Soil and Site Study
For
Bureau of Reclamation

Former Schaake Property
1180 Umptanum Road
Ellensburg, WA

Prepared for:

Bureau of Reclamation
1917 Marsh Rd
Yakima, WA 98901

Prepared by:

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Presented September 29, 2004

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Project Description

Setting

The 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 about 285 acres and includes a former cattle feedlot, meat processing facilities and hay ground irrigated by food processing wastewater. The property is generally bounded by the Yakima River along the west, I-90 and Umptanum Road to the north, BNSF railroad to the east and City of Ellensburg property to the south.

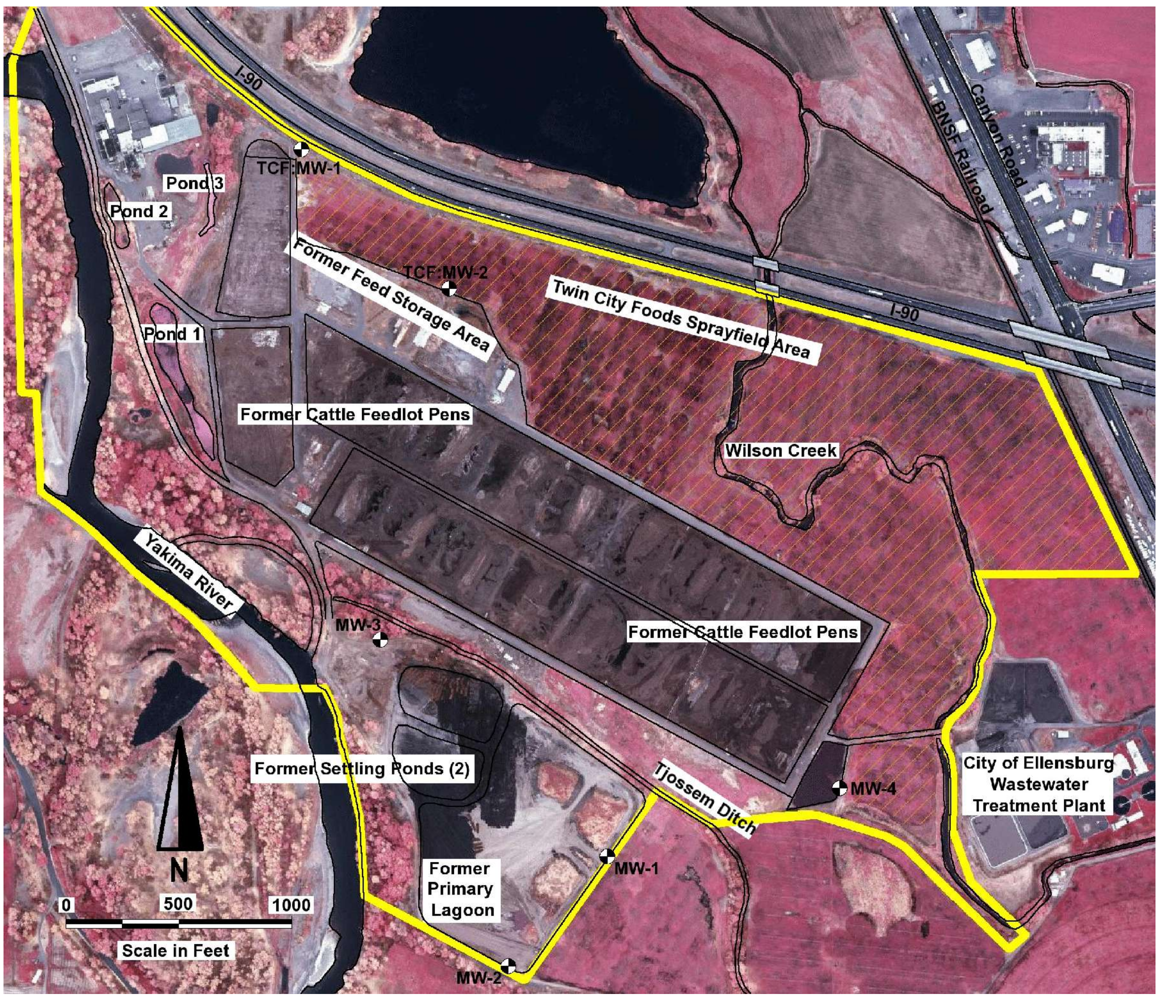

Figure 1 Site Map

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. The stratigraphy of the Ellensburg Basin from youngest to oldest consists of alluvium, the Ellensburg Formation, and the Columbia River Basalt Group. Drilling and test pits logs indicate that the subsurface materials below the feedlot property, to a depth of at least 20 feet, consist of alluvial sands and gravels with cobbles.[1]

Based on water level measurements from monitoring wells on the property, the inferred direction of groundwater flow fluctuates from south to east with a gradient ranging from 0.003 to 0.010 ft/ft. Depth to groundwater is shallow, fluctuates about 5 feet per year and may be as little as 1 foot below surface during high water conditions.[2]

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

Annual precipitation is 9 to 10 inches. The growing season begins about March 28th and ends about October 14th. Significant crop water demand (>0.03 inches per day) begins May 13th and ends September 30th. Average growing season evapotranspiration potential (ETp) is 39.0 inches. Net crop water demand (ETo) for a grass cover is 31.5 inches.

Proposed Use

The Schaake Reach of the Yakima River is being considered for improved rearing habitat for juvenile salmonids. 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, which provides cover from predation and possibly an increased abundance of food.

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 side channel or series of side channels may be constructed in such a manner that regular and frequent inundation of these channels will occur. The Bureau of Reclamation is working to develop a conceptual understanding of the potential behavior of the river under these circumstances.

Needs and Concerns

The Bureau of Reclamation needs to understand existing site soil chemistry as it relates to planned use of the site for channels, wetlands and salmonid habitat.

1 Landau Associates, 2001
2 ibid

The primary concern is that the proposed use will affect surface water constituents of concern to fish habitat potential. An associated concern is understanding how the proposed use will affect surface water constituents of concern to beneficial use of the Yakima River other than fish habitat.

Twin City Foods Sprayfield

Twin City Foods operates a 230 acre sprayfield under State Waste Discharge Permit ST5507. 74 acres (Twin City Foods Fields 2 through 6) are on land now owned by Bureau of Reclamation. The crop grown is grass hay. The irrigation system on the Bureau property is solid set handlines.

The Twin City Foods spray irrigation system was installed in 1967. Wastewater derives from the processing of peas, corn and carrots. Wastewater flow is about 1.1 million gallons per day during operations with a total annual flow of 130 to 150 million gallons per year, commencing in August. 10 to 40 million gallons of supplemental irrigation water is applied during the growing season months prior to processing.

Recommendations related to Twin City Foods are presented on page 16.

Records Review – Twin City Foods

Methods

File records were requested from Department of Ecology and Twin City Foods. Ecology records were reviewed on December 8, 18 and 22, 2003. Copies were requested of relevant materials.

Summary of Records

Sprayfield operations at Twin City Foods

State Waste discharge permit ST-5507 (1996)
1998 Annual Soil, Crop and Irrigation Management Plan (Land Profile)
1999 - 2002 Annual Crop and Irrigation Mtg Plans (Royal Consulting)
Engineering Report (1999)
State Waste discharge permit ST-5507 (2001)
Quality Assurance Project Plan Update (October , 2001)
Operation and Maintenance Plan Update (January, 2002)
Monthly Discharge Monitoring Reports (DMD) (2002)
Engineering Report – Phase I Draft AKART Analysis (January 2003)
Notice of Violation No. DE 03WQCR-5808 (October 15, 2003)
Response to NOV DE 03WQCR-5808 (November, 2003)

Findings

Application rates with surface waters are less than crop demand.

Wastewater derived from food processing operations is applied in the late summer and fall months. Application rates with wastewater are greater than crop demand. Wastewater applied in late October and November is unnecessary for crop production.

State Waste discharge permit ST-5507 prohibits runoff from the sprayfield and prohibits methods that cause “long-term anaerobic conditions in the soil”, “ponding of wastewater and produce objectionable odors”, and that cause “leaching losses of constituents of concern”. Twin City Foods ability to meet these prohibitions is progressing.

Annual Soil, Crop and Irrigation plans indicate that application of wastewater nitrogen is approximates crop removal but that application of wastewater potassium and phosphorus is greater than crop removal.

Site Visit– Twin City Foods

Methods

Soil Sampling was conducted on April 1, 2004. The soil profile was sampled in one foot increments with subsequent analysis by Cascade Analytical, Inc., Wenatchee,WA. Analysis involved standard methods applicable to agricultural determinations. Phosphorus analysis was performed on a sodium bicarbonate extract, commonly referred to as the Olson Method.

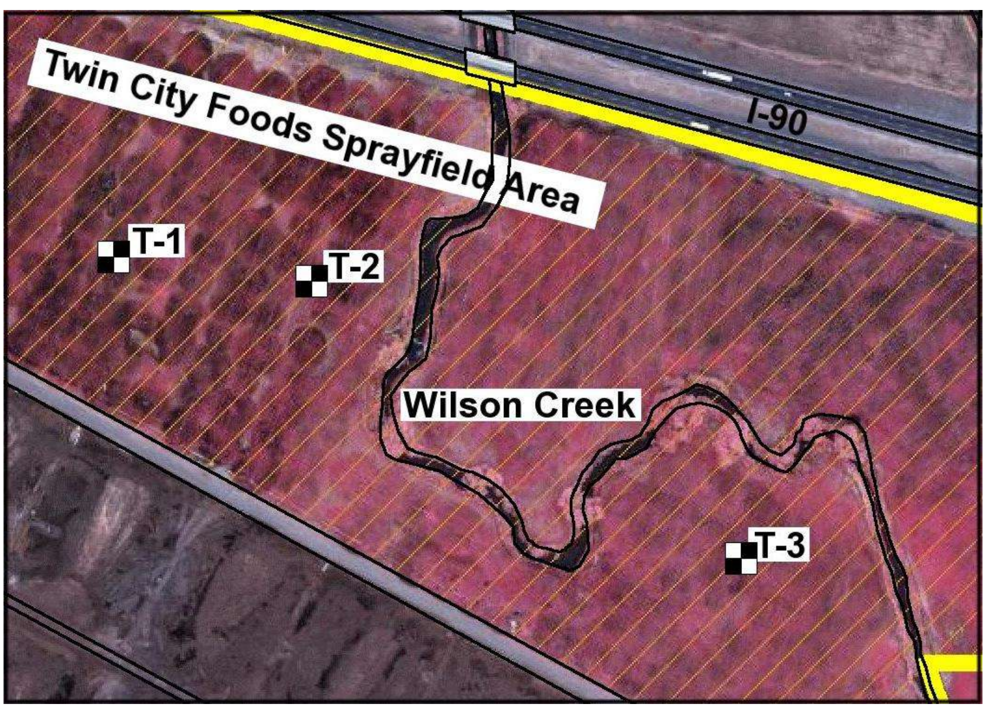

Figure 2 Sample Site Locations for T-1, T-2 and T-3

Samples were taken from the deepest portions of the pit first ahead of rising water levels and caving gravels. Pits were left open long enough to allow water in pit to equalize with the water table, typically about half an hour.

Observations

In the Twin City Foods irrigated area, sample site T1 was located in a cropped swale, T2 and T3 were located in cropped areas with normal conditions.

The grass hay crop had died at T1,apparently due to prolonged anaerobic conditions at the soil surface. The likely cause of these conditions is excess wastewater, as discussed on page 11. Gley,[3] an anaerobic soil condition, was observed at the surface and confirmed with dipyridil solution.[4] Gravel and water table were present below 36".

Figure 3 Site T-1 Note absence of growing crop.

Sites T2 and T3 were 18 and 44 inches, respectively, to water table with 14 to 36 inches of fine sandy loam over gravel.

3 Gleying is a soil term applied to the gray, blue, purple or green soils that have been waterlogged for prolonged periods of time. Anaerobic microbes flourish in the absence of air, reducing iron and manganese minerals. The chemical reduction of iron and manganese produces the characteristic gley colors.

4 Dipyridil turns bright red in the presence of ferrous iron (Fe++), a reduced form of iron.

T-3 had gley colors below the water table Photos of T2 and T3 to the right.

Figure 4 Sample Site T-2

Lab Data

Soil Data TCF

Depth	Analyte	Units	T1	T2	T3	Normal Range	Note
00-12 inches	Potassium (K)	ppm	606	690	401	120 – 200	Elevated K produces low Mg grass hay, a concern for tetany.
	Calcium (Ca)	ppm	2140	2900	2790	600 – 4000	
	Magnesium (Mg)	ppm	814	792	918	90 – 480	
	Sodium (Na)	ppm	193	116	137	50 – 500	
	Sum of Exchangeable Bases	meq/100g	19.8	23.3	23.1	15 - 25	
	Cation Exchange Capacity	meq/100g	28.2	24.4	29.8	15 – 25	
	pH		6.0	6.9	6.4	6.0 – 7.0	
	Lime Requirement	Tons/A	6.7	0.0	0.0	0 – 10	
	Soluble Salts	mmho/cm	1.10	0.85	0.81	0 – 1	
	Phosphorus (P)	ppm	68.7	162.0	30.8	8 – 20	Elevated P is a concern for surface water quality
	Boron (B)	ppm	0.52	0.68	0.40	0.5 – 1.0	
	Sulfate-S (SO_4-S)	ppm	13	13	10	6 – 20	
	Organic Matter		6.2%	6.2%	5.2%	4 – 6%	
	Nitrate-N (NO_3-N)	ppm	5.2	52.2	40.7	5 – 15	
	Anmmonia-N (NH_3-N)	ppm	85.0	11.0	7.7	2 – 15	High NH_3 with low NO_3 and high Mn indicates anaerobic chemistry
	Total Kjeldahl N (TKN)	ppm	2970	3000	2120	2000 – 3500	
	Zinc (Zn)	ppm	2.8	3.4	2.8	1 – 10	
	Iron (Fe)	ppm	610	186	153	5 – 30	
	Copper (Cu)	ppm	6.6	3.4	3.8	0.2 – 2.0	
	Manganese (Mn)	ppm	108.0	3.6	8.0	2 – 10	
12-24 inches	pH		7.5	7.4	6.7	6.0 – 7.0	
	Nitrate-N (NO_3-N)	ppm	31.5	16.3	30.6	1 – 10	
	Anmmonia-N (NH_3-N)	ppm	10.0	2.8	41.0	0 – 4	
	Phosphorus (P)	ppm	52.3	6.0	30.6	0 – 2	Elevated subsoil P more likely with anaerobic chemistry
24-36 inches	pH		6.6	7.2	7.0	6.3 – 7.3	
	Nitrate-N (NO_3-N)	ppm	4.2	75.8	14.5	0 – 5	
	Anmmonia-N (NH_3-N)	ppm	6.3	4.0	7.4	0 – 4	

Discussion – Twin City Foods

Current wastewater loading is within sprayfield treatment capacity for treating applied nitrogen.

Current wastewater loading exceeds sprayfield treatment capacity to prevent runoff, control odors, prevent long-term anaerobic conditions in the soil, avoid ponding of wastewater and avoid leaching losses of constituents of concern. All of these exceedances are violations of the requirements of State Waste Discharge Permit ST-5507.

Current wastewater loading exceeds sprayfield treatment capacity for treating phosphorus and potassium. While limiting these constituents is not a permit requirement, they are a potential source of liability to the property owner and need to be addressed.

Wastewater is produced late in the growing season subsequent to harvest and processing. Supplemental irrigation water prior to the processing season, is insufficient to achieve optimum crop production. This limits sprayfield treatment capacity for applied nutrients. As a consequence, phosphorus and potassium are building up in the soil.

Wastewater is produced late in the growing season in excess of crop irrigation needs. Poor application uniformity results in prolonged surface saturation as well as substantial discharges of constituents of concern to groundwater. Because the wastewater has elevated oxygen demanding constituents (examples are plant-derived sugars and proteins) the saturated soils are prone to forming anaerobic conditions. As a consequence of anaerobic soil conditions, crop production is impaired and, under extreme anaerobic conditions, eliminated. An additional concern is that anaerobic soil chemistry is less protective of groundwater quality than aerobic soil chemistry.

The elevated level of oxygen demanding constituents, along with it's seasonal distribution pattern, are the primary reasons why this wastewater cannot easily be diverted to a traditional treatment system like the City of Ellensburg wastewater treatment plant. The fact that Twin City Foods wastewater is not domestic waste water means that land treatment and subsequent discharge to groundwater is available as a lower cost option to mechanical aeration, engineered treatment and subsequent discharge to surface waters. However, land application is only feasible where sufficient land is available to match treatment demands with treatment capacity.

Nitrogen

Nitrate nitrogen of 75.8 ppm in the third foot of sample T-2 is noteworthy. Annual reporting by Twin City Foods indicates that nitrogen application is appropriate for the level of crop removal. Elevated subsoil nitrate indicates that nonuniformity of application is an issue.

Phosphorus

Twin City Foods has reported to Washington Department of Ecology that soil phosphorus levels are elevated due to wastewater application in excess of crop removal. Recent soil sampling results (April, 2004) show soil phosphorus levels (bicarbonate extract) between 30 and 162 ppm. Levels of 8 to 20 are considered normal. Levels above 100 ppm are associated with phosphorus induced zinc deficiency in alfalfa and copper deficiency in fruit crops. On the other hand, grass hay crops tolerate in excess of 1000 ppm.

Elevated soil phosphorus is a concern in the Yakima River basin primarily because it is associated with degradation of surface water quality. Levels above 60 ppm are associated with dramatically increased potential to impact water quality. Elevated phosphorus levels in the Yakima River are considered to be responsible for increasing algal growth and eutrophication, problems which are damaging to fish habitat.

Leaching losses of available phosphorus are also more pronounced above 60 ppm. Anaerobic soil conditions, induced by wastewater ponding at the site, also promote leaching losses.

Excess phosphorus is also subject to fixation, a soil process that normally prevents leaching losses. Subsoil samples from 1997 and 1998 show elevated soil phosphorus, an indication that additional phosphorus fixation capacity is not available. Consequently, future additions of phosphorus are likely to result in losses to groundwater and subsequent transport to the Yakima River.

Leaching appears to account for the removal of surface soil phosphorus reported as above 1000 ppm in 1997 and 1998 to below 100 ppm in 2000. A similar magnitude of removal was evident from the subsoil.

Depending on the year, Twin City Foods applies 20 to 120 lbs per acre more phosphorus than the crop removes and discharges about 12 inches of applied water to groundwater. This is the equivalent to between 7 and 45 mg/L phosphorus in 230 acre feet (75 million gallons) discharged to groundwater. This compares to a reasonable surface water quality limit of 0.1 mg/L for receiving waters.

The remedy is to increase crop removal of phosphorus and decrease applied phosphorus to maintain soil phosphorus levels below 60 ppm. This remedy appears to be beyond the ability of Twin City Foods to accomplish immediately. No other remedy is apparent.

Potassium

Recent soil sampling results (April, 2004) show soil potassium levels levels between 401 and 690 ppm when levels of 120 to 200 are considered normal. Twin City Foods has reported to Washington Department of Ecology that soil potassium levels are elevated due to wastewater application in excess of crop removal.

Elevated soil potassium is a concern because it is associated with reduced soil infiltration and poor forage quality.

Soil infiltration issues are normally associated with elevated sodium. Potassium is chemically similar to sodium in that both are monovalent ions that promote a loss of soil structure when they are present in excess. Potassium is a larger ion, and because of this, its effect on infiltration is less pronounced.

Winter tetany is a life threatening nutrient imbalance in animals fed poor quality hay. Lactating animals, young animals and animals coming off an inadequate feeding regime are particularly susceptible. Grass hay grown on soils with excessive potassium is one of several causes of winter tetany. This has been specifically associated in the literature as a concern with waste application of manure.

The most effective tool to prevent winter tetany in hay grown on high potassium soils is to grow a legume (like alfalfa) or a grass-legume mix and avoid growing a grass-only hay. Legumes, however, are prone to phosphorus induced zinc deficiency, an issue at this site. They are also intolerant to anaerobic soil conditions and prolonged saturation making legumes a poor alternative for the site.

The next most effective tool to prevent winter tetany is magnesium feed supplements. Providing the feed user with hay analysis for calcium, magnesium and potassium would enable them to determine if magnesium feed supplements are necessary.

The remedy is to increase crop removal of potassium and decrease applied potassium so that they are in balance. This remedy appears to be beyond the ability of Twin City Foods to accomplish. No remedy to reverse continuing potassium buildup at the sprayfield is apparent. Sprayfield operations are not sustainable.

Anaerobic conditions.

Anaerobic soil conditions were observed (April, 2004) at site T-1. This site was chosen because it was representative of a pattern of poor growth observed on aerial photos and confirmed to be in swale bottoms throughout the sprayfield. The patterned area, while distinctive, accounted for between 1% and 2% of the sprayfield portion of the study area at the time of the visit.

Anaerobic conditions observed at T-1 were due to wastewater application of oxygen demanding constituents in excess of sprayfield treatment capacity. The anaerobic conditions observed appeared to have persisted from the previous fall despite limited irrigation in the immediately preceding months. This persistence is an indication that anaerobic wastewater ponded on the surface for a significant period of time.

Anaerobic conditions are a concern because of odor, groundwater impacts and impaired wastewater treatment capacity.

Figure 5 Site T-1. Note gley soil conditions

Anaerobic Odors

Anaerobic odors are distinguished by their unpleasantness and by their ability to attach and persist on the person after leaving the source. Common terms used to describe anaerobic wastewater odors are “rotten vegetation” and “putrid”. Common terms used to describe anaerobic soil odors are “rotten eggs” and “sour”. The remedy is to prevent ponding of high strength watewater.

Anaerobic Soils and Groundwater Protection

Groundwater protection is best served by aerobic soil. Anaerobic soil chemistry causes many ions and compounds to become more soluble. Permit conditions require the prevention of anaerobic conditions. The discharge of oxygen demanding constituents to groundwater, as measured by Biochemical Oxygen Demand (BOD), is a specific concern because it causes anaerobic groundwater. It is a concern for BOD contamination that drove WDOE's Notice of Violation No. DE 03WQCR-5808 (October 15, 2003). BOD contamination of groundwater is preventable in that it is due to ponding and that ponding can be eliminated with established irrigation practices.

Anaerobic Impairment of Treatment Capacity

Forage crops are less productive in waterlogged, anaerobic soils. Prolonged anaerobic conditions, evident in some swales, will eliminate the crop.

Anaerobic Soil Prevention

A combination of management tools are available to prevent anaerobic conditions in the sprayfield.

The primary tool to prevent anaerobic conditions in this sprayfield is to increase application uniformity. Patterns of crop vigor around each sprinkler indicate that discharge pressure at the nozzle has been below the manufacturer's specified operating range. Crop vigor decreases with distance from the mainline indicating that pump discharge pressure has been insufficient to prevent excessive pressure drop down the individual laterals. This pattern of low discharge pressure may be attributable to excessive nozzle size due to wear or by choice in an effort to prevent clogging.

Managing application uniformity is key because runoff occurs first in areas that are receiving higher than average application rates. The elevated loading of oxygen demanding constituents exacerbates the problem of ponding and anaerobic soil formation. In the experience of Land Profile Inc., poor application uniformity is the single most common cause of unintended anaerobic conditions in wastewater sprayfields. Achieving uniformity usually requires judicious screening of the wastewater prior to discharge.

Runoff can occur even in highly uniform systems when application rates exceed soil infiltration rates. For example, under a 100% uniform center pivot system, runoff is most likely to occur under the far end of the pivot where the application volume is applied in the shortest period of time. Reducing instantaneous application rates to below nominal soil infiltration rate is effective under these circumstances.

Runoff can occur even when instantaneous application rates are less than nominal soil infiltration rates because a saturated soil has a reduced infiltration rate. Decreasing irrigation set time prevents runoff under these circumstances.

If runoff continues to be an issue after the aforementioned uniformity and management improvements, it will be because application volume is greater than percolation plus evapotranspiration volumes. Under these circumstances, wastewater in excess of hydraulic capacity should be withheld from land application.

Recommendations – Twin City Foods

Land Profile,Inc. recommends that current wastewater application be suspended as soon as is practical in order to prevent further accumulation of soil phosphorus and potassium and to prevent further discharge of phosphorus and oxygen demanding constituents to groundwater.

Land Profile, Inc. recommends that Twin City Foods be requested to provide information on soils (historical soil test values and sample locations from within the study area), harvested crop (including tissue analysis for N,P, K, Ca, and Mg), irrigation system operational measurements (flow, pressure, application pattern) sufficient to evaluate the observations and conclusions presented in this study.

Land Profile, Inc. recommends that Twin City Foods be requested to propose a wastewater land treatment design and sprayfield management strategy that would remediate the sprayfield portion of the site and prevent future discharge of phosphorus and oxygen demanding constituents to groundwater.

Land Profile, Inc. recommends the following wastewater management approaches to remediate the sprayfield area.

To improve yields, increase treatment capacity and to prevent ponding at the end of the growing season, excess wastewater should be stored and carried over into the next year to be applied during the summer months which currently experience significant deficit irrigation.

To manage elevated soil phosphorus, the sprayfield area should be irrigated and cropped but wastewater with significant phosphorus content should be withheld from the site until available soil phosphorus levels are below 60 ppm. Current levels appear to average 88 ppm. Depending on soil phosphorous interactions and effective rooting depth, this should take about 61 tons of hay (88% moisture) with applied phosphorus eliminated.

To manage elevated soil potassium, the sprayfield area should be irrigated and cropped to alfalfa or an orchard grass – alfalfa mix. Potassium applied should be less than crop demand for the foreseeable future.

To prevent anaerobic conditions, solids should be screened to the point that nozzle pressure can be maintained within manufacturer's performance specifications, with a discharge radius no less than sprinkler spacing down the laterals. Pressure loss down the lateral should be less than 20%.

Figure 6 Site T-1. Note gley soil conditions

Schaake Portion of Property

Site Activity

Past Use

Cattle slaughter and processing operations began in 1936. A rendering plant was constructed 1945. A new slaughtering and packing plant was constructed adjacent to the rendering plant in 1962.

The feedlot operation was established in the early 1960s and covered about 100 acres, of which about 60 acres were pens. The cattle holding area was divided into 24 unpaved and uncovered pens. The feedlot typically held 4000 slaughter cattle in the winter and up to 8000 feeder cattle during the summer.

Additions to the packing plant, including a cold-storage warehouse and office were added in the 1970s. Historically, the beef processing plant discharged 400,000 gallons per day (gpd).

Use of the lagoons south of the cattle feedlot pens ended in April, 1999. Cattle feeding operations ceased August 15, 1999.

Feedlot operations were protected from river flooding by levees constructed by the US Army Corps of Engineers. These levees are designated as Local Levees, not Authorized Levees,and do not offer 100-year flood protection.

Current Use

Structures associated with the Schaake operation have been removed. Lagoon contents and lagoon contents have been removed. All but about 6 inches of manure in the cattle feedlot pen area have been removed.

Proposed Use

The Schaake Reach of the Yakima River is being considered for improved rearing habitat for juvenile salmonids. 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, which provides cover from predation and possibly an increased abundance of food.

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 side channel or series of side channels may have to be constructed in such a manner that regular and frequent inundation of these channels will occur. The Bureau of Reclamation is working to develop a conceptual understanding of the potential behavior of the river under these circumstances.

Needs and Concerns

- Need to understand existing site soil chemistry as it relates to planned use for channels, wetlands and salmonid habitat.
- Concern that proposed use will affect surface water constituents of concern to fish habitat potential.

- Concern that proposed use will affect surface water constituents of concern to beneficial use of the Yakima River, other than fish habitat.
- Concern that proposed use will affect ground water constituents of concern to the local community.

Records Review - Schaake

Methods

File records were requested from Department of Ecology and reviewed on December 8, 18 and 22, 2003. Copies were requested of relevant materials.

Summary of Records

State Waste Discharge permit ST 9098 application (1994)
NPDES Permit No. WA 0522-1 and Fact Sheet (WDOE, 1997)
Manure Management Plan (Soil test Farm Consultants, 1998)
Hydrogeologic Report (Landau Associates – September 15, 1999)
Site Operations Closure Plan (September 15, 1999)
Voluntary Cleanup Action Reports (Landau Associates, 2001)

Findings

Cattle slaughter and processing operations began in 1936. A rendering plant was constructed 1945. A new slaughtering and packing plant was constructed adjacent to the rendering plant in 1962.

A 1 acre lagoon was present to the south side of the packing plant. It collected stormwater and wastewater. Located immediately south of the pond labeled Pond 3 on the site map, it is referred to in reports as the Packing Plant Lagoon or the Plant Pond.

Additional unlined lagoons were built in the early 1970s to hold and allow percolation of wastewater discharges from slaughtering and rendering operations. Construction included lagoons south of the cattle feedlot pens: a main lagoon about 13 acres in area and two adjoining settling lagoons about 1 acre each. Process wastewater discharge from the plant to the lagoons and subsequently to groundwater was permitted under State Waste Discharge permit ST 9098. Discharge of cattle feedlot pens storm water was not covered and NPDES Permit WA-005222-1 was issued in 1997 to cover all discharges other than those to the Plant Pond.

In 1998 permitted feeding, slaughter and packing operations at the site were discontinued.[5]

As part of the decommissioning process, Schaake performed an environmental

5 Landau Associates, 2001. It is unclear when significant slaughter operations actually ended – by one account it was in the 1980's.

site assessment (ESA) “to evaluate environmental conditions that could require attention.”

A site operations closure plan normally would have been proposed and approved prior to closure in order to satisfy NPDES permit requirements. It is apparent that what occurred instead at this site was that site operations closure elements were identified and discussed with WDOE, but that site operations closure proceeded without the benefit of a formal permit process. However, informal discussions with WDOE personnel indicate that needed closure operations appear to have been performed adequately. Lagoon structures were dismantled with significant lagoon contents and feed lot manure removed from the site.

Investigations in support of the environmental site assessment indicated the presence of contamination by metals and total petroleum hydrocarbons (TPH) in lagoon sediments, with TPH contamination being the most extensive. Levels of TPH as diesel was up to 8,950 ppm and as oil up to 20,200 ppm in the Plant Pond sediments. Cleanup standards for TPH are as low as 200 ppm, depending on site controls. Further investigation delineated the extent and degree of contamination. Groundwater contamination was determined to be below required cleanup levels. Voluntary cleanup action of lagoon sediment proceeded to completion and was formally accepted by WDOE.

Site Visit - Schaake

Suspected Petroleum Contamination

Methods

Sampling was conducted on May 24th, 2004. Sample location was about 100 feet SW of monitoring well (MW1). A single soil sample to 3 inches was taken at the point of highest apparent concentration. Total Petroleum Hydrocarbon analysis was conducted by Severn Trent Laboratories, Inc. (STL), Tacoma, WA. Samples were prepared and shipped

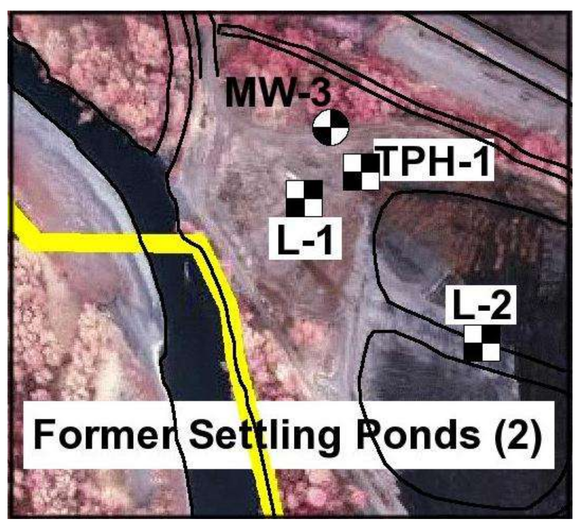

Figure 7 Sample Location TPH-1

Observations

Candidate petroleum contaminated soil at the north end of the main lagoon area was sampled on March 24th, 2004 in an area where an oily-appearing material was observed. Affected area was about 150 square feet. The substance of concern was up to 0.2 inches thick of a brown to gray translucent highly viscous substance. No point of origin or pattern of spill, run and fill was observed. The material of concern had no detectable odor.

Lab Data

APR-07-2004 WED 01:33 PM STL_SEATTLE FAX NO. 2539225047 P. 02

STL Seattle

Client Name	Land Profile Inc.
Client ID:	BLACK OILY SOIL(NT NPDES SED-3 SAMPLE)
Lab ID:	120249-01
Date Received:	3/26/2004
Date Prepared:	4/1/2004
Date Analyzed:	4/1/2004
% Solids	65.43
Dilution Factor	1

Diesel and Motor Oil by NWTPH-Dx Modified with Silica Gel Cleanup

Surrogate	% Recovery	Flags	Recovery Limits Low	Recovery Limits High
o-terphenyl	77.7		50	150

Sample results are on a dry weight basis.

Analyte	Result (mg/kg)	PQL	MRL	Flags
#2 Diesel	74.5	35.5	17.8	X2
Motor Oil	298	71.1	35.5	X2

Figure 8 Original Results

Depth	Analyte	Units	Results	Cleanup Level
00-03 inches	TPH (diesel)	ppm	74.5	200
	TPH (motor oil)	ppm	298	200

Table 2 Total Petroleum Hydrocarbon Results for Sample Site TPH-1

Findings - Suspected Petroleum Contamination

The lab result indicates a level of petroleum contamination below cleanup standards. On discussion with the lab, this is likely a false positive. Note the X2 Flag for the results (see Figure 8 Original Results): the material did not fit the expected characteristics of petroleum.

With the lab confirming the field observation that the material did not appear to be consistent with petroleum hydrocarbons, it is reasonable to conclude that petroleum hydrocarbons are not present or, if petroleum hydrocarbons are present, they are below a level of concern. No further action is warranted.

Schaake - Former Lagoons

Methods - Former Lagoons

Soil Sampling was conducted on 4/1/2004. The soil profile was sampled in one foot increments with subsequent analysis by Cascade Analytical, Inc., Wenatchee,WA. Analysis involved standard methods applicable to agricultural determinations. Phosphorus analysis was performed on a sodium bicarbonate extract, commonly referred to as the Olson Method.

Samples were taken from the deepest portions of the pit first ahead of rising water levels and caving gravels. Pits were left open long enough to allow water in pit to equalize with the water table, typically about half an hour.

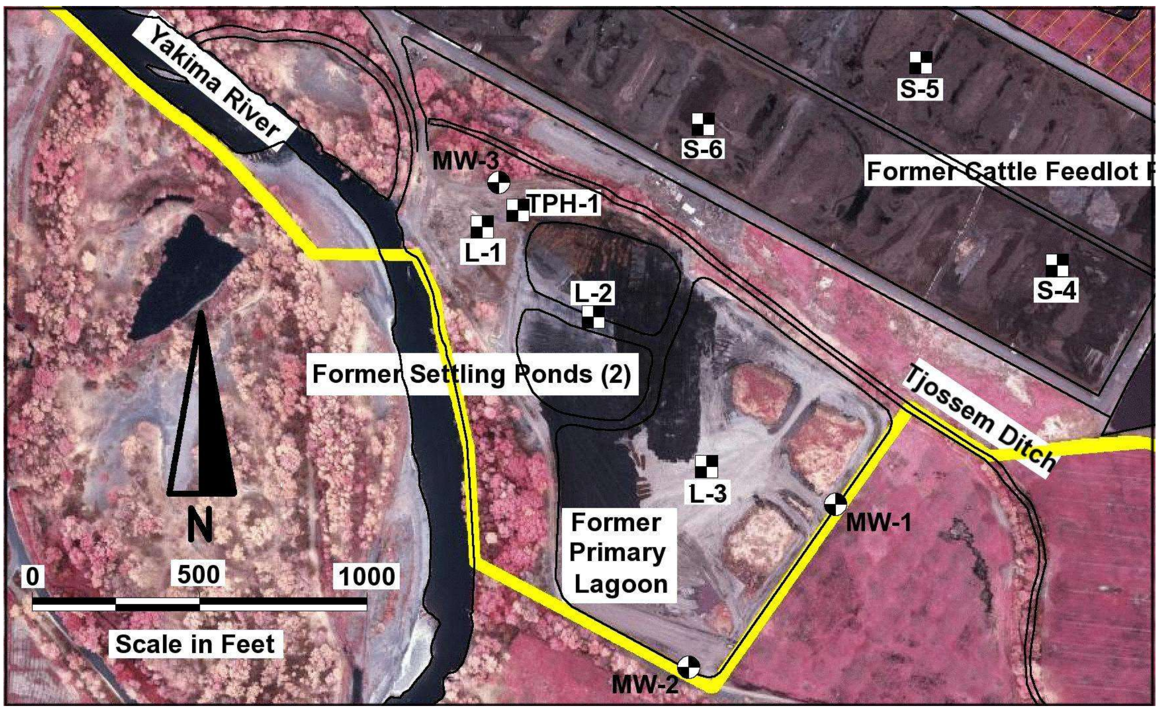

Figure 9 Sample Locations for L-1, L-2 and L-3

Observations- Former Lagoons

Apparent water table was 28 to 48 inches below the surface. The typical profile was a foot of manure and manure enriched gravel over extremely gravelly sand. Gravel content was 60 to 95% by volume through most of the profile, . No gleying was apparent.

Figure 10 Site L-1


Figure 11 Site L-2

Figure 12 Site L-3

Lab Data- Former Lagoons

Depth	Analyte	Units	L1	L2	L3	Avg	Normal Range
00-12 inches	Potassium (K)	ppm	9330	343	1300	3658	120 – 200
	Calcium (Ca)	ppm	2260	1590	1510	1787	600 – 4000
	Magnesium (Mg)	ppm	1760	298	495	851	90 – 480
	Sodium (Na)	ppm	4040.0	91.4	182.0	1437.8	50 – 500
	Sum of Exchangeable Bases	meq/100g	67.2	11.7	15.7	31.5	15 - 25
	Cation Exchange Capacity	meq/100g	38.0	15.1	18.4	23.8	15 – 25
	pH		8.3	4.7	6.3	6.4	6.0 – 7.0
	Lime Requirement	Tons/A	0.0	8.1	0.0	2.7	0 – 10
	Soluble Salts	mmho/cm	8.40	4.00	0.01	4.1	0 – 1
	Phosphorus (P)	ppm	3220	74.8	230	1175	8 – 20
	Boron (B)	ppm	2.20	0.63	1.00	1.28	0.5 – 1.0
	Sulfate-S (SO_4-S)	ppm	800	480	76	452	6 – 20
	Organic Matter		31.0%	8.5%	5.1%	14.9%	4 – 6%
	Nitrate-N (NO_3-N)	ppm	90.3	88.0	29.6	69.3	5 – 15
	Anmmonia-N (NH_3-N)	ppm	100.0	40.0	2.7	47.6	2 – 15
	Total Kjeldahl N (TKN)	ppm	16500	4540	2480	7840	2000 – 3500
	Zinc (Zn)	ppm	47.6	26.4	12.8	28.9	1 – 10
	Iron (Fe)	ppm	125	476	165	255	5 – 30
	Copper (Cu)	ppm	8.0	4.6	2.8	5.13	0.2 – 2.0
	Manganese (Mn)	ppm	50.8	41.2	7.6	33.20	2 – 10
12-24 inches	pH		5.0	5.5	6.2	5.57	6.0 – 7.0
	Nitrate-N (NO_3-N)	ppm	41.3	67.0	75.3	61.20	1 – 10
	Anmmonia-N (NH_3-N)	ppm	130.0	7.8	6.6	48.13	0 – 4
	Phosphorus (P)	ppm	23.7	76.9	32.3	44.30	0 – 2
24-36 inches	pH		4.5		5.0		6.3 – 7.3
	Nitrate-N (NO_3-N)	ppm	69.1		114.0		0 – 5
	Anmmonia-N (NH_3-N)	ppm	160.0		9.8		0 – 4
36-48 inches	pH		4.2				6.6 – 7.6
	Nitrate-N (NO_3-N)	ppm	101.0				0 – 4
	Anmmonia-N (NH_3-N)	ppm	55.0				0 – 3

Findings- Former Lagoons

Residual lagoon material is high in nitrogen and phosphorus. Soil profile is elevated in mineral forms of nitrogen (ammonia, nitrate) and phosphorus

Surface pH varies from 4.7 to 8.3 and pH in the substratum is lowest in this part of the site. Organic matter ranges from 5% to 31%. Sodium is elevated. Salinity is elevated above 4.0 mmhos/cm in an occasional sample.

Surface nitrate and ammonia levels are high, averaging 69.3 ppm and 47.6 ppm. Normal surface nitrate-N is 5 to 15 ppm, normal surface ammonia is 2 to 15 ppm. Subsurface nitrate averages 79 ppm, normal is <5 ppm. Subsurface ammonia averages 48 ppm or greater, normal is 0-4 ppm.

Phosphorus is extremely high in the surface soil, averaging 1175 ppm. Normal phosphorus is 8 to 20 ppm. Subsoil phosphorus, averaging 44.3 ppm, is also very high. Normal is 0 – 2 ppm.

Elevated soil phosphorus is a concern in the Yakima River basin primarily because it is associated with degradation of surface water quality. Soil levels above 60 ppm are associated with dramatically increased potential to impact water quality where sediment is concerned. Elevated phosphorus levels in the Yakima River are considered to be responsible for increasing algal growth and eutrophication, problems which are damaging to fish habitat.

Recommendations - Former Lagoons

During channel construction channels, spoils with greater than 60 ppm phosphorus should be moved outside areas which might yield sediments to the Yakima River

Identify areas adjacent to proposed channels where residual surface foot material with greater than 60 ppm should also be removed and replaced with less enriched soil to avoid risk of sediment transport.

To accomplish the above, a grid survey of surface soil phosphorus should be conducted by an agricultural personnel familiar with this type of survey.

Riparian vegetation should be established both within the channels and throughout the site to the extent practical. This will prevent undue sediment loss with a secondary goal of taking up the excess nutrients.

Establishing an irrigated field crop seems impractical in this area considering the gravel content, and is specifically not recommended at this time.

Estimates should be made of the sediment volume and phosphorus quantity which will be introduced to the Yakima River under various scenarios with the above recommended measures installed.

Former Cattle Feedlot Pens

Methods - Former Cattle Feedlot Pens

Soil Sampling was conducted on April 1st, 2004. The soil profile was sampled in one foot increments with subsequent analysis by Cascade Analytical, Inc., Wenatchee,WA. Analysis involved standard methods applicable to agricultural determinations. Phosphorus analysis was performed on a sodium bicarbonate extract, commonly referred to as the Olson Method. Samples were taken from the deepest portions of the pit first ahead of rising water levels and caving gravels. Pits were left open long enough to allow water in pit to equalize with the water table, typically about half an hour.

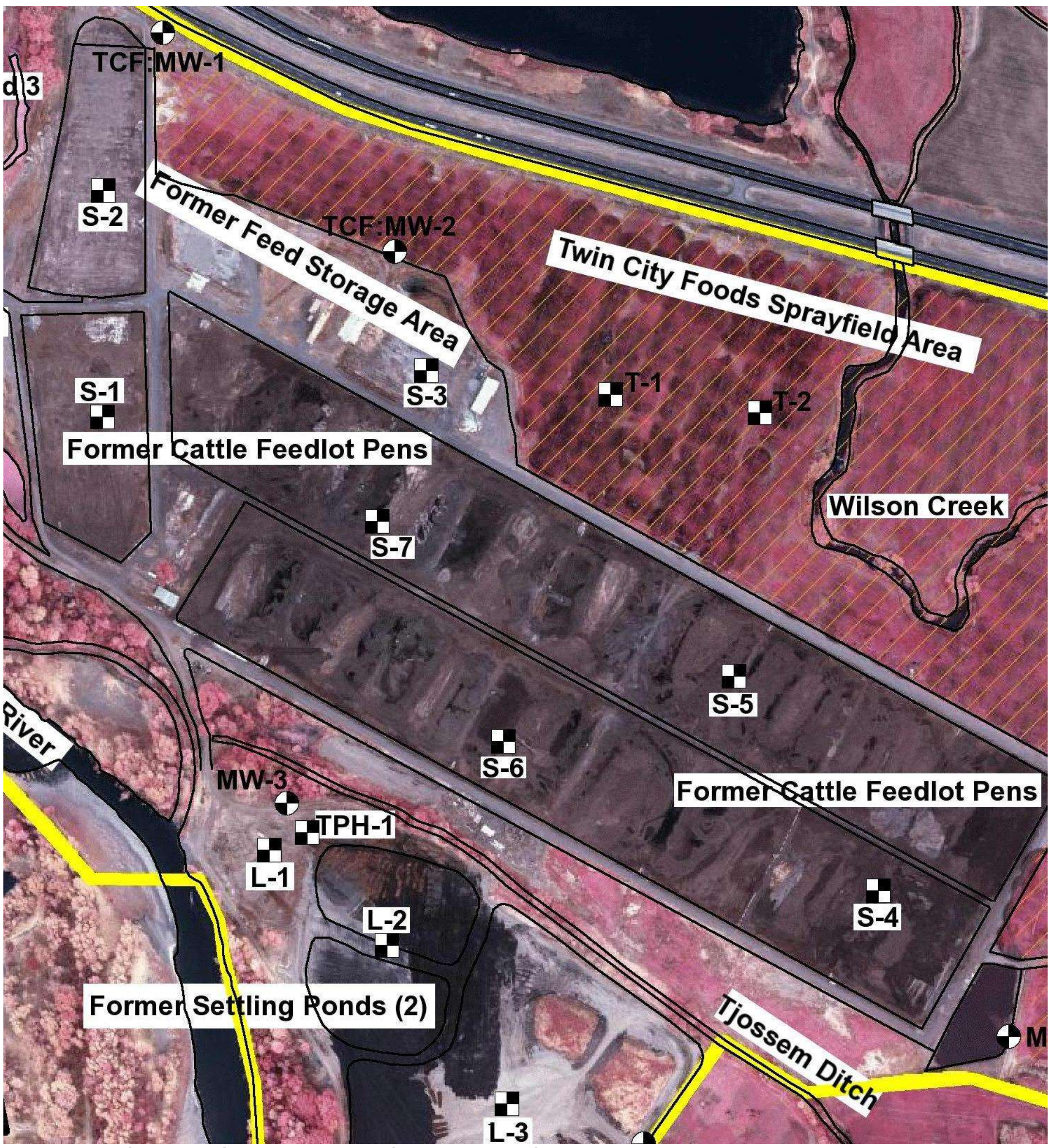

Figure 13 Sample Site Locations S-1 through S-7

Observations- Former Cattle Feedlot Pens

Sites S-1 and S-2 were located in pens west of the feed storage area. Each similarly had a foot of manure enriched soil and 60 inches to groundwater. Depth to gravel substratum was 48 inches (S1) and 22 inches (S2). Water table rose to 60 inches from the surface in both pits. Both of these sites were former cattle feedlot pen locations.

Figure 14 Site L-1 surface

Figure 15 Site L-1 profile

Site S3 was located on a former feed pad site,. The profile was gravelly to the surface and 36 inches to groundwater. Soil was highly compacted in the second foot and gleyed below that.

Sites S-4 and S-5 were located at the east end of the pens. Depth to water table was 42 and 44 inches respectively. Both had a surface foot of manure but had different profiles. S-4 had very gravelly sand (60 to 95% gravel) below the manure layer and no gley colors. S5 had gleyed sandy loam to 36 inches over mottled, ungleyed gravel.

Sites S-6 and S-7 were located in the middle of the pen complex, south of the feed storage area. Water table was at 60 and 55 inches, respectively. Both had a surface foot of manure enriched soil Below the surface enriched layer, S-6 had very fine sand with gley below 24 inches. This was underlain at 60 inches by gleyed gravelly fine sand. S-7 had no gley, with sand to 27 inches and gravel to 60 inches.

Figure 16Site S-3 Former Feed Storage Area

Figure 17 Site S-4 Southeast Corner of Pens

Figure 18 Site S-6

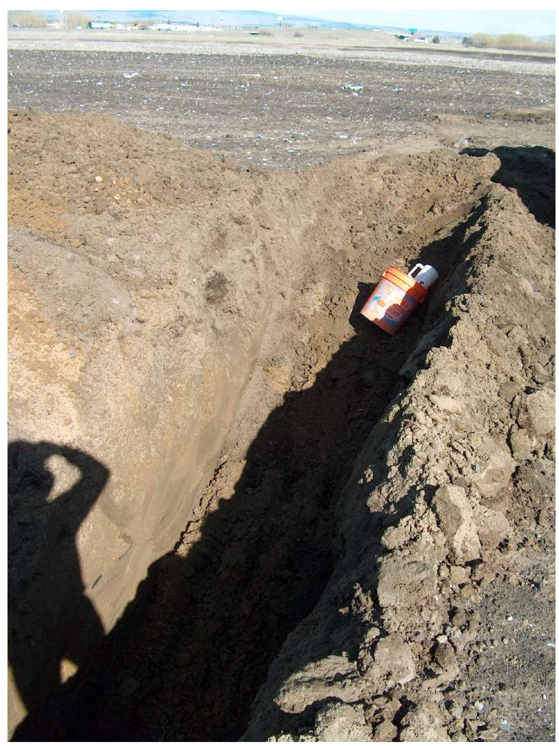

Figure 19 Site S-7

Lab Data- Former Cattle Feedlot Pens

Depth	Analyte	Units	S1	S2	S3	S4	S5	S6	S7	Avg	Normal Range
00-12 inches	Potassium (K)	ppm	11400	3260	959	9660	10500	4470	6090	6620	120 – 200
	Calcium (Ca)	ppm	1800	1180	2290	1970	2260	1950	2920	2053	600 – 4000
	Magnesium (Mg)	ppm	1650	519	273	2320	1450	1190	834	1177	90 – 480
	Sodium (Na)	ppm	4880.0	840.0	29.6	4170.0	5200.0	1700.0	2420.0	2748.5	50 – 500
	Sum of Exchangeable Bases	meq/100g	73.0	22.2	16.3	71.8	72.7	38.4	47.6	48.9	15 - 25
	Cation Exchange Capacity	meq/100g	28.4	14.0	11.8	34.8	34.4	24.0	20.4	24.0	15 – 25
	pH		7.1	7.3	7.0	7.1	8.0	7.0	7.3	7.3	6.0 – 7.0
	Lime Requirement	Tons/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 – 10
	Soluble Salts	mmho/cm	0.01	9.90	0.80	2.50	0.02	0.01	0.01	1.9	0 – 1
	Phosphorus (P)	ppm	2240	238	194	1640	3190	1460	603	1366	8 – 20
	Boron (B)	ppm	0.10	0.51	0.43	0.14	3.00	1.40	1.00	0.94	0.5 – 1.0
	Sulfate-S (SO_4-S)	ppm	600	26	21	610	670	190	110	318	6 – 20
	Organic Matter		18.0%	3.0%	3.7%	27.0%	53.0%	16.0%	7.1%	18.3%	4 – 6%
	Nitrate-N (NO_3-N)	ppm	1250.0	113.0	75.9	810.0	118.0	277.0	194.0	405.4	5 – 15
	Anmmonia-N (NH_3-N)	ppm	44.0	110.0	87.0	52.0	130.0	190.0	140.0	107.6	2 – 15
	Total Kjeldahl N (TKN)	ppm	10100	1400	2020	12500	12500	5720	3260	6786	2000 – 3500
	Zinc (Zn)	ppm	41.6	4.2	5.4	52.8	46.8	26.8	9.6	26.7	1 – 10
	Iron (Fe)	ppm	86.8	159	110	91.4	185	146	198	139	5 – 30
	Copper (Cu)	ppm	4.2	3.4	4.8	6.4	7.0	3.6	5.6	5.00	0.2 – 2.0
	Manganese (Mn)	ppm	45.6	18.8	14.6	64.0	63.2	62.4	94.4	51.86	2 – 10
12-24 inches	pH		6.0	6.8	6.4	6.8	7.3	6.9	6.7	6.70	6.0 – 7.0
	Nitrate-N (NO_3-N)	ppm	445.0	81.9	33.4	4.2	60.7	56.8	113.0	113.57	1 – 10
	Anmmonia-N (NH_3-N)	ppm	16.0	130.0	330.0	6.3	120.0	39.0	110.0	107.33	0 – 4
	Phosphorus (P)	ppm	30.3	17.5	182.0	72.9	32.3	17.3	24.6	53.84	0 – 2
24-36 inches	pH		6.5	6.3	6.4	6.3	5.8	5.8	6.5	6.23	6.3 – 7.3
	Nitrate-N (NO_3-N)	ppm	211.0	37.8	63.4	57.0	6.8	53.1	71.3	71.49	0 – 5
	Anmmonia-N (NH_3-N)	ppm	4.8	11.0	220.0	0.4	100.0	36.0	3.3	53.64	0 – 4
36-48 inches	pH		5.3	5.1	7.8	6.6	4.7	6.3	5.7	5.93	6.6 – 7.6
	Nitrate-N (NO_3-N)	ppm	76.5	33.5	12.3	78.2	89.2	98.0	72.0	65.67	0 – 4
	Anmmonia-N (NH_3-N)	ppm	4.4	5.1	810.0	12.0	26.0	11.0	3.6	124.59	0 – 3
48-60 inches	pH			4.8	7.6					6.20	7.0 – 8.0
	Nitrate-N (NO_3-N)	ppm		54.3	5.5					29.90	0 – 3
	Anmmonia-N (NH_3-N)	ppm		7.5	340.0					173.75	0 – 2

Findings- Former Cattle Feedlot Pens

Average phoshorus levels are 1366 ppm in the surface foot and 54 ppm in the second foot.

Excessive phosphorus from runoff and erosion can fertilize surface waters. In this process, called eutrophication, microscopic floating plants, such as algae, multiply rapidly when fertilized by phosphorus. When the algae eventually die, they decompose. During decomposition dissolved oxygen is removed from the water. Lowered oxygen levels make it difficult for other aquatic organisms to survive.

Eutrophication in the Yakima river is a growing concern. Suspended sediment levels in the system are decreasing as erosion is increasingly controlled. This is allowing sunlight to penetrate further into the water and portions of the system are experiencing increasing algae levels, with unstable oxygen and pH levels.

Phosphorus, attached to sediments derived from soil erosion, may accumulate in the sediments of lakes and streams. This phosphorus may be recycled slowly or released more rapidly when these sediments are disturbed, for example during a storm or flood. Pollution from phosphorus is therefore a long-term problem.

Soils highly enriched with manure and lagoon solids enriched soils should be moved away from areas prone to flooding, to prevent sediment transport into the Yakima River system. Removing surface soil may fit well with the plan to develop the site, in that lowering the surface would expedite introducing river hydrology into the area.

Any practice that will prevent the loss of material from the site is a constructive tool for dealing with this challenge.

No national criteria have been established for concentrations of phosphorus compounds in water; however, to control eutrophication, the EPA makes the following recommendations:

> Total phosphorus should not exceed 0.05 mg/L (50 ppb) in a stream at a point where it enters a lake or reservoir.
>
> Total phosphorus should not exceed 0.1 mg/L (100 ppb) in streams that do not discharge directly into lakes or reservoirs.
>
> It is significant that Schaake reported groundwater phosphorus levels as high as 5.48 mg/l. (MW-1, December 13th 1998)

Work has recently been started to address levels of phosphorus in the Yakima River. A synoptic survey of phosphorus levels has been scheduled for 2004. This project involves USGS, WDOE and local soil and water conservation districts. This work may offer some insight as to level of concern attached to this issue and help guide an appropriate level of response.

Recommendations - Former Cattle Feedlot Pens

In the areas of S-1, S-2, S-5, S-6 and S-7, soils have low gravel surfaces and are similar enough to those in the Twin City Foods sprayfield area to consider an irrigated field crop. A legume is recommended to avoid problems with tetany, as discussed on page 13.

Ponds (3)

Methods - Ponds

Sampling was conducted on May 24th, 2004, with subsequent analysis by Anatek Labs, Inc., Spokane, WA. Ponds 1 and 3 were sampled from an inflated raft. Pond 2 was too shallow for the raft so was sampled using waders. Sediment samples were extracted from Pond 1 and 2 using an open face soil probe. Due to greater depth, Pond 3 was sampled using a "sludge king" sampler, consisting of a Plexiglas tube and a one way valve.

Pond 3 had small blocks of a whitish industrial waste product floating in it. This material was sampled as was the pond water itself

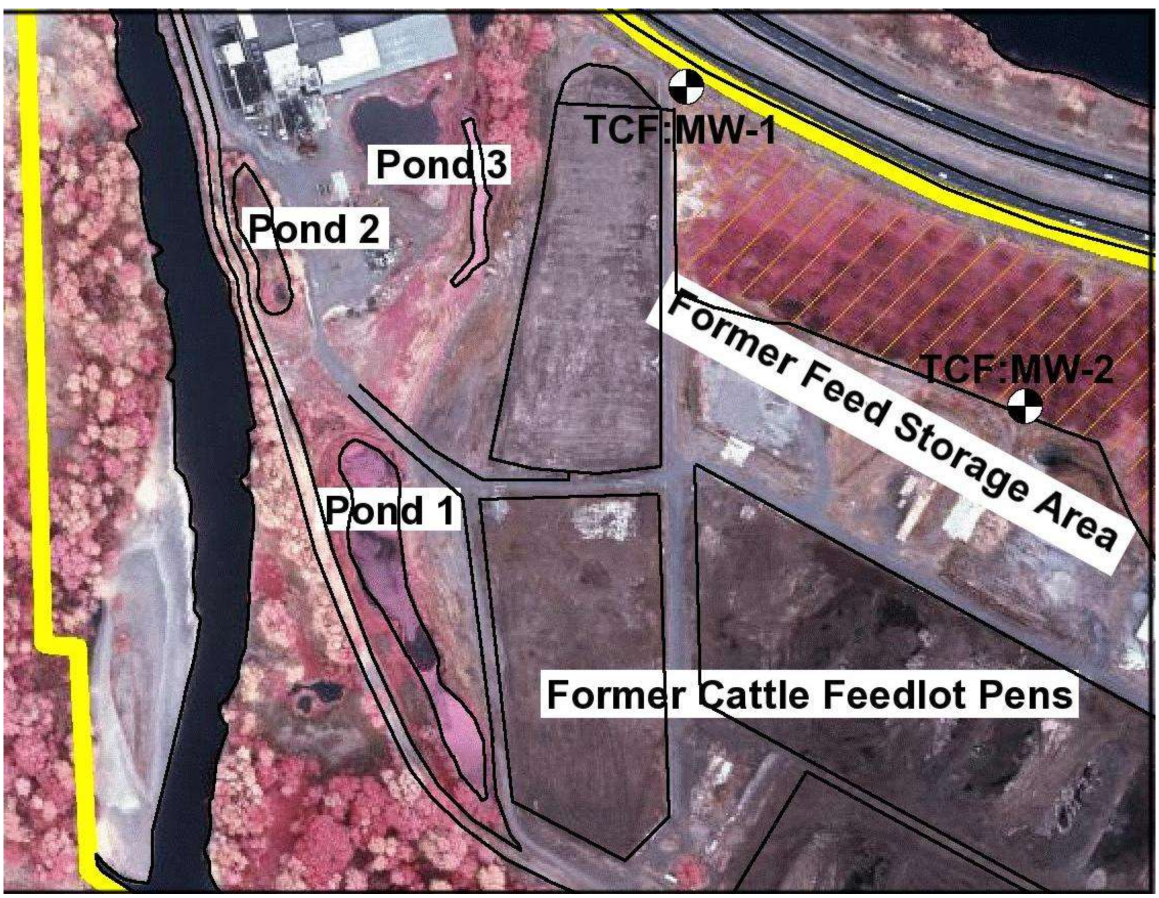

Figure 20 Pond Sample Sites

Observations- Ponds

On May 24th , three shallow pond bottoms were sampled. Ponds 1 and 2 were adjacent to the Yakima River levee. Pond 2, was in the most natural state, with a relatively intact forested riparian border, abundant and diverse aquatic invertebrate population. Depth was up to 3 feet. sediment was 6 to 12 inches over gravel Several newts or salamanders were observed in Pond 2.

Pond 1, located southeast of Pond 2 had lower diversity of vegetation and invertebrates. Depth was up to 3 feet, Sediment was 12 to 30 inches over gravel.

Pond 3, located north of Ponds 1 and 2, had no appreciable invertebrate population and had small blocks of a whitish industrial waste product floating in it. Depth of water was up to 12 feet. Sediment depth was 12 inches to more than four feet deep over gravel. In the deepest portion of Pond 3, an impeding layer of dark solids was encountered between 6 feet and 8 feet of depth. It appeared to be composed of natural substances but its presence was not natural.

Lab Data - Ponds

Material	Analyte	Units	1	2	3	Normal Range
Sediment	TKN	ppm	8250	6630	7020	8000 – 14000
	pH		8.05	5.56	6.58	6.0 – 7.0
	Ortho P as P	ppm	29.5	1.4	32.4	1 – 10
	Calcium	ppm	11100	12300	9760	2400 – 16000
	Sodium	ppm	540	740	660	200 – 2000
	Magnesium	ppm	8430	9810	5740	400 – 2000
	Potassium	ppm	2630	1490	1840	500 – 800
	Selenium	ppm			3.40	(see note)
	Arsenic	ppm			0.70	1 – 10
Water	pH				8.47	5.0 - 6.5
	Selenium	ppm			ND	<0.002
	Arsenic	ppm			0.23	<0.05
Cake	pH				4.83	
	FOG	ppm			69.2%	

Selenium: <1 ppm = No effect, 1-4 = Level of Concern, >4 = Toxicity Threshhold

Table 3 Ponds Lab Data

Findings – Ponds

Pond 2 appears to be in a natural state with few, if any, contaminants. Pond 3 is contaminated with byproducts from meat processing. Pond 1 is similarly contaminated, but less so than Pond 3, as might be expected, since Pond 1 is in line to receive material discharged from Pond 3, but further from the source.

Phosphorus and potassium is slightly elevated in Ponds 1 and 3.

The white floating cake material floating in Pond 3 is animal fat likely due to meat slaughter, rendering and packing operations.

Selenium sediment levels in Pond 3 represent a “level of concern” and are approaching a toxicity threshold.

Recommendations – Ponds

Avoid discharging sediment or water from Pond 3 to the Yakima River.

No further action is warranted.