Executive Summary

Wetland and Agricultural Lands Assessment for Tillamook County Senate Bill 1517 Pilot Program Planning Process

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December 12, 2017

Introduction

The goals of this wetland and agricultural lands stability assessment are to: 1) describe the functions, values, and benefits of wetlands and wetland restoration projects from an ecological and socio-economic perspective; 2) identify Exclusive Farm Use (EFU or F-1 zone) lands in Tillamook County that are high priority for maintaining the stability of the County's agricultural economy, based on metrics for agricultural land quality/production potential, production costs, and current land use; and 3) outline the limitations of the available data for evaluating wetland restoration opportunities and priorities for maintaining agricultural lands.

Data and Spatial Scale Overview

The wetland and agricultural lands assessment builds on the findings from the *Wetland and Agricultural Use Inventory Memorandum* (Runyon and Wyse July 5, 2017). The primary available GIS data sets for the wetland and agricultural lands assessment are the NRCS soil survey database (GSSURGO) for Tillamook County and the National Wetland Inventory (NWI)[1]. The wetland and agricultural lands assessment results are summarized at two spatial scales: 1) county-wide and 2) for each of the watersheds that drain areas within the County. Hydrologic Unit Codes (HUCs) are the national standard for delineating watersheds, and for this study we use 5th-field HUCs of which there are 18 in the county (see Figure 1). In this assessment, we focus on the 11 watersheds with EFU lands[2]. Wetlands are identified as "tidal" or "freshwater" based, respectively, on whether the areas are below or above the highest measured tide (HMT)[3].

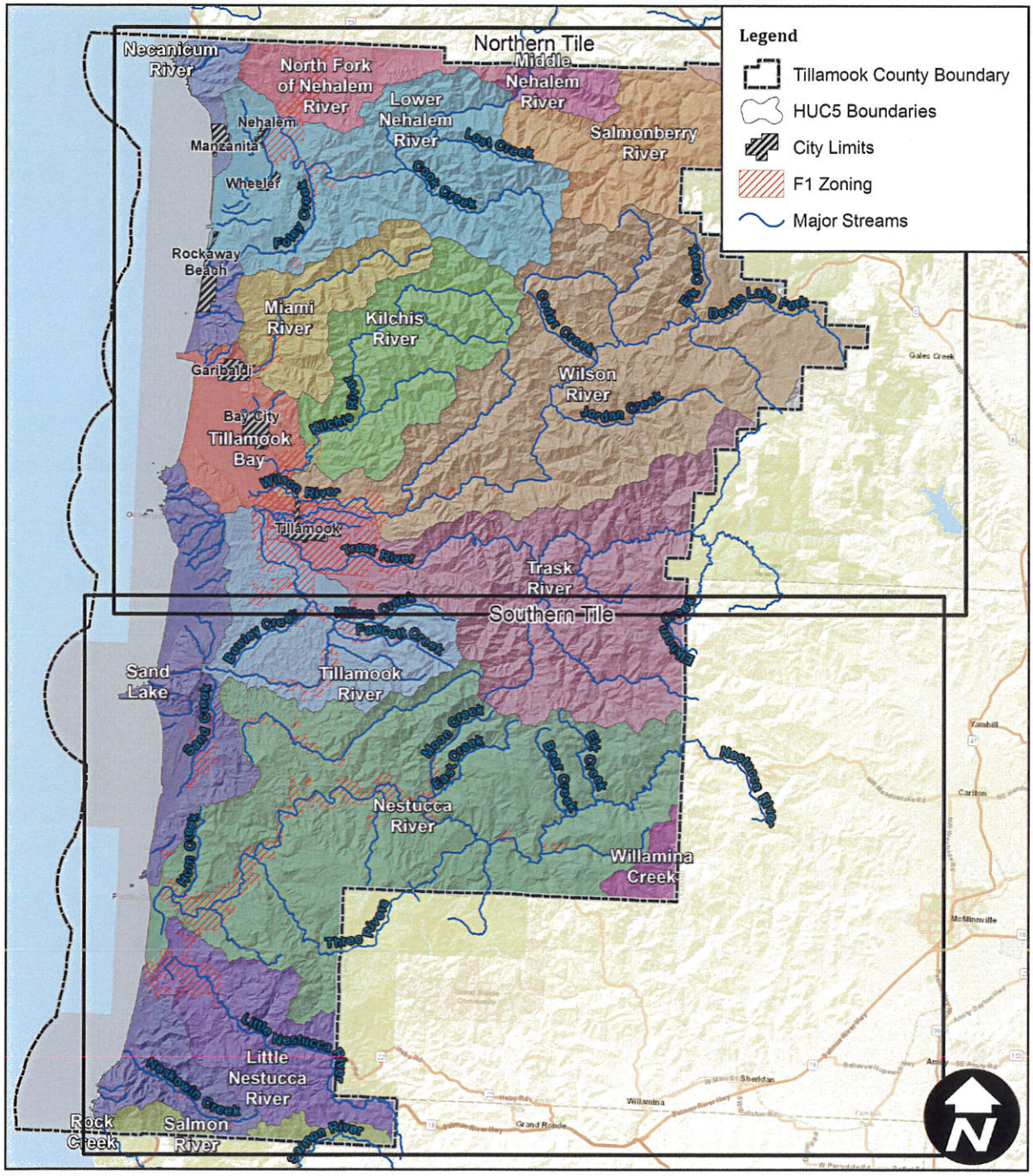
There are considerable data limitations for both wetlands and agricultural lands. For wetlands, important data limitations include potential underestimation of both potential historical wetland areas (i.e., areas that are not existing wetlands but were historically), and existing, modified wetlands (i.e., areas where ditching, levee construction, filling and other actions have resulted in significant loss of wetland function). The data also may include some sites that are erroneously classified as potential or existing wetland. As a consequence, while the findings of the wetland assessment presented here provide a broad picture of wetland status and restoration opportunities throughout the County and for specific watersheds, the

[1] See Runyon and Wyse July 5, 2017 for reference citations.

[2] There are no EFU lands in the following seven watersheds: Headwaters Nehalem River, Middle Nehalem River, Necanicum River, Rock Creek, Salmon River, Salmonberry River, and Willamina Creek.

[3] This method is in accordance with the Oregon Department of State Lands (DSL) definition of tidal and freshwater wetlands. Other County wetland studies have also used this method for defining tidal wetland extent (e.g., Ewald and Brophy 2012). The HMT was determined to be 11.62 feet, NAVD88.

Figure 1. Overview of Tillamook County Streams and Watersheds. The Northern and Southern Tiles Delineate the Focus Areas for Figures 2 and 3



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Scale: 1 inch = 6 miles
Data Source: ESRI, 2017; USGS, NHD, 2016; Tillamook County, 2016

County Overview Map

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findings are not suitable for evaluation of wetland status and restoration opportunities at finer spatial scales such as landownership parcels or site-specific areas.

There are similar problems with the data used in the agricultural lands assessment. Feedback from the agricultural community indicates that the available GIS data for agricultural lands provide poor indications of actual, on-the-ground agricultural production potential and costs. While the NRCS soil survey database provides excellent site-specific data on soil type, the agricultural community commented that the NRCS ratings on the productivity and suitability of land for dairy agricultural uses, including ratings for soil drainage, crop yields, and suitability for spreading animal waste, which are based largely on soil type, are not reliable at the site level. The agricultural community provided input that site management is more important than soil type in determining the production potential and importance of Tillamook County EFU lands for dairy uses. This has implications for future farm and wetland planning projects: generating an accurate county-wide map of priority EFU agricultural lands will be more feasible in areas where the value and quality of agricultural lands is largely determined by soil type, slope, and other factors with excellent and available site-specific GIS data on the county scale.

Prioritization of EFU Agricultural Lands and Areas for Wetland Restoration

As described in detail in the agricultural assessment and the wetland assessment, nearly all EFU cropland areas, 29,900 cropland acres of the 37,587 total Tillamook County EFU acres[4], may have high value for agricultural stability, and nearly all wetland areas that have been modified or lost may have high restoration value.

The GIS-based assessment of agricultural lands attempts to rate agricultural land productivity and suitability based on the available county-wide GIS data, which includes current land use (whether in crop production currently), NRCS-rated drainage class, NRCS-rated yield for pasture and silage, and NRCS-rated animal waste management capacity. While the GIS data used in the agricultural GIS-based analysis are not deemed accurate at the site-specific level by the agricultural community, at the county-scale the GIS data indicates that EFU croplands generally are high yielding and have value for agricultural stability; over 80 percent were rated in the GIS-based analysis as medium or high priority. Members of the agricultural community indicate that "all EFU lands are important" for agriculture, but feedback on the specific factors affecting which EFU lands are prioritized by the agricultural community include: 1) areas protected by drainage infrastructure and levees/tiling should be prioritized, as there is a cultural desire to not see one hundred years of work undone, and 2) areas contiguous to other agricultural properties; wetlands projects should be located on the 'fringes' to limit adverse impacts and minimize disruption of manure management relationships between farms.

Similarly, for the wetlands, potential restoration areas are identified for tidally-influenced wetlands and non-tidal freshwater wetlands connected to floodplains or streams, with all of these lands having potential high restoration value. Potential wetland restoration areas are defined as locations where wetland functions and/or extent has been lost or reduced; and include modified NWI wetlands as defined in the NWI and potential historical wetlands or locations that contain soils that indicate past wetland status.

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[4] Nearly all cropland supports the Tillamook County dairy industry. Of the approximately 7,700 acres in the EFU that do not support crop production, most are forested and located higher in the watershed.

Tidal wetland restoration is a high priority as the greatest loss of wetland area and function in the County has been in tidally-influenced salt- and freshwater wetlands. Tidally-influenced wetland types provide important habitat diversity, support key ecological and hydrological functions, and provide essential habitat and food sources for salmon and steelhead populations and other fish and wildlife species. Tidal wetlands act as buffers between upstream areas and the ocean. By some estimates, tidal wetlands support up to three-quarters of all harvested fish species, largely due to the high productivity and diversity of habitats.

Non-tidal freshwater wetlands associated with floodplains and streams also are very productive environments and high priority for restoration. This wetland type is hydrologically connected to rivers and streams. The wetland areas support nutrient absorption, high levels of primary productivity, aquatic insect production, and detrital inputs to the river system. River-associated wetlands include off-channel wetlands, sloughs, and side-channels. Non-tidal freshwater wetlands provide a diversity of habitats for juvenile salmon and steelhead, including high-water refugia where fish can reside and feed during flood events. These wetlands contribute to flood attenuation, aquifer recharge, and other hydrologic benefits. Floodplain-associated wetlands serve as a moderator of flood variability—storing flows and reducing flow velocities during flood events.

Overlap in Tillamook County's EFU Lands and Wetlands

Particularly in the lower reaches of watersheds, there is significant overlap between EFU lands and potential (existing and historic) wetlands. For the most part, EFU lands are concentrated in the valley bottoms, often within floodplains adjacent to rivers and streams. Nearly 50% of the County's EFU lands are within freshwater floodplains or tidal areas; 16% of the County's EFU lands is below high mean tide (HMT) and is periodically subject to tidal influence. Historical and current wetlands are concentrated in floodplains and areas subject to tides.

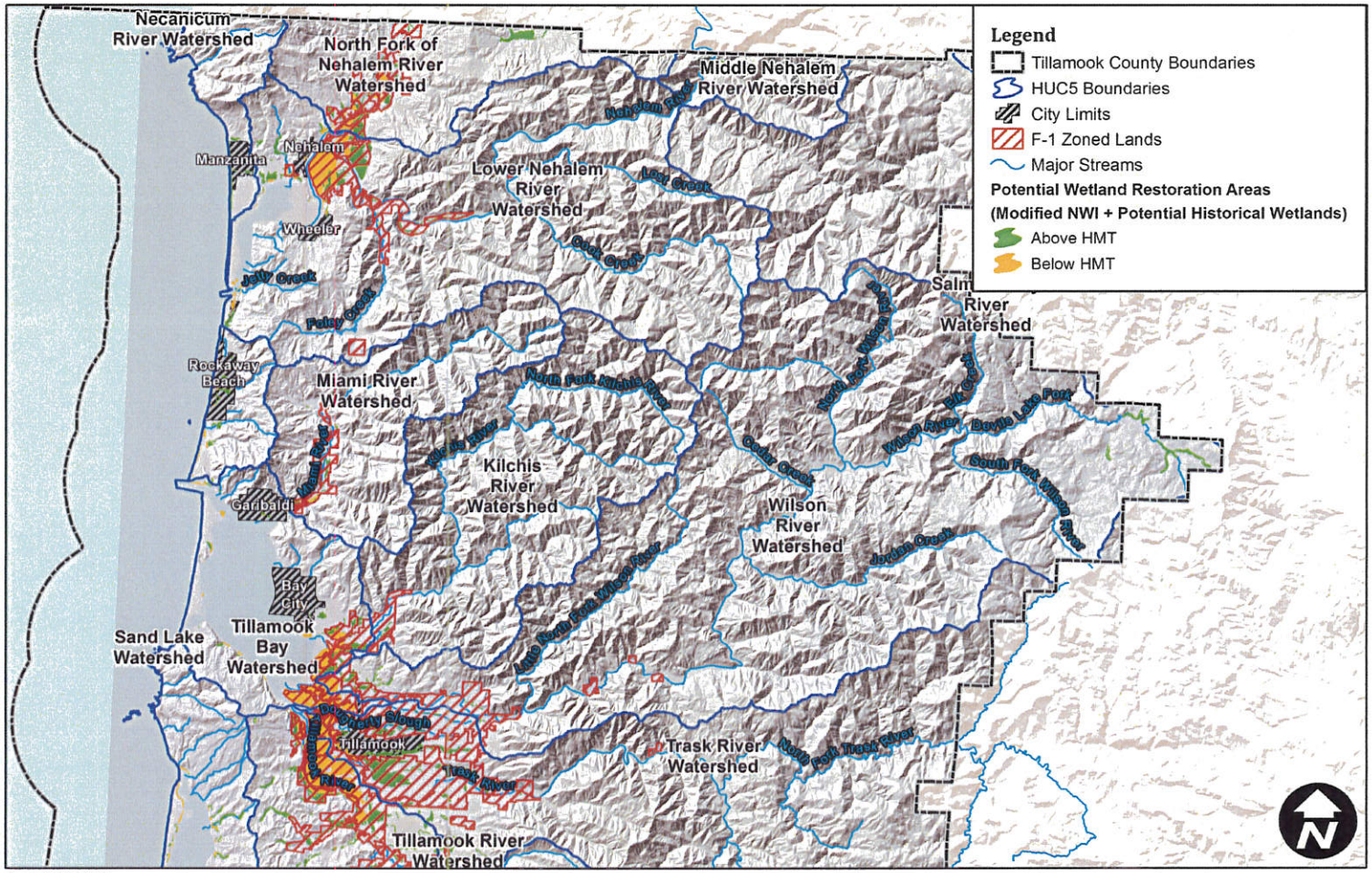
As there are data inadequacies in determining a high resolution, site-specific prioritization framework for both EFU agricultural lands and potential wetland restoration sites, detailed information on the spatial overlap between EFU lands and wetlands provides the most important basis for understanding potential compatibility between EFU land uses and wetland restoration.

Table 1 summarizes amount and proportion of "potential" (NWI and potential historical) tidal and freshwater wetlands located in EFU lands for each of the 11 watershed areas with EFU acreage. As shown in the last column of Table 1, there are 12,691 acres of estimated current and historical wetlands located in the EFU zone, or approximately 42 percent of the estimated 29,900 acres of EFU cropland. Almost all of these estimated historical wetlands in the EFU zone have been lost or modified, as shown in Tables 2 and 3, and thus represent potential wetland restoration areas. Approximately 84 percent of potential tidal restoration areas are in the EFU zone (Table 2); although only 57 percent of potential freshwater wetland restoration areas are in the EFU zone, representing substantial opportunity for restoration of this type of wetland outside of the EFU zone (Table 3). However, in contrast to non-EFU lands, a higher proportion of freshwater restoration opportunities on EFU lands are within floodplains adjacent to rivers and streams which is a higher priority for restoration.

Table 1. Overlap of Tillamook County Wetlands and EFU Lands

Watershed (5th Field HUC)	EFU Estimated Cropland	Estimated Potential Tidal Wetland *(NWI + Potential Historical)*		Estimated Potential Freshwater Wetland *(NWI + Potential Historical)*		Total Potential Wetland Restoration in EFU
		County	EFU	County	EFU	
Tillamook River	5,368	1,896	1,578	3,149	1,260	2,838
Nestucca River	6,576	1,029	265	4,901	2,229	2,494
Trask River	6,800	694	448	2,985	1,309	1,757
Lower Nehalem River	2,055	3,630	788	2,784	673	1,461
Tillamook Bay	1,845	10,341	893	1,317	347	1,240
Little Nestucca River	1,946	983	458	1,515	645	1,103
Sand Lake	923	4,339	0	4,173	498	498
Wilson River	1,549	173	121	2,556	376	497
North Fork Nehalem River	1,791	590	201	1,198	239	440
Miami River	543	44	30	636	195	225
Kilchis River	506	0	0	715	138	138
Other 7 Watersheds with no EFU Land	0	120	0	1,060	0	0
TOTAL	29,900	23,839	4,782	27,113	7,909	12,691

Figure 2. The Northern Section of Tillamook County Showing Streams, EFU (F-1 Zoned) Lands, Potential Tidal and Freshwater (above HMT) Wetland Restoration Areas



Date: 12/8/2017
Scale: 1 inch = 3 miles
Data Source: ESRI, 2017; USGS, NHD, 2014; Tillamook County, 2016

F-1 Zoning and Potential Wetland Restoration Areas in Northern Tillamook County

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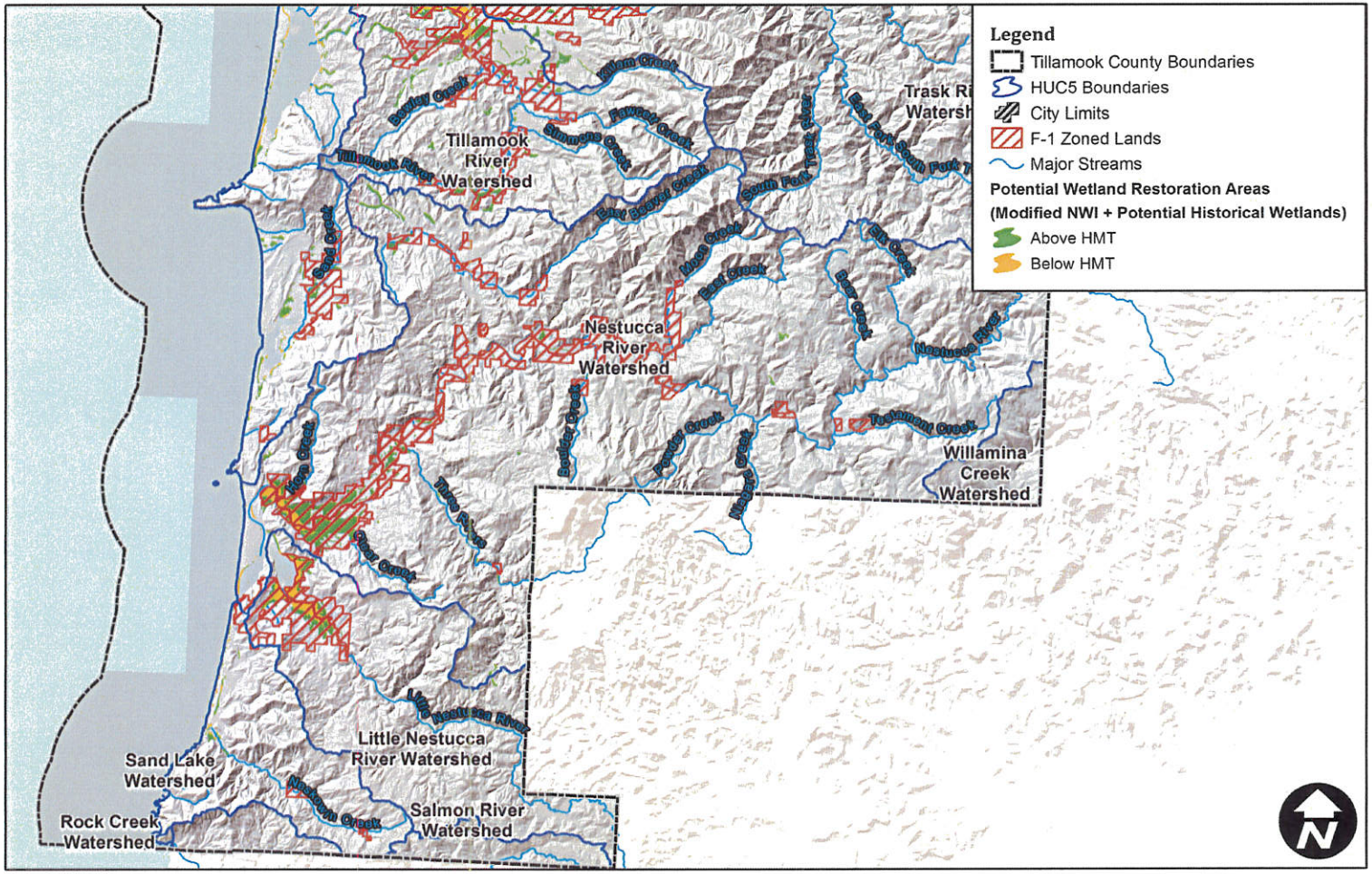
Figure 3. The Southern Section of Tillamook County Showing Streams, EFU (F-1 Zoned) Lands, and Potential Tidal and Freshwater (above HMT) Wetland Restoration Areas



Date: 12/8/2017
Scale: 1 inch = 3 miles
Data Source: ESRI, 2017; USGS, NHD, 2014; Tillamook County, 2016

F-1 Zoning and Potential Wetland Restoration Areas in Southern Tillamook County

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Tables 2 and 3 show that there is substantial current and historical wetland acreage located outside the EFU zone: approximately 80 percent of estimated historical tidal wetlands (19,057 acres of 23,839 acres) and 70 percent of estimated historical freshwater wetlands (19,204 acres of 27,113 acres) are located outside of the EFU zone. In the watersheds without EFU lands, there are only 120 acres of estimated historical tidal wetlands, potentially limiting opportunities for wetland restoration in areas far from agriculture, but there are 1,060 estimated historical freshwater wetlands in these watersheds.

As Table 2 shows, within the County's EFU lands, there are 4,171 acres of potential tidal wetland restoration areas or modified NWI and potential historical tidally-influenced wetlands. The area of potential tidal wetland restoration area ranges from 1,399 acres in the Tillamook River Watershed, to no acreage in the Kilchis River or Sand Lake Watersheds.

For non-tidal freshwater wetlands within EFU lands, there are 5,335 acres of potential non-tidal freshwater wetland restoration area (see Table 3). The area of potential non-tidal freshwater restoration ranges from 1,599 acres in the Nestucca River Watershed to 48 acres in the Kilchis River Watershed.

Wetland restoration projects have been completed on EFU and non-EFU lands. Completed restoration projects include river and floodplain restoration in freshwater areas above tidal influence and estuary restoration projects in areas subject to tidal influence. More than 1,000 acres have been restored on EFU lands: 881 acres of tidal and 473 acres of freshwater restoration. These restoration areas overlap both modified wetland areas and wetlands that have been filled or dramatically altered. Due to challenges identifying the site-specific restoration actions and locations the summary of potential wetland restoration areas, the data presented in Tables 2 and 3 does not account for restoration projects that have been implemented.

The overlap of potential wetland restoration areas and EFU lands provides the context for assessing the compatibility of restoration with agricultural uses and establishing a process for the condition use review. In the compatibility assessment, we expect to define factors, such as drainage infrastructure and levee locations, that can be evaluated at the site-specific level to determine agricultural land priority and potential adverse impacts of wetland restoration on adjacent lands that affect production costs or land use patterns. Both the wetland and agricultural use information will help to inform which areas of EFU land may or may not be compatible with restoration.

Table 2. Tidal Wetland Acreage: Total Historical, Existing Unmodified, and Potential Wetland Restoration for EFU and Non-EFU Lands

Watershed (5th-Field HUC)	Estimated Historical Tidal Wetland *(NWI + Potential Historical)*		Existing Unmodified Wetland *(NWI-NWI Modified)*		Potential Restoration Areas *(NWI Modified + Potential Historical)*		
	County	EFU	County	EFU	County	EFU	% on EFU Lands
Tillamook River	1,896	1,578	428	179	1,468	1,399	95%
Tillamook Bay	10,341	893	9,304	93	1,037	800	77%
Lower Nehalem River	3,630	788	2,947	192	683	596	87%
Trask River	694	448	215	51	479	397	83%
Little Nestucca River	983	458	582	70	401	388	97%
Nestucca River	1,029	265	718	3	311	262	84%
North Fork Nehalem River	590	201	326	0	264	201	76%
Wilson River	173	121	54	14	119	107	90%
Miami River	44	30	17	9	27	21	78%
Kilchis River	0	0	0	0	0	0	0%
Sand Lake	4,339	0	4,192	0	147	0	0%
Other 7 Watersheds with no EFU Land	120	0	92	0	28	0	0%
SUM TOTAL	23,839	4,782	18,875	611	4,964	4,171	84%

Table 3. Freshwater Wetland Acreage: Total Historical, Existing Unmodified, and Potential Restoration or EFU and Non-EFU Lands

Watershed (5th-Field HUC)	Estimated Historical Tidal Wetland *(NWI + Potential Historical)*		Existing Unmodified Wetland *(NWI-NWI Modified)*		Potential Restoration Areas *(NWI Modified + Potential Historical)*		
	County	EFU	County	EFU	County	EFU	% on EFU Lands
Nestucca River	4,901	2,229	2,864	630	2,037	1,599	78%
Tillamook River	3,149	1,260	1,632	305	1,517	955	63%
Trask River	2,985	1,309	1,446	354	1,539	955	62%
Little Nestucca River	1,515	645	737	144	778	501	64%
Lower Nehalem River	2,784	673	1,965	246	819	427	52%
Tillamook Bay	1,317	347	832	65	485	282	58%
North Fork Nehalem River	1,198	239	602	0	596	239	40%
Wilson River	2,556	376	2,063	224	493	152	31%
Sand Lake	4,173	498	3,430	409	743	89	12%
Miami River	636	195	513	107	123	88	72%
Kilchis River	715	138	628	90	87	48	55%
Other 7 Watersheds with no EFU Land	1,060	0	885	0	175	0	0%
SUM TOTAL	27,113	7,909	17,684	2,574	9,429	5,335	57%

Date: November 29, 2017

To: Hilary Foote, Tillamook County

From: John Runyon, Cascade Environmental Group

Re: Wetland Service Assessment for Tillamook County Farm and Wetland Pilot Planning Project

Introduction

This memo describes the assessment of wetland services on Exclusive Farm Use (EFU or F-1 zone) lands in Tillamook County (County) (hereafter referenced as EFU lands). The purpose of the wetland service assessment is to: 1) describe the functions, values, and benefits of wetlands and wetland restoration projects from an ecological and socio-economic perspective; 2) characterize the quantity and location of potential wetland restoration areas on EFU lands; and 3) outline the limitations of the available data for evaluating wetland restoration opportunities.

Methods Overview

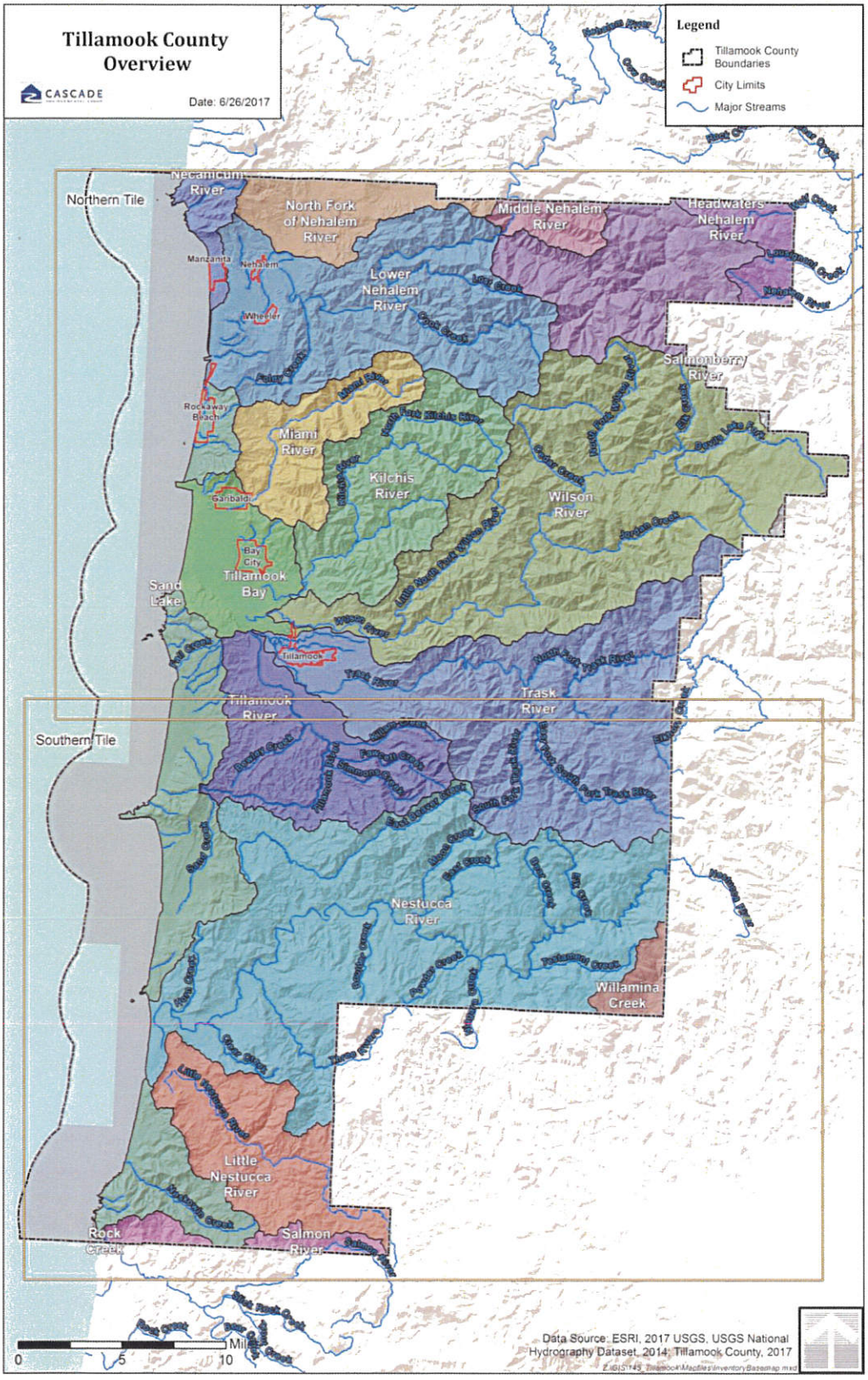
The wetland assessment builds on the findings from the *Wetland and Agricultural Use Inventory Memorandum* (Runyon and Wyse July 5, 2017). The primary available GIS data sets for the inventory and wetland assessment are the NRCS soil survey database (GSSURGO) for Tillamook County (NRCS 2016); and the National Wetland Inventory (NWI) (USFWS 2016). The soil survey database provides spatial information on the extent and location of geomorphic floodplains, soils drainage classes, and potential historical wetland areas. The NWI data are useful for mapping existing and modified (e.g., filled) freshwater and tidal wetlands.

The wetland assessment results are summarized at two spatial scales: County-wide and for each of the watersheds that drain areas within the County. Hydrologic Unit Codes (HUCs) are the national standard for delineating watersheds. For this study, the County is covered by eighteen 5th-field HUCs (Figure 1).

For the purposes of the wetland assessment, portions of watersheds are identified as "tidal" or "freshwater" based, respectively, on whether the areas are below or above the highest measured tide (HMT). This method is in accordance with the Oregon Department of State Lands (DSL) definition of tidal and freshwater wetlands (DSL 2016). Other County wetland studies have also used this method for defining tidal wetland extent (e.g., Ewald and Brophy 2012). The HMT was determined to be 11.62 feet, NAVD88[1].

[1] HMT was determined according to methods described by DSL (2010) using the National Oceanic and Atmospheric Administration (NOAA) tidal station located at Garibaldi, Oregon. The tidal station at Garibaldi was chosen to represent the entire County, as it is the sole station with a published "Highest Observed Water Level" value. The value of 15.91 feet, standard datum, was converted first into feet, mean lower low water (MLLW), then into feet, North American Vertical Datum of 1988 (NAVD88) with NOAA's online horizontal and vertical transformation utility, VDatum (https://vdatum.noaa.gov/vdatumweb/), to yield a value of 11.62 feet, NAVD88. The value of 11.62 feet was then applied to a 10-meter resolution raster-based digital elevation model (DEM) sourced from the National Elevation Dataset (USGS 2013; available at: https://viewer.nationalmap.gov/basic/#productSearch) in ESRI ArcGIS 10.1 software) to identify areas above and below HMT.

Figure 1. Overview of Tillamook County Streams and Watersheds. The Northern and Southern Tiles Delineate the Focus Areas for Figures 2 and 3



Overview of Tillamook County's EFU Lands

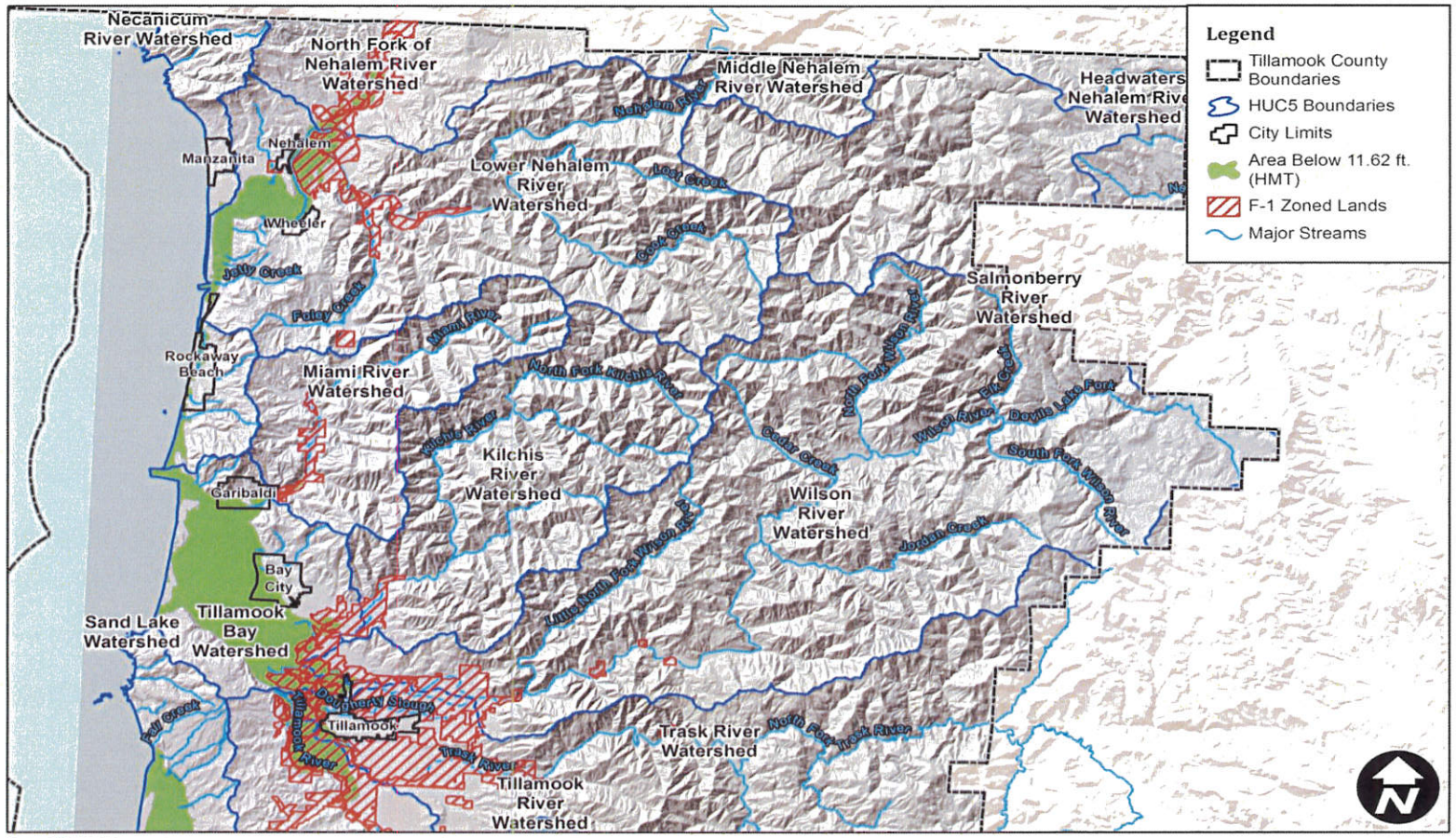
Table 1 summarizes the County's eighteen watershed areas and the proportion of each watershed designated as EFU[2]. The County covers approximately 718,719 acres, of which 37,589 acres (5.23%) are EFU (Figures 3 and 4). There are no EFU lands in the following seven watersheds: Headwaters Nehalem River, Middle Nehalem River, Necanicum River, Rock Creek, Salmon River, Salmonberry River, and Willamina Creek. The wetland assessment focuses on the eleven watersheds with EFU lands present.

Table 1. Summary of Tillamook County Watershed Areas, EFU Lands, and Areas Below HMT. The Seven Watersheds in Bold Type Have No EFU Lands Present

Watershed (5th-Field HUC)	Watershed Area (Acres)	EFU (Acres)	Percent of Watershed within EFU	Watershed Area Below HMT (Acres)	EFU Below HMT (Acres)	Percent EFU Below HMT (Acres)
Headwaters Nehalem River	9,928	-	0.00%	-	-	-
Kilchis River	41,280	557	1.35%	-	-	-
Little Nestucca River	32,413	3,021	9.32%	987	459	15.21%
Lower Nehalem River	70,078	2,714	3.87%	4,053	1,000	36.85%
Miami River	23,052	831	3.61%	79	54	6.47%
Middle Nehalem River	6,943	-	0.00%	-	-	-
Necanicum River	6,389	-	0.00%	120	-	-
Nestucca River	139,693	9,736	6.97%	1,115	279	2.86%
North Fork Nehalem River	17,574	1,994	11.35%	733	570	28.60%
Rock Creek	125	-	0.00%	6	-	-
Salmon River	7,108	-	0.00%	19	-	-
Salmonberry River	34,896	-	0.00%	-	-	-
Sand Lake	53,885	1,718	3.19%	4,909	1	0.06%
Tillamook Bay	21,255	1,948	9.17%	10,954	1,057	54.27%
Tillamook River	39,361	5,968	15.16%	1,995	1,669	27.97%
Trask River	90,666	7,008	7.73%	861	561	8.01%
Willamina Creek	5,439	-	0.00%	-	-	-
Wilson River	118,634	2,094	1.77%	312	196	9.36%
SUM TOTAL	***718,719***	***37,589***	***5.23%***	***26,142***	***5,847***	***15.55%***

[2] Two watersheds that are primarily within Washington County were not included in this study because they cover a very small area in Tillamook County and do not include any Agricultural Lands: Gales Creek (222 acres) and Scoggins Creek-Tualatin River (476 acres).

Figure 2. The Northern Section of Tillamook County Showing Streams, EFU (F-1 Zoned) Lands, and Areas below HMT



Date: 6/26/2017
Scale: 1 inch =4 miles
Data Source: ESRI, 2017; USGS, NHD, 2014

F-1 Zoning and Streams in Northern Tillamook County

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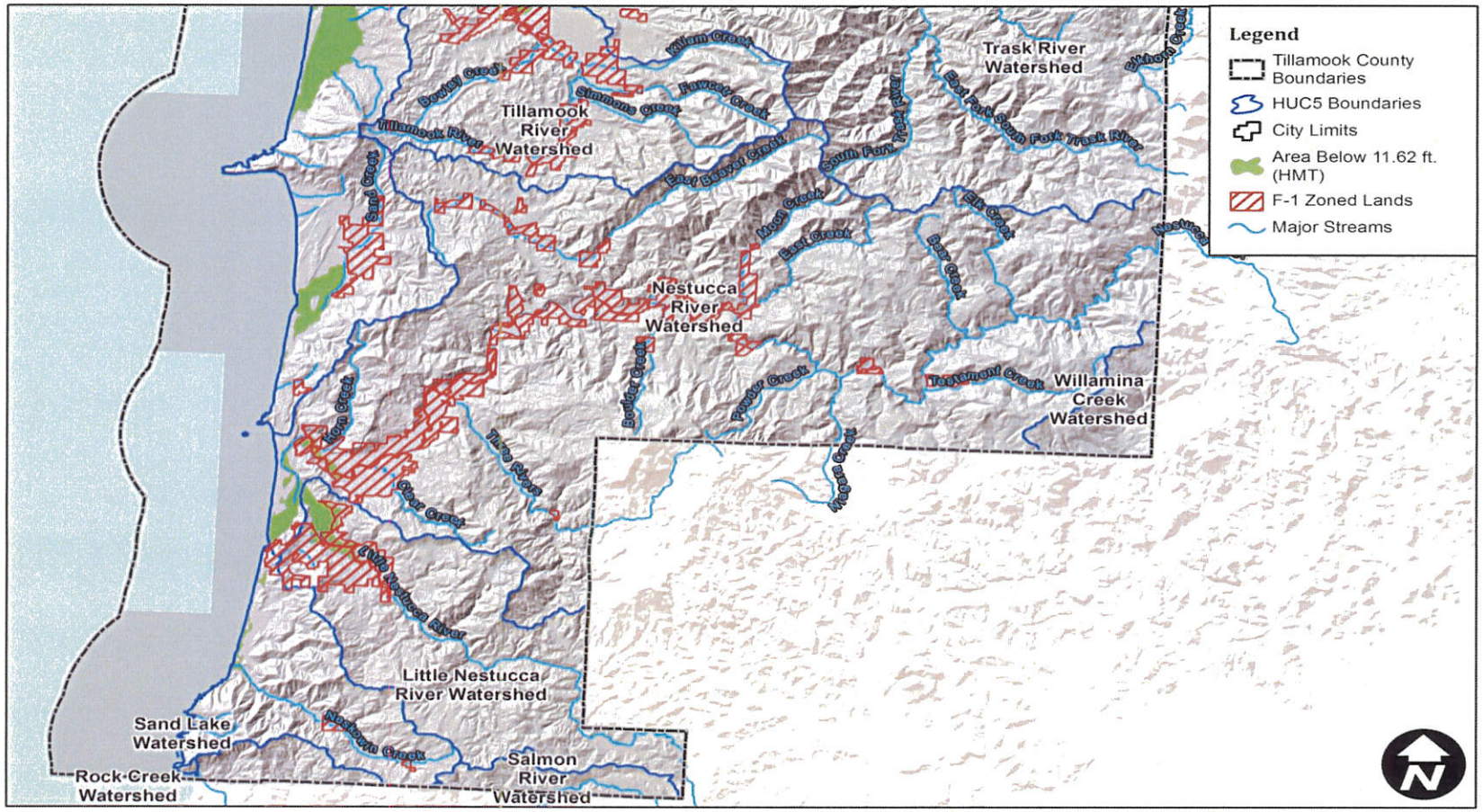
Figure 3. The Southern Section of Tillamook County Showing Streams, EFU Lands, and Areas below HMT



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Data Source: ESRI, 2017; USGS, NHD, 2014

F-1 Zoning and Streams in Southern Tillamook County

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For the purposes of the inventory, watersheds, or portions of watersheds, are identified as "tidal" or "freshwater" based, respectively, on whether the areas are below or above the highest measured tide (HMT). This method is in accordance with DSL's definition of tidal and freshwater wetlands (DSL 2016). Other County wetland studies have also used this method for defining tidal wetland extent (e.g., Ewald and Brophy 2012). The HMT was determined to be 11.62 feet, NAVD88.

For the most part, EFU lands are concentrated in the valley bottoms, often within floodplains adjacent to rivers and streams. In addition to the river valleys, a large proportion (15.55%) of the County's EFU lands is below HMT and is periodically subject to tidal influence. The areas below HMT include lands that were historically tidally influenced; in many instances land drainage has been altered (e.g., by levees or other modifications) to limit tidal inundation and accommodate agricultural land uses. Ten watersheds have some portion of EFU below HMT.

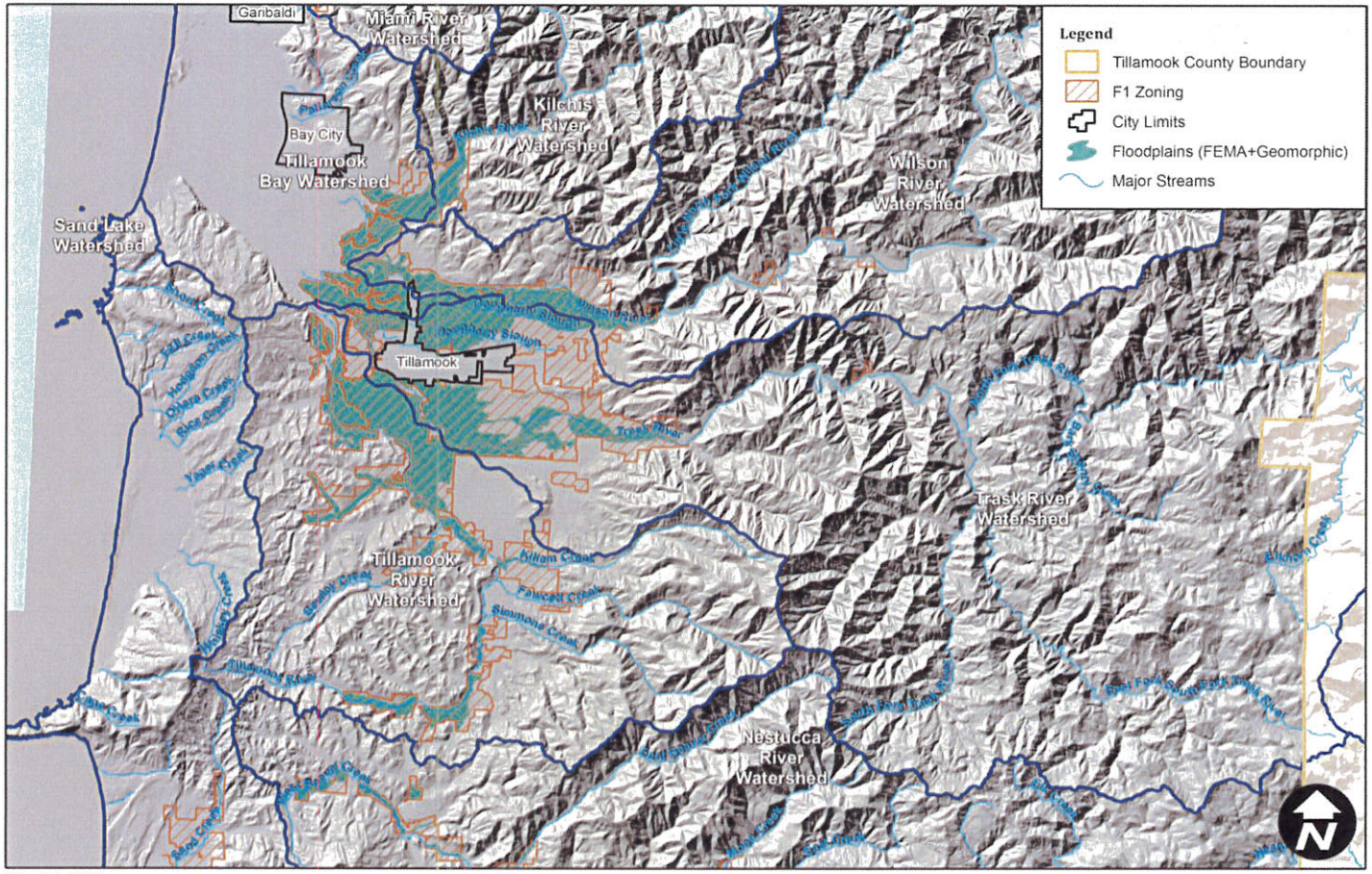
Floodplains are a focus for wetland restoration because these areas are adjacent to rivers, streams and tidal areas that provide complex and productive habitats important for fish and wildlife populations. For the purpose of the wetland assessment, floodplain areas are based on geomorphic floodplain features defined in the national soil survey, FEMA special hazard area mapped floodplains, and areas subject to tidal inundation up to HMT.

Table 2 shows the acreage and proportion of floodplain areas within EFU lands. Nearly 50% of the County's EFU lands are within freshwater floodplains or tidal areas, ranging from 84.5% in the Tillamook Bay Watershed to 3.35% in the Sand Lake Watershed. Figure 4 shows floodplains (including tidal areas) within EFU lands in central Tillamook County.

Table 2. The Acreage and Percent of Watershed Area within Floodplains on Tillamook County EFU Lands

Watershed	Floodplain Area (Acres)	Floodplain Area as Percent of Total EFU Lands
Kilchis River	405	72.80%
Little Nestucca River	1,018	33.68%
Lower Nehalem River	2,048	75.45%
Miami River	463	55.74%
Nestucca River	3,334	34.25%
North Fork of Nehalem River	1,324	66.43%
Sand Lake	58	3.35%
Tillamook Bay	1,646	84.50%
Tillamook River	3,452	57.85%
Trask River	3,581	51.10%
Wilson River	1,199	57.23%
TOTAL	***18,528***	***49.29%***

Figure 4. Floodplains within EFU Lands in Central Tillamook County.



Date: 9/6/2017
Scale: 1 inch = 3 miles
Data Source: ESRI, 2017; USGS, NHD, 2014; FEMA, 2016

FEMA Special Flood Hazard Areas (Preliminary) and Geomorphic Floodplains in Central Tillamook County

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Wetland Functions and Values

The County encompasses both tidal and non-tidal freshwater wetlands associated with streams and rivers. The County also contains freshwater wetlands that are not directly influenced by rivers or streams. While these upland freshwater wetlands are an important habitat type, the assessment is focused on tidal wetlands and freshwater wetlands that are within floodplain areas associated with streams and rivers because these wetland types are highly complex and productive habitats that support unique habitats and other important functions and values.

Tidal wetlands include freshwater areas influenced by the tide and estuary areas that are subject to a range of water salinity levels. Tidal wetlands are the most productive wetland type from the perspective of plant growth, nutrient and carbon dioxide (a greenhouse gas) uptake, and associated accumulation of organic matter (Simpson et al. 1983). Freshwater and saltwater-influenced tidal wetlands act as buffers between upstream areas and the ocean. Primary production and decomposition proceed at high rates and these wetlands are sinks for nutrients and heavy metals. This productive environment supports abundant plant biomass and detrital inputs into the aquatic system, which in turn supports aquatic insects and other sources of food for fish and wildlife. For this reason, tidal wetlands are critical habitat for a variety of fish and wildlife species, including salmon, crabs, and other shellfish, juvenile marine fish, marine mammals, and birds (ODFW 2016). By some estimates, tidal wetlands support up to three-quarters of all harvested fish species, largely due to the high productivity and diversity of habitats (ODFW 2016).

Non-tidal freshwater wetlands associated with floodplains are also very productive environments. This wetland type is hydrologically connected to rivers and streams. These wetland areas support nutrient absorption, high levels of primary productivity, aquatic insect production, and detrital inputs to the river system. River-associated wetlands include off-channel wetlands, sloughs, and side-channels. Non-tidal freshwater wetlands provide a diversity of habitats for juvenile salmon and steelhead, including high-water refugia where fish can reside and feed during flood events (ODFW 2016).

Tidal and non-tidal freshwater wetlands areas are critical habitats for juvenile salmon and steelhead growth and survival to maturity. These habitats provide a very productive and important environment as the fish feed, grow, and transition to the ocean environment. For example, one study observed a juvenile coho salmon that doubled in size during its 28-day residence within tidal wetlands (Jones et al. 2009). Tidal and non-tidal firewater wetlands contribute to the genetic diversity of salmon and steelhead populations by supporting a range life history patterns. For example, studies have identified coho salmon subyearling migrants with estuary-resident life histories that are dependent on access to diverse tidal wetlands (Jones et al. 2009).

Tidal and non-tidal freshwater wetlands also contribute to flood attenuation, aquifer recharge, and other hydrologic benefits. Because floodplain wetlands are located within a relatively flat landscape, their surface area expands and contracts as rivers rise and fall, allowing for the storage of large volumes of water (U.S. EPA 2008). As a consequence, floodplain-associated wetlands serve as a moderator of flood variability—storing flows and reducing flow velocities

during flood events. In addition, these wetland areas create low-velocity environments that are important for trapping nutrients and sediments (U.S. EPA 2008).

The storage of large volumes of water in both tidal and non-tidal freshwater wetlands can contribute to aquifer recharge: aquifers and groundwater are "recharged" with water that resides within wetland areas which then seeps into the ground. Wetlands connected to groundwater systems or aquifers are important areas for groundwater exchange (U.S. EPA 2008).

Tillamook County's EFU Wetlands: Restoration Definition and Evaluation Criteria

This section defines wetland restoration actions and outlines criteria for identifying wetland restoration opportunities and priorities within EFU lands.

Wetland Enhancement and Restoration: Definition and Examples

The County defines wetland "restoration" as encompassing two types of activities, wetland enhancement and wetland restoration:

Wetland Enhancement is the process of improving upon the natural functions and/or values of an area or feature which has been degraded by human activity.

An example of a wetland enhancement project is extending or improving an existing wetland channel and/or drainage network to more closely resemble the historical template. The Nature Conservancy Miami River project, which entailed recreating the historical tidal channel network, is an example of a wetland enhancement project.

Wetland Restoration is the process of returning a disturbed or altered area or feature to a previously existing natural condition. Restoration actions reestablish the ecological structure, function, and /or diversity which occurred prior to impacts caused by human activity.

An example of a wetland restoration project is removing a levee, fill, or other structure to restore historical wetland tidal or riverine hydrology, flooding, drainage patterns, and other processes and functions. The central Tillamook County Southern Flow Corridor Project is an example of a wetland restoration project that restored tidal connectivity to wetland areas that were disconnected from historical tidal processes by removing levees and other structures.

Wetland Restoration Evaluation Criteria

Criteria for identifying wetland restoration opportunities and priorities within the County's EFU lands were developed based on available GIS data. Because the existing data sources have varying levels of spatial resolution and accuracy, the criteria are focused on landscape-level indicators of wetland presence and modification (e.g., filling, levees, or other actions that disconnect or limit hydrologic interaction with tides or river flows), and restoration potential. This approach results in information on wetland status and restoration opportunities that is evaluated and summarized at the County-wide and specific watershed scales.

It is important to note that there are considerable uncertainties in interpreting the GIS data sets at a variety of scales. The uncertainties in interpreting the data include errors of omission and commission. Errors of omission, for example, involve missing potential historical wetland areas and potential wetland restoration areas. Errors of commission entail identifying areas that, upon further evaluation, are not wetlands or areas suitable for restoration. As a consequence, while the findings of the wetland assessment presented here provide a broad picture of wetland status and restoration opportunities throughout the County and for specific watersheds, the findings are not suitable for evaluation of wetland status and restoration opportunities at finer spatial scales such as landownership parcels or site-specific areas.

Evaluating site-specific areas for restoration benefits and assessing potential impacts on adjacent parcels requires a combination of datasets, depending on the nature of the restoration activities. For example, evaluating an estuary restoration project with the goal of restoring tidal influence to a site could require GIS data (e.g., levee locations), wildlife and fish use surveys, topographic information collected on local features such as drainage networks, data on groundwater levels, and the application of hydraulic modelling to predict upstream and downstream water level changes if the restoration is implemented.

The following is a description of the restoration criteria that are applied at the landscape level[3]:

Is the potential wetland area influenced or historically influenced by tidal flows?

Is the potential tidal wetland area modified or lost?

Rationale: The greatest loss of wetland area and function in the County has been in tidally-influenced salt- and freshwater wetlands (Ewald and Brophy 2012; Scranton 2004). As described above, tidally-influenced wetland types provide important habitat diversity, support key ecological and hydrological functions, and provide essential habitat and food sources for salmon and steelhead populations and other fish and wildlife species.

Methodology: 1) Identify and map areas below HMT; 2) For areas below HMT, identify and map NWI wetlands that have been modified (e.g., historical tidal wetlands that have no or limited tidal connectivity due to levees, filling, or channel modifications); and 3) Identify potential historical wetlands adjacent to estuary and tidal systems that have been lost by evaluating the proportion of mapped hydric soils.

Is the potential tidal wetland restoration area adjacent to coho salmon High Intrinsic Potential habitat?

Rationale: Coho salmon Intrinsic Potential (IP) is a measure of historical habitat quality in terms of supporting coho adult spawning and juvenile rearing. IP is an attribute modeled from GIS data based on key geomorphic and other characteristics: channel and valley constraint, channel

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[3] Refer to the ***Wetland and Agricultural Use Inventory Memorandum*** (Runyon and Wyse July 5, 2017) for descriptions of the data sources and analysis methods.

gradient, and mean annual water discharge. High IP coho habitat also provides an indicator of overall historical habitat quality because it captures broad, low-gradient floodplain areas with a diversity of habitat types that also support a variety fish and wildlife species.

Methodology: 1) Identify and map potential tidal wetland restoration areas within 200 feet of high IP coho streams.

Is the potential non-tidal freshwater wetland area influenced by or historically within floodplains and potentially hydrologically connected to river or stream flows?

Is the potential non-tidal freshwater wetland area modified or lost?

Rationale: The second greatest loss of wetland area and function in the County has been in floodplain freshwater wetlands. As described above, these wetland types provide habitat diversity, including off-channel habitats; provide insects and other food sources for fish and wildlife; attenuate flooding and contribute to aquifer recharge; and provide essential habitat, including off-channel areas, for salmon and steelhead populations and other fish and wildlife species.

Methodology: 1) Identify and map areas above HMT; 2) For areas above HMT, identify and map NWI wetlands that have been modified (e.g., historical freshwater wetlands that have no or limited hydrologic connectivity due to levees, filling, or channel modifications); and 3) Identify potential historical wetlands adjacent to river or stream systems that have been lost by evaluating the proportion of mapped hydric soils.

Is the potential freshwater wetland restoration area adjacent to coho salmon High Intrinsic Potential habitat?

Rationale: See above.

Methodology: 1) Identify and map potential freshwater wetland restoration areas within 200 feet of high IP coho streams.

Other Wetland Restoration Evaluation Criteria

In addition to the restoration evaluation criteria that are suitable for GIS analysis and mapping, the following criteria were not evaluated because the criteria are best applied at a site-specific level:

How does the wetland restoration project benefit targeted fish and wildlife species?

Rationale: Tidal and non-tidal freshwater restoration projects have the potential to improve habitat for a wide variety of fish and wildlife species. With the exception of high IP coho habitat, other fish or wildlife species' habitat needs and historical habitat quality was not evaluated. Restoration project development at the site-specific level usually considers habitat benefits for a variety of fish and wildlife species and, as part of the restoration design process, develops

restoration goals that meet the habitat requirements for targeted fish and wildlife species (e.g., fish, birds, amphibians, etc.).

What is the wetland restoration project size?

Is the restoration project adjacent to a restoration site or intact natural habitat?

Rationale: As a general rule, the larger the restoration site, the greater the value in terms of impact on habitat, fish and wildlife species occupancy and use, and ecological processes. Larger sites are also less susceptible to disturbance from adjacent land uses because the larger size buffers the site, particularly the interior areas, from disturbances. Restoration sites that are adjacent to intact natural habitats or restoration areas also can function essentially as one larger habitat area.

Does the restoration project change flooding, aquifer recharge, or other hydraulic or hydrologic conditions in a beneficial or negative manner?

Rationale: Wetland restoration projects within floodplain environments have the potential to positively or negatively affect flooding, aquifer recharge, and other hydraulic (e.g., downstream levee scour and erosion) or hydrologic (e.g., changing drainage patterns on adjacent properties) processes. Restoration project development considers on-site and off-site flooding and other hydrologic and hydraulic impacts. These impacts are best evaluated at the site-specific and rivers reach scale because the evaluations entail the development of hydraulic models and other analysis methods that require detailed and high resolution information (e.g., topography and elevations, water table depths, drainage patterns, etc.).

EFU Wetlands: Classification and Restoration Potential

Potential restoration areas were evaluated for tidally-influenced wetlands and non-tidal freshwater wetlands. In both cases, modified NWI wetlands and potential historical wetlands are classified and mapped in order to evaluate loss of wetland area and function. Modified NWI wetlands and potential historical wetlands represent areas where wetland functions and/or extent has been lost. Modified NWI wetlands represent areas were ditching, levee construction, filling and other actions have resulted in significant loss of wetland function. For the most part, modified NWI estuarine wetlands (areas below HMT) have been converted to freshwater wetlands as a result of levees blocking tidal flows. This modification represents a loss of tidal wetland function. Similarly, areas of potential historical wetlands (both above and below HMT) contain soils that indicate past wetland status, but wetland functions and area has been lost as a result of ditching, levee construction, filling and other actions.

Table 3 shows the potential tidally-influenced (below HMT) restoration areas for the watersheds with EFU lands present. Within the County's EFU lands, 4,247 acres encompass modified NWI and potential historical tidally-influenced wetlands. The area of potential tidal wetland restoration ranges from 1,399 acres in the Tillamook River Watershed, to no acreage in the Kilchis River Watershed (Figure 5).

Table 3. Tidally-Influenced (Below HMT) Modified NWI Wetlands, Potential Historical Wetlands, and Areas for Both Wetland Types Combined for Watersheds with EFU Lands Present

Watershed (5th field HUC)	Modified NWI Wetlands Below HMT (Acres)	Potential Historical Wetlands Below HMT (Acres)	Modified NWI + Historical Below HMT (Acres)
Kilchis River	0	0	0
Little Nestucca River	361	27	388
Lower Nehalem River	434	191	625
Miami River	14	7	21
Nestucca River	255	7	262
North Fork Nehalem River	46	201	247
Sand Lake	0	0	0
Tillamook Bay	738	62	800
Tillamook River	1,265	134	1,399
Trask River	343	54	398
Wilson River	95	12	107
SUM TOTAL	***3,553***	***694***	***4,247***

Figure 5. Total Area Encompassing Tidally-Influenced (Below HMT) Modified NWI Wetlands and Potential Historical Wetlands

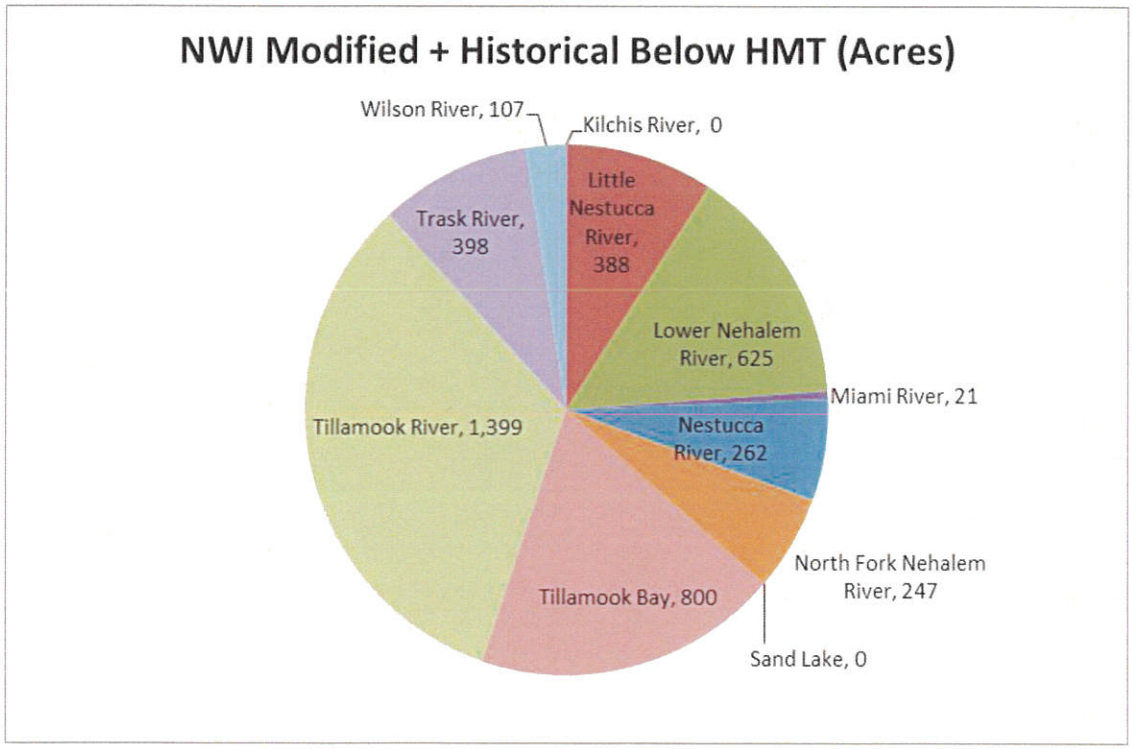


Table 4 shows the potential non-tidal freshwater restoration areas for the watersheds with EFU lands present. Within the County's EFU lands, 5,460 acres encompass modified NWI and potential historical non-tidal freshwater wetlands. The area of potential non-tidal freshwater restoration ranges from 1,599 acres in the Nestucca River Watershed to 90 acres in the Sand Lake Watershed (Figure 6).

Figure 7 illustrates the mapped areas encompassing both tidal (above HMT) and non-tidal freshwater modified NWI and potential historical wetlands for central Tillamook County EFU Lands. Figure 8 shows the range of tidal and non-tidal wetland types that are within 200 feet of high IP coho habitat for central Tillamook County.

Table 4. Non-tidal Freshwater Modified NWI Wetlands, Potential Historical Wetlands, and Areas for Both Wetland Types Combined for Watersheds with EFU Lands Present

Watershed (5th field HUC)	Modified NWI Wetlands Above HMT (Acres)	Potential Historical Wetlands Above HMT (Acres)	Modified NWI + Historical Wetlands Above HMT (Acres)
Kilchis River	9	39	48
Little Nestucca River	405	96	501
Lower Nehalem River	115	312	426
Miami River	46	42	87
Nestucca River	1,064	535	1,599
North Fork Nehalem River	125	239	364
Sand Lake	35	54	90
Tillamook Bay	215	67	282
Tillamook River	387	568	955
Trask River	133	822	955
Wilson River	27	125	152
SUM TOTAL	***2,560***	***2,900***	***5,460***

Figure 6. Total Area Encompassing Non-Tidal Freshwater Modified NWI Wetlands and Potential Historical Wetlands

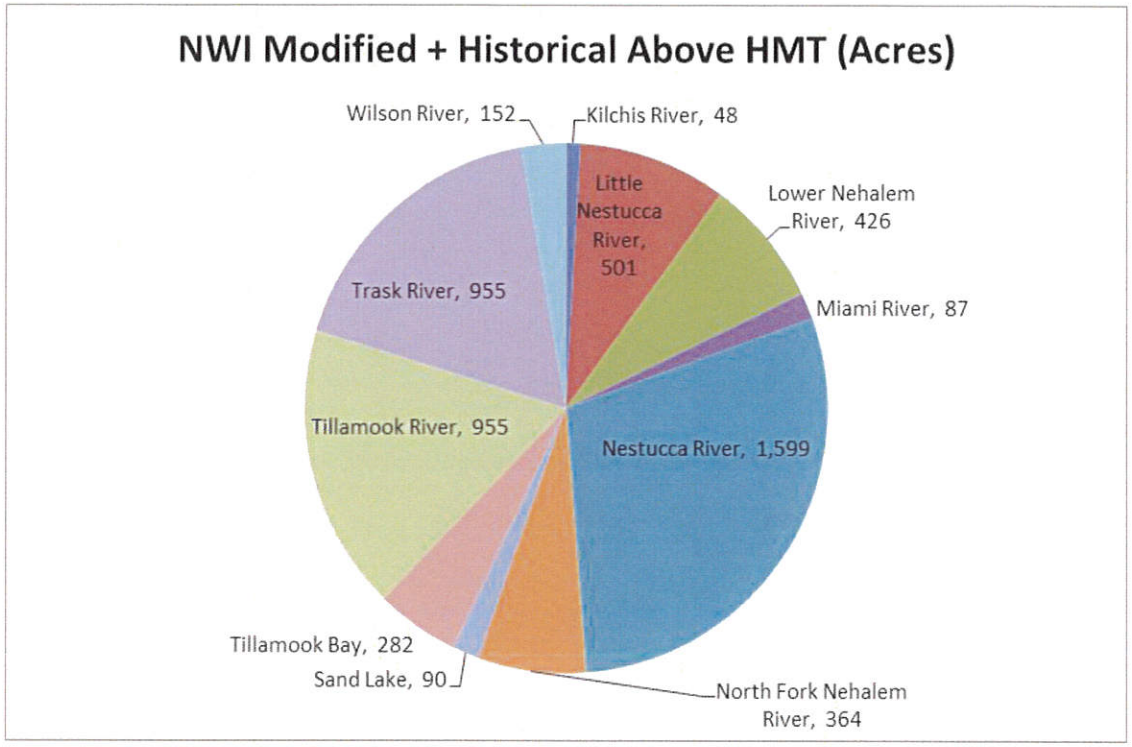
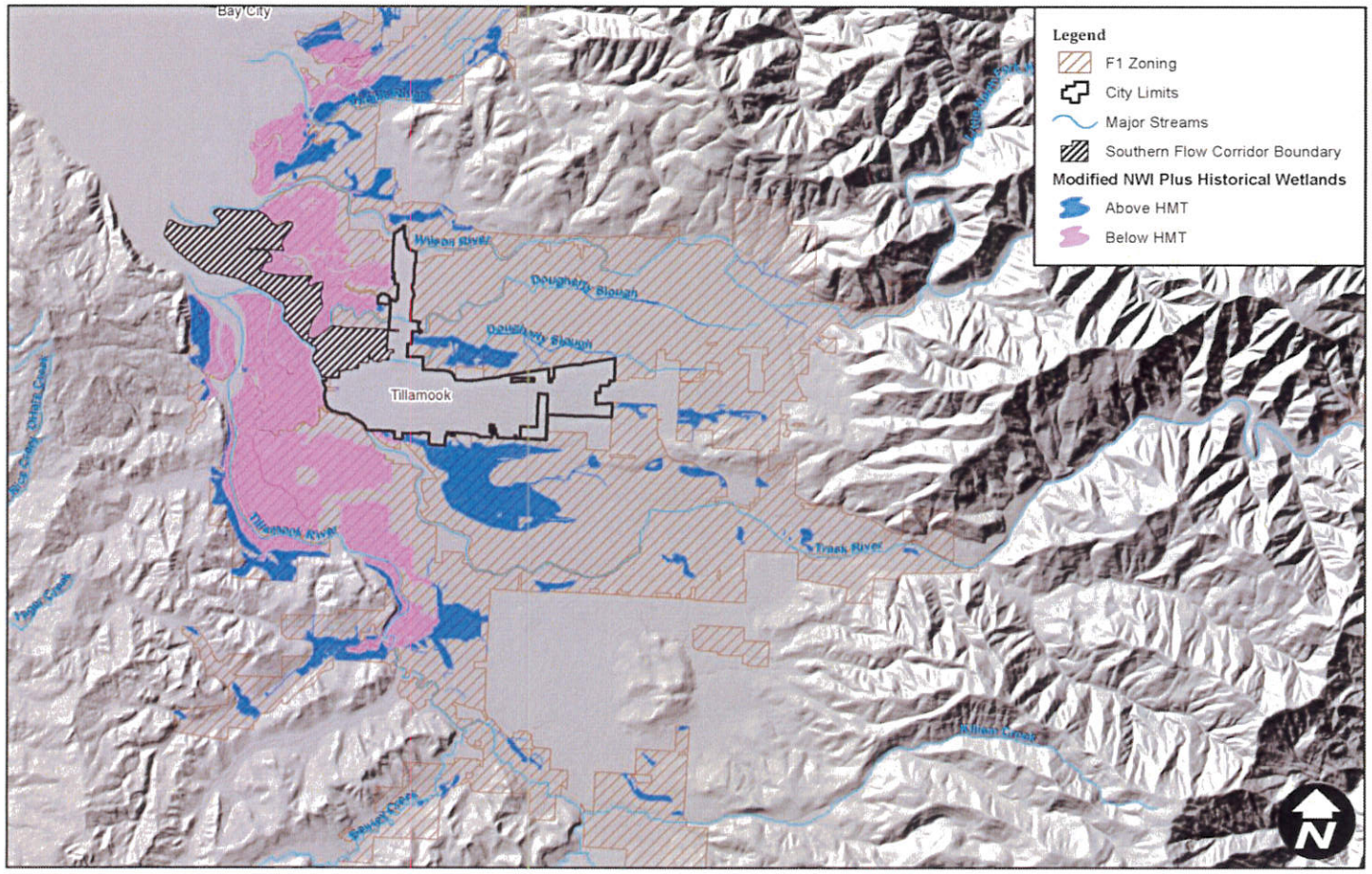


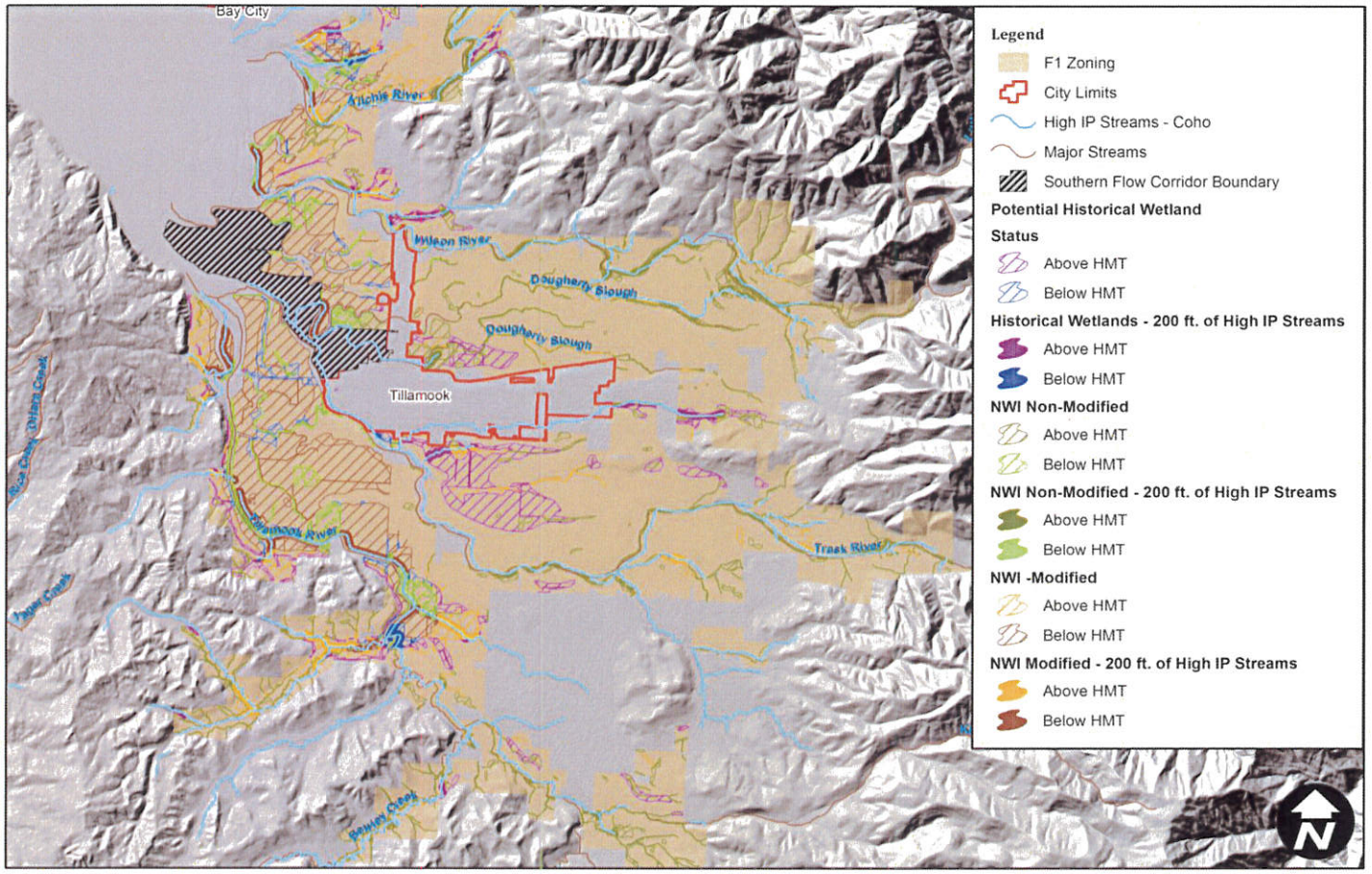
Figure 7. The Area Occupied by Tidal (Above HMT) and Non-Tidal Freshwater Modified NWI and Potential Historical Wetlands for Central Tillamook County EFU Lands



Date: 7/31/2017
Scale: 1 inch = 1 miles
Data Source: ESRI, 2017; USGS, NHD, 2014

Modified NWI and Potential Historical Wetlands in Central Tillamook County

Figure 8. The Range of Tidal and Freshwater Wetland Types that are Within 200 Feet of High IP Coho Habitat



Date: 11/20/2017
Scale: 1 inch = 1 miles
Data Source: ESRI, 2017; USGS, NHD, 2014

Historical and Existing Wetlands in Central Tillamook County

CASCADE ENVIRONMENTAL GROUP

0 0.5 1 2 Miles

Tillamook County SB1517 Pilot Project

Z:\GIS\145_Tillamook\Mapfiles\Wetlands_HighIP.mxd

Restoration Projects

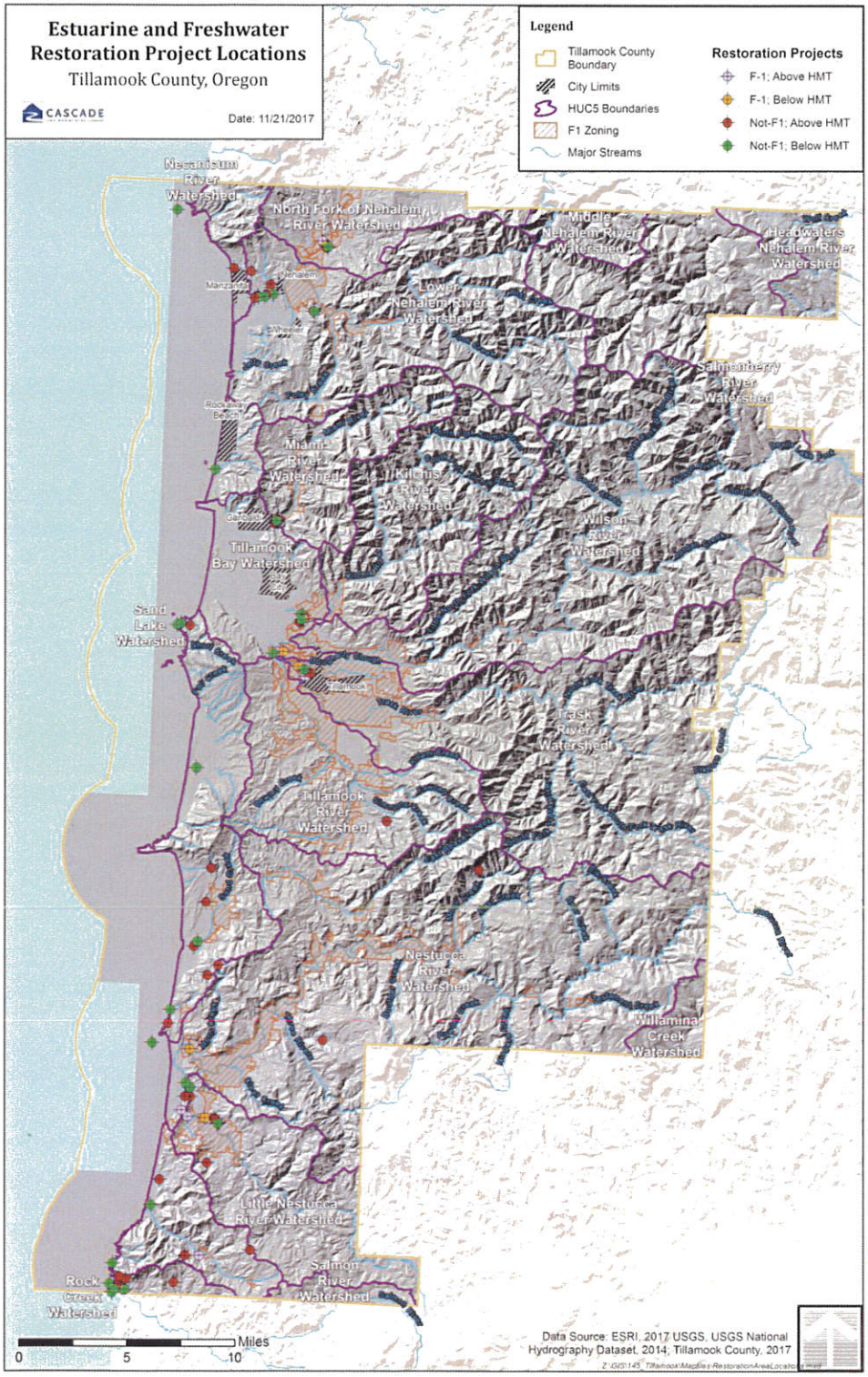
There have been a number of restoration projects implemented in Tillamook County. Completed restoration projects include river and floodplain restoration in freshwater areas above tidal influence and estuary restoration projects in areas subject to tidal influence (below HMT). Table 6 and Figure 9 show the watershed area and locations for completed tidal and freshwater restoration projects for EFU and non-EFU lands. The table and figure include both wetland enhancement and restoration projects. A wide range of restoration activities are summarized, including levee breaching to restore tidal and freshwater connectivity, wetland enhancement, and land protection mechanisms such as conservation easements. It is important to note that while the restoration project information is based on the best available data, there are completed restoration projects that are not included in this summary.

Wetland restoration projects have been completed on EFU and non-EFU lands. The Southern Flow Corridor project (see Figure 8 for location) is the largest restoration project completed to date in Tillamook County: 674.03 acres, of which 365.52 acres are in the Tillamook Bay watershed and 308.51 acres are in the Trask River Watershed, encompassing both EFU and non-EFU lands. The goal of this project is to reduce flooding in areas around the City of Tillamook and improve fish and wildlife habitat by restoring tidal waters into areas that were levee protected and also restoring floodplain freshwater wetlands.

Table 6. Estuary / Tidal (Below HMT) and Freshwater (Above HMT) Restoration and Enhancement Projects Completed in Tillamook County on EFU and Non-EFU Lands. Source: Oregon Watershed Enhancement Board, 2017 and The Nature Conservancy, 2017

Watershed (5th field HUC)	EFU Estuarine / Tidal Restoration Projects (Acres)	Non-EFU Estuarine / Tidal Restoration Projects (Acres)	EFU Freshwater Restoration Projects (Acres)	Non-EFU Freshwater Restoration Projects (Acres)
Little Nestucca River	222	96	260	267
Lower Nehalem River	23	7	32	48
Miami River	12	9	29	2
Necanicum River		2		2
Nestucca River	33	26	106	1,797
North Fk. Nehalem River	69	5	9	0.2
Rock Creek		1		117
Salmon River		3		3,356
Sand Lake		192	0.1	8,127
Tillamook Bay	377	104	33	4
Tillamook River				62
Trask River	145	93	5	99
SUM TOTAL	***881***	***538***	***473***	***13,882***

Figure 9. The Locations of Estuary / Tidal (Below HMT) and Freshwater (Above HMT) Restoration and Enhancement Projects Completed in Tillamook County. Source: Oregon Watershed Enhancement Board, 2017 and The Nature Conservancy, 2017



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Date: November 29, 2017

To: Hilary Foote, Tillamook County

From: Barbara Wyse, Highland Economics

Re: Agricultural Assessment for Tillamook County Farm and Wetland Pilot Planning Project

Introduction

This memo presents findings from an assessment of Exclusive Farm Use (EFU or F-1 zone) agricultural lands in Tillamook County. The purpose of the assessment is to identify lands that are high priority for maintaining the stability of the County's agricultural economy. The assessment aims to define EFU lands as low, medium, and high priority lands. Based on the available data, the assessment attempted to differentiate EFU lands into these three levels based on potential indicators of relative agricultural productivity potential and relative cost of agricultural production (i.e., the higher the production potential and the lower the cost of production, the higher the priority of a given EFU land area and vice versa).

Information from the agricultural use inventory (see previous memo) provides the foundation for this agricultural assessment. The inventory presented the available data for Tillamook County, and this memo provides an analysis of the spatial relationships between different soil and land use characteristics with the goal of determining the priority level of EFU lands throughout the county. The memo briefly summarizes methods and data, presents information on the relationships between key factors that may differentiate agricultural lands, and then concludes with findings and next steps.

This agricultural assessment was completed in late August and early September of 2017. As discussed throughout the memo, the methods and data used in this assessment were presented at a meeting with the agricultural community in late September of 2017. Input and feedback provided at this meeting indicated that the available data used in the assessment provide poor indications of actual, on-the-ground agricultural production potential and costs. The spatial data relied upon for the assessment were largely drawn from the NRCS soil survey geographic database (SSURGO). While this database provides excellent site-specific data on soil type, the agricultural community commented that the NRCS ratings on the productivity and suitability of land for dairy agricultural uses (including ratings for soil drainage, crop yields, and suitability for spreading animal waste), which are based largely on soil type, are not reliable at the site level. The agricultural community noted that site management is more important than soil type in determining the production potential and importance of Tillamook County EFU lands for dairy uses. While site management is important on all agricultural lands, agricultural productivity in Tillamook County may be more dependent on-site management (which can vary through time and by owner) and less dependent on intrinsic, site-specific characteristics as in other locations (thus making mapping and rating of agricultural land priority potentially less feasible in Tillamook County than other locations). This is an important finding that has

implications for future farm and wetland planning projects: generating an accurate county-wide map of priority EFU agricultural lands will be more feasible in areas where the value and quality of agricultural lands is largely determined by soil type, slope, and other factors with excellent and available site-specific GIS data on the county scale.

Due to the lack of reliable, site-specific GIS data on agricultural land productivity/quality, we do not anticipate generating an alternative agricultural assessment priority map to replace the GIS map-based agricultural assessment presented in this memo. Instead, we anticipate that additional input from the agricultural community and the general public will help to define factors, such as locational factors noted above, that can be evaluated at the site-specific level to determine agricultural land priority and potential adverse impacts on adjacent lands that affect production costs or land use patterns. Both of these types of information will help to inform which areas of EFU land may or may not be compatible with restoration.

Data and Methods

As presented in the agricultural inventory, the key available GIS (geographic information system) spatial datasets for the agricultural assessment are the NRCS soil survey geographic database (SSURGO), the USDA cropscape-cropland data, and Oregon Department of Agricultural CAFO (confined animal feeding operations) data. Also included in the assessment are data on irrigation water rights (Oregon Department of Water Resources water rights database) and data on drainage district boundaries. As in the inventory, the agricultural assessment summarizes results at two spatial scales: County-wide and for each of the 5th field HUC (Hydrologic Unit Codes) watersheds that drain areas within the County.

As noted above, the goal of the assessment is to differentiate EFU lands into these three levels based on relative agricultural productivity potential and relative cost of agricultural production. Actual agricultural output/productivity and cost of production by geographic area within the county are not available from public data sources (good agricultural production and economic value data are available at the county level only), so we use proxies. Specifically, we focus on NRCS soil data on silage/pasture yield levels and waste management ratings as a measure of the relative land productivity in terms of ability to support cows for a given amount of land (as dairy farms are the primary agricultural activity in Tillamook County now and in the foreseeable future), and we use data on soil drainage class as a proxy for relative production costs on EFU lands throughout the county (given the importance and challenge of drainage for farm operations in Tillamook County).

We also focus on current land use (i.e., whether the land has been prepared for pasture or crop production) as a key indicator of the relative priority of different EFU lands for maintaining agricultural stability. The analysis recognizes that another important factor affecting both agricultural productivity potential and cost of production is the level and condition of on-site infrastructure, particularly drainage infrastructure, but currently data is not available at the county-level to include this factor in the assessment.

Specifically, we conducted four steps in this GIS-based agricultural assessment.

1. **Define existing cropland in the EFU zone.** Only EFU lands that have been identified as currently in crop production or as suitable for crop production in the NRCS soil survey and/or the USDA cropland datasets are analyzed in the assessment. Lands that are not identified as cropland in at least one of the two datasets are classified as low priority for agricultural production (these lands do not have NRCS yield ratings, and most do not have manure management ratings, so we conduct no further analysis of these lands). In other words, we assume that if lands have not been used for pasture or crop production, then they are low priority for agricultural production and stability.
2. **Review characteristics of EFU lands identified for manure management in CAFO manure management plans.** The characteristics of lands currently used for CAFO manure management may provide information on the types of lands that are valued by agricultural operators. This is a partial dataset, as most of the data on CAFO operations are point data that indicate the general location of a dairy rather than the land base used to support the dairy and its operations.

3. **Analyze relationship between drainage, yield, and manure management capacity.** We look for correlation between drainage and yield, drainage and manure management capacity, and yield and manure management capacity.
4. **Categorize lands as low, medium, and high based on their drainage, yield, and manure management capacity.** The table below summarizes how agricultural priority is rated.

Table 1. GIS Data-Based Agricultural Land Priority Rating System

Priority Rating	NRCS Rating		
	Yield[1]	Drainage	Waste Management
High	High/Medium	Well drained OR Moderately Well Drained	Very Limited OR Somewhat limited OR Not Rated
High	Unclassified	Well Drained OR Moderately Well Drained	Somewhat limited
High	High/Medium	Any	Somewhat Limited
Low	Low OR Unclassified	All Drainage Classes	Very Limited
Medium	All other croplands		

1/See inventory memo for definition of yield ratings.

The available county-wide spatial datasets with pertinent information on agricultural lands are limited to those used in this analysis. Given the breadth of factors that may affect the relative priority of agricultural lands, this GIS-based assessment that is almost exclusively based on NRCS-rated yield potential, manure management, and soil drainage classifications provides a restricted and potentially inaccurate assessment of Tillamook County agricultural lands (as indicated by feedback from the agricultural community in late September). To supplement this assessment, we have begun collecting additional information from the agricultural community and the public to supplement the desktop, GIS data-based analysis presented in this memo.

Analysis

As described above, the first step in the analysis was to define the EFU lands that have been identified as currently in crop production or as suitable for crop production in the NRCS soil survey and/or the USDA cropland datasets. This forms our 'master cropland' dataset of approximately 29,900 acres, or 80 percent of the approximately 37,590 acres of EFU lands. The NRCS soil survey dataset indicates that there are approximately 23,760 acres of cropland; also including data from the USDA cropland dataset expands the potential area of cropland to 29,900 acres. Lands not in cropland are typically either developed or are forested and sloped areas higher in the watersheds. As shown in Table 2, nearly two-thirds (63 percent) of the EFU lands that are potentially cropland are located in the Trask River, Nestucca River, and Tillamook River watersheds. (We refer to the 29,900 acres as potential cropland, as the USDA cropland

dataset is at a fairly gross scale and may classify some lands as cropland that may be in other land uses.)

Table 2. Cropland in EFU

Watershed (5th Field HUC)	Cropland	Non-Crop	Total	% of EFU Land in Cropland	% County EFU Cropland
Trask River	6,800	208	7,008	97%	23%
Nestucca River	6,576	3,161	9,736	68%	22%
Tillamook River	5,368	598	5,966	90%	18%
Lower Nehalem River	2,055	659	2,714	76%	7%
Little Nestucca River	1,946	1,074	3,020	64%	7%
Tillamook Bay	1,845	104	1,949	95%	6%
North Fork of Nehalem River	1,791	202	1,993	90%	6%
Wilson River	1,549	546	2,095	74%	5%
Sand Lake	923	795	1,718	54%	3%
Miami River	543	288	831	65%	2%
Kilchis River	506	51	556	91%	2%
Grand Total	***29,900***	***7,686***	***37,587***	***80%***	***100%***

This 29,900 acres of potential cropland is the focus of the agricultural land assessment. In an attempt to identify the land and soil characteristics that may be most important for farming, we first reviewed the characteristics of lands in CAFO manure management plans (i.e., acreage designated as lands for manure management for CAFO operations). Following this discussion, the section summarizes the characteristics of all 29,000 acres of EFU croplands.

Table 3 presents the drainage, yield, and manure management characteristics of the 8,298 acres of CAFO manure management lands that have been mapped by Oregon Department of Agriculture, primarily in the Trask River, Tillamook Bay, and Tillamook River watersheds (and representing only part of the manure management lands in Tillamook County as designated in CAFO manure management plans). Acreages shaded in green in the Table 3 are rated as high priority lands, acreage shaded in blue are rated medium priority lands, and acreage shaded in grey are rated as low priority lands; this acreage by priority rating is also summarized in the bottom rows in the table. Approximately 10 percent of the CAFO lands are rated low, with the remainder split fairly evenly between medium and high priority ratings. There are relatively few CAFO manure management lands in the Trask Wilson, and Tillamook River watersheds with low or unclassified yield ratings (90 percent of lands have a high or medium yield rating). However, approximately one-third of manure management lands (as designated in CAFO plans) have poorly drained or very poorly drained soils (2,665 acres), and two-thirds (5,934 acres) have very limited waste management capabilities.

The fact that there are significant CAFO manure management lands with poor drainage and limited waste management capabilities may indicate that yield is the most important factor (amongst the map-able data available for this analysis) determining relative priority of lands for

dairies in Tillamook County. Or it may simply reflect the distribution of all EFU lands: as shown in Table 4 below, the distribution of ratings for drainage, yield, and waste management of all EFU lands are very similar to the distribution of ratings of the CAFO manure management lands. This may either be because 1) there are low priority/marginally productive lands included in the CAFO manure management plans due to the limited total supply of lands or spatial variation of land quality within a parcel of land or 2) the three available characteristics that we have used to try to differentiate the productivity and priority of EFU lands are not the key characteristics that differentiate the priority level of EFU agricultural lands for dairy operations.

Table 3. CAFO Manure Management Lands: Drainage, Yield and Waste Management Rank

	Yield Rank				
Waste Management/Drainage	**High**	**Medium**	**Unclassified**	**Low**	**Total**
Somewhat limited	**2,342**				**2,342**
Somewhat poorly drained	*26*				*26*
Well drained	*2,316*				*2,316*
Very limited	**1,954**	**3,202**	**190**	**589**	**5,934**
Moderately well drained	*44*				*44*
Poorly drained		*1,264*	***4***	***59***	*1,327*
Somewhat excessively drained				*41*	*41*
Somewhat poorly drained	*37*	*982*			*1,019*
Very poorly drained	*352*	*901*	***47***	***38***	*1,338*
Well drained	*1,520*	*55*	*139*	*451*	*2,165*
Not Rated	**1**		**21**		**22**
TOTAL	***4,297***	***3,202***	***210***	***589***	***8,298***
	Priority Rating				
	High	**Medium**	**Low**		
All EFU Manure Management Lands	**3,962**	**3,537**	**799**		**8,298**
% EFU Manure Management Lands	**48%**	**43%**	**10%**		**100%**

Table 4. Drainage, Yield and Waste Management Rank on CAFO Manure Management Lands and All EFU Croplands

	Mapped CAFO Manure Management Lands		All EFU Croplands	
Soil Characteristic	**Acreage**	**% of Acreage**	**Acreage**	**% of Acreage**
Drainage				
Well Drained/Moderately Well Drained	4,525	55%	16,491	55%
Somewhat Excessively Well Drained/ Somewhat Poorly Drained	1,086	13%	2,965	10%
Excessively Well Drained/Very Poorly Drained/Poorly Drained	2,665	32%	10,391	35%
Not Rated	22	0%	53	0%
	8,298	***100%***	***29,900***	***100%***
Yield				
High	4,297	52%	12,990	43%
Medium	3,202	39%	11,404	38%
Low	589	7%	3,164	11%
Unclassified	210	3%	2,340	8%
	8,298	***100%***	***29,900***	***100%***
Manure Management				
Somewhat Limited	2,342	28%	8,518	28%
Very Limited	5,934	72%	2,1169	71%
Not Rated	22	0%	212	1%
	8,298	***100%***	***29,900***	***100%***

The tables below show the drainage, yield, and manure management ability of all 29,900 acres of EFU croplands. Table 5 presents the acreage by yield and drainage class (based on NRCS ratings), Table 6 presents the acreage by waste management and drainage class, and Table 7 presents the acreage by waste management and yield. Each table presents two of the three characteristics used to rate lands as low, medium, and high. As presented in Table 1, generally, if acreage rates high on two of the three characteristics, it is rated high; this acreage is highlighted in green in the tables below. Acreage that is rated low (regardless of the rating of the third characteristic) is highlighted in grey in the tables below. In terms of drainage and yield (as shown in Table 5 below), 93 percent of high yielding lands have well drained/moderately well drained soils. Conversely, of the well or moderately drained soils, approximately 80 percent provide for high or medium yields and only 8 percent are low yielding (the remainder have unclassified yields). However, low yields can be found on most soil types.

In terms of waste management and yield (as shown in Table 6 below), all soils that are rated as low yielding also have very limited waste management capacity. Nearly all somewhat limited waste management soils (the best waste management rating given by NRCS for EFU soils in

Tillamook County) are high yielding. However, 36 percent of high yielding soils are rated as very limited for waste management, showing that high yields and relatively better waste management capacity do not necessarily go together on all lands. Finally, in terms of waste management and drainage (as shown in Table 7 below), to have relatively better waste management capacity (i.e., somewhat limited waste management rating), fairly well drained soils are necessary (99 percent are located on well drained or moderately well drained soils). All soils that are very poorly or excessively drained and nearly all poorly drained soils are very limited for waste management. However, drainage is not the only factor affecting waste management, as high slopes or other characteristics on well drained soils may result in very limited waste management capacity.

Table 5. EFU Cropland by Drainage Class and Yield

	Silage/Pasture Yield Level					
Drainage Class	**High**	**Medium**	**Low**	**Unclassified**	**Total**	**Proportion**
Well drained	11,827	1,041	1,344	2,010	16,223	54%
Moderately well drained	268				268	1%
Somewhat excessively drained			472	135	607	2%
Poorly drained		4,345	712	68	5,125	17%
Somewhat poorly drained	486	1,868		3	2,358	8%
Very poorly drained	409	4,150	637	67	5,263	18%
Excessively drained				3	3	0%
(blank)				53	53	0%
Total	***12,991***	***11,404***	***3,165***	***2,340***	***29,900***	***100%***
Proportion	43%	38%	11%	8%	100%	

Table 6. EFU Cropland by Drainage Class and Waste Management Rank

	Waste Management Rank				
Drainage Class	Not rated	Somewhat limited	Very limited	Total	Proportion
Well drained	25	8,209	7,989	16,223	54%
Moderately well drained		205	63	268	1%
Somewhat excessively drained	132	4	472	607	2%
Somewhat poorly drained	3	101	2,254	2,358	8%
Poorly drained			5,125	5,125	17%
Very poorly drained			5,263	5,263	18%
Excessively drained			3	3	0%
(blank)	53		1	53	0%
Total	***212***	***8,519***	***21,169***	***29,900***	***100%***
Proportion	1%	28%	71%	100%	

Table 7. EFU Cropland by Yield and Waste Management Rank

	Waste Management Rank				
Yield	Not rated	Somewhat limited	Very limited	Total	Proportion
High	25	8,283	4,683	12,991	43%
Medium			11,404	11,404	38%
Unclassified	187	236	1,917	2,340	8%
Low			3,165	3,165	11%
Total	***212***	***8,519***	***21,169***	***29,900***	***100%***
Proportion	1%	28%	71%	100%	

Findings and Implications: GIS-Based EFU Lands Assessment

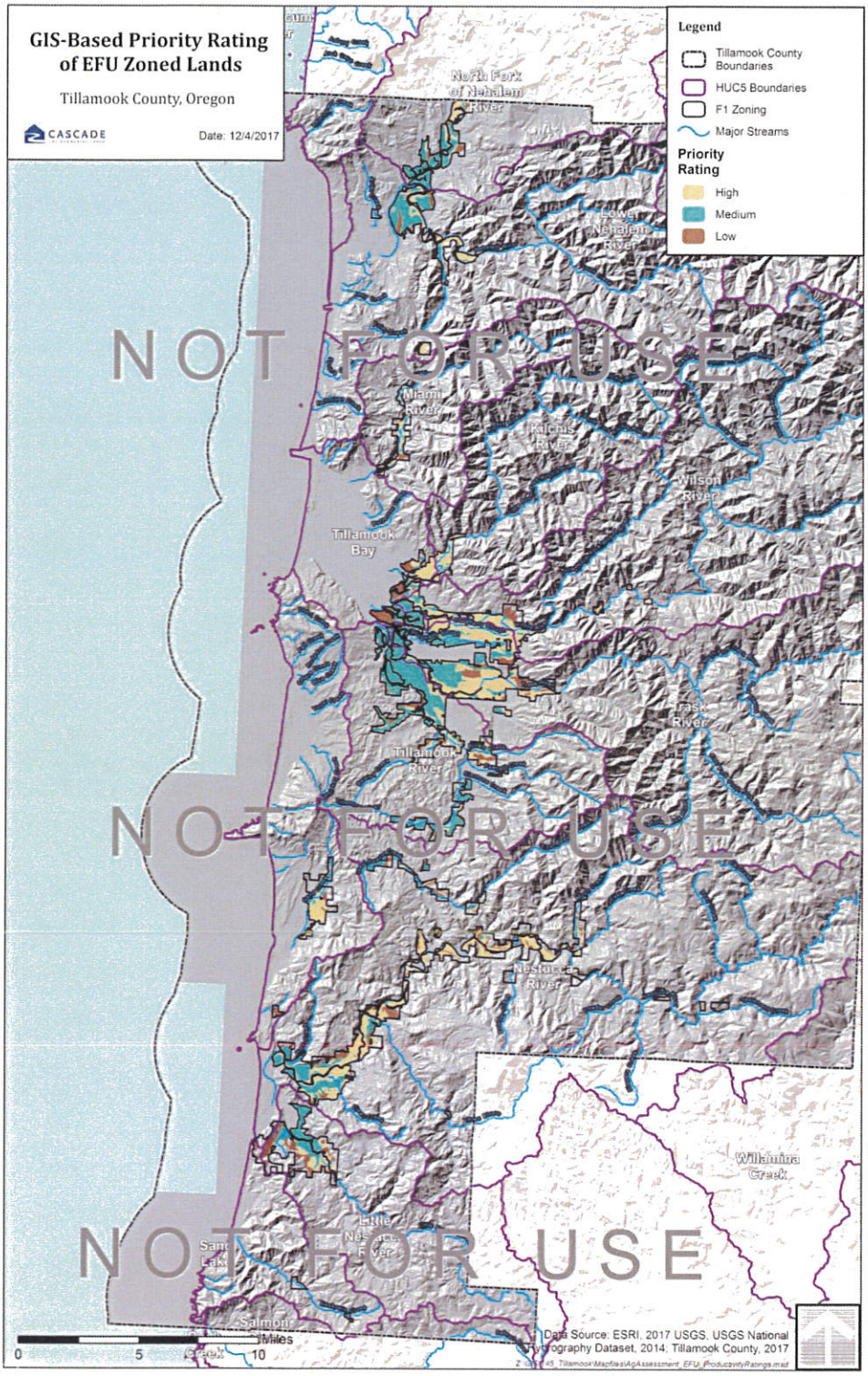
Based on the data presented above and the priority rating system for EFU lands provided in Table 1, this section presents the GIS-based agricultural assessment. As shown in Table 8, the GIS-based priority rating of EFU lands results in approximately two-thirds of EFU lands being high or medium priority, with one-third of EFU lands either not in cropland or rated as low priority croplands. Of the 5,269 acres of potentially low priority croplands, there are 438 acres of land in

drainage districts classified as low, and 534 acres with irrigation water rights that are classified as low. In terms of spatial distribution, there is a concentration of potentially low priority EFU croplands near Tillamook Bay and the remainder are interspersed throughout the EFU lands. Some of the lands identified as low priority near Tillamook Bay may already be in the process of being restored to wetlands through the Southern Flow Corridor Project; however, at this time, the spatial data outlining the extent of that and other restoration projects is not available to overlay with the results of this analysis. As noted in the introduction, feedback from the agricultural community indicates that this GIS-based analysis is not an accurate representation of agricultural land priority in the county for any specific site. While the acreage totals by watershed presented in Table 8 may provide an indication of the quantity of agricultural lands at the watershed level that may be high priority, the data are not at a scale to allow for parcel specific mapping and priority determination. As such, the Figure 1 which maps the GIS-based results for rating the priority of EFU lands in Tillamook County is for illustrative purposes only and is not intended for use.

Table 8. GIS-Based Priority Rating of EFU Lands

Watershed	High	Medium	Low	Total, Cropland	Non-Cropland	Total
Nestucca River	3,733	1,517	1,325	6,576	3,161	9,736
Trask River	3,539	2,456	804	6,800	208	7,008
Tillamook River	1,435	3,188	745	5,368	598	5,966
Little Nestucca River	440	922	584	1,946	1,074	3,020
Tillamook Bay	743	534	567	1,845	104	1,949
Lower Nehalem River	803	935	316	2,055	659	2,714
Sand Lake	527	141	255	923	795	1,718
Wilson River	1,022	309	219	1,549	546	2,095
North Fork of Nehalem River	516	1,064	210	1,791	202	1,993
Miami River	296	58	190	543	288	831
Kilchis River	415	37	54	506	51	556
Total	***13,470***	***11,161***	***5,269***	***29,900***	***7,686***	***37,587***
Proportion EFU	36%	30%	14%	80%	20%	100%
Proportion Cropland	45%	37%	18%	100%	26%	126%

Figure 1: Map of GIS-Based Priority Rating of EFU Lands – NOT FOR USE DUE TO UNRELIABILITY OF SOURCE DATA



As shown in Table 9 and in Figure 1, watersheds with the most acreage of GIS-based low priority EFU cropland are the Nestucca River, Trask River, Tillamook River, Little Nestucca River, and Tillamook Bay watersheds. Watersheds with the highest concentrations of GIS-based low priority EFU cropland (as a proportion of all EFU cropland in that watershed) are the Miami River, Tillamook Bay, Little Nestucca River, and Sand Lake Watersheds.

Table 9. Distribution of GIS-Based Low Priority EFU Croplands

Watershed	Low Priority Cropland (Acres)	% of County Low Priority EFU Croplands	% of All EFU Cropland in Watershed
Nestucca River	1,325	25%	20%
Trask River	804	15%	12%
Tillamook River	745	14%	14%
Little Nestucca River	584	11%	30%
Tillamook Bay	567	11%	31%
Lower Nehalem River	316	6%	15%
Sand Lake	255	5%	28%
Wilson River	219	4%	14%
North Fork of Nehalem River	210	4%	12%
Miami River	190	4%	35%
Kilchis River	54	1%	11%
Total	***5,269***	***100%***	***18%***

As noted above, these are the findings of a desktop GIS-based analysis. However, these findings have been reviewed by the agricultural community and been found to not reflect the on-the-ground reality of which EFU lands are highest priority/most productive. The spatial data relied upon for the assessment are not reliable at the site level; this is largely because site management is more important than soil type in determining the production potential and importance of Tillamook County EFU lands for dairy uses. This is an important finding for future farm and wetland planning projects: generating an accurate county-wide map of priority EFU agricultural lands will be more feasible in areas where the value and quality of agricultural lands is largely determined by soil type, slope, and other factors with excellent and available site-specific GIS data on the county scale.

Due to the lack of reliable, site-specific GIS data on agricultural land productivity/quality, we do not anticipate generating an alternative agricultural assessment priority map. As an alternative to the approach taken herein, in the outreach meeting on September 25, the agricultural community noted several site-specific factors that can help to determine farmland priority level and potential for adverse impacts of nearby agricultural land conversion. First, location is an important factor: location affects the ease of access to the farmland, the types of surrounding land uses (complementary and potentially conflicting), and the potential magnitude of third party impacts from restoration (e.g., conversion of isolated farmlands are likely to have limited third-party impacts that may include hydrological impacts on water table and overland

flooding/erosion that affects access and use of croplands, crop damage from wildlife attracted to the restored area, introduction of invasive species/weeds, and trespassing concerns). While members of the agricultural community noted that "all EFU lands are important" for agriculture, other feedback on the specific factors affecting which EFU lands are prioritized by the agricultural community included: 1) areas protected by drainage infrastructure and levees/tiling should be prioritized (cultural desire not to see one hundred years of work undone), and 2) areas contiguous to other agricultural properties (i.e., wetlands projects should be located on the 'fringes' to limit adverse impacts and minimize disruption of manure management relationships between farms). To supplement the information provided at the meeting with the agricultural community, additional outreach is being conducted with the public and with the agricultural community to collect additional input and information to revise the assessment.

As such, we anticipate that additional input from the agricultural community and the general public will help to define factors that can be evaluated at the site specific level to determine agricultural land priority and potential adverse impacts on adjacent lands that affect production costs or land use patterns. Both of these types of information will help to inform which areas of EFU land may or may not be compatible with restoration.