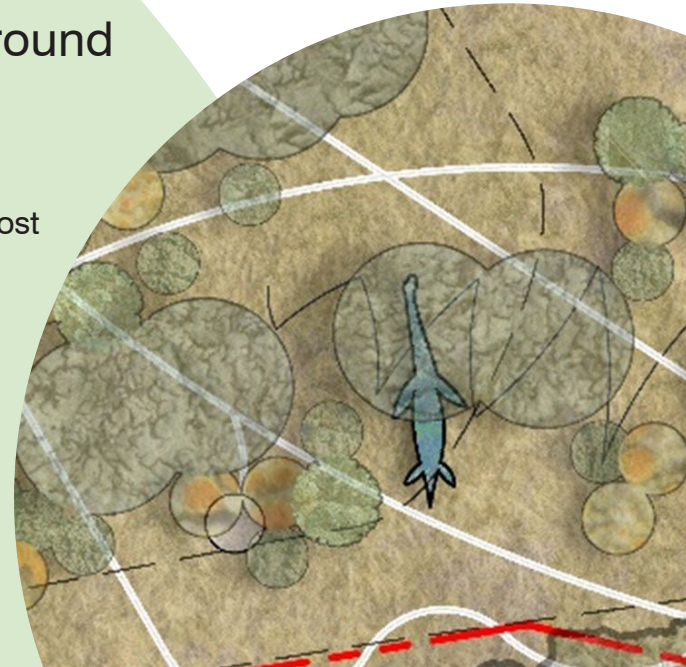
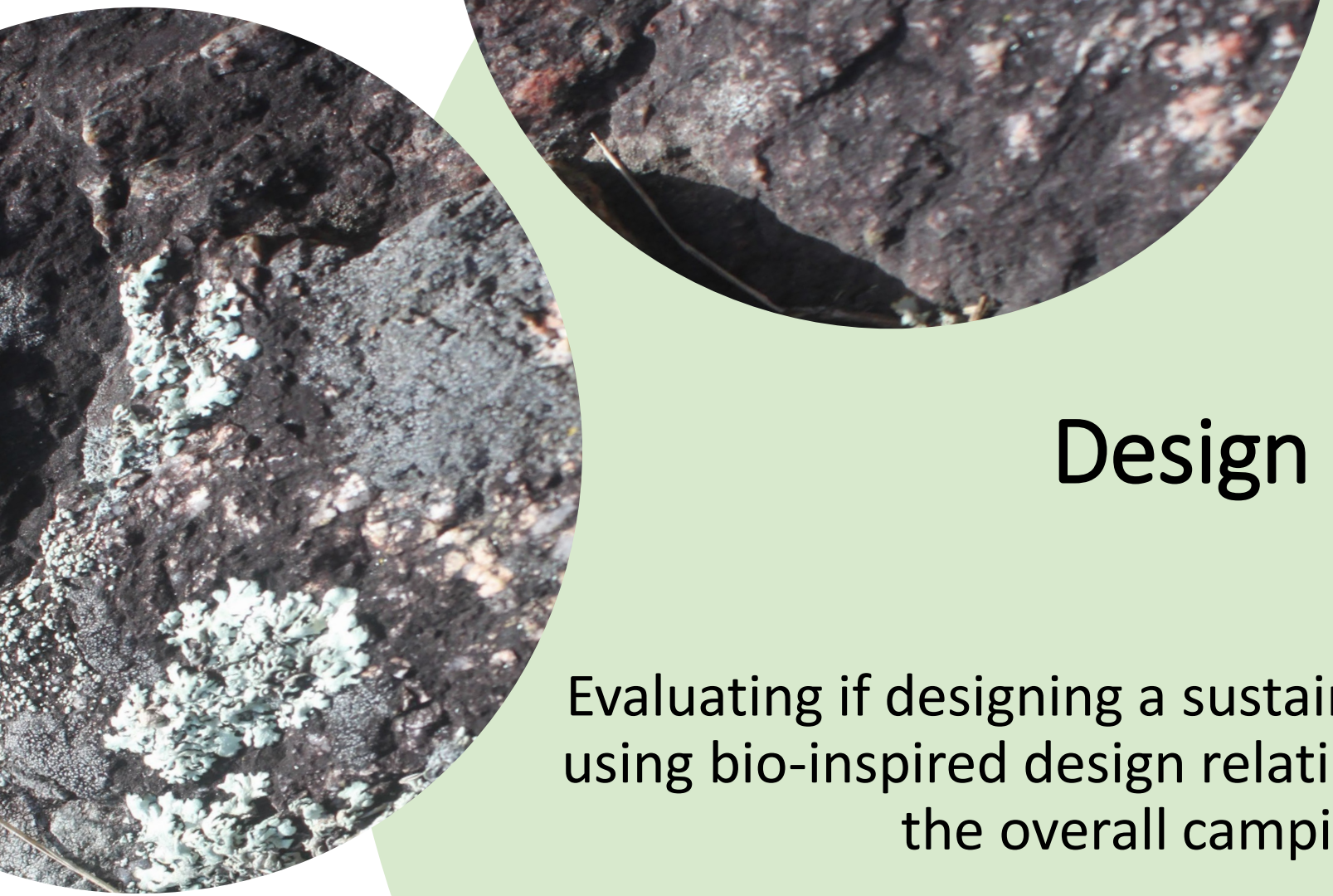
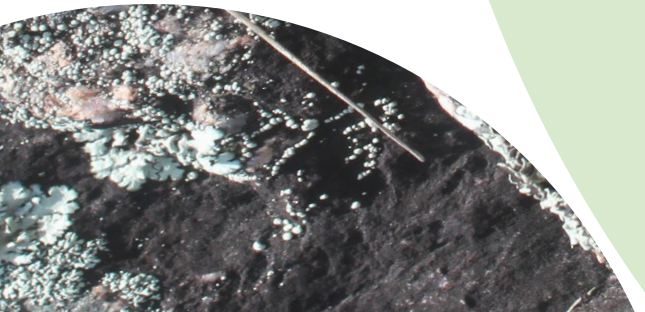
Sustainably Symbiotic

A Study Using Lichen Biomimicry to Design a Sustainable Multi- Use Campground in Cavalier County, ND.

Xantippean Lonewolf | LA 772 | Spring 2023 |Primary Advisor: Matthew Kirkwood | Secondary Advisor : Jay Kost







Design Intent

Evaluating if designing a sustainable multi-use campground using bio-inspired design relating to LICHEN is beneficial for the overall camping experience?

What is sustainable?

- The ability to be maintained at a certain rate or level.
  - Sustainable techniques
  - Sustainable agriculture
  - Sustainable methods relating to lifestyle.

What is sustainability?

Fulfilling the needs of the current generations without compromising the needs of future generations, while ensuring a balance between

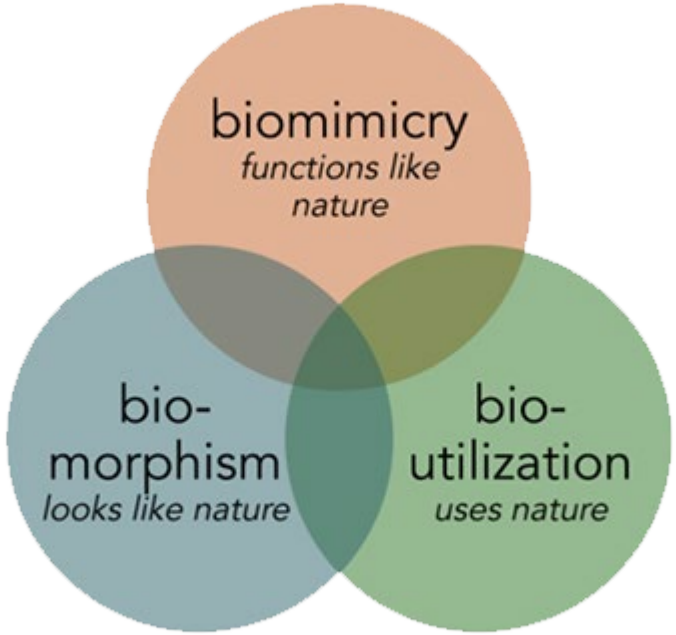
- economic growth
- environment care
- social well-being.

What is bio-inspired Design?

Taking an idea from nature and finding a way to improve on it for your own purpose.

What is biomimicry?

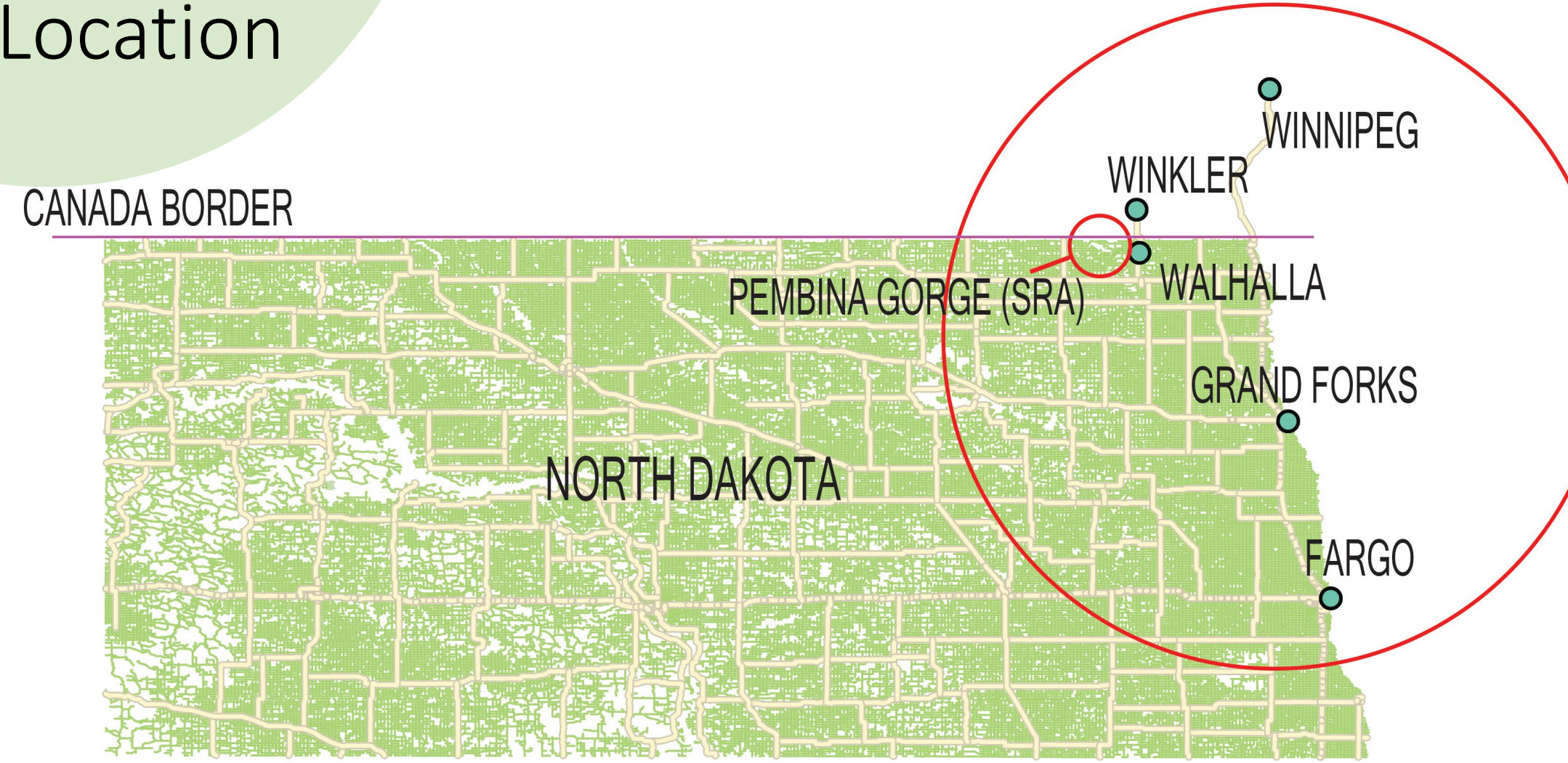
Copying directly from nature.



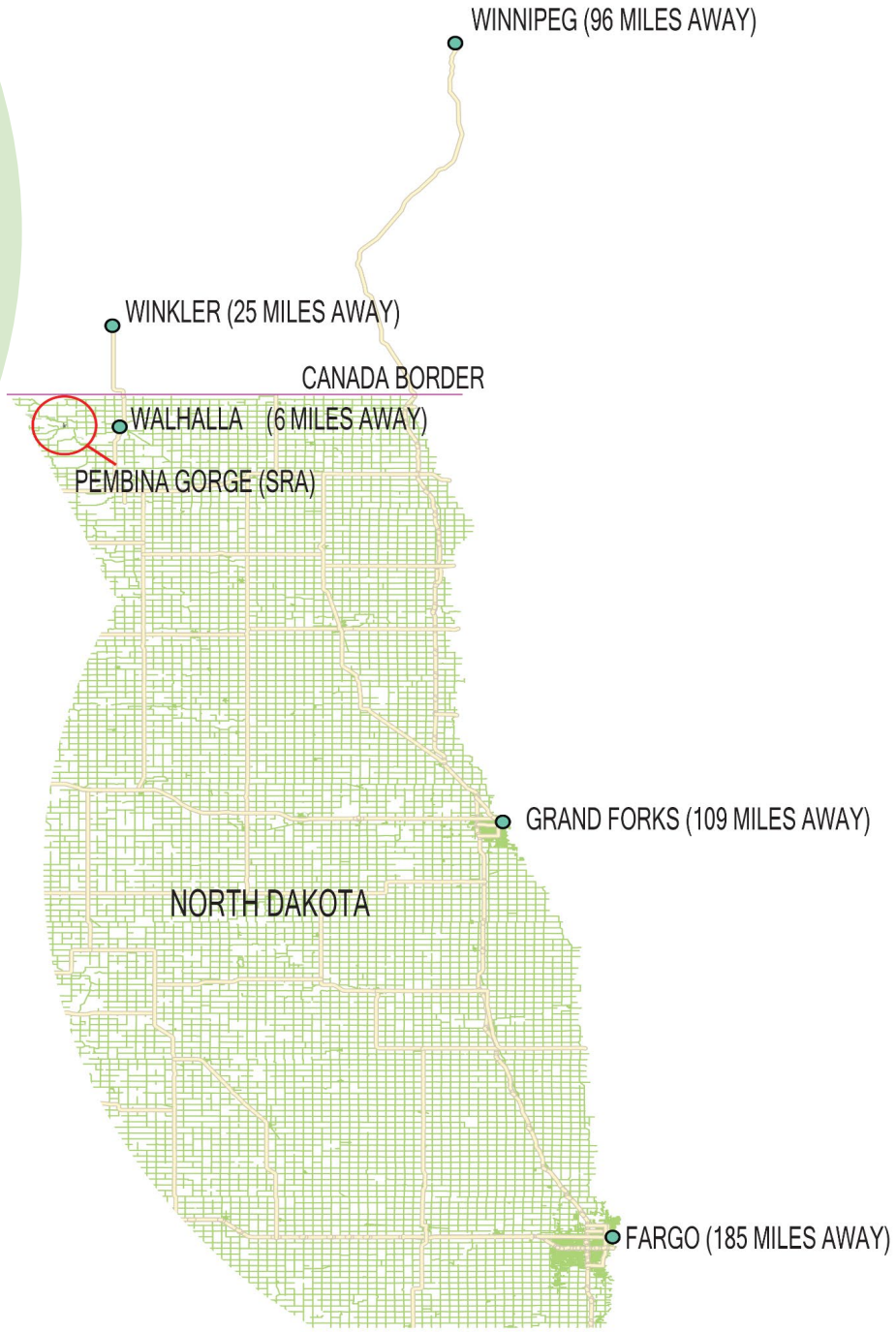
Three types of biomimicry.

1. Design (form and shape)
2. Process (ex. photosynthesis in a leaf)
3. Systems (mimicking at an ecosystem level like building a nature inspired city).

Site Location



Site Location



Site Location

PEMBINA GORGE (SRA)
(2 MILES AWAY)

FOSSIL DIG SITE
(3 MILES AWAYS)

105TH ST NE

121 ST AVE NE

PROJECT SITE

35 +/- ACRES

TETRAULT STATE FOREST
(5.9 MILES EAST)

WALHALLA 6 MILES EAST

PEMBINA RIVER

103RD ST NE

104TH ST NE

KAYAK LAUNCH

FROST FIRE PARK
(2.3 MILES AWAY)

WALHALLA COUNTRY CLUB
(.6 MILES AWAY)

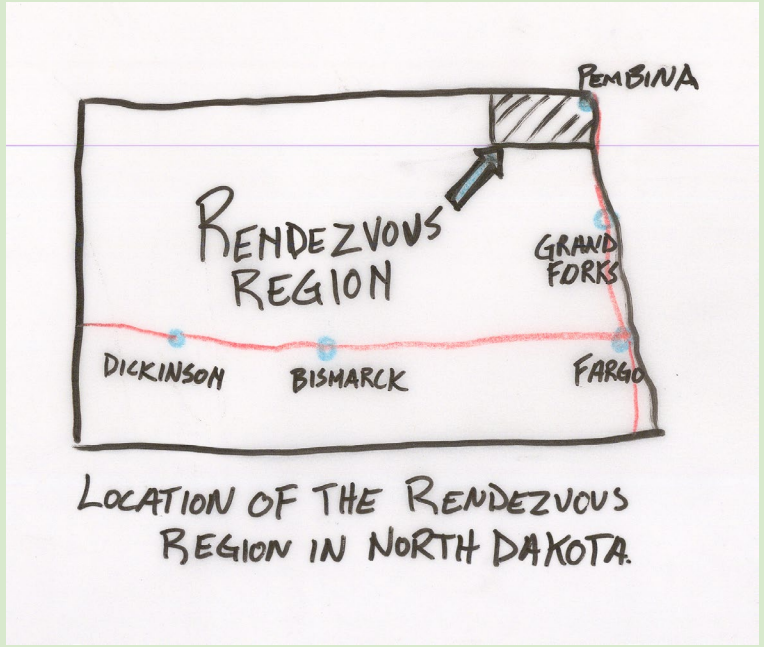
Why Pembina Gorge?

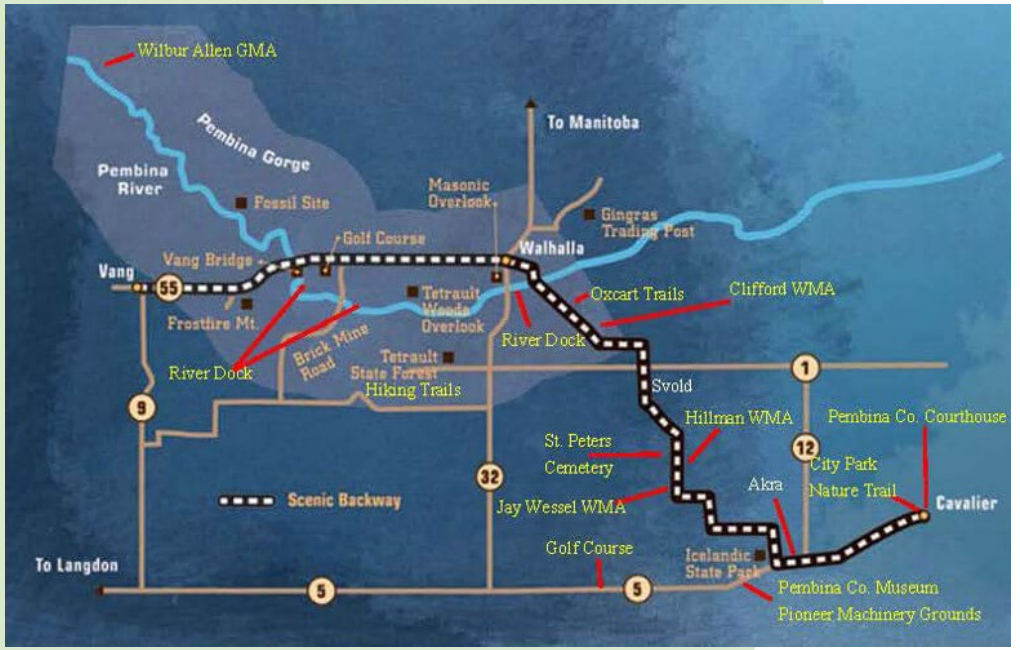
- Passion Project
  - Local project.
- Campground requested by community in 2014(different location).
- Project site has been underutilized state own land since 2012.
- Great location for potential economic growth regarding tourism and community building.

Site Conditions (09.22.2022)

Great Location

- Located on the established Rendezvous Region Northeast Dakota Scenic Backway.





What type of camping?

- Modern
- Equestrian
- Primitive

Case Studies

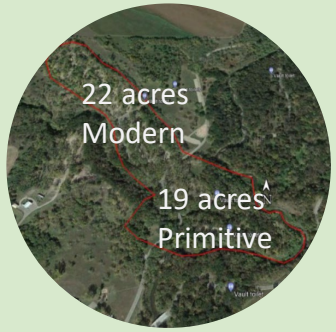
Icelandic State Park, Cavalier, ND

41 Acres

- 147 modern with 9 group sites @ 38.2 acres./147= .2598 acres per modern campground.
- 10 primitive campgrounds @ 2.88 acers./10= .288 acres per primitive campground

Turtle River State Park, Grand Forks, ND

41 Acres



- 71 modern with 3 group sites @ 22 acres/71= .3098 acres per modern campground.
- 10 primitive campgrounds @ 19 acres/10= 1.9 acres per primitive campground

Little Missouri National Grassland, Buffalo Gap Campground

12 Acres

- 36 modern campgrounds, with on accessible @ 12 acres/36= .3333 acres per modern campground.

Black River Falls, Wi Black River State Forest, Pigeon Creek

13.64 Acres

- 38 primitive campgrounds, with one accessible @ 13.64 acres/38= .3589 acres per primitive campground.

Beltrami Island State Forest, Bemis Hill Campground, Warroad, MN

6.5 Acres

- 4 primitive equestrian sites.
- 6 drive in sites. @ 6.5 acres/10= .65 acres per equestrian site.

George Washington State Forest Horse Trails/Camps

Stony Brooks Horse Camp Bear River, MN

17.2 Acres

- 15 primitive equestrian sites with one being accessible @ 17.2 acres/15= 1.146 acres per equestrian site.

Togo Horse Camp Togo, MN

15 Acres

- 14 primitive equestrian sites with one being accessible @ 15 acres/14= 1.071 acres per equestrian site.

Modern Campground Average 0.3 Acres each site

Primitive Campground Average 0.85 Acres each site

Equestrian Campground Average 0.96 Acres each site

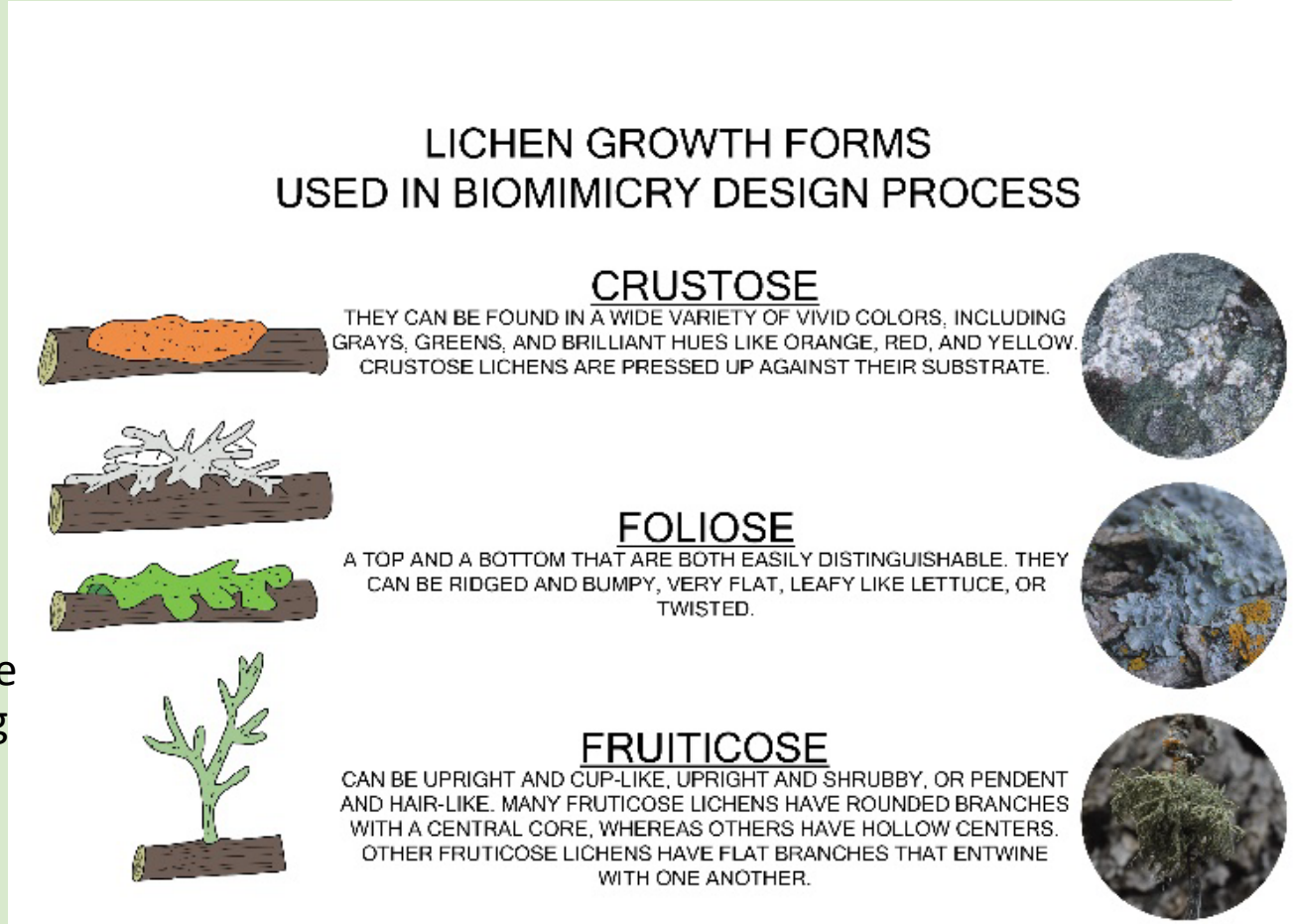
Pembina Gorge State Recreation Area, Walhalla, ND

35.379 acre site divided by 3 types of camping equals 11.79 acres for each camping types to utilize.

39.31 Modern
13.87 Primitive
12.28 Equestrian

Lichen Research Questions

- What is Lichen?
- What makes lichen so adaptable to harsh environments?
- Can the shapes and forms of lichens help design sustainable well-planned campgrounds of National & State Park quality?
- Can replicating the growth form of lichens be used to establish a native planting plan? If so, how?
- What design methods can be extracted from the micro symbiotic structures of algae and fungus in lichen. And how can such structure/design knowledge help concrete sustainable design methods or ideologies when thinking about a low impact multi-use sustainable campground in Pembina Gorge?



Project Framework

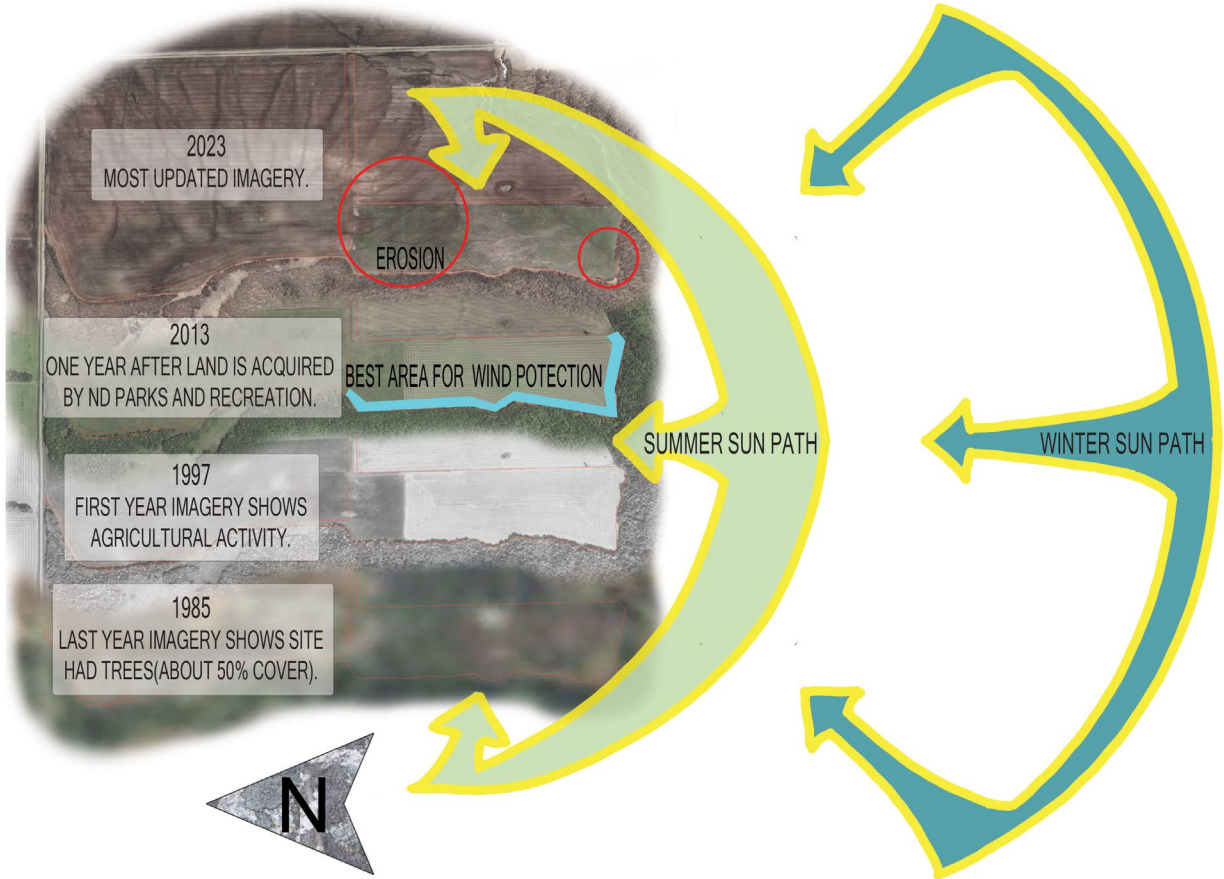
- Case studies
- Lichen findings
- Public Documents
  - Pembina Gorge SRA Masterplan 2014
    - Surveys and public meetings
  - ND Parks and Rec- Grant Summary 2020
  - Pembina Gorge STA Public Recreation Survey 2014
  - SCORP (State Comprehensive Outdoor Recreation Plan 2018-2022)
  - Pembina County Strategic Plan 2019-2024
  - ND Forest Action Plan 2020
  - ND Chap 33-33-02 Trailer Park and Campground Rules
  - ND Department of Commerce Tourism 2021 Annual Report
  - Sites V2 handbook, rating system and overall goals.

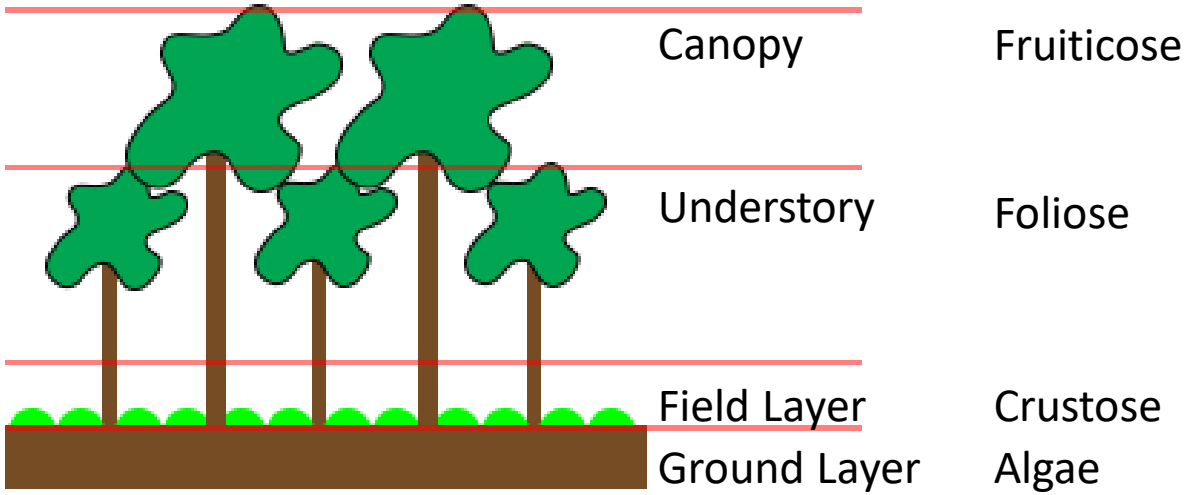
Project Objectives

- Micro-Climate Design
- Public Hospitality
- Regenerative Landscapes

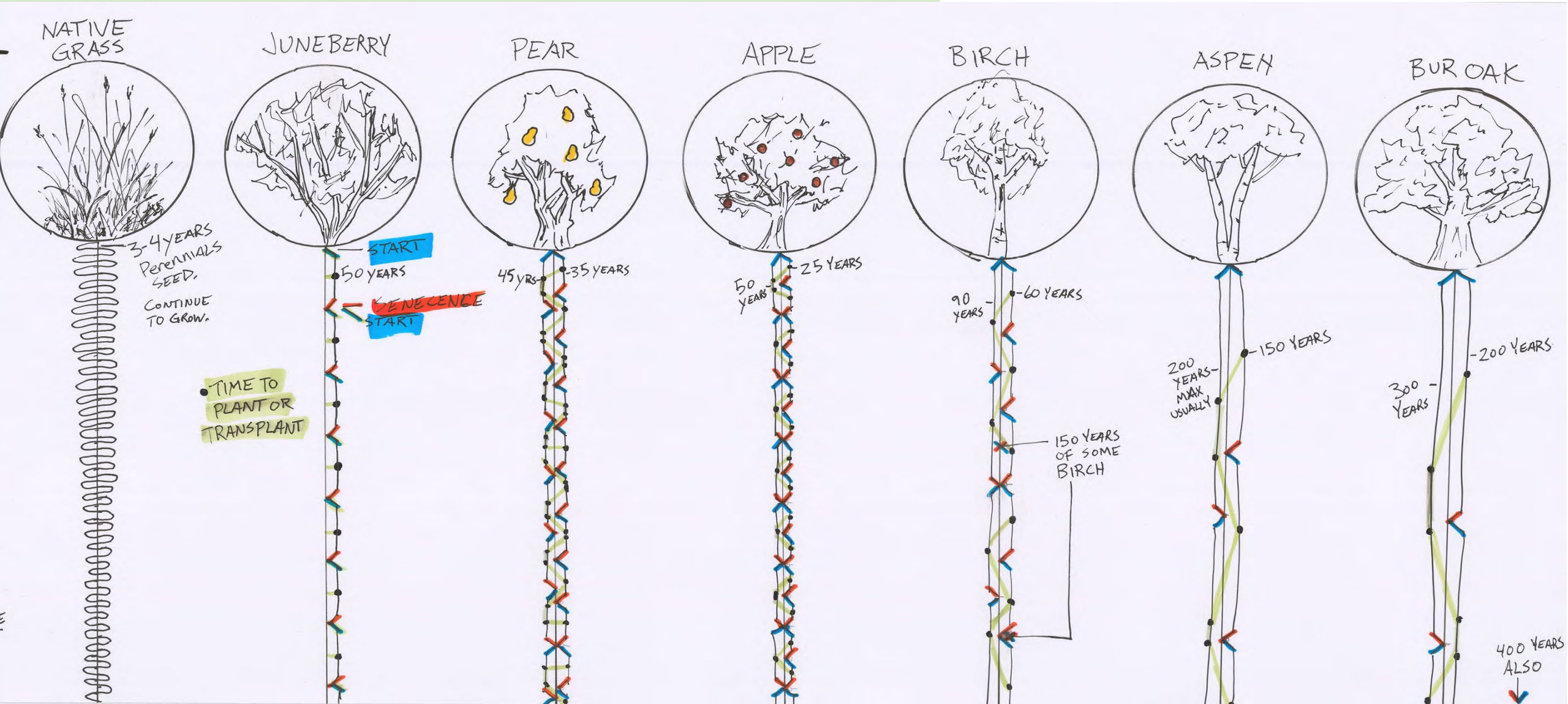
Site Analysis

- What was the site prior to agriculture practices?
- What are the conditions now?
- Prevailing winds
- Snow drifting
- Sun Exposure
- Slope
- Drainage

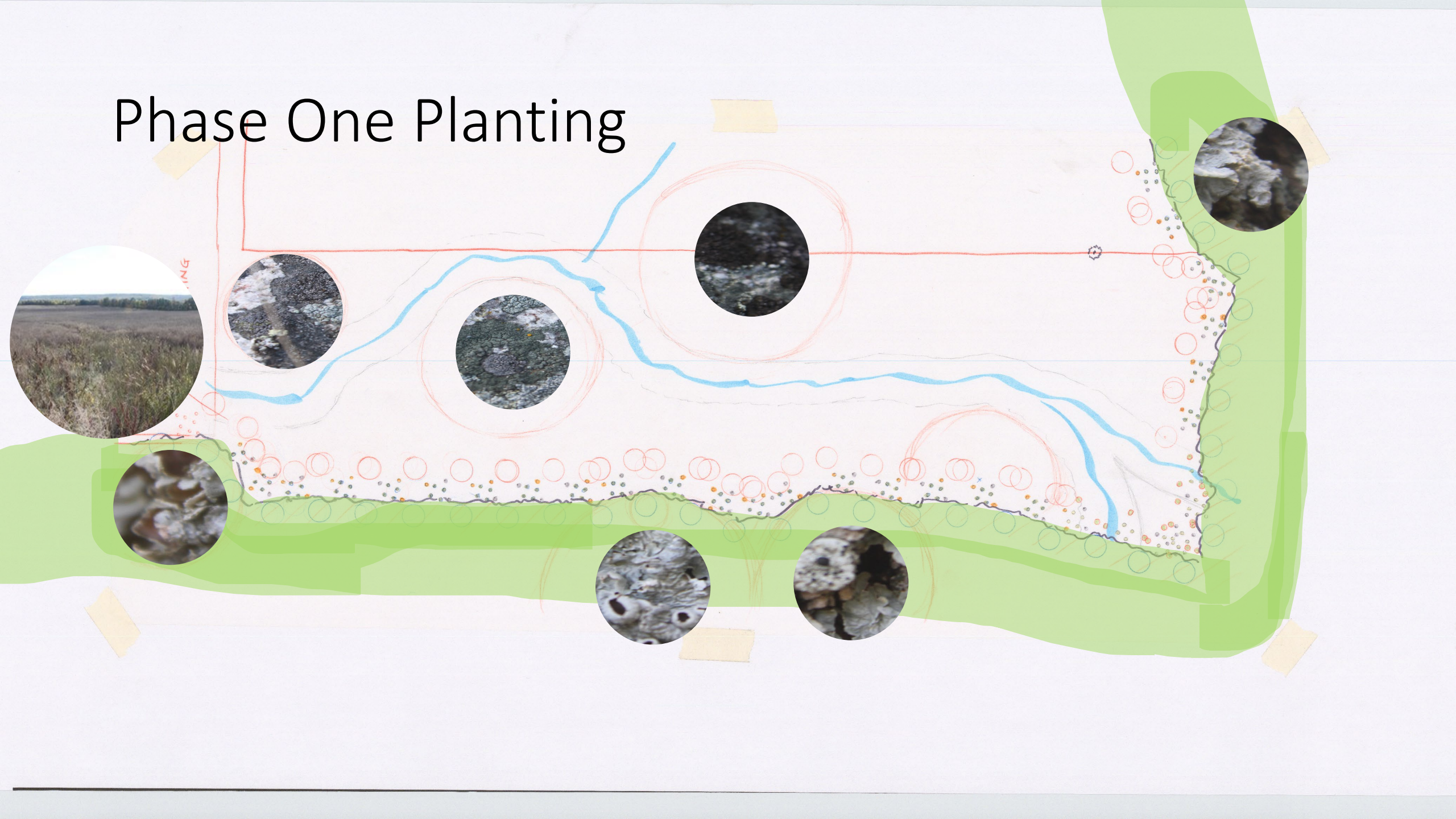




Regenerating Landscapes

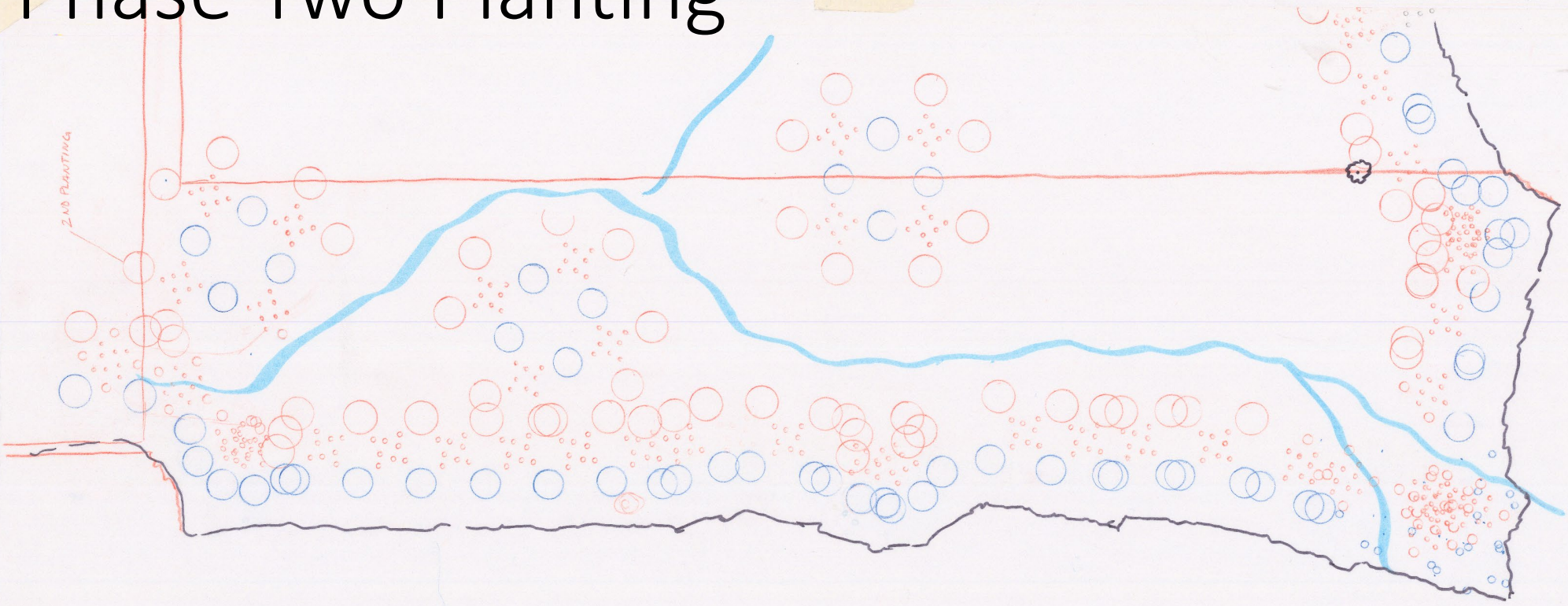


Phase One Planting

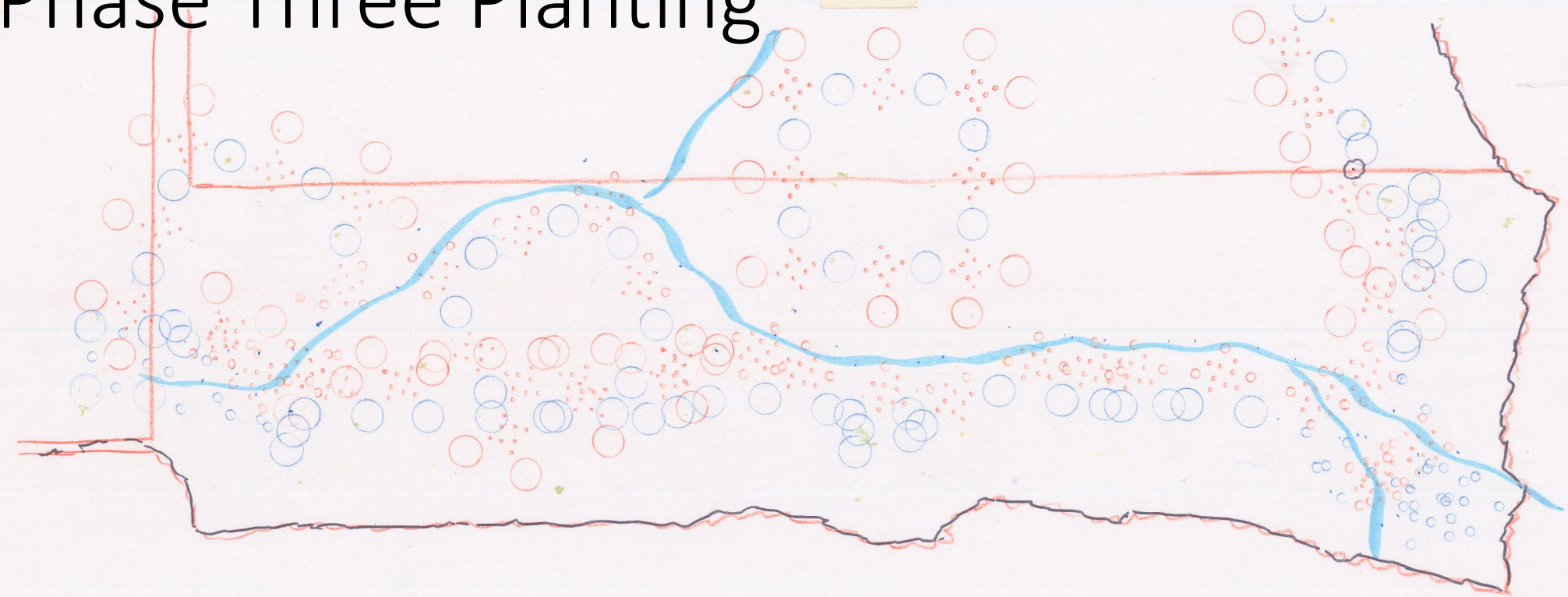


Phase One Planting

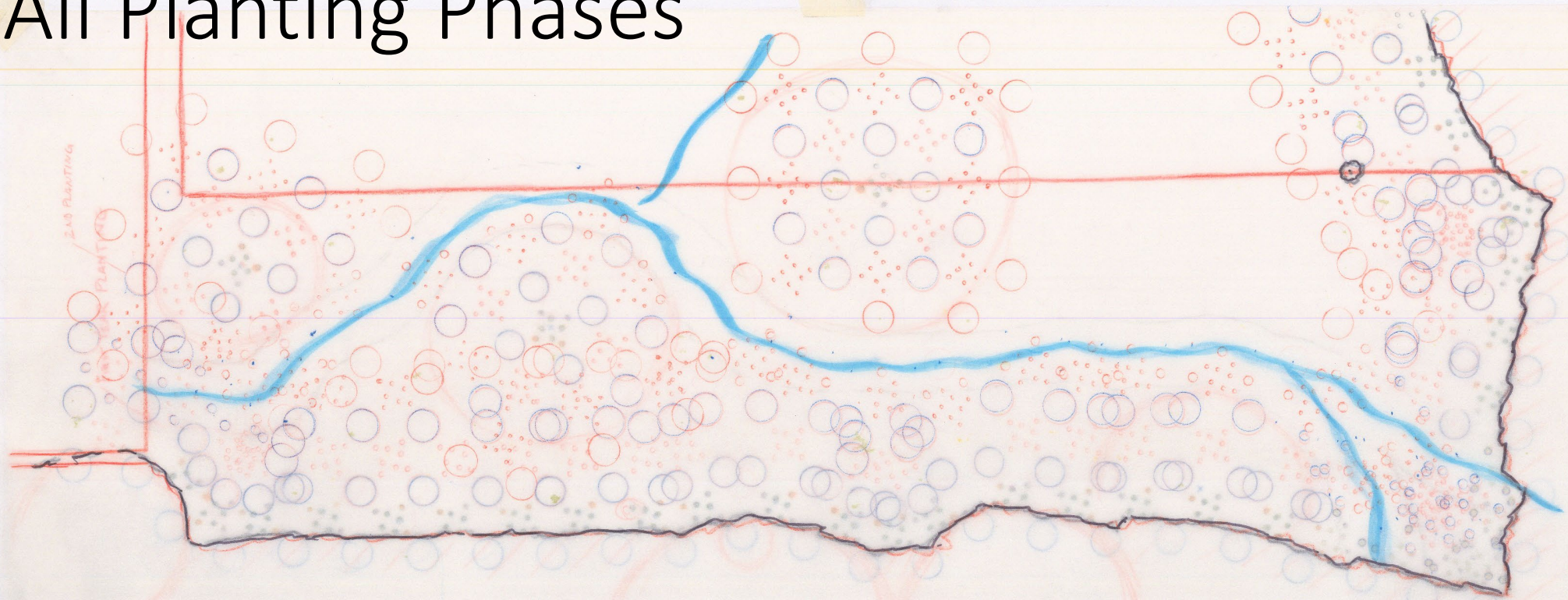
Phase Two Planting



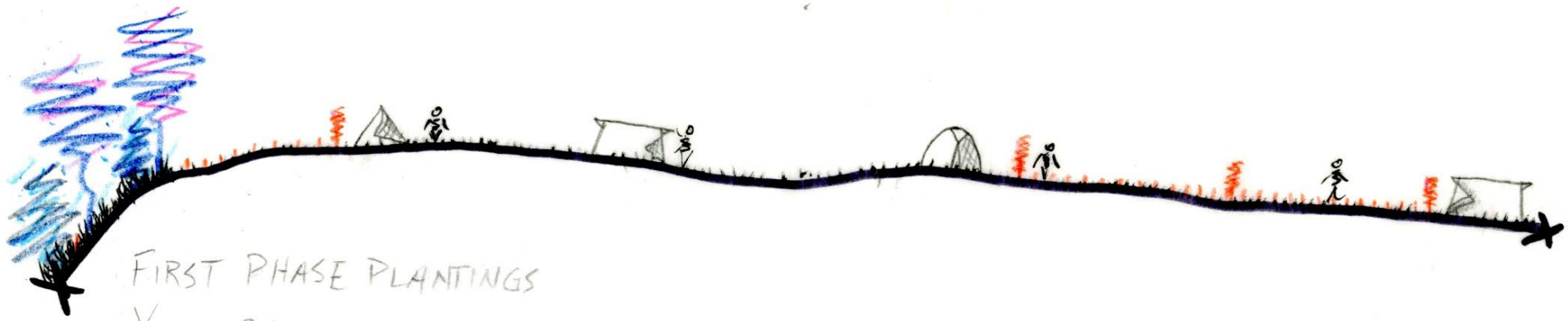
Phase Three Planting



All Planting Phases




CURRENT CONDITIONS

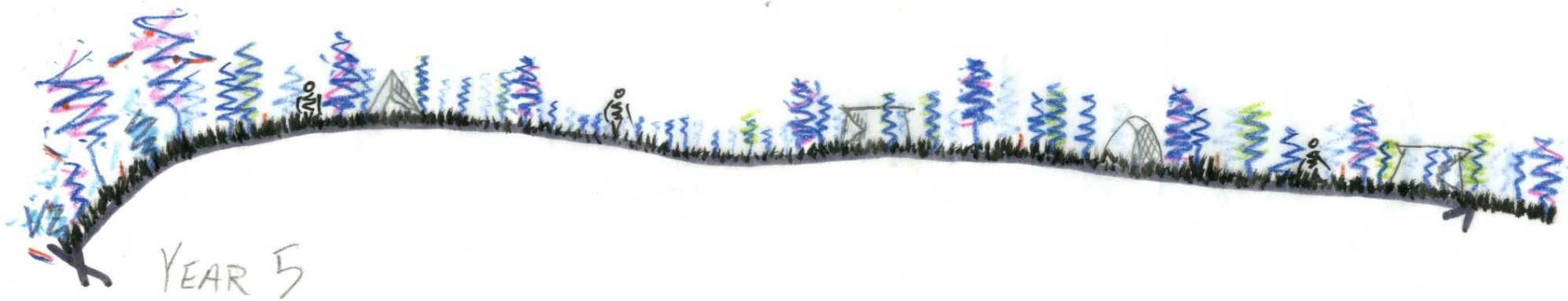


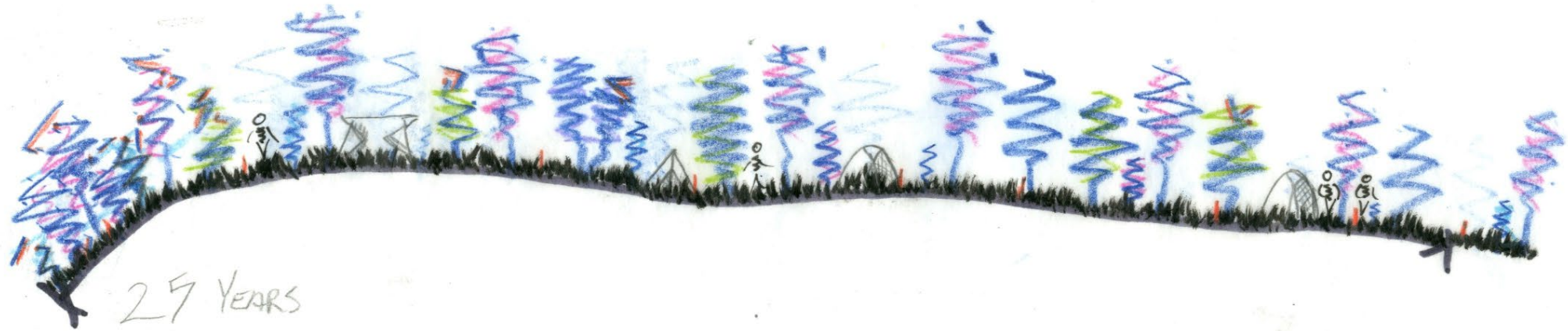
FIRST PHASE PLANTINGS

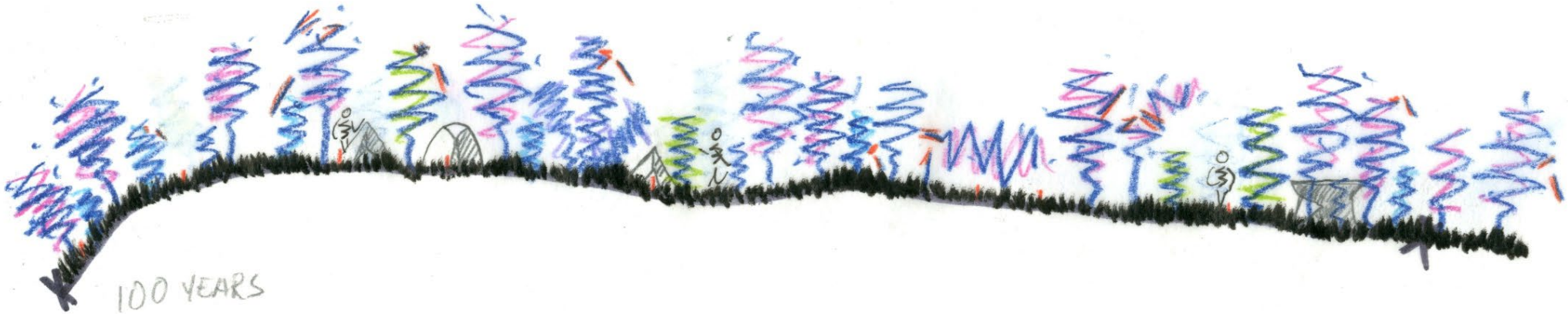
YEAR 0

SECOND PHASE PLANTING
YEAR TWO

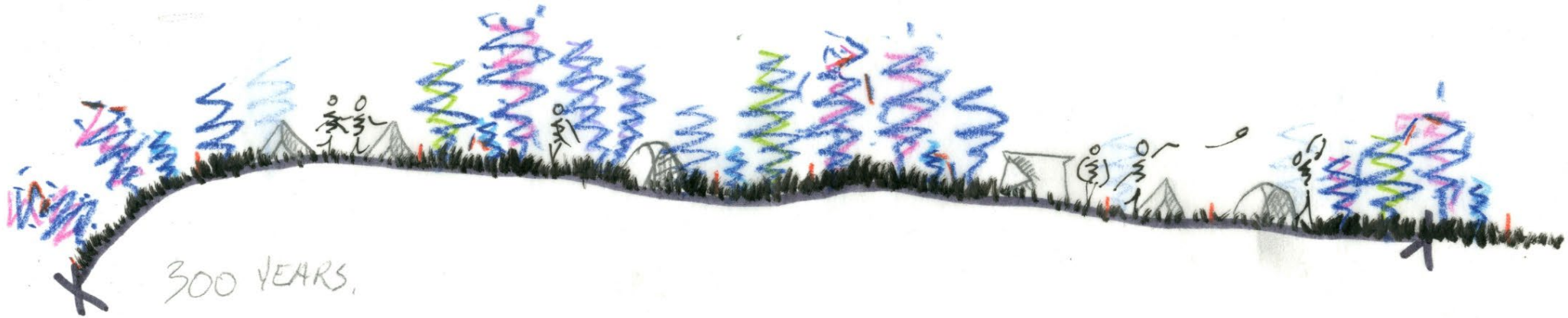
THIRD PHASE PLANTING
YEAR 4


YEAR 5

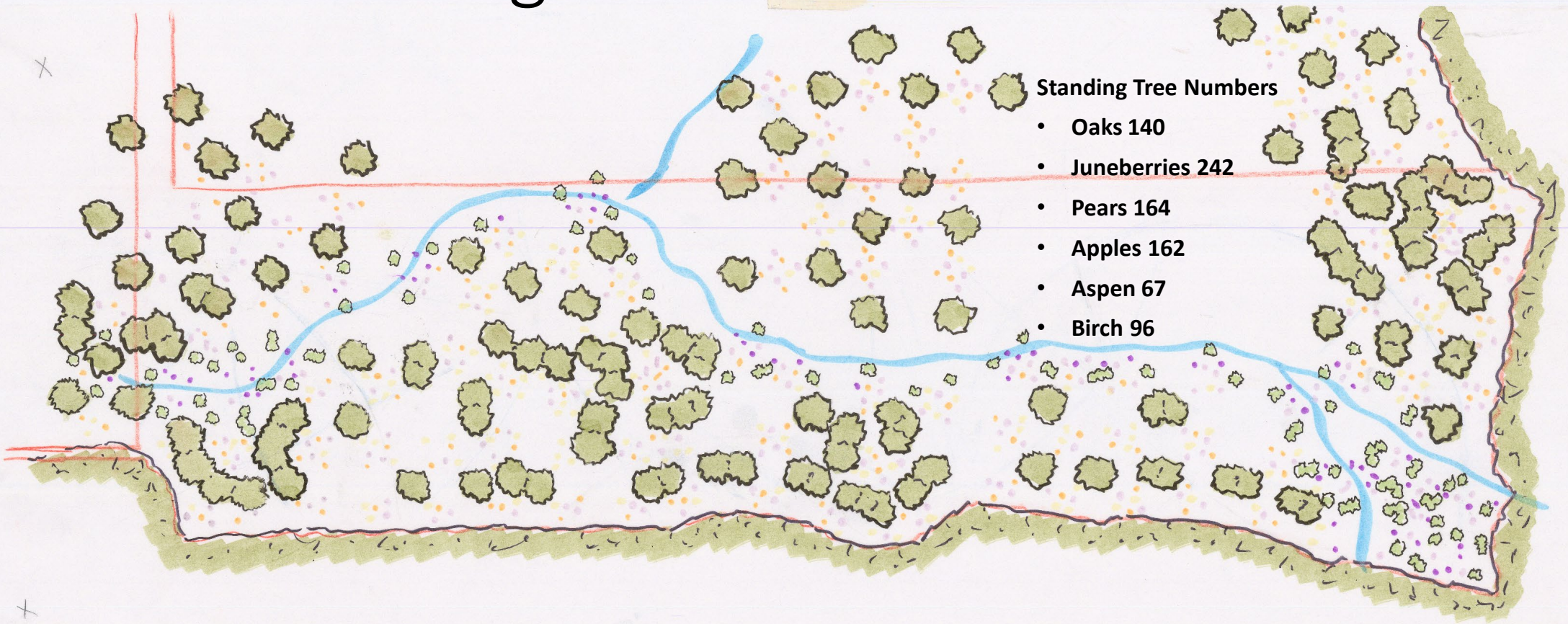

25 YEARS


100 YEARS


200 YEARS


300 YEARS.

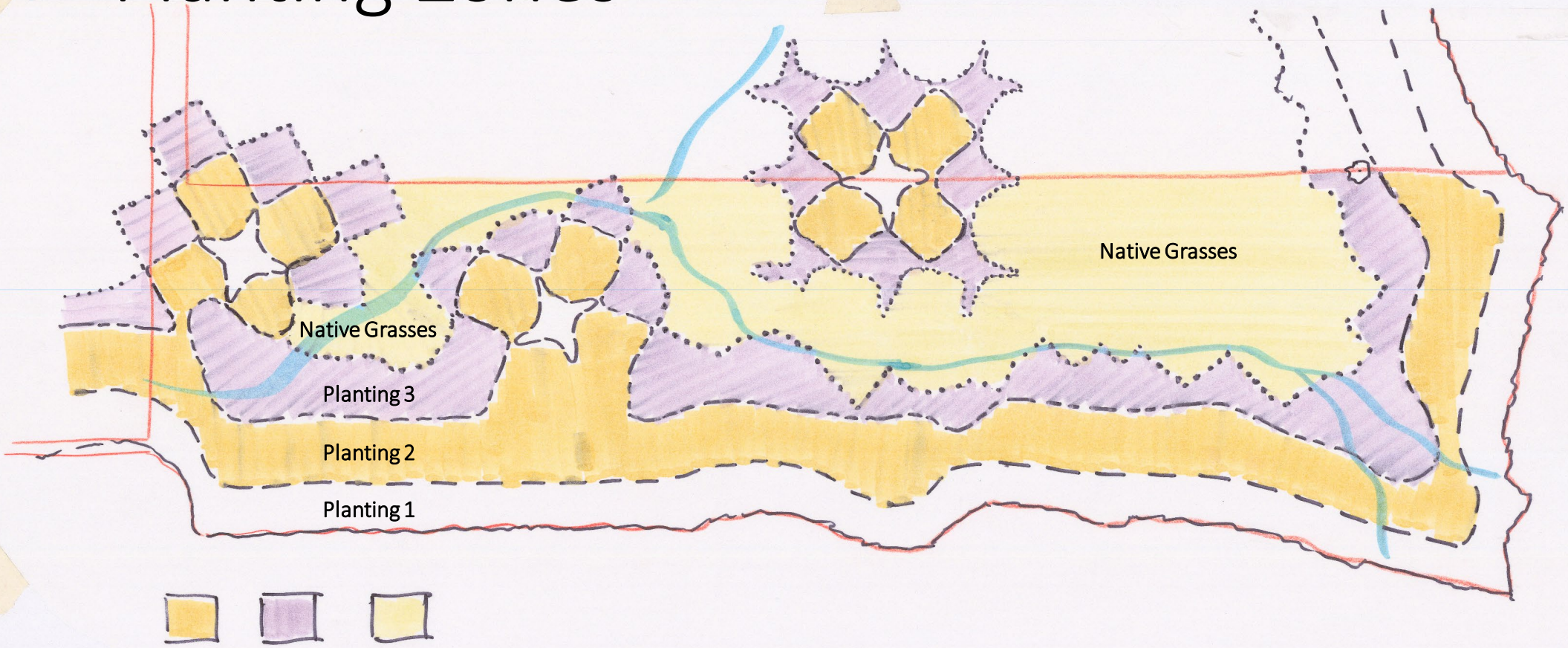
Tree Planting With 15% Die off



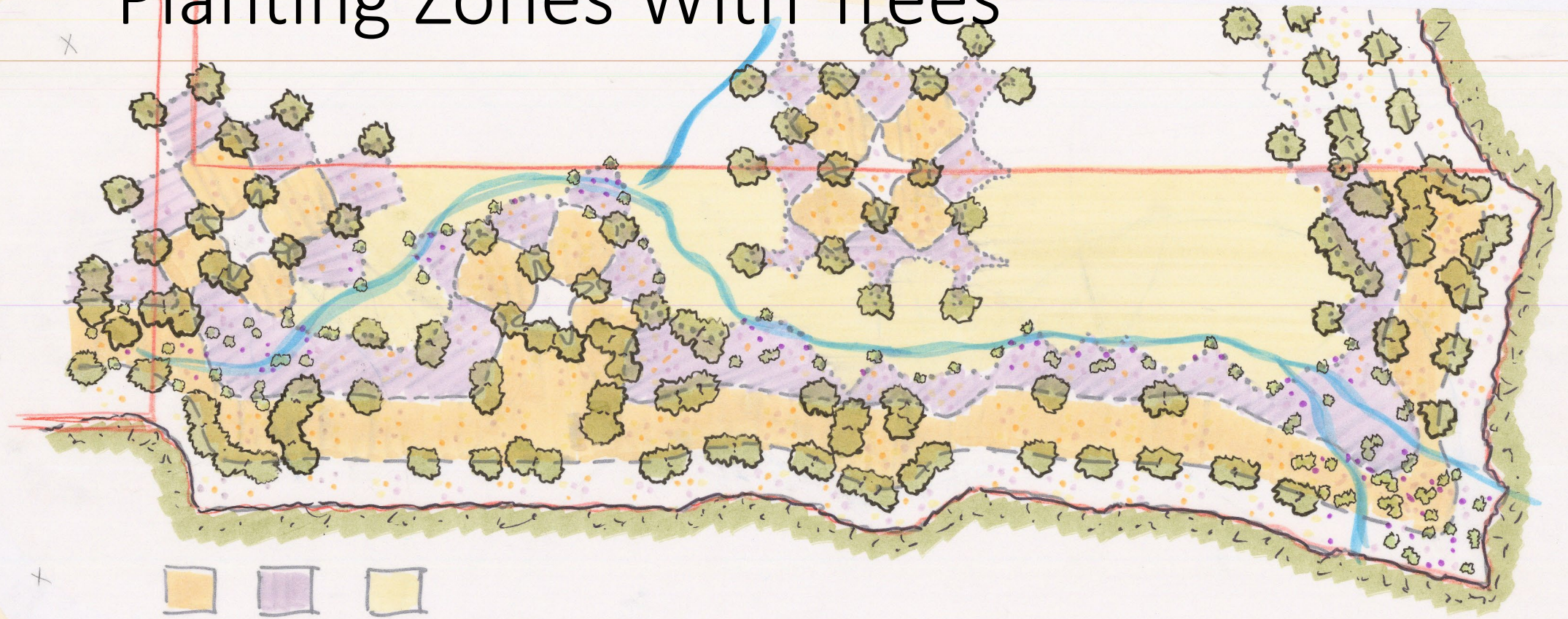
Standing Tree Numbers

- **Oaks 140**
- **Juneberries 242**
- **Pears 164**
- **Apples 162**
- **Aspen 67**
- **Birch 96**

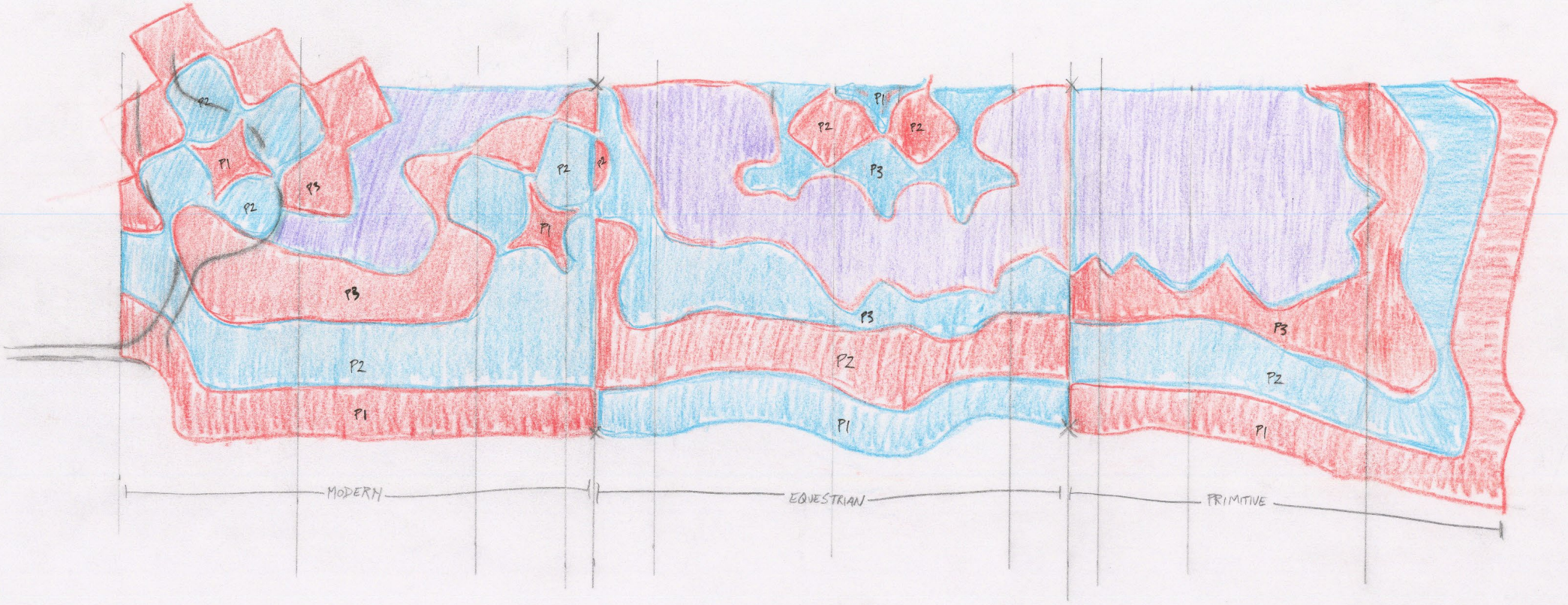
Planting Zones

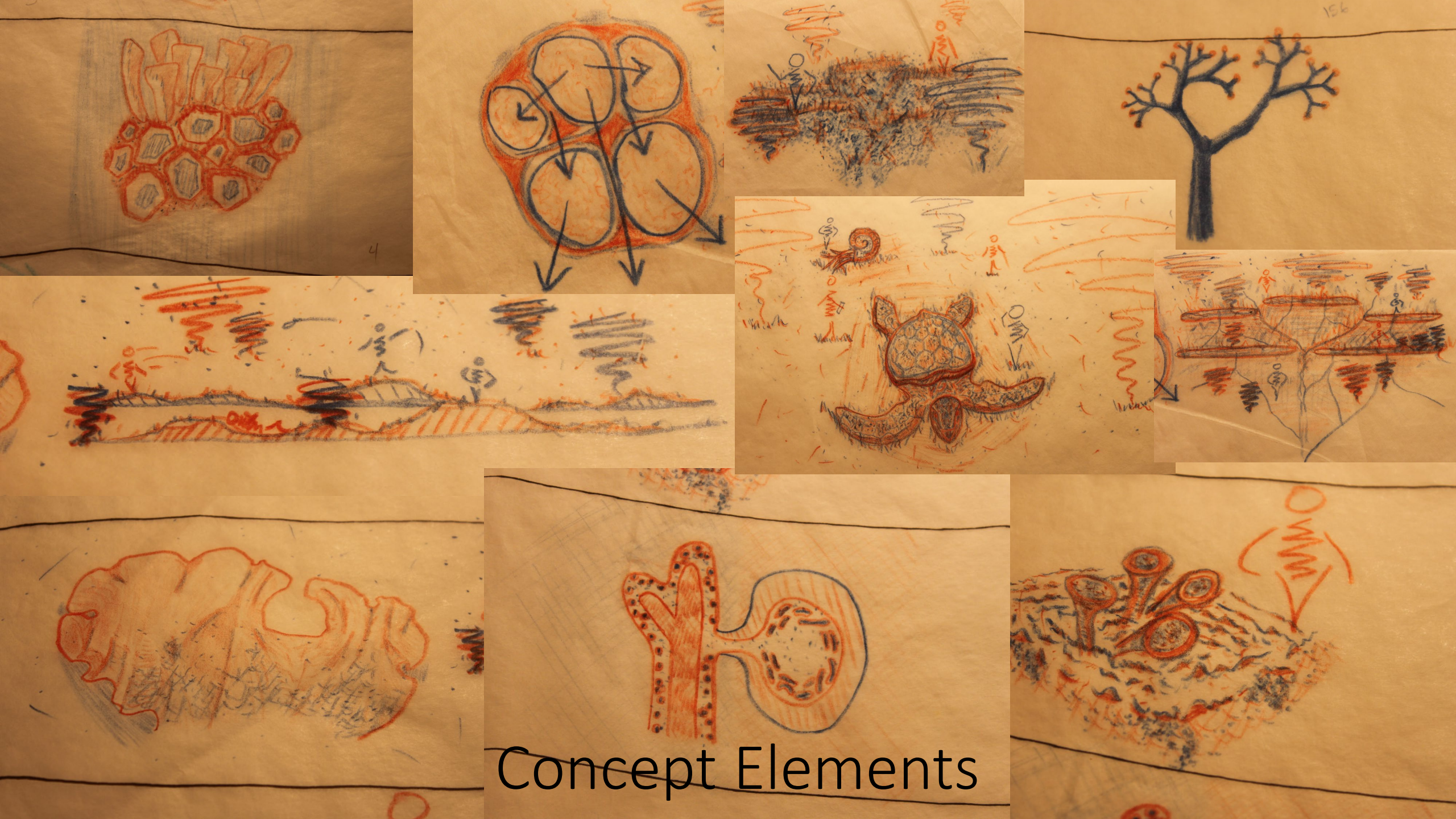


Planting Zones With Trees



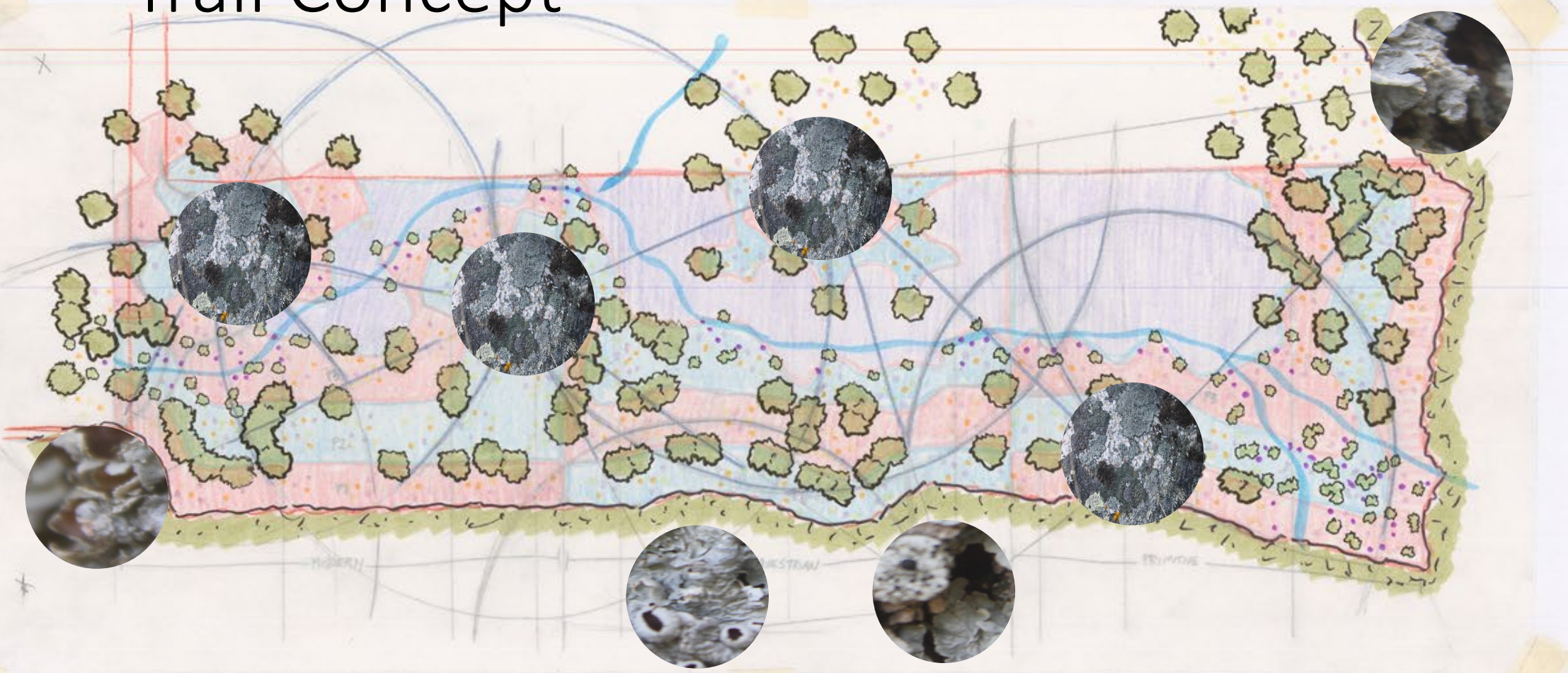
Camping Zones



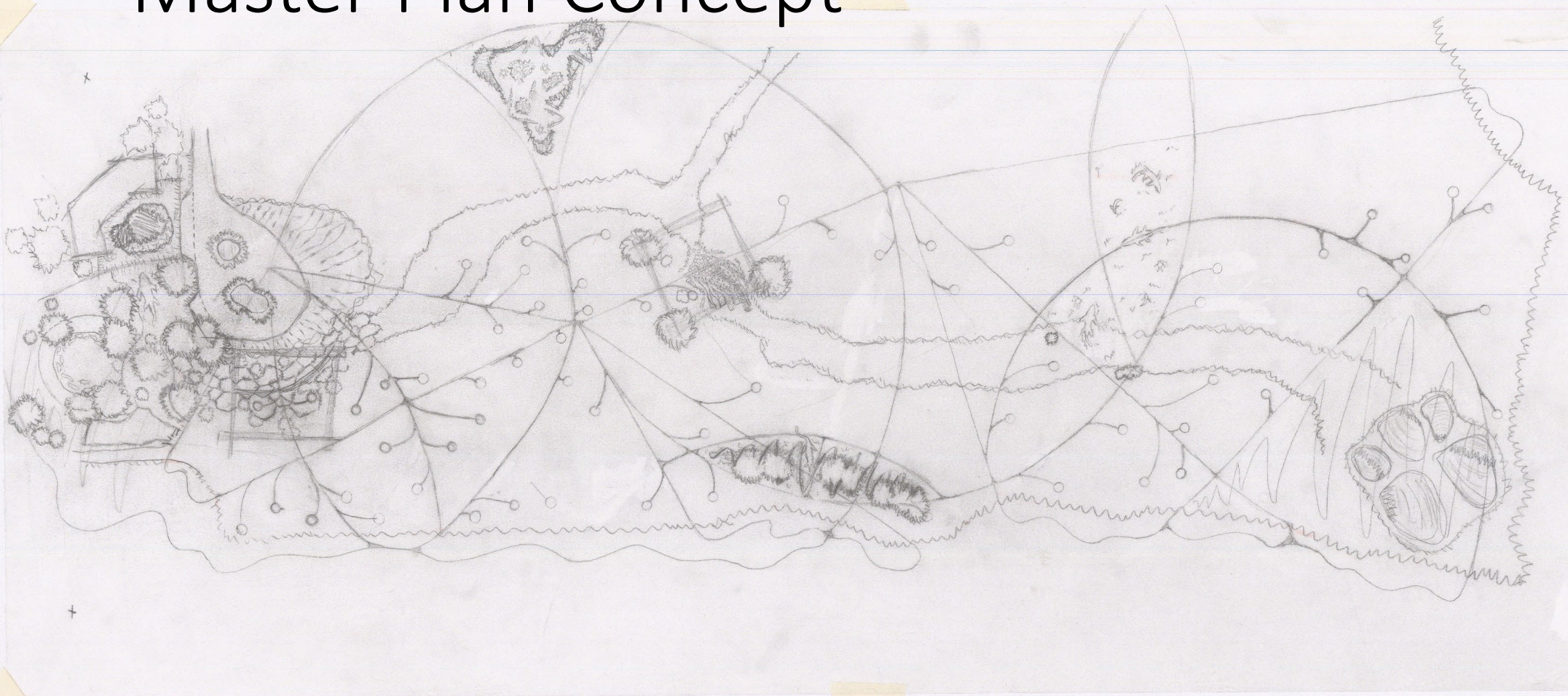


Concept Elements

Trail Concept

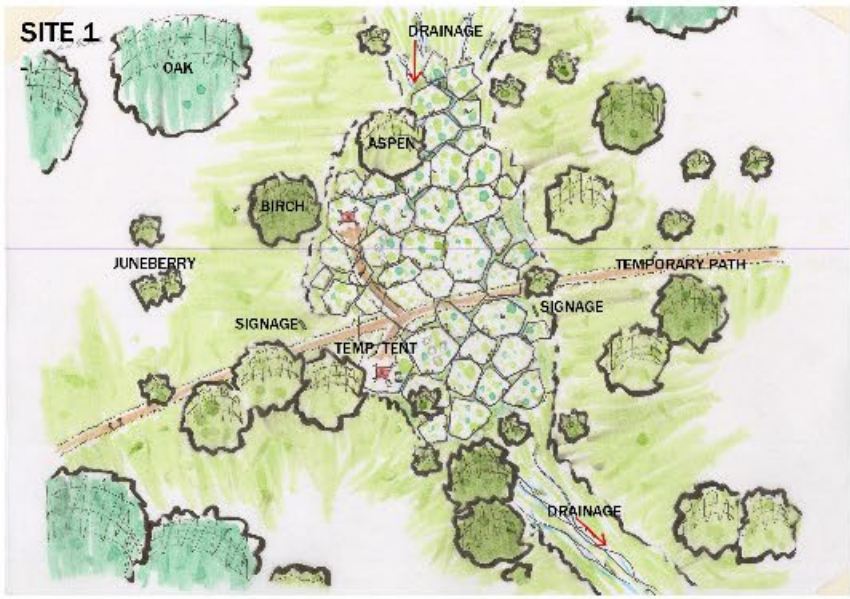


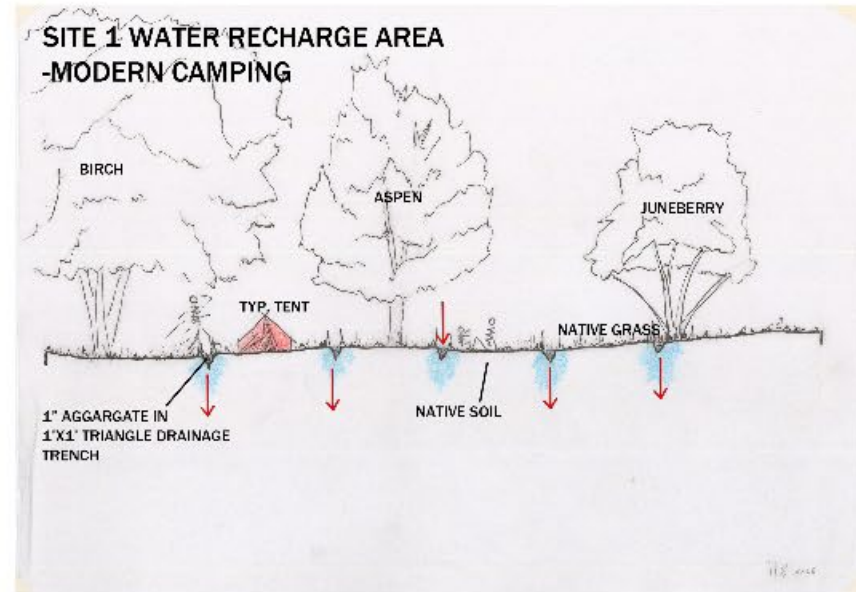
Master Plan Concept



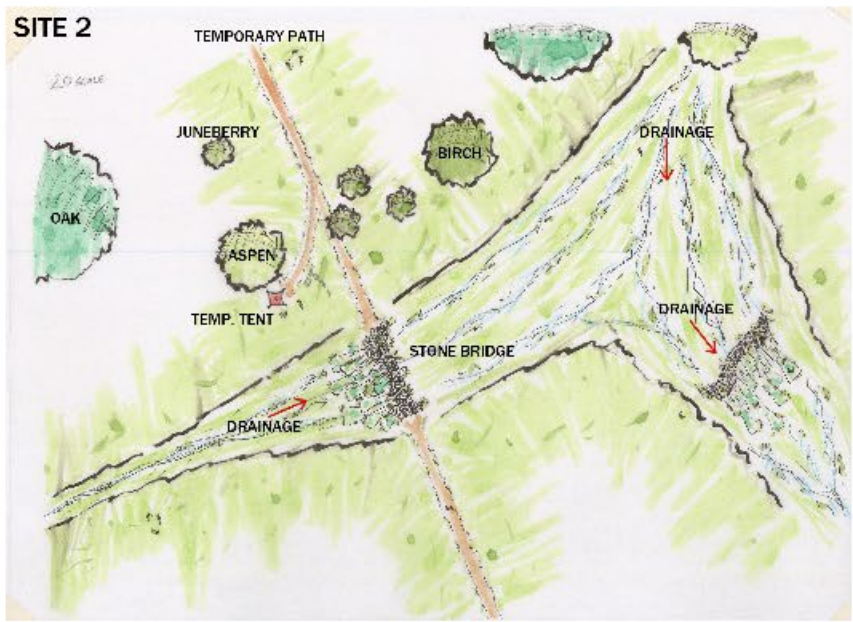
Master Plan and Trails Concept

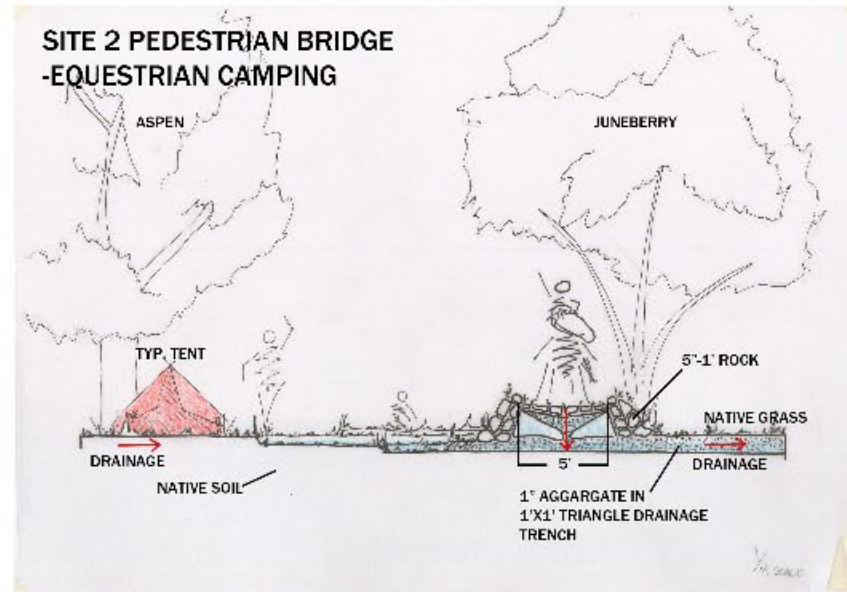
Site 1 Concept



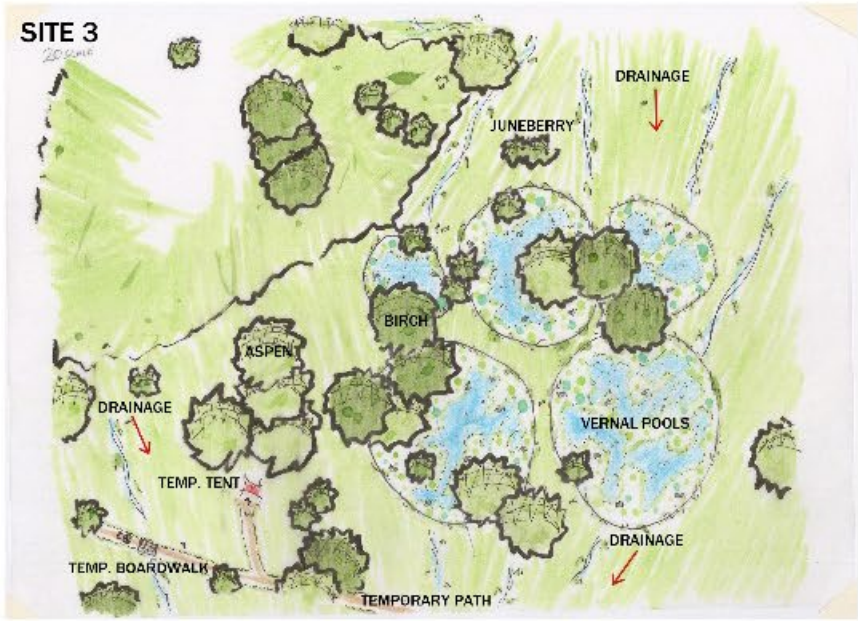


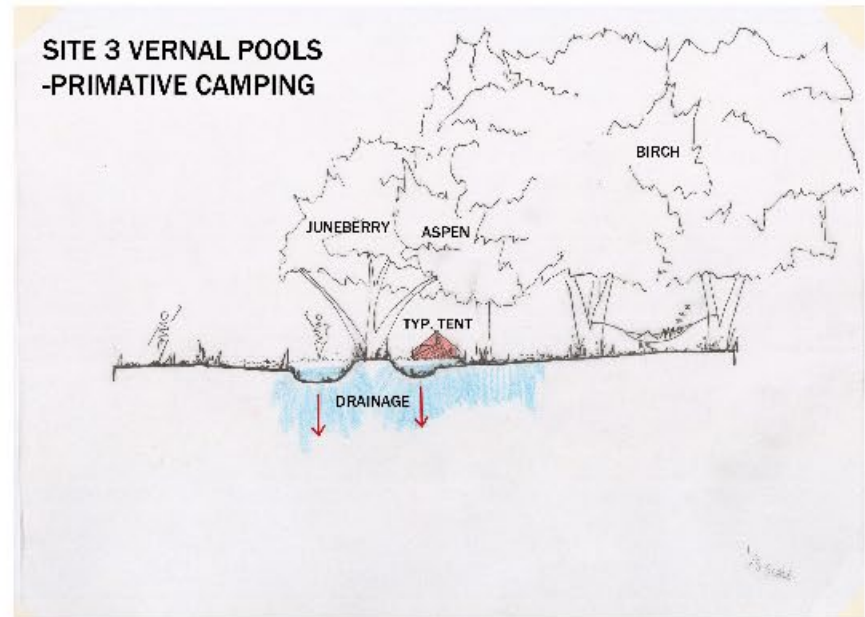
Site 2 Concept





Site 3 Concept

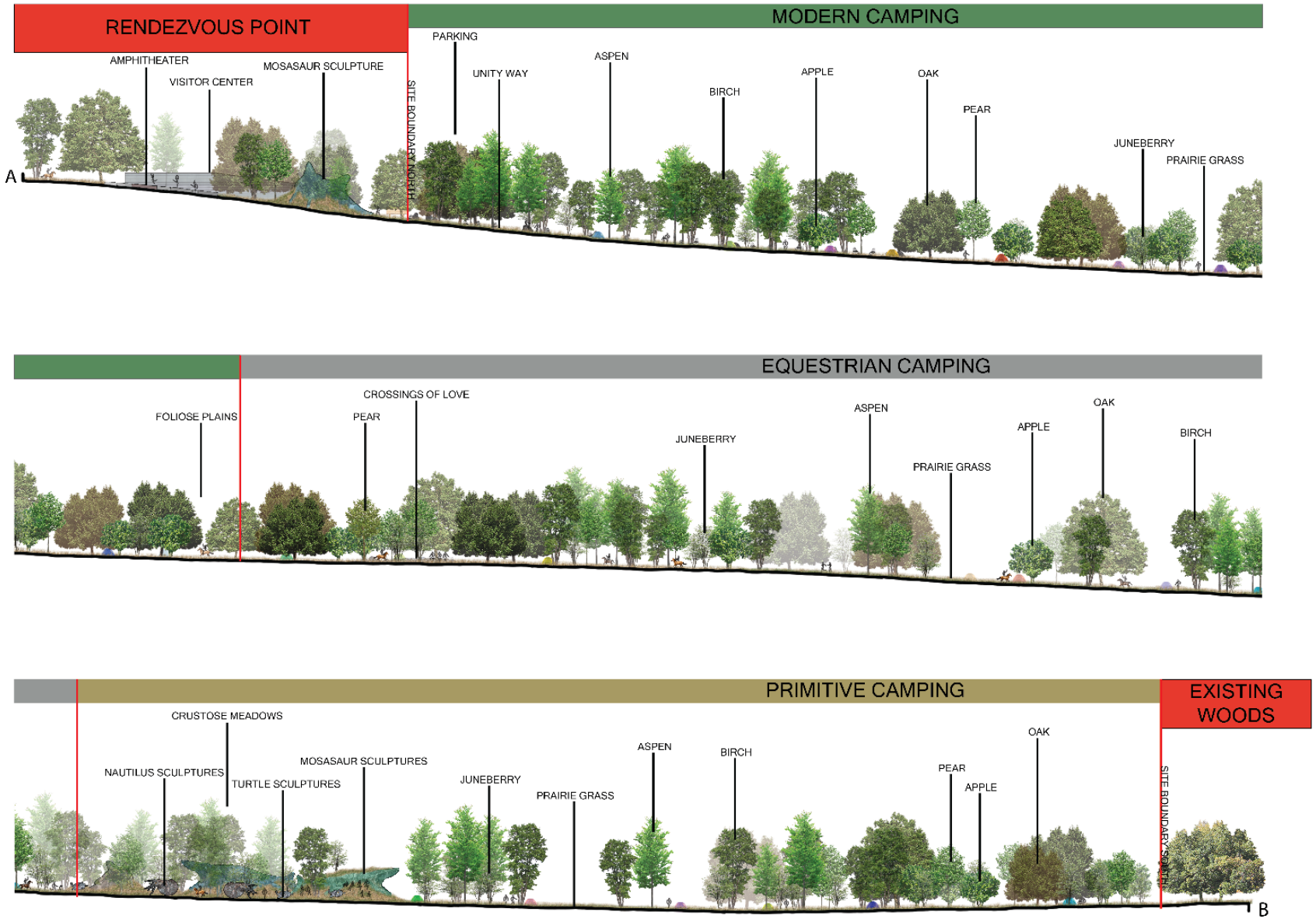




Master Plan

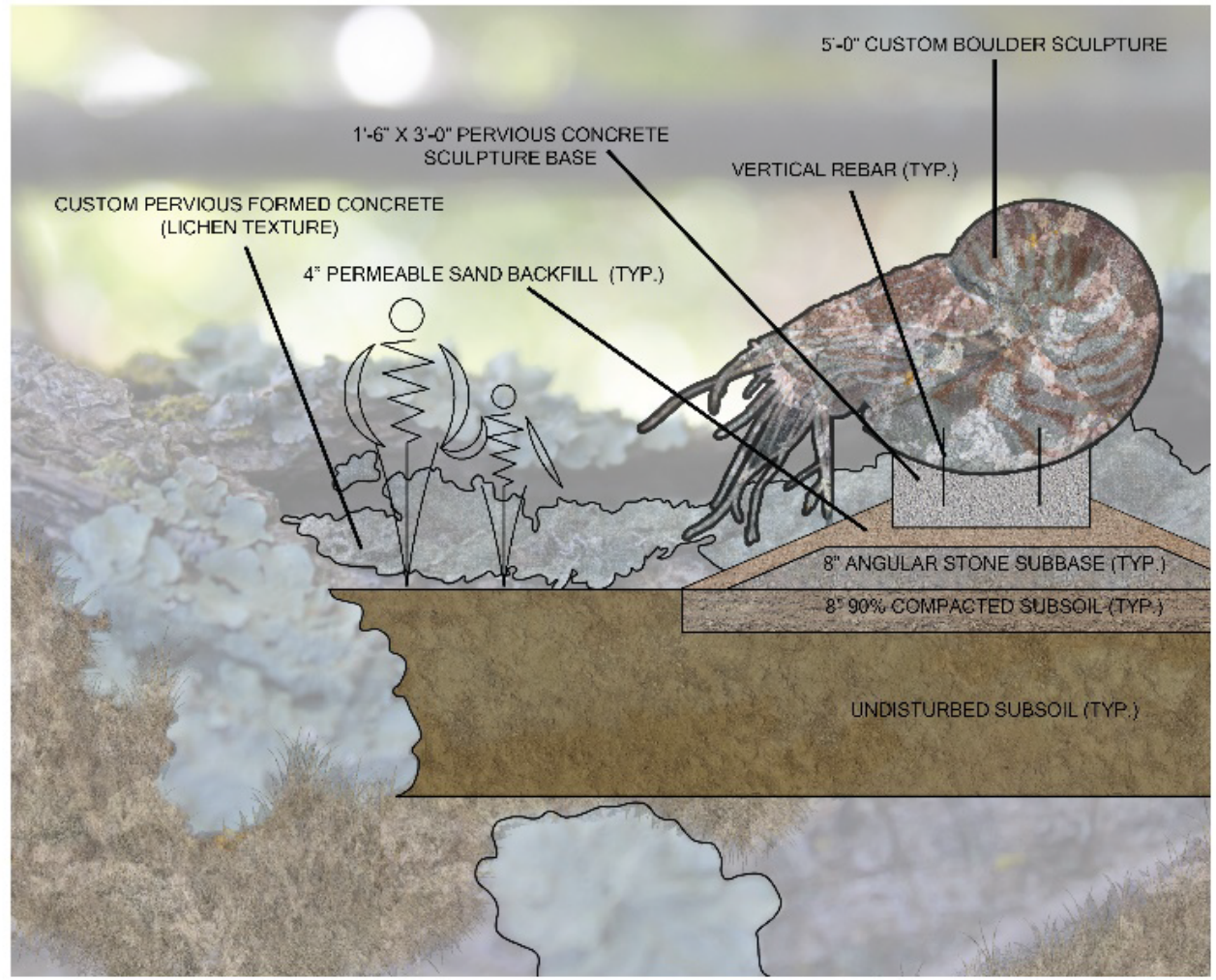

PEMBINA GORGE CAMPGROUND
MASTERPLAN
SCALE | 1:70
5' CONTOURS
N
VEHICLE ACCESS
TRAIL
FOLIOSE PLAINS
DRAINAGE
CROSSINGS OF LOVE
SITE BOUNDARY
VISITOR CENTER
P-1
PARKING
RENDEZVOUS POINT
AMPHITHEATER
P-2
S-1
UNITY WAY
HORSE CORRAL
HORSE AND WALKING TRAIL
ELEVATION 1375 FT
(HIGHEST CONTOUR ON MAP)
A
B
S-2
P-3
CAMPING SPOTS
CRUSTOSE MEADOWS
FRUTICOSE GROVE
P-4
VERNAL POOLS OF HOPE
MODERN CAMPING ZONE
EQUESTRIAN CAMPING ZONE
PRIMITIVE CAMPING ZONE

NORTH SOUTH CAMPGROUND CENTERLINE SECTION
EAST FACING
NO SCALE



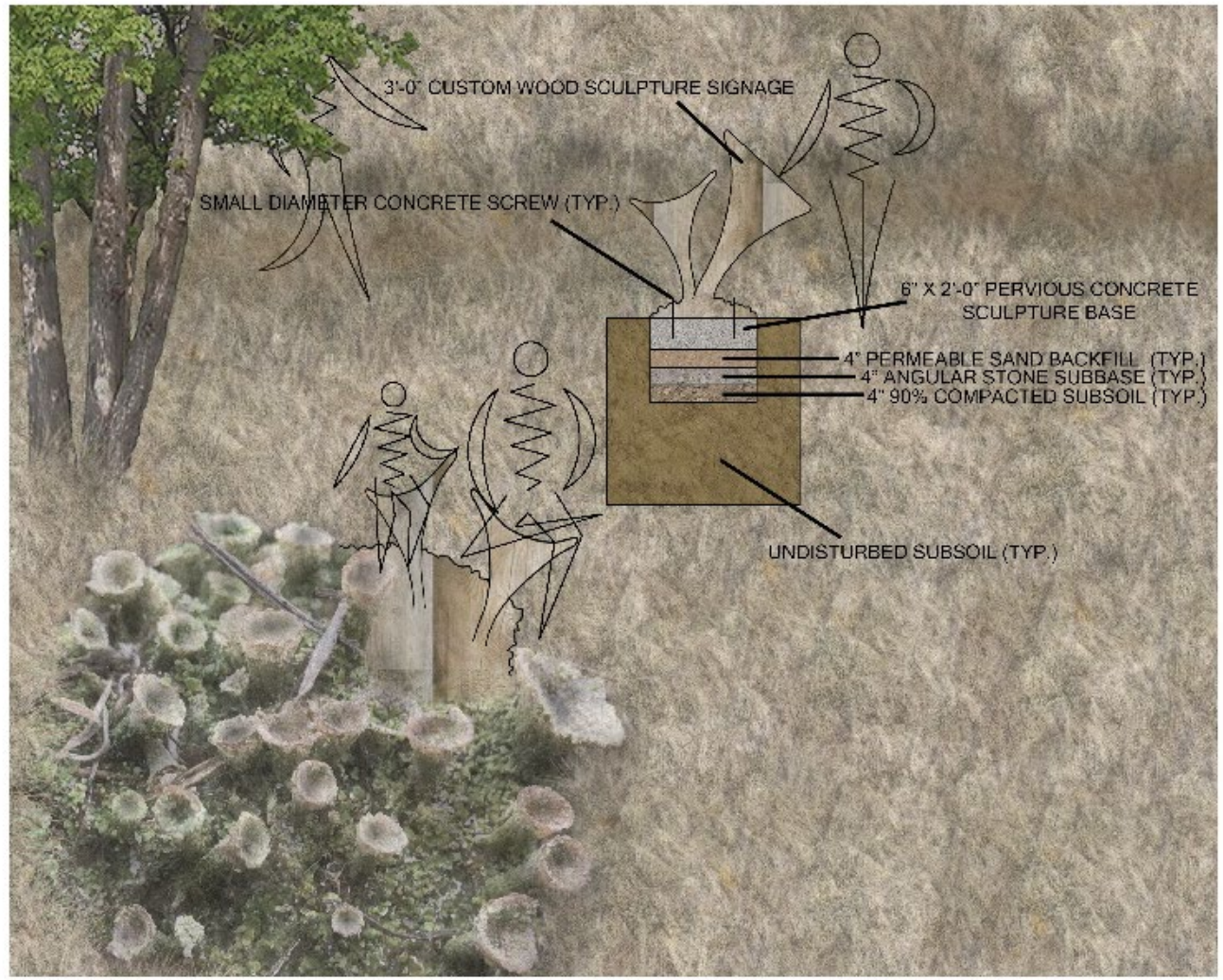
NAUTILUS SCULPTURE

THE NAUTILUS IS ONE OF SEVEN ANIMALS IMPLEMENTED IN THE CAMPGROUND SCULPTURE DESIGN. DURING THE LATE CRETACEOUS TIME ABOUT 80 MILLION YEARS AGO, THE WESTERN INTERIOR SEAWAY COMPLETELY COVERED NORTH DAKOTA AND WAS INHABITED BY MARINE REPTILES SUCH AS MOSASAURS, PLESIOSAURS, AND TURTLES, FISH, AND SHARKS WERE ALSO FOUND IN THE AREA. PEMBINA GORGE IS CURRENTLY ONE OF FOUR FOSSIL DIG SITES IN NORTH DAKOTA. IMPLEMENTING LIFE SIZED SCULPTURES INTO THE CAMPGROUNDS NARRATIVE CONNECTS THE USERS TO THE AREAS HISTORY, CREATING A STRONGER COMMUNITY THROUGH SHARED EXPERIENCE AND MEMORIES. ALL MATERIALS USED IN THE MAKING OF ANIMAL SCULPTURES ARE FOUND LOCALLY AND CREATED BY LOCAL ARTIST.



INFORMATIONAL LICHEN SCULPTURE

THROUGHOUT THE CAMPGROUND, LICHEN SCULPTURES ARE PLACED IN AREAS WHERE SIMILAR LICHENS ARE KNOWN TO BE FOUND, THESE INFORMATIONAL SCULPTURES HELP USERS UNDERSTAND THE LICHENS THAT ARE FOUND IN THE AREA, WHILE CONNECTING USERS TO NATURE THROUGH THE ADDED USE OF SEATING AND OTHER LANDSCAPE ELEMENTS SUCH AS BIRD BATHS. ALL MATERIALS USED IN THE MAKING OF LICHEN SCULPTURES ARE FOUND LOCALLY AND CREATED BY LOCAL ARTIST.

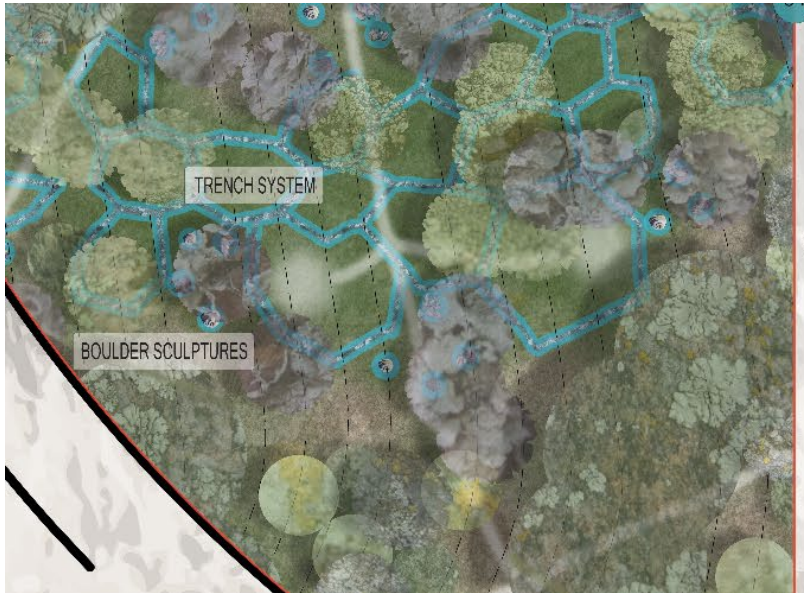


Rendezvous Point

Unity Way

Crossings of Love

Vernal Pools of Hope



UNITY WAY

SCALE | 1:20
1' CONTOURS

CROSSINGS OF LOVE

SCALE | 1:20
1' CONTOURS

WATER HOLDING CAPACITY NUMBERS

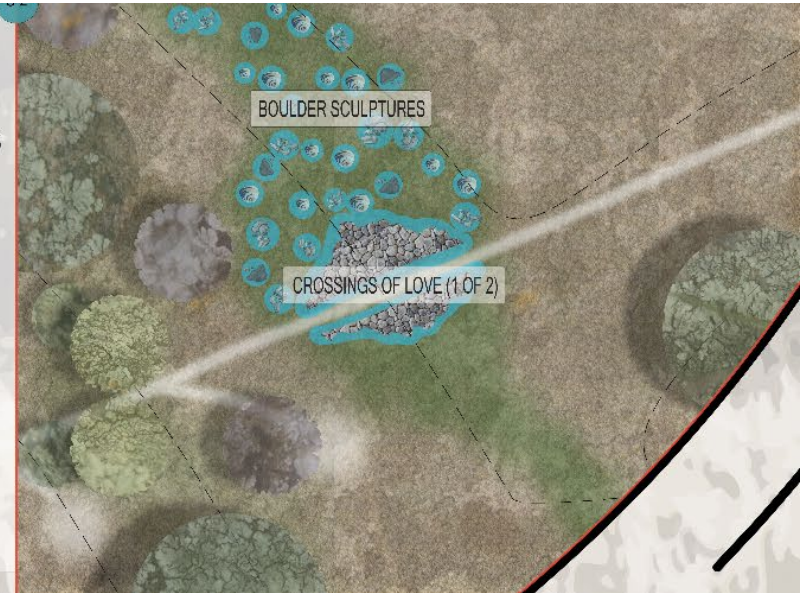
57 WATER STORING BOULDER SCULPTURES
1,137 CUBIC FEET HOLDING CAPACITY.

104 WATER STORING BOULDER SCULPTURES
2,074 CUBIC FEET HOLDING CAPACITY.

23 WATER STORING POLYGON TRENCH SYSTEM
1,148 CUBIC FEET HOLDING CAPACITY.

2 WATER STORING BOULDER CROSSINGS
1,291 CUBIC FEET HOLDING CAPACITY.

FOR THESE TWO SITES ALONE AND EXCLUDING ADJACENT SOIL HOLDING CAPACITY NUMBERS, THE TOTAL HOLDING CAPACITY IS 5,650 CUBIC FEET OR 42263 GALLONS.
ENOUGH WATER TO FILL ONE 20' X 40' POOL AT A DEPTH OF SEVEN FEET.



Thank you