PACIFIC NORTHWEST WOOD-BASED BIOFUELS

Volume II | SITE SELECTION & DESIGN

IDX Studio - Spring 2015

Northwest Advanced Renewables Alliance

TABLE OF CONTENTS

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.

ACRONYMS

AFRI	Agriculture and Food Research Initiative
AHB	Advanced Hardwood Biofuels Northwest
BDT	Bone Dry Tons
Brownfield	Abandoned or underutilized site with real or perceived contamination
CAPS	Coordinated Agricultural Projects
CAAM	Community Asset Assessment Model
C&D	Construction and Demolition Debris
CIA	Community Impact Analysis
CY	Cubic Yard
Greyfield	Vacant or underutilized site with no contamination
IDX	Integrated Design Experience
IO	Input-Output Analysis
LCA	Life Cycle Assessment
MRF	Material Recycling Facility
MSW	Municipal Solid Waste
N&E	New and Emerging
NARA	Northwest Advanced Renewables Alliance
NIFA	National Institute of Food and Agriculture
OSU	Oregon State University
RFA	Resource Flow Analysis
RWW	Recycled Wood Waste
SLA	Site Location Analysis
TEA	Techno-Economic Analysis
UI	University of Idaho
USFS	United States Forest Service
MC2P	Mid-Cascades to Pacific
WSU	Washington State University

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Northwest Advanced Renewables Alliance

Pacific Northwest

2.1.0 NARA OVERVIEW

NARA

Northwest Advanced Renewables Alliance

The Northwest Advanced Renewables Alliance (NARA) is examining the wood-based biofuels supply chain in the Pacific Northwest (PNW), specifically in Oregon, Washington, Idaho and Montana during 2014/2015. The four-state region is shown in Figure 2.1.1.

NARA was initiated in 2011. It is one of six regional bioenergy Coordinated Agricultural Projects (CAPs) within the Sustainable Bioenergy challenge area funded by the USDA National Institute of Food and Agriculture (NIFA) in its Agriculture and Food Research Initiative (AFRI) program. CAPs in Sustainable Bioenergy are charged to:

> facilitate the establishment of regional systems for the sustainable production of bioenergy and biobased products that: contribute significantly to reducing the National dependence on foreign oil; have net positive social, environmental, and rural economic impacts; and are integrated with existing agricultural systems (USDA NIFA 2010).

This charge is being addressed through collaborative research, education and workforce development, as well as technology transfer through outreach. NARA's goal is to integrate research-based findings, knowledge of regional resources, and direction provided by regional partners and stakeholders in ways that a sustainable biofuels industry can germinate, take root, become established, and flourish in the Pacific Northwest.

NARA is focused on developing feasibility studies and a supporting environment for the sustainable production of biobased products derived from woody biomass feedstock, specifically post-harvest softwood forest residuals, in Washington, Oregon, Idaho and Montana. The USDA defines woody biomass as the trees and woody plants, including limbs, tops, needles, leaves, and other woody parts, grown in a forest, woodland, or rangeland environment, that are the by-products of forest management (USDA 2008). In addition to focusing on post-harvest forest residuals, NARA is also examining construction and demolition (C&D) wood waste (indifferent to species) as a potential feedstock. In this document, the term woody biomass is used to cover softwood forest residuals and C&D wood waste.

GOALS AND OBJECTIVES

NARA' s primary challenge is to envision and facilitate an environmentally, economically, and socially sustainable wood-based biofuels and co-products industry in the Pacific Northwest. NARA's basic task is to develop, with regional stakeholders, a viable integrated pathway for commercially producing a bio-based aviation fuel (biojet).

Towards this end, NARA's five specific goals include:

1) CREATING sustainable biojet from forest residuals and construction and demolition waste
2) PRODUCING value-added polymer and carbon products from lignin to aid in the economic viability of a biorefinery
3) DEVELOPING regional supply chain coalitions to facilitate biorefinery infrastructure
4) PROMOTING rural economic development
5) ENHANCING bioenergy literacy for citizens and professionals

To accomplish its goals, NARA is divided into five teams: Feedstock, Conversion, Sustainability Measurements, Outreach, and Eduction.

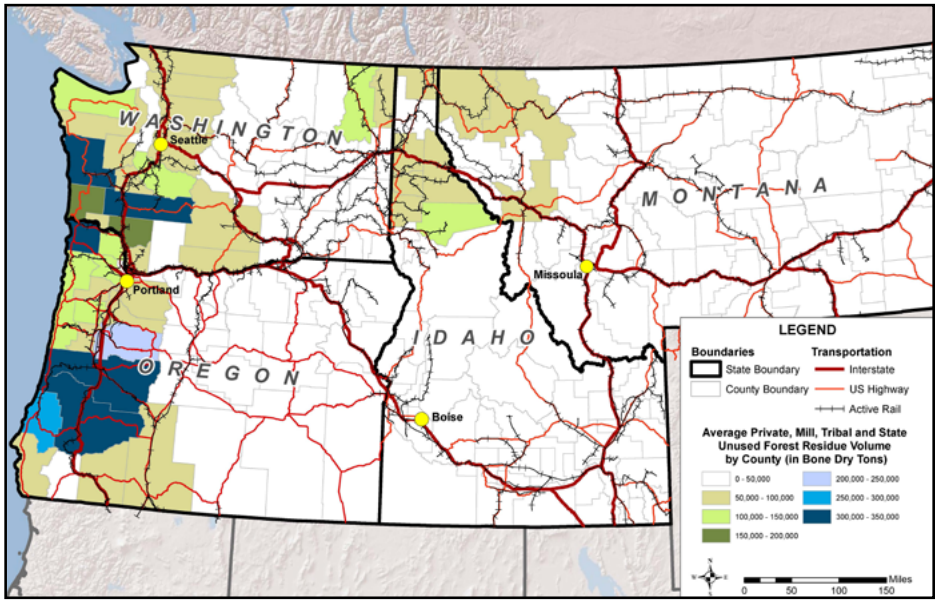


Figure 2.1.1. NARA Pacific Northwest Study Area

This document has been prepared by members of the IDX studio at Washington State University and the University of Idaho. IDX faculty and students are part of the NARA Education Team. IDX examines wood-based biofuels supply chains, identifying facility sighting locations based on assets such as biomass availability, transportation options, and proximity to markets.

During the 2014/2015 academic year, IDX focused on the site selection and design for a liquids depot co-located with an operating pulp and paper mill. A liquids depot receives raw and mechanically processed post-harvest forest residuals directly from nearby forests, or in chip form from a solids depot. Sugar-rich syrup from a liquids depot could be shipped to a biorefinery to produce biofuels, or into a number of other valuable products including bioplastics and solvents. In our analysis, a liquids depot brings in about 250,000 BDT of feedstock, and requires 10 to 20 acres of land.

This document, Volume II - PNW Site Selection & Design, gives an overview of the site selection process, and describes the site analysis and preliminary designs at the selected site, the Wauna Mill in Clatskanie, Oregon.

In addition to this document, Volume I - the PNW Profile, is available at: www.nararenewables.org/pacificnorthwest/. The PNW Profile outlines the region's assets and our analysis approach.

NARA fully recognizes that the quality of these volumes depends on the quality of the input data. As the project evolves, NARA continues to welcome regional stakeholders feedback on these 'living documents'.

Volume II is the culmination of information gathered over the last year, and presents our final PNW Supply Chain estimates, case studies of specific sites within the PNW region, and conceptual master plans for consideration by stakeholders and communities as they search for ways to engage in this new and emerging biojet fuel sector. Much of the site information was collected through electronic means, by accessing state and county websites and reports, etc.

To find out more about NARA and other regional supply chain analyses in the Clearwater Basin, Western Montana Corridor, and the Mid-Cascade to Pacific, please visit www.nararenewables.org. To sign up for NARA updates and newsletters, please go to http://nararenewables.org.

2.2.0 LIQUID DEPOT OVERVIEW

2.2.1 NARA SUPPLY CHAIN - LIQUIDS DEPOT

Major: WSU Civil Engineering
Student Author: Matt Jarrett

The liquids depot process of the NARA supply chain is highlighted in Figure 2.2.1. The input to a liquids depot is post-harvest forest residuals. Within the depot, the biomass must be mechanically broken down, chemically pre-treated, and transformed into a simple sugar output through enzymatic hydrolysis. The resulting simple sugars would then need further processing at a conversion facility to ultimately produce a bio-jet fuel.

Although the input is post-harvest forest residuals and the output is simple sugar, it is important to note that the process is not as linear nor as simple as Figure 2.1.2 suggests. Figure 2.2.1 does not illustrate energy requirements, or the co-products produced from the lignin-rich byproduct, or the various steps within the liquids depot and their influence upon the design of the process system. While the current pretreatment under consideration in our analysis is the mild-bisulfite process, NARA is also examining additional pretreatment methods, such as wood milling.

2.2.2 NARA SUPPLY CHAIN AND PRODUCTION PROCESS

Major: WSU Civil Engineering
Student Author: Christian Williams

For this study, the supply chain for a wood-based biofuels industry begins by collecting forest thinnings and commercial harvest residuals (slash) primarily from private, state, and tribal lands. This slash, which is normally piled and burned, is densified into chips and perhaps pellets. The feedstock is then subjected to pretreatment, by a mild bisulfite solution, that breaks down the wood structure, allowing for separation of cellulosic and hemicellulosic polymers plus lignin. The hemicellulose and cellulose are broken down through enzymatic hydrolysis into simple sugars. The simple sugars are fermented in a large reactor by specialized yeast to produce isobutanol. The isobutanol is then isolated from the fermentation broth and dehydrated through oligomerization and hydrogenated to produce iso-paraffinic kerosene (IPK). The iso-paraffinic kerosene (bio-jet fuel) obtained from the refining stage is then blended with a petroleum derived jet fuel to produce biofuel for aircraft use.

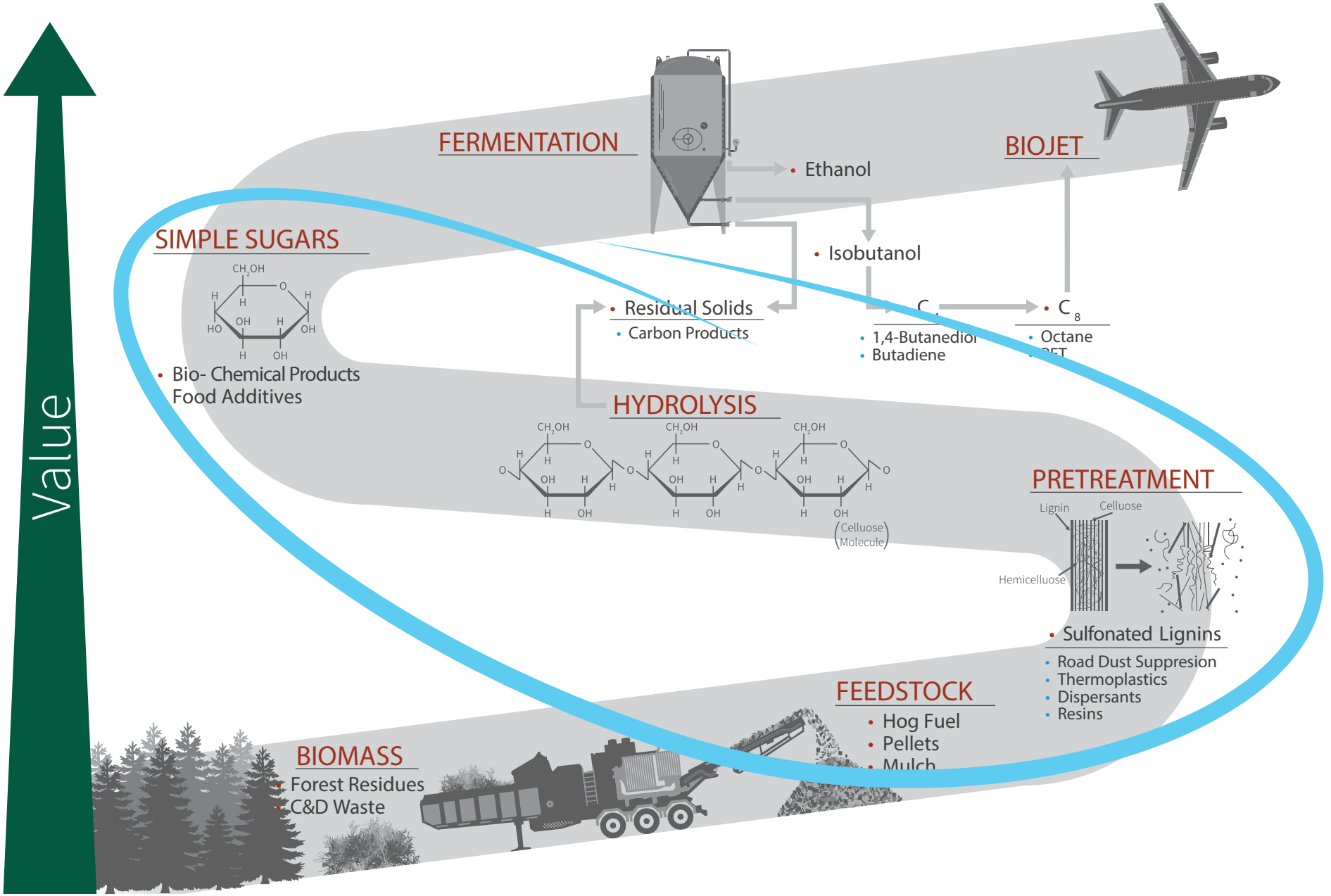


Figure 2.2.1. NARA Supply Chain Products

2.2.3 FACILITY OPTIONS

Major: WSU Civil Engineering
Student Author: Cody Lane

NARA is exploring two main facility options. Option one is a centralized production facility, referred to as an integrated biorefinery or IBR (See Figure 2.2.2). Here post-harvest forest residuals would be delivered to the IBR where chipping, pre-treatment and all conversion process steps would produce bio-jet fuel ready to be mixed with fossil-jet fuel.

Option two is a distributed production model including either liquids or solids depots or a conversion facility supported by several solids depots. For the liquids depot option, slash would be delivered, mechanically reduced to chips, pretreated, and then undergo enzymatic hydrolysis before being shipped to a biorefinery for fermentation and conversion to isobutanol and IPK. The solids depot option calls for slash collection and mechanical reduction of biomass at several remote sites. The refined feedstock would then be delivered to a conversion plant for further processing. During the 2014/2015 academic year, the IDX team developed a site selection method and conceptual designs for a liquids depot facility.

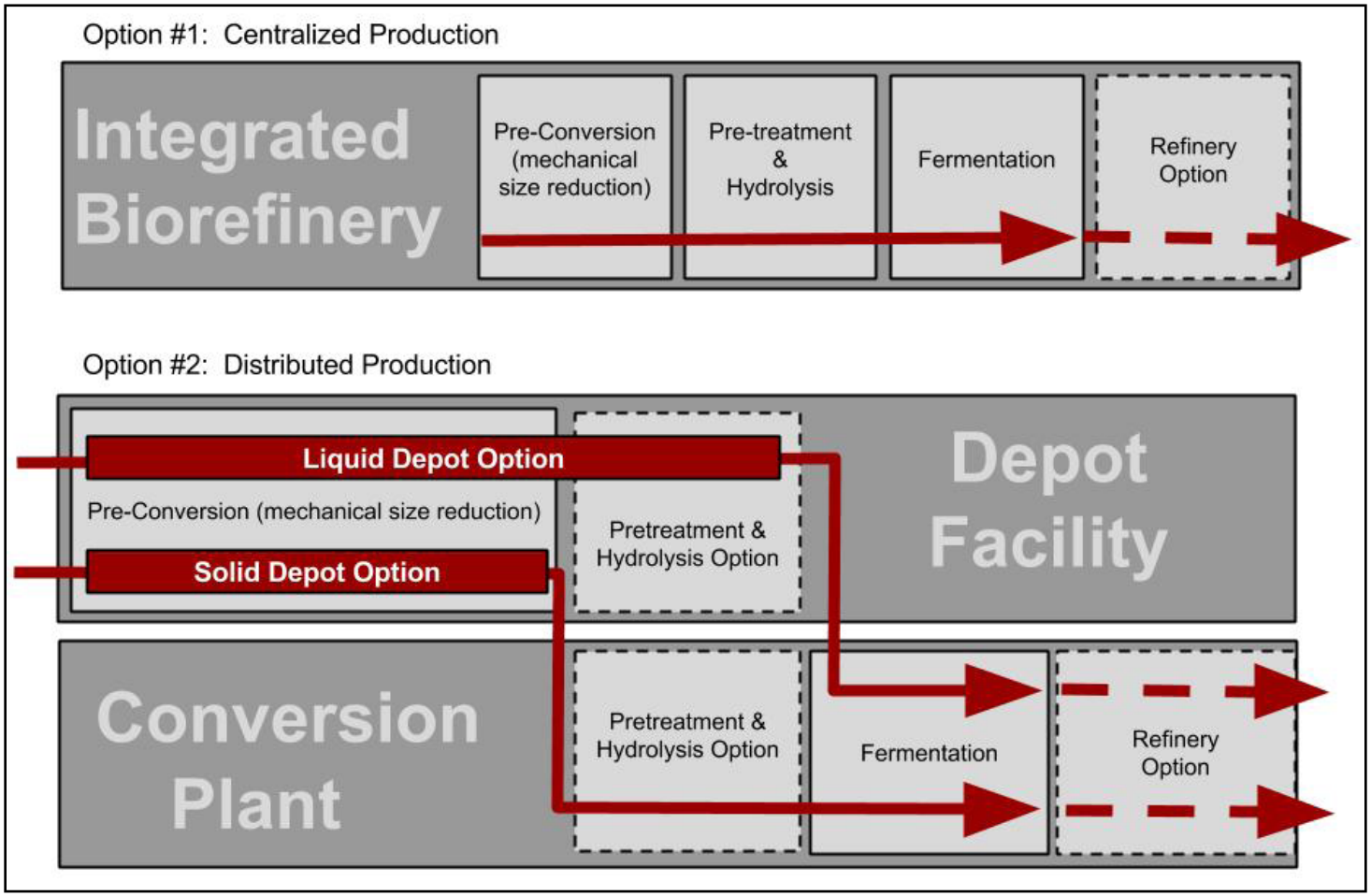


Figure 2.2.2. Option 2; Liquid Depot is the focus of the design effort in 2015

2.2.4 LIQUID DEPOT OVERVIEW

Major: WSU Civil Engineering
Student Author: Ian Smith

To better understand the concept of a liquids depot, Figure 2.2.3 depicts the major inputs and outputs as well as the three main areas of the facility. The most important input is post-harvest forest residuals that are currently collected at logging sites and burned. These practices result in economic and environmental costs. Utilizing a waste product as a feedstock does not compete with the existing wood industry, and it has the added benefit of reducing economic and environmental impacts. The other inputs are the materials used to condition and convert the woody biomass into simple sugars. The following discussion illustrates how each input fits into the process of creating wood-based biofuels.

The slash is collected and delivered to the woodyard where electricity is used to mechanically transform it into chips. The chips are pretreated with a water, sulfur and calcium solution to break down the biomass at a molecular level. Then enzymatic hydrolysis is used to remove the simple sugars from the woody biomass. In addition to simple sugars, a number of other outputs are also generated from this process. An output of the mechanical processing is hog fuel, which is bark and wood waste material that could be burned in a biomass boiler to create steam and electricity.

There are multiple outputs from the chemical pretreatment step. One of the most important coproducts, that has a major market, is lignosulfonate. This can be used as an admixture to concrete. Finally, in the separation stage the two major outputs are the simple sugars and a solid lignin-rich material. The simple sugar is shipped as the final product of this facility and the solid lignin can be dealt with in two ways: it can be burned in the biomass boiler to create steam, or it can be sold as a co-product to enhance the value chain of the liquids depot. The option selected would be based on the market value of the lignin and the cost offset of using the lignin as fuel. Potential markets for the solid lignin include using it as an input for: powdered activated carbon to capture mercury from coal power plants, electrodes in supercapacitors, thermoplastics, epoxies, and valuable industrial chemicals. For more information on co-products research being conducted by NARA, please read the annual reports available at: https://research.libraries.wsu.edu/xmlui/handle/2376/5310. Now with a better understanding of what happens at a liquids depot, we can focus on criteria used to select potential sites for a liquid depot prototype.

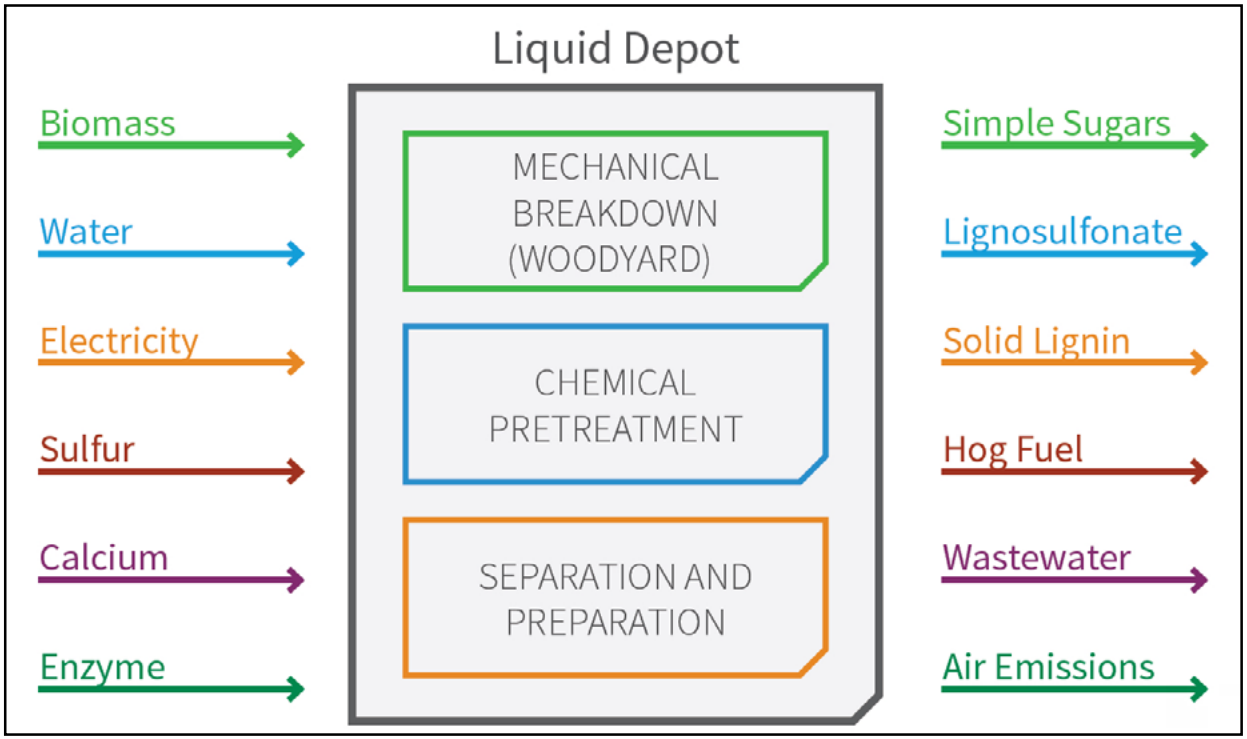


Figure 2.2.3.

2.3.0 SITE SELECTION PROCESS

2.3.1 SITE SELECTION PROCESS

Major: WSU Civil Engineering
Student Author: Ian Smith

The site selection process used by IDX for identifying locations for biofuels facilities involved a number of steps, shown in Figure 2.3.1. The first step was to narrow down the list of all potential sites (e.g., pulp/paper mills, primary and secondary wood mills, refineries, etc.) in NARA's four state region (WA, OR, ID, MT) to roughly 30 sites, using a suitability mapping process. Once the sites were narrowed down to 30, a site inventory was conducted for each site. The site inventory examined sites for a specific set of assets that are needed to operate a facility as part of the NARA supply chain (e.g., wastewater facility, industrial permitting, or water rights). After researching each site and completing the site inventory, the IDX team developed a ranking system based on the importance of the asset and the quality/quantity of the asset. Each site was entered into this ranking matrix and the top sites were found for each type of facility in the NARA Supply Chain: Solids Depot, Liquids Depot, Conversion Facility, and Integrated Biorefinery.

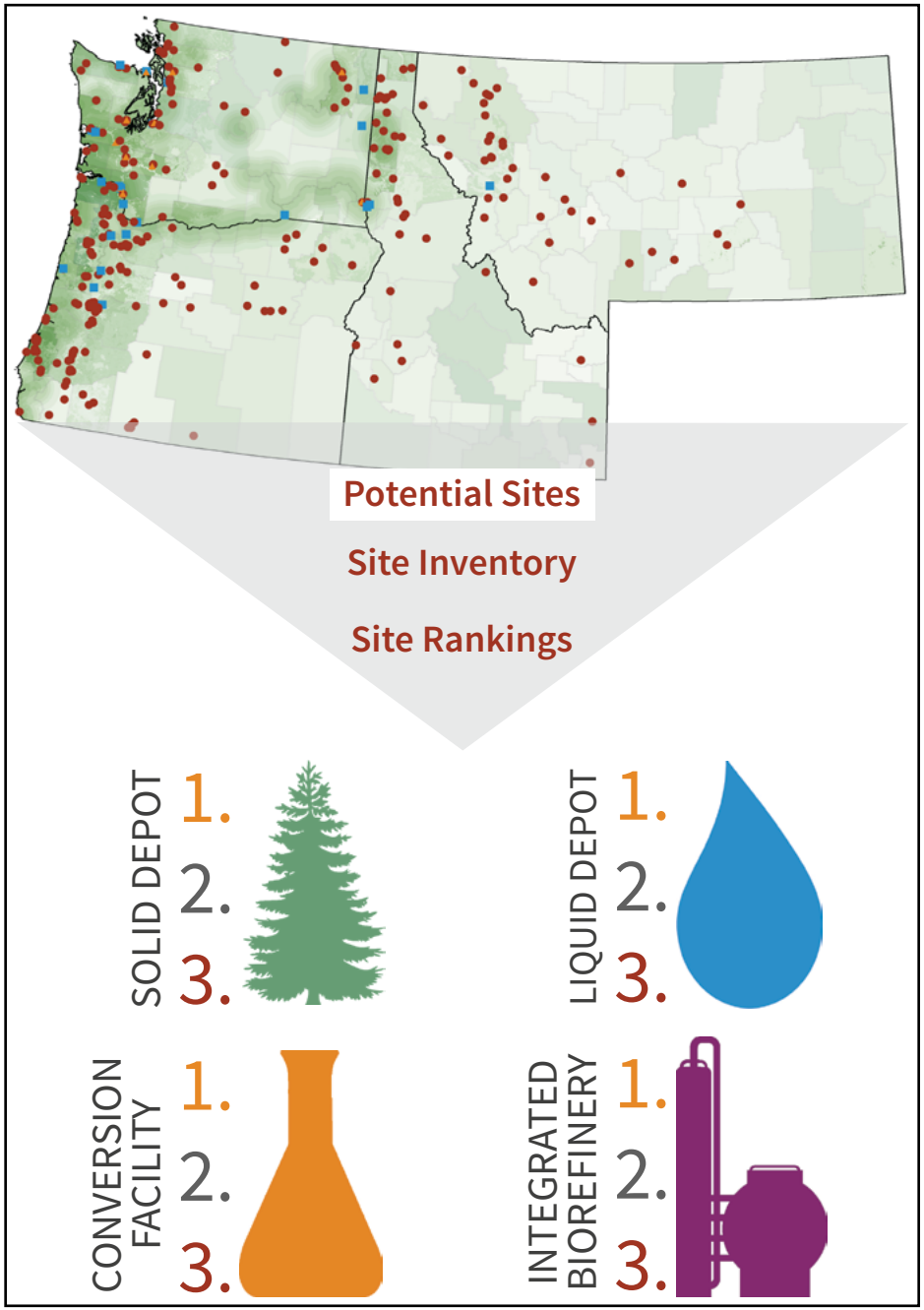


Figure 2.3.1. Site Selection Process

2.3.2 SUITABILITY MAPPING

Major: WSU Civil Engineering
Student Author: Christian Williams

Figure 2.3.2 provides further details on how the site selection process took place. Various factors were taken into account when narrowing down sites. Some factors included in the suitability mapping were biomass availability, port access, social capital, creative vitality index, poverty rates, and electricity rates. These factors were scored on a -5 to 5 scale. Weights were also used for each factor. The weights for each factor were differentiated on a map with different shades of green. The factor's transparency was adjusted based on the weight of the factor. This was done for each factor. Each map was then placed on top of one another to produce a hot spot map. Areas with darker shades of green on the hot spot map indicate areas of interest in the Pacific Northwest that would be best suited for an integrated biorefinery or depot facility.

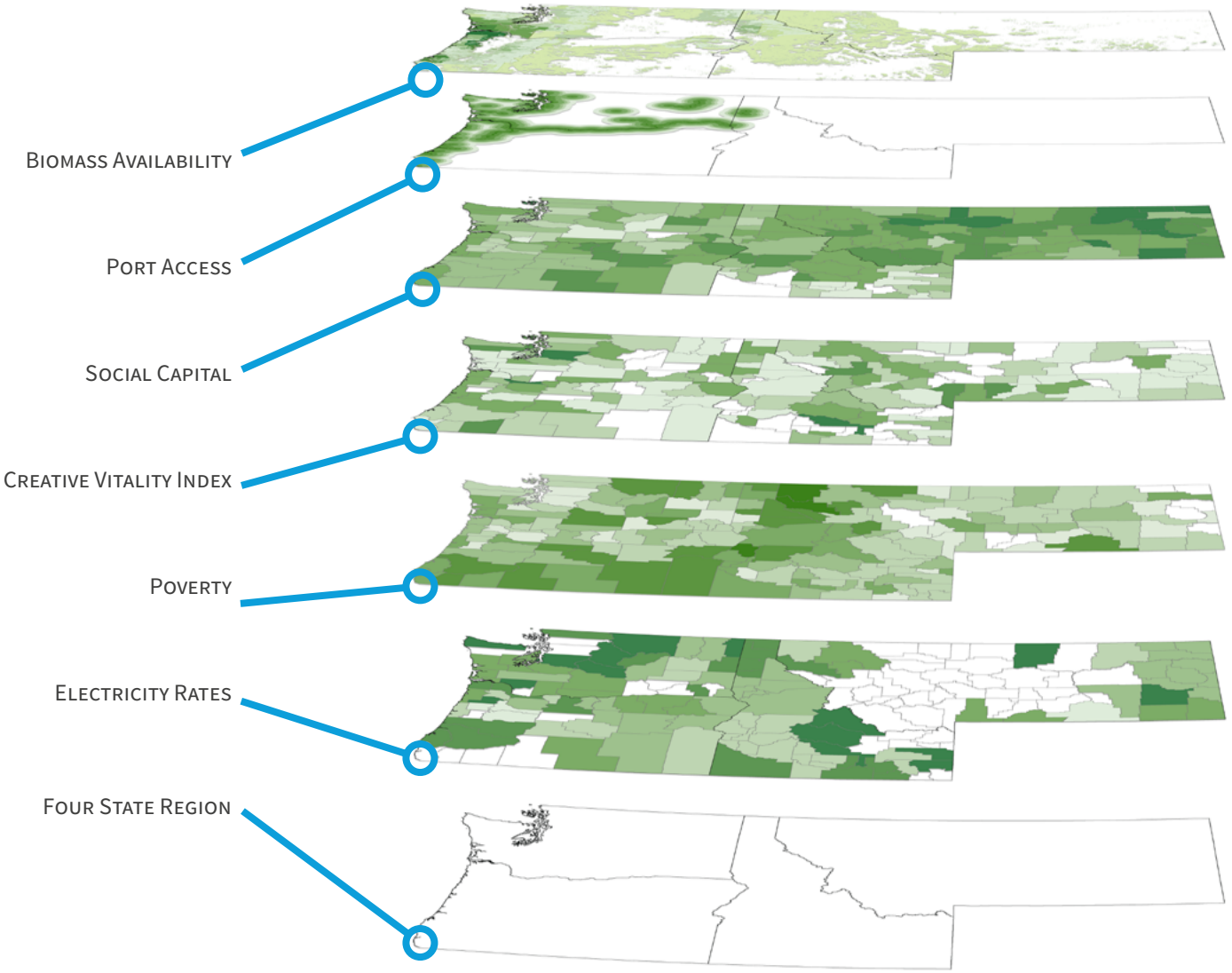


Figure 2.3.2. Suitability Mapping - The weights of each factor are represented by varying layer transparencies

2.3.3 SUITABILITY COMPILATION

Major: WSU Civil Engineering
Student Author: Ian Smith

Because of the vast selection of potential sites, the process described above as suitability mapping was a method developed to narrow down the scope so that IDX could identify feasible locations for biofuels facilities. Figure 2.3.3 shows five hot spot regions. One hot spot is on the border between western Washington and western Oregon, another is in southwest Oregon, one is located in northern Idaho, and a final hotspot is found in western Montana. The facility types are labelled: an orange triangle represents an existing chip mill, a blue square represents an existing paper mill, and a red circle indicates an existing sawmill.

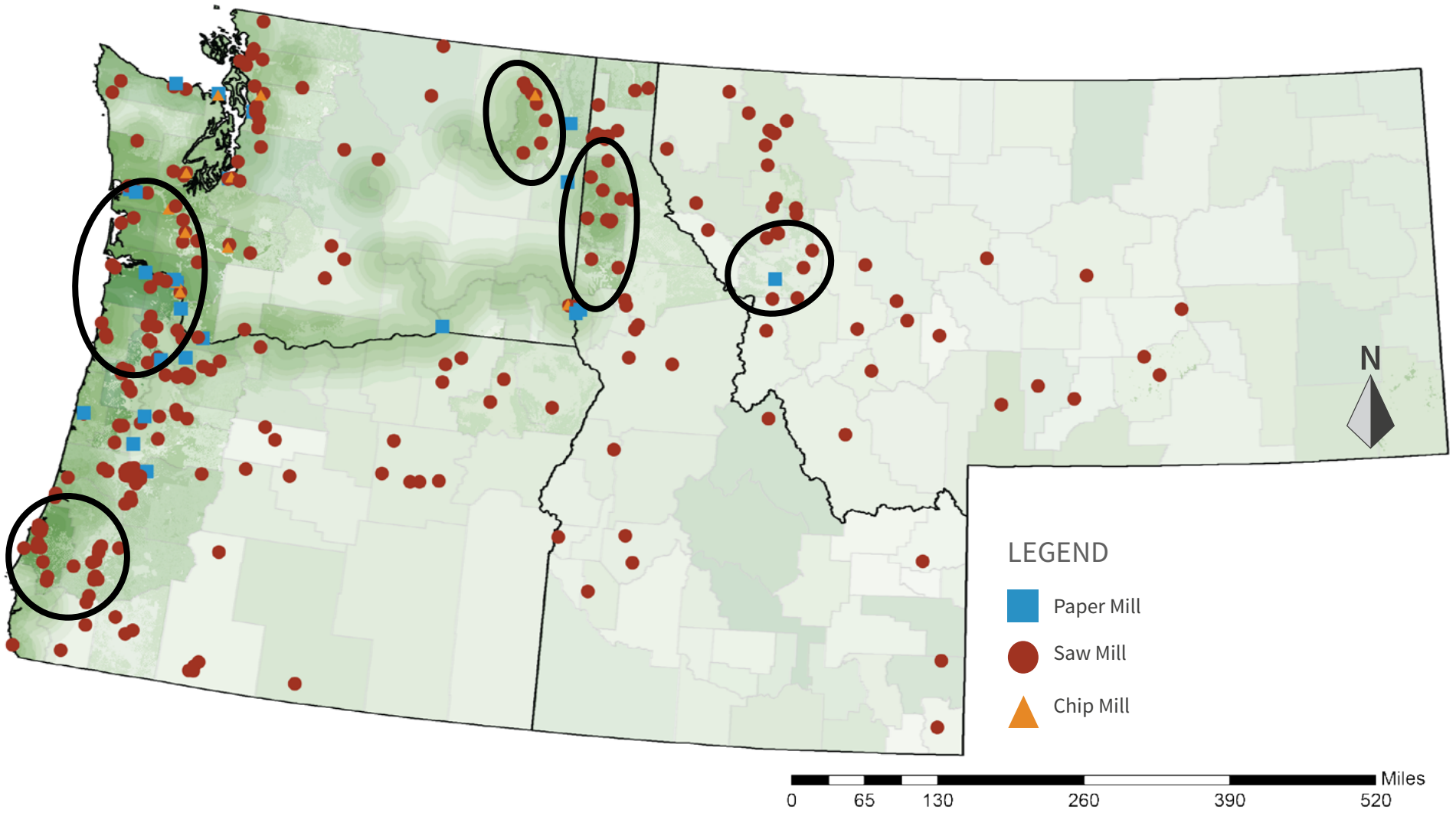


Figure 2.3.3. Suitability Compilation: Solids Depot Example

2.3.4 SITE INVENTORY

Major: WSU Civil Engineering
Student Author: Sydnee Dieckman

The next step of the site selection process was to compile a site inventory. The suitability mapping exercise narrowed the list of potential sites to 30 for further investigation. A list of important factors relevant to siting was compiled, which included factors shown in Figure 2.3.4 such as site acreage, natural gas rates, whether or not the existing site had wastewater treatment, or whether or not the site had a boiler (and if so, what was its capacity). The factor data was collected for each of the 30 top sites and compiled in a spreadsheet, where they could be easily compared.

ACREAGE

source: www.northernpulp.ca

NATURAL GAS RATES

source: www.lngworldnews.com

WASTEWATER TREATMENT

source: www.remke.com

BOILER

source: www.nationalboiler.com

Figure 2.3.4. Site Inventory

2.4.0 OREGON LIQUID DEPOT SITE RESULTS

NORTHERN OREGON LIQUID DEPOT SITE RANKINGS

Major: WSU Civil Engineering
Student Author: Sydnee Dieckman

After collecting the site specific data in the site inventory process, a ranking system was used to rank the sites in order of suitability. The factors that contributed to site decision making were weighted by importance depending on the type of facility considered (e.g., depot, conversion, IBR). For example, biomass availability is very important factor for a liquids depot, and so biomass availability was weighted heavily for liquids depot siting. A site with access to a significant amount of biomass would receive a higher overall score for liquids depot site ranking than a site which had several of the other factors in its favour (e.g., better electricity and natural gas rates) but low biomass availability. In comparison, the biomass availability factor would receive a lower weight for a conversion facility because the cost of bringing in biomass is not as large a portion of the overall cost of a conversion facility as it is for a liquids or solids depot. Regardless of the type of facility being considered, the sum of the weights for all of the factors was equal to 20.

After the factors were weighted by level of importance, a scoring system was applied to each factor for each site. If a particular site exhibited unfavorable conditions for a particular factor, it received a low score for that category, and vice versa. For example, a site located in a county with natural gas rates lower than $0.18/therm would receive a score of "5" for its natural gas factor, while a site in a county with natural gas rates above $0.51/therm would be assigned a score of "-5" for its natural gas rates factor. These scores (of -5 through 5) were then multiplied by the weights for each factor to give their contributions towards the overall ranking. A score of 100 would be obtained if the site received a score of 5 for each factor.

The top sites were broken up into smaller regions, and the ranking system was applied. For the northern Oregon region, as shown in Table 2.4.1, the Georgia-Pacific Wauna Mill was found to be the most ideal site for a liquids depot because it received better scores for factors of higher weight than did the other sites in the area.

EACH SITE FACTOR WEIGHTED BY IMPORTANCE TO SITING DECISION

FACTORS ASSIGNED SCORES FROM -5 TO 5 FOR EACH SITE (E.G. ONE SITE RECEIVES A 5 FOR BIOMASS AVAILABILITY, WHILE ANOTHER RECEIVES A -5)

SUM OF WEIGHTS = 20

FACTOR SCORES FROM -5 TO 5

} MAXIMUM SITE SCORE = 100

Table 2.4.1. Northern Oregon liquid depot site rankings

RANK	FACILITY NAME	COUNTY	SCORE
1	Georgia Pacific - Wauna Paper Mill	Clatsop	43.00
2	Warrenton Fibre Tansy Point	Clatsop	-0.24
3	Pacific Fibre Products Inc. North Plain	Washington	-42.08
4	West Linn Paper Co.	Clackamas	-53.65
5	Blue Heron Paper Company	Clackamas	-56.80

2.4.1 GEORGIA-PACIFIC WAUNA MILL
Major: WSU Civil Engineering
Student Author: Anna Martin

IDX selected the Georgia-Pacific Wauna pulp and paper mill site to examine the feasibility of co-locating a liquids depot. Figure 2.4.1 is a broad view of the markets in the Pacific Northwest. If the Georgia-Pacific Wauna Mill were to co-locate a liquids depot on their site, the products produced there would likely support biofuel markets in the Portland area. The Portland market alone uses 316 million gallons of jet fuel per year.

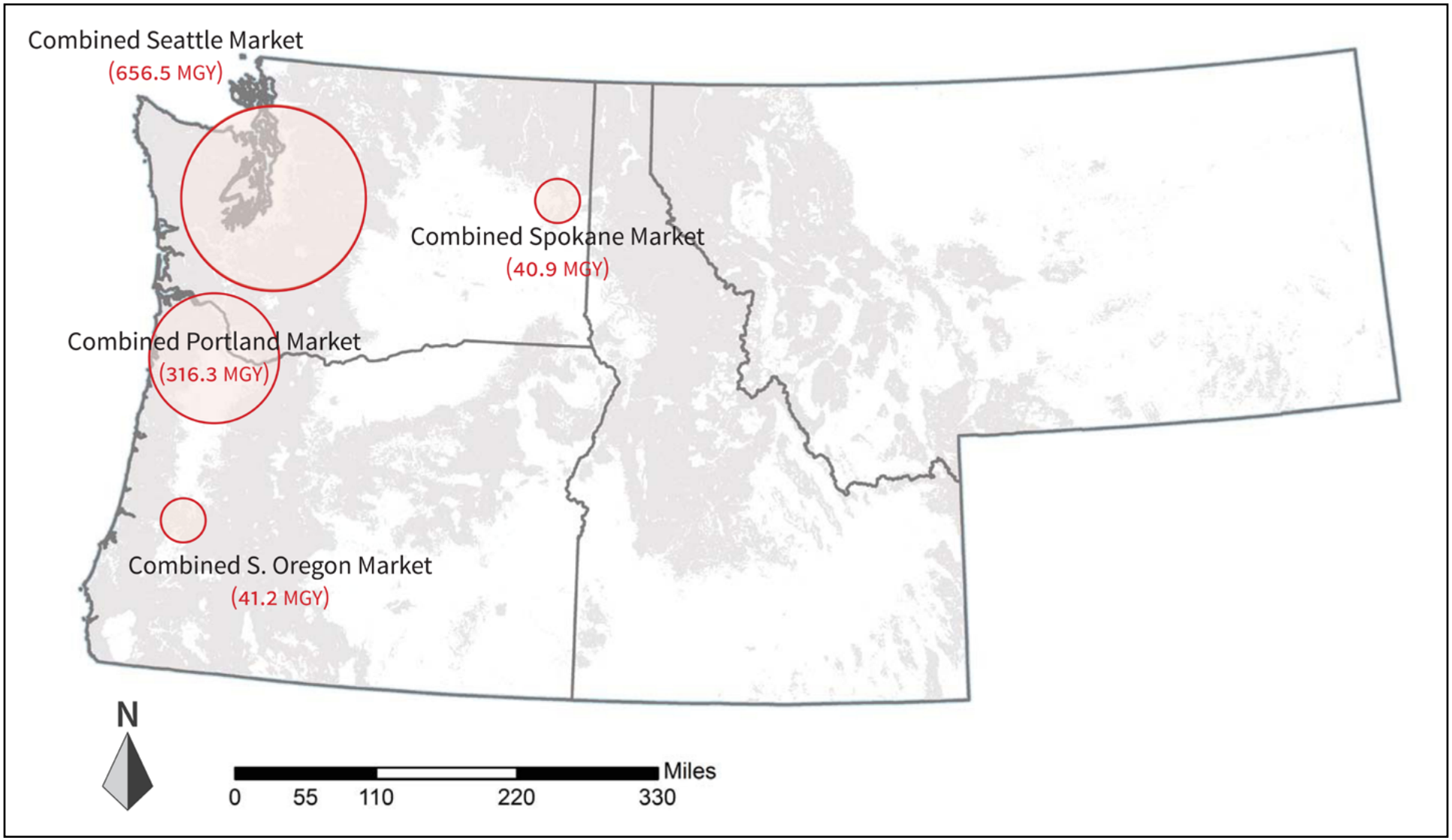


Figure 2.4.1. Ranked 1st for liquid depot suitability Oregon region (43.00/100) Portland, Military, & Commercial Markets

2.5.0 GP WAUNA MILL OVERVIEW

The design of a liquids depot at the Georgia-Pacific Wauna Mill, shown in Figure 2.5.1, is being considered from several different angles. The IDX team broke the site analysis into three parts: the regional assets, the biological and geological assets, and the physical assets.

The Georgia-Pacific Wauna Mill site analysis considers the social, economic, and environmental impacts and opportunities associated with the potential siting of a liquids depot at the site.

source: imgick.oregonlive.com

Figure 2.5.1. GP Wauna Mill

2.5.1 NORTHWEST OREGON HISTORY

Major: UI Bioregional Planning & Community Design
Student Author: Alexandria Marienau

The Georgia-Pacific Wauna Mill, though addressed to Clatskanie, Oregon in Columbia County, is actually located just across the county line in Clatsop County near the community of Westport.

Before the West was explored, Clatsop County (shown in Figure 2.5.2 and 2.5.3) was home to primarily two Northwest Indian tribes—the Clatsop and Nehalem—who lived from the mouth of the Columbia River down to the area surrounding current-day Tillamook, Oregon. These two tribes often intermingled and settled together, particularly in the winter. The county is named for the Clatsop tribe, meaning "place of smoked salmon" (1). These tribes fished, hunted, and gathered in the waters and forests of this area. These two tribes, today, are the only tribes in Oregon that were not relocated to reservations during the 1800s (2).

This area takes pride in the fact that the Lewis and Clark expedition traveled down the Columbia River, making stops on both the Oregon and Washington sides, and built their western-most fort, Fort Clatsop, just outside Astoria, Oregon. They wintered there from 1805 to 1806, trading with the tribes and exploring and documenting the region. Today, communities along the Columbia River shores use their rich history to attract tourism.

This area also featured some of the first mills and canneries in the west. The waters were thick with salmon and other fish, and the forests were filled with large evergreen trees. These resources were quickly exploited and attracted the first settlements in the area. Northwestern Oregon's economy was heavily reliant on its natural resources, but during the twentieth century, they began to decline. With overfishing and the construction of the lower Columbia dams, fish populations decreased. The Endangered Species Act and the rush to save the spotted owl in western Oregon and Washington, along with economic and technological changes, closed the doors on most logging operations, and the timber industry crashed. Most small towns were dependent on these industries and suffered for many years. However, more recently, this area of Oregon has transitioned to leisure and tourism industries, along with health and education service industries.

(1) University of Missouri-St. Louis, The Louisiana Expansion. http://www.umsl.edu/continuinged/louisiana/Am_Indians/14-The_Clatsop/14-the_clatsop.html

(2) Official site of the Clatsop-Nahelem Confederated Tribes. http://www.clatsop-nehalem.com/history.html

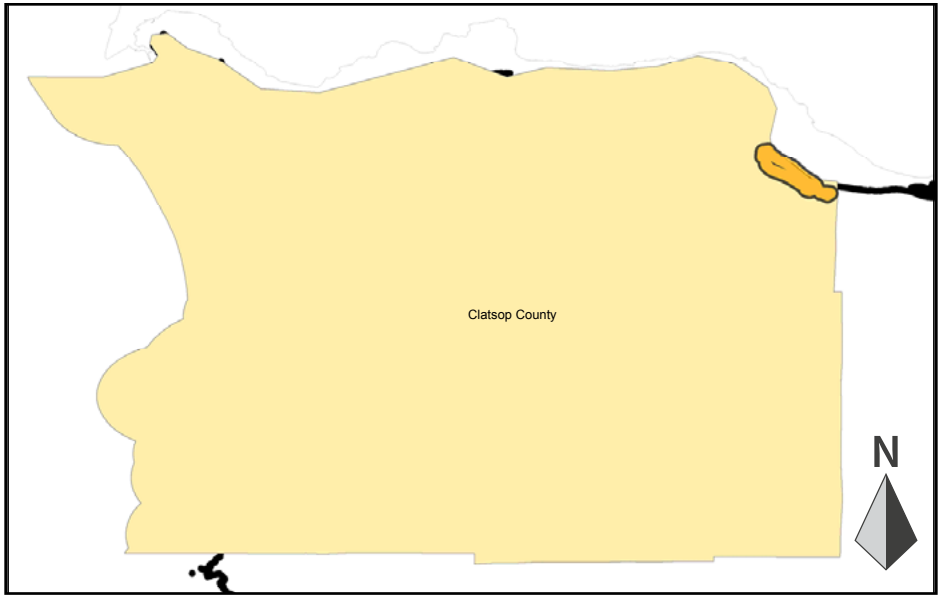


Figure 2.5.2 Northwest Oregon History, Clatsop County, Wauna Mill location

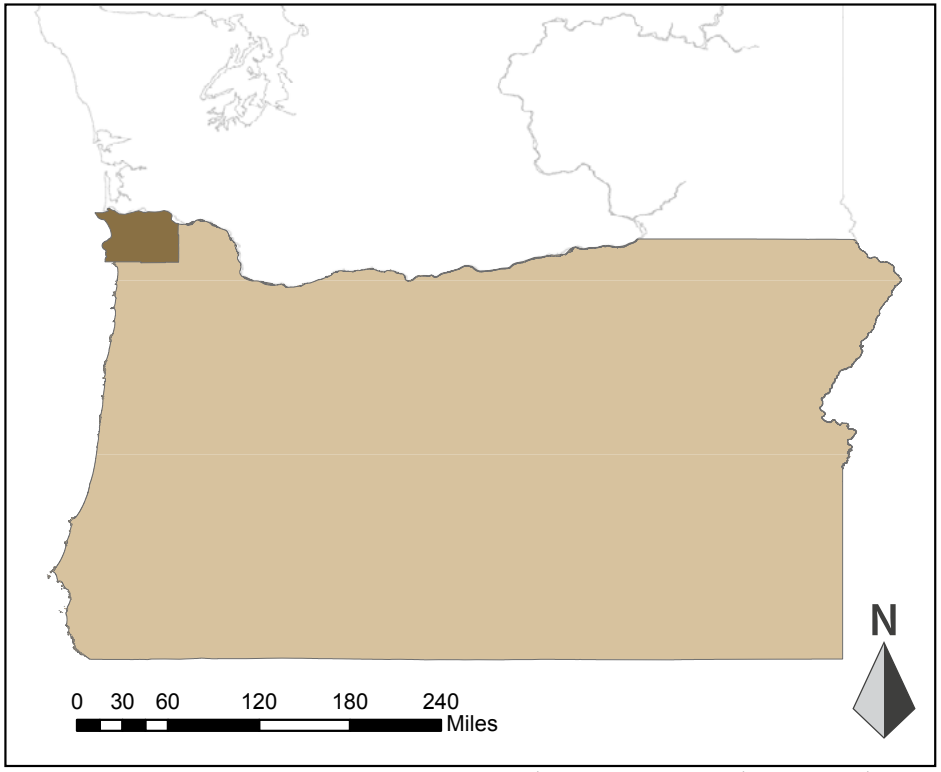


Figure 2.5.3. Northwest Oregon History, Clatsop County location

2.5.2 HISTORY OF GP WAUNA MILL SITE

Major: UI Bioregional Planning & Community Design
Student Author: Alexandria Marienau

The Georgia-Pacific Wauna Mill, since it was first opened, has operated as a paper mill. The Crown Zellerbach Company opened the mill September 1, 1965. On May 5, 1986, James River acquired Crown Zellerbach and the Wauna Mill. James River and Fort Howard companies merged on August 13, 1997 to form the Fort James Company. The Wauna Mill switched hands again in 2000, when Georgia-Pacific (GP) attained Fort James, and still operates under the company today. In 2007, GP completed construction and started operation of their No. 7 paper machine.

This machine is one of two in the country—the other is located in Louisiana. This machine produces a high quality Brawny paper towel and supplies this product to all markets west of the Rocky Mountains (1). Since 2000, approximately two in five workers at the GP mill are from Clatskanie, OR, just 12 miles east of the mill (2). Including creating jobs, GP has given back to the area in other ways as well. In 1992, James River donated a parcel of land, that once served as a log storage area northwest of the mill, as a conservation easement to The Nature Conservancy. In 2010, GP donated an additional 682 acres of land around that easement which became the Blind Slough Swamp Preserve, the best remaining example of Sitka Spruce swamp in Oregon (3). Most recently, they donated 27 acres at the southeast end of their property to the Clatsop County Parks Department to serve as a park for the community of Westport (4). These events are illustrated in Figure 2.5.4.

(1) The Daily Astorian, Mar.1, 2008. http://www.dailyastorian.com/20080301/georgia-pacific-commits-to-long-term-operations-of-wauna-paper-mill
(2) The Clatskanie Chief, Jul. 20, 2000. http://news.google.com/newspapers?nid=1028&dat=20000720&id=D-kdlAAAAIBAJ&sjid=uJMNAAAAIBAJ&pg=1359,2551267
(3) The Nature Conservancy. http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/oregon/placesweprotect/blind-slough-swamp.xml
(4) The Daily Astorian, Jan. 15, 2015. http://www.dailyastorian.com/Local_News/20150115/wauna-gift-lands-westport-a-new-place-to-play

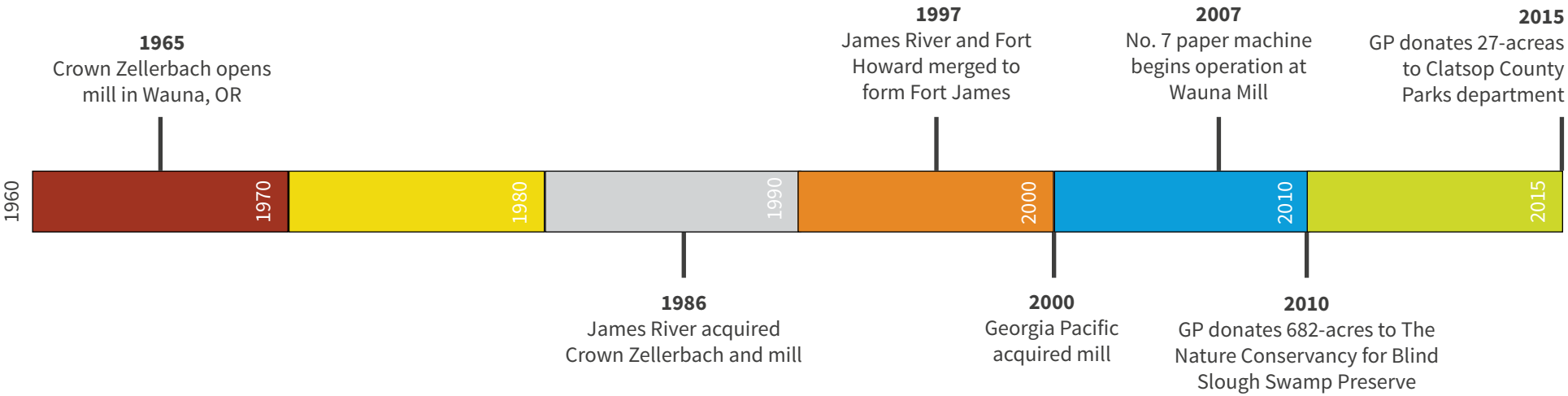


Figure 2.5.4. History of GP Wauna Mill site

2.5.3 GP WAUNA MILL CULTURAL MAP
Major: UI Bioregional Planning & Community Design
Student Author: Courtney Matoon

Because of this area's rich history and abundant natural resources, there are a variety of cultural amenities surrounding the Georgia-Pacific Wauna Mill site (Figure 2.5.5). The cultural sites were broken down into four categories: recreation, historic, nature refuges, and miscellaneous.

Bradley State Scenic Viewpoint is the recreational site providing a rest area, picnic tables, monument, and expansive views of the Columbia, Coffee Pot Island, and the shores of Puget Island (1).

There are four historic sites located near the mill shown on the map, two of which are former sawmills, and the third a logging tunnel - all serving as evidence of the area's history and natural resource based economy. The fourth is a heritage area located on Puget Island.

The Shepherd and Morse Sawmill was established in 1910 by the Westport Lumber Company and are listed on the State of Oregon's Inventory of Historic Sites and Buildings. Originally the site of Henry Hunt's mill in 1843, and named for later mill operators Fred Bradley and Walter Woodard, the Bradwood Sawmill was listed by the Citizen Advisory Committee as being an important historical site. The Westport Logging Tunnel was created to transport timber via oxen circa 1890 by John West, and was later expanded for locomotive use. It was also listed by the Citizen Advisory Committee as having historical importance (2).

The Buffington Park and Heritage Area is located on Puget Island across the Columbia from the Westport Slough. It is a prime ferry viewing spot and provides visitors with a rest area and information on the travels of Lewis and Clark through the area (3).

Three nature refuge sites are identified and include: the Julia Butler Hansen Refuge for the Columbian White-Tailed Deer, located north of Puget Island and containing 5,600 acres (4); Robert W. Little Preserve for Columbian White-Tailed Deer on Puget Island (5); and the Westport Slough Lower Columbia Estuary Partnership, a wetland habitat enhancement and restoration project (6).

Lastly, the miscellaneous site listed is the Georgia-Pacific Conservation Area, a 27-acre parcel of land donated to the county by the Georgia-Pacific Wauna Mill for park and recreational development (7).

(1) Oregon State Parks. 2015. "Bradley State Scenic Viewpoint." Accessed January 22, 2015. http://www.oregonstateparks.org/index.cfm?do=parkPage.dsp_parkPage&parkId=127

(2) Clatsop County Oregon. 1980. "Clatsop County Goal 5 County Wide-Element: Open Spaces, Scenic/ Historic Areas, and Natural Resources." Clatsop County Comprehensive Plan. Accessed January 21, 2015. http://www.co.clatsop.or.us/sites/default/files/fileattachments/land_use_planning/page/609/comp_plan_goal_5.pdf.

(3) Wahkiakum County Chamber of Commerce. 2015. "Wahkiakum County Washington Chamber of Commerce: Information." Accessed February 3, 2015. http://www.cathlametchamber.com/puget_island.php.

(4) U.S. Fish and Wildlife Service. 2015. "Overview: Julia Butler Hansen Refuge for the Columbian White-Tailed Deer.". Accessed February 3, 2015. http://www.fws.gov/refuges/profiles/index.cfm?id=13554

(5) The Nature Conservancy. 2015. "The Robert W. Little (Puget Island) Preserve." Accessed February 4, 2015. http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/washington/placesweprotect/puget-island.xml

(6) Lower Columbia Estuary Partnership. 2010. "Reach C Westport Slough - Karamanos." Accessed February 4, 2015. http://www.estuarypartnership.org/restorationsite/1335.

(7) The Daily News. 2015. "Wauna Mill Donates Land for Clatsop County Waterfront Park." January 27. Accessed February 2, 2015. http://tdn.com/news/local/wauna-mill-donates-land-for-clatsop-county-waterfront-park/article_dbd74a54-a5ef-11e4-ac7d-b7cd0e23e317.html.

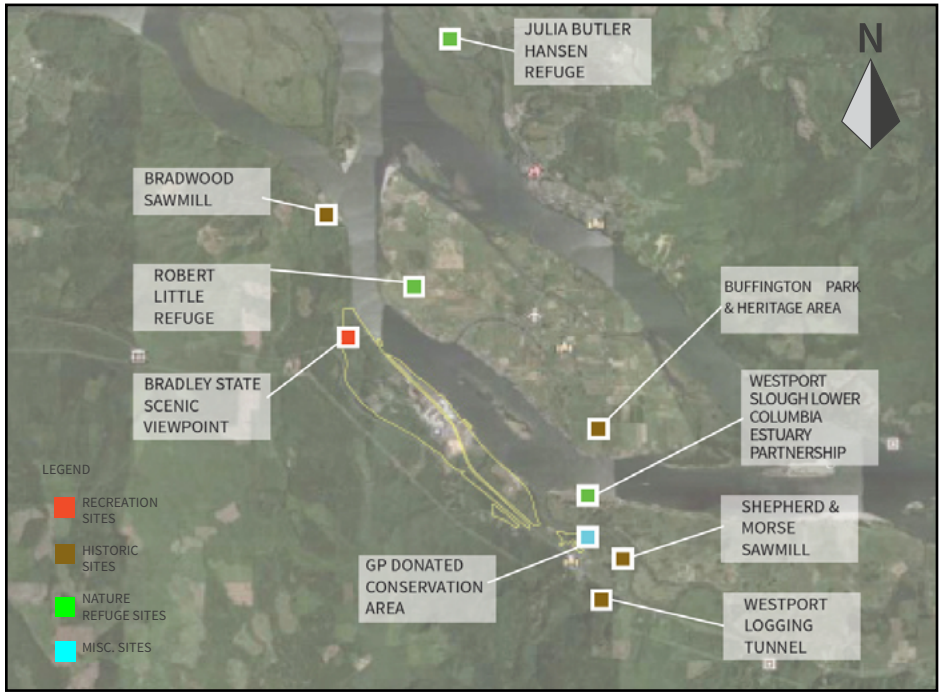


Figure 2.5.5. Cultural site map

2.5.4 CLATSOP COUNTY DEMOGRAPHICS

Major: UI Bioregional Planning & Community Design

Student Author: Alexandria Marienau

Clatsop County is fairly rural, home to 1% of Oregon's population, with about 37,000 residents. The county was compared with the State of Oregon on a number of demographic factors. The county's economy has changed in the past few decades, with fewer people employed in natural resource occupations, and more employed in service jobs. Service jobs hold the highest percentage of occupations for Clatsop County. The percentage of workers in service jobs is slightly higher than the percentage for the entire state. Even though natural resource occupations have shrunk, the county has a slightly higher percentage of people who work in natural resources, maintenance and construction, and production and transportation occupations than recorded at the state level (1) (Figure 2.5.6).

(1) American Fact Finder 3-year estimates. http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_3YR_DP03&prodType=table

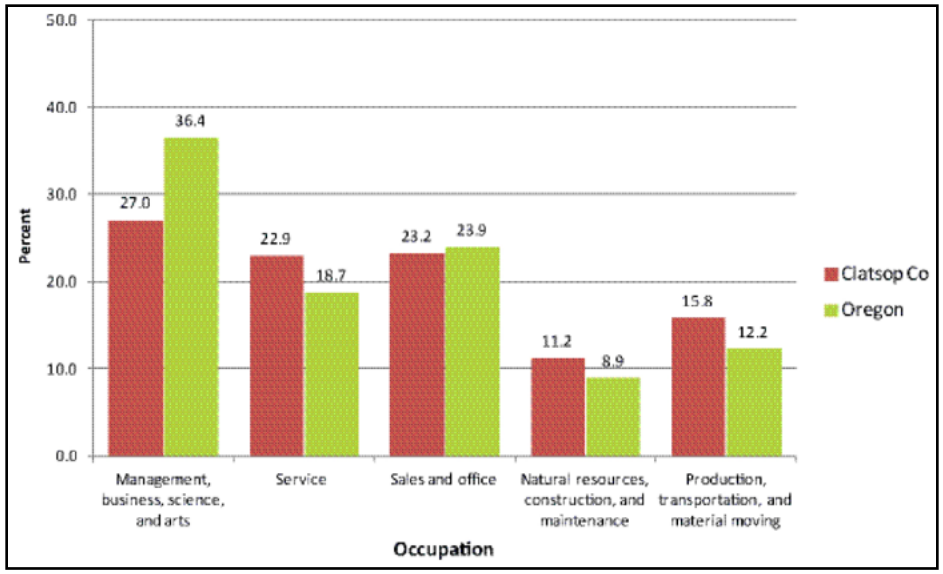


Figure 2.5.6. Clatsop County demographics - Occupation

The top four industry groups listed for both Clatsop County and the state of Oregon are the same: education and health services; arts, recreation, and service; manufacturing; and retail trades (Figure 2.5.7). Clatsop County's fifth largest industry is construction, while the state of Oregon's fifth largest industry is professional, scientific, management, administrative and waste management services (1).

(1) American Fact Finder 3-year estimates. http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_3YR_DP03&prodType=table

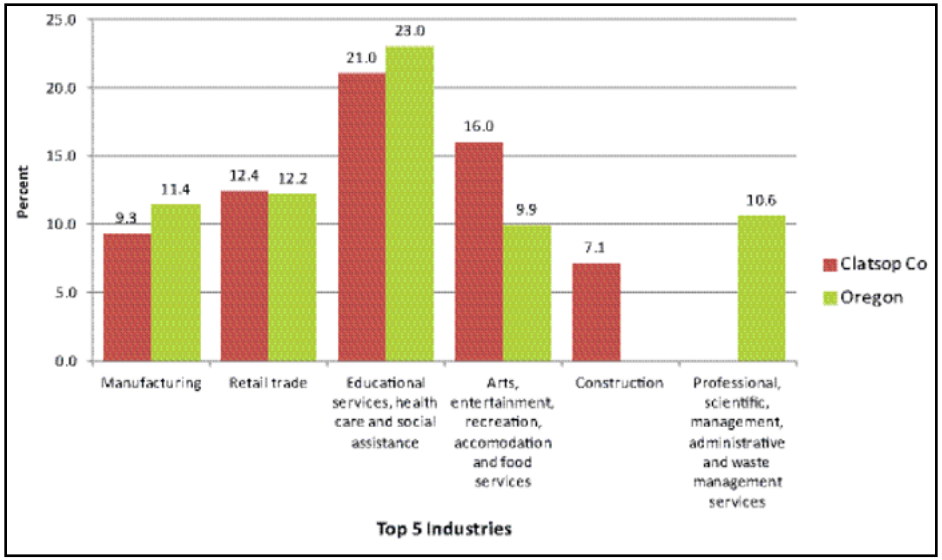


Figure 2.5.7. Clatsop County demographics - Top 5 Industries

The population of Clatsop County is primarily of white descent. It is split fairly evenly between males and females. The average age of residents is 43 years, and about one in four has a bachelor's degree or higher (1). The median and per capita income for Clatsop County is slightly lower than the median and per capita income recorded for the state (Figure 2.5.8). Clatsop County also has more adults over 18 years, families, and families with children that fall below the poverty line than recorded for state. Twenty-six percent, or just over 1 in 4, of families with children in Clatsop County fall below the poverty level (Figure 2.5.9). In Clatsop County, there are slightly less people 16 or older in the labor force than for the state of Oregon. This could maybe be due to the fact that Clatsop County has a slightly higher population of those 60 years and older. The county's percent of the labor force that is unemployed is slightly lower than Oregon as a whole (2) (Figure 2.5.10).

(1) American Fact Finder 3-year estimates. http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_3YR_DP02&prodType=table

(2) American Fact Finder 3-year estimates. http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_3YR_DP03&prodType=table

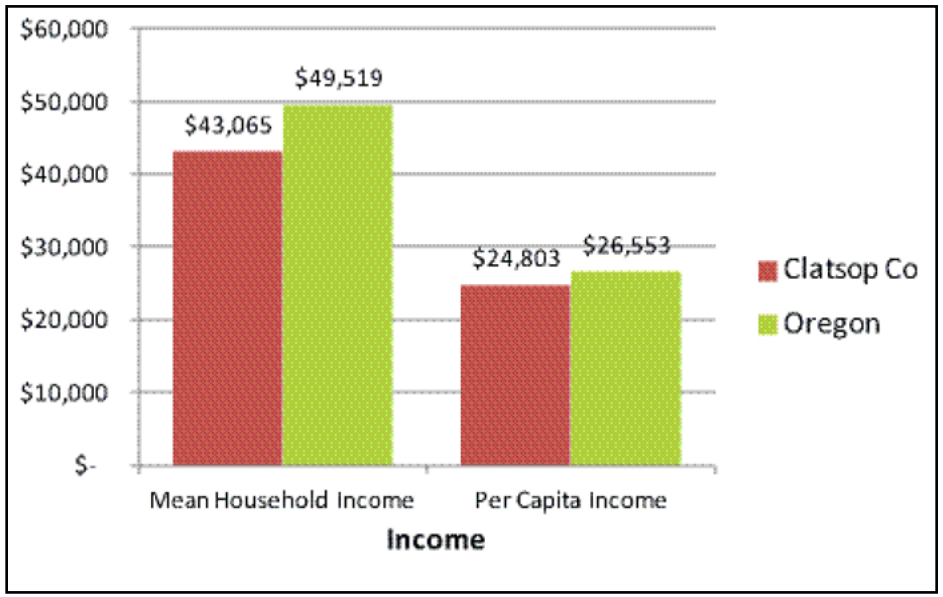


Figure 2.5.8. Clatsop County demographics - Income

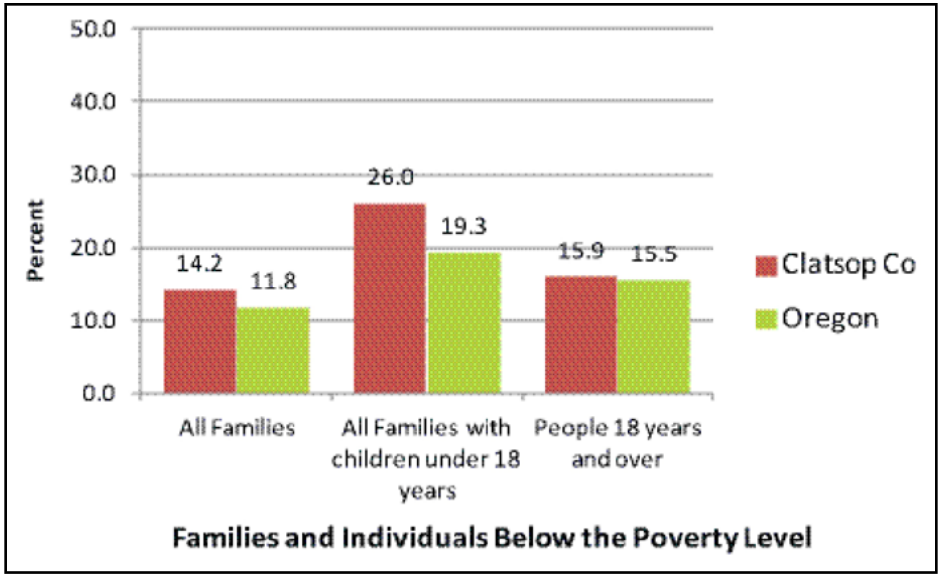


Figure 2.5.9. Clatsop County demographics - Families and Individuals Below Poverty Level

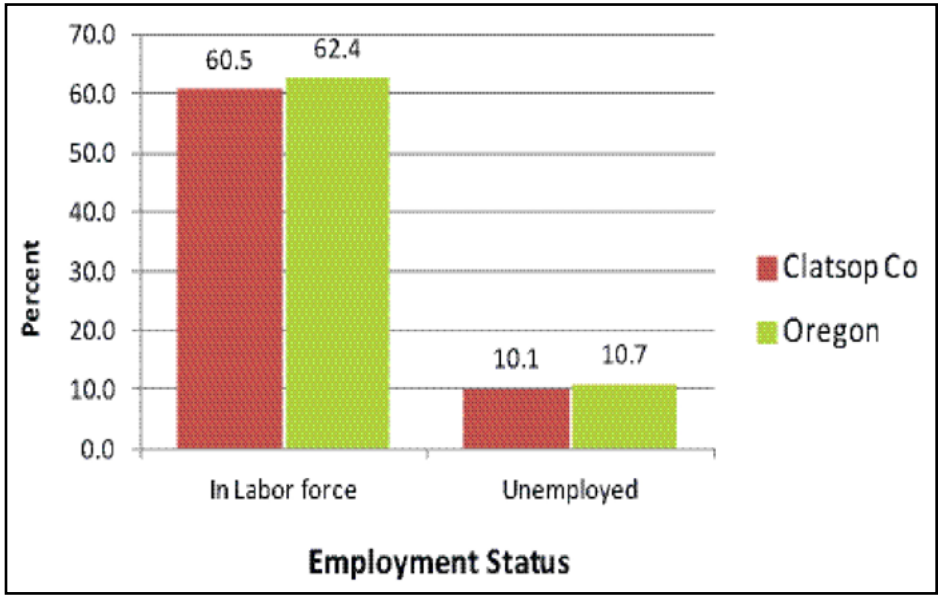


Figure 2.5.10. Clatsop County demographics - Employment Status

2.5.5 ECONOMIC DEVELOPMENT POTENTIAL

As stated before, this area has gradually made a shift from a heavily natural resources based economy toward an economy focused on leisure and other services. To examine if a wood-based biofuels facility would be supported as a viable economic opportunity for this region, the comprehensive economic development strategies developed for the Columbia-Pacific Economic Development District, for northwest Oregon, and the Cowlitz-Lewis Economic Development District for Wahkiakum County, Washington were reviewed. These economic development districts operate under the U.S. Economic Development Administration and are required to develop comprehensive economic development strategies (CEDS) that outline goals and strategies for economic development.

The Columbia Pacific (or Col-Pac) Economic Development District includes Columbia, Clatsop, and Tillamook Counties and the western part of Washington County. One area of the Col-Pac's mission is to: "Sustain and grow NW Oregon's businesses by exploiting opportunities in areas such as marine based industry, tourism, small manufacturing, forest products, agriculture and aviation." This statement emphasizes a desire to continue to find ways to incorporate forest products and other natural resources into the economy. The CEDS documents the 2014 regional condition stating: "Historically associated with abundant natural resources, NW Oregon's employment and investment in timber, wood products, fisheries and agriculture have declined over the years. ….Growth in renewable energy is also fueling interest in logging waste for bio-fuel." Here they note that natural resource industries have decreased, but there is interest in bio-fuel production, particularly using woody biomass. The CEDS also observes that aviation and energy, including biofuels, are emerging industry clusters, and that there has been private investment interest in biofuels in this area (1).

Because the Georgia-Pacific Wauna Mill currently attracts workers from Wahkiakum County, such as Puget Island, the Cowlitz-Lewis Economic Development District materials were reviewed. The District's mission statement is: "to promote the creation of family wage jobs; diversification of the economic base; and growth, development and retention of business and industry within the Cowlitz- Lewis County region." One of the goals stated is: "To maintain and develop new opportunities for renewable and natural resource industries to provide a growing and sustainable economic base" They hope to achieve this by: "1) Promot[ing] opportunities for renewable, alternative energy industries; 2) Encourag[ing] workforce training and development programs to expand "green collar" job skills; 3) Support[ing] value-added activities that diversify economic benefits for natural resource industries; 4) Focus[ing] on retaining renewable and natural resource industrial jobs" (2).

(1) Northwest Oregon Comprehensive Economic Development Strategy (CEDS), 2014-2018 http://www.nworegon.org/Assets/dept_2/PM/pdf/2014-2018ceds-final.pdf

(2) Cowlitz-Lewis Economic Development District CEDS Action Plan, 2013-2014. http://www.nado.org/wp-content/uploads/2014/08/WA-Cowlitz-Lewis-Economic-Development-District-2013.pdf

Along with the opportunity for economic development for this region, introducing a liquids depot in this area would create other opportunities within the local economy. For one, operation of such a facility would create more jobs for the local workforce. The skills this facility would require would be similar to those at an ethanol facility. The technical report "Process Design and Economics for Biochemical Conversion of Lignocellulosic Biomass to Ethanol: Dilute-Acid Pretreatment and Enzymatic Hydrolysis of Corn Stover" contains a breakdown of the fixed costs for operating an ethanol facility taking in about 770,000 BDT/year of biomass, including labor and supervision positions and wages (1). The wood-based liquids depot would take in about 250,000 BDT of feedstock, thus the workforce estimates are based on about ⅓ of what the ethanol study reported. Total employment for the liquids depot is estimated at 20 new employees. The average annual income for these positions would be $44,000 and the median at $38,000, which is slightly lower than household incomes for Clatsop and Columbia counties. These positions could draw workers from Clatskanie, Westport, Astoria, and Rainier, Oregon, along with Puget Island and Cathlamet, Washington. The positions would include both skilled and non-skilled positions, attracting those with formal education and those with a minimum of a high school diploma or GED.

This facility would also affect the economies of local communities and increase property tax revenue for the county. It also has the potential to increase local business revenue, as there would be more working individuals with living-wage jobs. These workers would spend their money in local communities to by meals, groceries, gas and other goods, whether residing there or passing through due to commuting.

(1) National Renewable Energy Lab. 2011. "Process Design and Economics for Biochemical Conversion of Lignocellulosic Biomass to Ethanol: Dilute-Acid Pretreatment and Enzymatic Hydrolysis of Corn Stover, Table 31." NREL/TP-5100-47764. http://www.nrel.gov/biomass/pdfs/47764.pdf.

2.5.6 PUBLIC SENTIMENT

Major: UI Bioregional Planning & Community Design
Student Author: Courtney Mattoon

In order to understand the public sentiment regarding the Georgia-Pacific Wauna Mill, and the possible addition of a liquids depot onsite, area newspaper articles were reviewed using key search terms: Koch Industries (owners of GP Wauna Mill), Wauna Mill, Georgia-Pacific Mill, Clatskanie, Westport, Cathlamet, Puget Island, and complaints. The newspapers included:

- The Daily News Online (TDN.com), of Longview, Washington
- The Chief News (thechiefnews.com), of Clatskanie, Oregon
- The Oregonian (oregonlive.com), of Portland, Oregon
- The Daily Astorian (thedailyastorian.com), of Astoria, Oregon

The main findings from the newspaper review were: a) generations of families have worked at the mill (1), and b) employees of Georgia-Pacific Wauna Mill have raised funds yearly to donate to the local United Way organization (2, 3). These findings do not provide a clear picture of the public sentiment regarding the Wauna Mill, nor what it may be if a liquids depot were to be built onsite. Without surveys it is hard to know whether there would be support for the addition of a liquids depot. Additional information and photos were obtained via United Way of Clatsop County's website (4) (Figures 2.5.11 and 2.5.12).

(1) Williams, Mike. "The Wauna Mill: A Half-century of Family Pride." - The Daily Astorian. February 4, 2015. Accessed February 15, 2015. http://www.dailyastorian.com/CRBJ/news/20150204/the-wauna-mill-a-half-century-of-family-pride/1.

(2) Manny, Janine. "Wauna and Its 1,000 Millworkers Donate $256,000 to United Way." The Daily News Online: Serving the Lower Columbia. December 13, 2006. Accessed February 15, 2015. http://tdn.com/business/local/wauna-and-its-millworkers-donate-to-united-way/article_8daeb8de-115d-582f-ba29-21852a116d55.html

(3) Fischer, Amy M.E. "United Way Cleans up with Paper Towel, Cash Donations." The Daily News Online: Serving the Lower Columbia. December 15, 2010. Accessed February 15, 2015. http://tdn.com/news/local/united-way-cleans-up-with-paper-towel-cash-donations/article_8c5fe3ca-08e9-11e0-bba1-001cc4c002e0.html.

(4) Docherty, Scott. "2013-2014 Fundraising Campaign." United Way of Clatsop County. May 21, 2014. Accessed February 15, 2015. http://www.clatsopunitedway.org/category/news/.

Figure 2.5.11. Public Sentiment - United Way Donations

Figure 2.5.12. Public Sentiment - United Way Donations

2.5.7 AVAILABLE INCENTIVES

Major: UI Bioregional Planning & Community Design
Student Author: Emma Liang

There are various incentives for biofuels producers and renewable energy subsidies available at the federal and state level, including Corporate Tax Credit, Property Tax Exemption, and Grants and Loan Guarantees (1). Table 2.5.1 summarizes the main incentives. If the Georgia-Pacific Wauna Mill were interested in adding a wood-based liquids depot on their site, these incentives could mitigate startup costs.

(1) U.S. Department of Energy EERE (Energy Efficiency & Renewable Energy) Database of State Incentives for Renewables & Efficiency (DSIRE)
(2) Oregon Department of Energy (http://www.oregon.gov/energy/Pages/index.aspx)

Table 2.5.1. Available Incentives

TYPE	PROVIDER OR ORGANIZATION	ELIGIBLE GROUP	WEBSITE
Federal			
Advanced Biofuel Production Payments	Bioenergy Program for Advanced Biofuels	eligible producers of advanced biofuels, or fuels derived from renewable biomass other than corn kernel starch	http://www.afdc.energy.gov/laws/8503
Advanced Biofuel Feedstock Incentives	Biomass Crop Assistance Program	landowners and operators that establish, produce, and deliver biomass feedstock crops for advanced biofuel production facilities	http://www.afdc.energy.gov/laws/10292
Advanced Biofuel Production Grants and Loan Guarantees	Biorefinery Assistance Program	development, construction, and retrofitting of commercial-scale biorefineries that produce advanced biofuels	http://www.afdc.energy.gov/laws/8502
State of Oregon			
Corporate Tax Credit	Oregon Department of Energy	biomass used to produce biofuel; production or collection of biomass must take place in OR and must also be used in OR	http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OR144F&re=0&ee=0
Property Tax Exempt	Oregon law	installation of a qualifying renewable energy used to heat, cool or generate electricity	http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OR01F&re=0&ee=0
Renewable Energy Development Grant	Oregon Department of Energy	renewable energy, including biomass	http://programs.dsireusa.org/system/program/detail/5305

2.6.0 GP WAUNA MILL ECO & BIO ATTRIBUTES

2.6.1 GP WAUNA MILL - ECOREGION

Major: UI Landscape Architecture
Student Author: Garrett Gorgen

The Georgia-Pacific Wauna Mill site is located within the Oregon Coast Range. Specifically, it is part of the Columbia-Clatskanie and Willapa Hills. The key habitats near the Georgia-Pacific Wauna Mill site are freshwater wetlands, oak woodlands, and riparian areas (Figure 2.6.1).

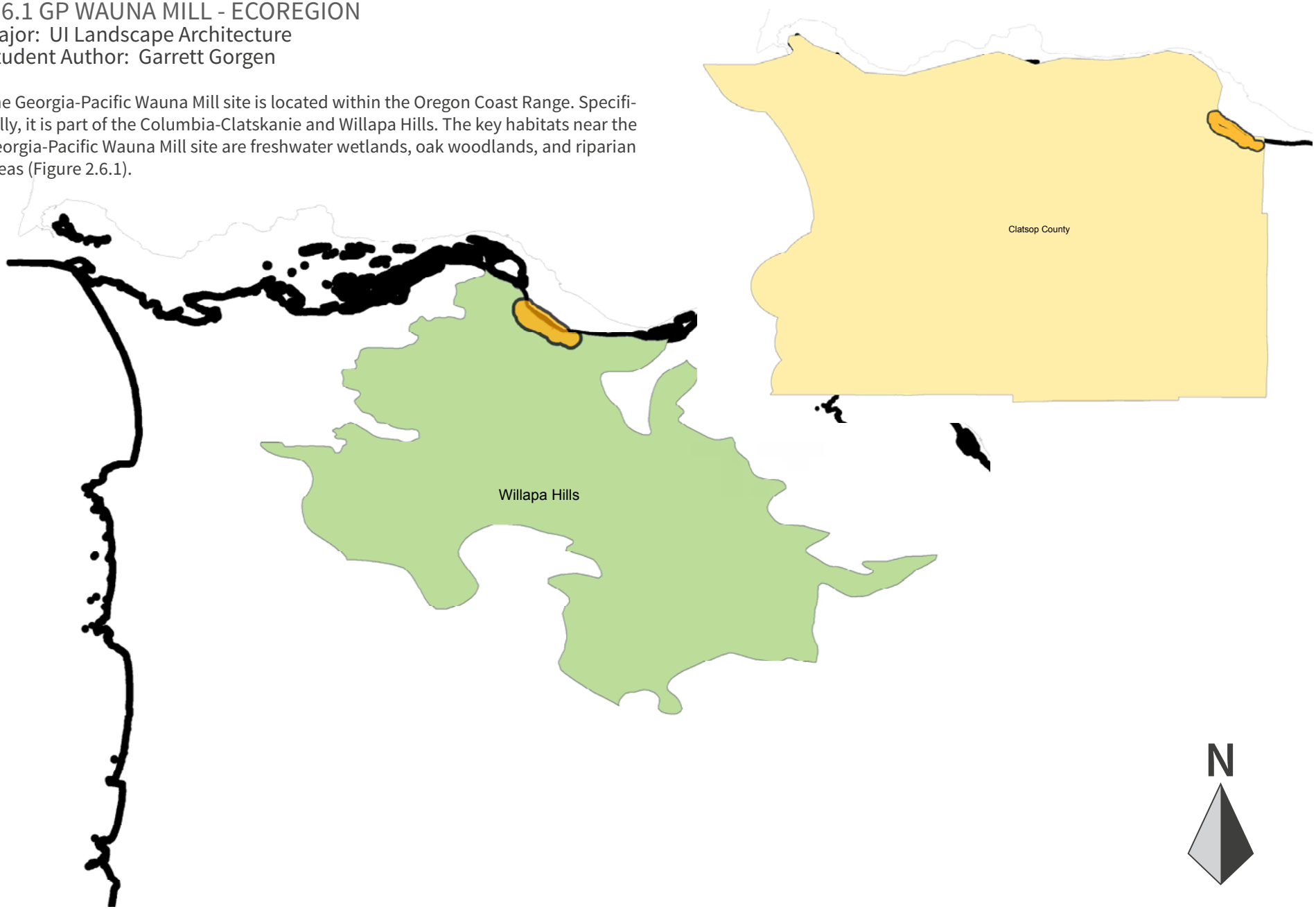


Figure 2.6.1. Oregon Coast Range Ecoregion

2.6.2 GP WAUNA MILL - WATERSHED

Major: UI Landscape Architecture
Student Author: Kate Shrosbree

The Georgia-Pacific Wauna Mill site is located in the Lower Columbia River watershed (Figure 2.6.2). In this watershed, a network of small streams and tributaries drain into floodplains and the tidal reaches of the Columbia River. Most of the species diversity in the floodplain environments has declined due to many dike, levee and dam alterations along the Columbia River that have been built to protect developed areas and farms.

Many fish species including the Chinook, Coho and Steelhead that depend on the watershed's streams and habitat for passages are listed as threatened by the EPA. The IDX design solutions for the liquids depot will mitigate water quality impacts and include critical habitat restoration.

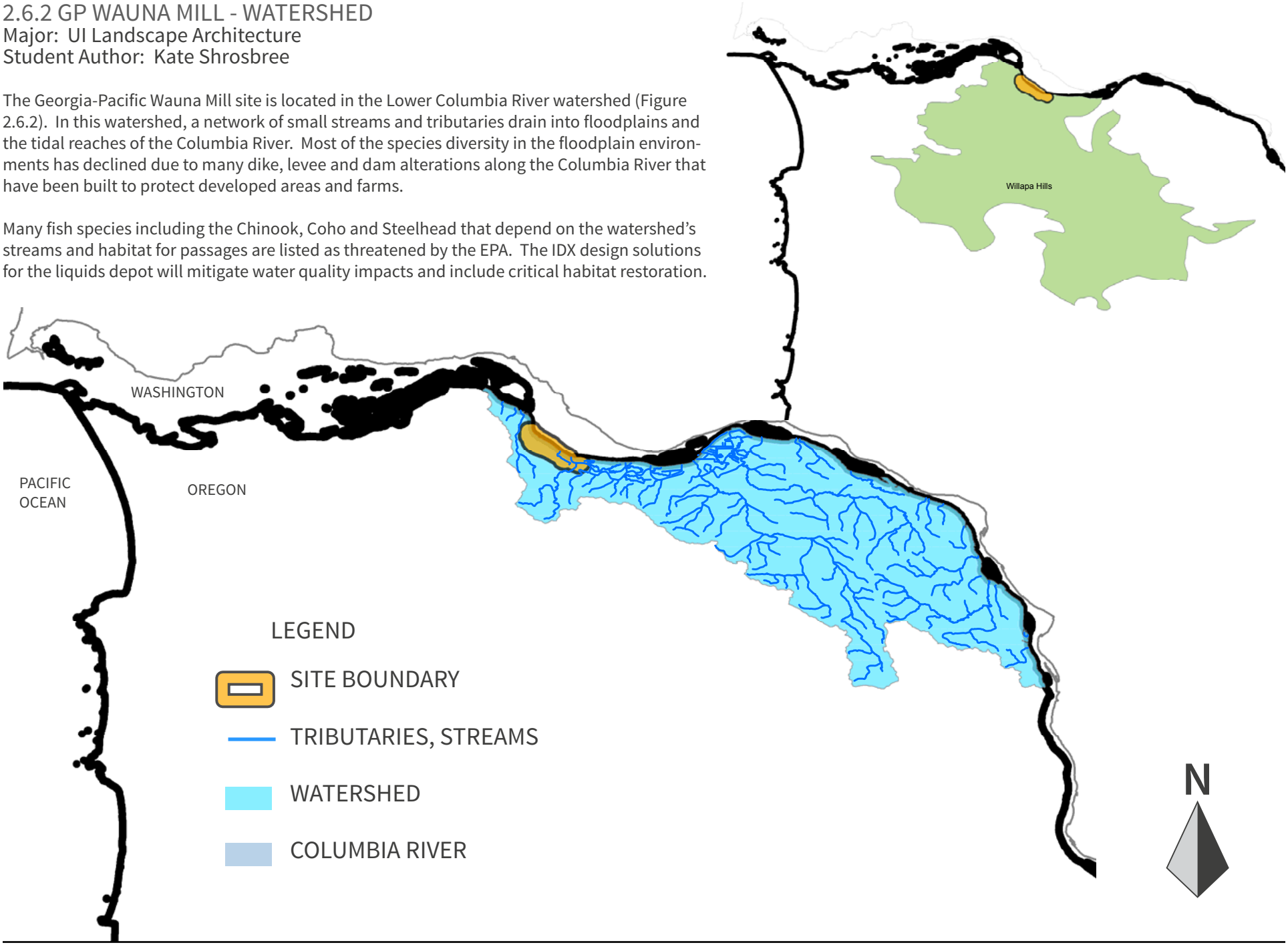


Figure 2.6.2. Columbia River watershed

2.6.3 GP WAUNA MILL - WETLANDS

Major: UI Landscape Architecture
Student Author: Kate Shrosbree

Figure 2.6.3 indicates the areas within and near the Georgia-Pacific Wauna Mill site where wetland habitat is found. These wetlands play a role in providing critical habitat for both resident and migratory wildlife species, as well as plants. Development and alteration of the native habitats in the bioregion has fragmented many of the unique wetlands in the area and has threatened their health and functioning.

Wetland areas play a role in reducing flooding and pollution. Water accumulates in the wetland's hydric soils where water-loving plants grow and sequester pollutants that would otherwise enter the river. In addition, as a transition area between the dry land and riparian environment, the wetland areas on the site have a role in mitigating flooding.

These wetlands provide opportunities not only for conservation, but for recreation as well. The form of wetlands change with the seasons, and these areas can accommodate recreational uses during the dry season. However, any recreational use of these areas must be low-intensity so that the native habitat is not threatened.

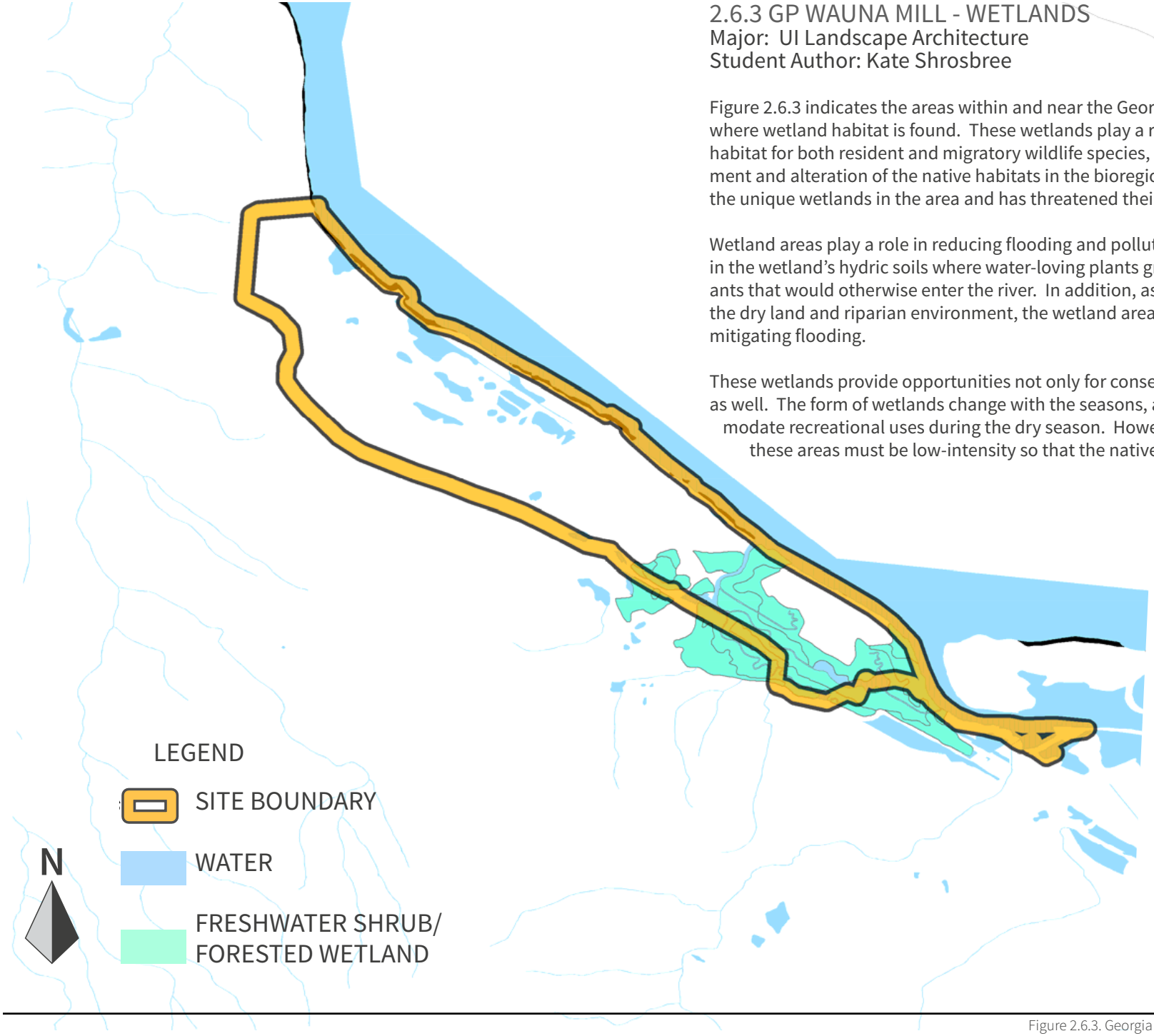


Figure 2.6.3. Georgia Pacific Wauna Mill - wetland habitat

2.6.4 GP WAUNA MILL - SOILS

Major: UI Landscape Architecture
Student Author: Nathan Beck

Soils can play a key role in site development. Figure 2.6.4 shows soil types and locations. The chart expands on the traits of the three major soils that are contained in the Georgia-Pacific Wauna Mill site. The wetland areas contain the poorly drained soils, or locada silt loam, and these soils are considered hydric, or typically saturated most of the year. Existing and future infrastructure will be planned on the other major soil types, Udipsamments and Alstony Gravelly Loam, which are well drained and for the most part fertile soils.

Identifying soil types, how fertile, how well or poorly drained, and how hard they are to compact and remove, helps to select appropriate locations for different built environments. For a large industrial operation, some clay or gypsum rich soils may be imported because they are easily compacted and typically used as a base for new buildings and infrastructure. Having existing well-drained soils with decent fertility will help the site incorporate different types of landscaping for the multi-purpose plans being developed.

Table 2.2.1. Georgia Pacific Wauna Mills - Soils

	Udipasamments	Locada silt loam	Alstony gravelly loam
Parent material	Stratified alluvium	Recent silty alluvium	Colluvium from igneous rock
Fertility	Low		Moderately- high
Erodibility (T-Factor)	Slight (5)	Slight (5)	
Drainage class	Well- drained	Very- poorly drained	Well- drained
Infiltration rate	5.95 to 19.98 in/ hr	.20 to .57 in/mr	.57 to 1.98 in/ hr
Depth to bedrock	> 80 in	> 80 in	40 to 60 in.
Depth to water table	> 80 in.	0- 12 in.	> 20 in.
Ph		Moderate (5.3-6.3)	Strongly-moderately acidic
Hydrologic soil group	A	C/D	C

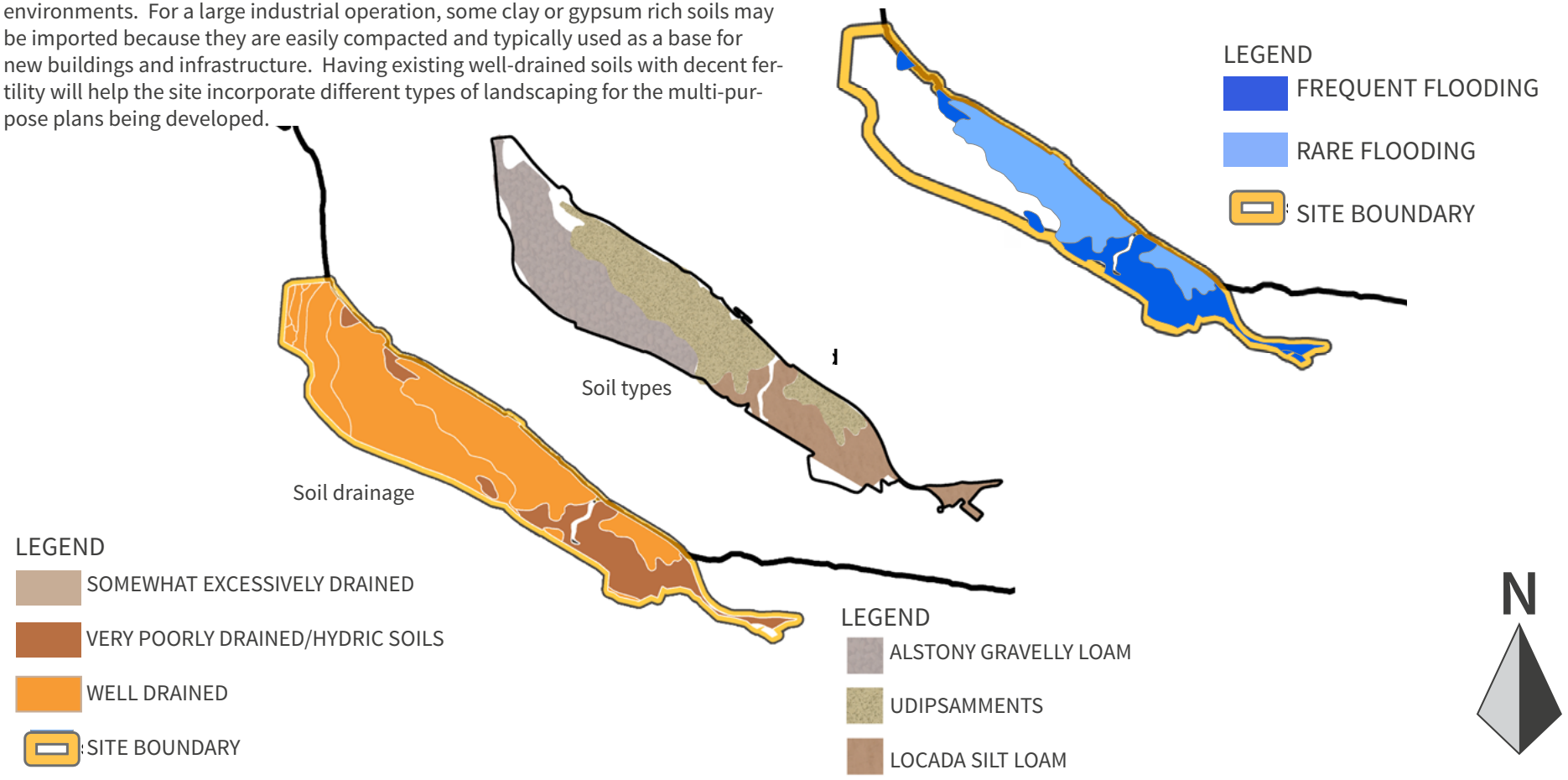


Figure 2.6.4. Georgia Pacific Wauna Mill - Soils

2.6.5 GP WAUNA MILL - TOPOGRAPHY & FLOOD ZONES

Major: UI Landscape Architecture
Student Author: Nate Beck

The images show topography and the Federal Emergency Management Agency (FEMA) Flood Zones (2010).

The topography map (Figure 2.6.5) is in 40 foot intervals. While this is not a very accurate map for final design purposes, it is helpful in providing an overview. Having a general idea of the topography helps in the preliminary design stages. Topography can greatly dictate future locations of roads, buildings, and other features for the site design.

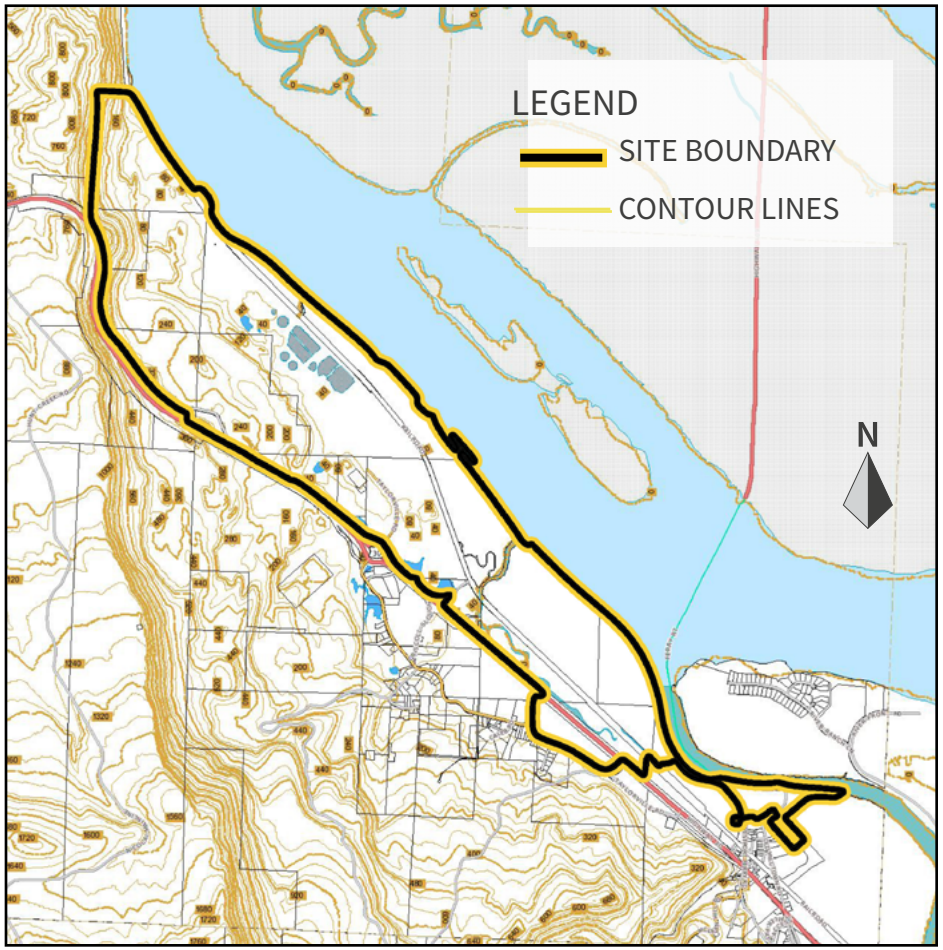


Figure 2.6.5. Georgia Pacific Wauna Mill - Topography

The existing infrastructure and surrounding areas are relatively flat for this site. By viewing the general site topography, IDX was able to locate potential areas where the liquids depot could be built. More detailed and accurate contour/topographic mapping is being developed, which will be used for construction documentation later in the process of developing this site.

The FEMA flood map (Figure 2.6.6) is important to take note of as well. Areas that are prone to flooding are not proper locations for new infrastructure. This information informed initial proposed depot locations at the Georgia-Pacific Wauna Mill site.

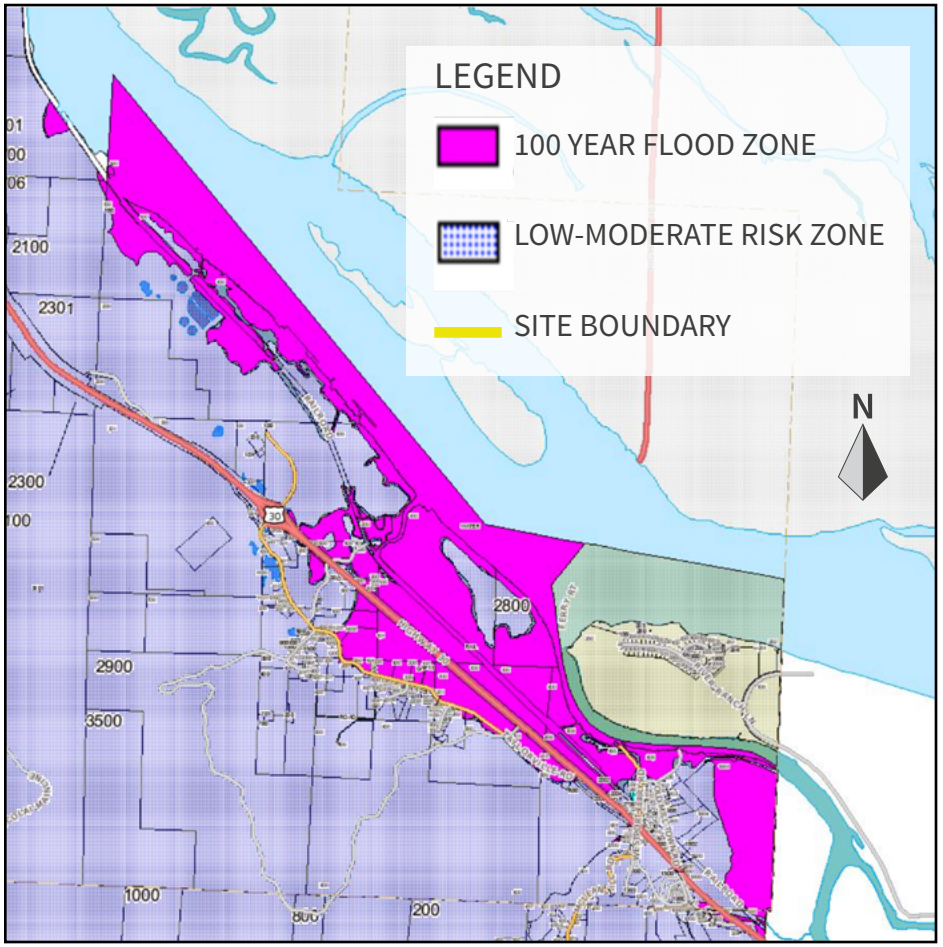


Figure 2.6.6. Georgia Pacific Wauna Mill -Flood Zones

2.6.6 GP WAUNA MILL - VEGETATION & WILDLIFE

Major: UI Landscape Architecture
Student Author: Garrett Gorgen

The Georgia-Pacific Wauna Mill site is home to a variety of tree, shrub, and herbaceous plant species. The site provides habitat and corridors for a variety of wildlife species. In the liquids depot designs, IDX will provide the best structure, function and components to support plant and wildlife habitats.

KEY PLANTS SPECIES:
Cascade Head catchfly, Coast Range fawn-lily, Nelson's checker-mallow, Pink sand-verbena, Saltmarsh bird's-beak, Silvery phacelia, Western lily, Wolf's evening-primrose.

KEY WILDLIFE SPECIES:
Olive-sided Flycatcher, Coho Salmon, Fall Chinook Salmon, Winter Steelhead, Columbian White-tailed Deer, waterfowl, and loons.

ENDANGERED SPECIES:
Coastal Tailed Frog, Eulachon, Green Sturgeon, Marbled Murrelet, Spotted Owl, Silverspot Butterfly, Red Knot, Pearlshell Mussel, Snowy Plover.

Tolmiea
Tolmiea menziesii

Lady Fern
Athyrium filix

Oxalis
Oxalis oregana

Red Alder
Alnus rubra

Vine Maple
Acer circinatum

Red Huckleberry
Vaccinium parvifolium

Elderberry
Sambucus racemosa

Stink Currant
Ribes bracteosum

Salmonberry
Rubus spectabilis

Coho Salmon

Waterfowl

Winter Steelhead

Chinook Salmon

Olive-sided Flycatcher

White-tailed Deer

Loons

2.7.0 GP WAUNA MILL PHYSICAL ATTRIBUTES

2.7.1 GP WAUNA MILL - FACILITIES

Major: UI Landscape Architecture
Student Author: Nathan Beck

The Georgia-Pacific Wauna Mill owns over 12,000 acres of land which is outlined in yellow (Figure 2.7.1). Their current operations roughly use about 250 acres, which are broken out into the following land uses:

- Waste water treatment plant =71 acres
- Buildings=150 acres
- Storage/pretreatment=30 acres

(Note= This was roughly estimated by measuring in Autocad and GIS).
A future liquids depot site would only need around 20 acres to be developed. This represents a small area of the total and thus would not have a significant impact on existing facilities.

Figure 2.7.1. Georgia Pacific Wauna Mill - Facilities

2.7.2 GP WAUNA MILL - REGIONAL TRANSPORTATION

Major: UI Landscape Architecture & Bioregional Planning
Student Authors: Kate Shrosbree and Emma Liang

The transportation options for the Georgia-Pacific Wauna Mill site are highway, rail and water (Figure 2.7.1). The highway serving the site, U.S. 30, runs east-west between Westport and the City of Astoria. This highway provides a major connection between Astoria and the towns along the Lower Columbia River. From U.S. 30, there is an existing off ramp that provides access to and from the site.

A single track railroad intersects the site. This railroad serves The Portland and Western Railroad Astoria Line route, which runs east-west along the Columbia River from Portland to Astoria. This regional railroad is capable of carrying large quantities of freight and serves the manufacturing operations along the Lower Columbia River. Major sources of traffic along the railroad include train cars carrying loads of paper, lumber products and wood chips.

There is a ferry terminal at the southern end of the site at Westport. The ferry route runs from Westport through the Westport Slough and across the Columbia River northeast to Puget Island. On Puget Island, the ferry terminal meets Highway 409. This ferry accommodates both passengers as well as vehicles.

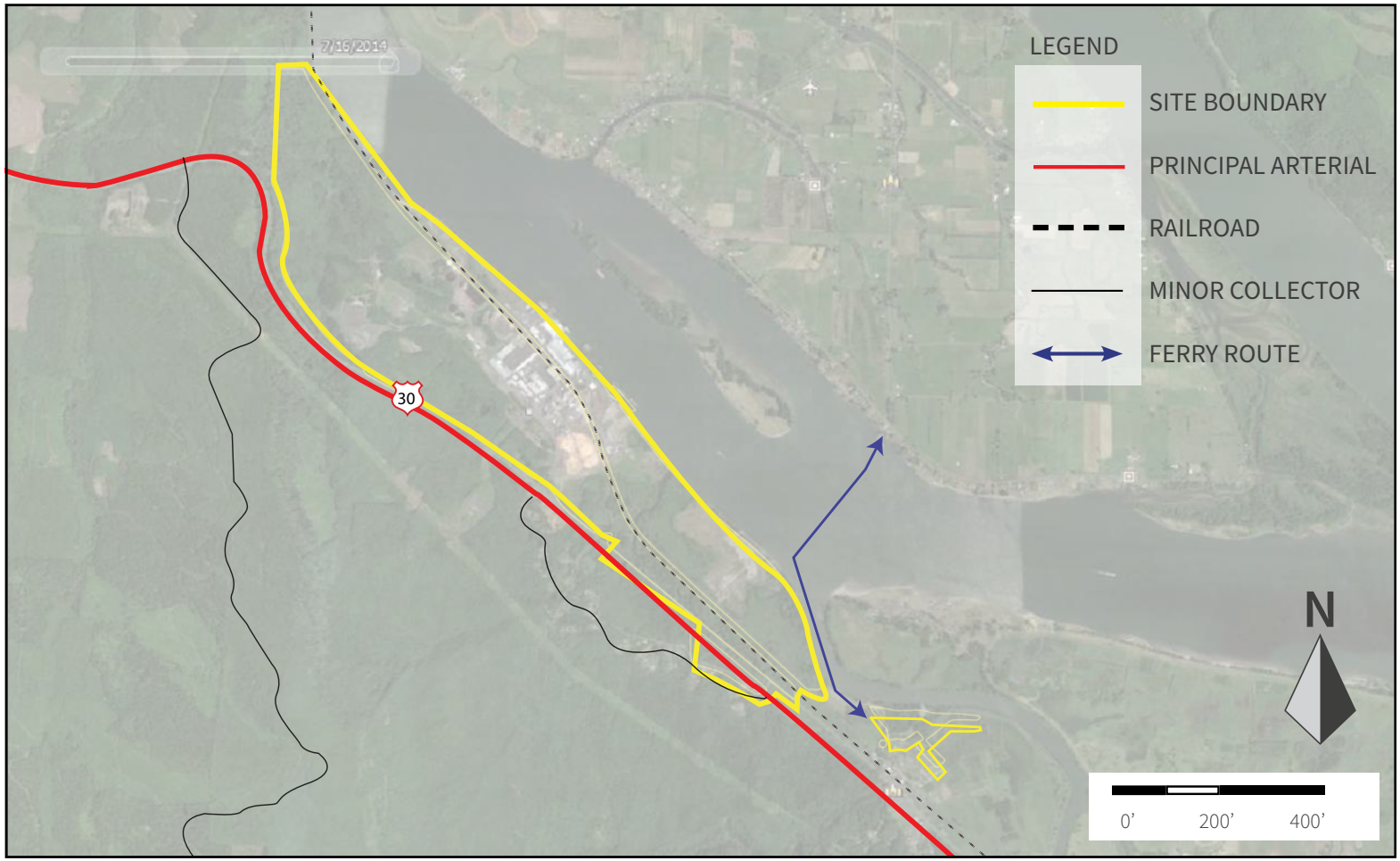


Figure 2.7.2. Georgia Pacific Wauna Mill - Transportation

SITE TRANSPORTATION ASSETS & ANALYSIS

Site Transportation Change in 2011

In April 2011, a freighter crashed into the dock on Columbia River at the Georgia-Pacific Wauna Mill site (1). After the barge accident the Georgia-Pacific Wauna Mill began to ship all its products by truck. About 100 trucks a day were making trips from the paper mill — a major change for the mill, which normally did 90 percent of its shipping by barge. IDX has not been able to find information on the company's current shipping methods. It is unknown at this time whether the dock has been repaired or not.

Distance to Portland International Airport

The Georgia-Pacific Wauna Mill is 73.8 miles away from Portland International Airport, which takes 1 hour and 18 minutes to drive without traffic. That means the site is fairly close to a potential market for aviation biofuels use.

Traffic Flow around the Site

According to the Traffic Flow information from Oregon Department of Transportation (ODOT), the Annual Average Daily Traffic on Highway 30 is about 6200 vehicles as indicated near Westport (2) (Figure 2.7.3). Currently, the traffic around the mill site is not that significant compared to what occurs in the Portland metropolitan area. However, if a new liquids depot site were to be built on this site, there will be additional employees driving to the site as well as increased commercial traffic.

(1) The Daily News, April 29, 2011 http://tdn.com/news/local/wauna-mill-adapts-to-new-shipping-methods-in-cargo-ship/article_d975ff40-72d0-11e0-a5f5-001cc4c03286.html

(2) Oregon Department of Transportation

Traffic Flow Map: http://www.oregon.gov/ODOT/td/tdata/Pages/tsm/tvt.aspx#Transportation_Volumes

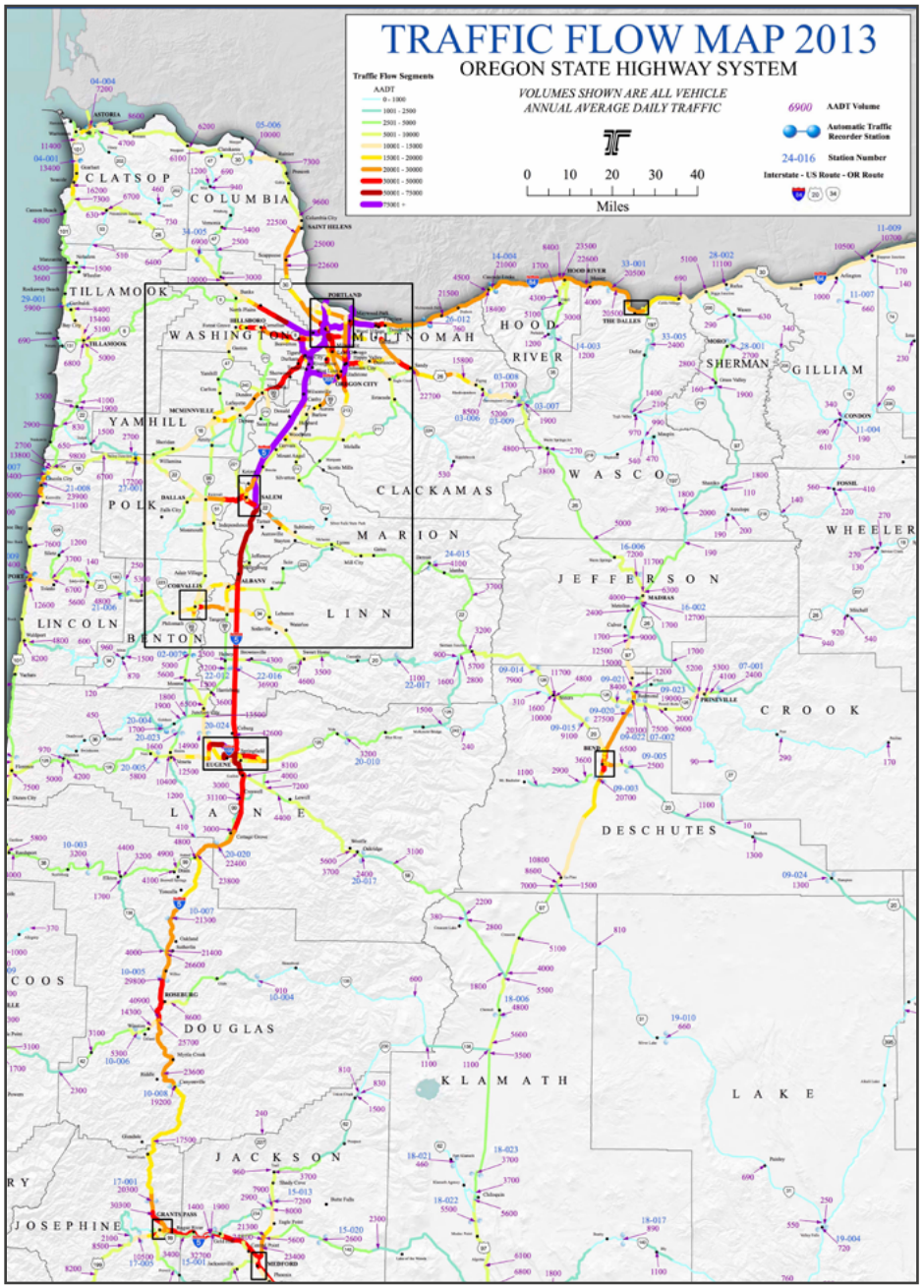


Figure 2.7.3. Georgia Pacific Wauna Mill Regional Transportation Network

2.7.3 GP WAUNA MILL LAND USE MAP

Major: UI Bioregional Planning & Community Design
Student Author: Emma Liang

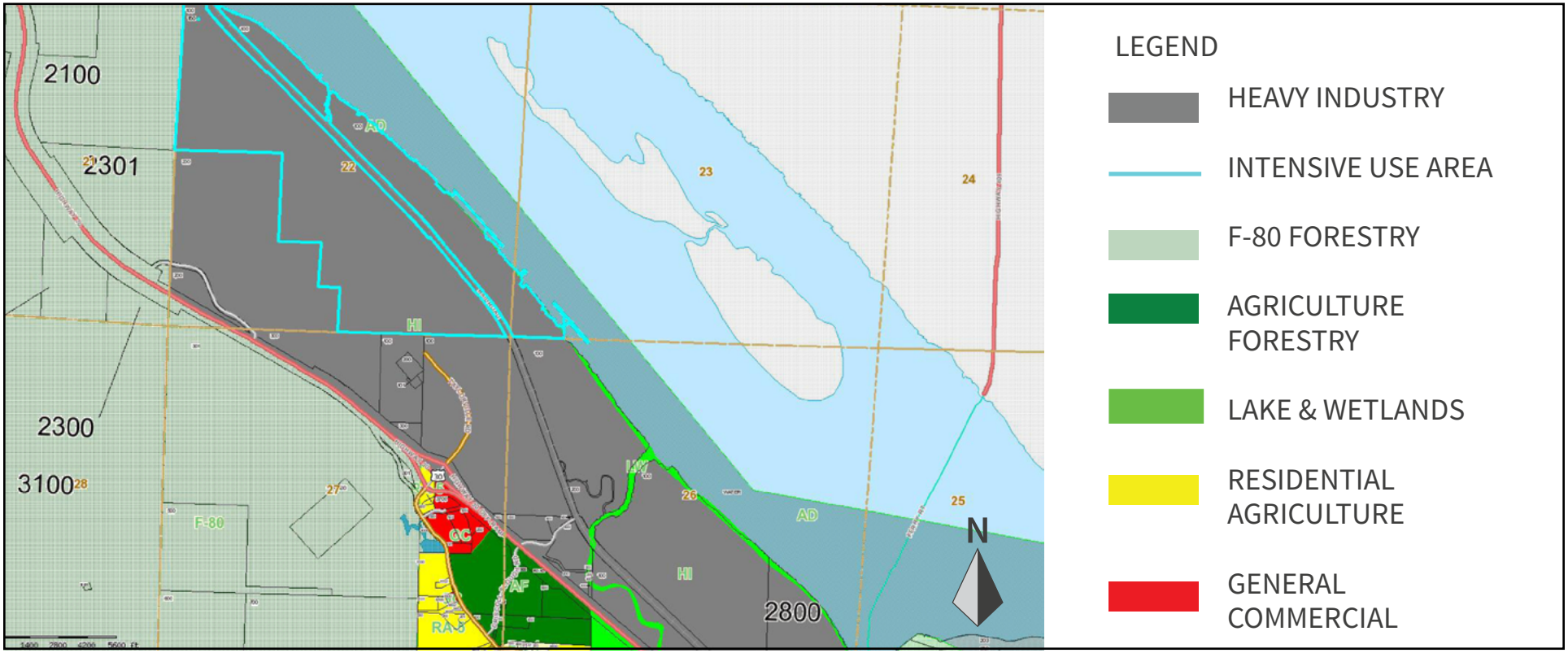
The subject property, 92326 Taylorville Road, is part of the Georgia-Pacific Wauna Mill industrial site. Tax lot 806220000100 is outlined in aqua blue in Figure 2.7.4. There are various land use types surrounding the property site, but the site itself is zoned heavy industrial. The grey area on the land use map indicates the heavy industrial zone, all owned by the Georgia-Pacific Wauna Mill. The existing property has adequate room to accommodate the proposed wood-based liquids depot.

Most of the lands nearby are zoned Forestry-80 (F-80). The purpose of the F-80 zone is to conserve forest lands by maintaining the County's forest land base, to protect the County's forest economy, and to provide for public and private recreational opportunities and agriculture.

A small Residential-Agriculture area (yellow) (RA-1, 2, 5) and General Commercial area (red) are indicated on the land use map. The other green colors are Agriculture/Forestry (AF) and Lake and Wetlands (LW) zones, which are not developable. According to Clatsop County Land and Water Development and Use Ordinance, the purpose of the LW zone is to ensure the conservation of important shoreland and wetland biological habitats and conserve examples of different natural ecosystem types in Clatsop County. Low intensity uses, which do not result in major alterations, are appropriate in this zone. Low to moderate intensity recreation is appropriate in coastal lakes. The Columbia River is zoned Aquatic Development along the mill's waterfront.

(1) Department of Land Use Planning, Clatsop County, OR. Link of Land Use Map: https://drive.google.com/open?id=0B2vm78TnbqrpeXBiUkE1WWlWWnM&authuser=0

(2) Clatsop County. 2014. Land and Water Development and Use Ordinance 80-14. Planning Division, Community Development Department. http://www.co.clatsop.or.us/sites/default/files/fileattachments/land_use_planning/page/612/zoning_0rdinance_80-14_codified_08-25-14.pdf



Source: Oregon Department of Transportation (ODOT)
http://www.oregon.gov/ODOT/td/tdata/Pages/tsm/tvt.aspx#Transportation_Volumes

Figure 2.7.4 Land use map

2.7.4 GP WAUNA MILL - OPPORTUNITIES & CONSTRAINTS

Major: UI Landscape Architecture
Student Author: Garrett Gorgens

Opportunities and constraints are used to analyze the suitability of co-locating a liquids depot at the Georgia-Pacific Wauna Mill site (Figure 2.7.5). One constraint is the site's location on the Columbia River, which puts sections of the site in flood-plain. Parts of the site are outside of the floodplain, and if positioned properly, can be utilized for buildings and infrastructure. Another constraint are the steep slopes found on the site. This results in challenges associated with slope erosion and water quality impacts. A couple of issues can be considered both a constraint and an opportunity. One is the numerous wetlands on and around the site. Although the presence of wetlands limit where proposed structures can be built, they also could provide opportunities for natural stormwater mitigation. Another opportunity are the existing facilities on the site. While they are fixed, and thus reduce the potential options for where a liquids depot could be sited, the existing infrastructure on the site could reduce some of the capital expenditures. For example, the Georgia-Pacific Wauna Mill site has a wastewater treatment plant, existing roads, rail and parking facilities. It also has electricity and natural gas on site.

FORESTED AREA:
+ POSSIBLE AREAS FOR CONSTRUCTION
- PERCENTAGE OF AREA MUST BE KEPT

RIVER FRONT:
+ ADDED TRANSPORTATION
- IN FLOOD PLAIN

RAILWAY:
+ ADDED TRANSPORTATION
- SPLITS SITE IN HALF

ACCESS TO HIGHWAY:
+ ADDED TRANSPORTATION
+ EASY ACCESS TO SITE

UNUSED DEVELOPED AREAS:
+ POSSIBLE USE FOR DEVELOPMENT
- UNKNOWN EXISTING USES

WETLAND:
- STATE CONSERVATION
- MAINTAIN OR EXPAND for WILDLIFE

SURROUNDING AREA OF SITE:
- STATE FOREST
- STEEP SLOPES

EXISTING WASTEWATER FACILITIES:
+ WASTEWATER TREATMENT IN PLACE
- FOOTPRINT ALREADY IN PLACE

Figure 2.7.5. Georgia Pacific Wauna Mill - Opportunities and Constraints

2.7.5 SUMMARY OF IMPACTS & OPPORTUNITIES

Major: UI Bioregional Planning & Community Design
Student Author: Courtney Mattoon

There would be social, economic and environmental impacts and opportunities if a liquids depot was to be built at the Georgia-Pacific Wauna Mill site (Figure 2.7.1). Social impacts include increased traffic (due to additional employees and commercial traffic) and potential impacts to the viewshed, while opportunities of providing living wage jobs and possibly decreasing unemployment rates exist. Economically, infrastructure and utility upgrades would be necessary, yet 20+ new jobs and a new liquids depot would increase local tax revenue and potentially increase local business revenue. Furthermore, state and federal incentives for biofuels production are available. Environmental impacts include increased stormwater runoff and increased air emissions. Additionally, opportunities for wetland enhancements and green infrastructure at the Georgia-Pacific Wauna Mill site are being evaluated and will be discussed in the following pages.

Table 2.7.1.Conclusions of impacts & opportunities

SUSTAINABILITY	IMPACTS	OPPORTUNITIES
Social	• Increased traffic • Potential impact to view shed	• Provides living-wage jobs • Decrease in unemployment
Economic	• Need for infrastructure and utility upgrades	• Approx. 30+ jobs created • Aligns with CEDS goals • Would increase tax revenue • Potential to increase local business and spending
Environmental	• Increased air emissions • Increased stormwater runoff	• Potential for wetland enhancement and green infrastructure

2.8.0 GP WAUNA LIQUID DEPOT PROGRAMMING

Major: UI Landscape Architecture
Student Author: Kate Shrosbree

IDX proposed two locations for the liquids depot on the Georgia-Pacific Wauna Mill site: the upper site and the lower site (Figure 2.8.1). The types of impacts/activities associated with the liquids depot are organized into five major factors: existing permitting, direct infrastructure, associated infrastructure, societal implications, and environmental impacts.

A key component of the proposed development is that the facility is located where the land is zoned for industrial use. Having the necessary permitting for wastewater treatment and discharge in place is also important for the new operations on the site.

The significant infrastructure for a liquids depot include woodyard, chemical pretreatment, and separation locations. The woodyard must provide space for the storage of truck shipments, slash and woodchip storage as well as a chipper. The chemical pretreatment includes facilities for boiler, tanks, and fermentation equipment.

Equally important to the direct infrastructure are the processes associated with our operations including stormwater, transportation, and wastewater infrastructure. Stormwater infrastructure must be able to handle fluctuations in rainfall as well as the expected contaminants from industrial activities. Wastewater infrastructure must meet the the water quality standards of Oregon's Department of Environmental Quality(DEQ) before water can be discharged. Transportation systems need to handle traffic flow through the site efficiently and effectively without interfering with the existing operations.

Societal implications at the site address the health and well-being of people involved with the site. The natural beauty of the site is important for people who view the site from across the river as well as from the scenic viewpoints near the site. As a major part of the economic base in the county, the site provides many benefits for daily users such as employment.

The proposed site designs will consider opportunities to address environmental issues. These include wetland conservation for the benefits of a healthy watershed. Air quality is also important for the short-term and long-term health of the region.

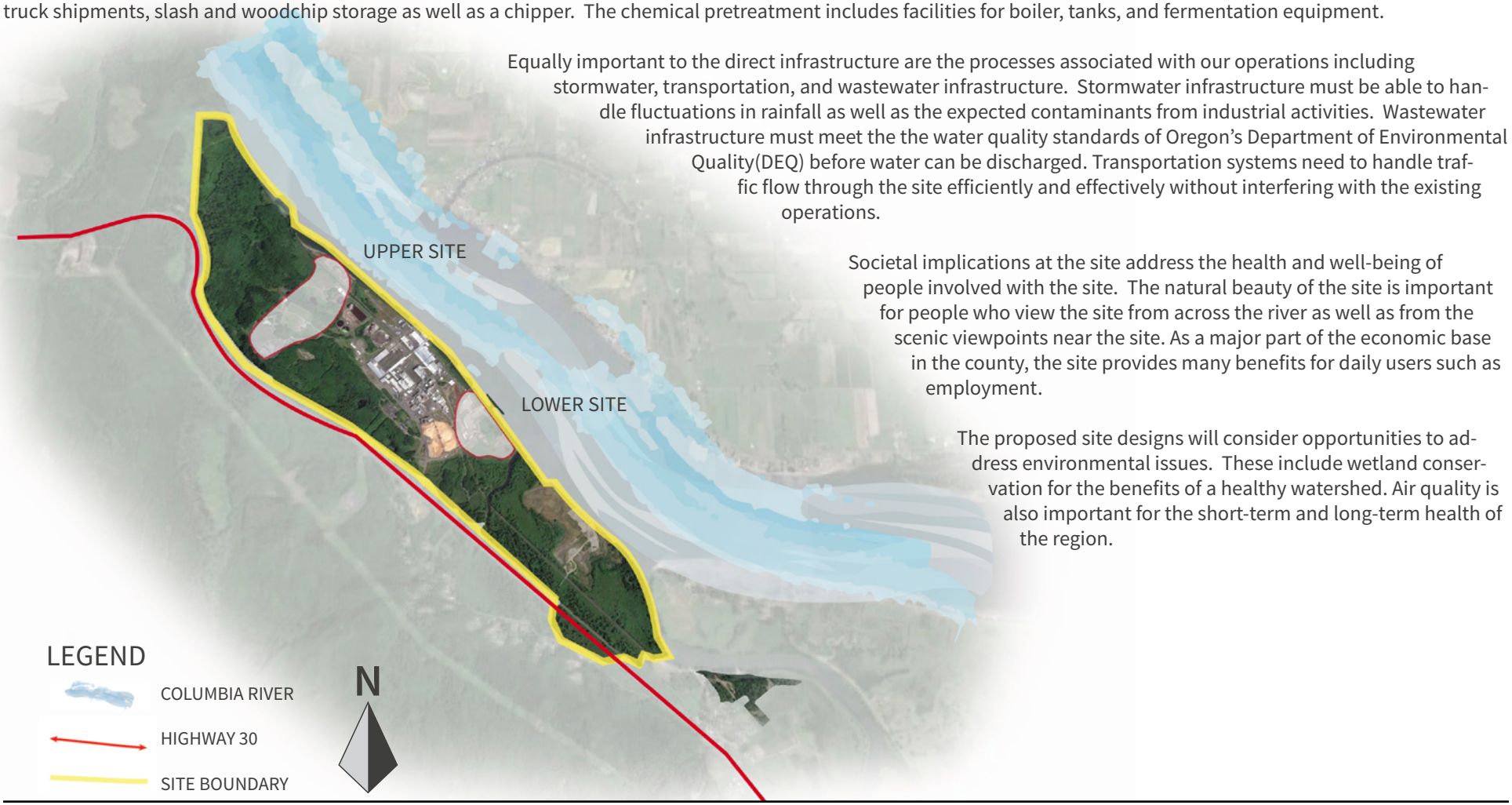


Figure 2.8.1. Georgia Pacific Wauna Mill - Liquid Depot Programming

2.8.1 GP WAUNA MILL SCHEMATIC DESIGN RELATIONSHIP TO FEEDSTOCK SEQUENCES

Major: UI Landscape Architecture
Student Author: Nate Beck

Feedstock handling is one of the major issues that will define how the site is developed. The flow of the feedstock, which is post-harvest forest residual slash and/or wood chips, determines the order in which required infrastructure will be designed.

Feedstock arrives to the site via trucks, where it is stored as slash or chips and then moves in a linear fashion through the liquids depot to produce the final product, a sugar-rich slurry. It is important to show how the feedstock will flow, or move, through each proposed location to justify why buildings, roads, and other structures are located in each design. The upper team's design moves the feedstock downhill using the natural terrain to its advantage. (Figure 2.8.2) The lower team's design attempts to mirror the current operation's material flow (Figure 2.8.3). It is important to assess the existing roads and traffic to the site so that the two teams can adjust and plan if the two operations conflict.

Upper Site

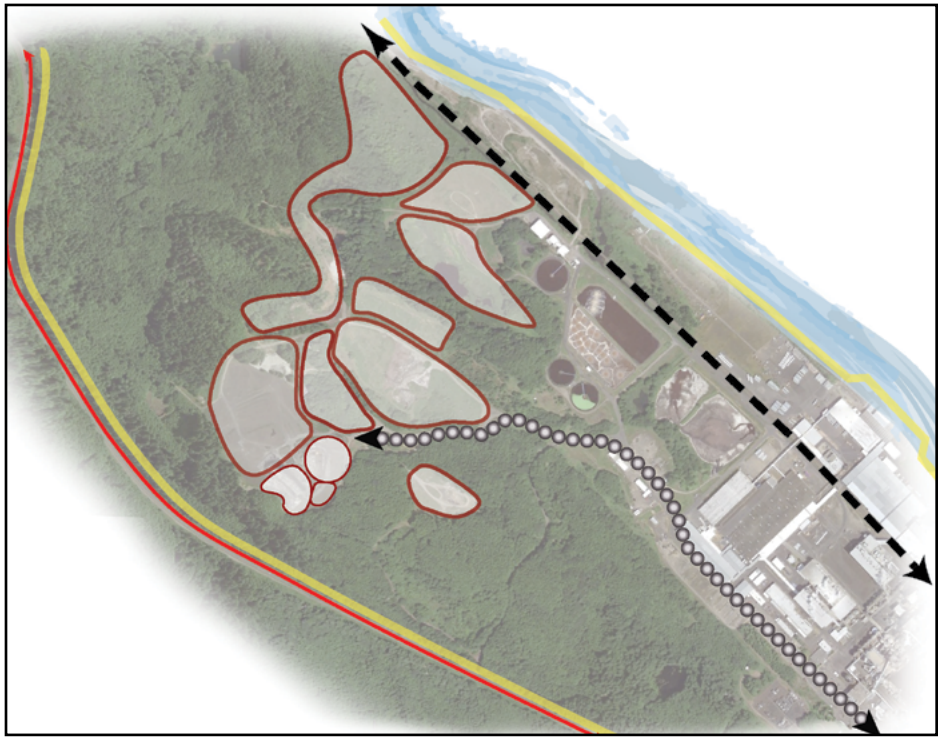


Figure 2.8.2. Georgia Pacific Wauna Mill - Feedstock Sequences, Upper Site

Lower Site

Figure 2.8.3. Georgia Pacific Wauna Mill - Feedstock Sequences, Lower Site

2.9.0 GP WAUNA MILL UPPER SITE DESIGN STUDY

Major: WSU Civil Engineering
Student Authors: Sydnee Dieckman and Christian Williams

The upper site concept for a liquids depot is to design a facility that utilizes existing terrain for an efficient and sustainable process, while also providing conservation practices that support and reflect the bioregion.

2.9.1 GP UPPER SITE - SCHEMATIC DESIGN

The Upper Site schematic is broken up into several components including the woodyard stormwater treatment , and chemical pretreatment areas (outlined in dark red; Figure 2.9.1). There is an existing road at the Georgia-Pacific Wauna Mill which leads to the upper site area that can be utilized for access.

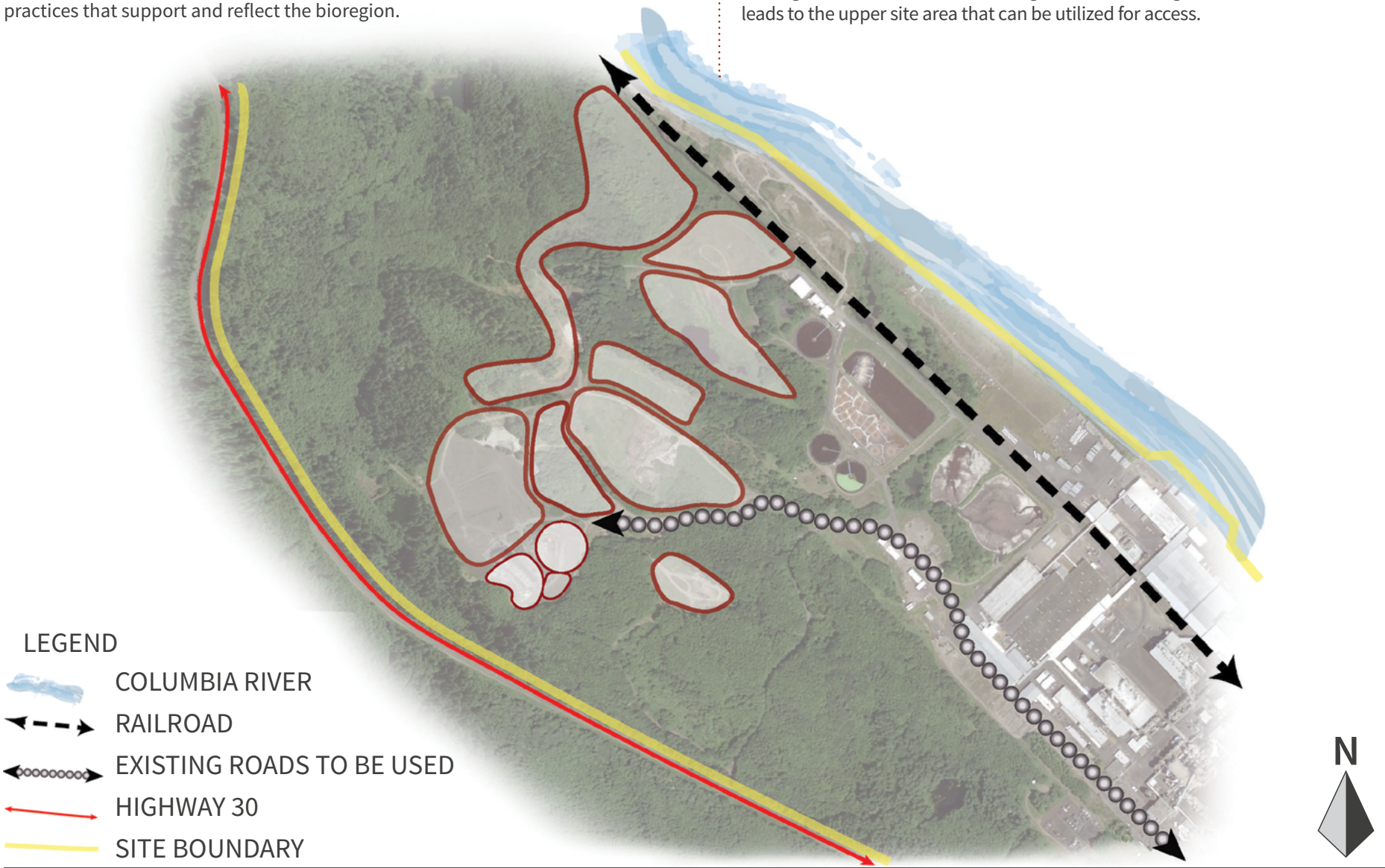


Figure 2.9.1. Georgia Pacific Upper Site Design Study

2.9.2 GP UPPER SITE - WOODYARD

Major: WSU Civil Engineering
Student Author: Christian Williams

The woodyard for the liquids depot will consist of a chip pile, a hog fuel pile, and a slash pile (red shaded area; Figure 2.9.2). The locations of these piles are important for the processes occurring at the facility. The slash pile must be near the chipper so that the slash can be broken down into chips and put in the chip pile. It also must be accessible to trucks dumping slash and front loaders moving the slash around. The hog fuel pile must remain close to the chip pile and slash pile, but also must be close to the power boiler to use as fuel. One advantage of having the woodyard where it is proposed is that there is a large forest buffer that will be able to treat runoff from the wood piles. It is also close to the highway, so if gravel roads are developed further, trucks would not have to go through the existing facility to deliver their loads. A downside to this proposal is that the existing roads are not paved, which may be an issue for trucks. Turn lanes would also need to be added to Highway 30 if the roads are to be improved and used on a frequent basis.

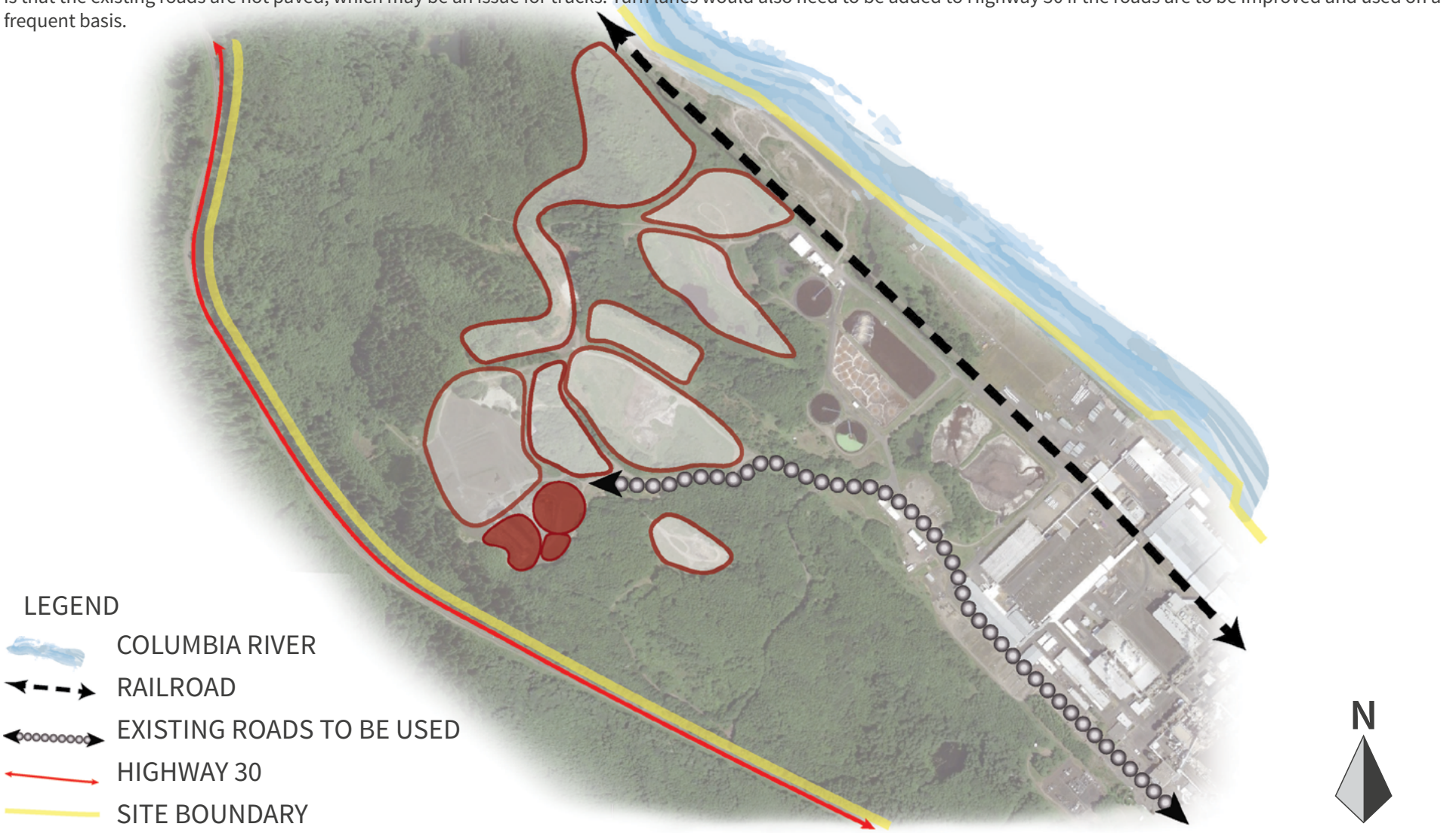


Figure 2.9.2. Georgia Pacific Upper Site - Woodyard

2.9.3 GP UPPER SITE - CHEMICAL PRETREATMENT

Major: WSU Civil Engineering
Student Author: Ian Smith

The chemical pretreatment option for a liquids depot is characterized by a mild-bisulfite protocol, which breaks down the woody biomass at a molecular level. The main piece of equipment required for this operation is the digester. The digester breaks down wood chips using steam and chemical compounds. The chemical portion will require both storage for the two primary chemical inputs and a mixing tank and furnace for chemical creation, which will need to be placed adjacent to the digester. After the digester, a blow tank is used to bring the slurry to atmospheric temperature and a flash tank will follow to recycle the heat back to the digester (red shaded area; Figure 2.9.3).

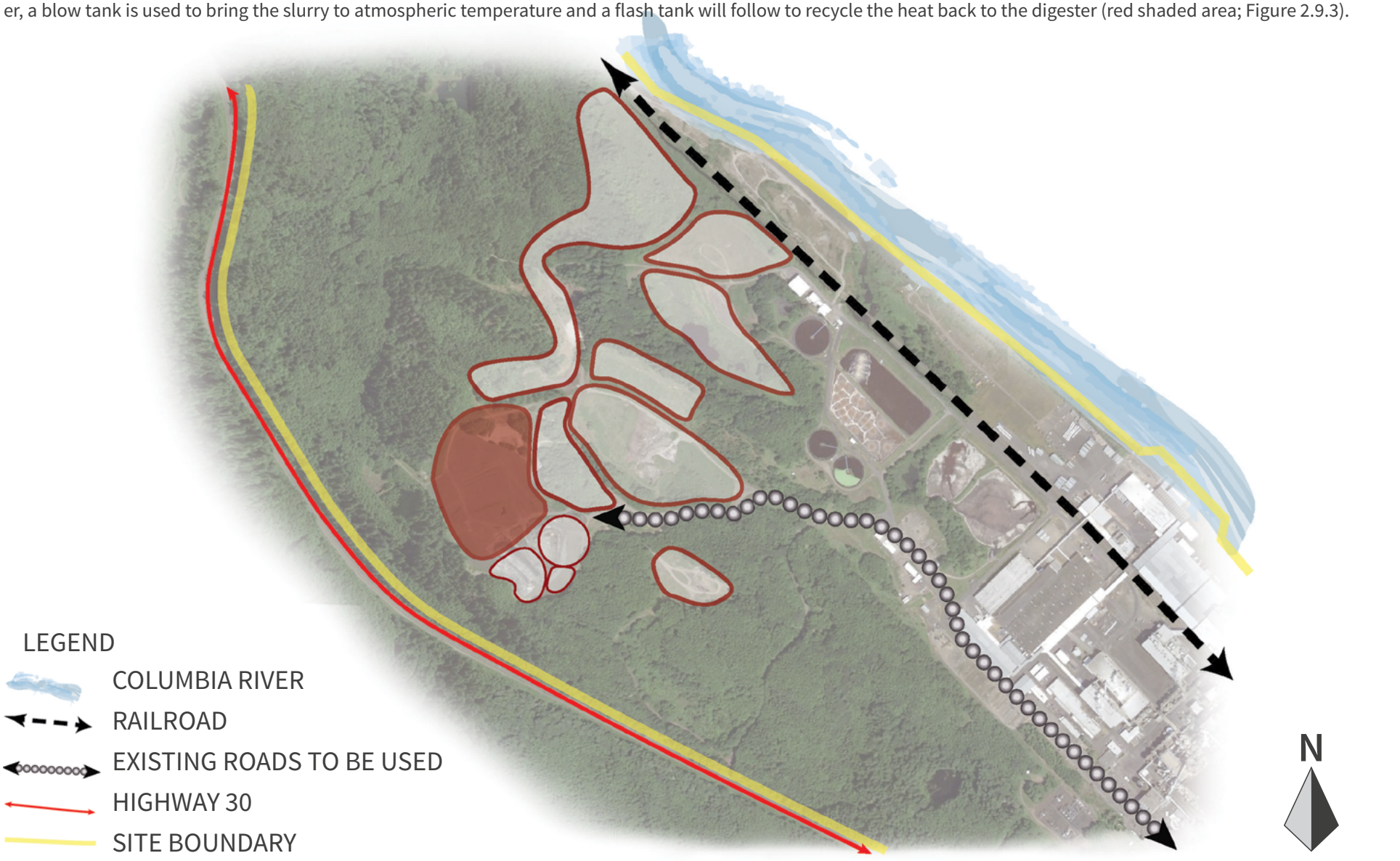


Figure 2.9.3. Georgia Pacific Upper Site - Chemical Pretreatment

2.9.4 GP UPPER SITE - PREPARATION AND SEPARATION

Major: WSU Civil Engineering
Student Author: Ian Smith

The next stage of the liquid depot process includes another material size reduction, using a disk mill. After the disk mill, the pretreated material is washed. A rotary vacuum is used for the washing process. In this design, the vacuum will be contained within the same building as the disk mill. Another piece of equipment is the evaporator, which will be placed in conjunction with the vacuum to reduce the water content of the liquid flow stream out of the vacuum (filled in light red; Figure 2.9.4). The liquid outflow from the washing process is the co-product lignosulfonate. The solid output will then be prepared for enzymatic hydrolysis by neutralizing the pH of the solid, which will then proceed to the enzymatic hydrolysis stage. This final manipulation of the feedstock will require multiple batch reactors with a relatively large footprint due to the long residence time the enzymes need to break down the material (48 hours). A vacuum filter will then be used to isolate the simple sugars from the solid lignin co-product.

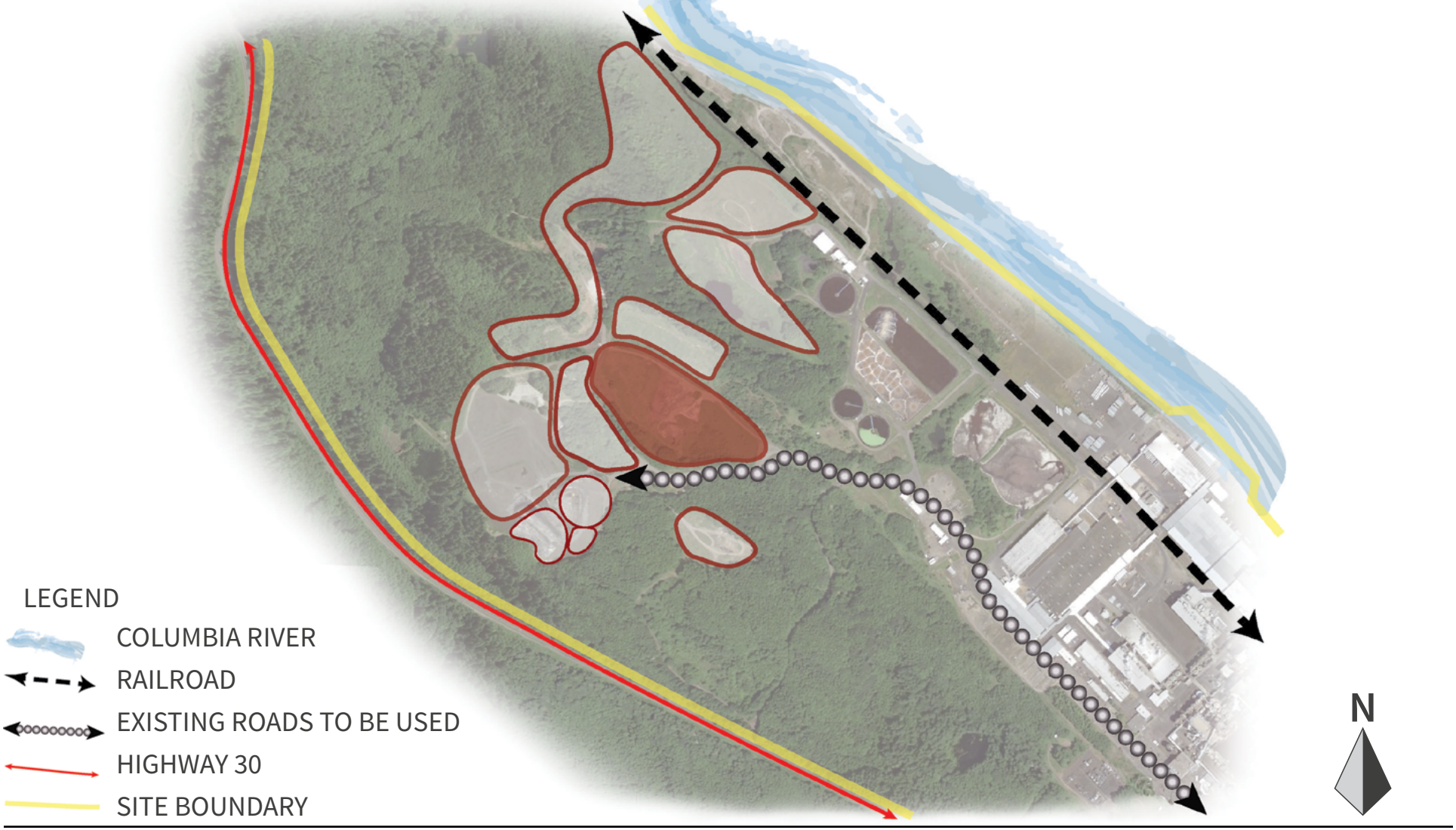


Figure 2.9.4. Georgia Pacific Upper Site - Preparation & Separation

2.9.5 GP UPPER SITE - CIRCULATION

Major: WSU Civil Engineering
Student Author: Sydnee Dieckman

There are existing roads on the mill site. The road outlined in red circles (Figure 2.9.5) leads from Highway 30 through the general area of the upper site. If used, this road, which is currently unpaved, would minimize traffic volumes through the Georgia-Pacific Wauna Mill. However, it is only wide enough for one-way circulation.
There other road, shown in black circles, leads through the Georgia-Pacific Wauna Mill to the upper site area. This existing road is paved, however it would need to be widened to accommodate the additional traffic that the upper site would bring, and it runs through an already busy mill area.

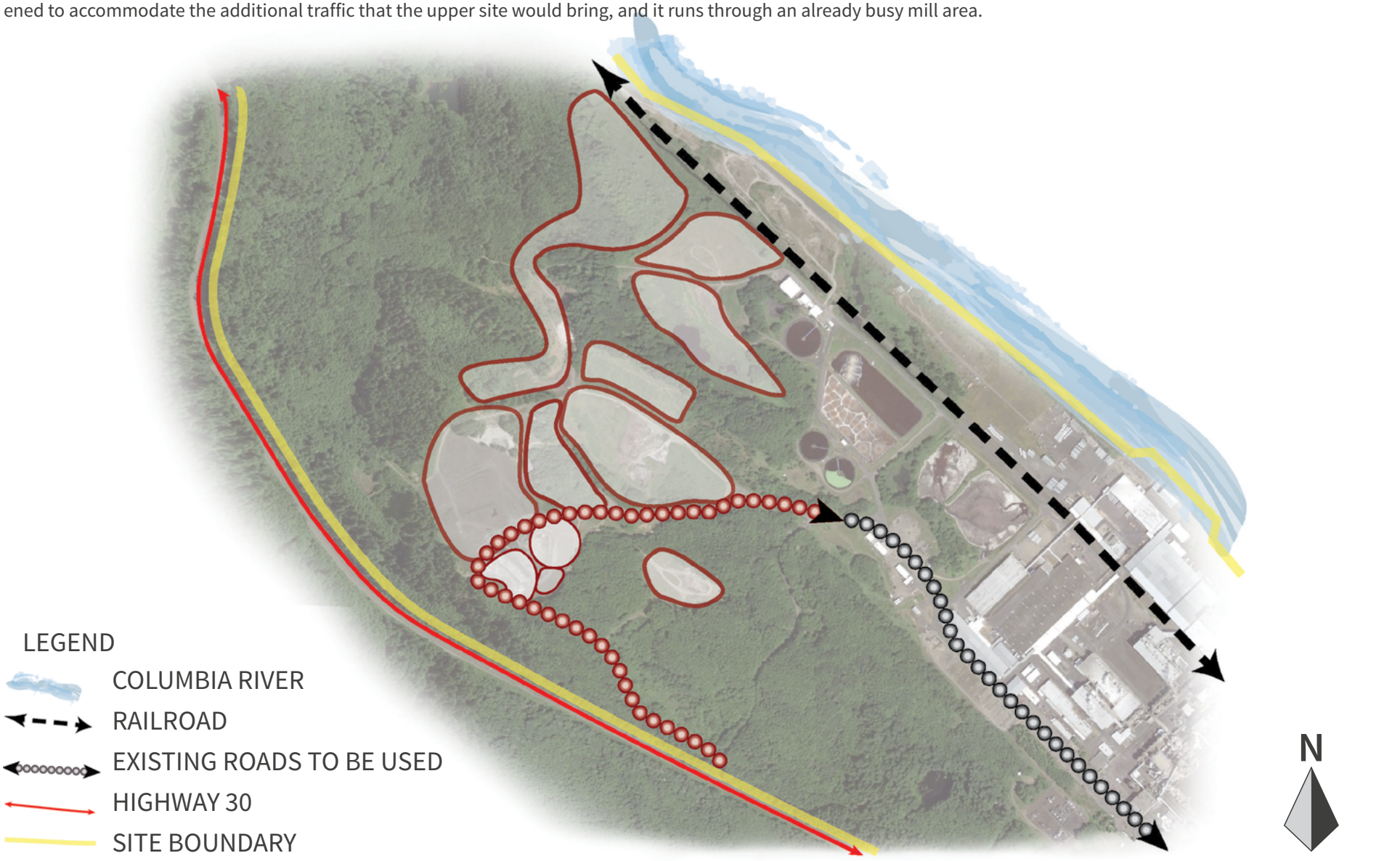


Figure 2.9.5. Georgia Pacific Upper Site - Circulation

2.9.6 GP UPPER SITE - STORMWATER

Major: WSU Civil Engineering
Student Author: Christian Williams

Stormwater is a major consideration for an industrial facility. The facility must consider stormwater runoff to address chemicals and sediment runoff from various processes. There are many advantages to stormwater runoff from the upper site option, as well as a few disadvantages. The biggest advantage for the upper site stormwater management is its elevation. Since the site is at a higher elevation, stormwater will be easily directed down to the Columbia River through open channels. Another advantage associated with the upper site is its size. There is a lot of room available to treat stormwater through low impact development practices, such as vegetated swales, infiltration ponds, or wetlands (red shaded areas; Figure 2.9.6).

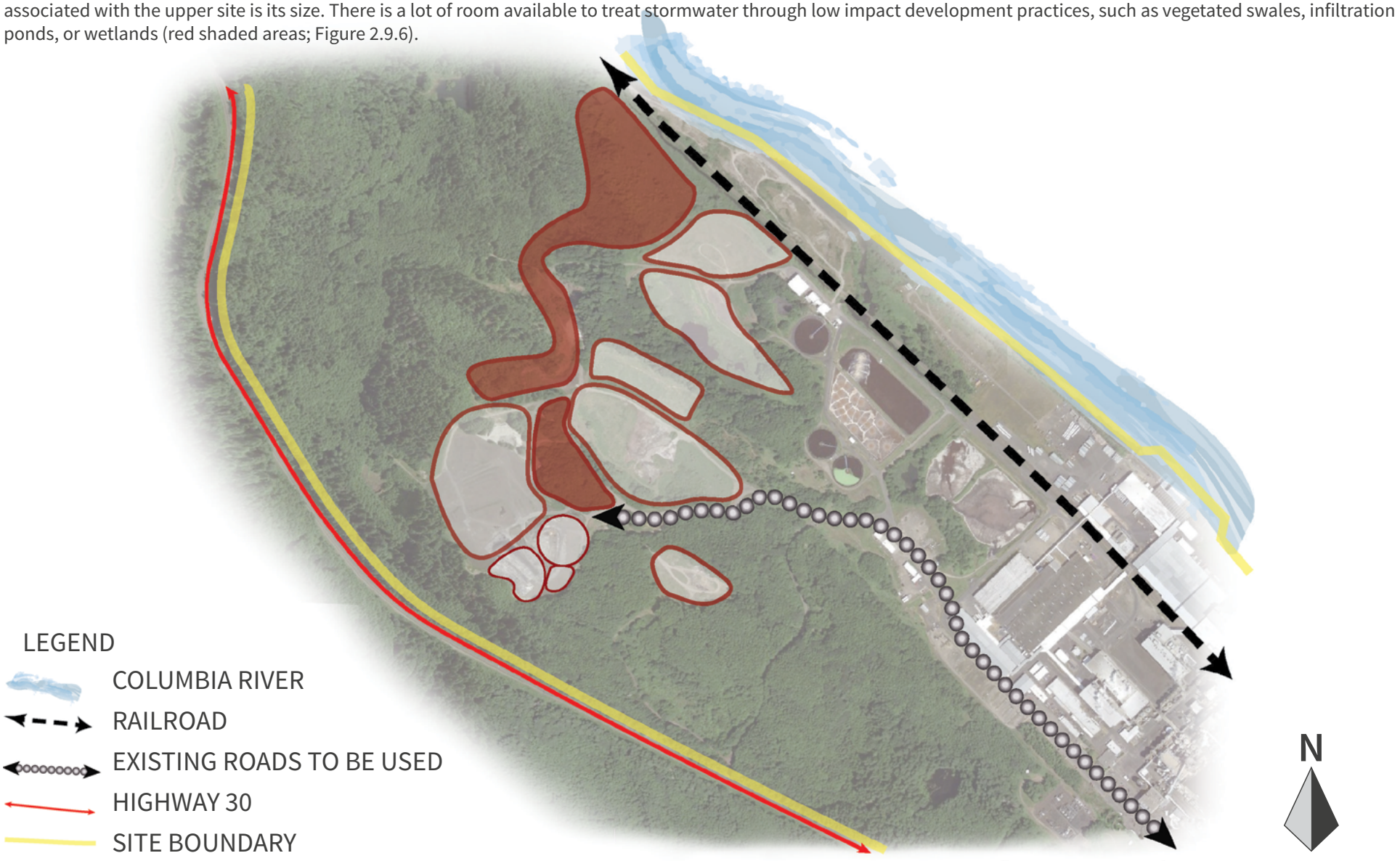


Figure 2.9.6. Georgia Pacific Upper Site - Stormwater

2.9.7 GP UPPER SITE - WASTEWATER

Major: WSU Civil Engineering
Student Author: Sydnee Dieckman

One great advantage of choosing to develop the upper site area is its proximity to the existing wastewater treatment facilities present at the Georgia-Pacific Wauna Mill (red shaded areas; Figure 2.9.7). However, it is not yet clear whether or not those processes could be utilized at the upper site or if an independent treatment plant would need to be designed. A disadvantage of this proposed wastewater treatment facility location is that it is relatively close to the floodplains, which could potentially lead to permit violations if the area were to become flooded.

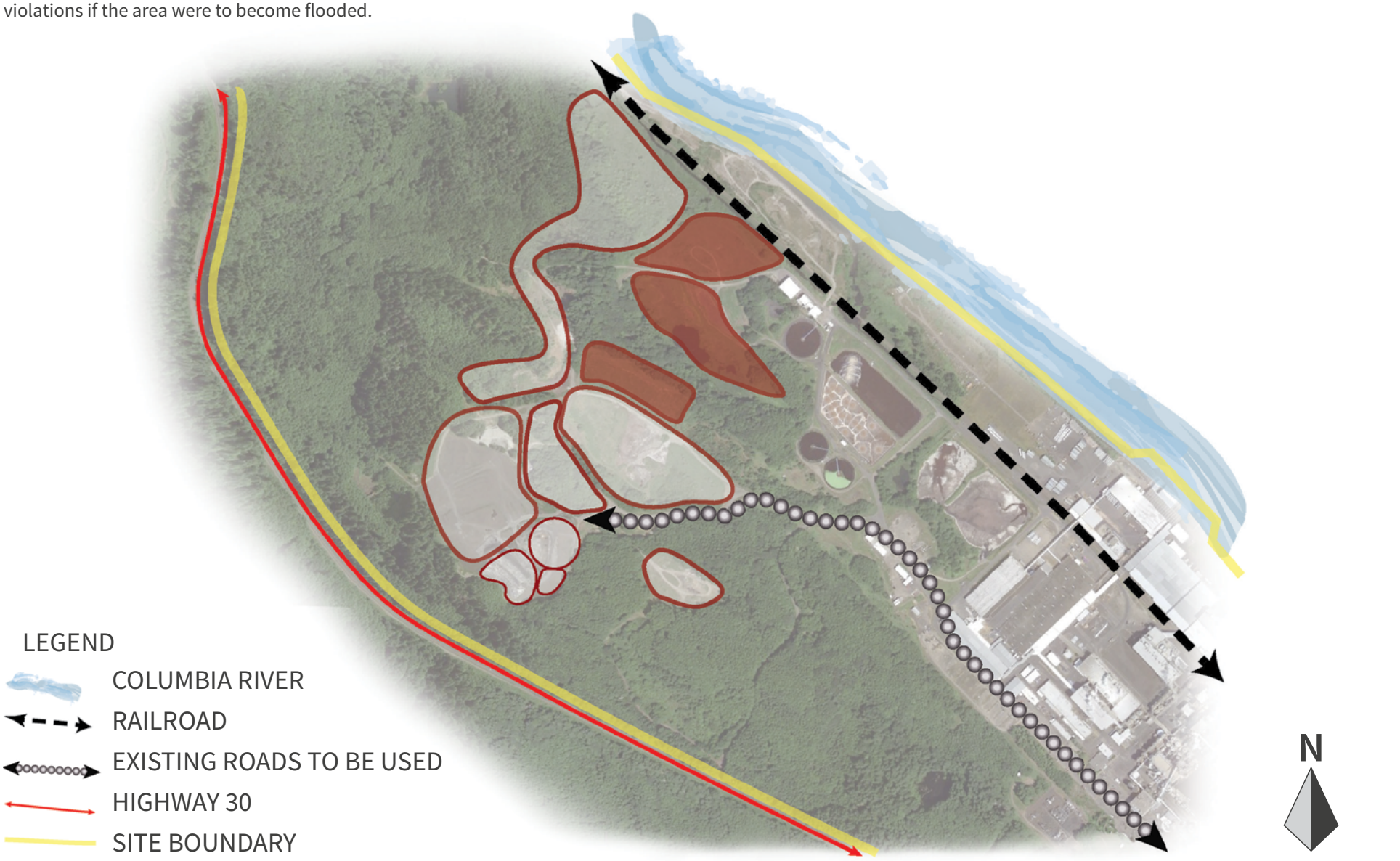


Figure 2.9.7. Georgia Pacific Upper Site - Wastewater

2.9.8 GP UPPER SITE - ADVANTAGES & DISADVANTAGES

Major: WSU Civil Engineering
Student Author: Christian Williams

Overall, there are many advantages to the upper site, as well as a few disadvantages (Figure 2.9.8). The first advantage is that the proposed area where the site would be is already flat and cleared of vegetation. This means that minimal grading would need to be done. The upper site is also outside of the floodplain, so that it would be unaffected by flood events from the Columbia River. The upper site also will not interfere with present operations at the Georgia-Pacific Wauna Mill. The site is also relatively close to the wastewater treatment facility. The wastewater would simply flow downhill to the treatment facility. The upper site has area for expansion as well. A few more advantages for the upper site are it's proximity to existing circulation and it's efficient site flow. There are a few disadvantages to the upper site. The first of which is the lack of parking for employees and visitors to the facility. A separate parking lot closer to the site will have to be constructed. Another disadvantage is that the site has a higher elevation. This may make the facility visible to residents of Puget Island, which could be an issue. The upper site is also a far distance from the current infrastructure at the facility. This includes the power boiler, which means that a new boiler might need to be installed. The upper site has a lack of developed roads surrounding it. The roads do have gravel, but they are not currently paved.

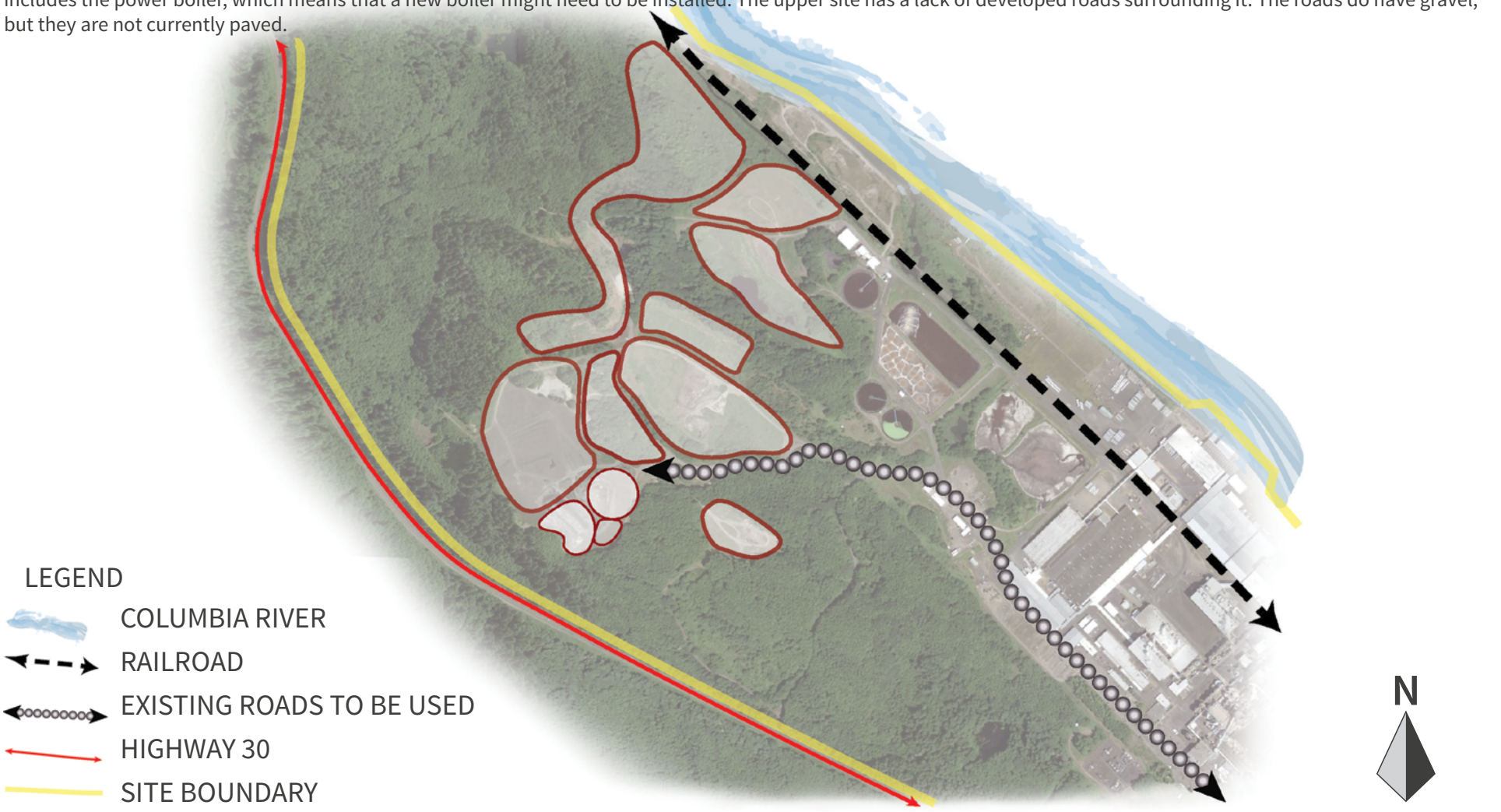


Figure 2.9.8. Georgia Pacific Upper Site - Advantages & Disadvantages

2.10.0 GP LOWER DESIGN STUDY

2.10.1 GP LOWER SITE - REASONS FOR SELECTION

Major: WSU Civil Engineering
Student Author: Matt Jarrett

The proposed lower site is located closer to existing operations, which could benefit the proposed liquids depot development. The benefit of this proximity is based on access to transportation options as well as infrastructure overlap between the existing operations and the liquids depot operations. Furthermore, the concentration of facilities limit exposure of the site to nearby residents (Oregon or Washington). Lastly, the site is relatively flat and partially developed (Figure 2.10.1).

Image Source: oceanview.blogspot.com

Figure 2.10.1. Georgia Pacific Lower Site

2.10.2 GP LOWER SITE - SCHEMATIC

The site layout is dictated by the pre-existing infrastructure and the most efficient activities flow for the liquids depot. The operation's inflow starts with the roadway exit from Highway 30. Incoming feedstock would be hauled along the roads indicated with a red arrow (Figure 2.10.2) in a looping fashion, dropping off the feedstock at the woodyard (green).

From here, production activities would continue through pretreatment (blue) and separation (orange) to where the final sugars would be stored and shipped out (purple). From here, they would be sent to a conversion facility for final processing, or made available to other markets that would use the sugars to produce value added products like epoxies or industrial chemicals.

Figure 2.10.2. Georgia Pacific Lower Site - Schematic

2.10.3 GP LOWER SITE - WOODYARD

Major: WSU Civil Engineering
Student Author: Matt Jarrett

The woodyard design consists of three primary elements. The slash pile, which consists of raw post-harvest forest residuals, will be the primary input storage for the liquids depot. From here, the slash will go through a chipper for initial size reduction. This chipper lies between the slash pile and the chip pile. The chip pile will be the last major element of the woodyard and will store chips until they are sent to pretreatment.

Other pieces of equipment include hydraulic dumpers to empty the trucks as well as a front end loader to move material. Adjacent to the site will be a staging area for semi trucks if the maximum inflow capacity results in vehicular congestion. (Figure 2.10.3)

The location of the woodyard is close to the Georgia-Pacific Wauna Mill's current chip pile, which allows for shared use of the current truck scale. In addition, the piles are located in such a manner that if more space is required for storage, they could be expanded south. The size of these piles will be directly correlated with anticipated minimum time storage values. This is to say the piles must be large enough as to ensure plant operations could continue a given number of days without any additional input. The current anticipated values are a seven day chip pile and a two day slash pile. The footprint of these piles are the result of volumetric analysis of the daily processing volume of 250,000 BDT a year.

Figure 2.10.3. Georgia Pacific Lower Site - Woodyard

2.10.4 GP LOWER SITE - CHEMICAL PRETREATMENT

Major: WSU Civil Engineering

Student Author: Matt Jarrett

The proposed lower site chemical pretreatment facility is marked in light blue (Figure 2.10.4).

Figure 2.10.4. Georgia Pacific Lower Site - Chemical Pretreatment

2.10.5 GP LOWER SITE - SEPARATION & PREPARATION

Major: WSU Civil Engineering
Student Author: Matt Jarrett

The proposed lower site separation and preparation facility is marked in orange (Figure 2.10.5).

Figure 2.10.5. Georgia Pacific Lower Site - Separation & Preparation

2.10.6 GP LOWER SITE - TRANSPORTATION

Major: WSU Civil Engineering

Student Author: Sydnee Dieckman

The proposed transportation layout is shown in red (Figure 2.10.6). Trucks would enter from the highway towards the bottom left corner of the image, then pass through the existing scale on the Wauna site (shown in gold). Traffic could then continue in the direction of the red arrows and could utilize the large staging area (about 1 acre in area) shown in yellow. Trucks could then pass near the proposed woodyard location, dump, then continue along the existing road and leave the site. An additional entry road is shown near the bottom center of the image; this provides another opportunity for access, but may not be ideal because it passes through a small residential area before reaching the site.

Some advantages of transportation at the lower site versus the upper site is that there are many existing roads, as shown in red, and the site is located near the highway. It also makes use of the Georgia-Pacific Wauna Mill's truck scale and truck staging area. The roads on the lower site reach all the way to the port and comes into contact with the railroad running through the site, further aiding transportation of materials on and off the site. However, some of these roads are narrow and may only support one-way traffic. Additionally, it is unknown how much the port and rail are able to be utilized; if they are not that useful, then it is not a great advantage to have easy access to them on our site.

Figure 2.10.6. Georgia Pacific Lower Site - Transportation

2.10.7 GP LOWER SITE - STORMWATER

Major: WSU Civil Engineering

Student Author: Sydnee Dieckman

A couple of options were considered for the stormwater design. The first would be to design a catchment basin system where the stormwater on the lower site is collected (area in blue; Figure 2.10.7). This basin would include sediment filtration and oil/water separation, then would pipe the water to the existing retention pond on the outskirts of the lower site area. Another option considered would be to construct a wetland for stormwater treatment. Also considered is a series of small bioretention cells to treat the stormwater runoff, or using some bioretention cells in conjunction with other treatment processes.

Figure 2.10.7. Georgia Pacific Lower Site - Stormwater

2.10.8 GP LOWER SITE - WASTEWATER

Major: WSU Civil Engineering

Student Author: Anna Martin

The wastewater treatment plan for the lower site liquids depot is to pipe it into the existing facilities' wastewater plant (brown dotted line toward top of picture; figure 2.10.8). Currently, the Georgia-Pacific Wauna Mill has a permit for 11,000 lbs per day of biological oxygen demand (BOD) with a flow of 10.3 millions gallon per day (MGD). Our flow rates are about 7.9%-27% of this flow rate depending on what kind of wastewater treatment we will need. The needs and flow rates will change based on a mechanical or chemical milling process. If this flow and BOD is too significant, we have also looked into using a wetland tertiary treatment to either completely treat our water or add to the wastewater treatment process. A challenge with the wastewater plan is the distance between the proposed liquids depot and the existing wastewater plant. The current plan would involve piping through the existing facilities. A possible option would be to design a wetland treatment as a backup plan to the more economical option of combining wastewater streams.

Figure 2.10.8. Georgia Pacific Lower Site - Wastewater

2.10.9 GP LOWER SITE - ADVANTAGES & DISADVANTAGES

Major: WSU Civil Engineering
Student Author: Matt Jarrett

A advantage of the lower site proposal is the location near roadways and existing infrastructure (Figure 2.10.9). The main component of this is the roadways and railways since input and output shipping compose a large portion of the liquid depot's daily operation. Furthermore, the location of an existing settling pond offers an opportunity to treat stormwater without the addition of extensive, new stormwater infrastructure. The site is also fairly flat and somewhat developed which aids in construction feasibility. The other added bonus of this ground is that it is already cleared of trees.

While this lack of elevation change is desirable, the overall elevation of the site remains an issue as portions of the site lie within FEMA's 100 year floodplain. The proximity to the river helps transportation prospects but also puts the facility far from existing employee parking, which would necessitate the construction of new parking areas. This new parking is just one component of many, which would make the site more tight on space than the upper site. This acreage limitation is highlighted by the wetlands to the southeast, which are unbuildable.

Figure 2.10.9. Georgia Pacific Lower Site - Advantages & Disadvantages

2.11.0 GP WAUNA MILL SUMMARY

This document, Volume II - PNW Site Selection & Design, describes the site selection process that IDX undertook to identify potential locations in the Pacific Northwest where biofuels facilities might be located. Our analysis identified the GP Wauna Mill in Clastkine, Oregon as a top site for locating a liquids depot. Co-locating a liquids depot with an operational kraft pulp and paper mill has several advantages including similar chemical pretreatment processes; utility, water/wastewater treatment, transportation infrastructure; and industrial zoning.

IDX developed two conceptual designs, an upper site and a lower site, for the proposed liquids depot. While both sites have advantages and disadvantages, the overall assessment is that the GP Wauna Mill site has the space and other site assets necessary to support the co-location of a wood-based liquids depot.

Figure 2.11.1 Image of a biorefinery