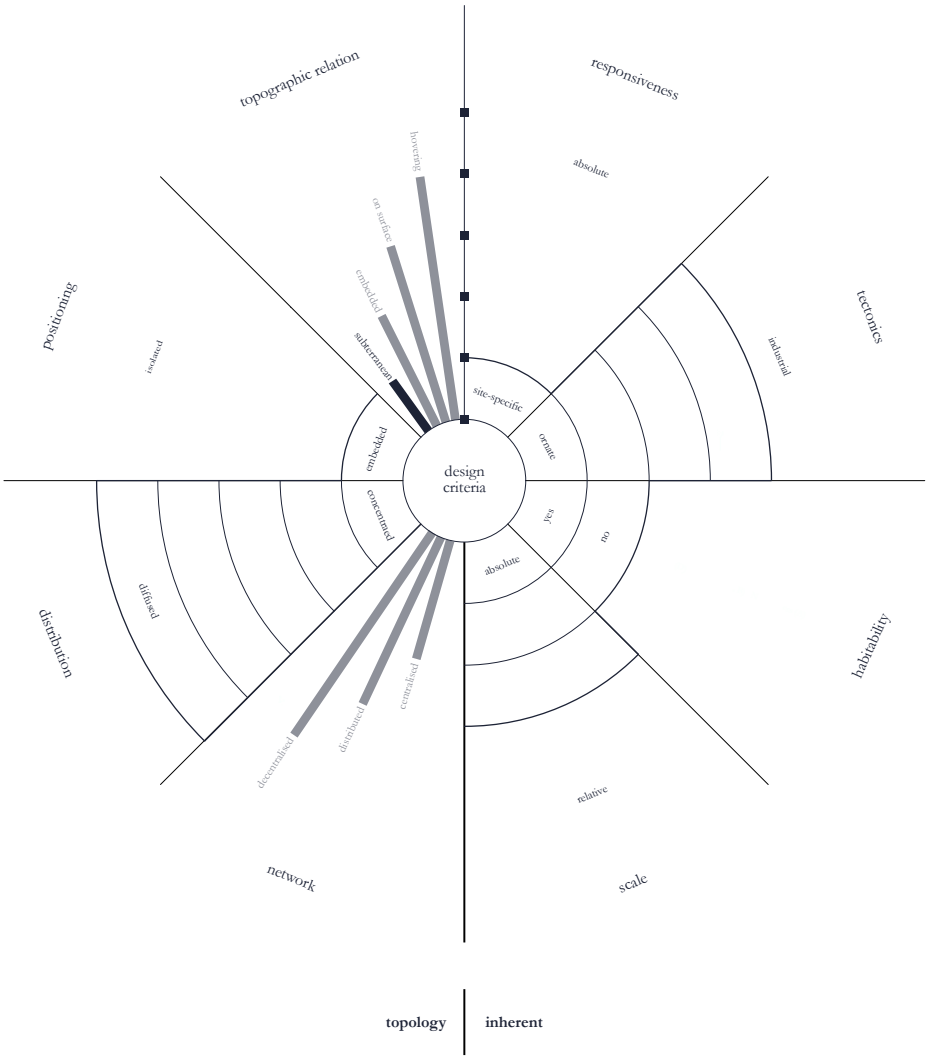
Localised cistern
vessel | water storage



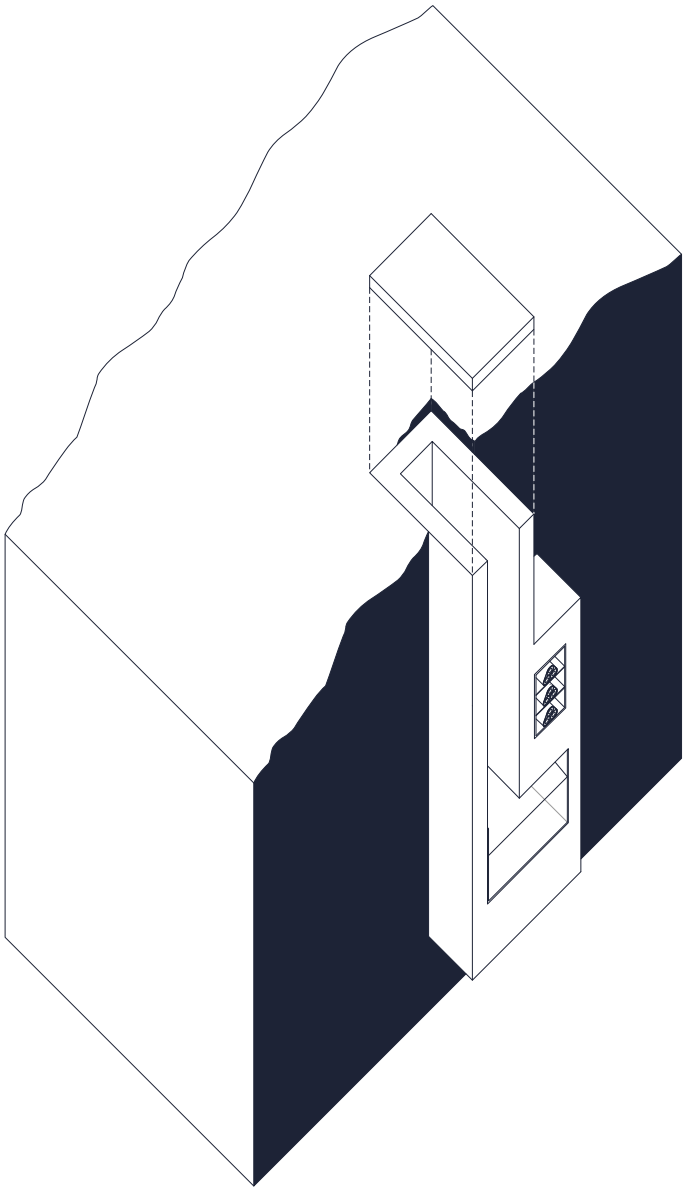


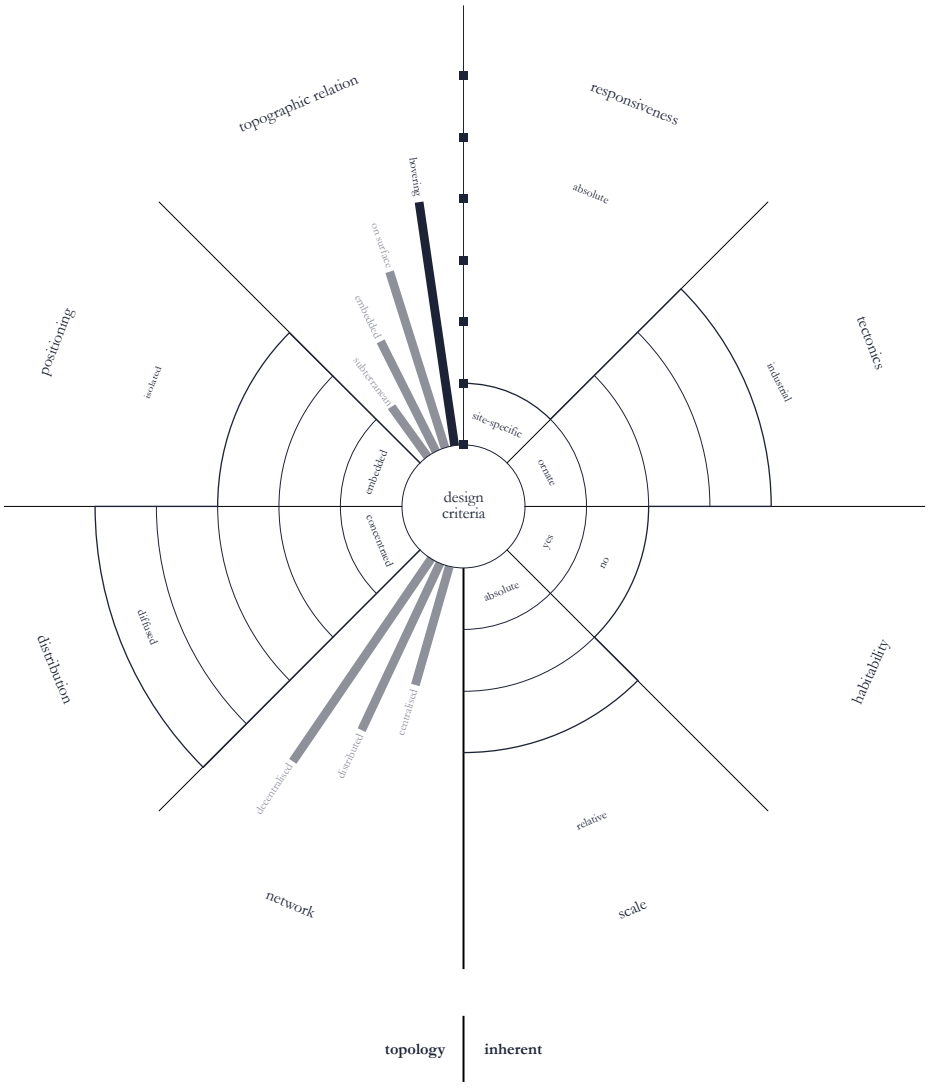
Electro-aqueduct | embedded
conduit



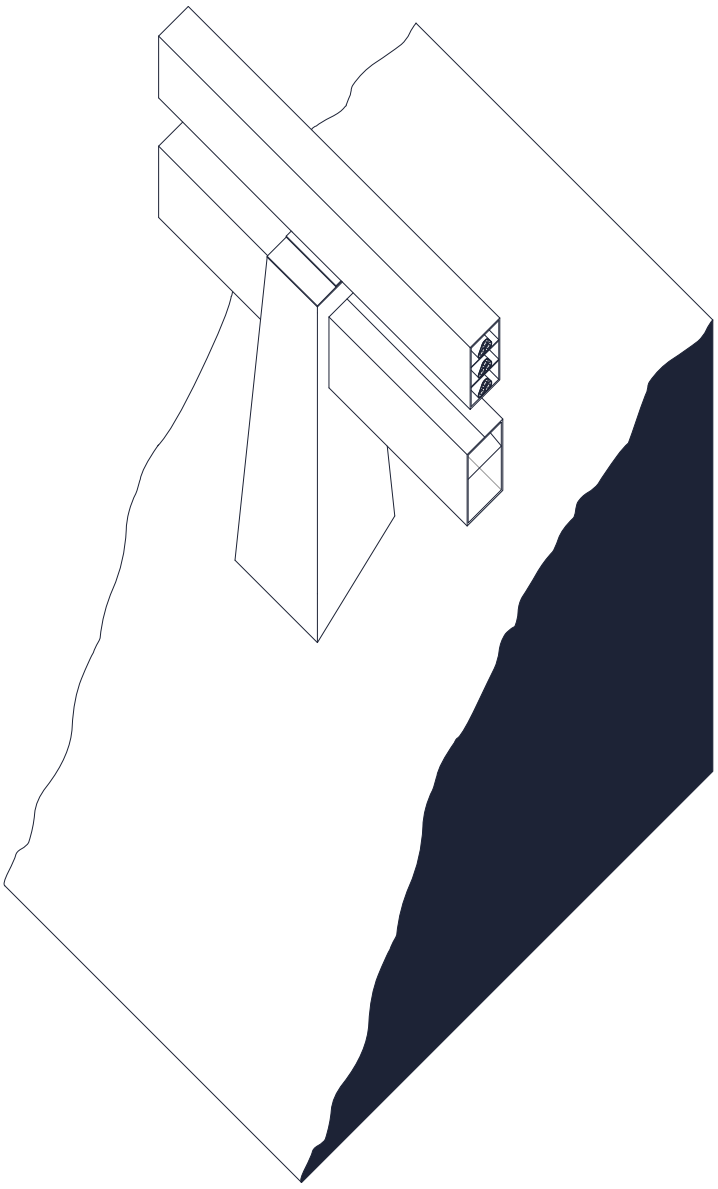


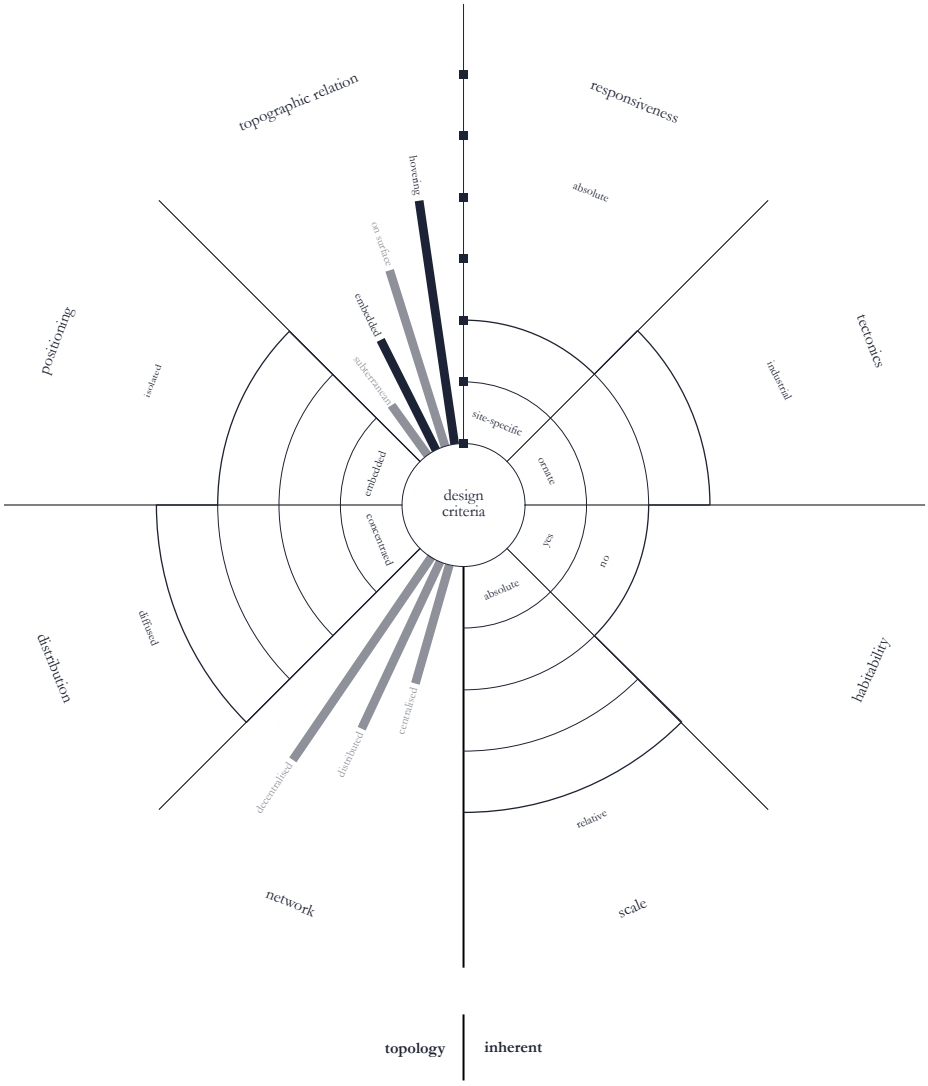
Electro-aqueduct | subterranean with inspection chamber
conduit



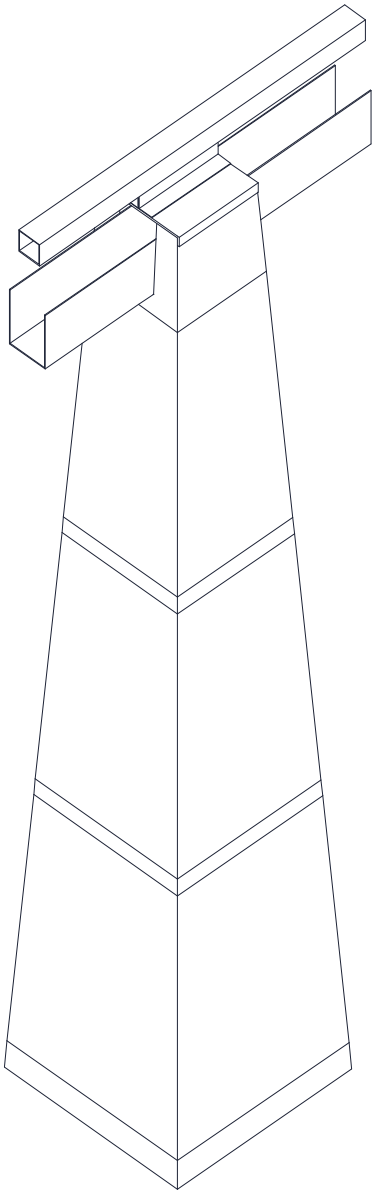


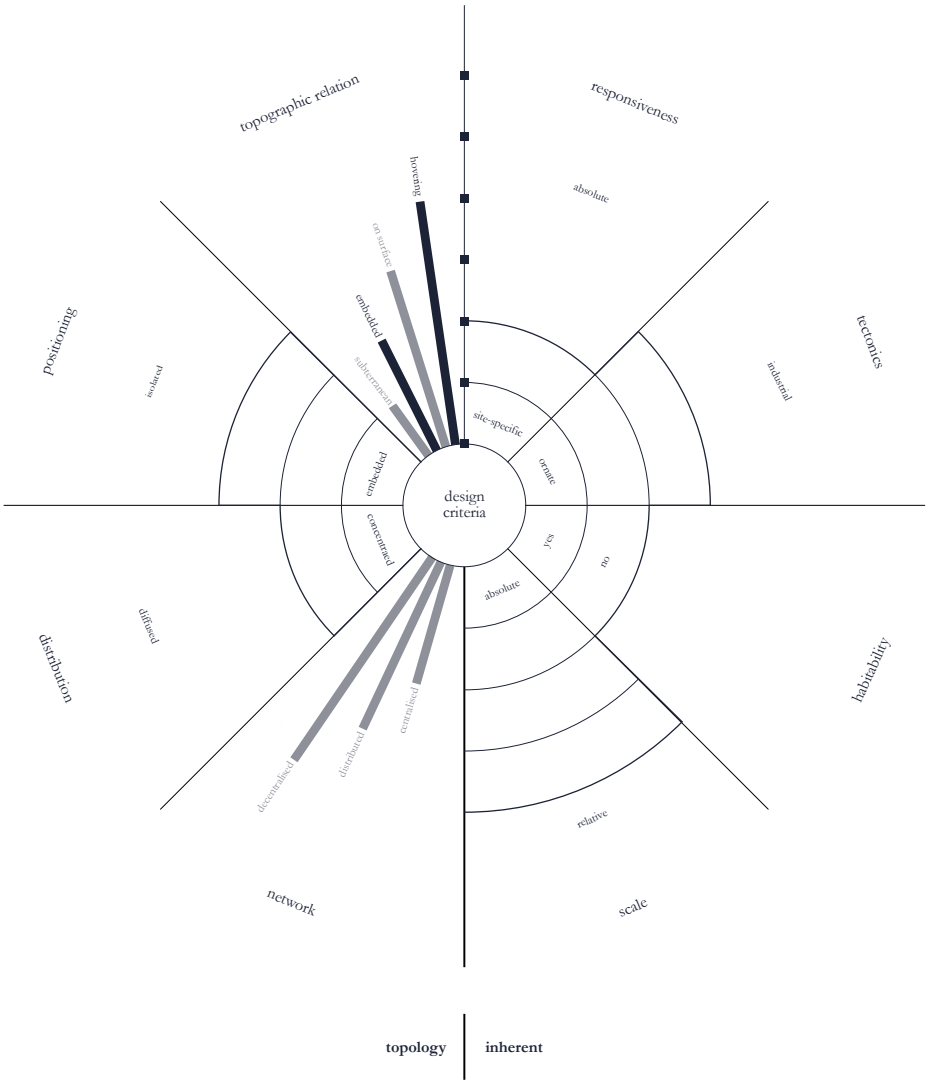
Electro-aqueduct | elevated
conduit



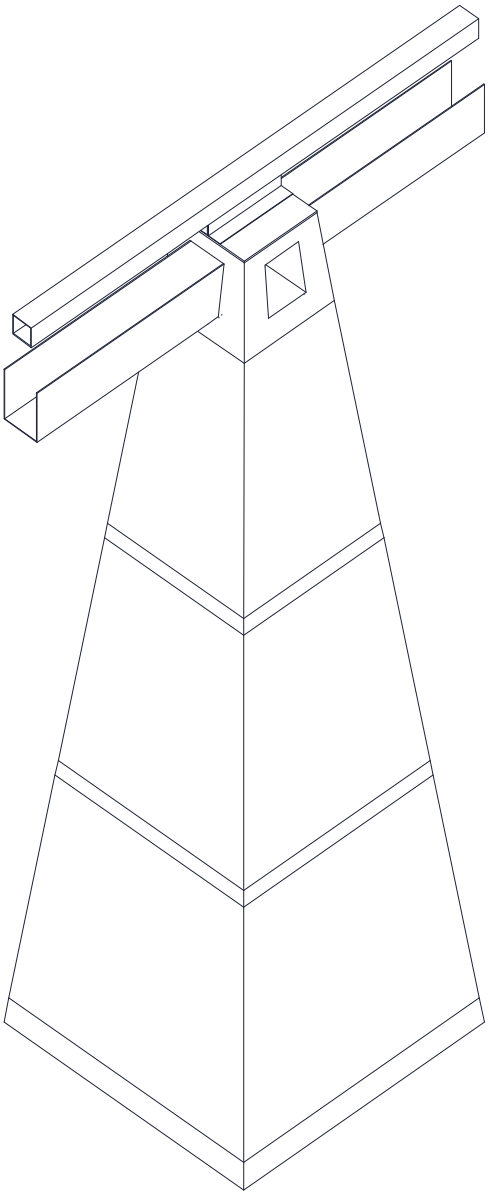


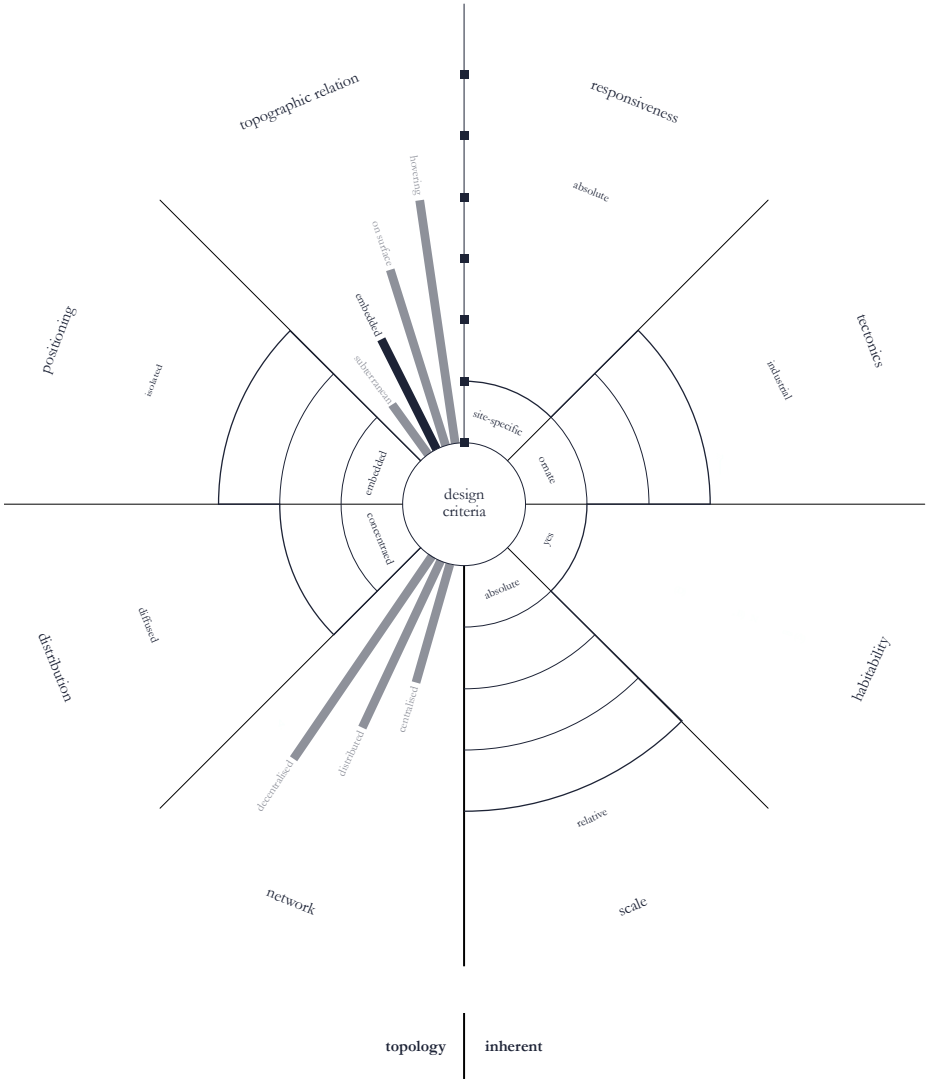
Electro-aqueduct | typical column
auxiliary structure



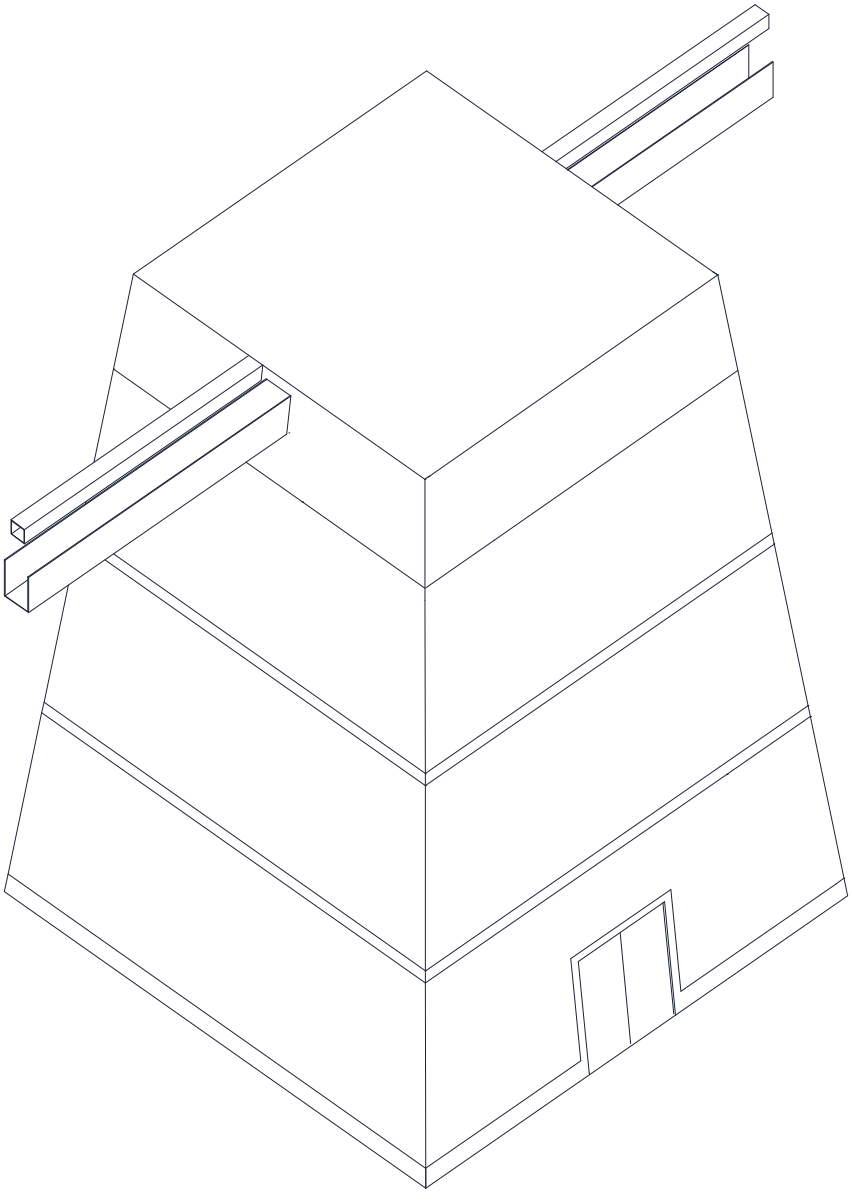


Electro-aqueduct | water delivery column
auxiliary structure





Electro-aqueduct | inhabited column: sub-station
auxiliary structure



IV.III Design Precedents

Learning from the past

During the design process, a number of ancient design precedents were utilised. Turkey's Basilica Cistern provided me with a infrastructure functionality precedent, suggesting the use of cisterns as nodes of future growth in cities.

Basilica Cistern, Istanbul

Functionality precedent

Roman aqueducts were an obvious starting point for hydraulic design and efficiency. The proposal modernised these historical structures, by incorporating steel conduits for material efficiency and spanning requirements. However, stone from the local Brora quarry was still used to create triangulated columns, that act as auxiliary support where needed, that is, when the aqueduct reaches the Brora basin from the hills.

Viaducts/aqueducts

Technical hydrology precedent

Last but not least, Scottish brochs were also used as an architectural precedent. Inspired by the local vernacular of solid masonry construction, the materials used in the aqueduct, be it in the embedded walls or the columns, are local and of the landscape itself.

Scottish brochs

Historical vernacular design precedent

V Impressions

An energy landscape

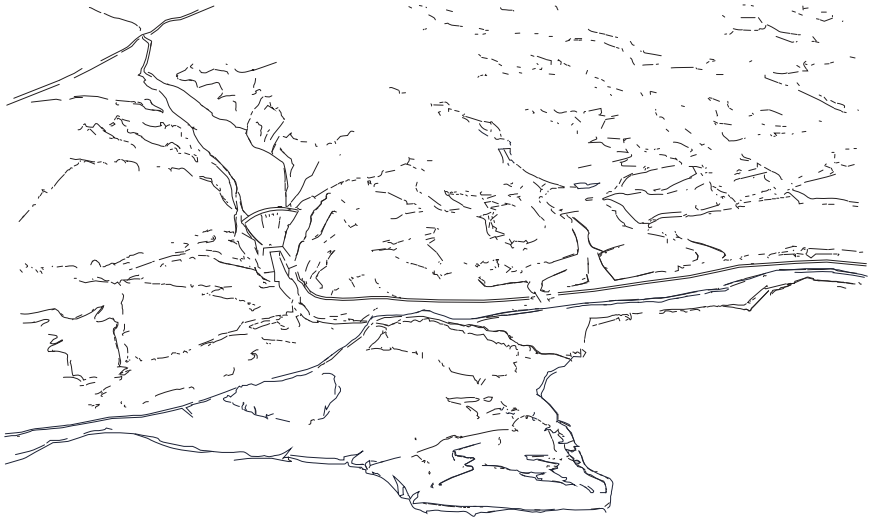
These sketches provide glimpses into the kind of landscape morphology the infrastructure will create in the area.

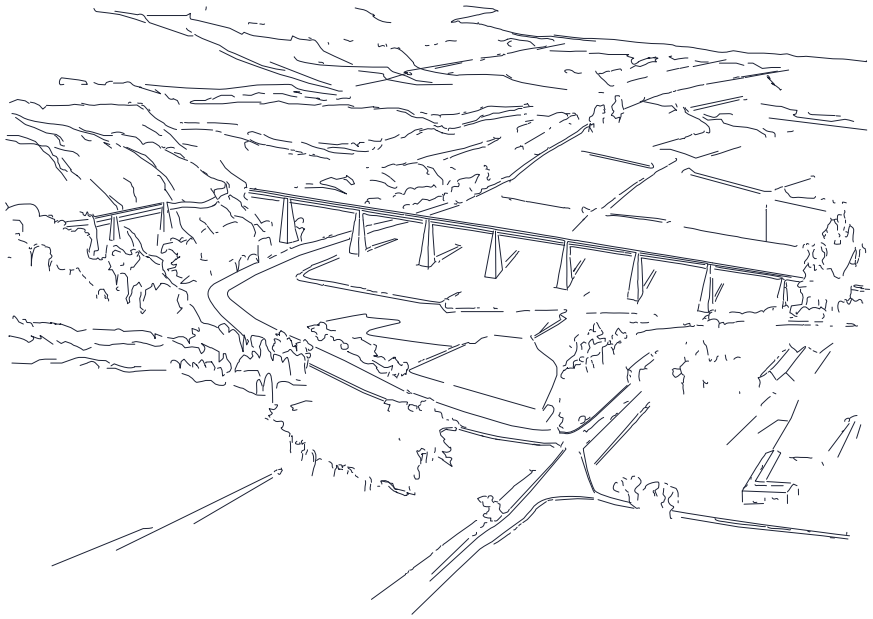
The first sketch illustrates the reservoir overlooking Loch Brora. The ariel perspective is taken overlooking Gordon's Bush, looking east.

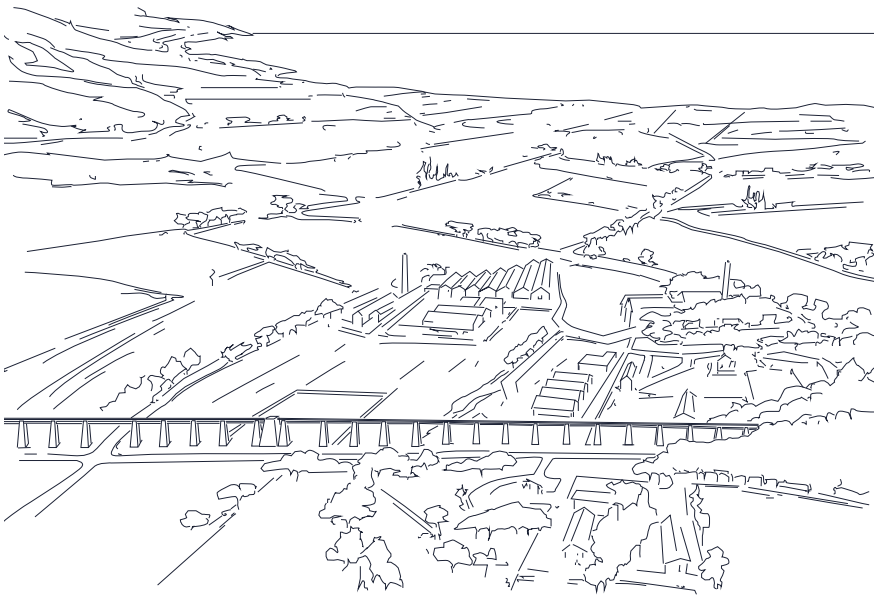
The second sketch denotes the electro-aqueduct's change in state, from embedded wall to elevated colonnade. This is site-responsive to the landscape's topography.

The final sketch illustrates the aqueduct passing through the village of Clynelish, the site of the architectural portion of this project.

Impression sketches







Allt an t-seana bhalie | facing east
View of dammed reservoir

Coffin walk | facing south
View of embedded wall using local stone

Electro-aqueduct | facing west
View taken from East Clyne Road

References

Endnotes

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