IDX SPRING 2016

MILLED WOOD DEPOT ANALYSIS

NARA
Northwest Advanced Renewables Alliance

NARA is led by Washington State University and supported by the Agriculture and Food Research Initiative Competitive Grant no. 2011-68005-30416 from the USDA National Institute of Food and Agriculture.

USDA

NARA Introduction

Northwest Advanced Renewables Alliance

Organization Comprised of:

- Public Universities
- Private Stakeholders
- Government Laboratories

Funded by a 5-year grant from the USDA National Institute of Food and Agriculture

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NARA Introduction

Sustainable jet fuel from biomass

Marketable Co-products

Rural Economic Development

Regional supply chains

Bioenergy literacy

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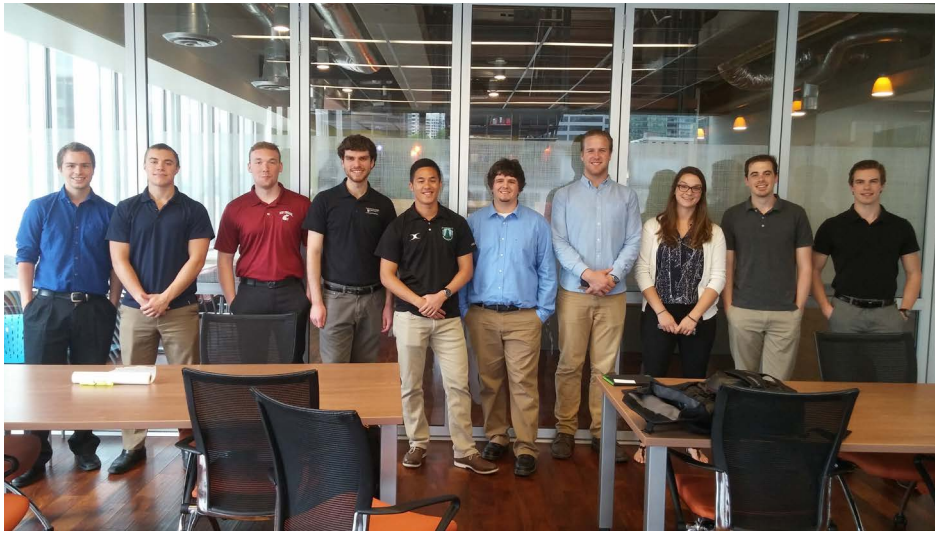
IDX Introduction

Integrated Design Experience

Olympic Peninsula Team

- 10 WSU Civil Engineering Undergrads
- Water Resources, Infrastructure and Construction
- Graduate this spring or next fall

Instructed by Dr. Karl Olsen



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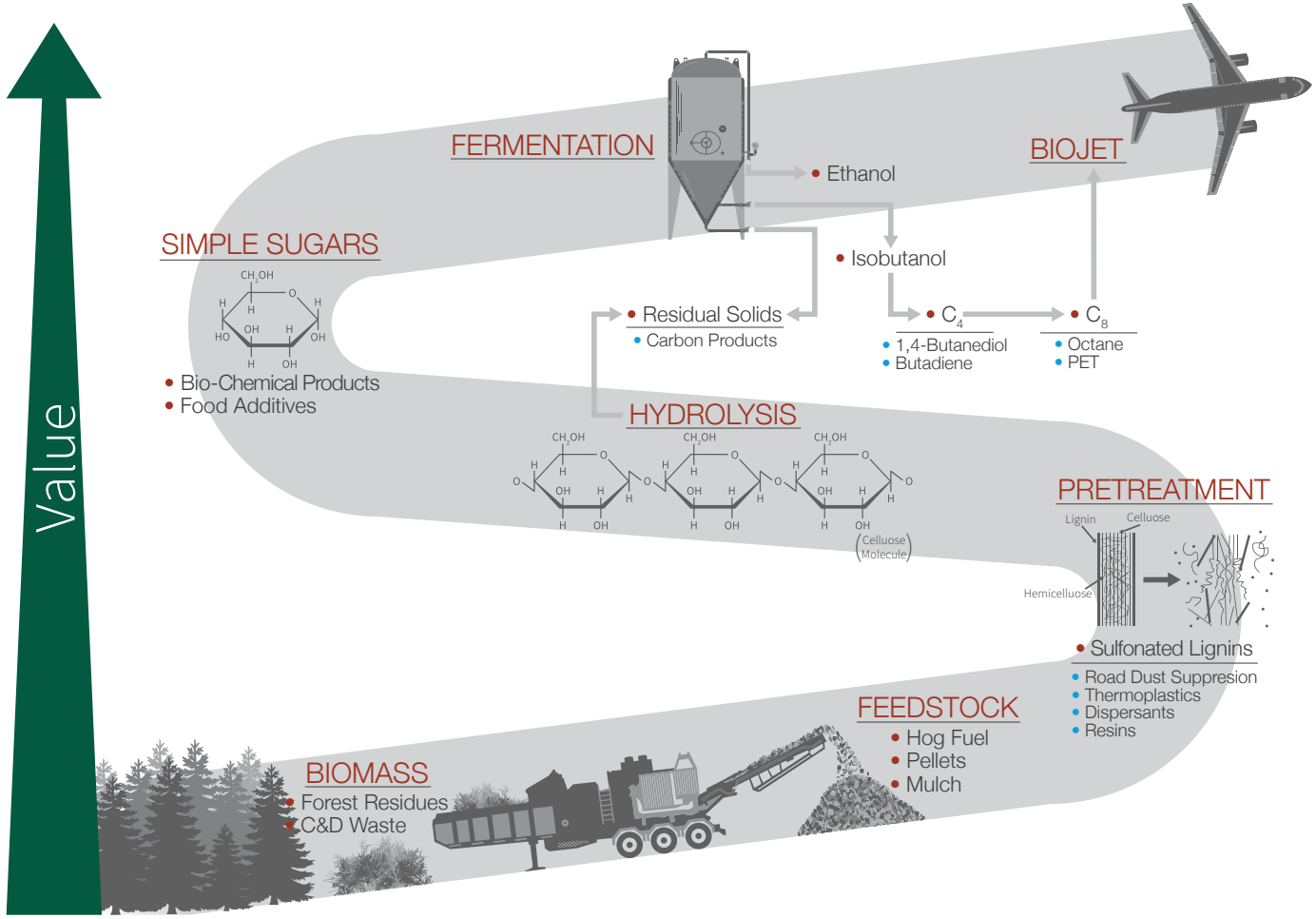
Wood to Wing



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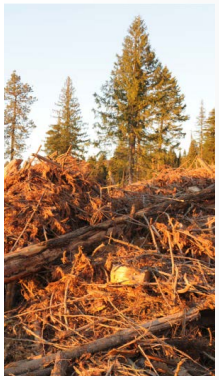
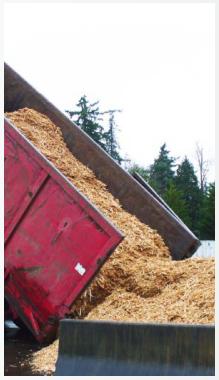
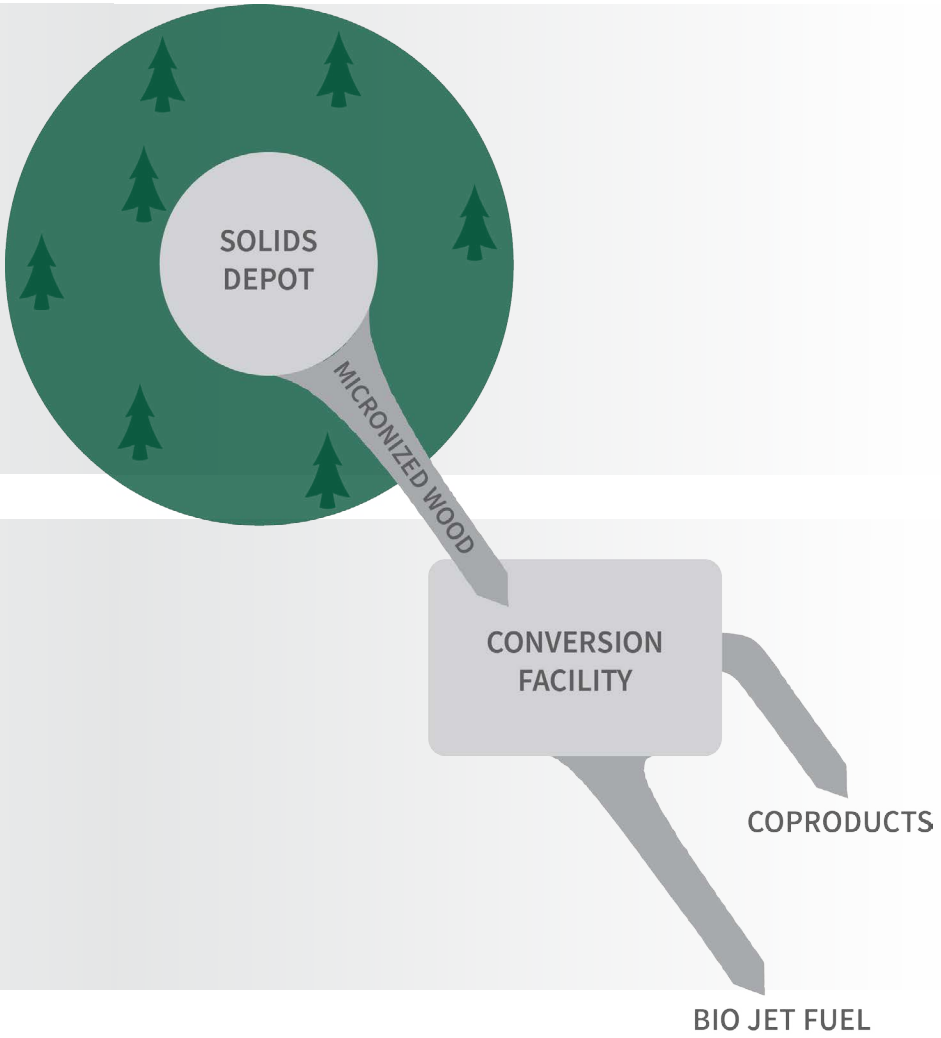
Depot Model

Introduction


Biomass to Milled Wood


Milled Wood to Isobutanol



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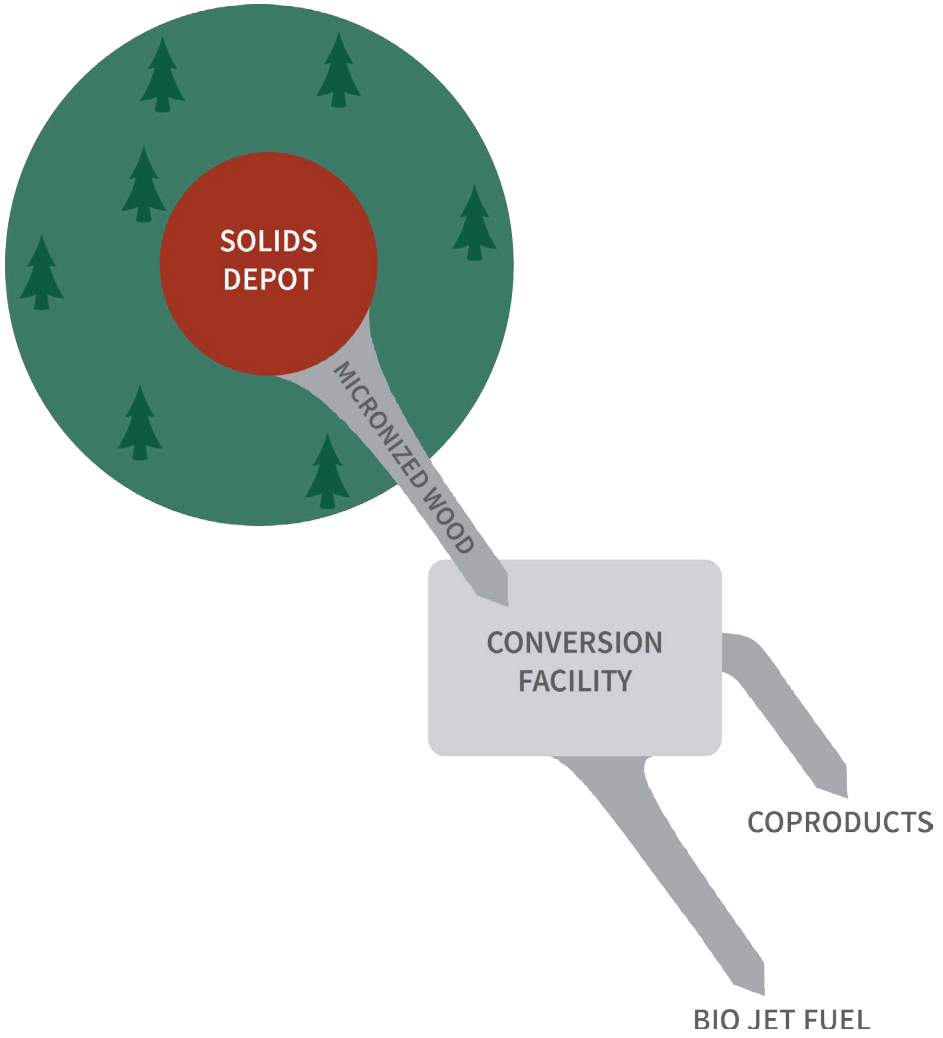
Depot Model
Solids Depot

Solids Depot

- Hermann Brothers Logging
- Biomass to Milled Wood
- 50,000 BDT/yr



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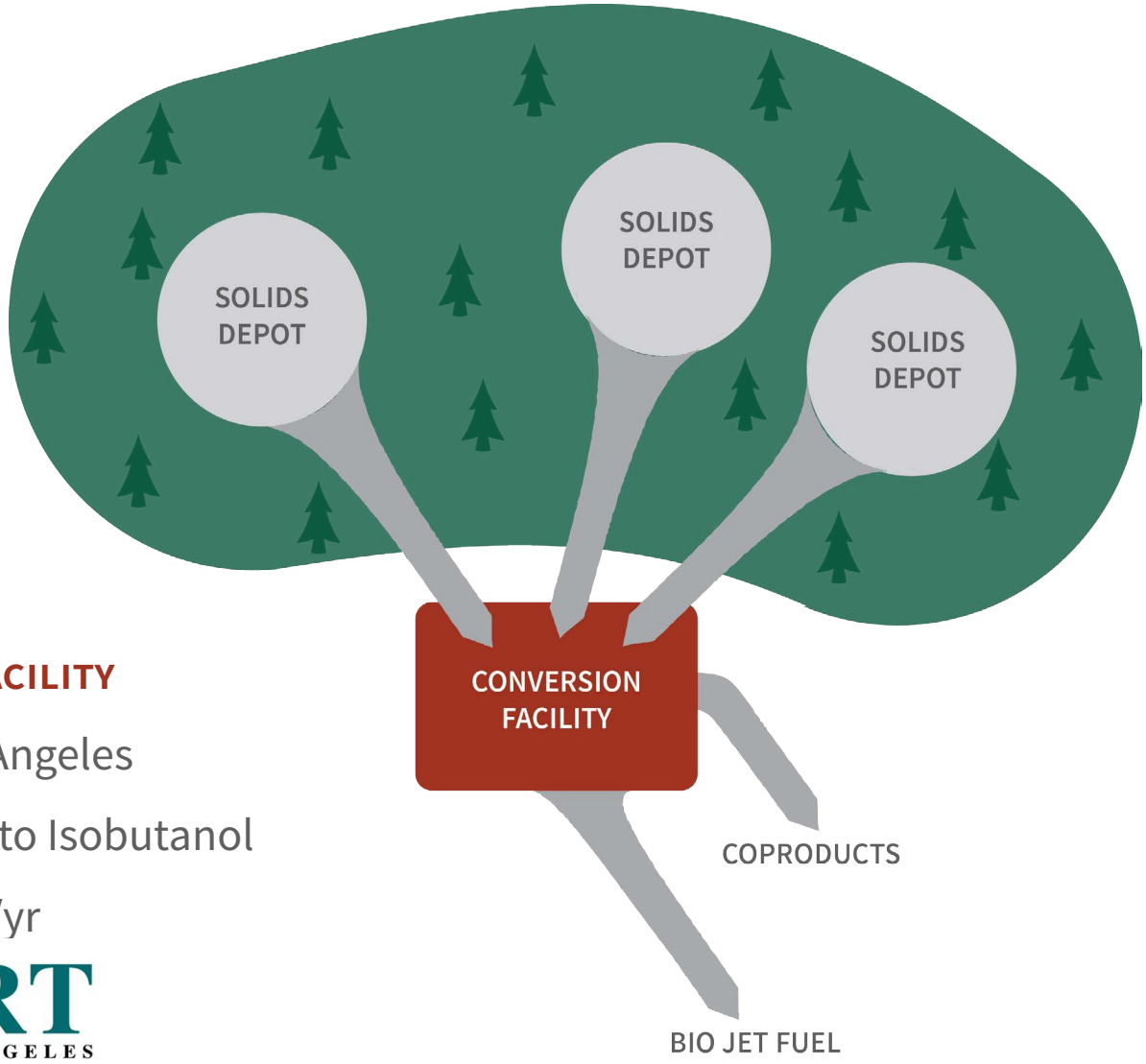
Depot Model
Conversion Facility



Conversion Facility

- Port of Port Angeles
- Milled wood to Isobutanol
- 380,000 BDT/yr

PORT OF PORT ANGELES WASHINGTON

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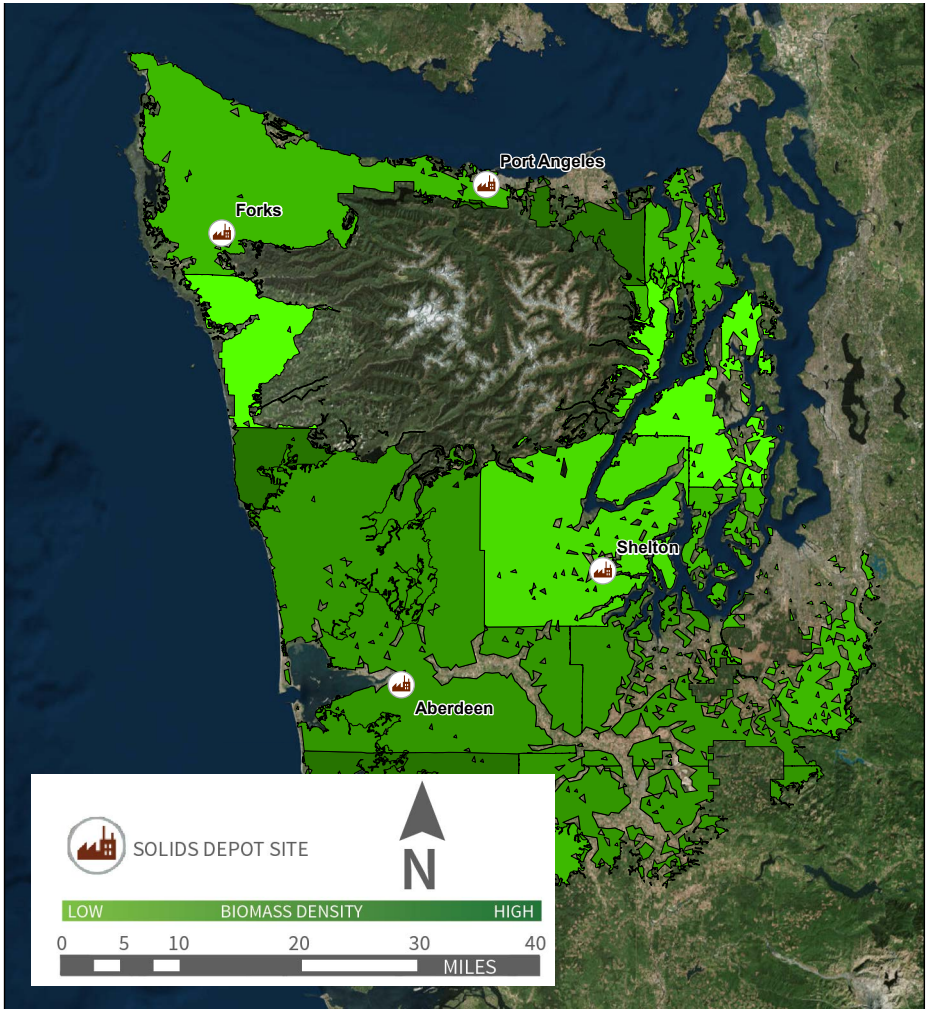
Biomass and Siting

Olympic Peninsula

Region includes Olympic Peninsula and Twin Harbors

945,000 BDT/yr

- Does not inlcude biomass on federal land
- Other industries may be competing for biomass



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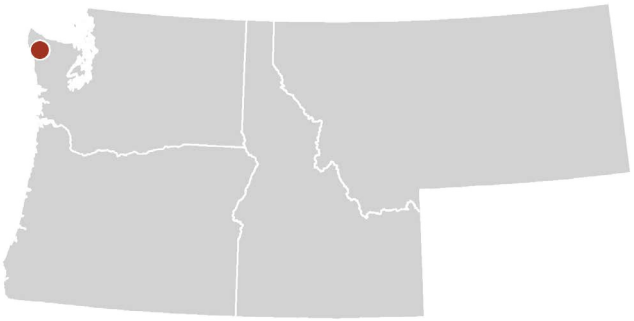
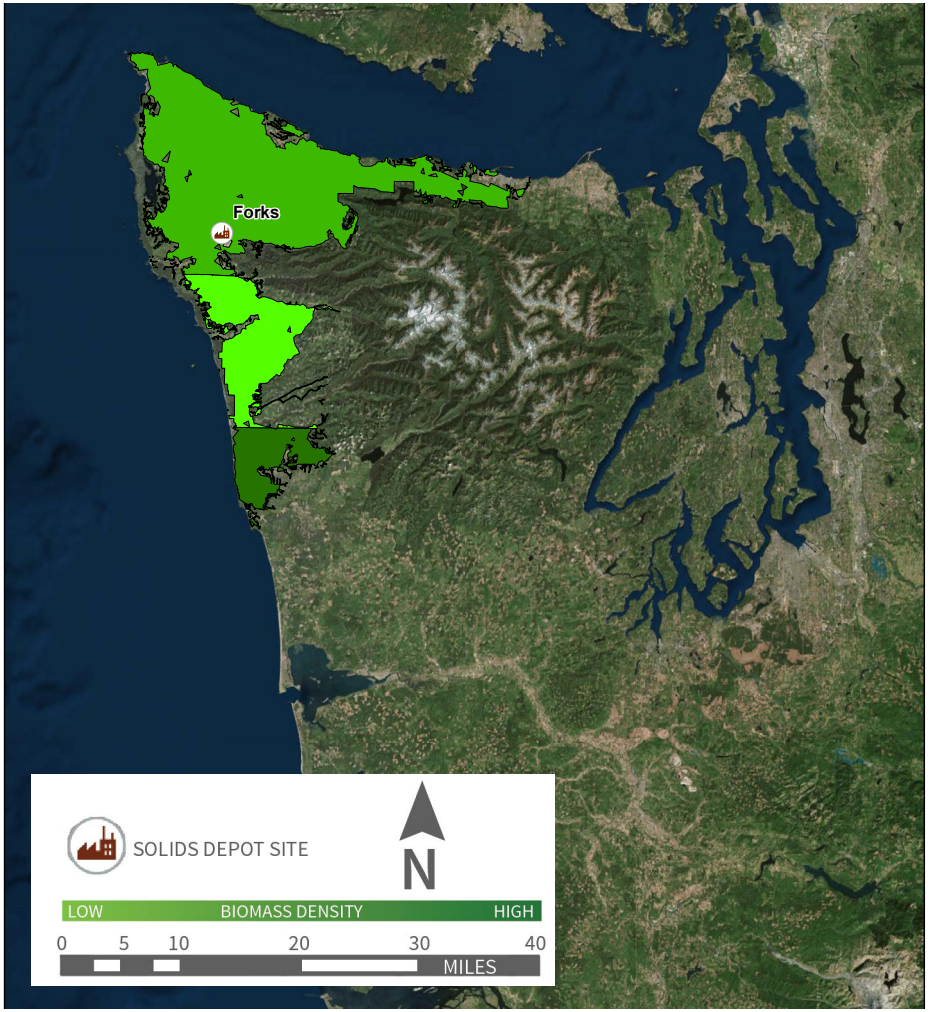
Biomass and Siting

Siting

Depot 1

City: Forks , WA
Biomass: 140,000 BDT/yr
Proximity: 56 miles





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Biomass and Siting

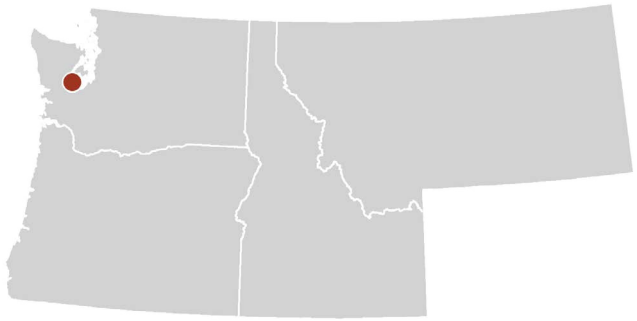
Siting

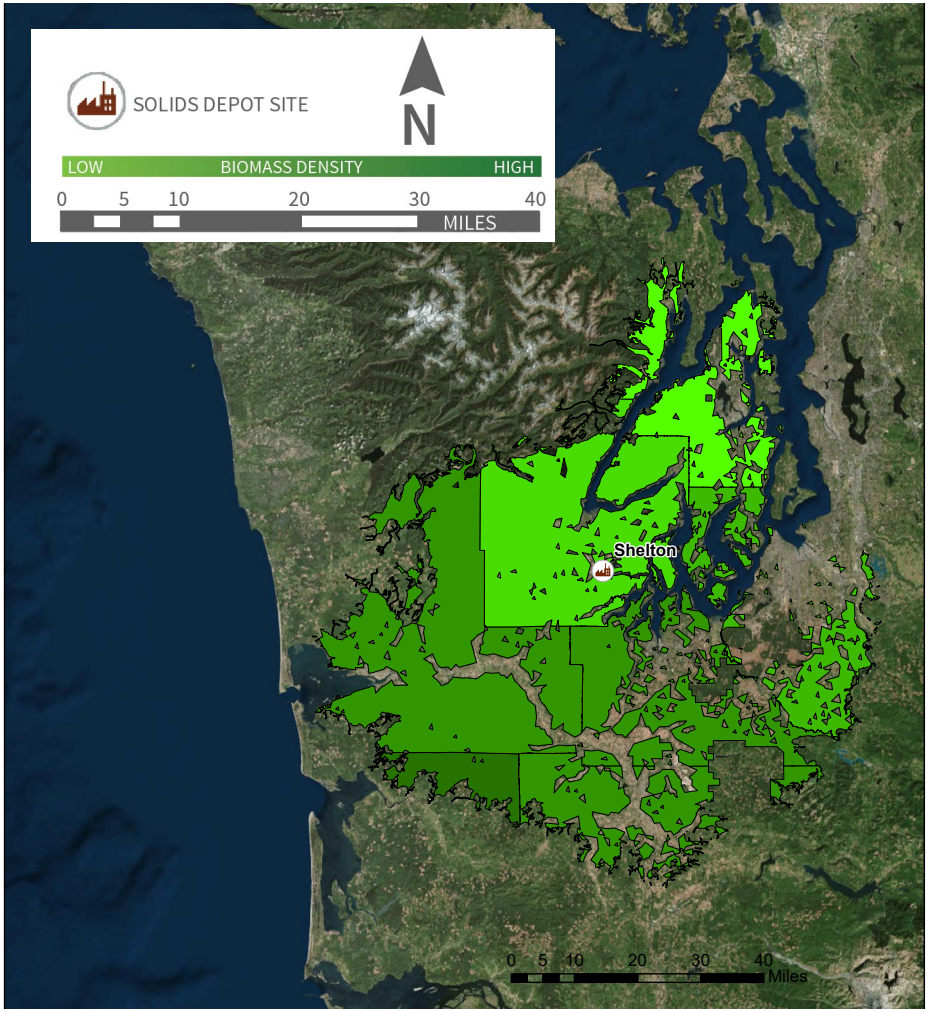
Depot 2

City: Shelton, WA

Biomass: 460,000 BDT/yr

Proximity: 99 miles





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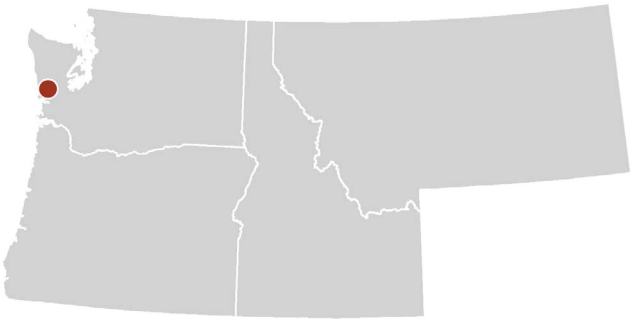
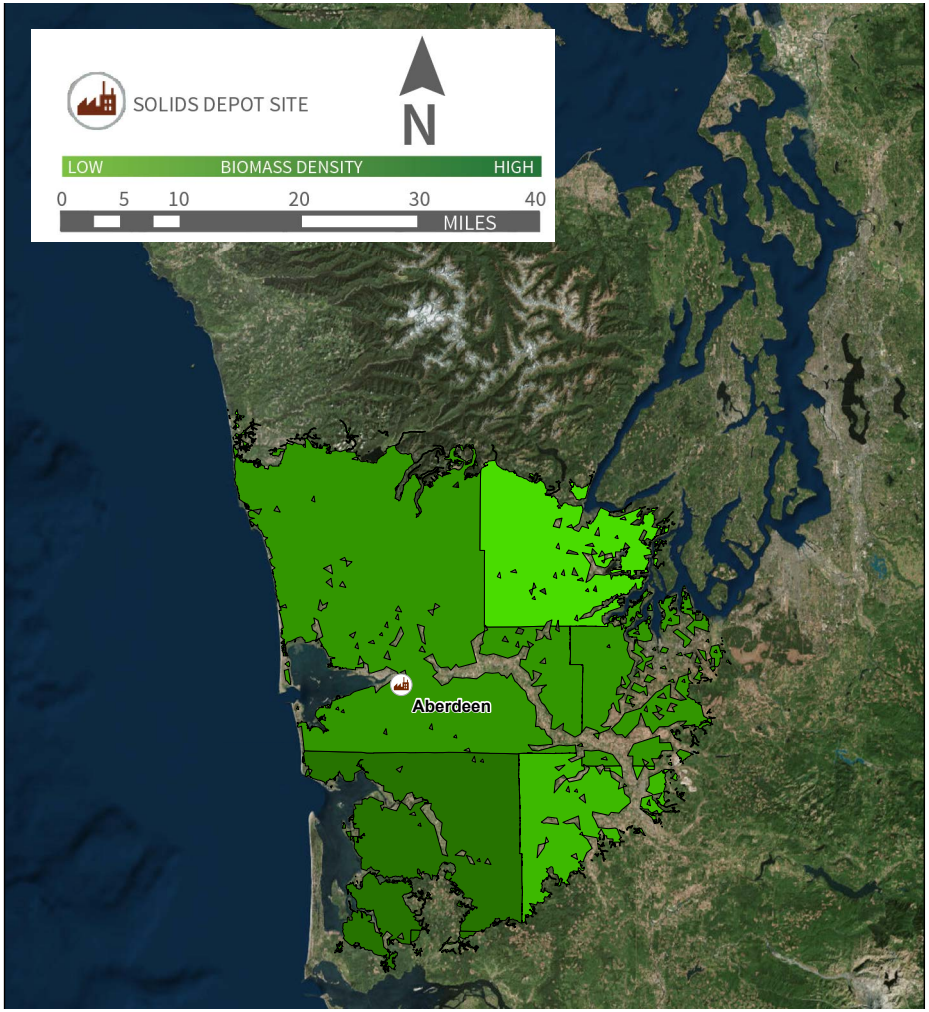
Biomass and Siting

Siting

Depot 3

City: Aberdeen, WA
Biomass: 615,000 BDT/yr
Proximity: 144 miles





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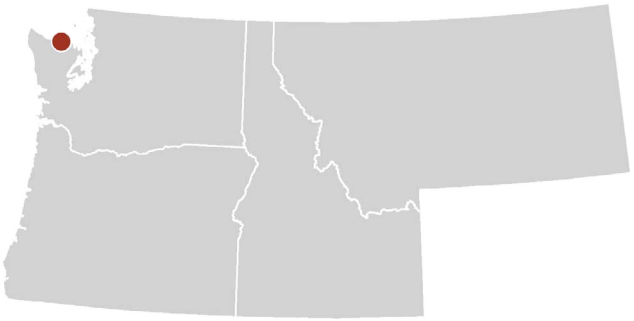
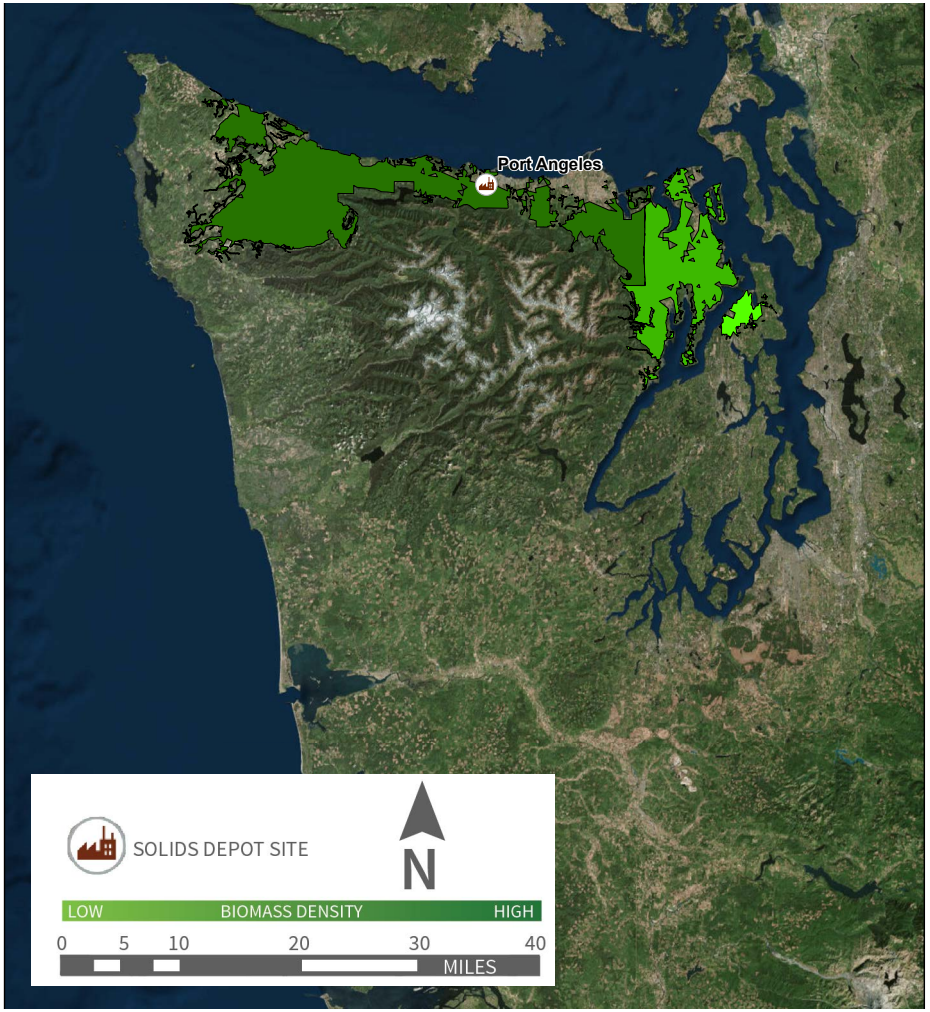
Biomass and Siting

Siting

Depot 4

City: Port Angeles, WA
Biomass: 88,000 BDT/yr
Proximity: 3 miles





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Biomass and Siting

Forest Residuals

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USDA

Biomass and Siting
Collection

Shovel

Horizontal Grinder

Chip Van

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Collection

Shovel

Horizontal Grinder

Chip Van

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Shovel

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Hermann Brothers

Introduction

- Port Angeles, WA
- 4.33 acre pacrel
- Adjacent to existing Hermann Brother Site
- 0.6 miles from US-101

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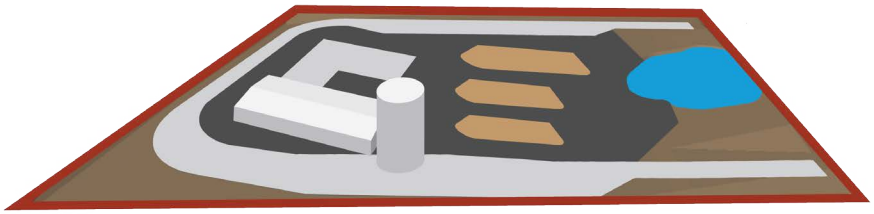
Hermann Brothers

Construction Layers



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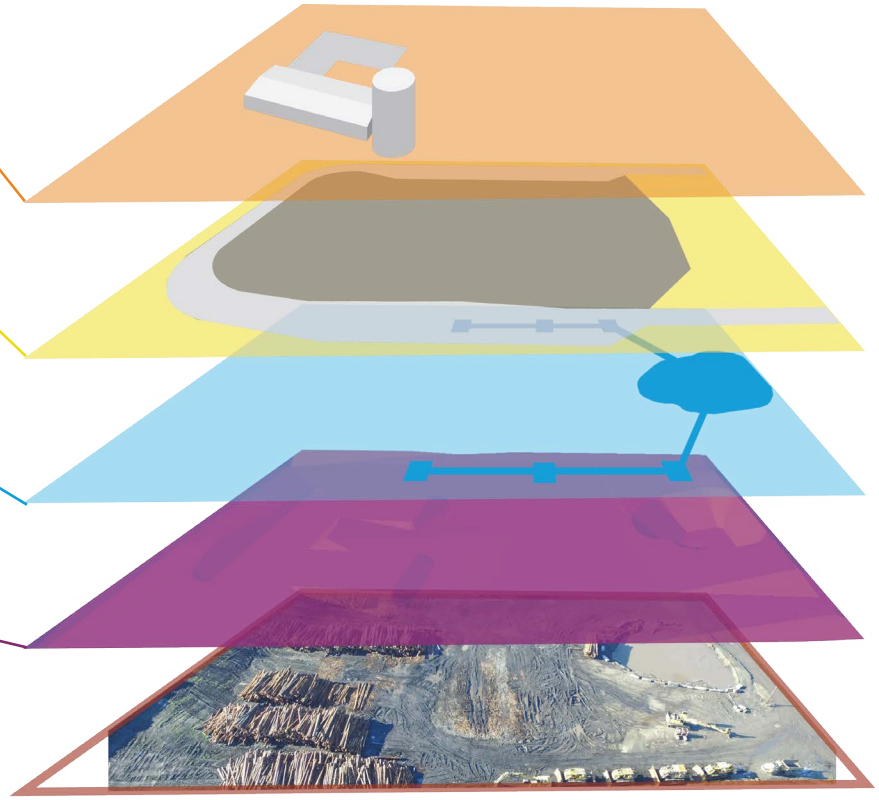
Hermann Brothers
Construction Layers

Structures and Equipment
Brent Siegfried, Dane Camenzind

Pavement
Tyler Thornton

Stormwater and Utilities
Tyler Kerschner, Victor Schlonga

Grading
Victor Schlonga



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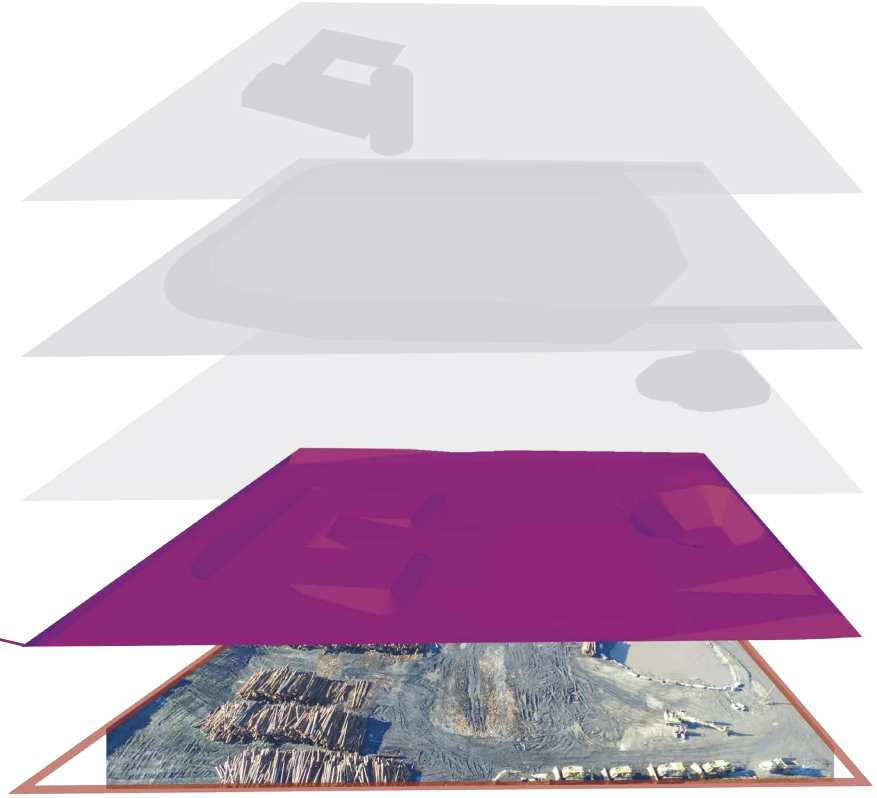

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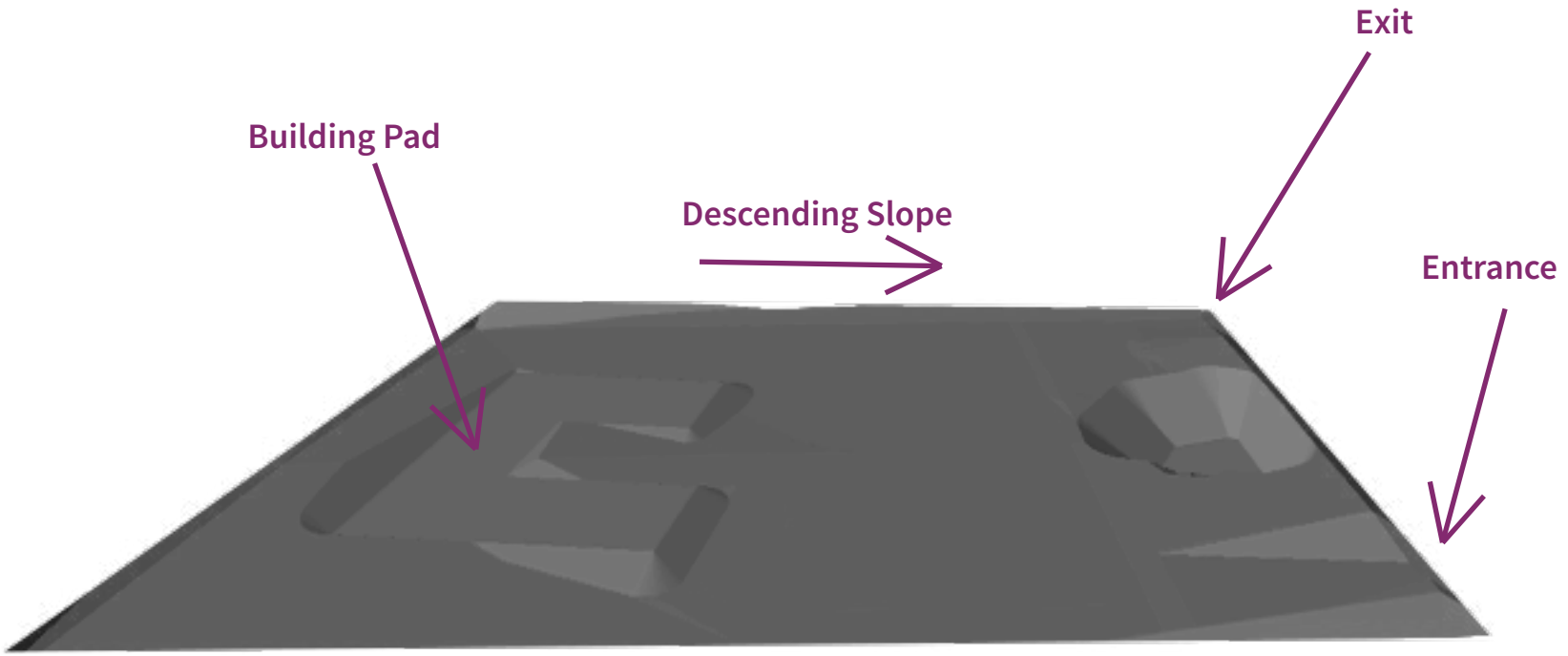

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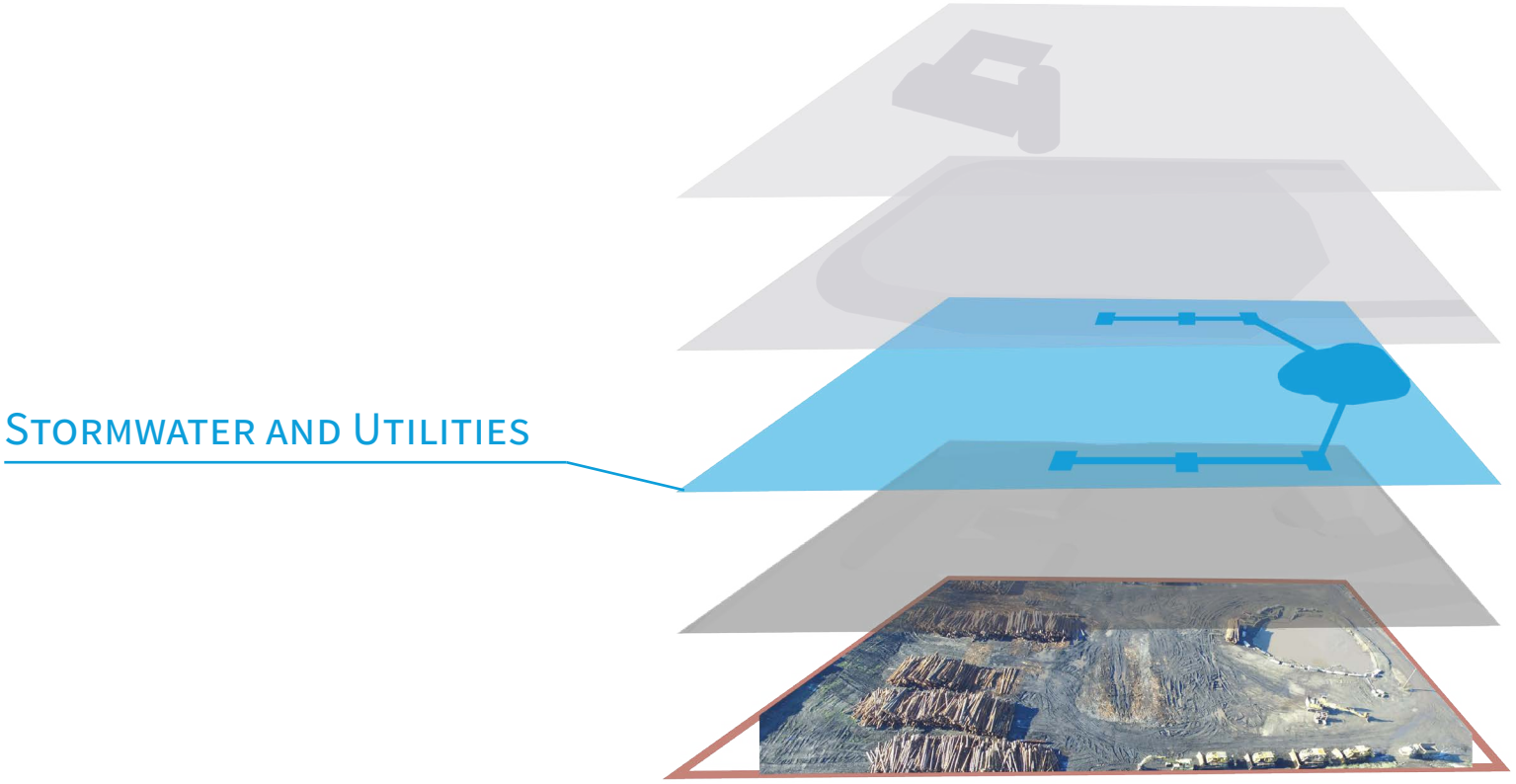
Stormwater and Utilities



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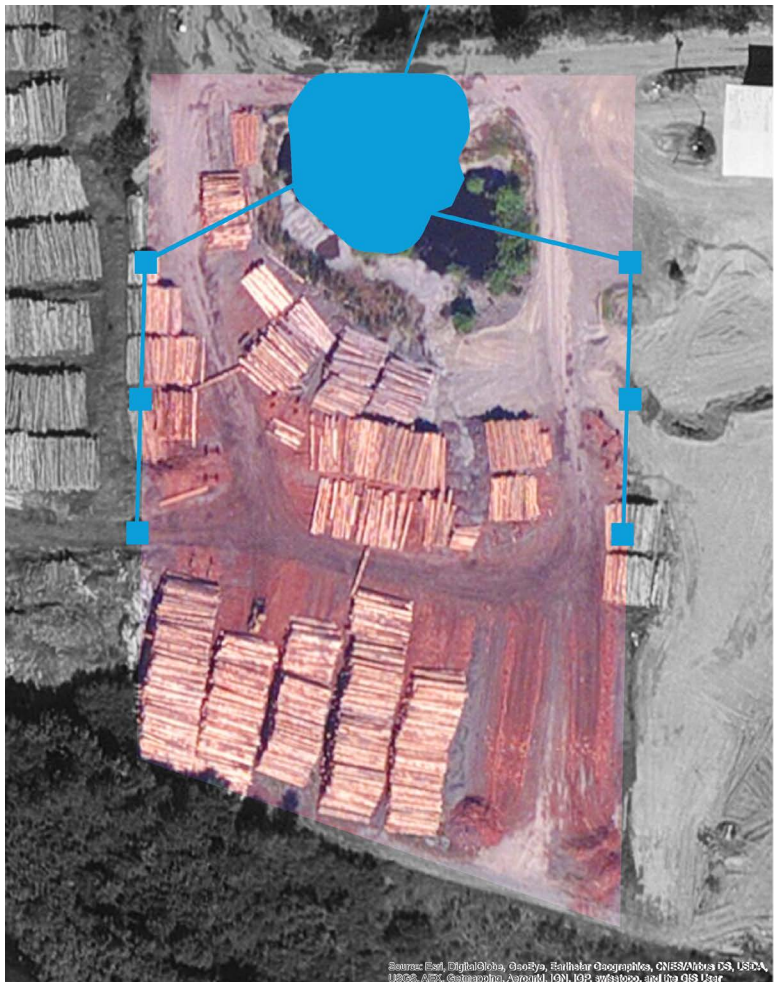
Hermann Brothers

Stormwater

- Site is crowned at the center to direct water towards catch basins
- water is directed to the pond through 6 catch basins and 12 inch pipes
- water is drianed to the main Hermann Site through an 18 inch pipe



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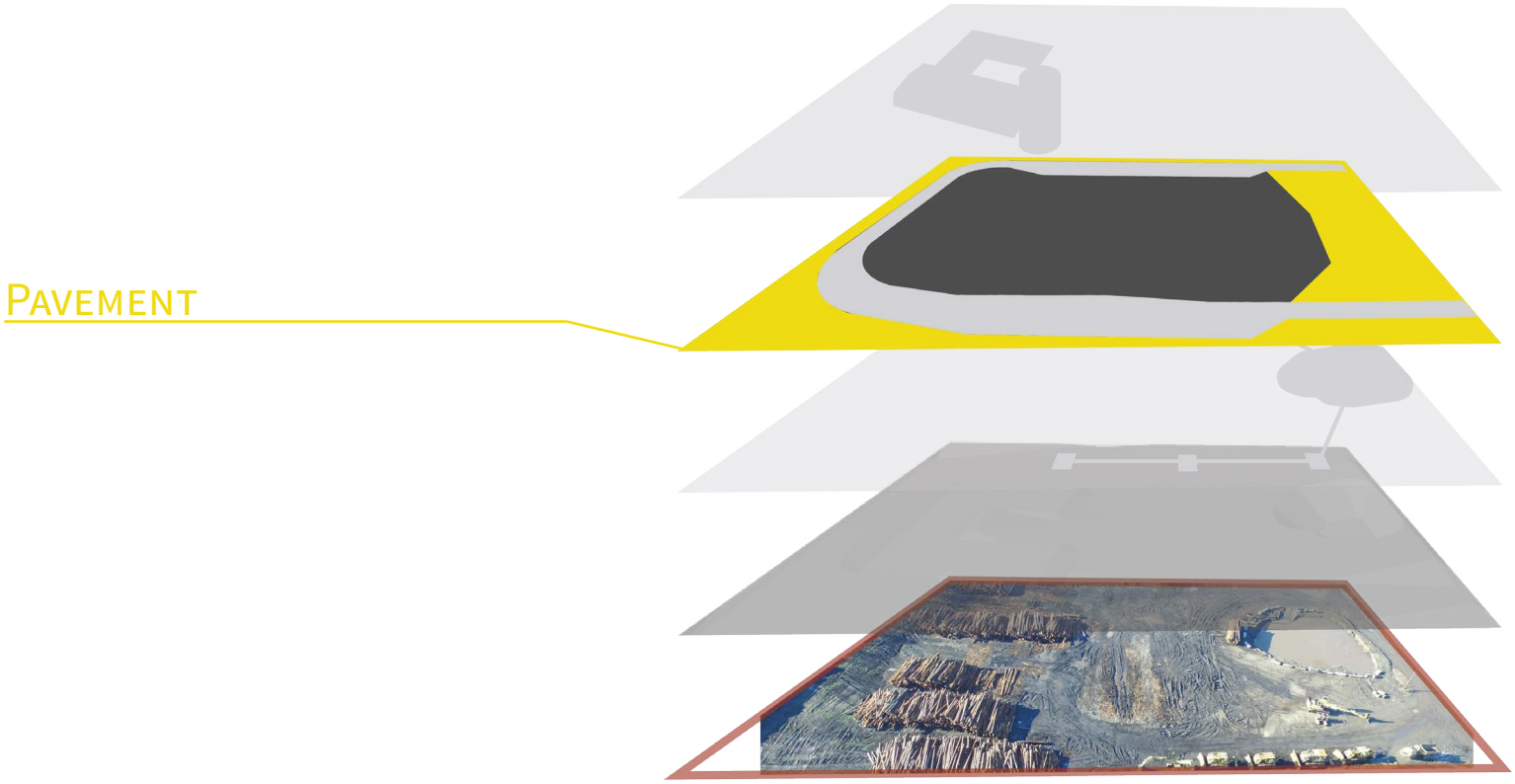
Pavement



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Rigid Pavement

Rigid pavement covers the drive path of all loading and unloading trucks

- 5.5 inches of continuously reinforced concrete pavement (CRCP)
- 15.5 inches of crushed gravel base

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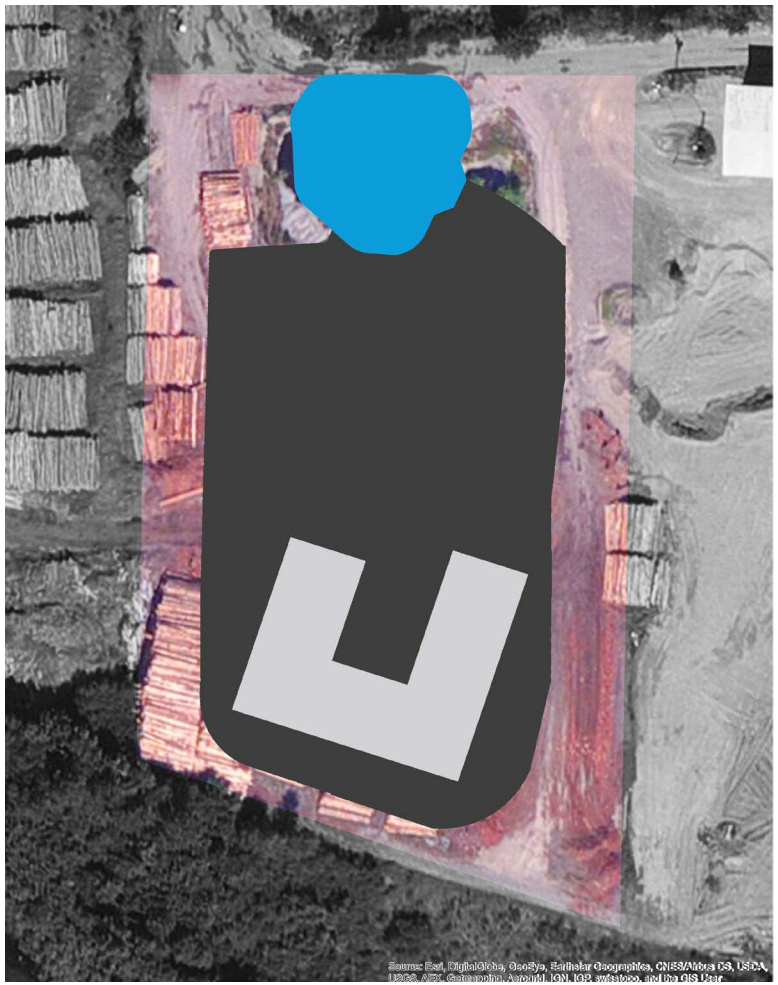
Flexible Pavement

Flexible pavement covers wet biomass storage and remaining center of the site

- 5.5 inches of hot mix asphalt (HMA)
- 15.5 inches of crushed gravel base



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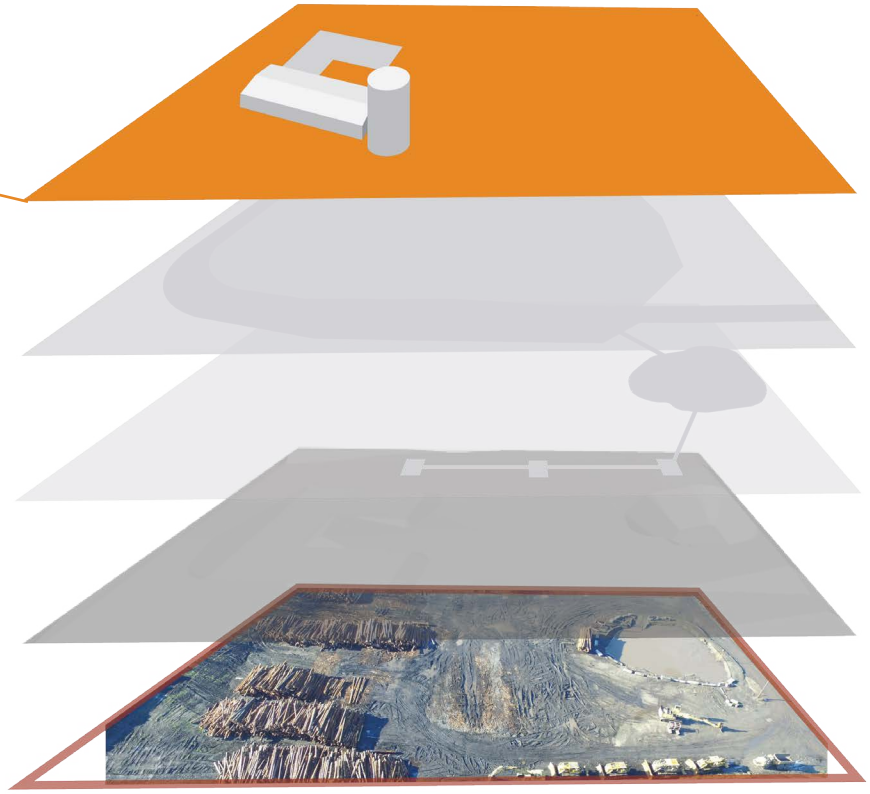
Hermann Brothers

Structures and Equipment

Structures and Equipment



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Hermann Brothers
Equipment

- Horizontal Grinder
- Rotary Dryer
- Hammer Mill
- Air Classifying Mill
- Ball Mill
- Dry Storage

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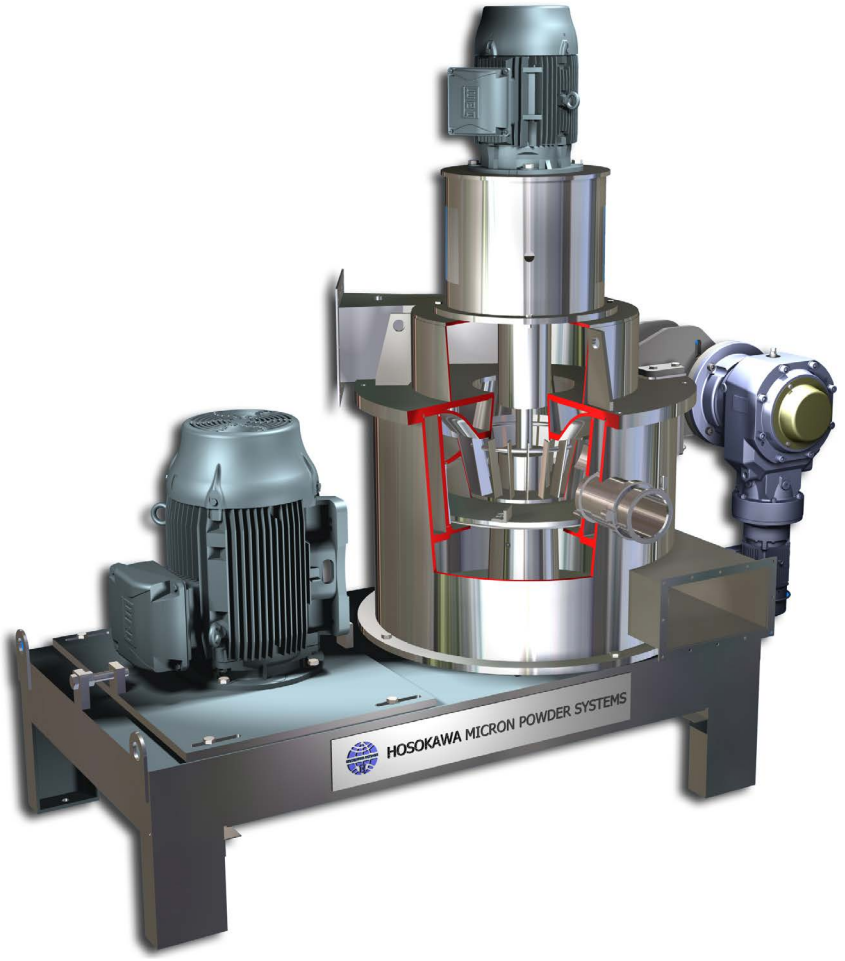

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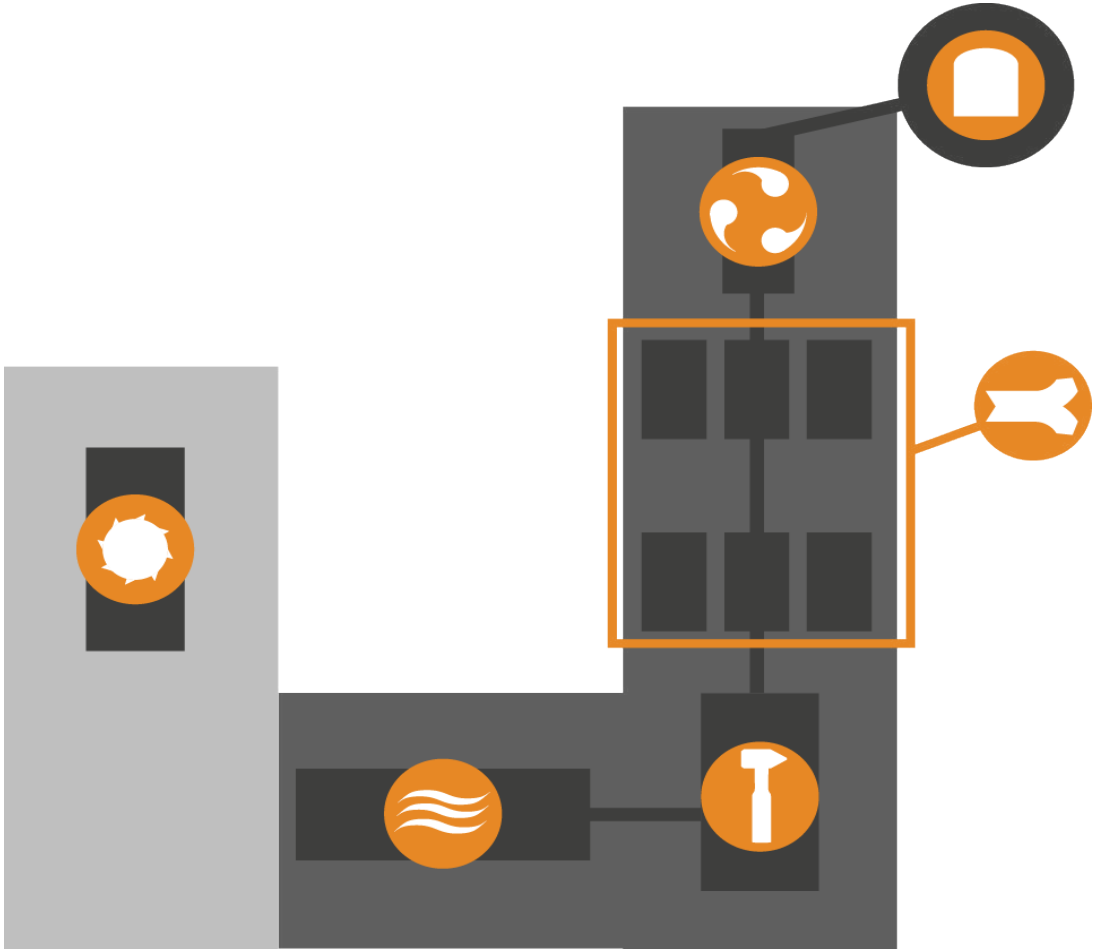
Hermann Brothers
Equipment Layout



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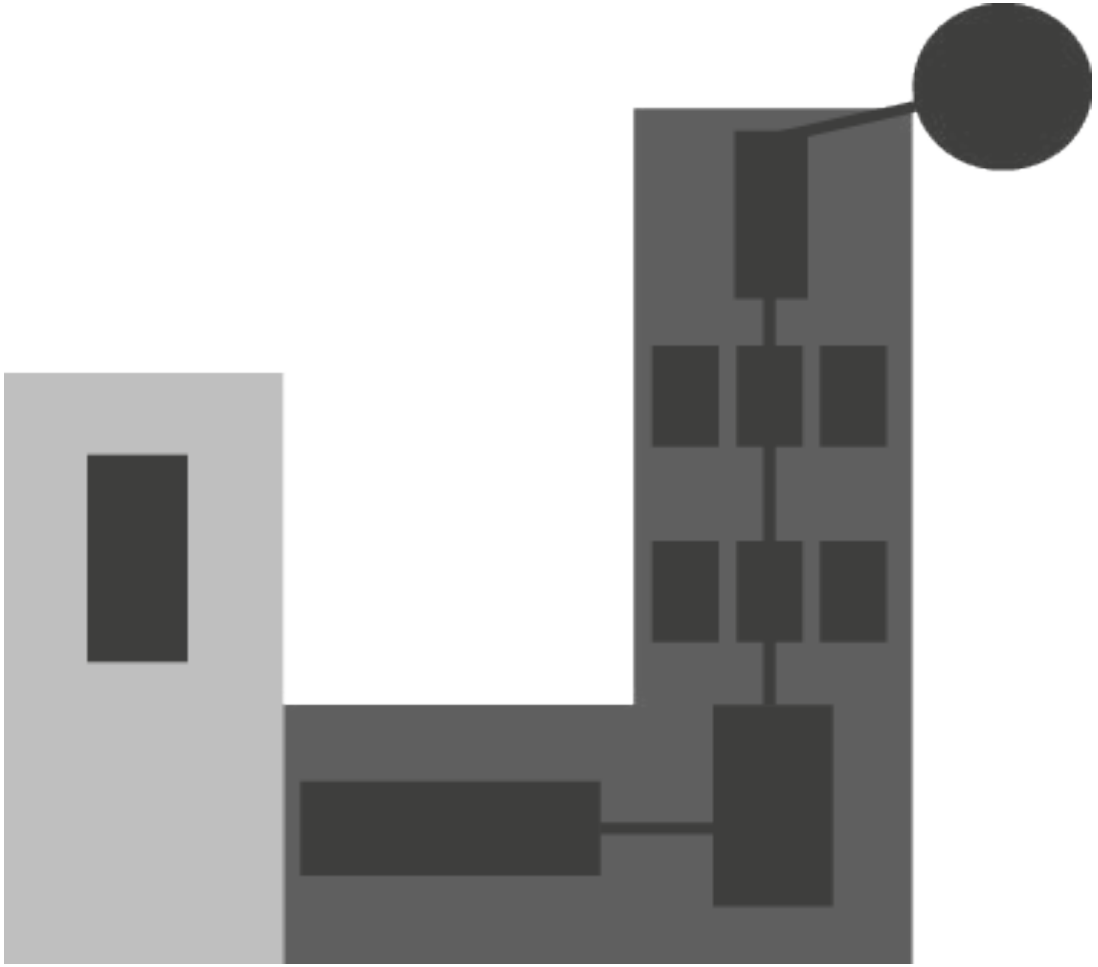
Hermann Brothers
Equipment Layout

Foundations
- 17,000 square feet
- Shallow mat foundations

Covered Structure
- 12,000 sq ft
- Gable symmetrical steel frame structure



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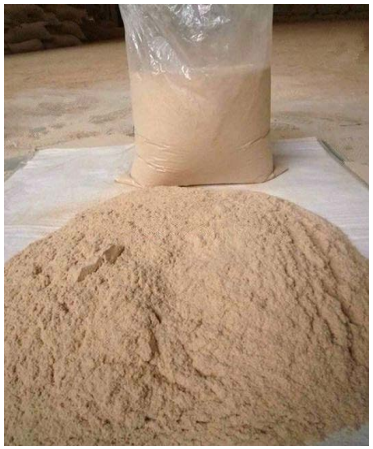
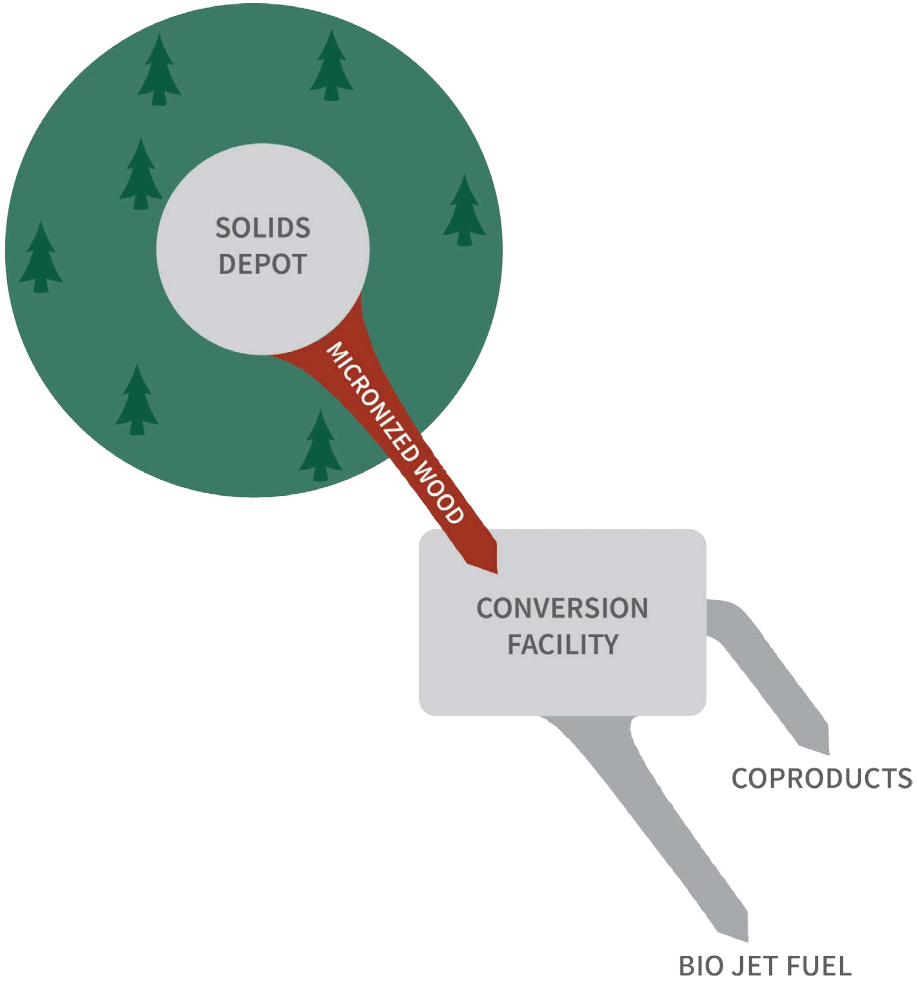
Dry Bulk Transportation

Intro

Similar Materials

- Dry cement
- Flour
- Lime
- Fly Ash





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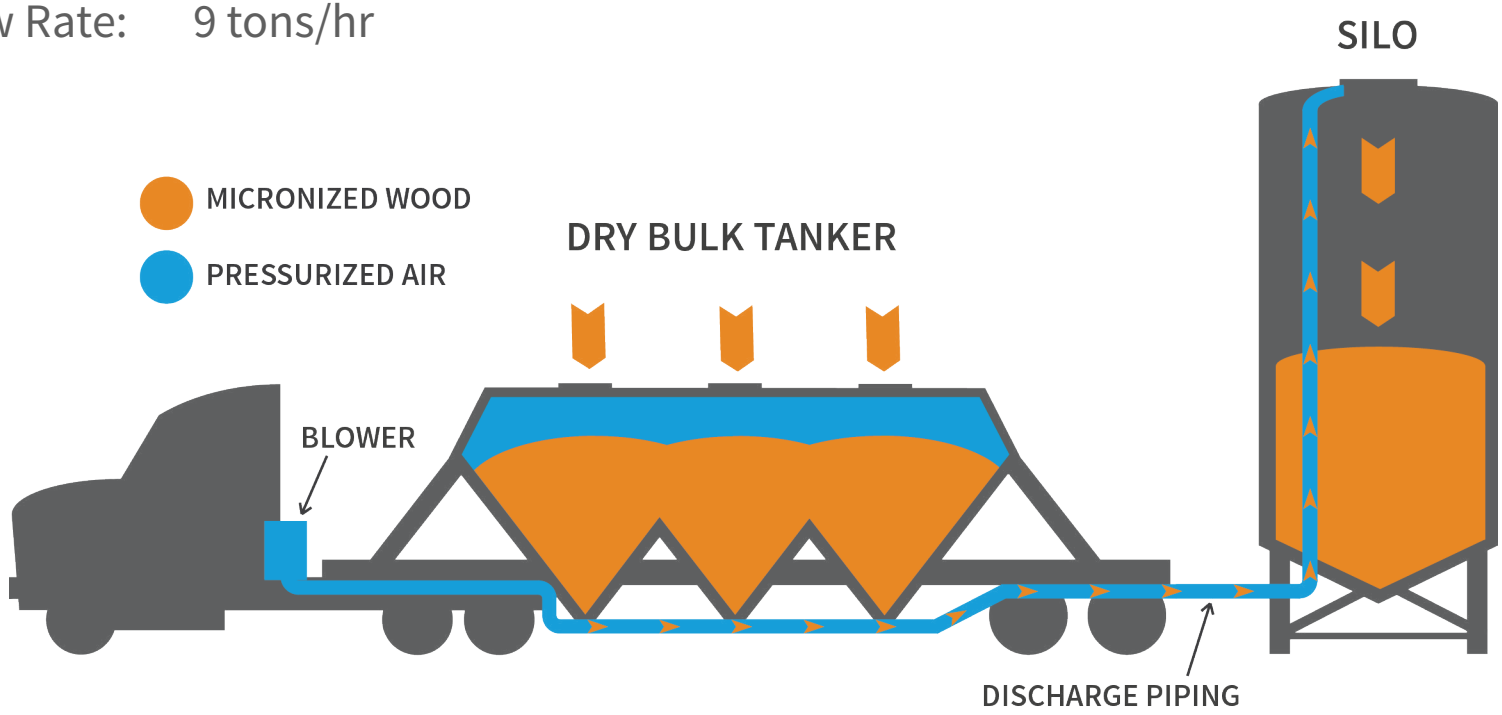
Dry Bulk Transportation

Pneumatic Conveying

Operations

Material Size:	50 microns
Pressure:	15 psi
Height:	80 ft
Distance:	15 ft
Mass Flow Rate:	9 tons/hr



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Dry Bulk Transportation

Loading

Dry Bulk Silo

Loading Spout

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Dry Bulk Transportation

Unloading

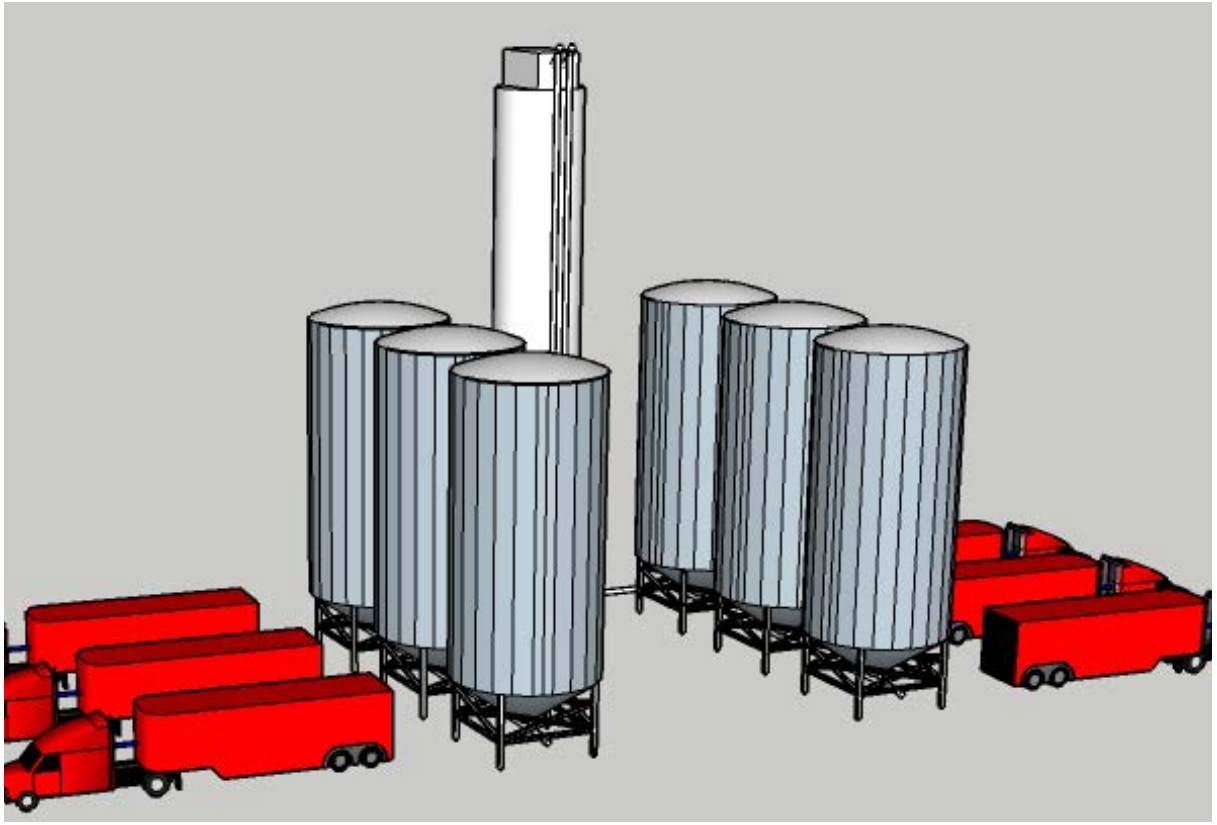
Dry Bulk Tanker

Storage Silo

Screw Conveyor

Pugmill Mixer

Hydrolysis Tower



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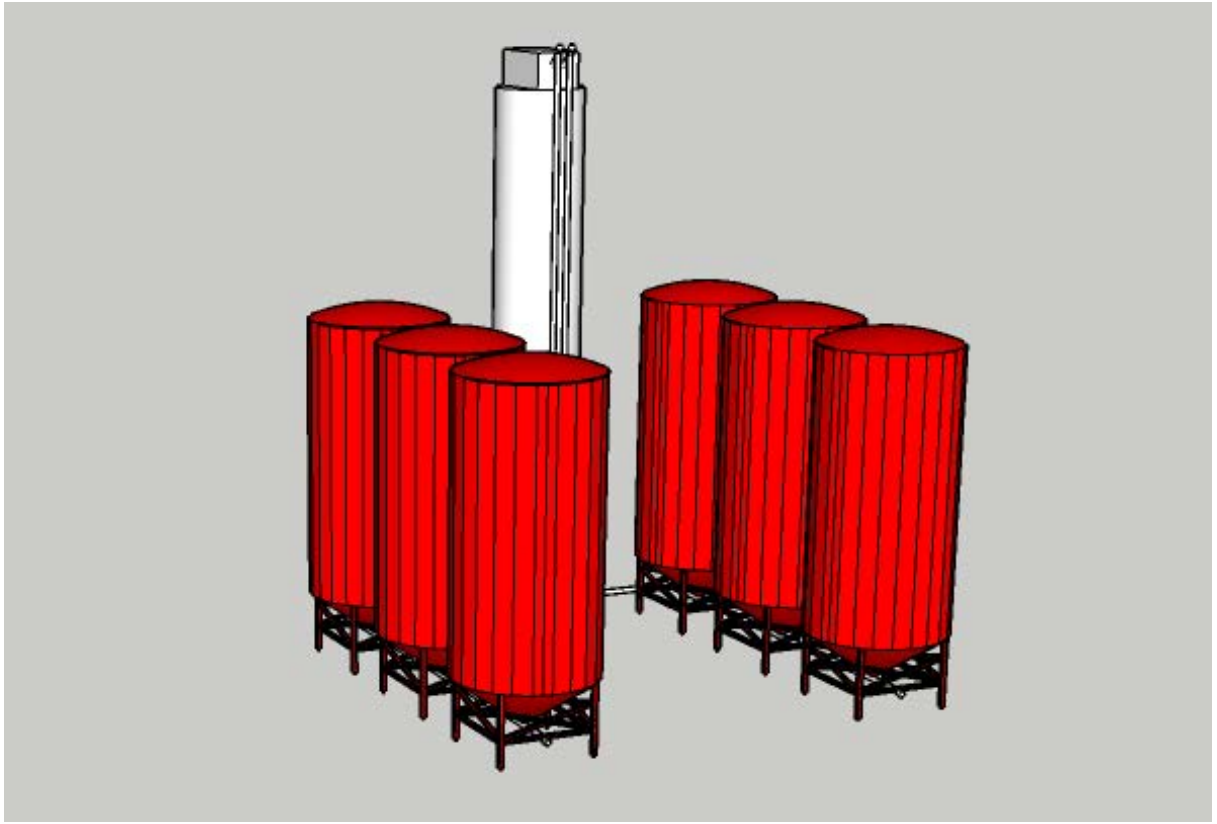

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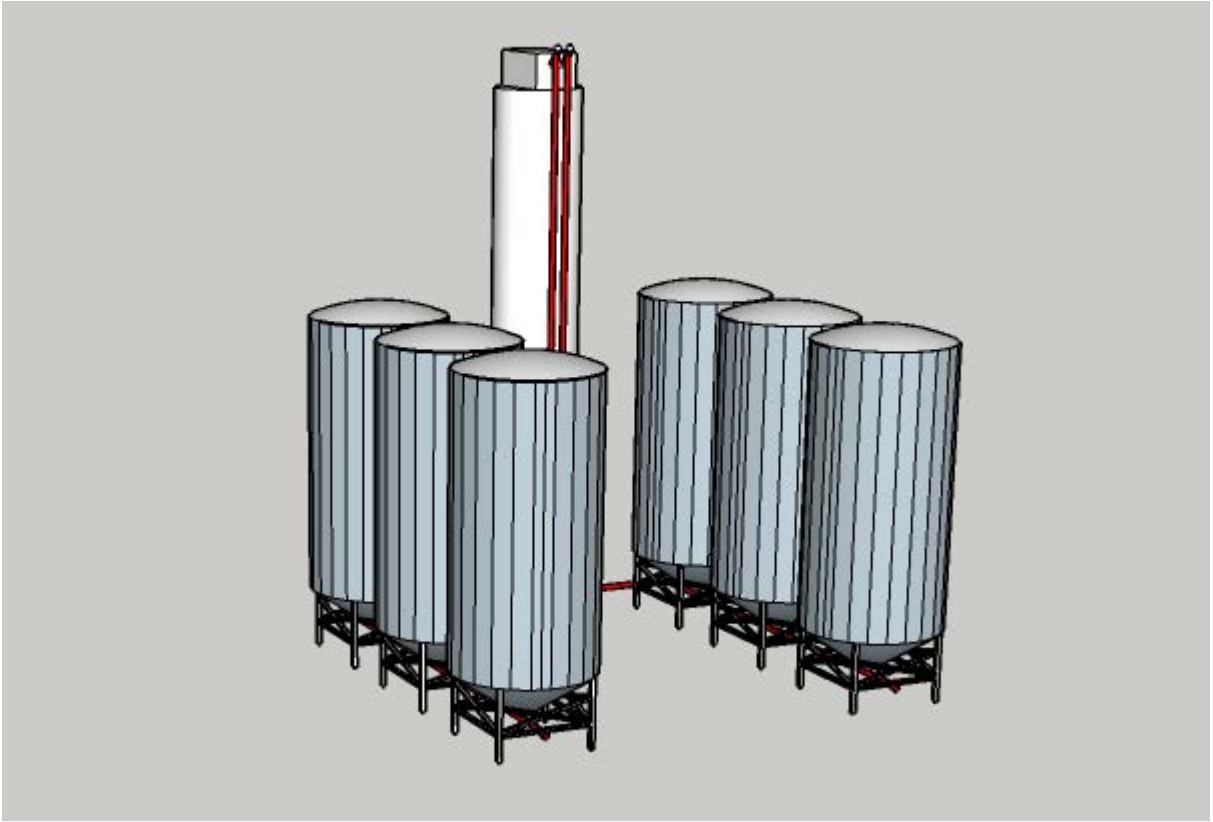

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Dry Bulk Transportation

Unloading

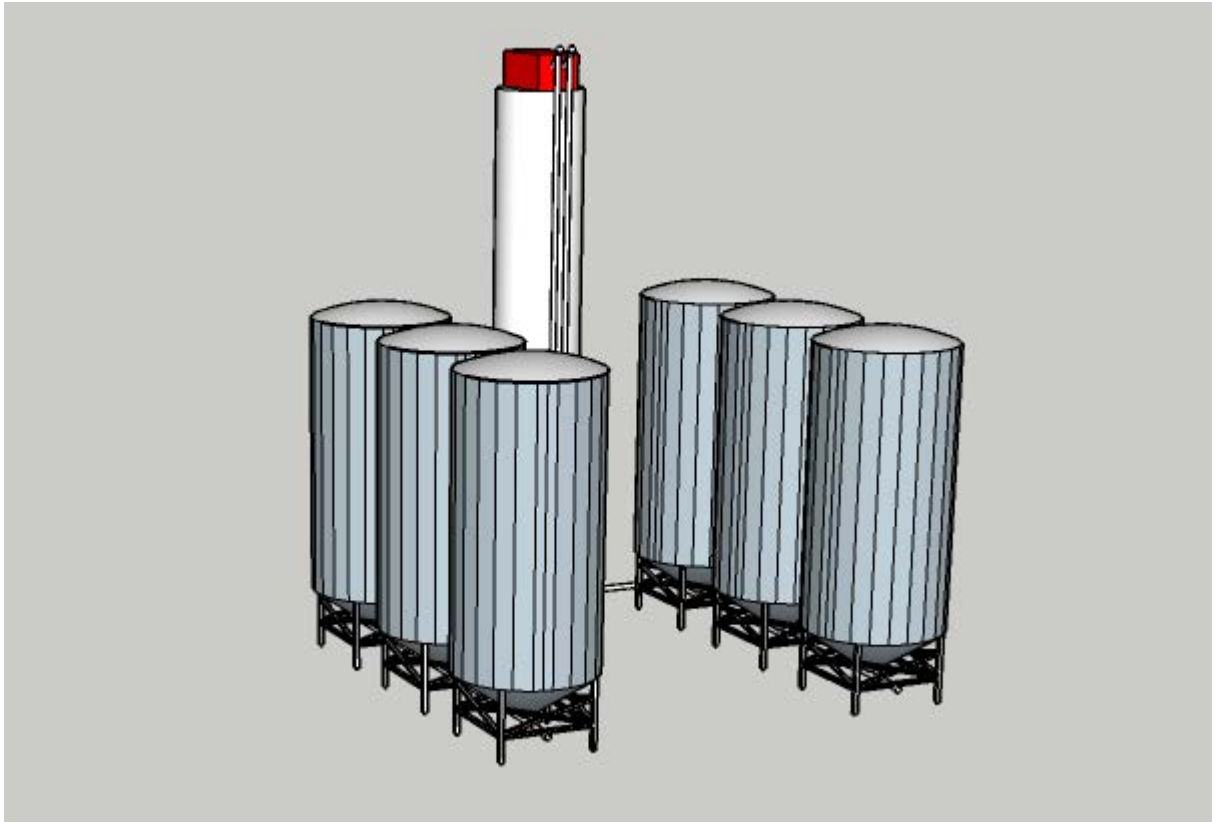
Dry Bulk Tanker

Storage Silo

Screw Conveyor

Pugmill Mixer

Hydrolysis Tower



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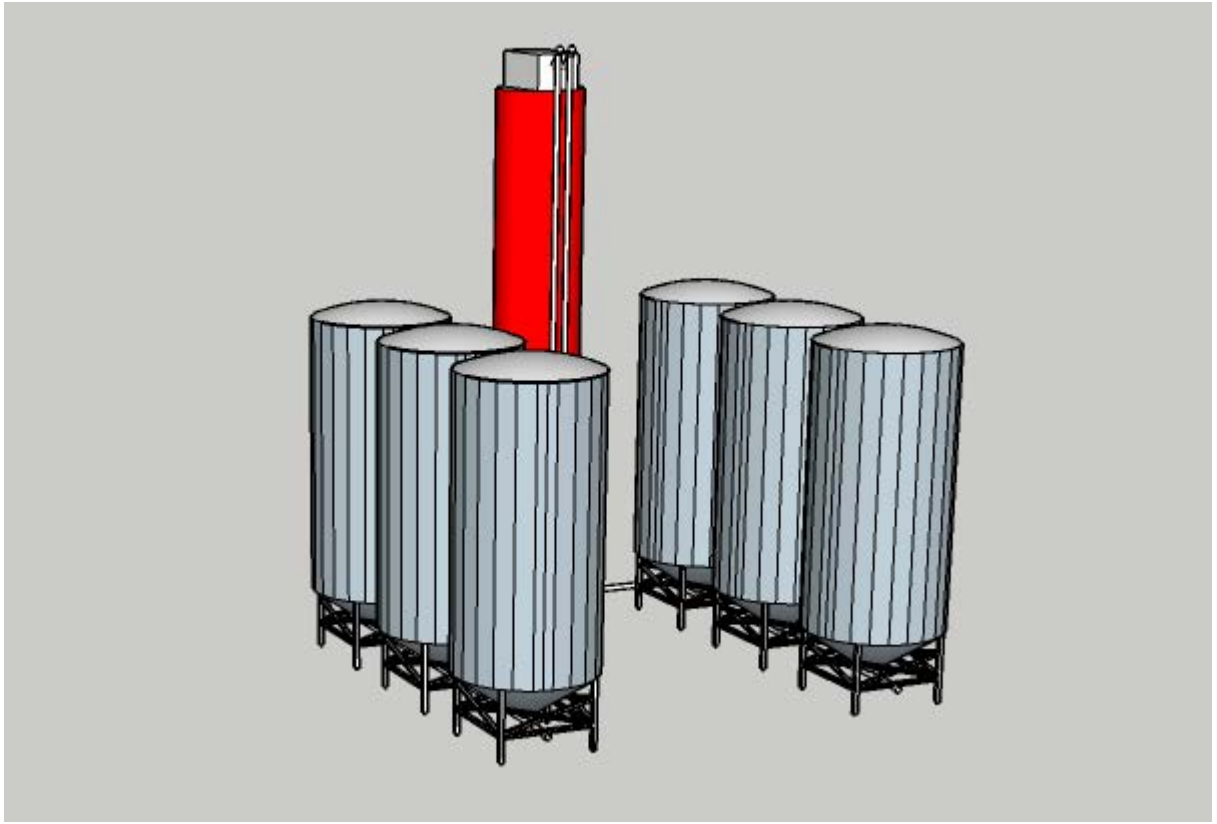

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USDA

K-Ply

Introduction

- Port Angeles, WA
- 18 acre pacrel
- Property owned by Port of Port Angeles
- Adjacent to WA-117
- 380,000 BDT/yr

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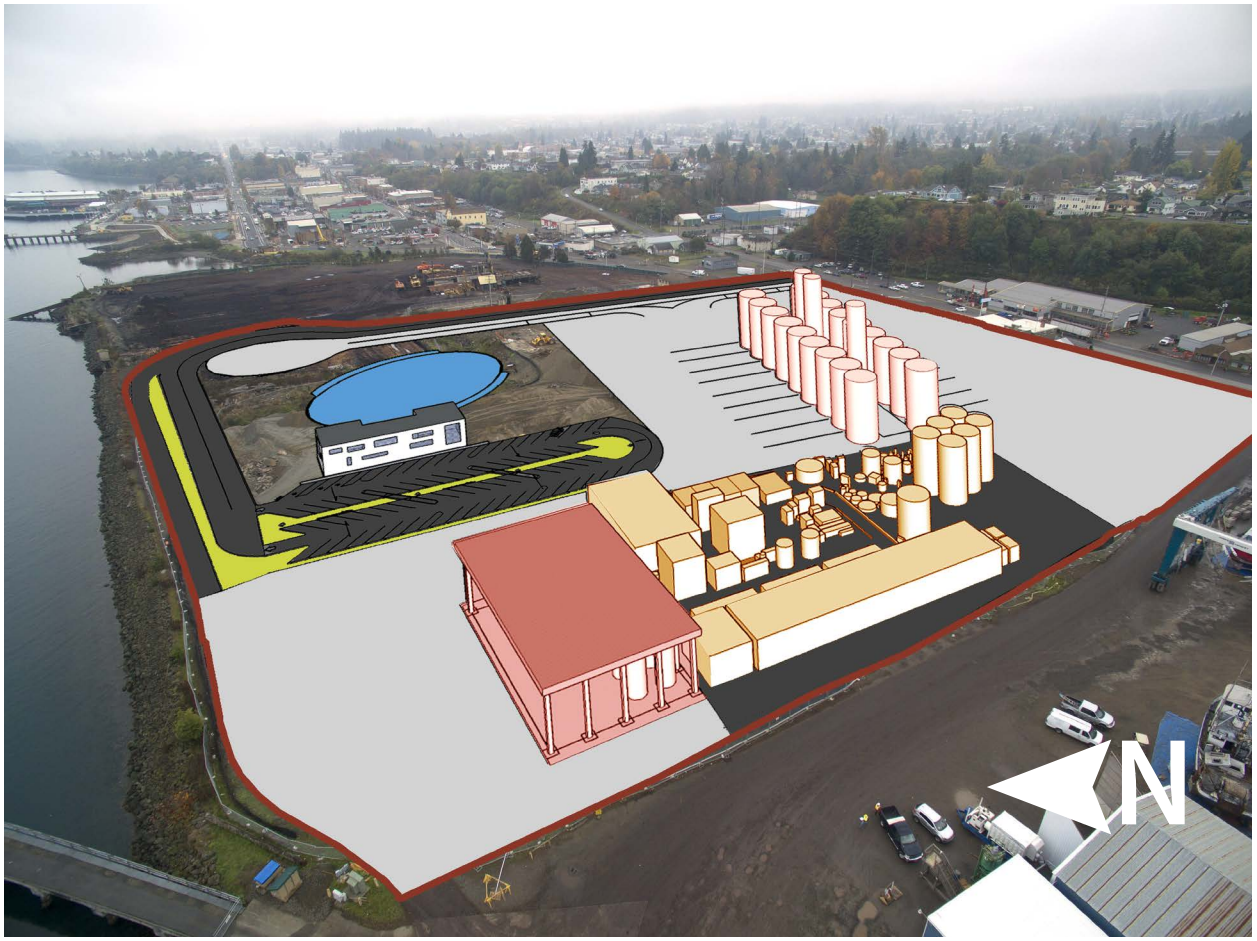

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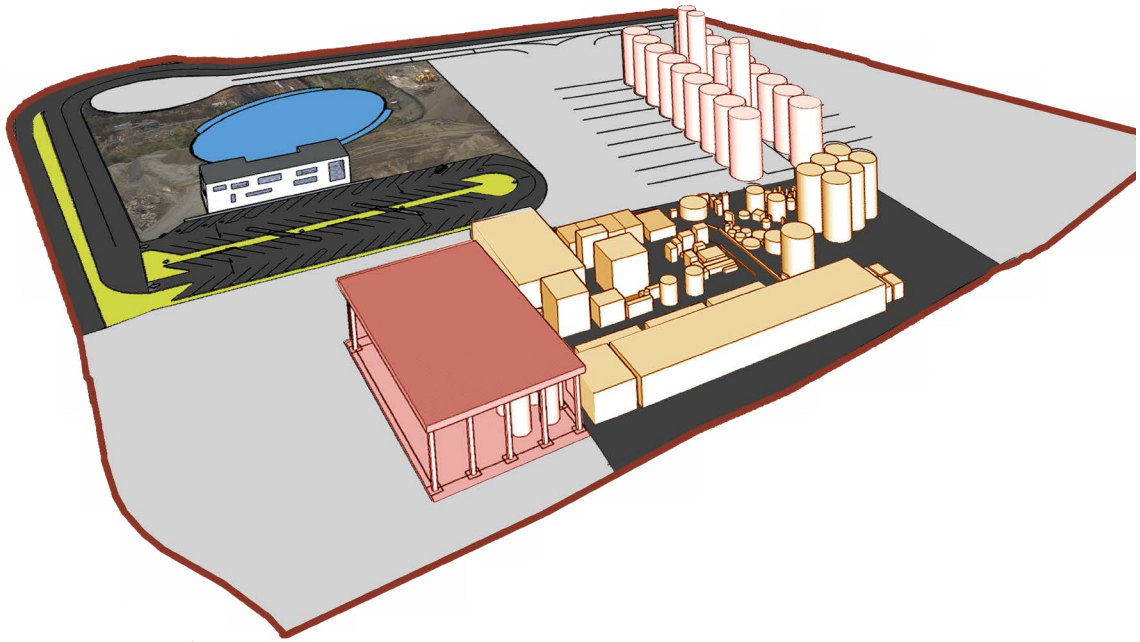
K-Ply
Introduction

Conversion & Refining
Taylor Arndt, Joey Malloy, Cody Wuestney

Loading and Unloading
Dane Camenzind, Taylor Arndt

Pavement
Tyler Thornton, Taylor Arndt

Water Treatment/Utilities
Casey Torres, Destry Seiler



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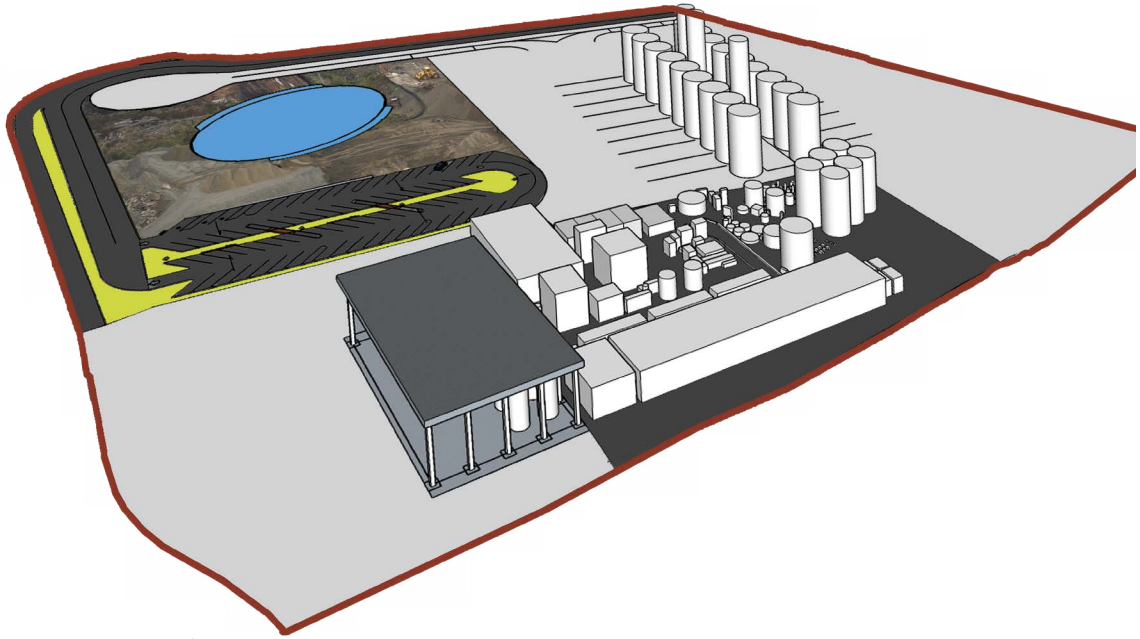
K-Ply
Water Treatment

Water Treatment



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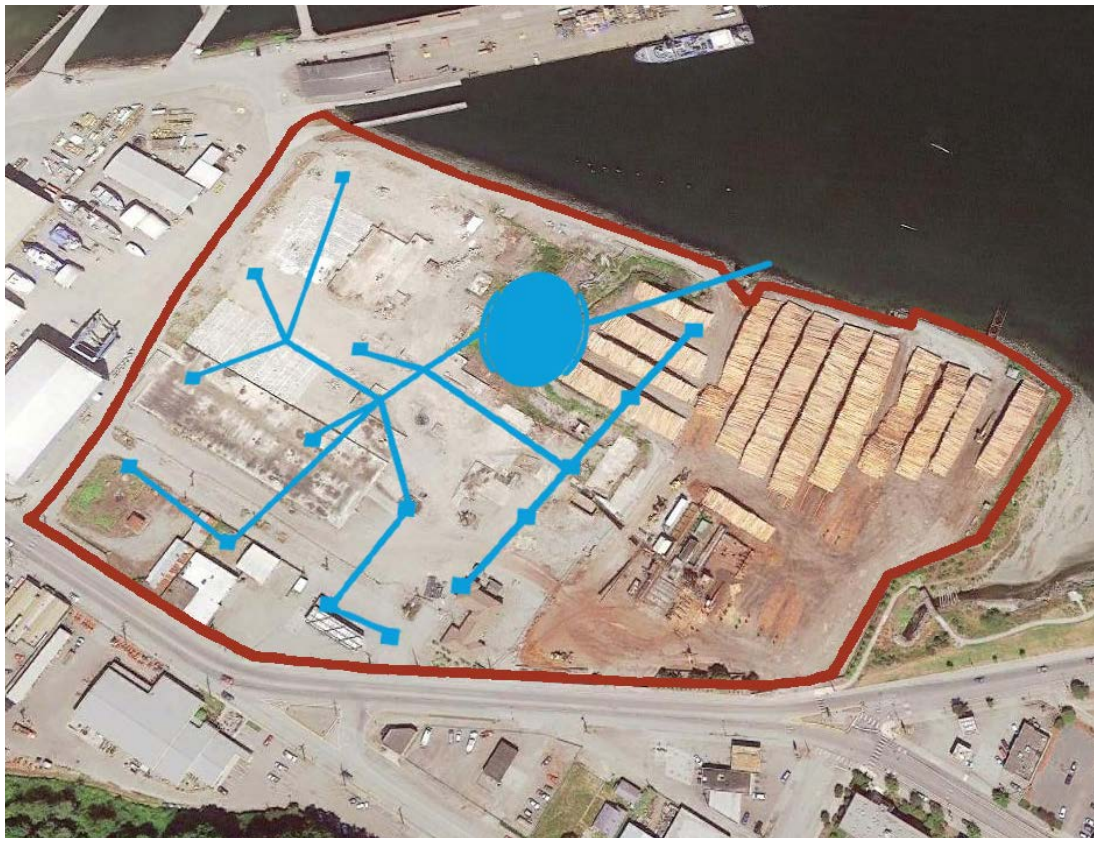
K-Ply
Drainage System

- Drainage system is designed for 25-year 24-hour storm
- Stormwater is collected in one of fifteen catch basins
- Stormwater flows in to the retention pond



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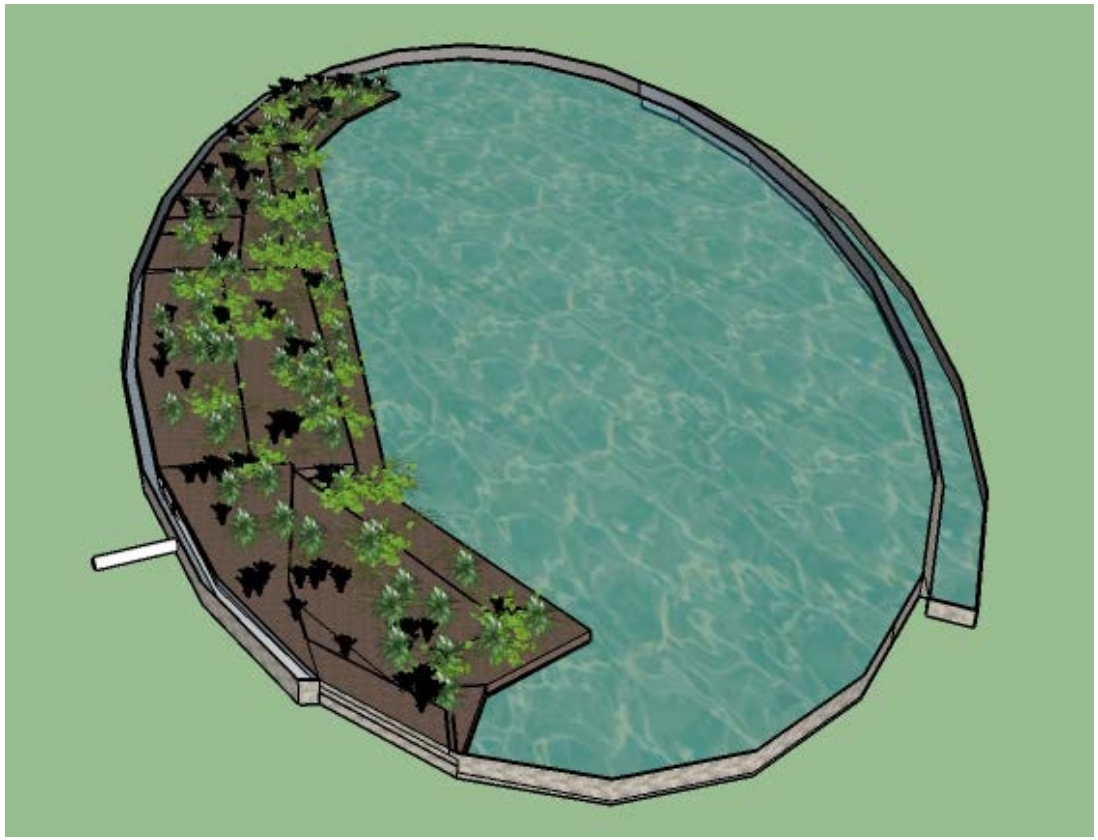
K-Ply
Retention Pond

- Acts as temporary storage for stormwater, allowing sedimentation of debris
- Aesthetic focal point of the site
- receives stormwater runoff from drainage system
- Holds 88,000 cu ft



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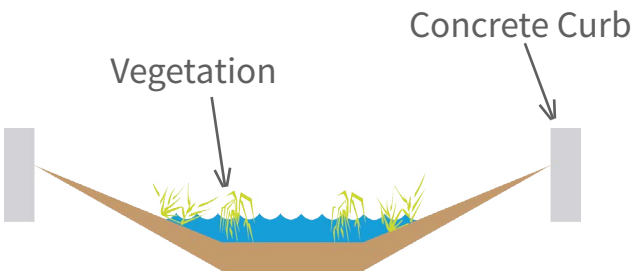
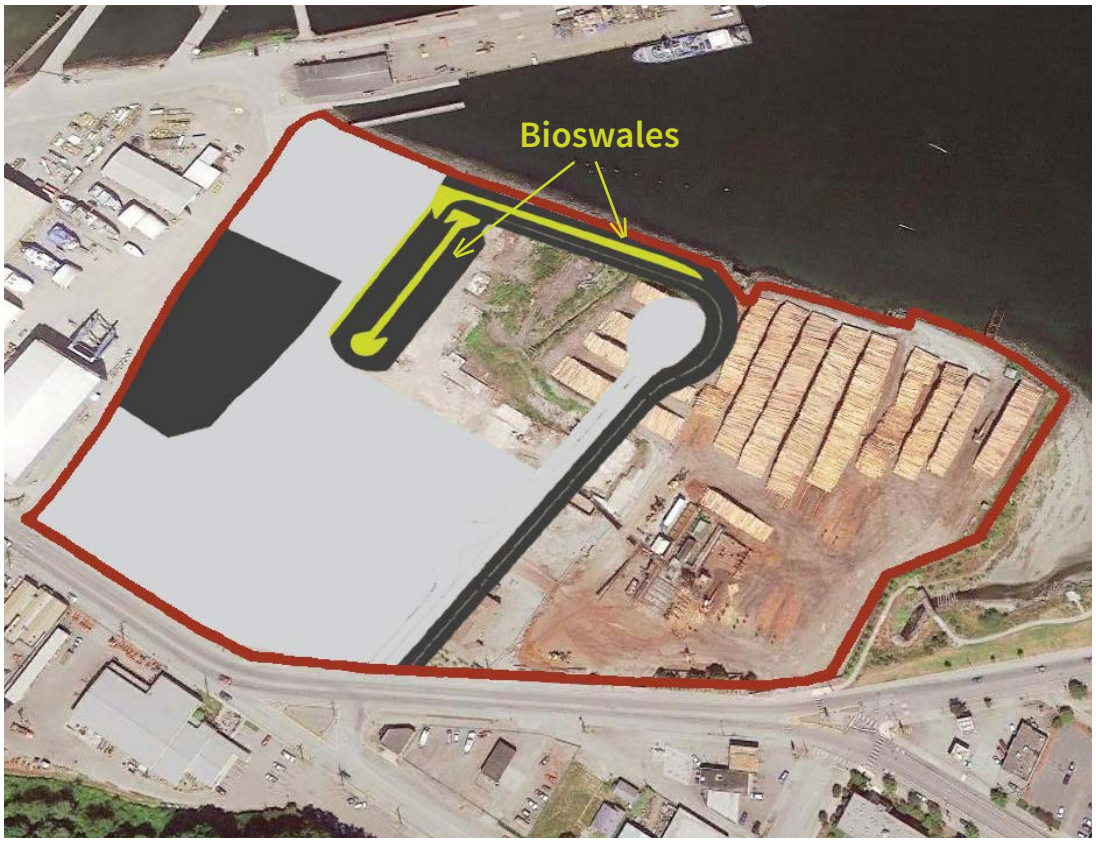
K-Ply
Bioswales

- Bioswales are used as an environmentally friendly way to mitigate stormwater
- Water enters the swales through curb cuts





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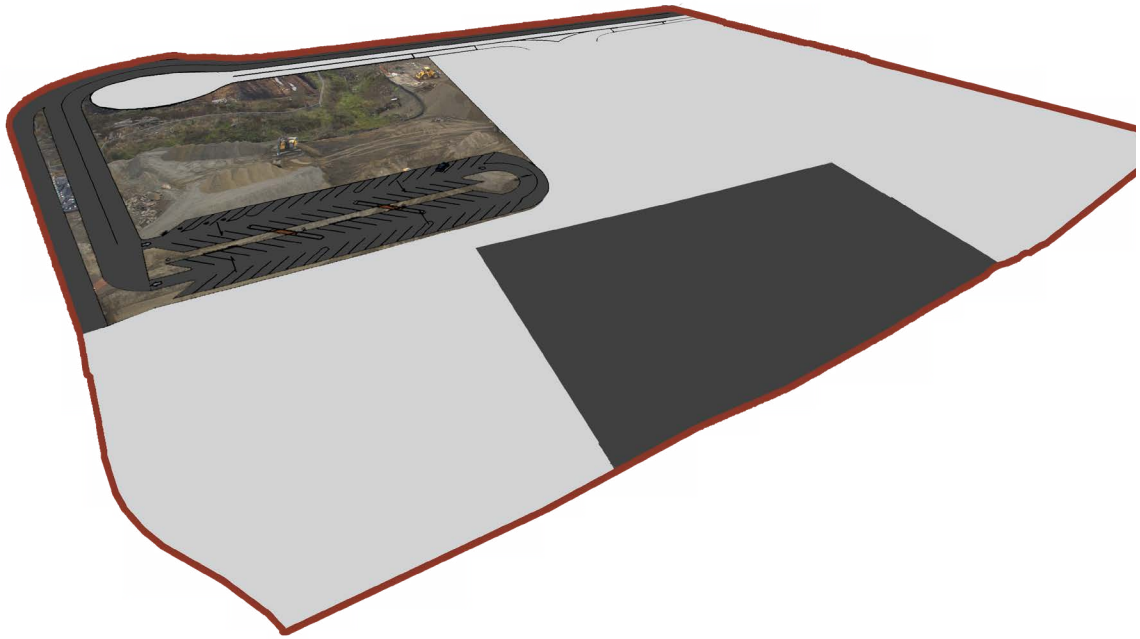
K-Ply
Pavement

Pavement



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K-Ply
Pavement

Flexible Pavement
- 6.5 inches of crushed gravel base
- 6.5 inches of hot mix asphalt (HMA)

Rigid Pavement
- 7.5 inches of crushed gravel base
- 11.5 inches of continuously reinforced concrete pavement (CRCP)

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K-Ply
Loading and Unloading

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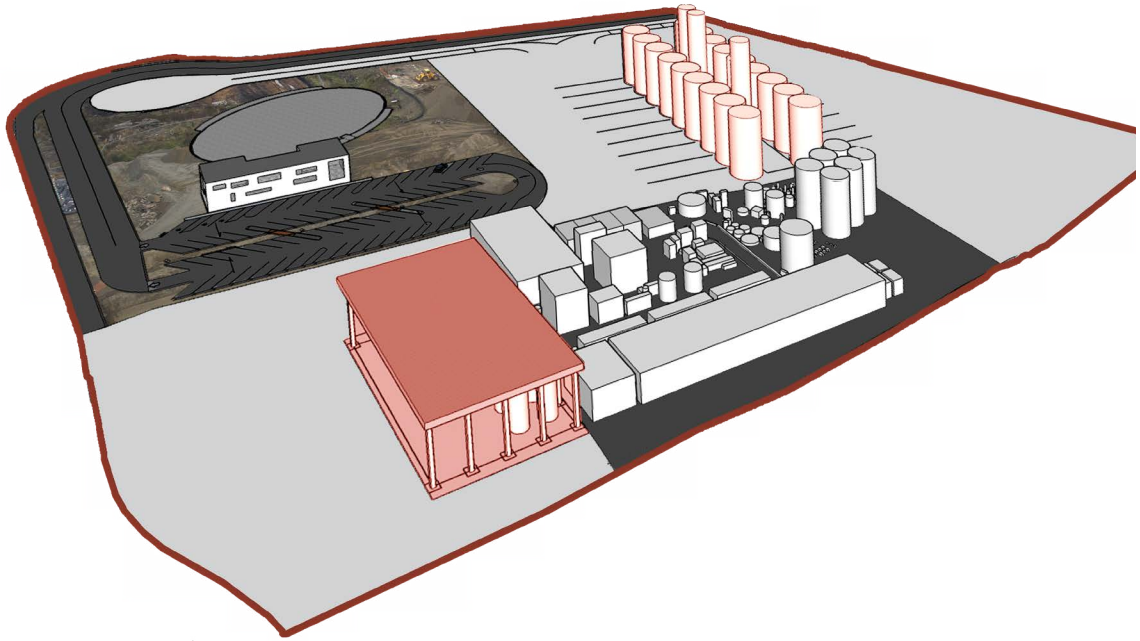

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K-Ply
Unloading

- Micronized wood is unloaded into silos at the site
- the entire drive path is covered in rigid pavement

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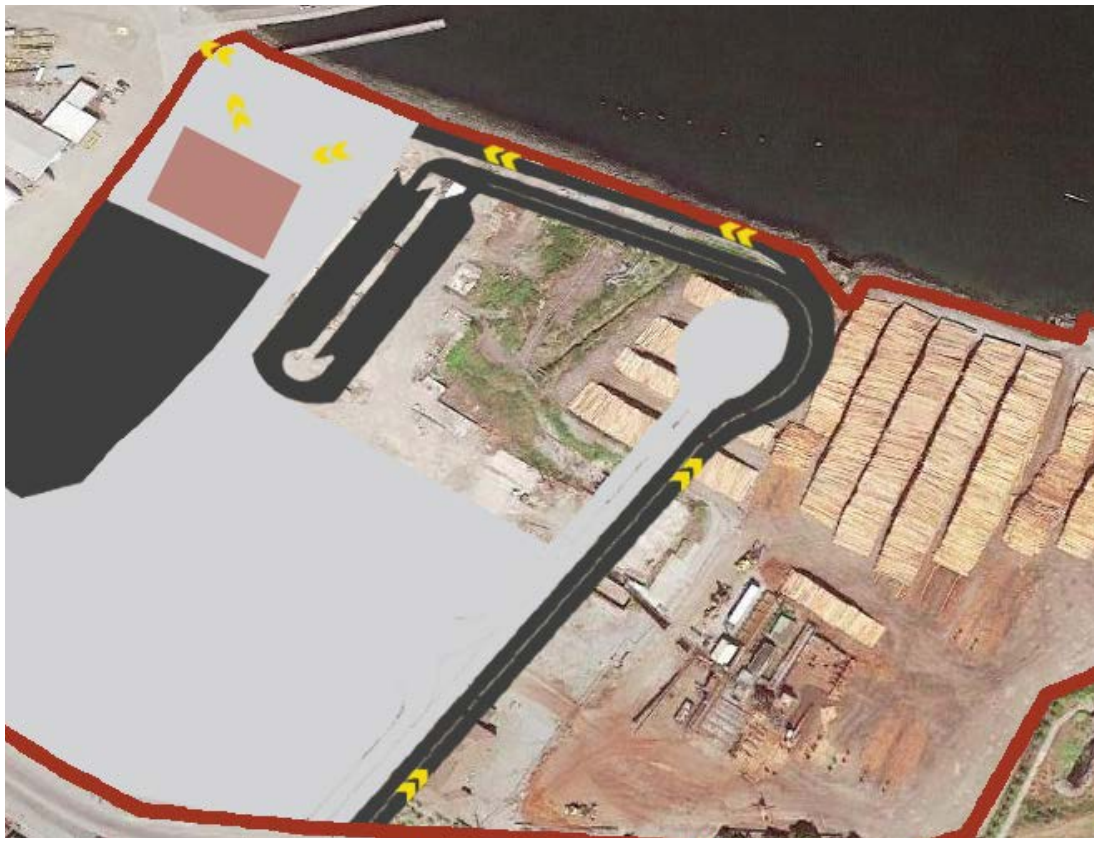
K-Ply
Loading

- Jet fuel is loaded into liquid tankers
- The drive path is covered by flexible pavement
- The loading area is covered by rigid pavement



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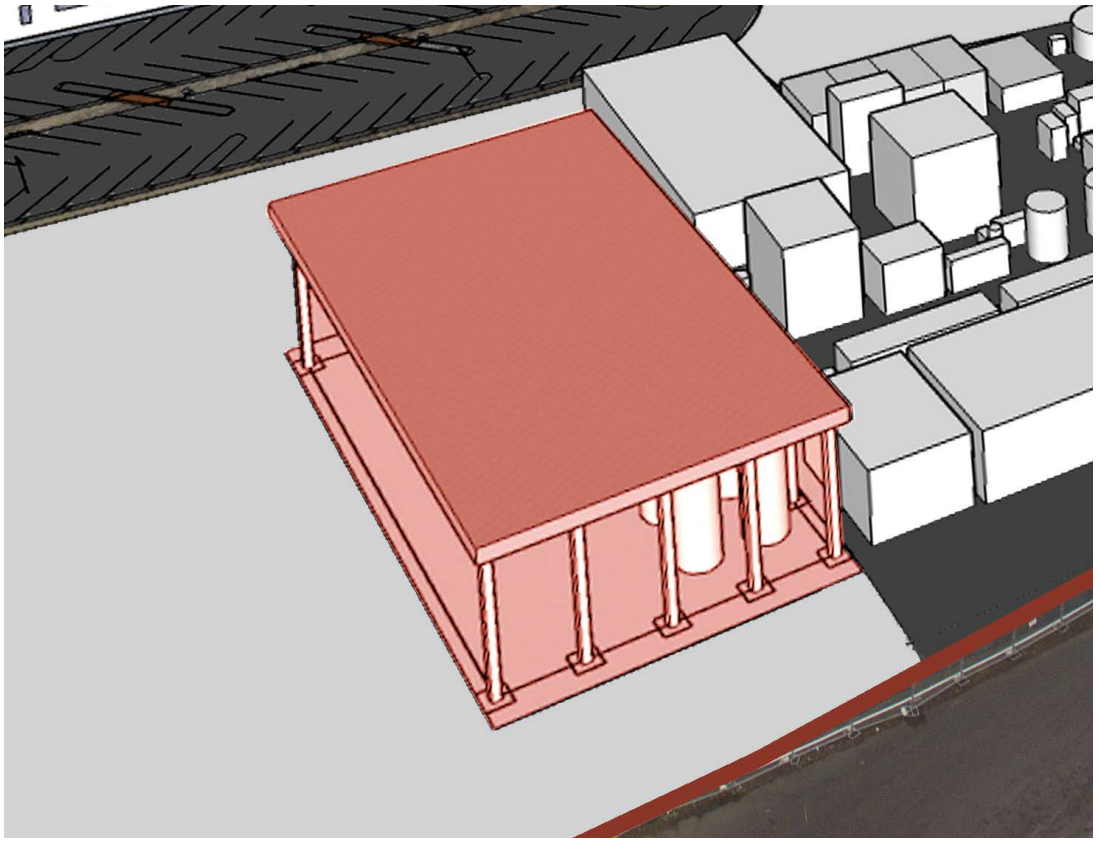
K-Ply

Loading structure

- Weather protection for jet fuel storage tanks
- Helps to suppress potential fires
- Storage hold one week's worth of product



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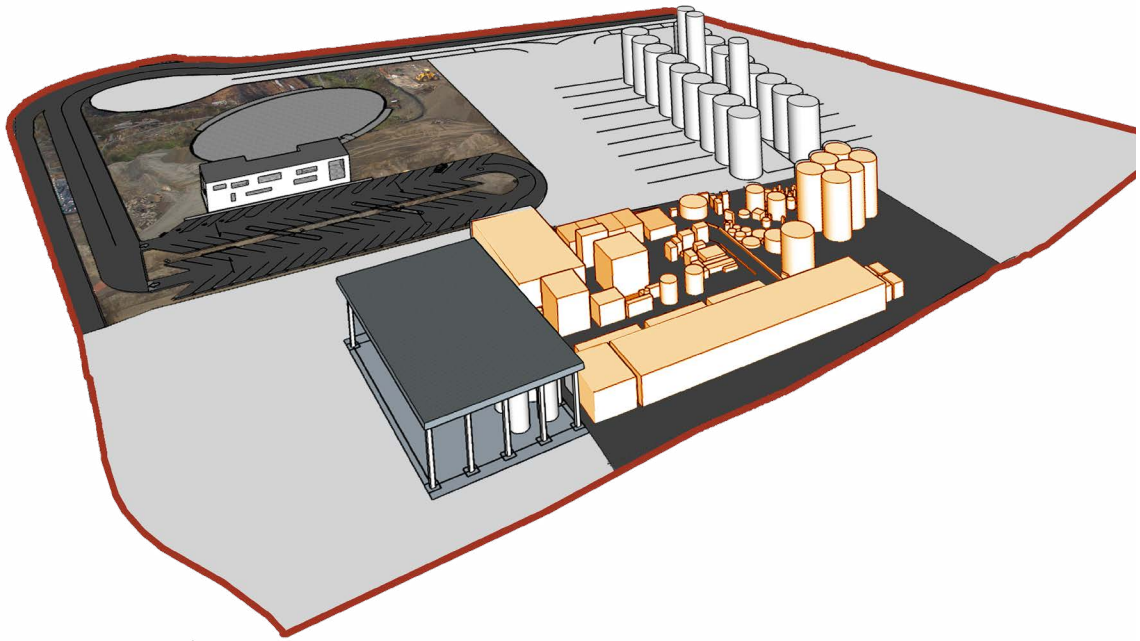
USDA

K-Ply
Conversion & Refining

Conversion & Refining



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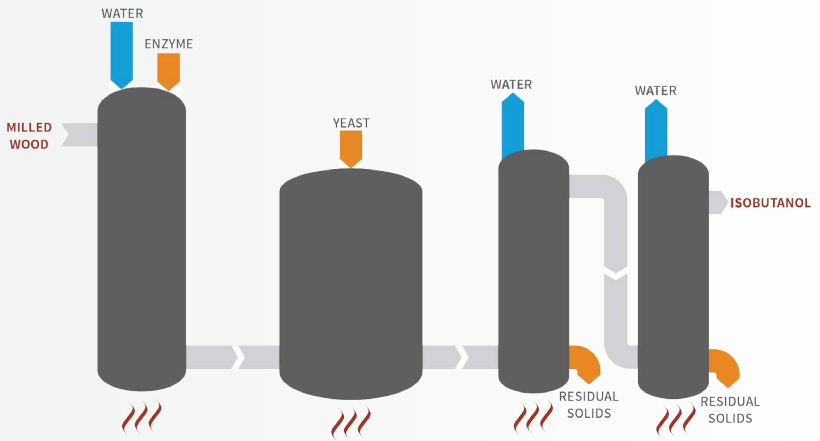
K-Ply

Conversion

Modeled after NREL's process for the conversion of corn stover into ethanol

- Enzymatic Hydrolysis
- Fermentation
- Distillation



Refining

Refines isobutanol into paraffinic kerosene (Jet fuel)

- The "Alchohol to Jet" process is being pioneered by the NARA member, Gevo

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Conclusion

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Vik Yadama, WSU
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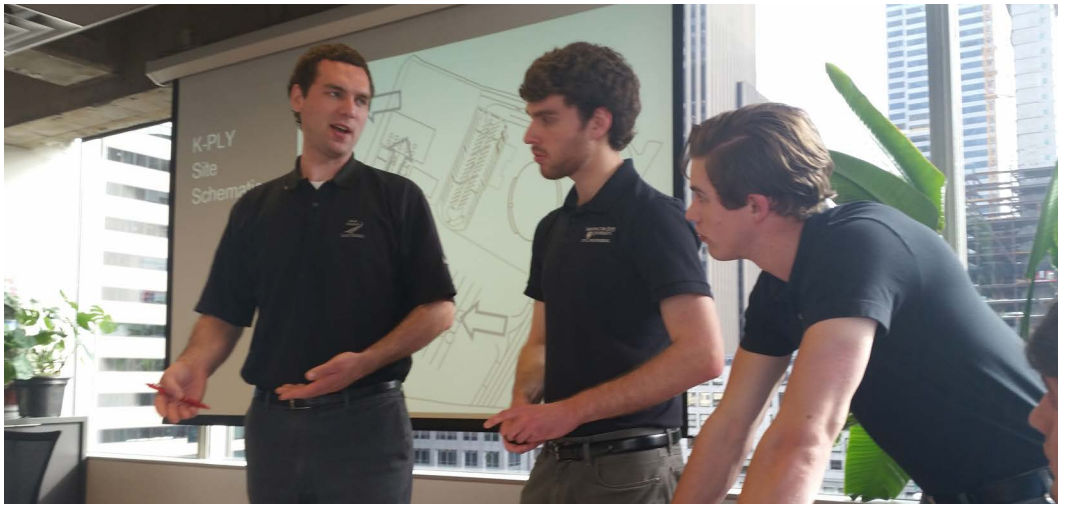
Cara Morton, WSU
John Petrie, WSU
Jeff Peterson, CPL
Kyle Malaspino, CPL
Kristin Brandt, WSU
Kristy Olsen



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