Soil Phosphorus Study
For
Bureau of Reclamation

Former Schaake Property
1180 Umptanum Road
Ellensburg, WA

Prepared for:

Bureau of Reclamation
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Yakima, WA 98901

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Summary

Soil phosphorus was evaluated in five candidate side channel location areas.

The lowest phosphorus levels occur in the extensive riparian habitat areas riverward of the flood control levee. Represented by side channel 4A and the lower end of side channel 1, these areas will not require extraordinary handling. From a phosphorus impact and management potential, study area 4A is the most suitable of the areas studied.

Samples of pond and channel sediment in areas 1, 2 and 4A have lower phosphorus levels than adjacent soil. This supports a fundamental design goal to utilize these features for side channel placement.

Study areas 3 and 4 have elevated phosphorus due to past use, with the City portion of area 4 more elevated than area 3. In the former lagoon area covering area 3 phosphorus impact can be reduced by removal of surface soil darkened with waste solids. From a phosphorus impact and management potential, area 4 is the least suitable of the areas studied.

Portions of study areas 1 and 2 have elevated phosphorus due to past use, with area 2 having the highest levels within the study area. Side channel 1 avoids phosphorus elevated soil. Side channel 2 would require crossing an area of phosphorus elevated soil near where it connects to side channel 1.

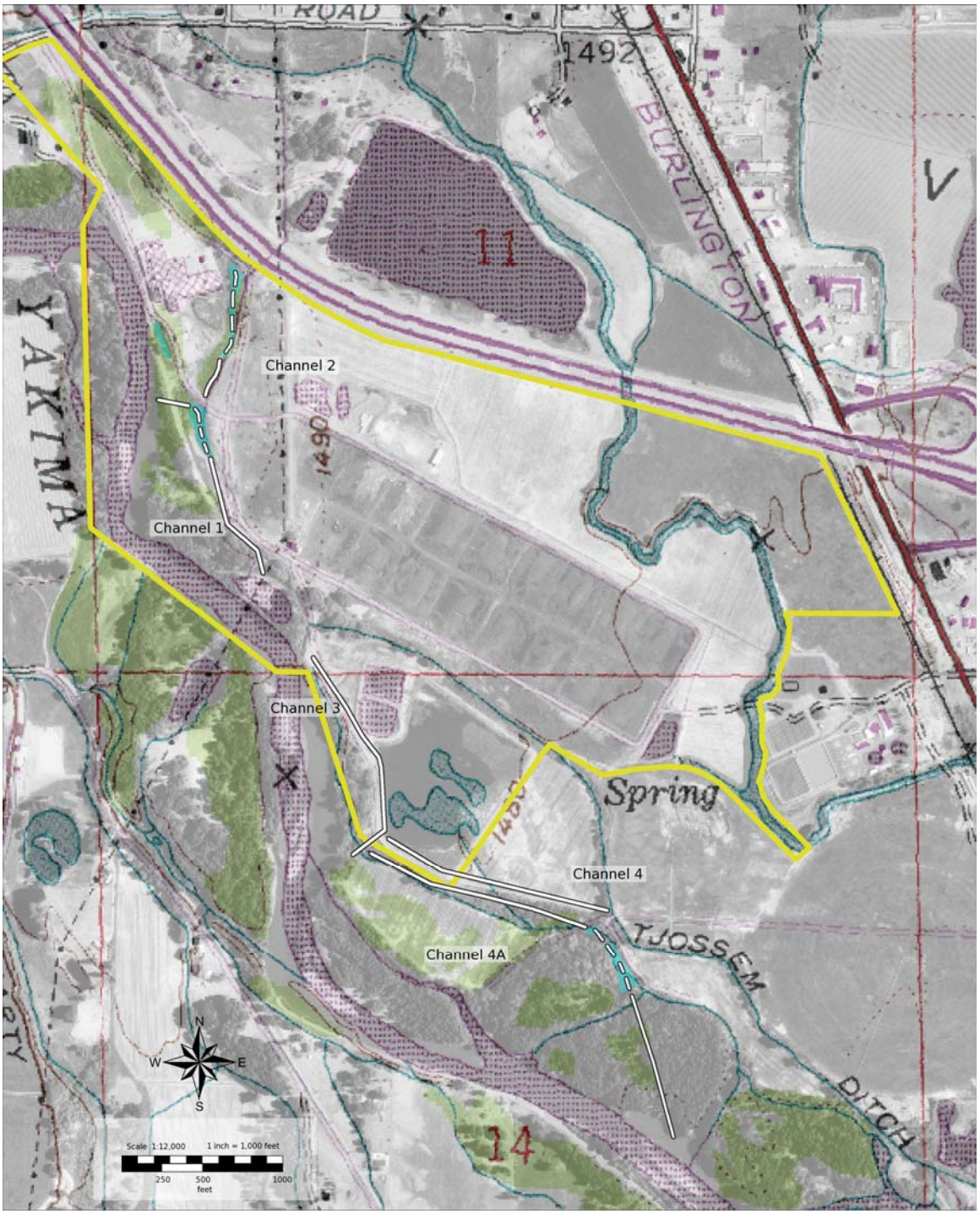
Project Description

Setting

The former Bureau of Reclamation's (Bureau) property is located at 1180 Umptanum Road in Ellensburg, Washington, and lies within the eastern portion of Section 10, the southern half of Section 11 and the northern portion of Section 14 Township 17 North, Range 22 East, WM.

The study area consists of a combination of Bureau property and City of Ellensburg (City) property. The Bureau property includes former cattle feedlot, meat processing, and wastewater handling facilities. The City property consists of riparian habitat and hay ground irrigated by food processing wastewater. The soil phosphorus study area is about 1 mile long and within 1500 feet of the Yakima River.

Site elevation is about 1480 feet. Topography is gently rolling valley bottom land. The site is located in the Ellensburg Basin (Kittitas Valley) in the upper Yakima River Basin of central Washington. The Ellensburg Basin lies within the Columbia Plateau physiographic province.



Map 1: Site Map with Proposed Side Channel Locations

The stratigraphy of the Ellensburg Basin from youngest to oldest consists of alluvium, the Ellensburg Formation, and the Columbia River Basalt Group.

Groundwater flows generally south.[1] Depth to groundwater is shallow, fluctuating about 5 feet per year and may be as little as 1 foot below surface during high water conditions. Subsurface materials consist of alluvial sands and gravels with cobbles.[2]

Surface water is prevalent in the study area and includes irrigation ditches, creeks, ponds and wetlands. Most of the study area is within the 100 year flood plain of the Yakima River.

Background

The Schaake Reach of the Yakima River is being considered for improved rearing habitat for juvenile salmonids.[3] Off channel habitats such as overflow channels, spring brooks, backwaters and disconnected channels are considered critical to the survival of juvenile salmonid populations. This type of habitat provides lower water velocity and increased ratio of bank habitat to center channel habitat.

Removal or relocation of flood control levees is proposed to achieve improved rearing habitat. Depending on the anticipated frequency of of out-of-bank flows following modification of levees, a series of side channels would be constructed. Regular and frequent inundation of these channels will occur. Side channel construction may result in sediment discharge. Previous study demonstrated elevated soil phosphorus.[4] Discharge of sediment-bound phosphorus is a concern. This study provides information on the pattern of elevated soil phosphorus within the areas being considered for side channel placement.

Methods

Soil sampling was conducted in August, 2005. Samples were arranged in parallel transects across the area of candidate side channel installation.

Samples taken from the vicinity of the proposed locations for Channels 1 through 4, and alternate Channel 4A. Some sample locations depressions are ponded. Alternate side channel 4A is immediately south of 4 in riparian habitat. Most of Channel 4 and all of alternate Channel 4A are on City property.

A composite soil sample of the surface six inches was removed from each sample location. Each composite consisted of cores taken at 5' in three directions from sample point center. Phosphorus analysis was performed by Cascade Analytical, Inc., Wenatchee, WA using an HCl and NH_4F extract, commonly referred to as the Bray method.[5]

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1 Landau Associates, 2001
2 ibid
3 Hilldale, 2004
4 Land Profile, 2004
5 Elrashidi, Moustafa A., Selection of an Appropriate Phosphorus Test for Soils, Soil Survey Laboratory, National Soil Survey Center, USDA-NRCS, Retrieved July 14, 2006 from ftp://ftp-

Discussion

Phosphorus

Phosphorus (P) is an essential element for plant growth. Animal waste and food processing wastewater can have a high concentration of P. Within the study area, both of these sources have contributed substantial amounts of P-rich manure and wastewater to the soil.[6]

Nonpoint sources of P, such as surface runoff and subsurface leaching are contributors to eutrophication in freshwater bodies. Phosphorus is lost from land to surface water bodies in sediment-bound and dissolved forms. Dissolved P includes orthophosphate which is readily bioavailable. Sediment-bound P includes P associated with minerals and organic matter. Sediment-bound P, unlike dissolved P, is not readily bioavailable.[7]

The concern in the study area is that side channel construction in P-enriched soil areas could result in the discharge of sediment-bound P. Identifying P enriched areas allows avoidance or mitigation.

Level	Bray P (mg/kg)
Low	<20
Medium	20 – 40
High	40 – 100
Excessive	>100

Table 1: Bray P Interpretation (From Marx, 1999[8])

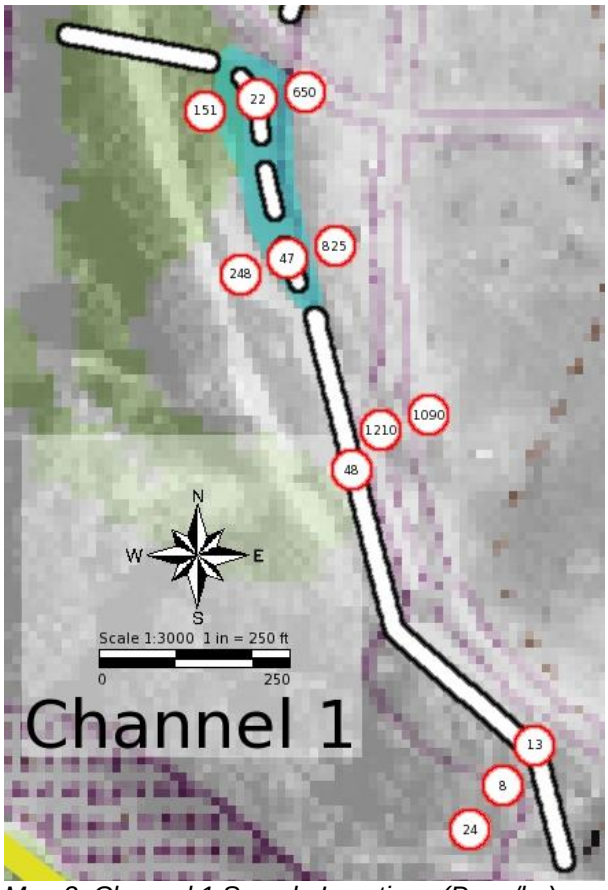
Channel 1 Area

fc.sc.egov.usda.gov/NSSC/Analytical_Soils/phosphor.pdf
Alternate source: http://soils.usda.gov/technical/methods/

6 Land Profile, 2004

7 Elrashidi, Moustafa A., Selection of an Appropriate Phosphorus Test for Soils, Soil Survey Laboratory, National Soil Survey Center, USDA-NRCS, Retrieved July 14, 2006 from ftp://ftp-fc.sc.egov.usda.gov/NSSC/Analytical_Soils/phosphor.pdf
Alternate source: http://soils.usda.gov/technical/methods/

8 E. S. Marx, J. Hart, R. G. Stevens (1999) Soil Test Interpretation Guide. EC 1478. University of Oregon. Retrieved July 18, 2006 from http://extension.oregonstate.edu/catalog/pdf/ec/ec1478.pdf



Map 2: Channel 1 Sample Locations (P mg/kg)

The upper end of Channel 1 connects to the Yakima River. Its lower end connects to the Tjossem ditch access channel. The upper portion of Channel 1 crosses the levee and follows an existing depression that is currently ponded. Below the pond the proposed side channel crosses the levee and follows an existing channel to the Tjossem ditch access channel. Sediment and soil indicate the proposed side channel location has moderate phosphorus levels whereas adjacent soil areas have moderate to extremely high phosphorus levels.

Sediment phosphorus levels in the pond, arranged from N-S, are 22, 47, and 48 mg/kg.

Six samples adjacent to the pond range from 151 to 1210 mg/kg.

Samples taken between the lower end of the proposed side channel and the levee are 13, 8 and 24 mg/kg.

Sediment in the existing channel is 13 mg/kg.

Soil on the bank of the access channel is 8 mg/kg.

Soil south of the access channel is 24 mg/kg.

Channel 2 Area

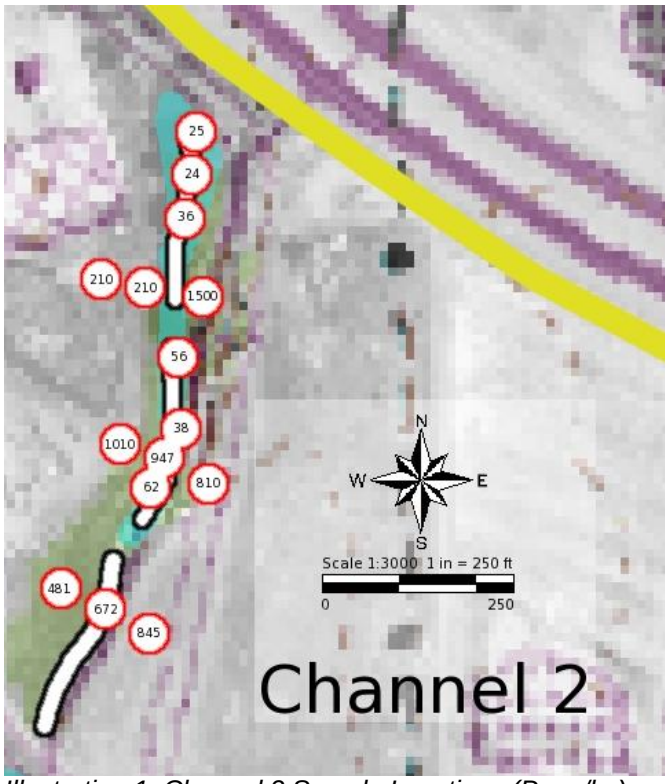


Illustration 1: Channel 2 Sample Locations (P mg/kg)

Proposed side channel 2 extends north from side channel 1 to near the property boundary. It follows an existing depression which is ponded in the north portion.

Sediment and soil indicate the proposed side channel location has moderate to high phosphorus levels whereas adjacent soil areas have high to extremely high phosphorus levels.

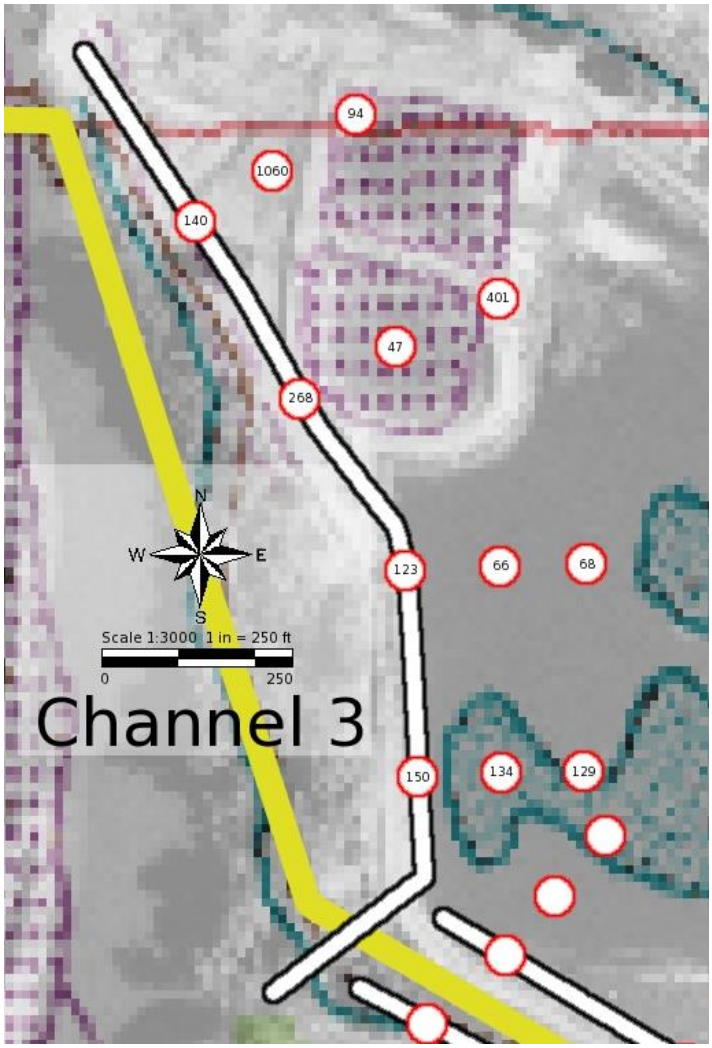
Sediment (pond) phosphorus levels, arranged from N-S, are 25, 24, 36, 56, 38 and 62 mg/kg.

A soil sample taken from the unponded portion of the depression is extremely high at 672 mg/kg. Channel 2 connects to Channel 1 through this area. Organic material was not evident, possibly due to cultivation.

A soil sample from pond bank is extremely high at 947 mg/kg.

Adjacent soil was very high to extremely high, with seven samples ranging from 210 to 1500 mg/kg. Sample with 1500 mg/kg is organic waste solids. Both samples with 210 mg/kg are from below a one-inch layer of organic waste that was excluded from the sample.

Channel 3 Area



Map 3: Channel 3 Sample Locations (P mg/kg)

Channel 3 connects at both ends to the Yakima River. It follows the base of the existing flood control levee. Soil phosphorus levels in 12 samples range from 47 to 1060 mg/kg.

> Soil with 401 and 1060 mg/kg had identifiable waste solids at the time of sampling. This upper portion of the Channel 3 study area is the former of a settling lagoon. The native soil here is light colored and coarse gravelly material. In this area, phosphorus impact can be reduced by removal of finer surface soil material darkened with organic waste solids

Channel 4 Area

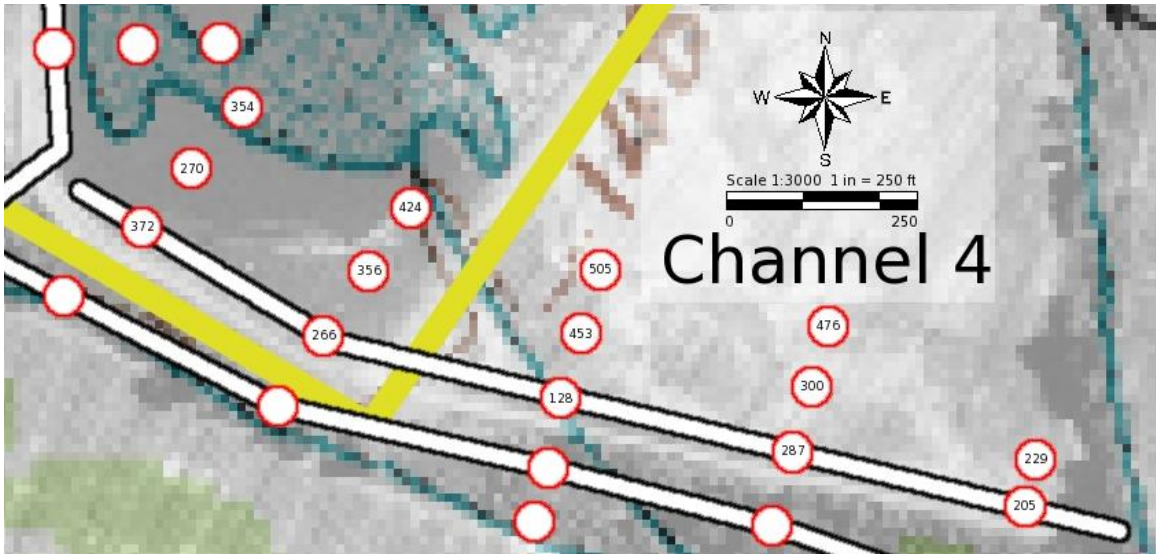
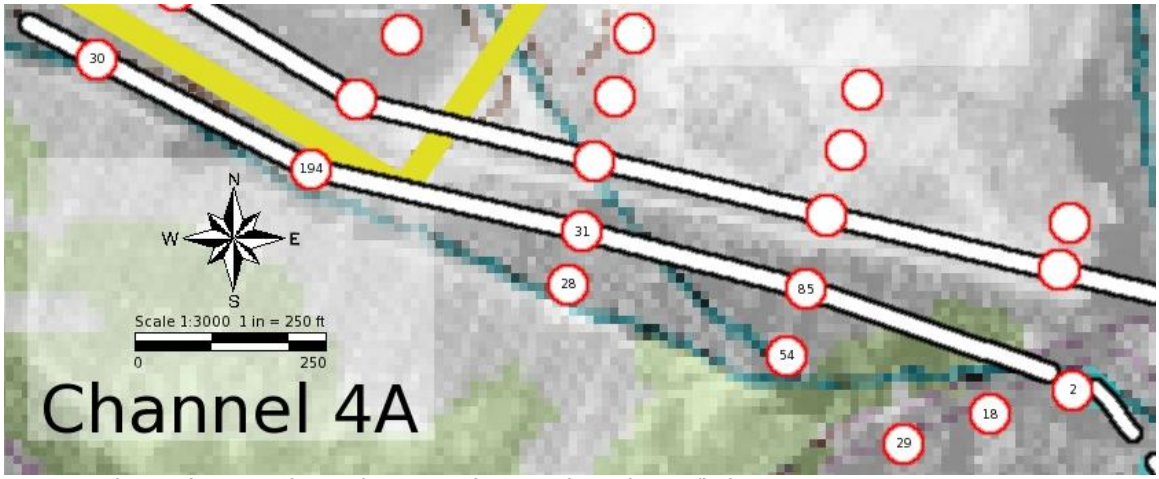


Illustration 2: Channel 4 Sample Locations (P mg/kg)

Channel 4 extends along the north side of the flood control levee, connecting Channel 3 to the Tjossem ditch. This location has very high phosphorus levels. Soil phosphorus levels in 14 samples range from 128 to 505 mg/kg. From a phosphorus impact and management potential, area 4 is the least suitable side channel location of the five areas studied.



Map 4: Channel 4a North Portion Sample Locations (P mg/kg)

Channel 4A Area

Channel 4A is an alternate location to proposed side channel 4 connects extends from channel 3 to the Yakima River.

The north portion, depicted in Map 4, extends along a depression along the south side of the flood control levee.

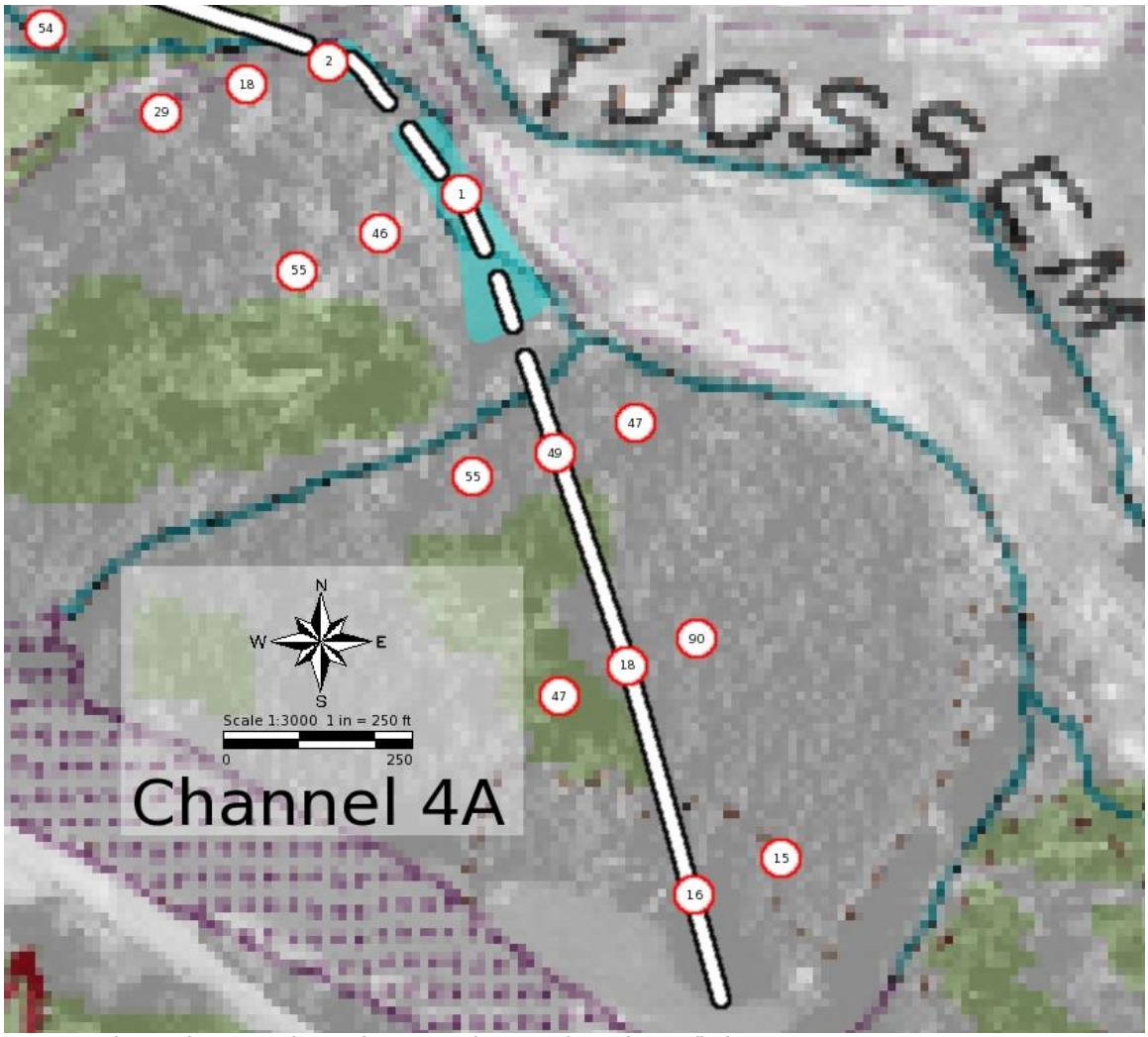
The south portion, depicted in Map 5, follows a series of ponded depressions and proceeds to join the Yakima River.

Phosphorus in the north portion (six samples) is moderate to very high, ranging from 28 to 194 mg/kg.

Sediment phosphorus in the south portion is very low (two samples): 1 and 2 mg/kg.

Phosphorus was low to high in soil (12 samples): 15 to 55 mg/kg.

From a phosphorus impact and management potential, study area 4A is the most suitable of the areas studied.



Map 5: Channel 4a South Portion Sample Locations (P mg/kg)