The Underbelly

Nicole Chen | OAA Awards-Sustainability and Climate Change | Project Site: Stratford, PEI, Canada

This Project Seeks to:

1. Receive sun as energy and light.

2. Create habitable year-round outdoor space.

3. Bring public awareness to, and protect against shoreline erosion and rising tidal levels.

4. Protect the futures of the next generation that will be inhabiting this school through its design, material choice and sourcing, construction, and operation.

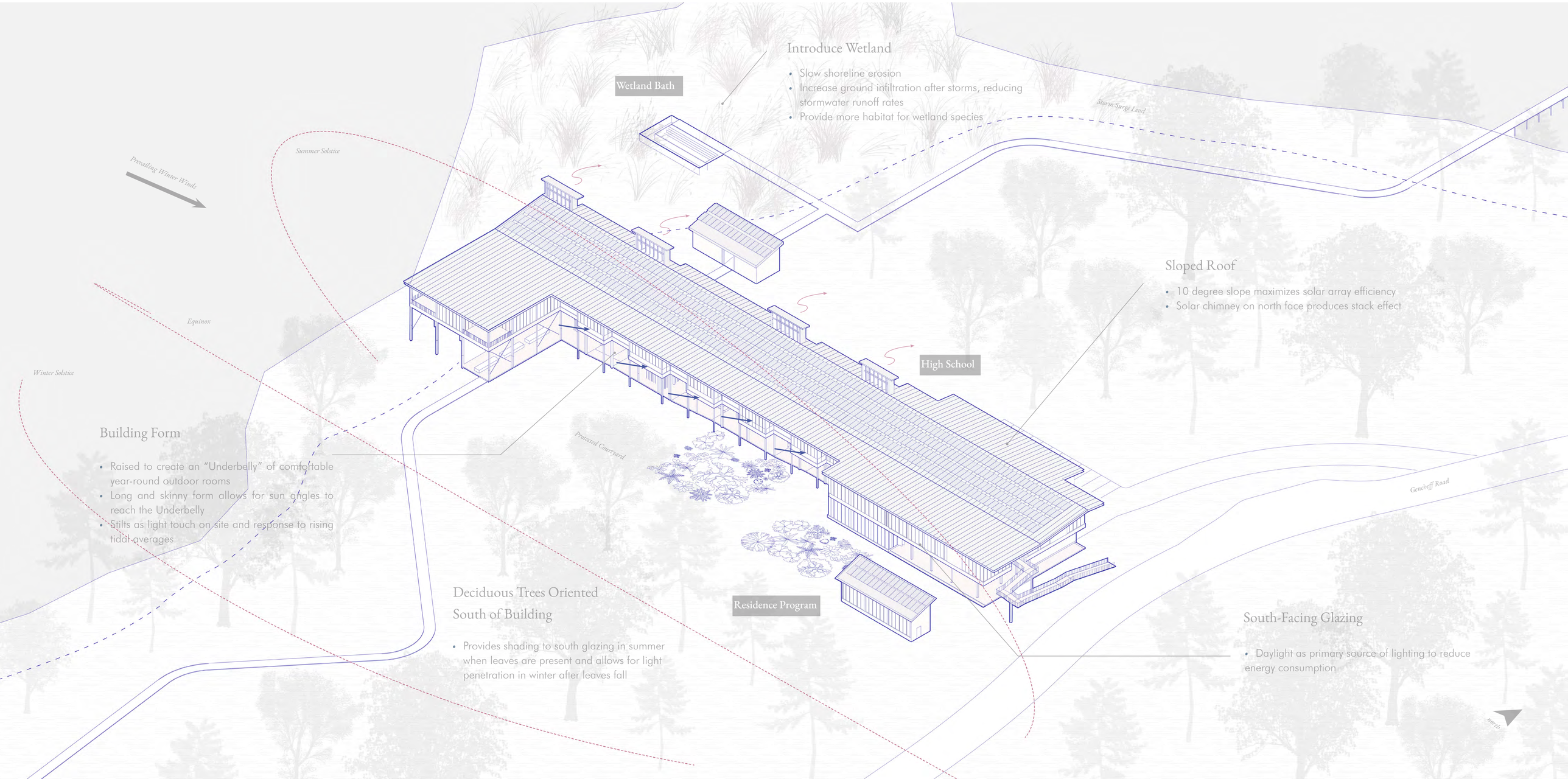
As we experience the world, so we are also experienced by the world.

To know yourself, you must first know the earth.

-Gregory Cajete, Native American Educator

This project seeks to facilitate continual participation with nature as an integral part of life-long education. Modern education favours an abstracted, detached view of the world in lieu of direct experience of the environment. This pedagogy of abstraction is perhaps what enables the disregard modern people feel for the human-led destruction of nature and its resources. In hopes of fostering environmental stewardship among the next generation, where the effects of climate change will be felt the most, the school and its adjacent programs of wetland bath, Elder-in Residence program, and site-wide path system seek to re-contextualize users' relationship to the environment through immersion.

Embracing Stratford's precipitation-heavy climate, the project creates habitable outdoor spaces that can be used comfortably year-round to varying degrees. The result is a building form that is raised on stilts to create an "underbelly", and its effect is threefold: it extends outdoor comfort through Stratford's long winter and rainy seasons; it anticipates and brings awareness to rising tidal averages in the near future; and it respects the site by touching down lightly. The underbelly becomes a community resource for gathering and is connected to Stratford by a site-wide path system, which also allows for access to the wetland bathhouse and the Elder-in Residence Program.



Site Forces and Systems

A major goal of the project is to protect the futures of the next generation that will be inhabiting this school through its design, material choice and sourcing, construction, and operation.

The project seeks to use local and regenerative materials with low embodied energy in their manufacturing and transportation wherever possible.

South-facing solar chimney utilizes stack effect for passive ventilation

Solar Array supplies 42% of operational energy

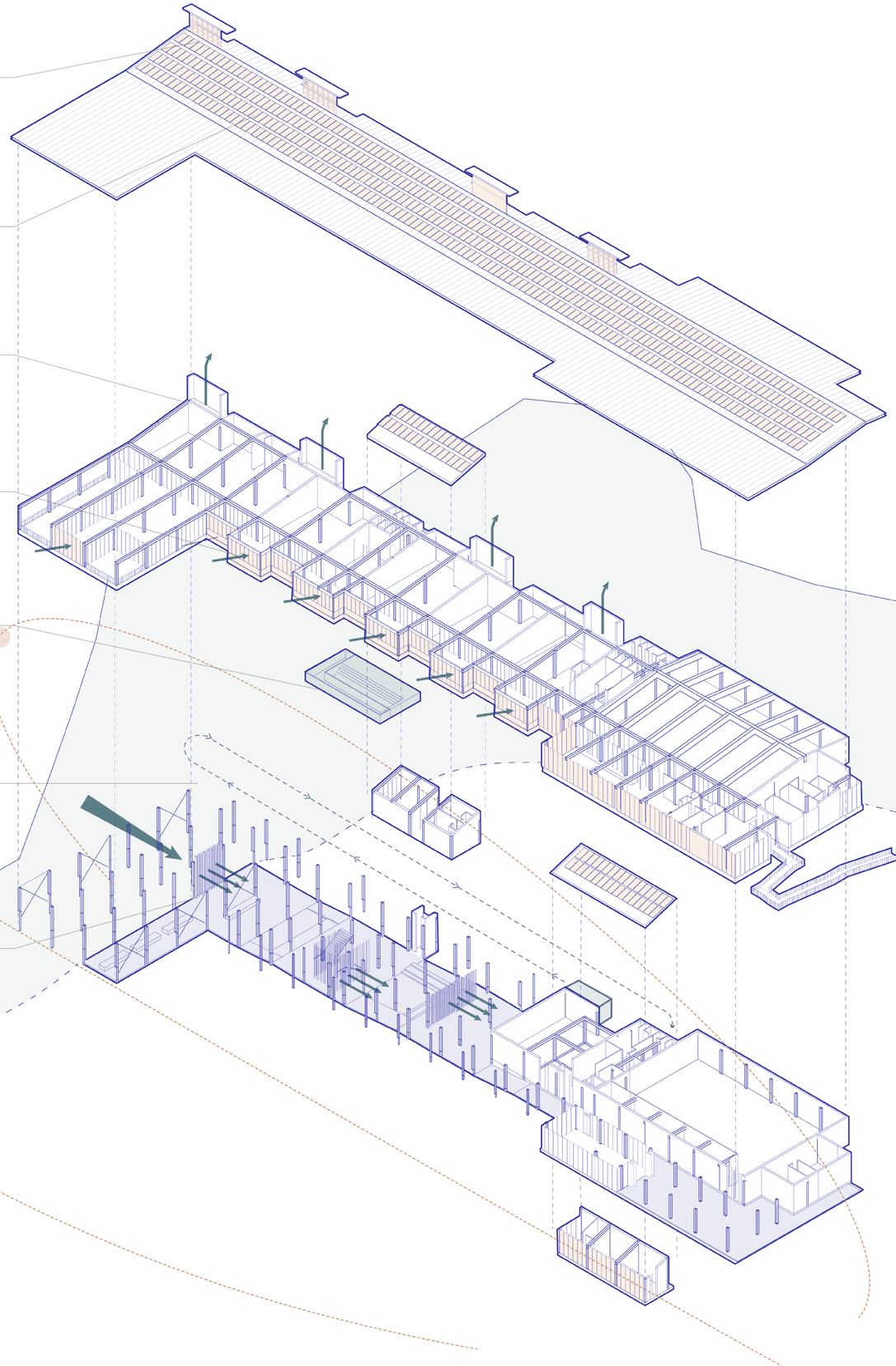
Passive ventilation and cooling achieved through operable windows and solar chimney

South-facing glazing maximizes daylighting and heat gain in colder months

Wetland pool utilizes natural filtration and regeneration capacities of wetland for water filtration

Greywater from sink, shower, and stormwater inputs filtered through wetland and used for flushing toilets

Underbelly screens and plantings break up harsh winter winds from the west



Material Source Relative to Site

- **Site** - Stratford, PEI, Canada
- **Lumber** - **Greenfield**, Nova Scotia, Canada
- **Hemp Insulation** - Asbestos, Quebec, Canada
- **CLT & Glulam** - Chibougamau, Quebec, Canada
- **Recycled Steel Connectors** - Sept-Iles, Quebec, Canada

Material

Expected Life Cycle

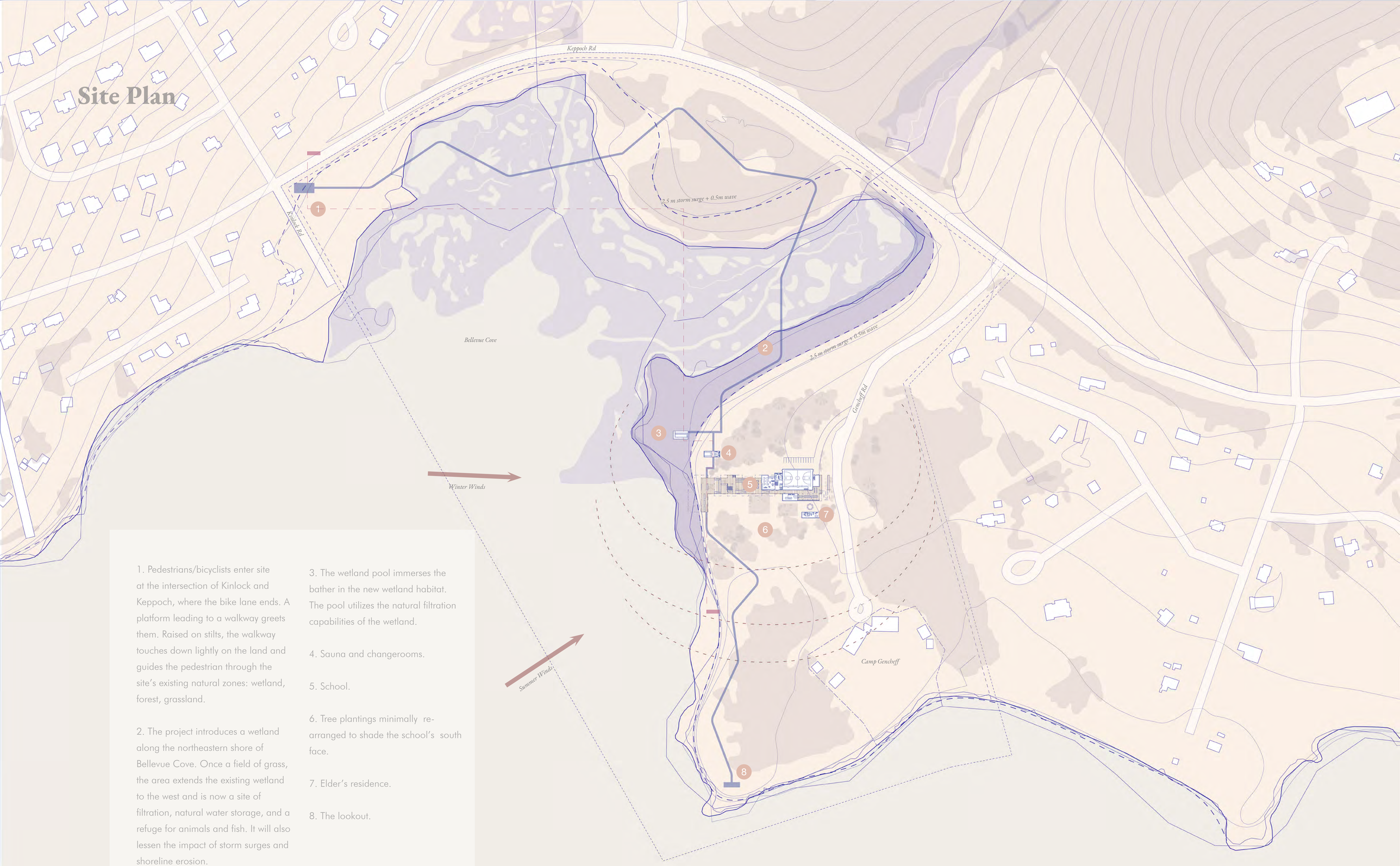
Reuse

	Source	Manufacturer	Virgin or Recycled	Distance to Site	Service Lifespan	Reuse	Recycle	Compost	Biofuel
Glulam +	Quebec's Boreal Forest	Nordic Structures, an engineered wood manufacturer that sources and manufactures wood in Chibougamau, Nord-du-Quebec region	Virgin	1259 km via truck	100 + years	-members can be disassembled for use in construction -members can be cut into smaller pieces for resale	-can be processed into wood chips, pulp, etc. -can be remanufact-ured into non-structural materials	-can be composted, but not recommended before it is either reused, recycled, or burned as biofuel	-can be burned as biofuel, but not recommended before it is either reused or recycled
CLT +	Quebec's Boreal Forest	Nordic Structures, an engineered wood manufacturer that sources and manufactures wood in Chibougamau, Nord-du-Quebec region	Virgin	1259 km via truck	100 + years				
Wood Framing +	Nova Scotia Forests	Freeman Son & Ltd Sawmill and sustainable forest management in Greenfield, Nova Scotia	Virgin	450 km via truck	100 + years				
Plywood + *	Nova Scotia Forests	Freeman Son & Ltd Sawmill and sustainable forest management in Greenfield, Nova Scotia	Virgin	450 km via truck	100 + years				
Hemp Insulation *	Hemp Farm in Asbestos, Quebec	Nature Fibres, grows hemp and manufactures hemp insulation on site in Asbestos, Quebec	Virgin	1076 km via truck	100 + years	-can be re-used to insulate other structures if still intact	n/a	-can be composted	-can be burned as biofuel
Steel Connectors + *	Recycled Metals	Metal Recycling Plant - Aluminerie Alouette Inc. Sept Iles, Quebec	Recycled	838 km via truck	100 + years	-can be disassembled and re-used for construction if still structurally intact	-can be recycled for use in other steel products	n/a	n/a

+ Structure

* Envelope

Site Plan



1. Pedestrians/bicyclists enter site at the intersection of Kinlock and Keppoch, where the bike lane ends. A platform leading to a walkway greets them. Raised on stilts, the walkway touches down lightly on the land and guides the pedestrian through the site's existing natural zones: wetland, forest, grassland.

2. The project introduces a wetland along the northeastern shore of Bellevue Cove. Once a field of grass, the area extends the existing wetland to the west and is now a site of filtration, natural water storage, and a refuge for animals and fish. It will also lessen the impact of storm surges and shoreline erosion.

3. The wetland pool immerses the bather in the new wetland habitat. The pool utilizes the natural filtration capabilities of the wetland.

4. Sauna and changerooms.

5. School.

6. Tree plantings minimally re-arranged to shade the school's south face.

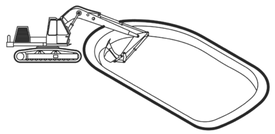
7. Elder's residence.

8. The lookout.

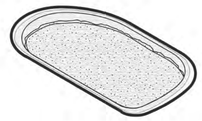
1:1500 Scale

Constructed Wetland

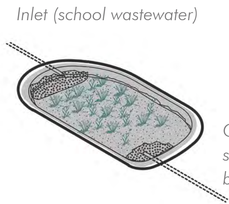
The project introduces a wetland along the northeastern shore of Bellevue Cove. Once a field of grass, the area extends the existing wetland to the west and is now a site of filtration, natural water storage, and a refuge for animals and fish. It will also lessen the impact of storm surges and shoreline erosion. The project uses the natural filtration capacities of the introduced wetland to filter and treat greywater from the school's and residence's sink, shower, and stormwater inputs. Treated greywater is then used for flushing toilets.



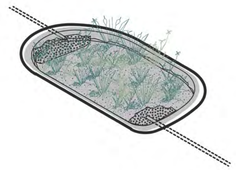
1. Create cells by excavating basins and building up earth embankments. Site should be gently sloping to allow for water to flow through the system by gravity and contain soils that can be compacted to prevent groundwater seepage.



2. Line wetland with synthetic liner to prevent groundwater infiltration/contamination. A strong, thick, and smooth liner, such as asphalt or plastic, are preferable to prevent root attachment or penetration. Fill basin with gravel and soil.



3. Add inlet from wastewater source and outlet to control water level / direct water to filters for sterilizing. Coarse rock piled beneath the entry zone ensures rapid infiltration. A perforated subsurface manifold can be used to adapt to fluctuating water levels. Introduce plants.



4. Wait. Though growth rates will vary, it may take several years before filtration performance of the constructed wetland reaches optimal levels.

Wetland Plants

Cordgrass*

Bladder Wrack

Reeds

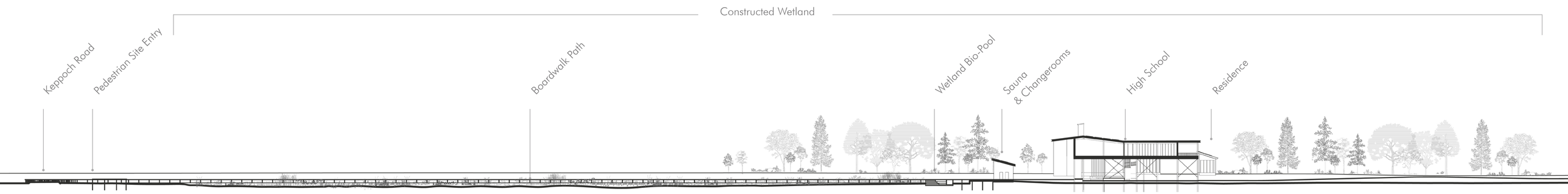
Sedges

Marram Grass*

Wetland Animals

+ Salt Marsh Copper
+Piping Plover
+Bank Swallow
Wood Duck
American Bitten
Water Boatman
Beavers
Tickleback
Green-winged Teal
Muskrats
Mummichog

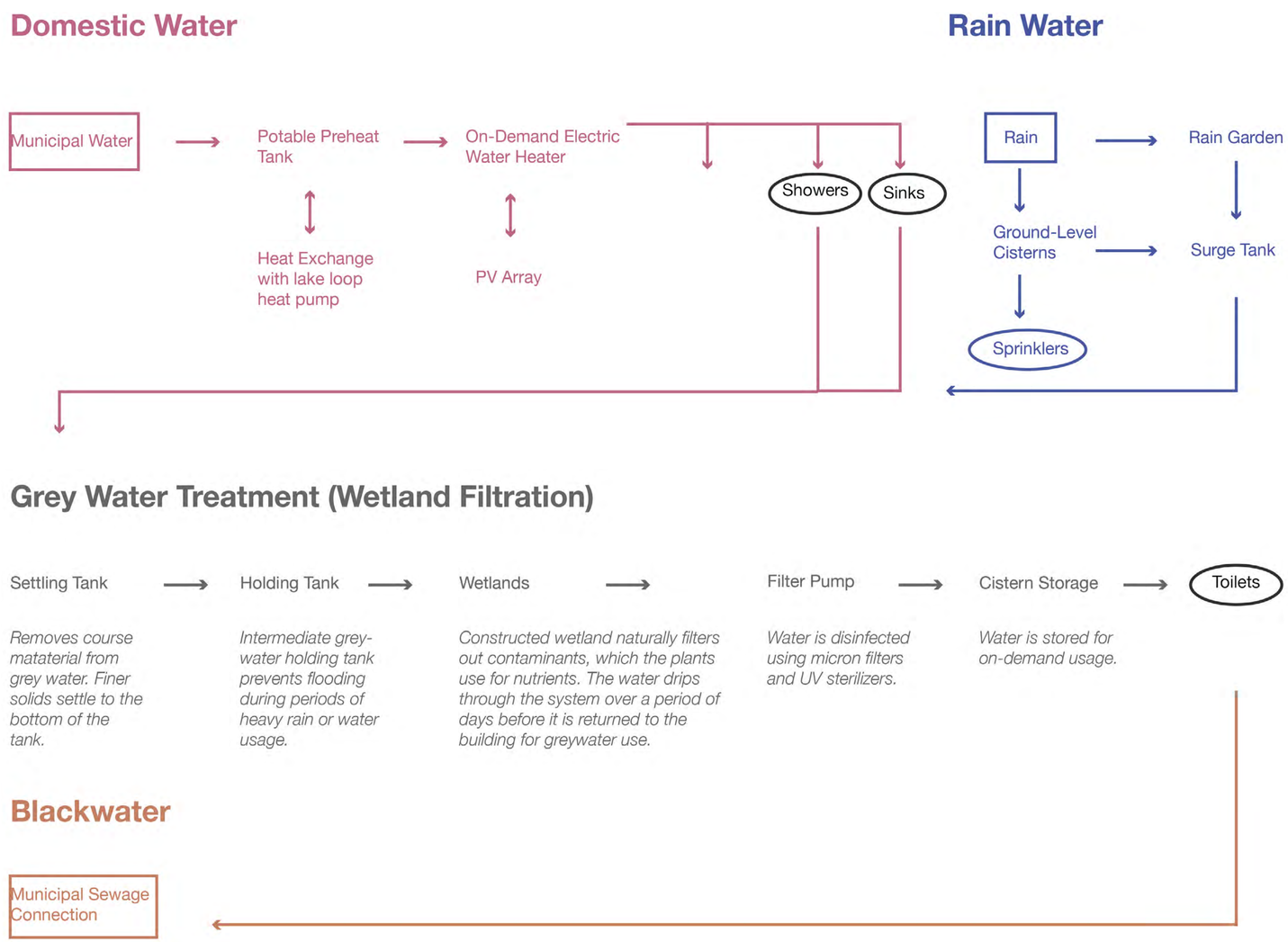
+At Risk Species
*Shoreline Erosion Prevention

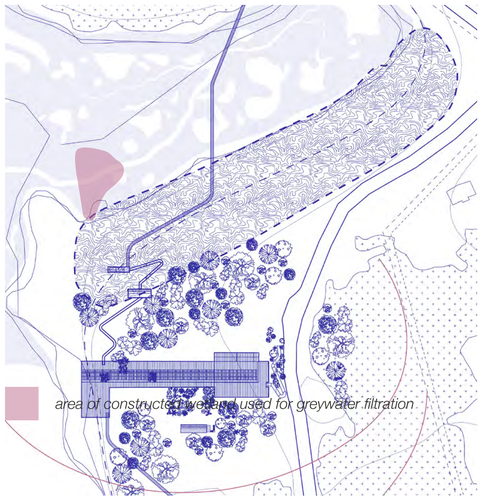


1-500 Site Section

Water Sources and Systems

To offset the demand for municipal water as well as dependency on storm sewer systems, the project uses the natural filtration capacities of the introduced wetland to filter and treat greywater from the school's and residence's sink, shower, and stormwater inputs. Treated greywater is then used for flushing toilets.

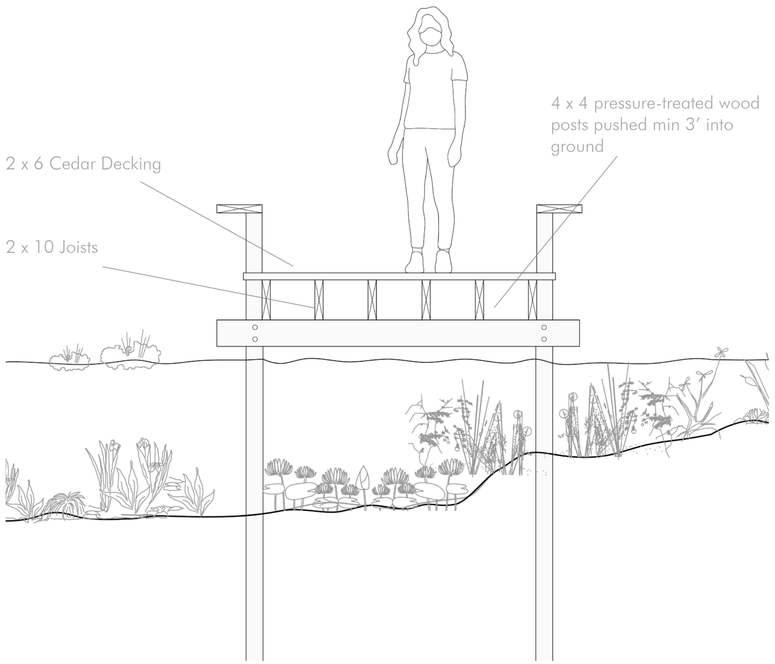




Greywater storage and filtration tanks are located in the underbelly.

Site Entry

Pedestrian Entrance at intersection of Kinlock and Keppoch Road



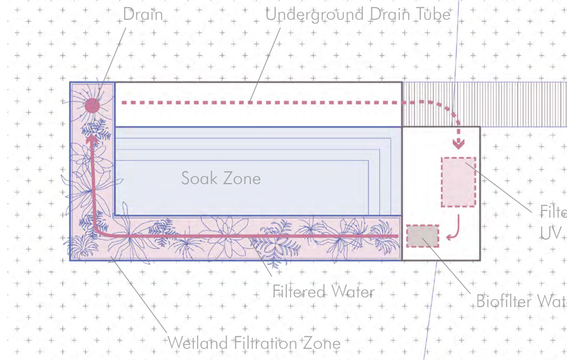
Boardwalk Cross Section

Site Map

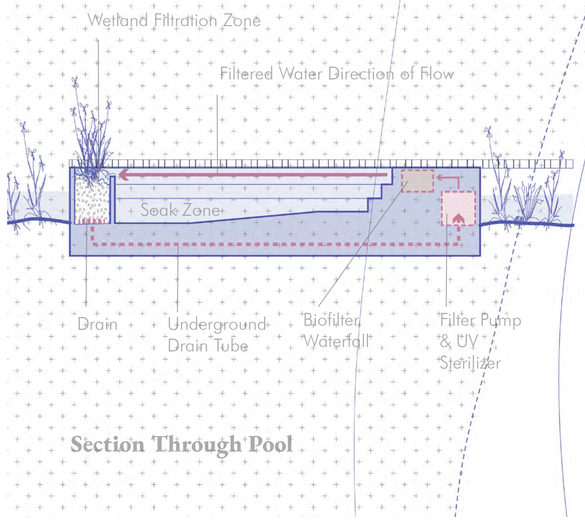
Wetland Bio-Pool

The bathhouse is set in the introduced wetland area. It utilizes the natural filtration and regeneration capacities of the wetland. It uses a bio-pool system for water filtration, rejecting the use of harsh chemicals and mechanical filtering systems that have the potential to leach into the environment.

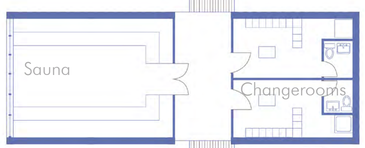
The pool is separated into two zones: the swimming area and the wetland. The water within this contained space is constantly circulated through via a pump, and allows the water to move through the wetland's plants for filtration. Further filtration and disinfecting is achieved through a UV filter.

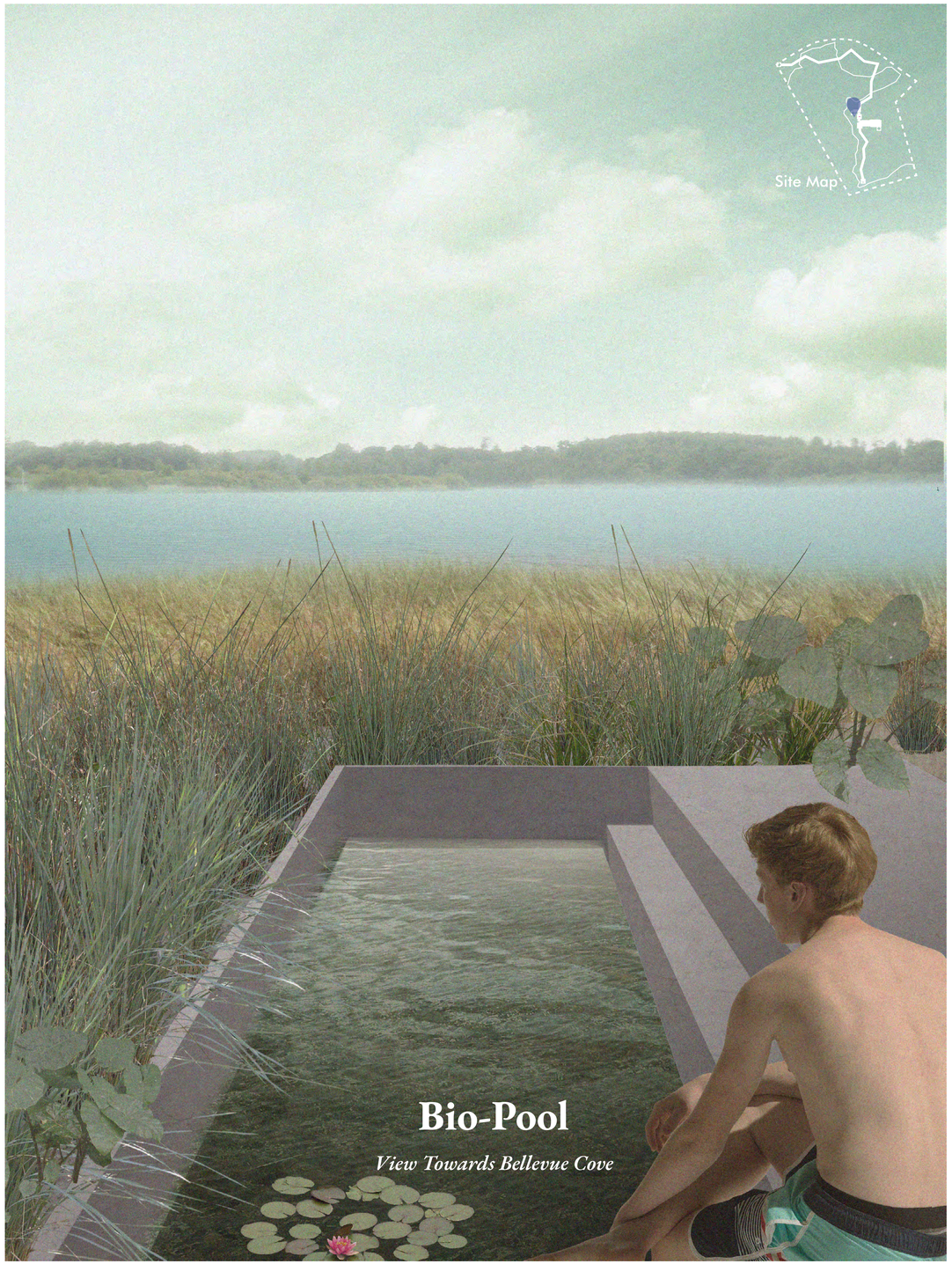


Plan of Wetland Pool



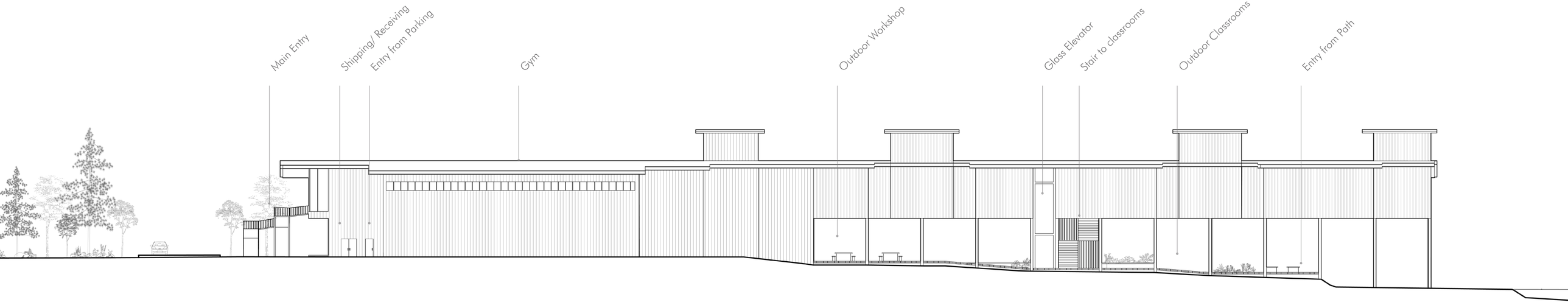
Section Through Pool





North Elevation

School



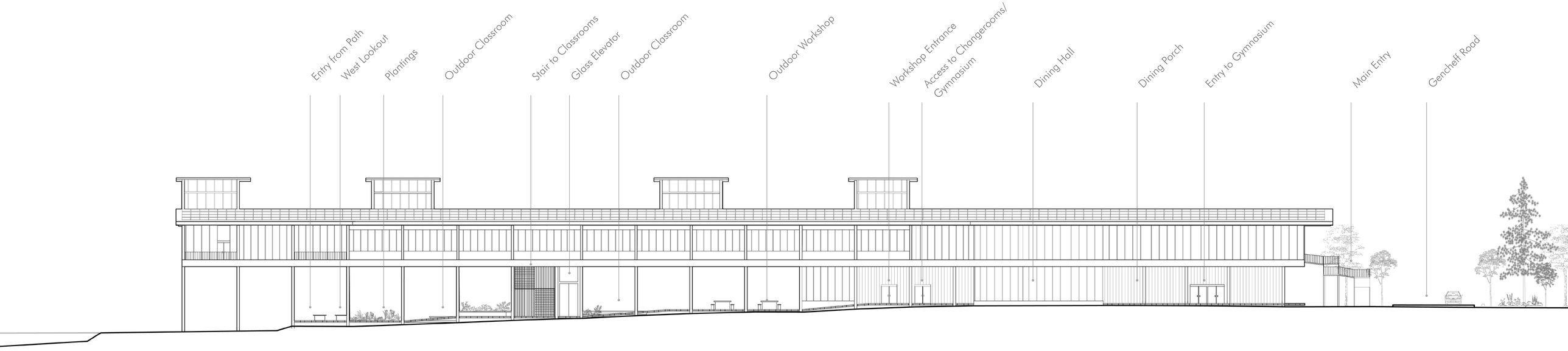
And then in the distance,
a glimpse of the school...

A long structure rising out of the earth,
raised to invite and shelter.

1:200 Scale

South Elevation

School



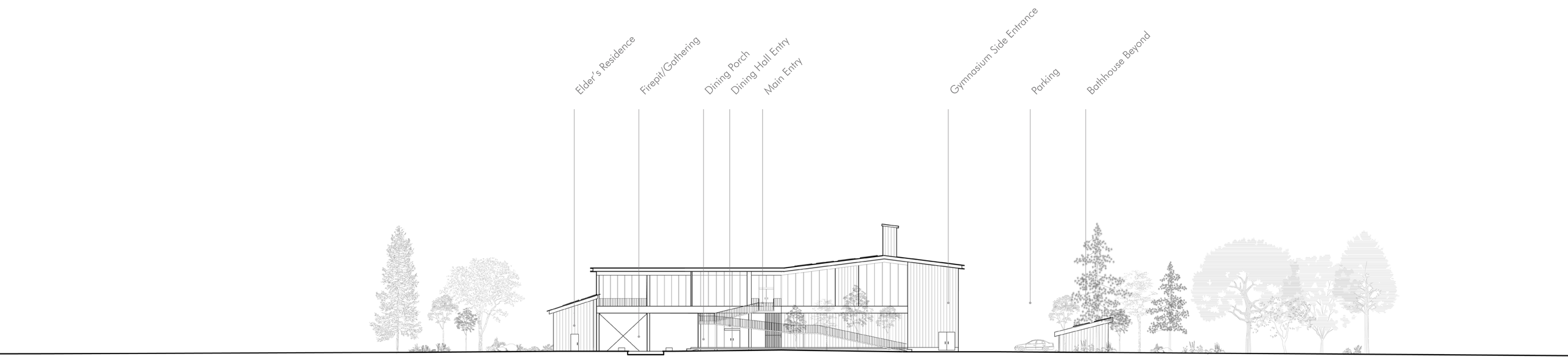
Glazed and transparent, ready to receive the southern sun as light and energy.

A counterpart to the sealed north elevation, which insulates.

1:200 Scale

East Elevation

School

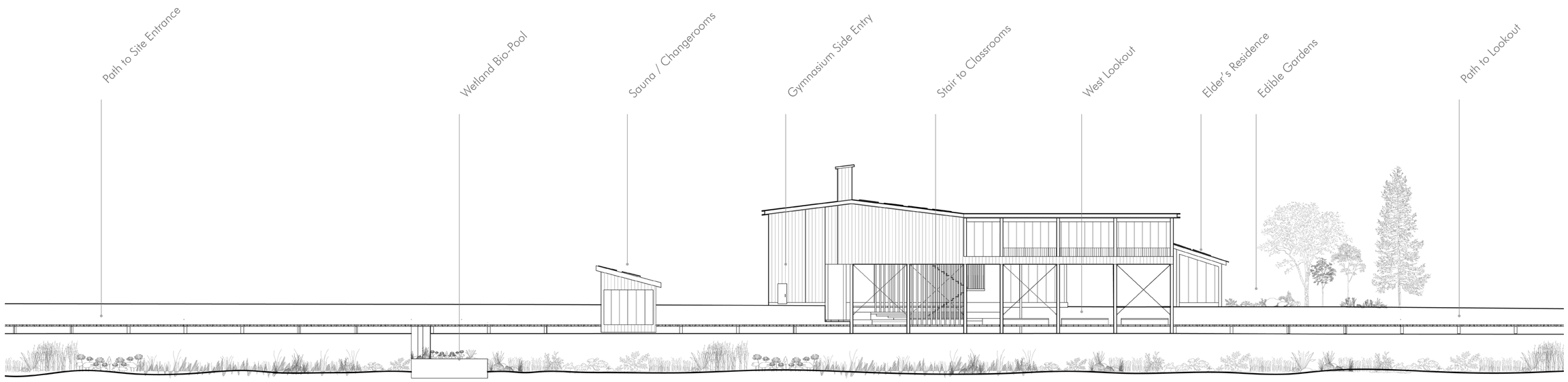


The main entry from Gencheff Road

Administrative functions
Parking, pickup and dropoff / loading

West Elevation

School



Quiet, natural zones

Lookout to bellevue cove and connection to wetland path

the path leads you to your
first encounter with the school...

Underbelly

Gathering Space

Ground Floor Plan

01. Ramp to Entry Above
02. Bike Parking
03. Outdoor Dining Porch
04. Firepit
05. Elder's Residence
06. Edible Garden
07. Dining Hall
08. Gymnasium
09. Parking
10. Entry from Parking
11. Shipping/Receving
12. Waste/Laundry/Mech
13. Storage
14. Changerooms
15. Workshop
16. Outdoor Workshop
17. Outdoor Classroom/ Gathering
18. Stair to 1st Level
19. Courtyard
20. Bellevue Lookout
21. Introduced Wetland
22. Sauna
23. Bathing Changeroom
24. Wetland Pool
25. To Southern Lookout

Introduced Wetland

Pedestrian Path

Goodeff Road

1:200 Scale

To Wetland Bath

Introduced Wetland

Ground Floor Plan - West

06. Edible Garden
15. Workshop
16. Outdoor Workshop
17. Outdoor Classroom/ Gathering
18. Stair to 1st Level
19. Courtyard
20. Bellevue Lookout
21. Introduced Wetland
25. To Southern Lookout

1:100 Scale

Ground Floor
Plan - East

01. Ramp to Entry Above
02. Bike Parking
03. Outdoor Dining Porch
04. Firepit
05. Elder's Residence
06. Edible Garden
07. Dining Hall
08. Gymnasium
09. Parking
10. Entry from Parking
11. Shipping/Receving
12. Waste/Laundry/Mech
13. Storage
14. Changerooms
15. Workshop
16. Outdoor Workshop

Residence

05a. Gathering / Living Space
05b. Open Kitchen
05c. Mechanical
05d. Bathroom
05e. Bedroom

1:100 Scale

Pedestrian Path

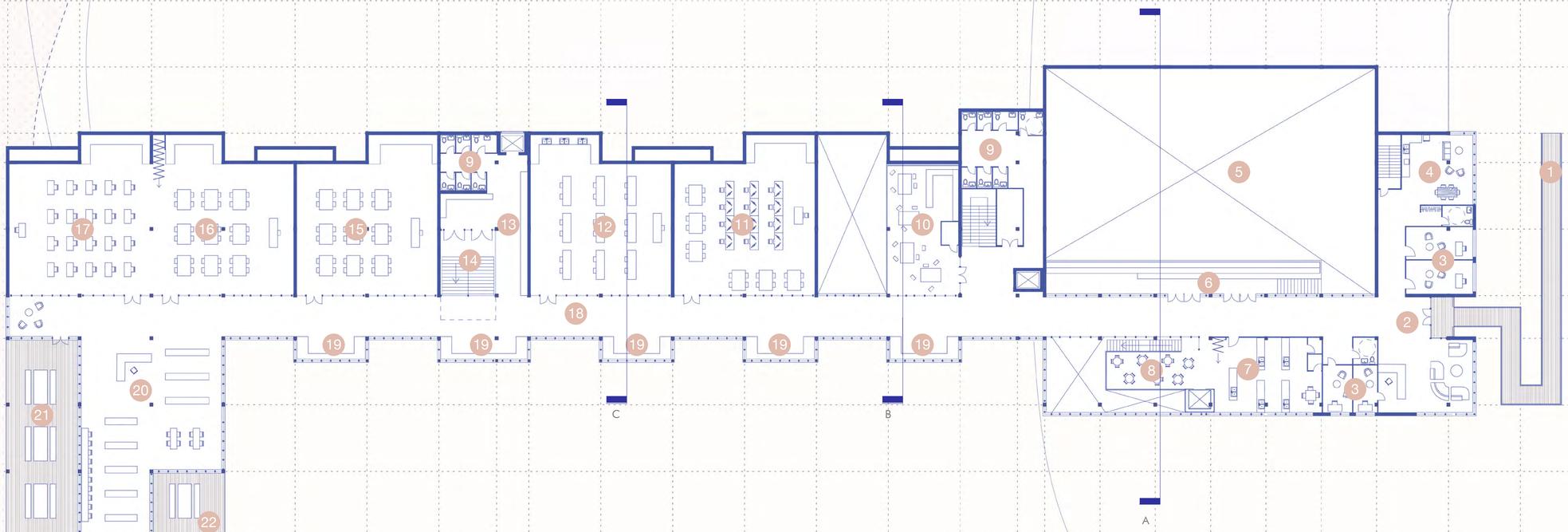
Gerrard Road

Residence

Elder in Residence - pictured: Inuk Writer Mini Aodla Freeman

First Floor Plan

01. Entry Ramp
02. Entry Foyer
03. Staff Offices/Admin
04. Staff room
05. Gymnasium
06. Mezzanine Seating
07. Learning Kitchens
08. Dining Mezzanine
09. Gender-free W/C
10. Artroom Mezzanine
11. Computer Lab
12. Science Lab
13. Boot/Coat Room
14. Stair to Underbelly
15. Classroom
16. Flex Classrom 1
17. Flex Classroom 2
18. Hallway/Classroom Breakout Space
19. Quiet Study Nooks
20. Library
21. Reading Porch
22. Outdoor Meeting Room



1:200 Scale

First Floor Plan - East

01. Entry Ramp
02. Entry Foyer
03. Staff Offices/Admin
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10. Artroom Mezzanine
11. Computer Lab
18. Hallway/Classroom Breakout Space
19. Quiet Study Nooks

1:100 Scale

First Floor Plan - West

09. Gender-free W/C
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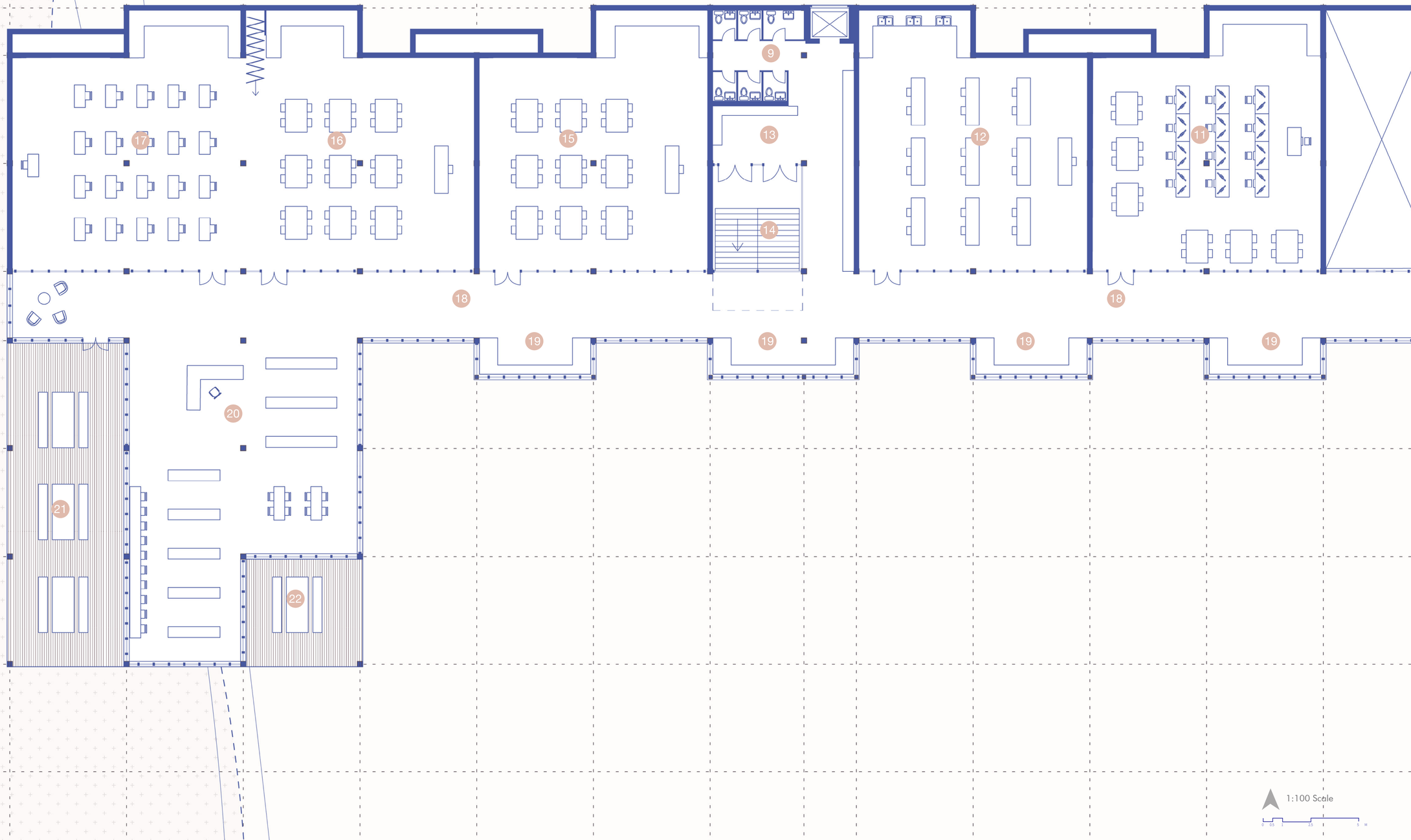
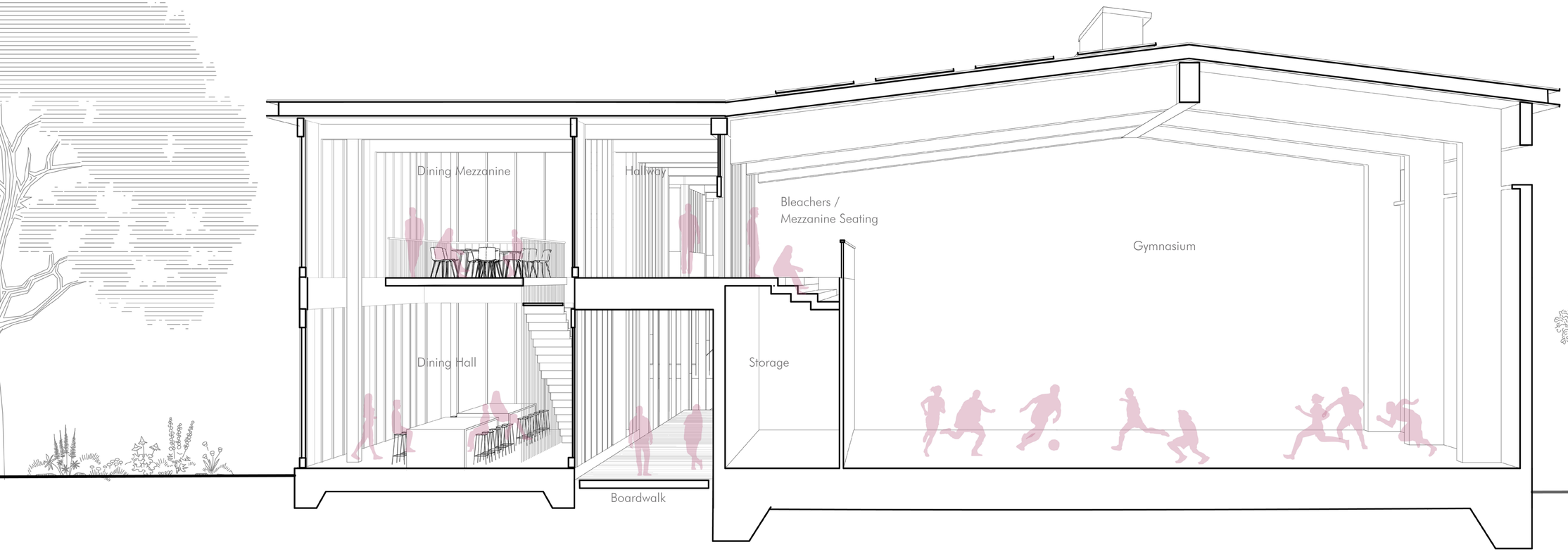
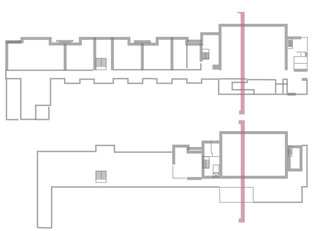


Section A

Gymnasium, Dining Hall





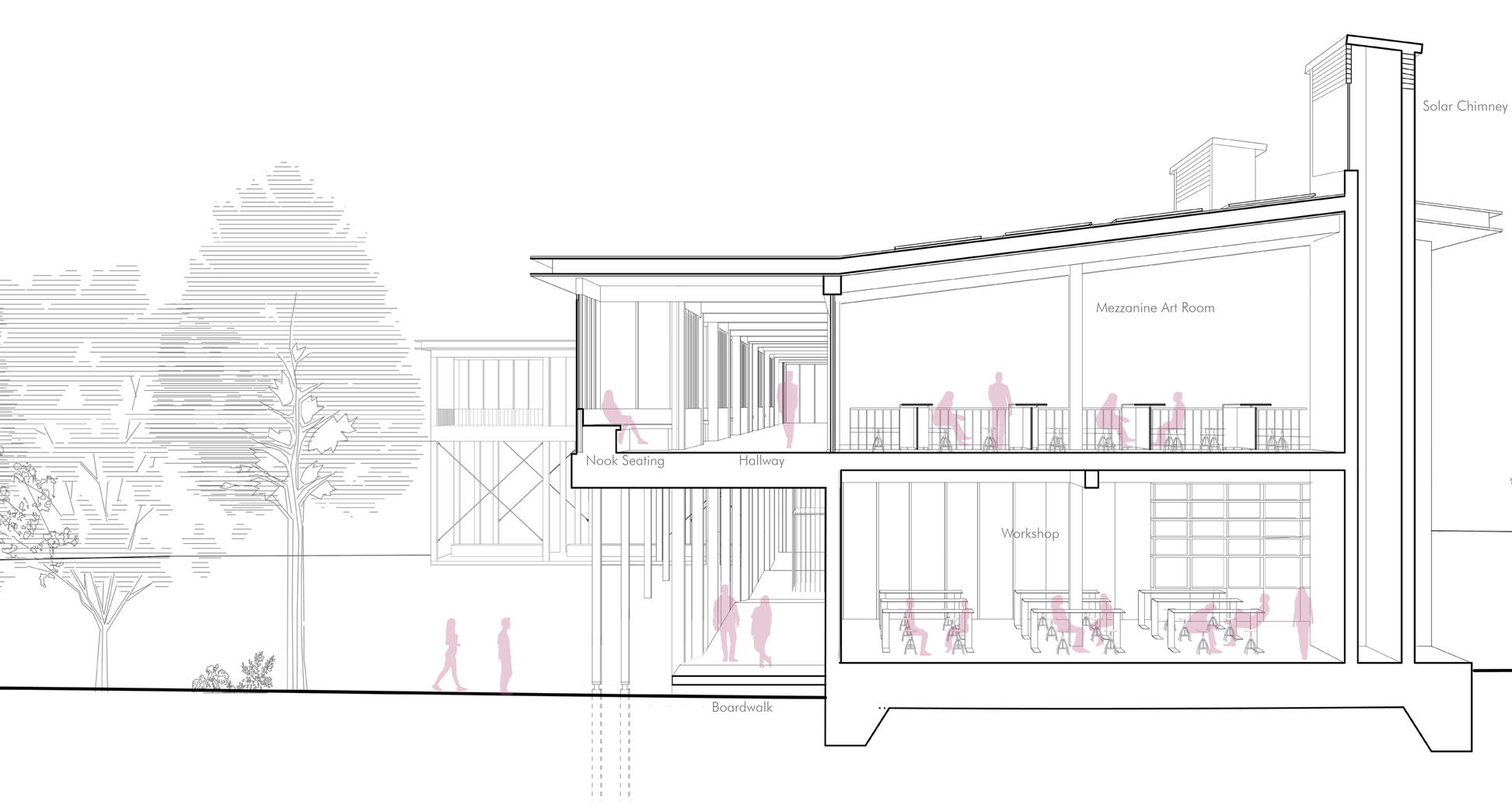
1:50 Scale

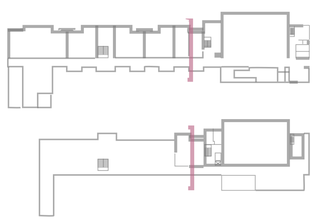
Dining

Indoor dining hall adjacent to outdoor dining porch

Section B

Workshop, Art Room, Solar Chimney





1:50 Scale

Passive and Active Strategies

The project seeks to use passive strategies first, and then active strategies as a supplement. The active strategies used have low environmental impact. The site generated electricity works to offset active systems as much as possible. 42% of the building's operational energy is supplied by the PV array on the roof.

Summer

Passive Strategies

1. Natural Ventilation - corridor and classroom windows open
2. Continuous draw through solar chimney - solar chimney louvres open
3. Deciduous trees shade and cool south face of building

Active Strategies

4. Radiant floor cooling - supplement cooling effects of natural ventilation
5. ERV - Ventilation through raised underfloor plenum

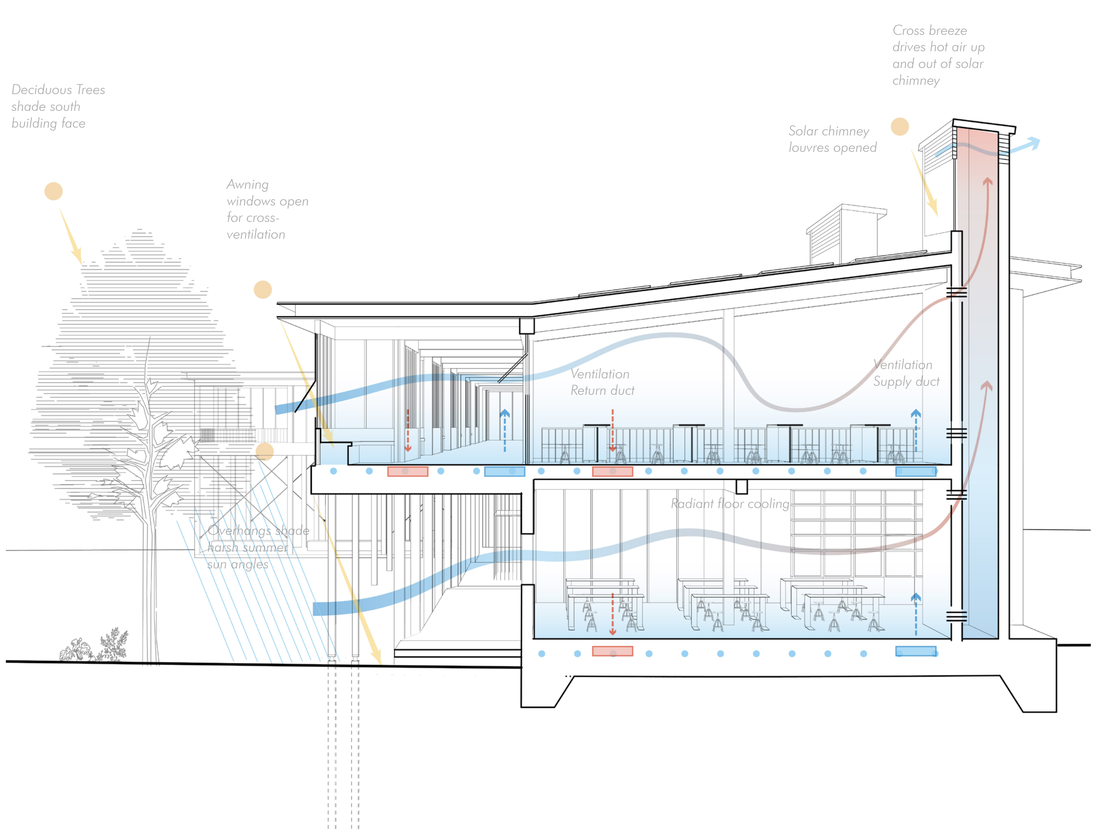
Winter

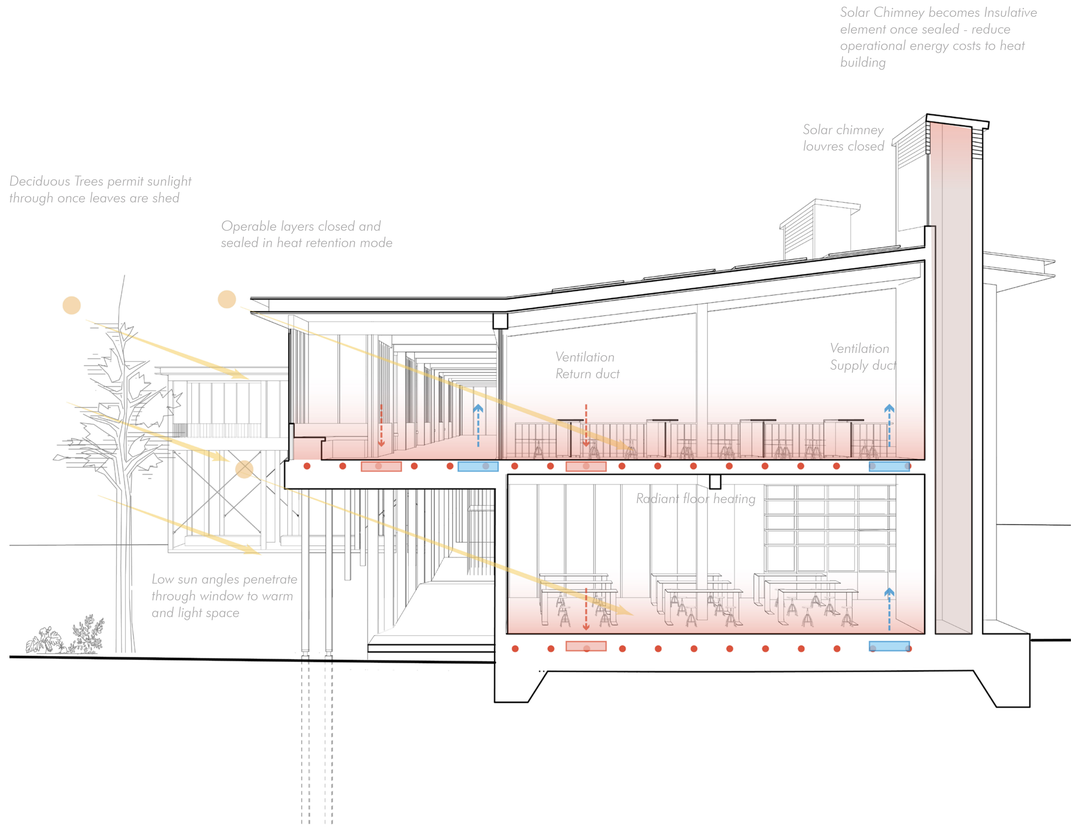
Passive Strategies

1. Sealed Envelope - Heat retention mode, all door and window layers closed
2. Winter solar gain through glazed hallway and classroom walls
3. Decidious trees permit sunlight through to warm south surface of building

Active Strategies

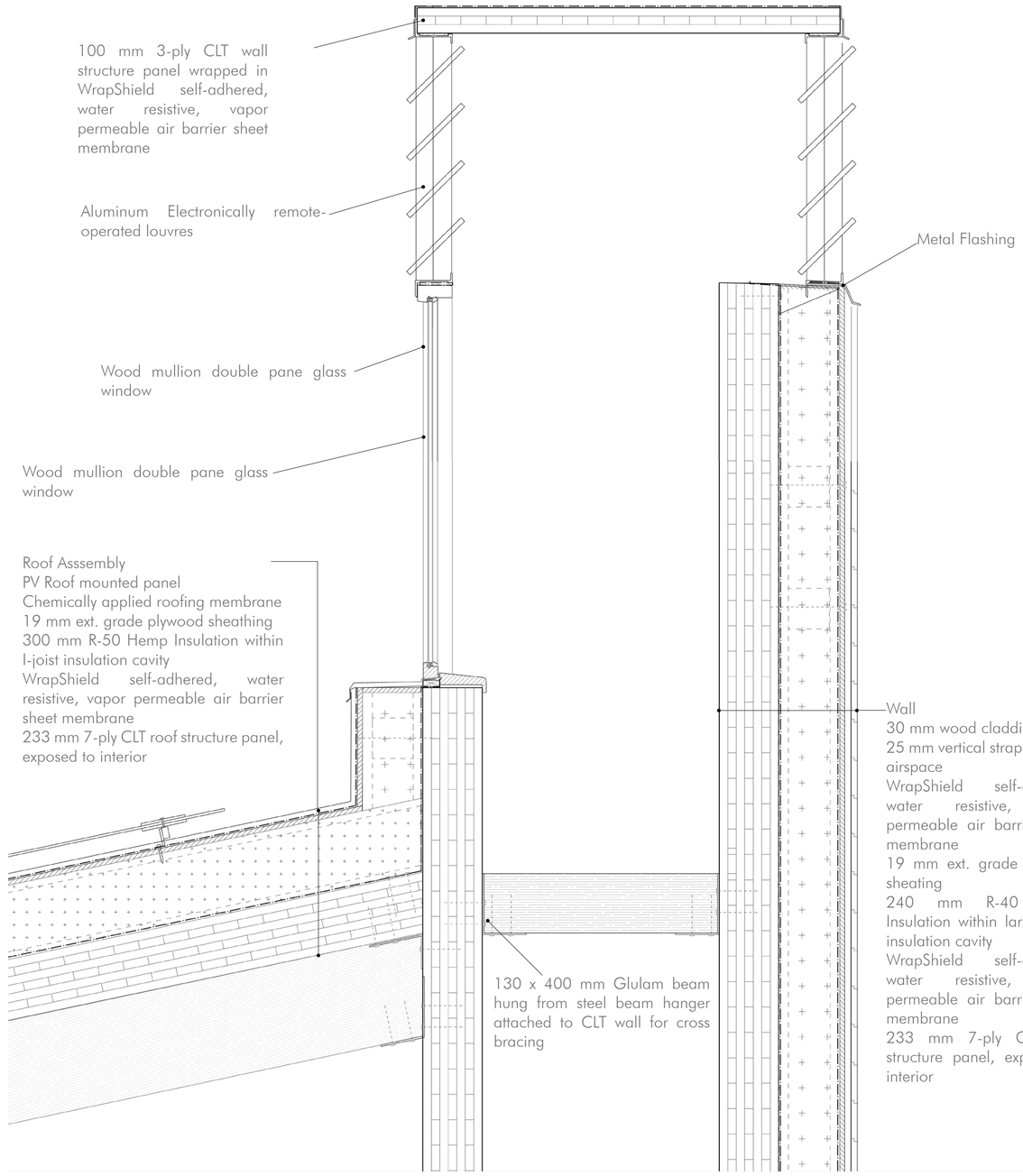
4. Radiant floor heating
5. Heat recovery ventilator - ventilation through raised underfloor plenum





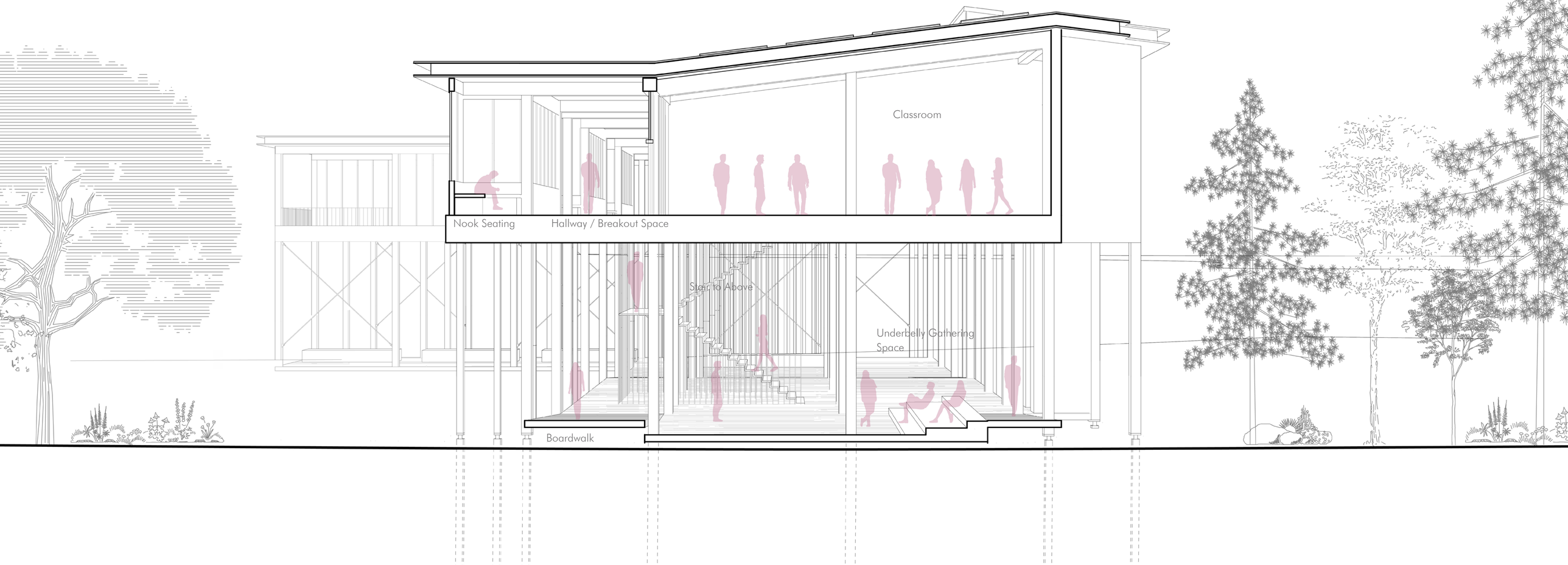
Solar Chimney Detail

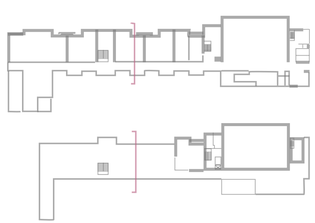
The enclosure adapts to seasonal fluctuations while utilizing them for passive cooling and heating. Its operable components give it the ability to be open and receiving of wind and sun, or sealed off to retain heat.



Section C

Classroom, Underbelly Outdoor Classroom





1:50 Scale

Hallway

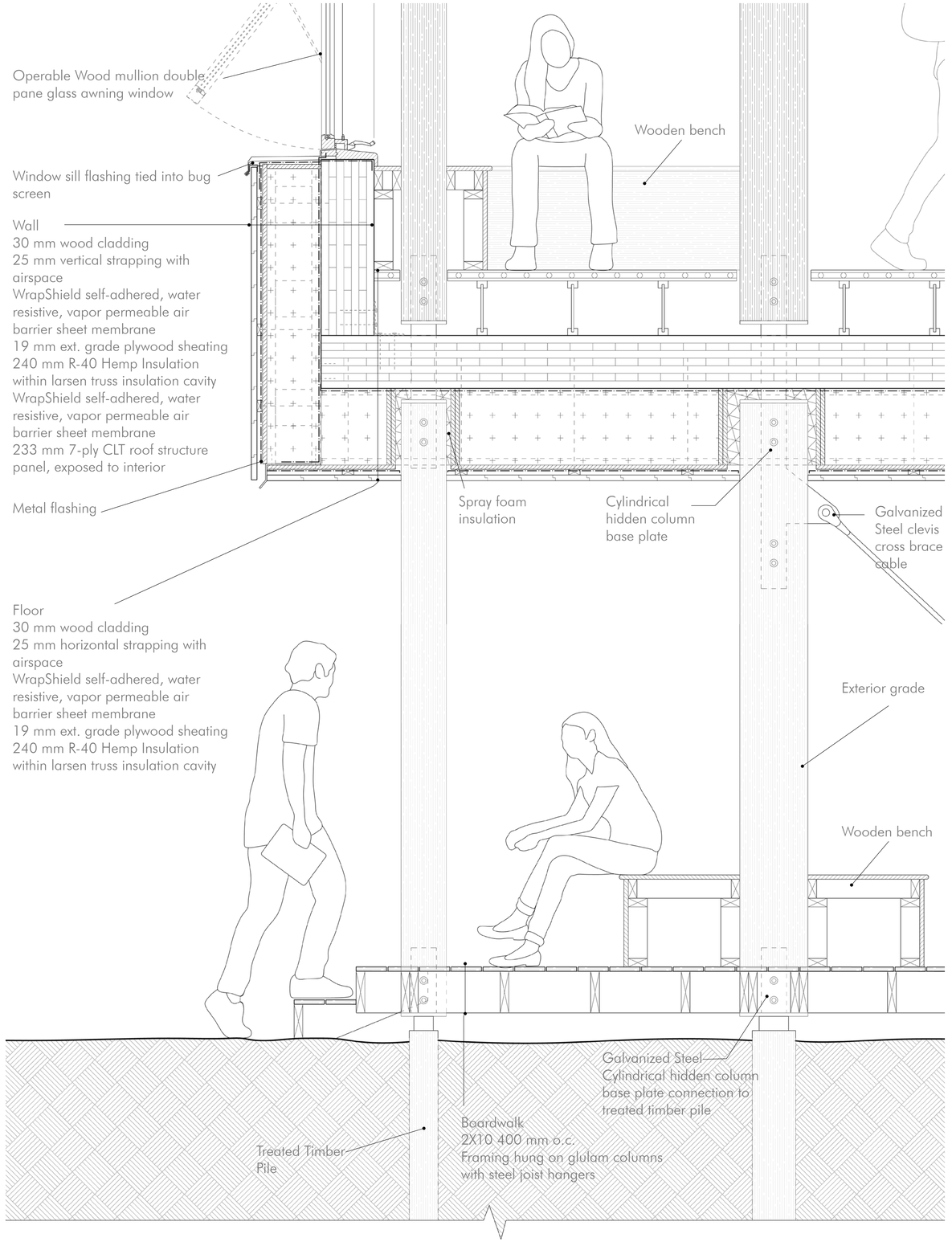
Breakout space for classrooms

Nook Seating

South-facing private zones for group or individual study

Nook Seating at South Wall
&
Underbelly Deck Detail

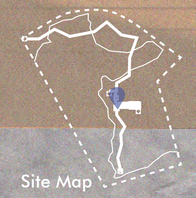
The insulation and primary structural materials account for most of the building's volume and such, highest potential for embodied carbon. The project uses mass timber and hemp insulation for this reason. Mass timber sourced sustainably from responsibly managed forests becomes an renewable resource for building. Hemp is a crop that grows easily, without the need for pesticides or much water, rendering it an ideal crop for productive use. The hemp is sourced from Quebec, where it is grown and manufactured into insulation materials.



a pause before continuing
along the path...

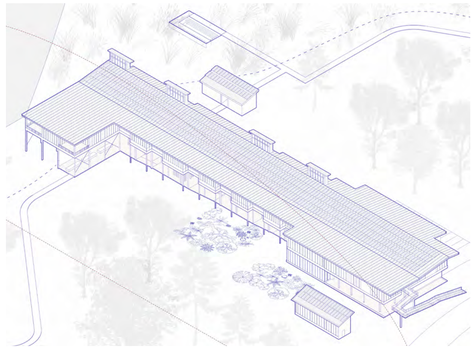
West Lookout

View of Bellevue Cove



Final Lookout

Northumberland Strait



Thank you!