2019
PINA
PERMACULTURE DESIGN CONTEST

Entry for:

INDUSTRIAL HEMP based PERMACULTURE family farm

Growing and Building Demonstration Site

Food Forests, Gardens, Chickens, Goats, Bees and More.

Owner and designer:
Christina Goodvin,
B.Eng., M.A.Sc. PDC

Site location:
54011 Range Road 42,
Wabamun, Alberta, T0E2K0, Canada

Site coordinates:
53.633086, -114.492132

Industrial hemp permaculture site
@ 53.633086, -114.492132 (Alberta, Canada)

Design Explanation

Here on the edge of the parkland and boreal biome regions of Alberta, the growing season is short, the shoulder seasons unpredictable, and it is not uncommon to see multiple wildfires or the odd tornado. Land-use around here is based around natural pastures and hobby farms, with the distinction that we are one growing zone higher (3b) due to the influence of surrounding lakes. Since purchasing we have installed perennial food forests, hugelkultur beds, annual gardens, and incorporated animals to enjoy/manage. Like many, our goal is to use our skills and land resources to find the intersection where one can build a resilient life while making a living on the land to pay the mortgage. For this among many other reasons, we have turned to industrial hemp.

"the only way to get high on industrial hemp, is to make a rope and climb it"

Alberta is an ideal growing zone for industrial hemp, specifically those fibre varieties that like the longer solar days and short growing season. Hemp shines as a robust food and fibre source, but also as a building component: hempcrete. Over the last year I have applied my building envelope experience and engineering background to learning about this material, and how to use it as a vapour-permeable thermal mass in northern climate solar greenhouses and tiny homes. But, in the next stage of growing and producing, how can I start and bring crops to full term with the challenges of our shoulder seasons? How can we make our land safer through the yearly wildfires, large and multi-vectored wind inputs, and other possible disasters? And, in this journey, could we develop models to share and also generate an income? The focus of this design project is to answer these questions – using permaculture-based building.

Building through the permaculture lens brings focuses on two structures for this design, both integrated into land considerations: incoming energies, workflows, and zoning as the most critical, after considering water patterns and access. The first structure is a 200 square foot dome building, utilizing aircrete technology with hemp fibre reinforcement. The dome will be positioned and built to act as a storm shelter, crop processing area, and extra lodging. Aircrete is a type of on-site structural material that is easy to make and build with. Aircrete dome houses would also make excellent emergency response shelters in any climate.

The second structure is a northern three-season solar greenhouse, 192 sqft, made with hempcrete infill. The greenhouse is sized and designed for our high insolation levels, with glazing angles set to maximize shoulder season growing. The infill thermal mass is hempcrete, with inputs/exchange with solar earth tubes to extend overnight shoulder season temperatures. The greenhouse will also function as a winter animal shelter, and bee house. The greenhouse is also scale-able, able to extend in length (rubble trench foundation).

The goal with both structures is to utilize recovered/donated materials and on-site resources, and have a model for each that can be shared with the community.

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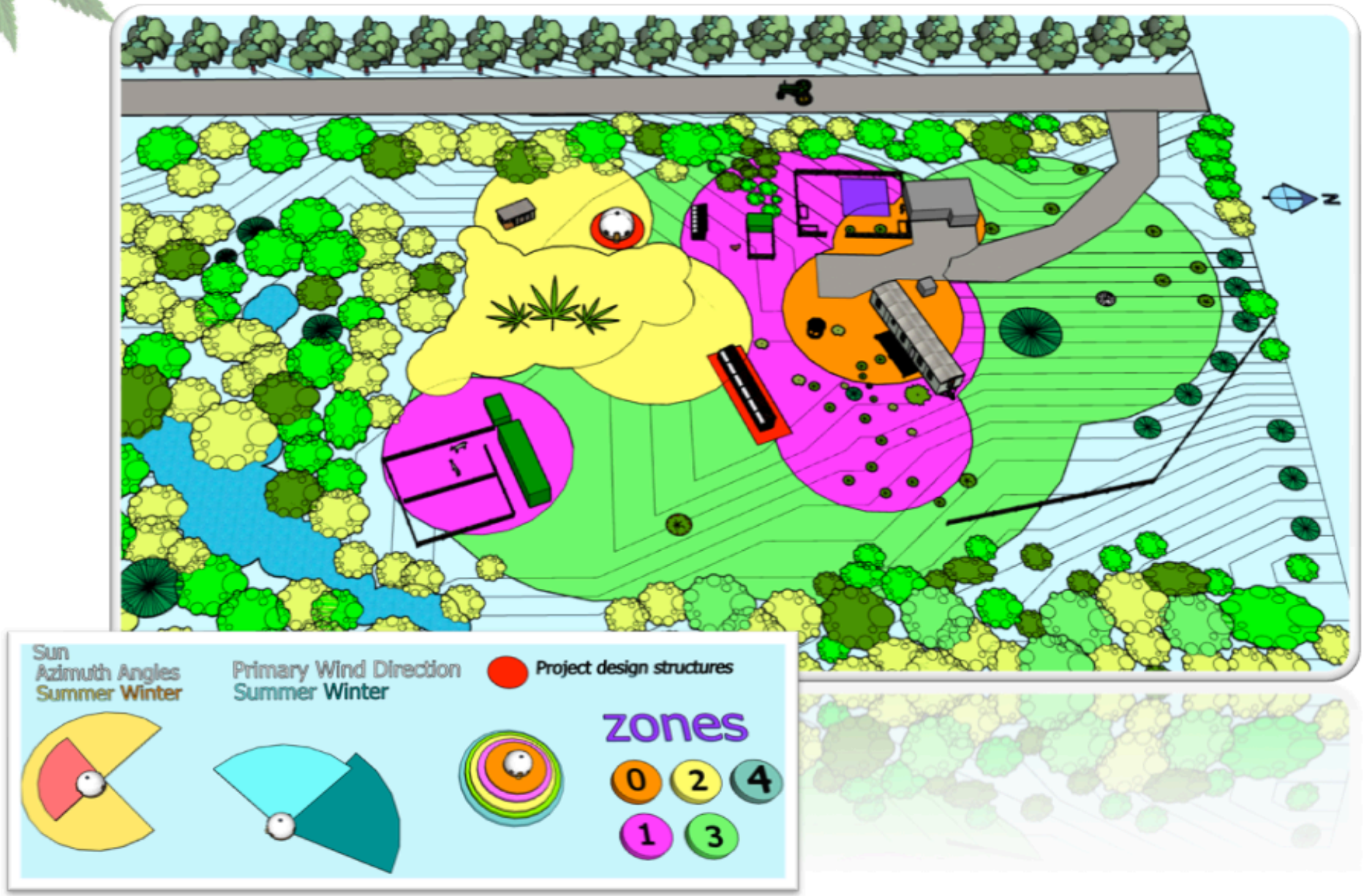

Sketchup Pro Design, based on geo-location and topo capture.

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Proposed budget

Monolithic Hempcrete/Aircrete Dome (innovation: addition of hemp hurd fibers)

Shell only. Function: storm shelter/harvest storage/teaching space/cabin.

Material	Volume/Amt	Source	Cost	System	Note
Portland cement	117 bags	Home depot	615	Shell, floor	
Foaming agent	15 (9lb)	Grocery	90	Aircrete	
Foaming machine	1	Domegaia	750	Aircrete	
Hemp hurd	1 tote	Biocomp	0	Aircrete fiber	Donated
Lime	6 bags	Home depot	80	Hemp treatment	
Gravel	4 yrd3	Repurpose	0	Rubble trench	
Excavation	na	By hand	0	Rubble trench	
Geotex, french drain, etc.	system	repurpose	160	Rubble trench	purchase tubes
Radial arm	1	handmade	0	Block placement	
Dome sheath fabric	12 yards	Envirotextiles	350	Wrap	Fabric strips hemp
Window forms	2	handformed		Aircrete buck	New idea
Windows	2	reuse	0		
Door form	1	handformed	0	Aircrete frame	New idea
Door	1	on hand	0	Entry	
Mixing tubs	4	reused barrels	0		
Cutting saws	4	on hand	0		
Mortar	39	recipe	120	Bonding recipes	Domegaia recipes
Design	na	self	0		
Labour	na	self	0		
Plaster	3 yards	made on site	0	Exterior	On site clay
		TOTAL (USD)	**2165**		
					Hemp is fibre

Northern 3-Season Hempcrete Greenhouse and Beehouse reinforcement only

Framing and earth-tube set-up, winter chicken coop, rabbit run.

Material	Volume/Amt	Source	Cost	System	Note
Lumber	see below	Home depot	844.5	framing	Look for reuse
Screws	3 lrg buckets	Home depot	90	framing	
Hemp hurds	1 tote	Innotech	0	Hempcrete	Ask for donation
Lime	10	Home depot	126	Hempcrete	Light density
Forms	reusable	scrap	0	reusable forms for hempcrete	
Cement mixer	na	on hand	0	mixing	
Glazing	8 carb	plastics inc	280	glazing	
gravel	20 yard	burnco	400	rubble trench	
Excavation	na	by hand	0	rubble trench	
Geotex, french drain, etc.	system	repurpose	480	Rubble trench	
Earth tubes		repurpose/find	0	earth tube	Prep/Phase 2
Controllers/sensors	na	home depot	0	earthtube	Phase 2
Sheeting (roof)	6	home depot	145.5	roof	Phase 2
Vents	na	make manual	0	airflow	handmade
Roofing tile	195 sqft	home depot	497.6	roofing	Ondura system
Dataloggers	2	Inkbird (on hand)	0	Temp and humidity logging	
Hemp batt	240sqft	Biocomp	0	Roof	

Timber	Qty	Price			Price each (USD)
2x4x8	29	83.52			2.88
2x4x10	15	59.7			3.98
2x6x10	15	102			6.8
2x6x12	12	102.48			8.54
1x6x12	78	405.6			5.2
4x4x12	6	91.2			15.2
		844.5			
Light density hempcrete					
1:1 weight hurd:binder		**Total cost:**	**2863.6**		
200-300 kg/m3 (max)		**Total cost (all):**	**5028.6**	USD	

Timeline

Timeline Hempcrete/Aircrete Dome (innovation: addition of hemp hurd fibers)

Task	April	May (Thaw)	June	July	Aug	Sept	Oct	Description
Secure funding	■							Win permaculture contest :)
Finish design package	■							
Order foam machine	■							This may take 6-8 weeks
Assemble supplies	■	■						Store in materials barn
Gravel		■						
Hemp hurd	■	■						
Lime	■							
Sheath fabric		■						
hand tools								
cement	■							
Excavation			■					Ground thaw (late May)
Rubble trench set-up			■					Ground thaw (late May)
Radial arm assembly		■						Garage workshop
Building			■	■				
Sheathing				■				
Plastering				■	■			
Estimated finish date:				■	■			Based on part-time construction
(Latest possible date)								
Based on 2-3 person build								

Northern 3-Season Hempcrete Greenhouse and Beehouse

Phase 1: Structure and insulation, possibly laying earth tubes

Phase 2: (outside of funding scope) Set up air handling for geothermal storage and air-heat exchange.

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Secure funding	■							Win permaculture contest :)
Finish design package	■							
Assemble supplies	■							Store in materials barn
lumber	■							
screws	■							
hemp hurds	■	■						
lime	■							
forms	■	■						
geotex, french drain	■							
roofing		■						
earth tubes		■						
sheeting		■						
hemp batt	■							
Excavation			■					Ground thaw (late May)
Rubble trench			■					Ground thaw (late May)
Framing		■						Can assemble walls earlier
Hempcrete fill		■	■					Once overnights above 0degC
Interior plaster			■					
Rain screen			■					
Phase 2						■	■	Additional funded required
Estimated finish date:				■	■			Based on part-time construction
Based on 2-3 person build								

PERMIT NOTE:	We are zoned agricultural and have permission to build agricultural buildings of any size.
	Permits are required for plumbing (none) and elec (partner is a cert. red-seal electrician)
	Greenhouse will not be wired in phase 1.
	Dome is off-grid.