

Practice
Landscape

HOW TO GROW A SHORELINE



Practice Landscape works with the living environment as designers, researchers, and gardeners. We believe that landscape is a process not a product, and that the most meaningful landscapes emerge from a strategy of working with plants first. The Manuals series can be found on our website and is open source and free to download.

Jardin de bord de mer was completed in collaboration with Les Jardins de Métis and the municipality of Sainte-Flavie, sponsored by Fonds de solidarité FTQ and Telus. The creation of this manual was funded by the Landscape Architecture Canada Foundation.



Practice Landscape benefited from an Annual Grant from the Landscape Architecture Canada Foundation (LACF). We thank LACF for supporting the creation of this manual “How to Grow a Shoreline.”

Introduction

4-13

How to use this manual
Pilot project

Step 1

14-27

Principles
Research
Goals + Intention

Step 2

28-51

Materials + Supplies
Planning + Design

Step 3

52-77

Implementation + Installation
Long-term care



Introduction

How to use this manual
Pilot project

Alnus crispa



Ste-Flavie, Québec, “Jardin de bord de mer.” In collaboration with Les Jardins de Métis and the municipality of Sainte-Flavie, sponsored by Fonds de solidarité FTQ and Telus.

This manual is a ‘how-to’ guide for managing shoreline and coastal erosion with plant life. Rather than a design prototype, a plan that is copied and pasted across sites regardless of local conditions, this manual describes principles and processes for initiating your own resilient shoreline garden. Think of this as a recipe, the ingredients and quantities will change based on your local conditions, but the proportions and overall flavor will stay the same. We will share a foundation from which to develop a design that can be manipulated and measured alongside other, more typical construction methods and materials.

The goals for the design are to mitigate erosion, develop a low maintenance, cost effective landscape, and create accessible and beautiful public space along shorelines subject to regular flooding and seasonal storms. **The design centers on a few key ingredients: create topography to break wave action and work with plants and their roots (primarily woody, rhizomatic plants) to hold topography and soil.**

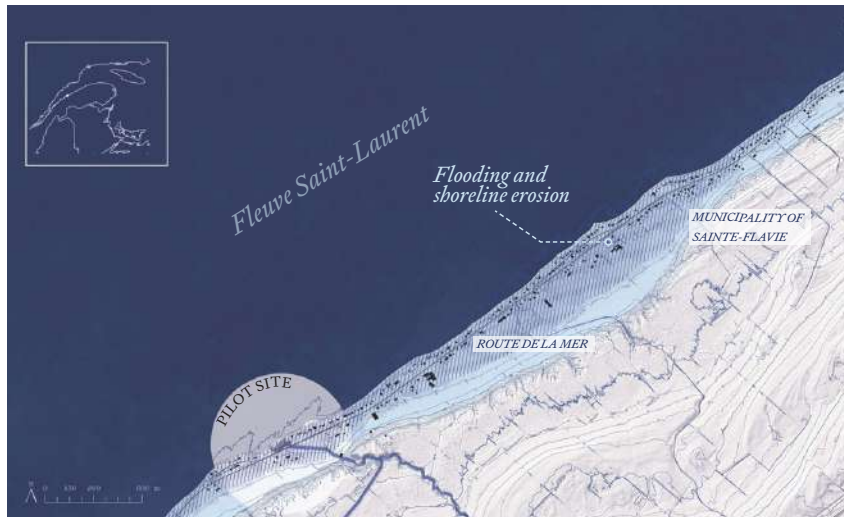
This manual is for you if you are part of a community looking for ways to manage land that can no longer support permanent dwellings. Rather than as a loss, this can be reframed as an opportunity to develop public space that simultaneously acts as protective buffer, community resource, and biodiverse habitat.

“The future of coastal resilience may rest on the adaptive capacities and changing dynamics of plants. Yet plant matter rarely serves as the basis of resilient strategies. In place of vain notions of permanence, the following model of coastal living for this century begins with plants and ultimately challenges the defining characteristics of restoration and green infrastructure.”

Rosetta S.Elkin “Planting Coastal Infrastructure”—Moving beyond restoration to dissolve the limiting dichotomy between green and grey infrastructure. (Climate Change Management, 2017)



Image: Google Earth



“This landscape of retreat was catalyzed in December 2010, when the highest high tide united with eighty-kilometre-per-hour north-east winds that together carved up the shores along Route 132, breaking the connection for residents along the shores.” Elkin, *Landscapes of Retreat* (K. Verlag, 2023)

Jardin de bord de mer

This manual is based on our experience researching, designing, and installing a series of shoreline gardens in rural Quebec, *Jardin de bord de mer*. The gardens address the consequences of climate change along the St. Lawrence and the ongoing retreat of communities away from the shoreline. Practice Landscape is working with the municipality of Sainte-Flavie and Jardins de Métis to value the land that is left behind following retreat; specifically, by relying on the adaptive capacity of plant life to address extreme shoreline erosion and celebrate the transformation of abandoned private lots into vibrant public spaces.

This approach to shoreline management differs from typical mitigation work because it prioritizes the use of plants rather than hard or gray infrastructure. Accepting a transitional shoreline means asking how to shape the shoreline rather than how to preserve it. It means designing a series of gardens in lieu of attempting to restore existing, fragile ecologies, and forces consideration of how the living environment is valued and managed. And, it requires the deliberate selection of plant species that have the potential to shape the environment through their root systems.

The gardens in Quebec are not looking to remove humans from nature, rather, the opposite: we want people to come here. This is a project to recover private spaces on the shore and make them public. An inclusive fabric that transforms the shoreline along the Saint Lawrence River estuary and strengthens it for an uncertain future.

In 2022 and 2023 two *Jardin de bord de mer* sites were designed and installed by a team from Practice Landscape and Les Jardins de Métis in collaboration with the municipality of Sainte-Flavie and the generous support of Fonds de solidarité FTQ and Telus. These gardens are envisioned as the first of many along the shoreline.

The goal is to move away from the commonly held idea that only the materials of grey infrastructure (concrete, steel) are resilient to storm events and erosive force, while “green” infrastructure is relegated to ecosystem services.



Ste-Flavie, Québec, “Jardin de bord de mer” June, 2022.

Woody plants offer protection because they add integrity and stabilize the soil. This project exploits the disturbance caused by frequent or intense storms to cultivate rhizomes from plant species with extended and interconnected root mass. These concealed root masses are similar to synthetic structural components, but because they are alive, they are adaptable to change. Rhizomes will expand below ground and grow into a coastal, partially underground, forest. This woody ecology can develop into essential protection for the Route by mitigating wind, capturing debris, expanding recreational opportunities, and more importantly, by offering a critical setback for future developments. In other words, the project spurs the growth of green infrastructure that actually performs and can become an adaptive model for other sites along the shoreline.

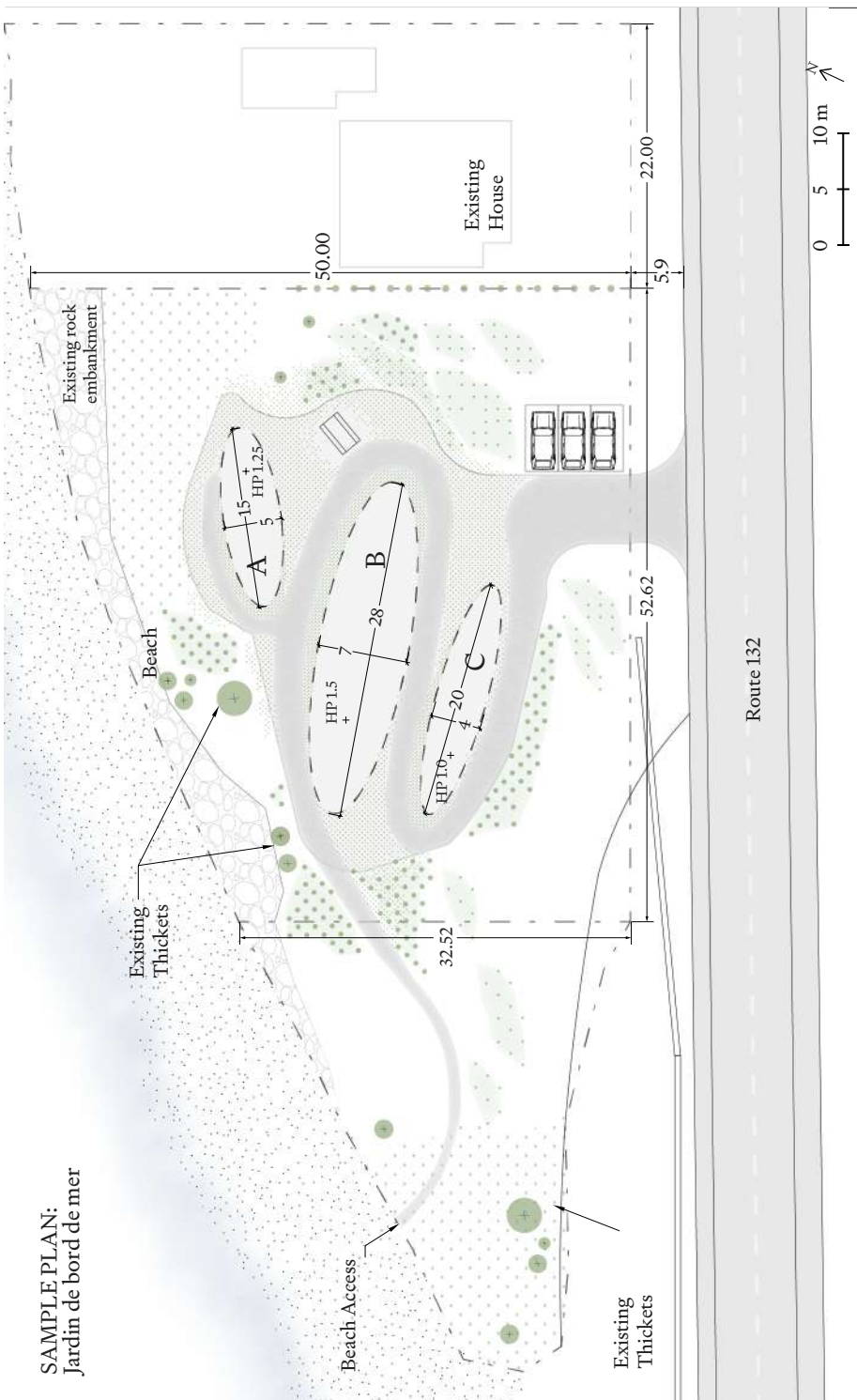
By relying on disturbance and integrating maintenance into the initial concept, the design is necessarily time based, as upkeep is imagined through seasonal cycles of management so that the entire site can become more durable in the face of strong winds and erosive waves.

To construct the 2022 and 2023 *Jardins*, woody plants and grasses were planted along elevated drifts of beach pebbles and stones. The spreading vegetation was planted in found and donated aggregates that help stabilize the soil. This sandy, porous substrate forms the foundation of the coastal shrubland made up of low thickets, and seasonal groundcover. Critically, the project prioritized local, found, or donated materials. In this case, taking beach stones that had been displaced from the shore and moved to a quarry and returning them to the beach. Thicketing woody plants were located and transplanted by the team, and herbaceous plants were grown by Les Jardins de Métis in a special coastal nursery established to cultivate sea-spray tolerant plants.

By emphasizing rhizomatic root structures and salt tolerance the Jardin de bord de mer and future gardens function as educational space to try, test, and demonstrate why plants are a critical component of shoreline protection.

Historic and archival research for Jardin de bord de mer was completed as part of the publication *Landscapes of Retreat*, Rosetta S. Elkin (K. Verlag, 2023). *Landscapes of Retreat* are portraits of climate adaptation. The stories suggest that communities are more likely to adapt to change when the landscape is appreciated, so that retreat can be valued.

Free online publication: landscapesofretreat.com



SAMPLE PLAN:
Jardin de bord de mer

Goal: Mitigate extreme shoreline erosion and create new public gardens by working with the adaptive capacity of plant life.

Ingredients:

Materials: Beach pebbles and stones, driftwood, gravel and aggregates, gabions, recycled billboard

Plants: *Leymus arenarius*, *Alnus crispa*, *Cornus sericea*, *Picea glauca*, *Populus tremuloides*, *Rosa blanda*, *Salix discolor*

Recipe:

1. Clear site of debris and sort material to be reused.
2. Create a base of aggregate and gravel for paths, parking and stone drifts.
3. Mound beach stones that had been displaced from the shore into drifts perpendicular to the wave direction to mitigate wave action.
4. Plant herbaceous plants, including edibles, in stone drifts and directly into aggregate and gravel.
5. Plant coastal forest of low woody plants and trees to provide soil stabilization and shelter around drifts.



LEGEND: PILOT PROJECT PLAN (LEFT)

Units: Meters

Plants

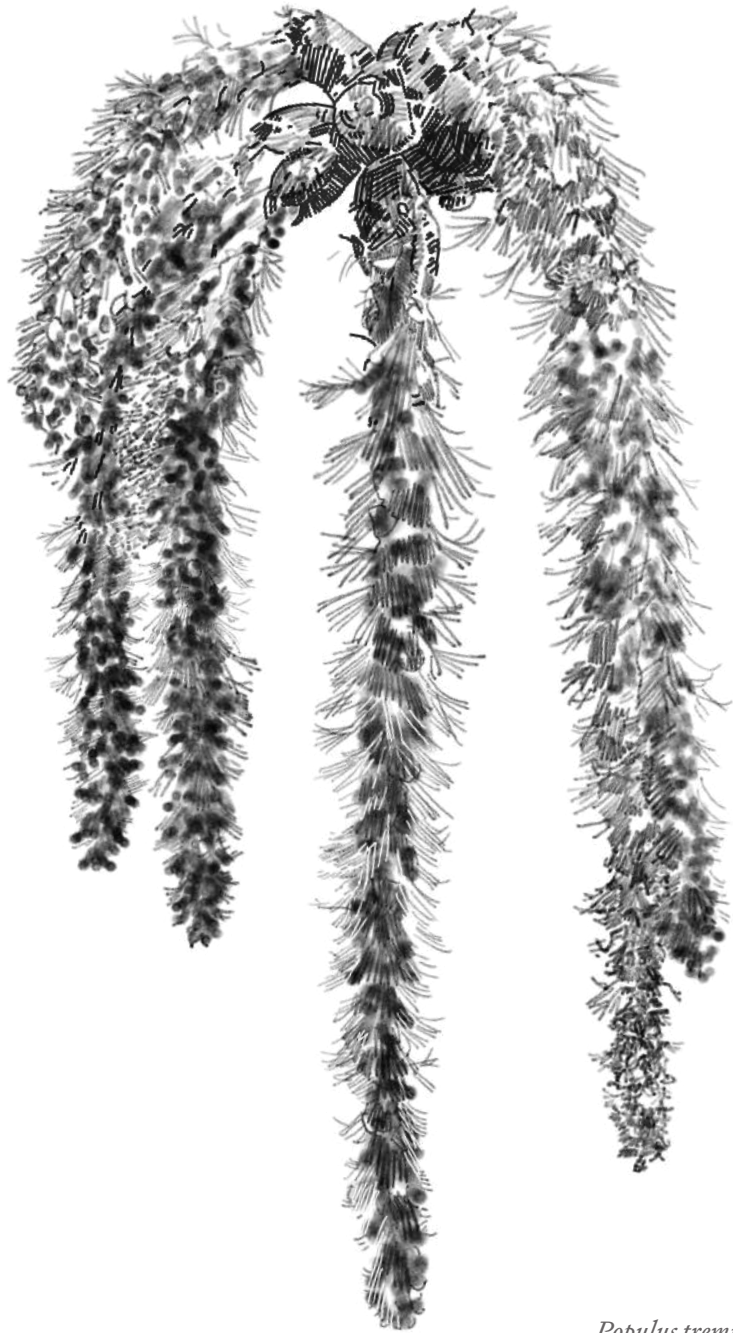
-  Planted Thicket
-  Planted Woody Species
-  Planted Herbaceous (grasses)
-  Existing Thicket
-  Existing Herbaceous (grasses)

Materials

-  Gravel Path Defined by Planted Grasses
-  Beach Pebbles

Features

- A = Mound A, B = Mound B, C = Mound C
-  Picnic Table



Populus tremuloides

Step 01

Principles

Research

Goals + Intention



The recipe for your design will vary based on the climate, environmental and site conditions, community needs, and available ingredients (plants and materials), but these five guiding principles can be used for any site and list of ingredients. Think of them as our cooking methods.

1

PLANT SMALL

Smaller plants are more resilient over time because they've spent more of their energy developing healthy root systems. These healthy roots systems allow the plants to quickly establish in the soil and support new growth (leaves and branches). Small plants can be planted with minimal shock, are better able to adapt to new conditions, and over time typically outgrow individuals that are planted at a larger size. Small plants also have the benefit of being less expensive and easier to transport and plant.

2

USE WOODY-SPROUTING PLANTS

Woody sprouting plants are those that can sprout back through burls, roots, and stems. Many woody-sprouting plants can persist and even thrive in conditions with frequent environmental disturbance such as fires, floods, or windstorms. This is because their root zone thickens with disturbance and their adaptive capacity to withstand future disturbance multiplies (Del Tredici, 2001). The woody plant material therefore becomes the primary wave attenuation and erosion mitigation agent by stabilizing the soil, cultivating an extended and interconnected underground root mass.

Beach stones and driftwood were readily available materials in the area. Jardins de Métis donated unused picnic tables and sea lyme grass (*Leymus arenarius*) grown at their coastal nursery.



3

UTILIZE TRANSPLANTS

Transplanting is the relocation of an established plant from one location to another. This is the one exception to “plant small.” Sprouting woody species (i.e., perennial trees and shrubs) can be transplanted at a larger size because they respond well and resprout when disturbed, in this case being dug up, moved, and replanted. It is important to select plants growing in a similar condition to your site (i.e., select plants growing near the coast when working on a coastal site), and only transplant part of an existing thicket so the remaining patch has a chance to resprout.

4

REPURPOSE MATERIALS

Material reuse is the utilization of existing or donated material in the design, installation, and long-term care of a project. Reusing material saves money and reduces your carbon footprint by limiting the need for production of new materials and transportation. The materials you use will be specific to your local conditions, from compost and mulch to seating built with salvaged materials. This is a chance to work with ordinary materials and make the extraordinary.

5

DESIGN WITH MAINTENANCE

Construction should be thought of as a process that occurs through care overtime. Landscapes change, and rather than fight that change, there is an opportunity to work with continued disturbance. Long-term care, or maintenance, allows you to design with plants and materials as they shift, grow, die and transform. This long-term care often occurs through seasonal maintenance that engages your community (weeding, replanting, clean-up, watering, etc.) and ensures the long-term success and community investment in your project.

Your site research should aim to answer the questions, “*What is the landscape made of? And how does it work?*” This initial assessment will reveal the cultural and environmental dynamics at play. Caring for the land in a time of great change requires understanding how it functions as part of a system because all land is conditioned by change. Understanding the patterns and phenomena that catalyze or inhibit change encourages design in collaboration with the land.

SITE HISTORY

Data analysis: The most useful exercise is to visually compare your site overtime to present-day conditions through historic imagery. Understanding how the land was used and how it has changed will impact your design today.

Questions:

- *What used to grow here and how has that changed over time?*
- *How have landscape features changed over time? (i.e., erosion, drought, development).*
- *How was the land used in the past? (i.e., farming, development, and industrial uses).*

Data collection: Archival imagery including photographs, maps, surveys, written and oral histories, land-use data and ownership (plat) maps.

Resources:

- Historical societies: These are repositories of images, narratives, and self-published histories.
- Libraries and academic institutions: Seek out experts and librarians, they are available and trained to help.
- Interviews: Talk to people! There is a wealth of knowledge to be gained from being in conversation with people in your community.

Databases (examples):

- National Archives Aerial Photography [archives.gov/research/cartographic/aerial-photography](https://www.archives.gov/research/cartographic/aerial-photography)
- Historical Climate Data climate.weather.gc.ca
- Library and Archives Canada (LAC) library-archives.canada.ca

CURRENT SITE CONDITIONS

Data analysis: The goal is to understand the conditions on site today. Present-day land use, soil quality, how water flows, and where vegetation is growing will all inform and limit your design. The three areas of data to collect are **A. Water + Soil, B. Plants, C. Land Use.**

A. Water + Soil

Questions:

- *How does water move on site? (topographic map)*
- *Where does water collect? Where is it typically dry?*
- *Are there times of the year when it is wetter or dryer? (observation)*
- *What is the soil type? Is it well drained or wet and swampy? (soil map)*
- *Is there any contaminated soil? (land use/site survey)*

Data collection: Flood mapping and flood risk maps, contour maps (topographic maps, surveys), soil map or soil testing*, erosion (changes to shoreline overtime), building or site survey (locate current and former building, driveways and roads, and existing infrastructure).

**Note: If soil maps or information aren't available, it could be worthwhile to do your own soil testing. University extension services often offer resources.*

Databases (examples):

- USGS National Map Viewer [usgs.gov/tools/national-map-viewer](https://www.usgs.gov/tools/national-map-viewer)
- Canadian GIS and Geospatial Resources [canadiangis.com](https://www.canadiangis.com)
- Natural Resources Canada [natural-resources.canada.ca](https://www.natural-resources.canada.ca)
- Statistique Canada [statcan.gc.ca](https://www.statcan.gc.ca)
- State, county, or municipal agencies:
- National Resources Conservation Service
- Department of Natural Resources
- Soil and Water Conservation District

B. Plants

Questions:

- *What is already growing on site? Do different species grow on different parts of the site?*
- *What plants are healthy? Which are struggling? Which are aggressive or invasive?*
- *What is growing nearby and regionally?*
- *What has the potential to be transplanted? (woody, thicketing plants)*
- *Are there seeds to collect and/or sow?*

Data collection: Vegetive survey or mapping (typically found at a larger regional scale), a vegetative site survey or plant inventory is unlikely to be available in which case you will need to collect this data yourself!

Resources:

- Network of Nature networkofnature.org
- Database of Vascular Plants of Canada (VASCAN) data.canadensys.net/vascan/search
- Ladybird Johnson Wildflower Center wildflower.org/plants/
- iNaturalist(ap)—IDing flora and fauna
- Local ecologist or horticulturalist, botanic gardens or university extension services.

C. Land Use

Questions:

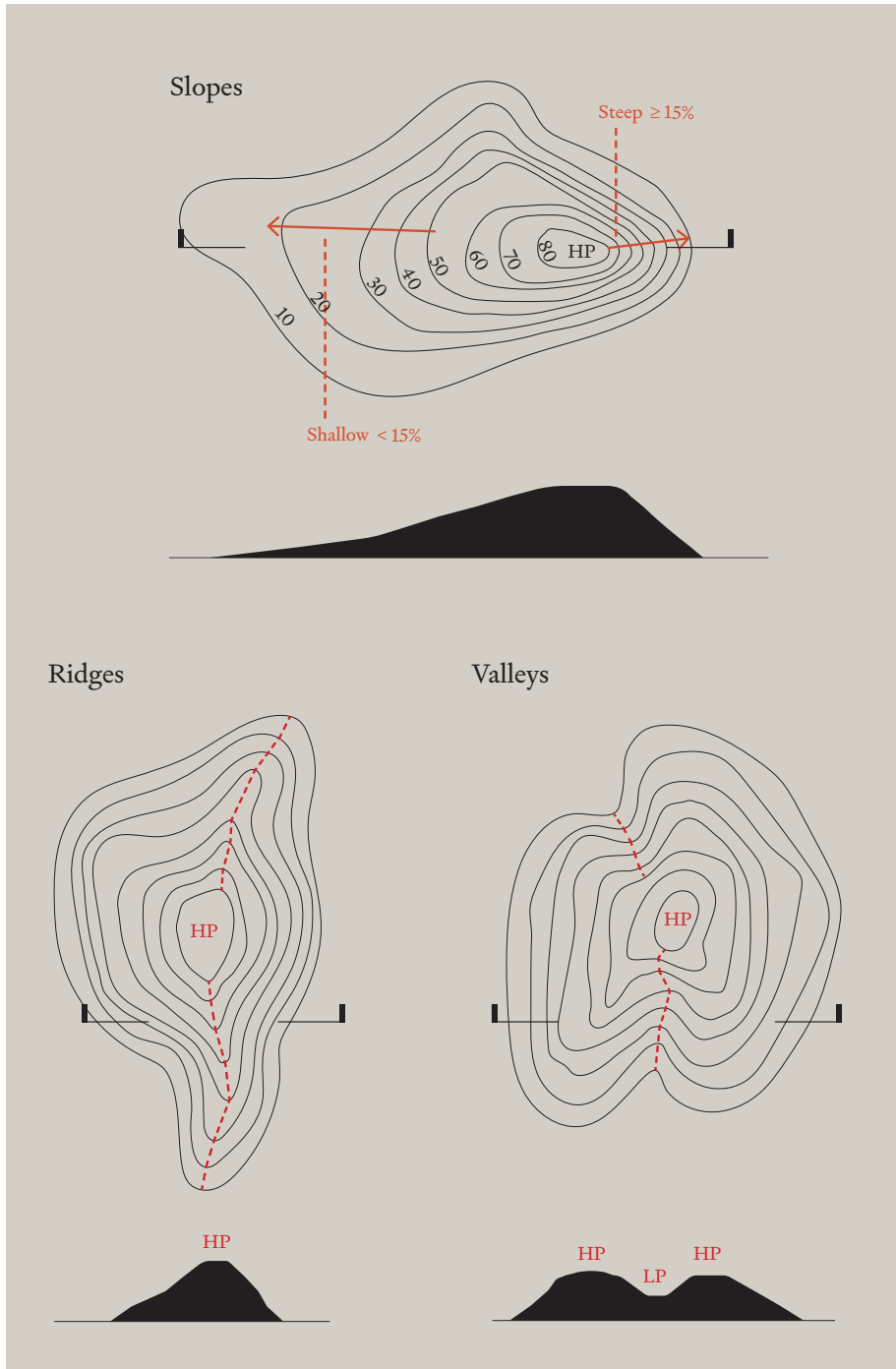
- *What are the built elements on site (buildings, structures, roads)?*
- *How are people currently using the land?*
- *Who is currently using the land? Consider humans and other non-human life.*
- *Where are the viewpoints, where are places of shelter?*

Resources:

- Interviews with neighbours, residents, and site users
- Municipality or town planning office — an existing study or plan for your site or region may exist.



Historic and archival images, in-person interviews and, current site conditions for the pilot project collected during research for *Landscapes of Retreat*. Elkin, *Landscapes of Retreat* (K. Verlag, 2023)



NOTES ON TOPOGRAPHY

When researching the topography of your site, you will likely encounter a contour map. The topography, or forms and features of the landscape, will often be represented by contour lines. A drawn contour line connects all points of the same elevation above sea level (0 m). A contour interval is the vertical distance or difference in elevation between contour lines. For example, contour lines may show a change in elevation of 1 m, 5 m, 10 m, 20 m, etc.

How to read contour lines:

- Identify the contour intervals (elevation change between vertical contour lines; should be indicated in the legend).
- The distance between contour lines indicates the slope. When lines are close together, the slope is steeper; when they are far apart, the slope is shallow. For example:
- Lines forming a “V” pointing uphill indicate a valley/depression, often a stream or river.
- Lines forming a “V” pointing downhill indicate a ridge, sometimes this is a road or trail.

Grade or slope will impact planting types and site program.

- Water moves quickly across a steep slope and drains away from high points and ridges.
- Shallow slopes hold more water and low points or depressions accumulate moisture.
- The aspect of a slope (the cardinal direction it is facing) is also important. South-facing slopes will get the most sun over the course of a day which can mean they dry out more quickly.

DESIGN WORKSHEET

Print and complete following Step 01

1. The design addresses the following site conditions and environmental forces:
2. The primary users of the site are (human and non-human):
3. The primary use, or program, for the site is (program including recreation, conservation, food production, etc.):
4. The following practices and methods will be used to manage the site long-term:
5. The key collaborators or community partners are:

Now that you've answered, "*What is the landscape made of? And how does it work,*" it is time to ask, "*How do I work with and care for the land?*" Steps 02 and 03 will cover design, installation and maintenance, but before jumping in try to clearly articulate your goals and intentions. The **worksheet** on the adjacent page can be used to answer some critical questions before you start your design.





Step 02

Materials + Supplies
Planning + Design

Rosa blanda



Typical materials used for the pilot include the borrowed wheelbarrow (above) and small plants purchased at a local nursery (right).



Rather than starting with a detailed site design, we recommend gathering available materials so you can design based on what is available. Repurposing materials (Principle 4), saves money and reduces your carbon footprint by limiting the need for production of new materials and transportation. Remember, this is a chance to work with ordinary materials and make the extraordinary.

Categories of materials include: Organic, Hardscape, and Programmatic. Below are examples of the types of materials you may need.

ORGANIC

- Plants
- Soil
- Mulch
- Compost
- Branches / Logs



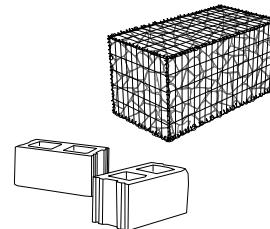
HARDSCAPE

- Gravel / Aggregate
- Pebbles
- Stone
- Boulders
- Pavers



PROGRAMMATIC

- Seating
- Tables
- Gabions, cinder blocks
- Fencing



TOOLS

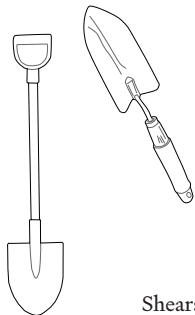
- *Vary by material type*



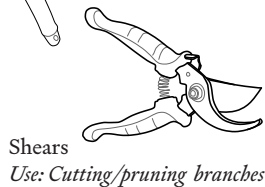


In addition to vegetative/plant material, you will need to gather tools for planting. The following is strongly recommended and can be relatively inexpensive to purchase or borrow.

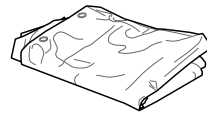
Shovel + Trowel
Use: Shovel for digging large holes and trowel for more delicate hand planting



Work gloves



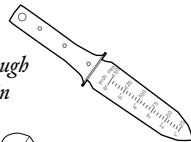
Shears
Use: Cutting/pruning branches



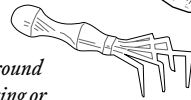
Tarp
Size: At least 2m x 2m
Use: Pile and transport material.

OPTIONAL (but useful)

Hori-hori
Use: cutting through roots or digging in compacted soil.



Handrake
Use: clearing ground debris for planting or seeding.



ORGANIC

Purchasing plants

- Buy small plants (Principle 1).
- Return or reuse plastic nursery containers.
- Inquire about wholesale or bulk-purchase discounts.

Donated plants

- Look for people/organizations already growing plants for/in similar conditions.
- Find out what is available and what could be donated.
- *Note: Look for plants grown in similar conditions to your site. For example, plants used to a harsh, salty climate will be more likely survive on a similar site.*

Transplants

- Identify existing thickets that could be divided and transplanted.
- Leave in place desirable species that are already thriving on site.

Compost + Mulch

New planting will benefit from a shovel-full of compost in the planting hole. Ideally, mulch and compost should be by-products of any garden landscape meaning there is no need to buy them. If you cannot produce your own:

- Inquire with nearby farms for large quantities of compost. For initial planting you will likely want more than any household can produce.
- If compost must be purchased, be sure to look at the plants growing around or in the pile to avoid bringing aggressive species on site (and no peat!)
- Coffee chaff also makes excellent compost/mulch and is often free from local coffee roasters.

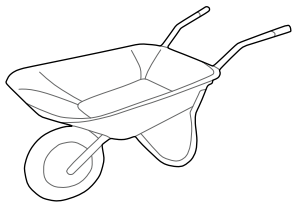
Mulching the area around new plants will also help the soil retain moisture and suppress aggressive species.

- Wood chips from tree and shrub pruning as well as raked leaves can be piled up to sit and ferment for a year or two. This makes excellent mulch.
- Often, tree removal companies will have large quantities of wood chip available. Ask for already decomposed material from the bottom of the pile.

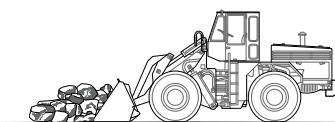
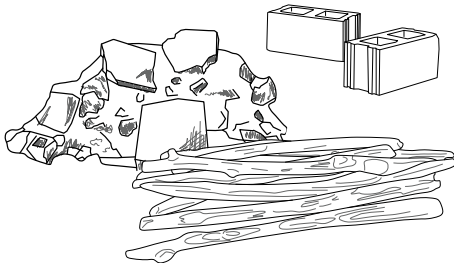
Displaced beach stones transplanted back on site to use as wave attenuation berms.



Stone or aggregate may be needed (paths, parking or erosion mitigation); in some cases wood and mulch can be used for paths.



OPTIONAL (but useful)



Backhoe or other large professionally operated equipment for large material.

Planting Medium

- Notice what plants are already growing in, on your site and adjacent or comparable sites (soil is just one of many planting media).
- Rather than buy topsoil, consider mixing compost (or decomposing organic material like leaf mulch) with whatever aggregate, sand, clay, or loam, you dig up on site.
- Plants will often grow in even the poorest conditions; many prefer it.

Tree material (branches, brush, driftwood, logs)

- Keep and reuse tree material to avoid hauling it off site.
- Branches and brush can be stacked between posts to create walls.
- Driftwood and logs can form barriers or be wedged into embankments.

HARDSCAPE

Gravel for walkways, base for berms, or as planting medium

- Determine what kind of gravel, small aggregate, or crushed stone is available locally, from quarries or recycled from other projects or construction sites.
- Permeable materials slow surface runoff of water and allow it to be absorbed into the soil. Often, this material is also a good planting medium since it drains well.
- *Note: The pH of your gravel can affect what plants will grow, limestone is extremely alkaline and there are far fewer plants that can tolerate extremely alkaline conditions.*

Larger pebbles, stones, and boulders for barriers, seating.

- Source from local quarries or from demolished/recycled infrastructure or construction.
- Mix recycled material like crushed concrete with other aggregates to become planting medium.
- *Note: Machinery is required to transport and spread heavy material. A skilled operator will be necessary for most volumes of hardscape material.*

PROGRAMMATIC

- Look for neighbouring or municipal sites donating seating and tables.
- Use existing materials like driftwood or concrete blocks to make seating, delineate parking, or create protective barriers.
- *Note: Avoid the impulse to fill the site with stuff (lighting, trash bins, signage, sculpture, umbrellas).*

Once you know what plants, materials, equipment, and assistance is available, you can begin to design and plan. There is nothing wrong with simplicity, with making use of existing features and qualities. Just as you might leave a happy and healthy tree, consider leaving an existing driveway or concrete footings. For example, there is no reason to clear vegetation and compact one area if another is already level and compacted.

Move regularly between drawing on paper and laying out in situ; something that seems very large on paper might feel very small on site, or vice versa.

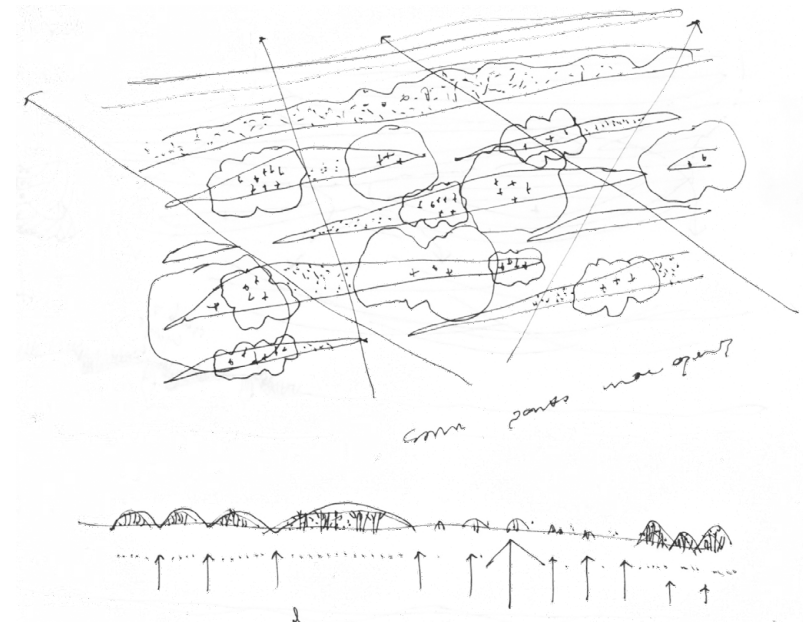
The following features should be designed, their locations and specifications determined:

ACCESS + CIRCULATION

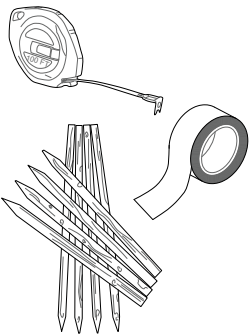
EROSION + FLOODING

PLANTING

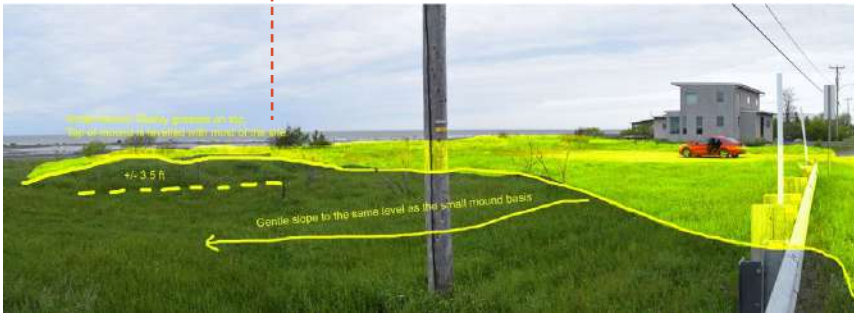
SCHEDULE



The sketches (above) and (far right) show the process of designing access points and view lines. We moved between drawing on paper and the computer, and laying the design out on site with stakes and tape (right).



Use your phone to design in situ. Drawing over a photo can help you imagine new possibilities.



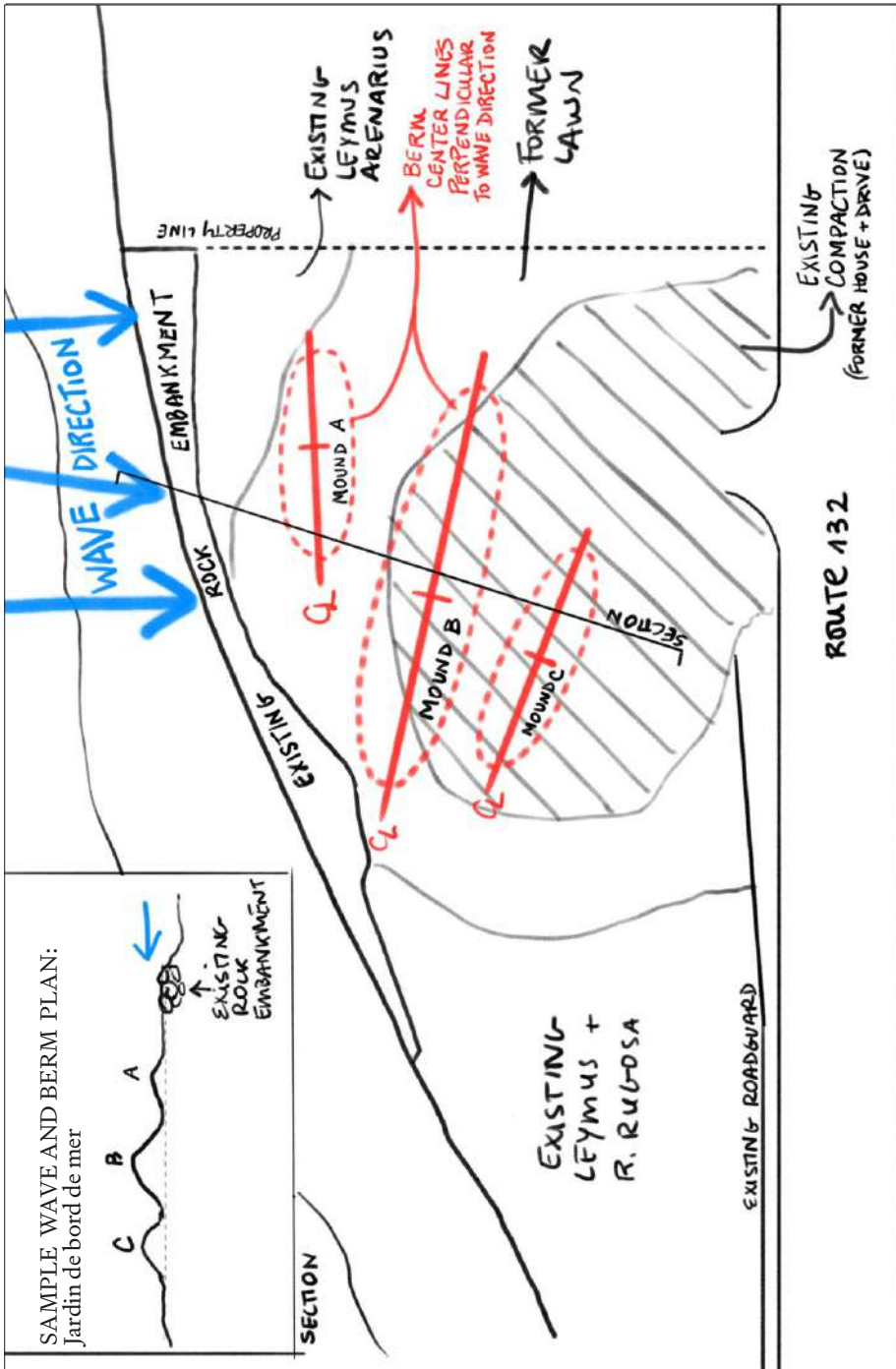
The design for the first of the two pilot sites utilized existing parking and access points in order to limit soil compaction and the need for demolition and new materials. (Right) Measuring and annotating dimensions for parking.

ACCESS + CIRCULATION

Question: *How will visitors and caretakers view and access the site?*

1. Locate a vehicle entrance and parking.
2. Limit traffic to areas of existing compaction (where nothing is growing, where there was a house or driveway).
3. Identify and protect pedestrian entry points.
4. Identify picnic areas and places to safely access the water.
5. Driveways or parking areas should drain away from water.





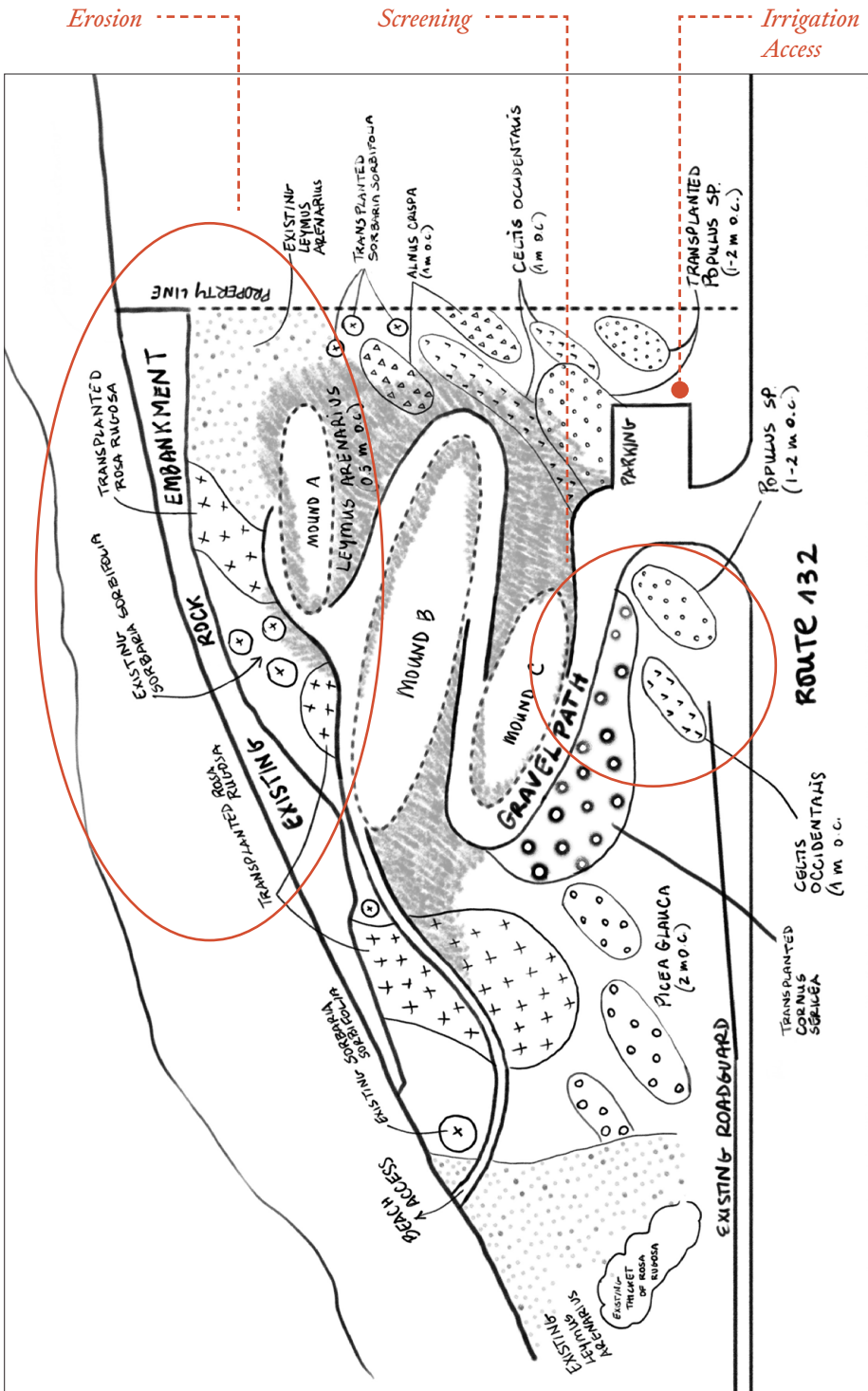
EROSION + FLOODING

Question: *Is flooding and/or erosion on your site the result of wave action of runoff (drainage across the surface)?*

For example, at the Métis pilot project, major shoreline erosion is due to wave action.

1. In the case of flooding and erosion from wave action, locate berms, mounds, or drifts of woody plants perpendicular to the direction of the wave action.
2. Material for berms could include rocks or pebbles, large boulders, recycled construction materials, or driftwood.
3. Calculate the approximate footprint, volume, and tonnage for your berm(s).





PLANTING

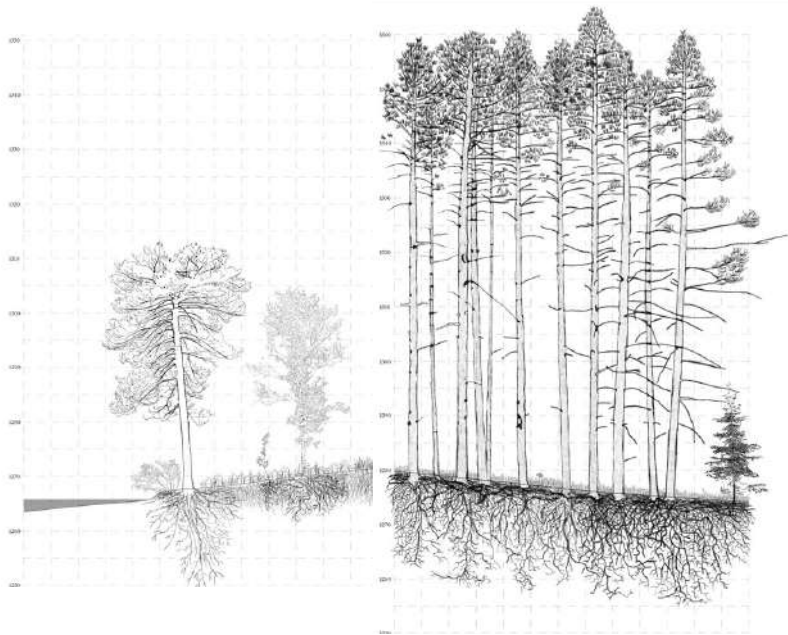
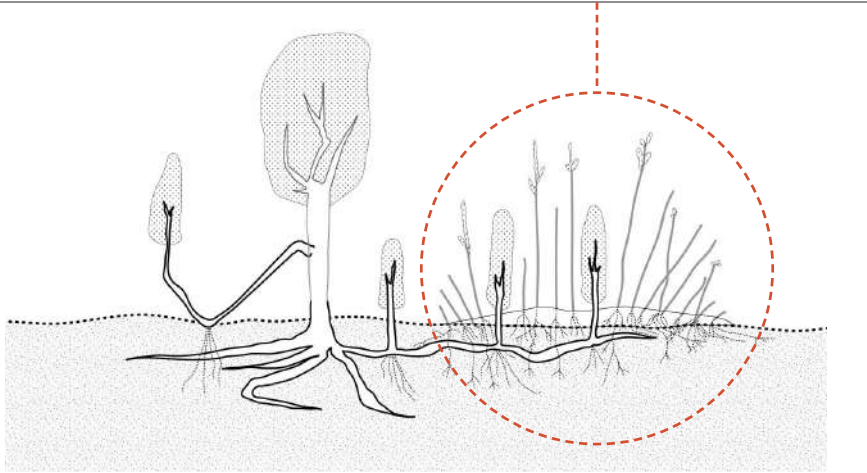
Locating planting areas

Question: *Where will plants establish and thrive?*

Note: Revisit site conditions (Research + Planning)

1. Identify environmental conditions.
 - Wet/dry: Where does water accumulates? Where does it run off quickly?
 - Sun/shade: Where does light comes from and how does that change through the seasons? North and south facing slopes might require different species.
 - Hardiness zone/climate: How long is the growing season? How cold is the winter?
 - *Note: Plants that like to keep their feet wet can live in low areas while plants that like drier conditions and well-drained soils should be on slopes.*
2. Locate unstable ground.
 - Woody, thickening plants should be used to manage erosion.
3. Identify views to keep open and views to screen.
 - Fast-growing plants will provide quick cover.
4. Determine irrigation capacity of the site and requirement of the plants.
 - We recommend selecting plants that do not require ongoing irrigation once established.
 - Access to irrigation will be very useful during installation and the first year of maintenance.
 - *Note: All plants require water when planted, smaller plants will need less.*

Root behaviour below ground and new woody material sprouting above ground following disturbance.



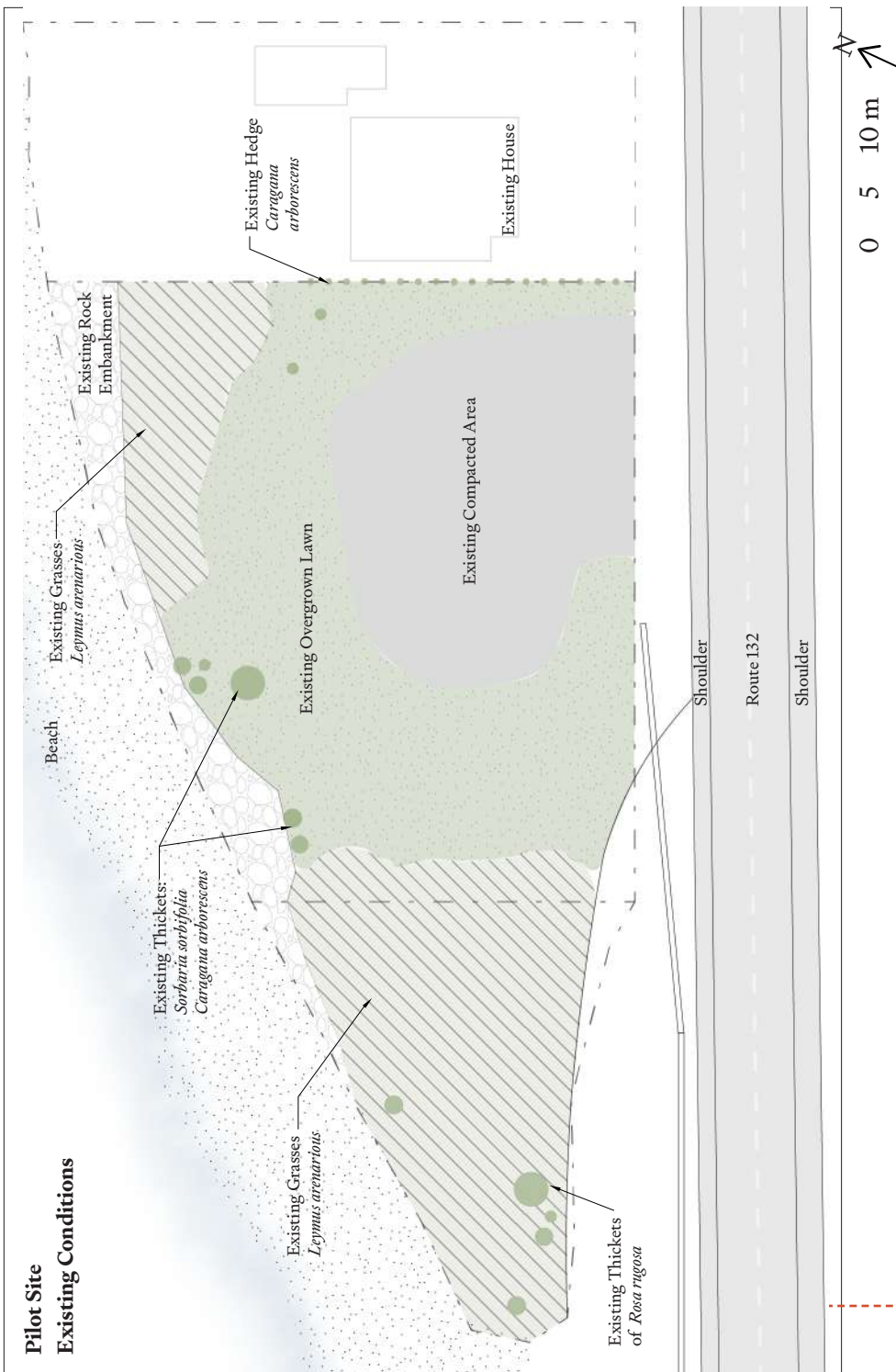
(Bottom) Example of how a tree, in this case, red pine, can develop a very different form depending on its context. On the left, the pine grew in full sun while on the right, the tightly spaced pines had to compete for light.

PLANTING

Plant Behaviour

Question: *How can you work with plants?*

1. Plants are not static or fixed, in form or location.
2. Plant form (morphology) changes depending on environmental conditions and disturbance.
3. Disturbance can include storms and flooding, fire, pollution and construction, or pruning and transplanting.
4. Plant behaviour includes patterns and methods of growing and reproducing.
5. Thicketing woody plants react to broken or cut limbs by sprouting new shoots and suckering from the roots.
6. Tightly spaced seedlings will compete for resources, growing narrow and tall, while lone individuals can spread their branches grow in width.
7. Plants make space through their behaviour over time.
8. Understanding plant behaviour will help determine how many plants you need, how far apart to plant them, and how quickly they will grow and spread.
9. The same plant can grow many different ways, depending on how it is planted and how it is disturbed.



PLANTING

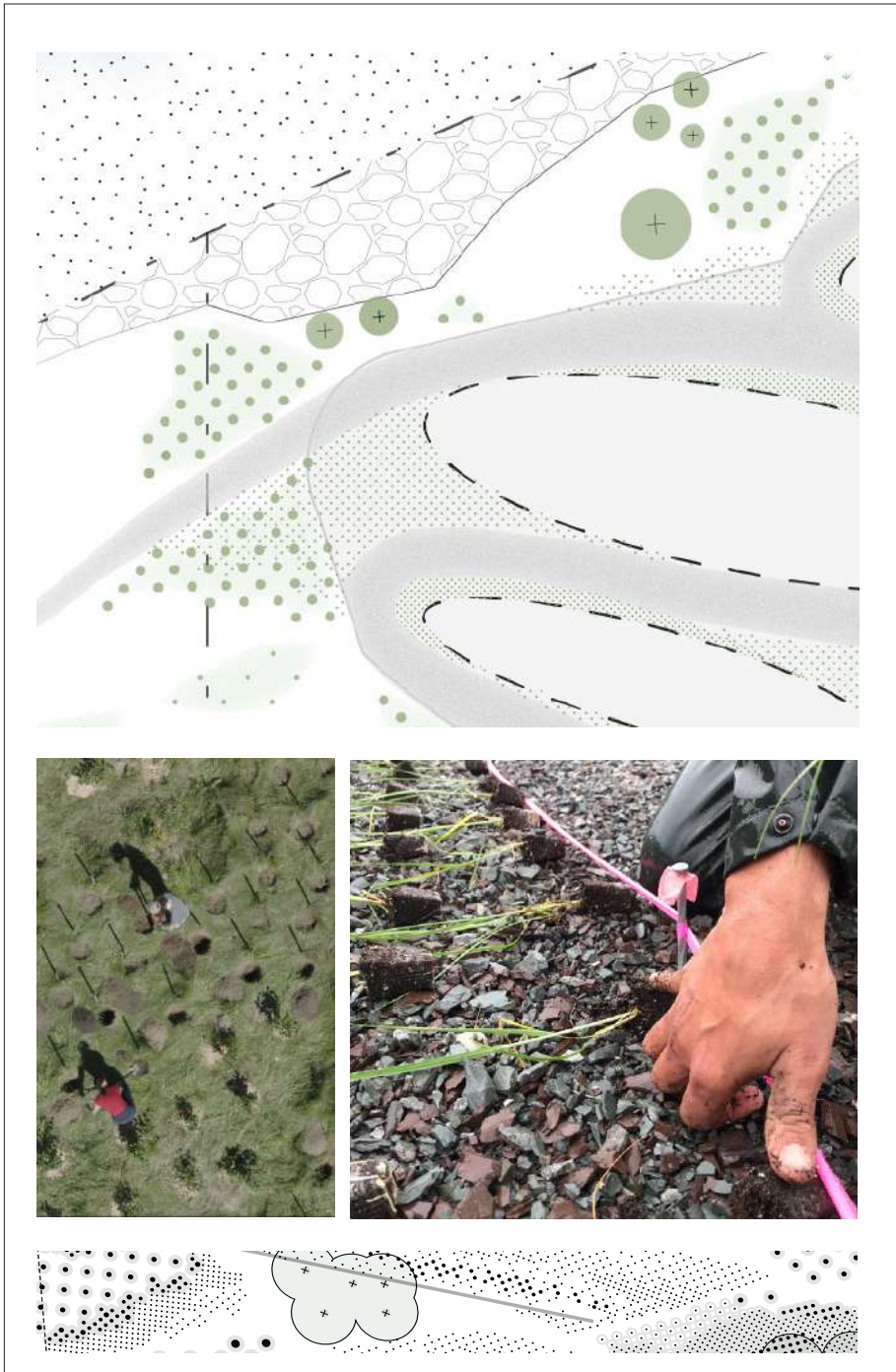
Plant Selection

Question: *What plants will be happy on site?*

1. Woody, thickening transplants:
 - Tough and will cover ground quickly.
 - Will hold soil or aggregate, stabilizing slopes and defining shapes.
 - Ideal adjacent to shoreline riprap or a seawall.
 - Resilient against the forces of wind and will catch debris thrown up by wave or wind action during storms.
 - *Note on finding transplants: Locate transplants in places that are difficult to mow (i.e. ditches, fence lines). Flag transplants with brightly coloured tape. Look for clumps under 60cm tall and wide for a more manageable root ball size.*
2. Individuals / nursery grown trees:
 - Can eventually provide shade.
 - Are the least resilient against erosion when planted as individuals.
 - Should be planted in protected areas. For example, away from the shoreline or behind berms.

Map the locations of existing plants, plant communities, and compacted areas to determine where new plants and transplants will thrive.





PLANTING

Planting Plan + Spacing

Question: *How many plants and how far apart?*

1. Design and plant individuals in grids.
2. Transplanted thickening clumps can be planted in drifts, diagonal groupings that will spread over time.
3. Spacing will depend on a given plant’s anticipated growth rate and desired form.
 - *For example: An oak tree might be capable of attaining a 50’ spread; this does not mean it needs 50’ of spacing to grow. Oak seedlings planted 2’ apart might one day appear to be one tree with multiple trunks; oak seedlings planted 10’ apart might grow to be tall and narrow with fewer low branches.*
4. Individuals that are vulnerable until established (like the grasses shown left) should be planted close together for protection.
5. Species guides or local nurseries can provide general rules for spacing and growth rate for different species. Keep in mind these guides are generalized and it’s important to understand how a plant might behave on your site.
 - *Note: Larger plants experience transplant shock. 4” and 1” caliper trees planted at the same time will be the same size after 5 years. Also consider the size of the hole you will need to dig, or the size of the rootball you will need to excavate and transport.*

Notes on planting in grids:

Plants are living, dying, moving, ever-changing, a tantalizing and unstable variable in any design. Starting with a grid, an array of points at a set distance from each other, creates a stable base which will immediately deform as the plants grow and change. Draw or imagine a field of points across your site and remove them to reveal paths or clearings. Consider changing the tightness of your grid in different areas, depending on how you want plants to grow.

SCHEDULE

When to do what.

1. It is important to know your site in all seasons.
2. Give yourself at least a year to learn what grows where, when plants emerge, when views become open or hidden, when storms or flooding happen.
3. Planning and design are a great winter activity.
4. Give yourself at least 6 months to grow plants.
5. On site layout and hardscape installation should happen during a dry season and avoided during the storm/flood season.
6. Only use heavy machinery when the ground is frozen or dry, never when muddy or saturated.
7. Herbaceous plugs should be started in the winter for spring planting while seeds can be sown in the late fall to stratify through the winter and germinate in spring.
8. Locate woody thickets for transplant during the spring or summer but do not dig until fall.
9. Woody plants can be planted in the spring (before the heat of summer) or fall and transplanted in the fall (before the first freeze) to quickly go dormant and establish new roots the following spring.
10. Irrigate at the start of the growing season (once buds break) and during warm months. Irrigation can stop once weather cools.



(Top) Herbaceous plugs grown by the Reford Gardens Horticulture Team

(Left) Transplant identification in summer for fall planting

(Right) Salix cuttings grown by the community



Step 03

Implementation
Installation
Long-term care

Salix discolor



(Top) Pilot site year one immediately after install.
 (Bottom) Site in year two after only one year of growth.

The following chapter will guide you in the construction of your project. This recipe is not meant to be prescriptive but, as with the rest of this manual, a general guide for you to use and modify based on your ingredients and desired outcome. You will find here the steps for our built pilot project. Feel free to skip steps if they are not relevant to your site. For example, if you don't need gravel paths or wave attenuation berms skip "A. Hardscape." Your project may also contain steps inspired by but not described in this section.

A. HARDSCAPE

B. FLOODING / EROSION MITIGATION

C. CIRCULATION

D. SOIL PREPARATION

E. PLANTING

1. Plugs
2. Transplants
3. Pots
4. Bareroots and Seeds

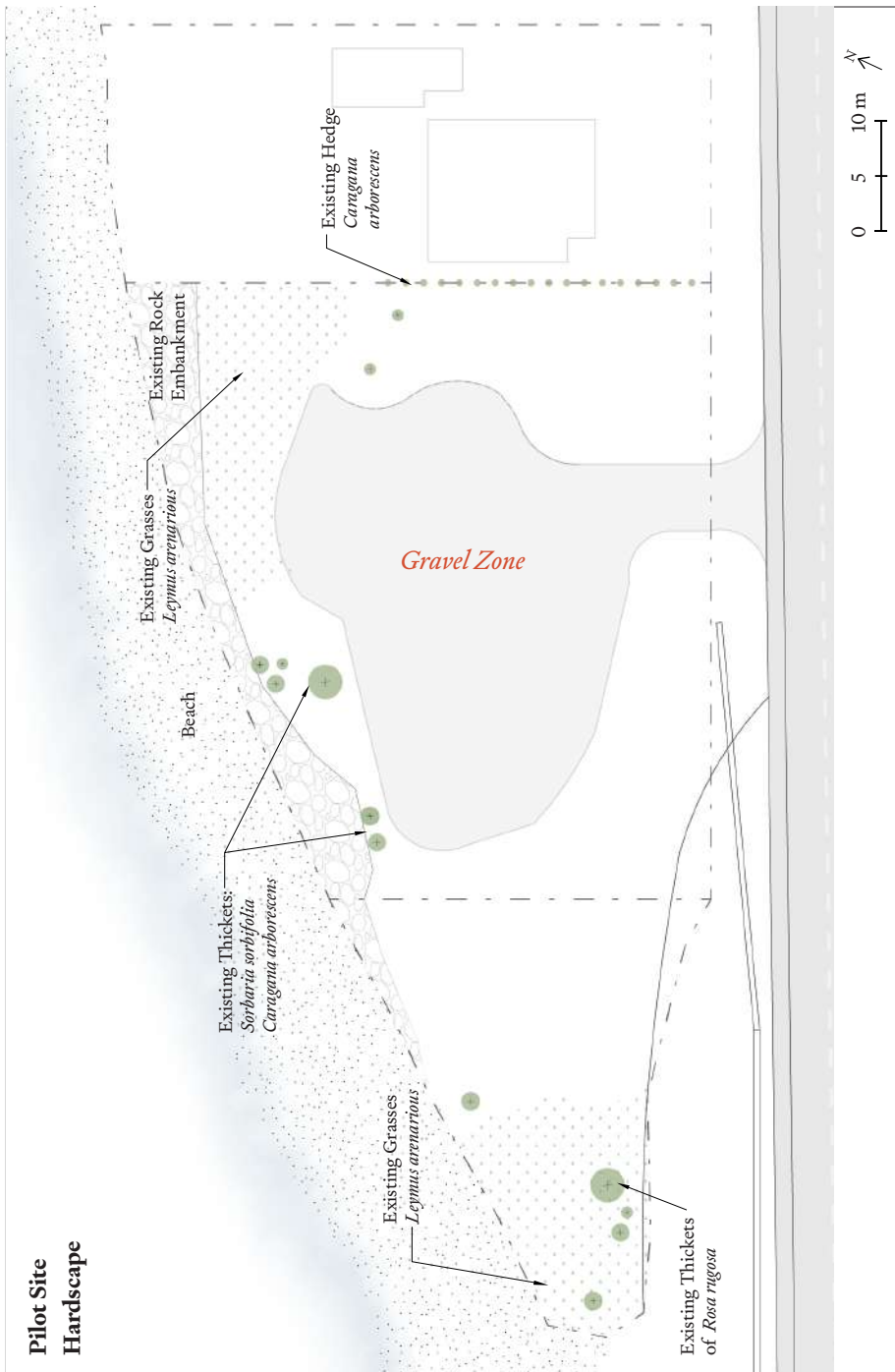
F. MANAGING VOLUNTEERS

G. DOCUMENTATION

H. LONG-TERM CARE

1. Seasonal Maintenance
2. Aggressive Species Management
3. Post-Storm Event Response

A. Hardscape Plan



A. HARDSCAPE

Note: If you don't have access to heavy machinery to create a gravel zone and berms, skip directly to C. Circuation.

Initial Layout:

1. Layout the hardscaped areas as you had planned with tape, string, spray paint or stakes.
2. Now adjust your design! The design you drew on paper should adjust to the conditions on the site as opposed to adjusting the site to the design.
3. Before grading or spreading gravel make sure to locate any plants you want to protect or move. If a large thicket coincides with the gravel zone, adjust the gravel zone to keep the established plants.

Gravel:

4. Fine gravel is the recommended base for walking paths, parking area, furniture, and berms rather than poured concrete or asphalt as gravel provides better drainage.
 - Use stakes, measuring tapes, and ribbon or string to mark area for fine gravel. Precision is not necessary. Use the tools you have and approximate areas (images on following page).
5. Unload the gravel and spread it with the help of local partners and heavy machinery if available. (*Note: Some light compression/grading may be needed before moving onto the next step*).
 - Once the finer gravel is spread, remove the stakes and ribbons. Keep them for the next steps.

Note: If there is large programmatic material (picnic tables, playground equipment) it should be placed on site before planting.

Laying out and placing gravel / hardscape

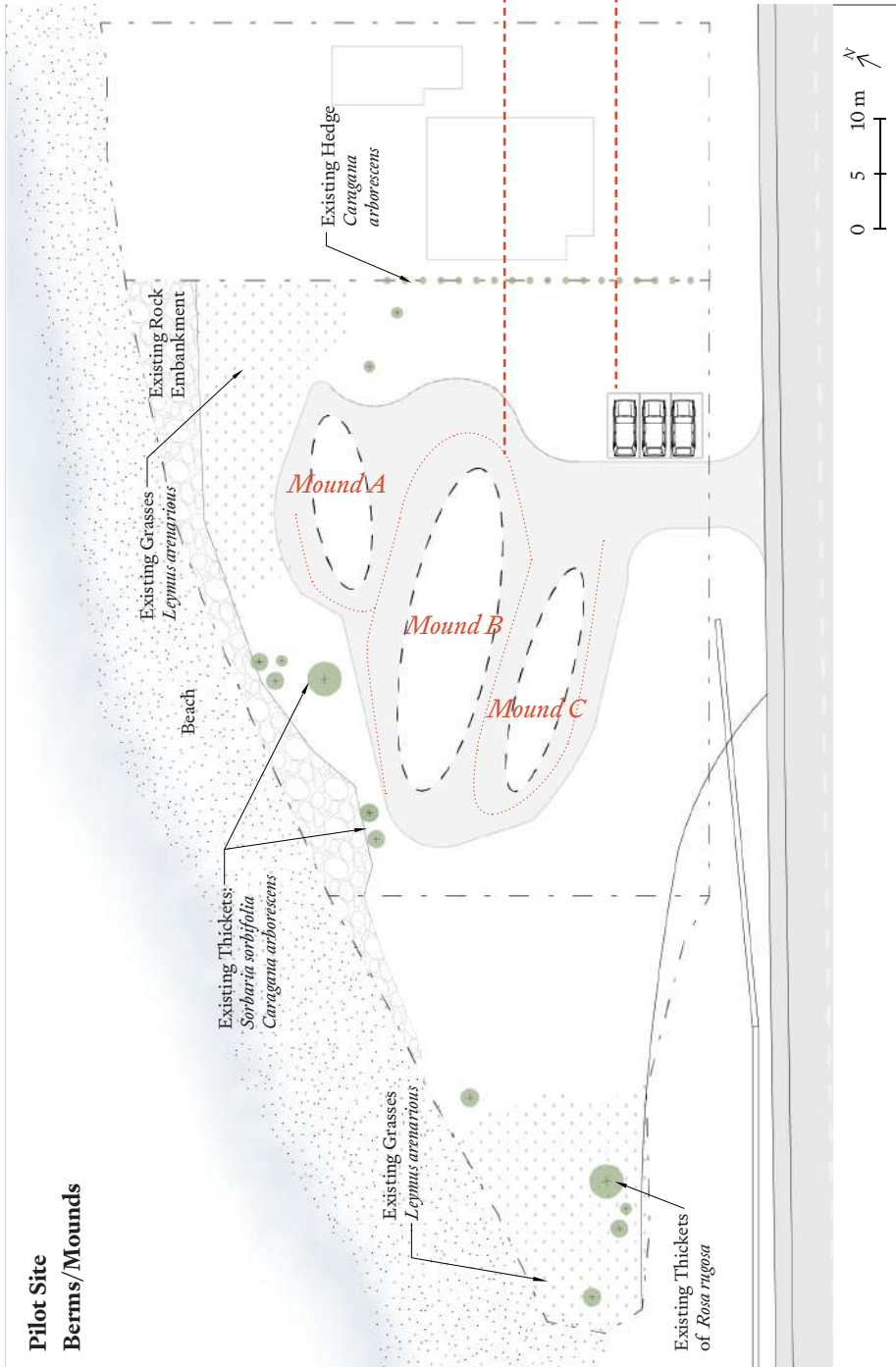
Once the gravel zone is tapes and staked (Above), trucks should place material for spreading nearby but not on top of gravel. Use machine or hand tools to spread fine gravel.

B. FLOODING / EROSION MITIGATION

1. Reuse the stakes, measuring tape, and ribbon from A to delineate the berms on the gravel zone.
 - Locate berms from the original plan, then adjust them based on the “as-built” dimensions and location of the gravel zone. Remember to keep the berms perpendicular to wave action.
 - Walk the site and find views you wanted to frame or screen.
 - Once all berms are marked, walk the envisioned path and adjust the berms as necessary. Repeat.
 - Once location and scale are set, measure and mark the two axes of each berm along with the high point.
2. Unload aggregate and pebbles to shape the berms
 - This is when you may use of heavy machinery if available.
 - It is OK for the material to spill out into the path, they will shift overtime as they settle and with disturbance.



Walking Path - - - - *Parking Area*



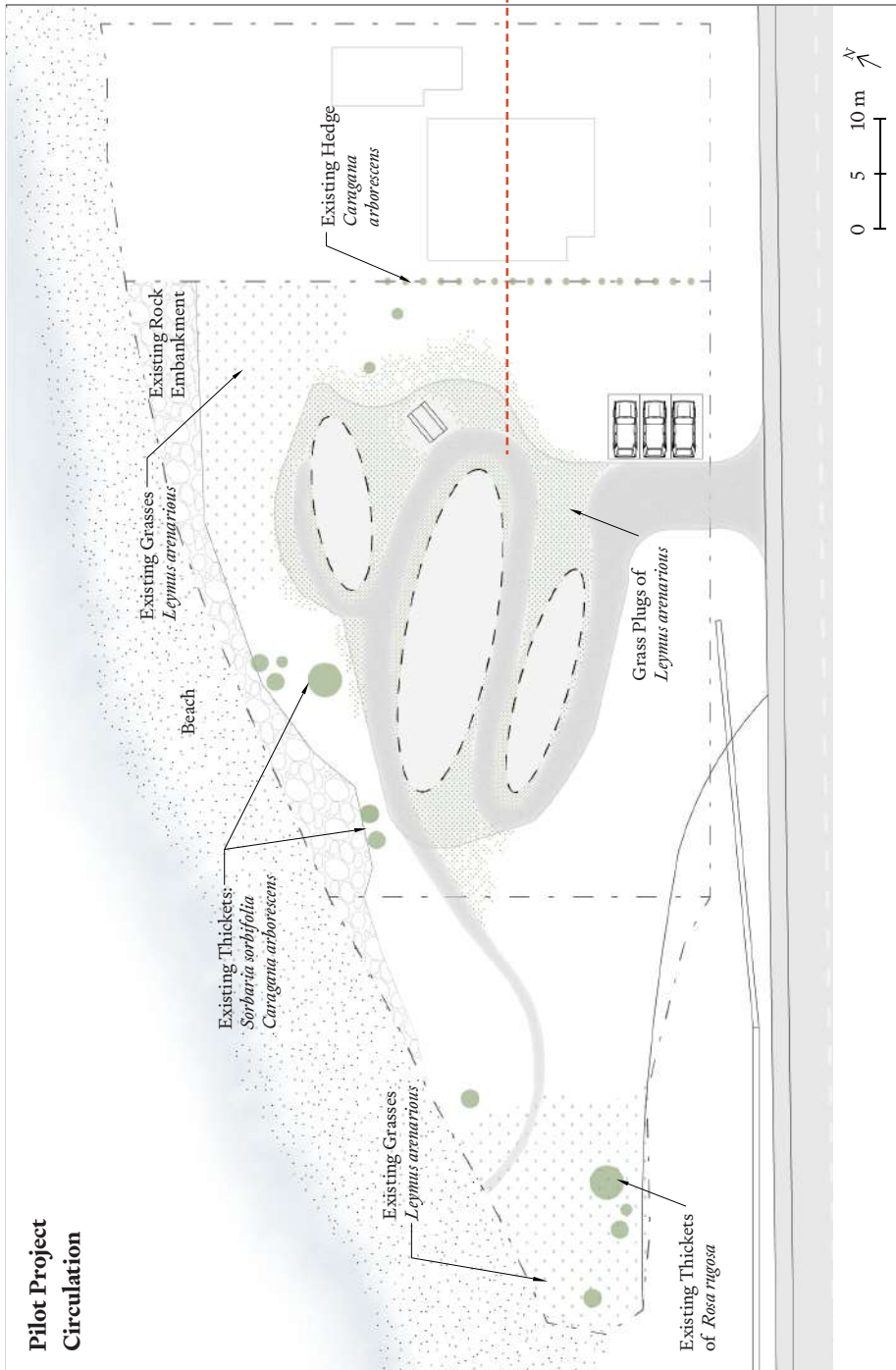
C. CIRCULATION

1. Reuse the stakes, measuring tape, and ribbon from A /B to delineate the circulation.
 - Circulation includes paths for walking, maintenance, parking and access.
 - Use whatever materials are available. This could be gravel and stone, wood chips, or tree branches for corduroy paths.
 - *Note: Plants should not generally be placed within circulation paths.*
2. Place and spread circulation material
 - This will need to be done by hand and require smaller machinery

D. SOIL PREPARATION

1. If you intend on planting in compacted soil, consider adding a layer of compost or leaf mulch, or breaking up the ground mechanically and mixing in the organic material.
2. Avoid fertilizers and chemical amendments. Most plants are actually used to nutrient-poor conditions.





Edges of paths will eventually be defined by plants

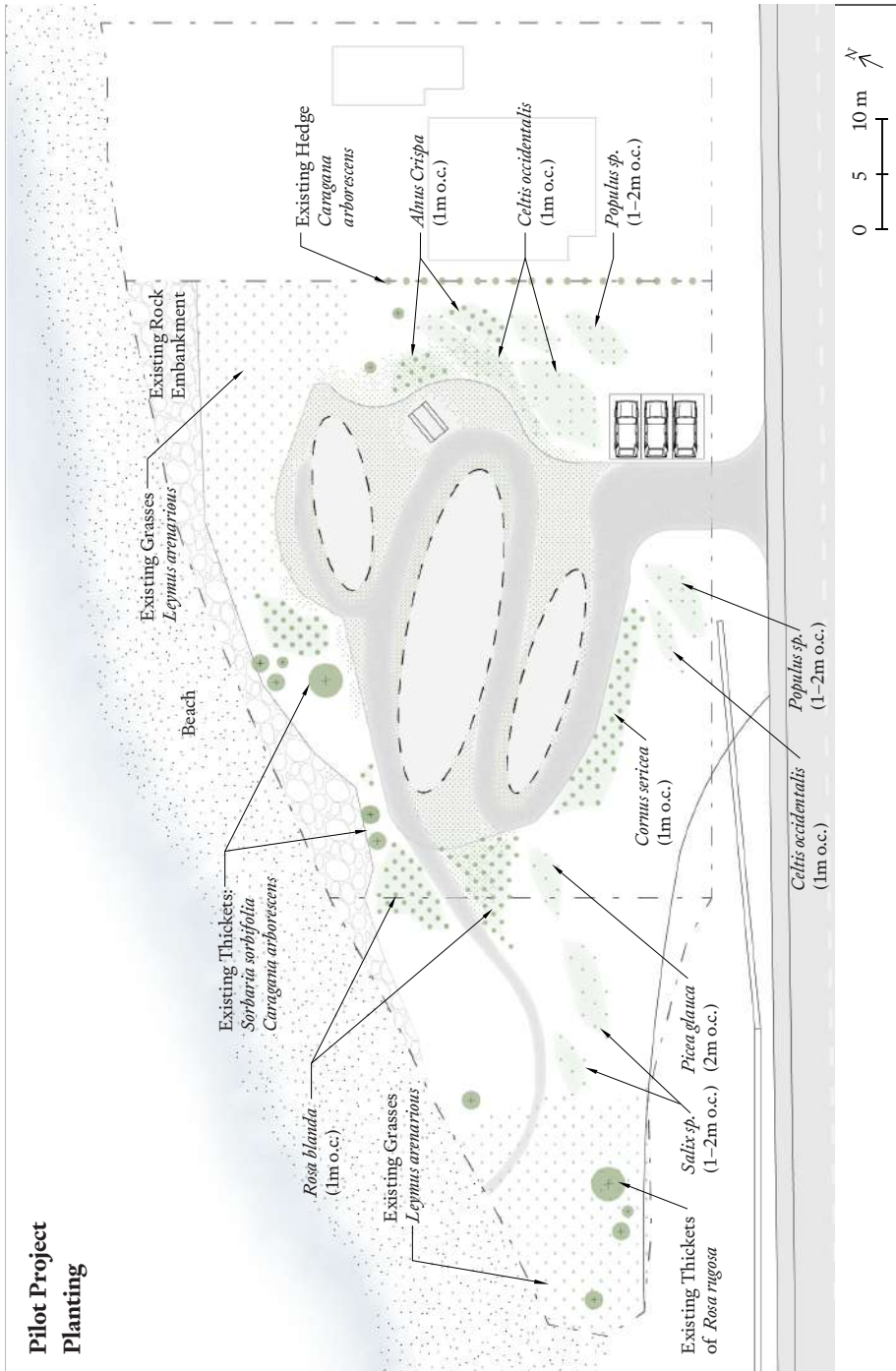
E. PLANTING METHODS

1. Plugs
2. Transplants
3. Pots
4. Bareroots + Seeds

1. Plugs
 - Layout in grid and planted into soil/gravel with a hand tool such as a dibble, trowel, or hori-hori.
 - Plant the berm slopes on opposite (protected) side of wave action.
 - Water the plugs before laying them out to prevent roots from drying. In general it is best to get the plugs into the ground as soon as possible once they are out of their trays.
 - Lay out only small sections at a time to limit the roots' sun exposure.
 - Dust the plug holes with compost before planting if available.
 - After each section is completed, water substantially.



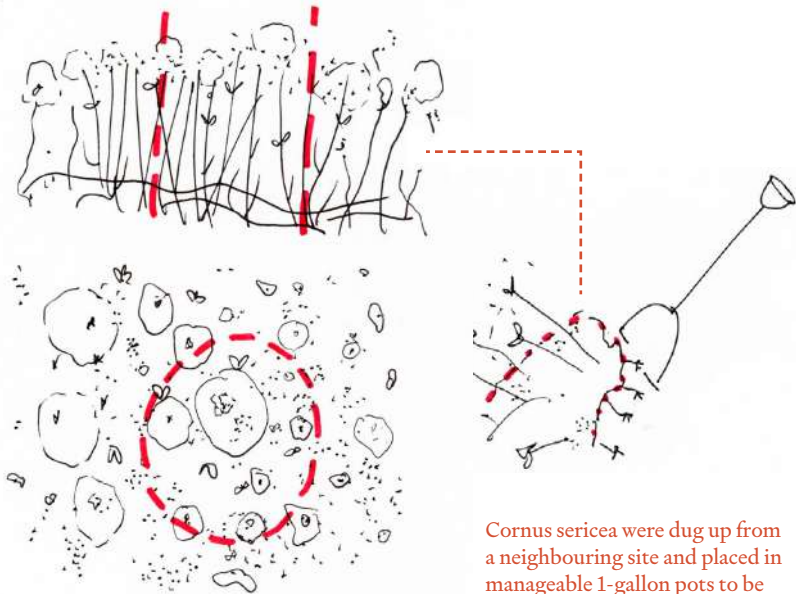
D. Planting Plan



2. Transplants

- Ideally, transplants should be planted the same day they are dug up.* If they need to be stored make sure to put the roots in a pot or wrap in burlap, set them in shade, and water regularly.
- Once on site, dig holes for transplants while trying to keep soil horizons separated. This means that if you dig a hole down to a sand or clay layer, infill that material first and then put topsoil over root ball. This is easier to do if you make separate piles when excavating.
- Fill each hole with water prior to planting.
- Once the plant is in place, backfill the hole and water profusely. The soil should be saturated.
- Add mulch around the transplants to help the soil retain moisture. Make sure not to mound mulch against the root flare or trunk.



Methods for transplanting...

Cornus sericea were dug up from a neighbouring site and placed in manageable 1-gallon pots to be planted.



Note on digging up transplants: Use a spade to cut through the primary roots and create a manageable area for removal. This should be done entirely by hand, as individual sprouting roots are loosened and cut out from the main clump. Size will vary. Large clumps can be lifted with a backhoe loader. Fill the disturbed area with wet mulch after removal.

3. Individuals (Pots)

- (See image on next page) When digging holes, try to keep soil horizons separated.
- Water in the hole before planting.
- Gently loosen a tight root ball with your hands before planting.
- Place plant in the hole so the base of the plant is level with the ground or slightly above (you do not want to plant the plant too low).
- Once the plant is in place, refill the hole respecting the soil's layers.
- Water the plants in, saturating the soil, before adding mulch (optional)
- If needed, add stakes windward to stabilize small trees.



*Preparing the ground for planting...**Soil Horizons**O— Organic Layer/
Humus—**A— Topsoil**B— Subsoil*

Saturate the planting hole
before planting.



4. Bareroot

- Soak bareroot plants planting
- Plant in early spring before breaking dormancy
- La Pépinière aux arbres fruitiers/Hardy Fruit tree nursery has a comprehensive guide for planting bareroot trees/shrubs:
- https://www.bardyfruittrees.ca/basics-of-fruit-trees-how-to-plant-a-bare-root-tree/?_ga=2.62245356.1722266814.1695217318-526000688.1695217318

Sowing seeds

- Seeds collected locally are best adapted to succeed on your site.
- Seeding can supplement plug planting or prepare an area for future planting. For example, you could seed a cover crop in fall and then interplant with plugs in spring.
- Prairie Moon Nursery has helpful guides for sowing seeds:
- <https://www.prairiemoon.com/faqs.html>



More on bareroot planting...

Dig the holes for all you bareroot plants before opening the bundle (above). It will reduce the time of sun exposure. Only 2 minutes exposed to the sun can kill the bareroot. Prepare a mixture of **3 part soil and 1 part water** to coat the bareroots before planting (right). It will reduce air pockets around the roots in the soil.

**Notes on watering / Irrigation in the first year after planting**Time After Planting Frequency

Week 1 and 2	Every other day
Week 3 to 12	Every 2–3 days
Week 13—onward	1 or 2 weekly

Watering frequency will depend on the weather. For example, you can skip watering after heavy rainfall but consider additional watering during drought. Make sure the soil has time to dry between waterings. If your soil retains moisture well, you may be able to water less frequently.

Larger plants will also require more frequent and deeper watering to reach the rootball. Water around the entire plant, pouring or spray from the main trunk or stems out and away to the edge of the drip line (the extents of the leaf canopy). It is best to water outside the sunniest times of day when much moisture will be lost to evaporation. Make sure water soaks into the soil and does not just run off.

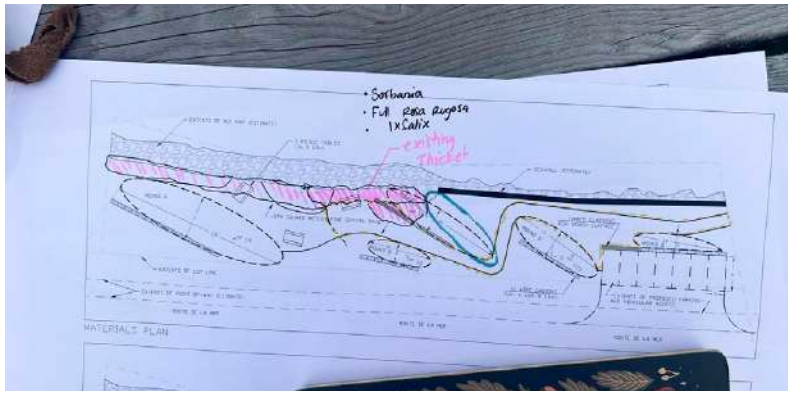




F. MANAGING VOLUNTEERS

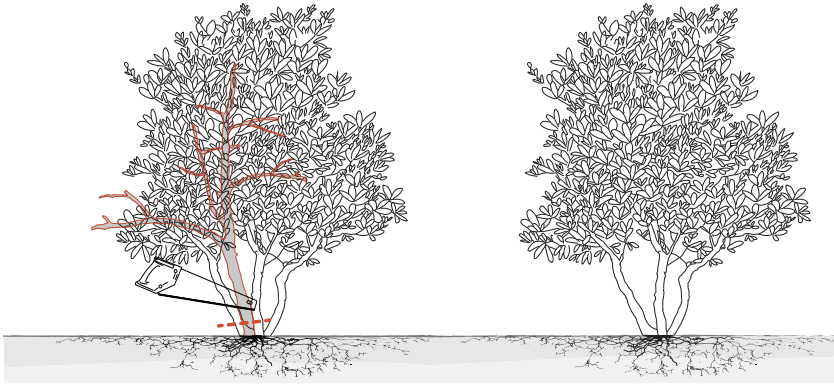
It is wonderful if your project installation can include neighbours and community members, the potential caretakers and users of the site. Your need for volunteers will vary greatly by the size of your site and the scale of the installation. In any case, including others in the design process is a great way to build community buy-in and educate others on your project.

1. Advise novice planters on appropriate clothing and equipment: wearing closed shoes (no exposed toes), dressing for the weather, gardening gloves, water!
2. We recommend assigning groups with specific tasks, organized by physical difficulty.
 - **Easy:** Laying out and planting plugs (must squat/bend)
 - **Easy:** Planting individual small to medium pots.
 - **Easy:** Documentation + photographs
 - **Medium:** Digging holes for transplants and individual pots.
 - **Medium:** Planting the transplants or large pots. Transplants are often unwieldy and the root ball may fall apart easily.
 - **Hard:** Digging out transplants. Team must understand the root system of the selected transplants to minimize damage. Some level of strength is needed to cut through primary roots and remove clumps. Care must be taken to keep root balls together and to refill hole with wet mulch.
 - **Hard:** Staking trees. Team must understand the direction of the main winds and techniques to safely tie rope around the tree.
 - **Easy to Strenuous:** Watering. Water is easy enough when your hose reaches the holes/area you are watering. However, in cases where buckets must be filled and then carried to holes the work becomes quite strenuous and may require frequent breaks.
3. Move from group to group throughout the day, making sure to be available for questions.
4. If possible, organize a treat for the end of the day to thank the volunteers.



G. DOCUMENTATION

1. Photograph process throughout.
 - Photographing plants will help show progress in the next following years.
 - You can also add a measuring tape in the photo or annotate with phone.
 - *Note: Drone photographs or footage can be useful for future site planning.*
2. Keep the sketches made on site and drawings of any adjustments.
3. Use any tools you have available to communicate scale or design intentions. For example, hands and feet can make great tools of measurement.
4. Keep a record of number, size and species of plants, volume of materials, hours per task. This will serve as a helpful baseline for future projects. These are some numbers for the pilot site:
 - 1908 *Leymus arenarius* plugs
 - 79 trees *Celtis occidentalis*, *Picea glauca*, *Populus spp.* (24 transplants and 55 individual pots)
 - 89 thicketing shrubs *Alnus viridis sb. crispa*, *Cornus sericea*, *Salix sp.*, *Rosa blanda*, (25 transplants and 64 individual pots)
 - 261 tons of beach stones
 - 285 tons of gravel
 - Planting time: 32 hours with a team of approximately 8 people.
 - Staking time: 9 hours per zone to stake with a team of 2 people.



Example: Pruning deadwood



(Above): After one year in the ground, *Cornus sericea*, left, responding to first year transplant die-back with multiple new shoots! Right, *Picea glauca* with nearly 30 cm of new growth.

H. LONG-TERM CARE

1. Regular seasonal maintenance

- **Winter:** Store anything light-weight or moveable before winter.
- **Spring:** Clean-up debris accumulated in winter. What new materials can you repurpose (i.e. driftwood?) Clean-up trash. Optional: Cut back grasses or seed heads to make way for new growth.
- **Spring/Summer:** Watering during the growing season (bud break to fall):
 - Year 2 and 3: water deeply 1–2 times/week, especially if there is prolonged drought.
 - After year 3: water only in the case of prolonged drought; however, the plants should be established at this point and able to withstand fluctuations in precipitation.
- **Fall:** Safety prune any branches at risk of breaking or falling before winter.
- *Note on planting: Transplanting existing plants or introducing new plants should happen in the spring or fall before growing season and after winter freeze.*

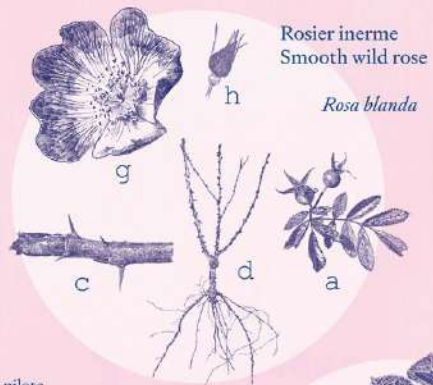
2. Aggressive species management

- Keep track of any new species on site for identification and monitoring.
- Take care when pulling anything from the roots. This disturbs the soil and can uproot adjacent small or delicate plants.
- Prevent root compaction by avoiding heavy machinery like lawn mowers.

3. Post-storm event response

- Rhizomatic plants should respond to disturbance with a flush of new growth so don't worry if woody plants have broken or look dead.
- It's OK if the berms have moved, changed shape, or even disappeared!
- Additional aggregate and stones can be brought to the site or displaced material can be raked or scraped back into a mound.
- Try seeding into the disturbed aggregate/soil.
- Use new materials that have washed onto the site to create new topography, seating, or habitat for plants and animals.

Jardin de bord de mer



Nous espérons que ce projet pilote inspirera une série de jardins similaires visant à revitaliser les berges grâce à la capacité des racines de plantes ligneuses à retenir le sol. Plus les plantes seront soumises à des changements climatiques sévères, plus elles fortifieront leurs racines en rhizome, qui deviendront ainsi un réseau dense et compact, offrant une alternative supérieure aux matériaux typiques de construction tels que le béton et l'acier. En effet, contrairement à ces derniers, les plantes choisies auront une espérance de vie supérieure en raison de leur nature vivante et de leur capacité à s'adapter. Notez que tous les matériaux et végétaux utilisés proviennent des environs et ont été en partie acquis avec l'aide financière de nos généreux donateurs.

a. branche b. fruits c. écorce d. racines e. chatons f. feuilles g. fleurs h. bourgeon



Plant side of the billboard designed for the pilot.

P