Wind River Environmental Quality Commission

UMTRA Program - Phase II
Surface Water, Sediment, and Biota Final Draft Report

Clean Water Act Section 106 Special Project

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Prepared for:

WIND RIVER ENVIRONMENTAL QUALITY COMMISSION
Eastern Shoshone and Northern Arapaho Tribes
Fort Washakie, Wyoming

and

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
Denver, Colorado

Prepared by:

David Haire, Water Quality Scientist
Powell, Wyoming

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TABLE OF CONTENTS

PAGE

LIST OF TABLES

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

Introduction

The documented groundwater contamination, and the potential surface water, sediment and biota contamination at the Riverton Uranium Mill Tailings Remediation (UMTRA) Site has been an ongoing concern of the Wind River Environmental Quality Commission (WREQC). In 2001, WREQC secured a Clean Water Act (CWA) Section 106 Special Project grant from the EPA Region VIII office in Denver and designed a project to further assess the impacts of the UMTRA site on the ecological and human health of the immediate area.

Phase I of the UMTRA Project was a data audit of existing information, by Maxim Technologies, completed in June, 2002. The purpose of Phase II (this report) was to address the concerns and issues raised in Phase I (Data Audit) of the Special Project. Based on the conclusions and information in this report, the WREQC Water Quality Program designed and implemented a reconnaissance-level investigation into the existence of "contaminants of potential concern" (COPC) identified by the Department of Energy (DOE) previously in various reports and management plans.

The following report describes the tasks completed by WREQC under Phase II of the Special Project. This report focuses on Phase II tasks related to data collection activities concerning surface water, surficial sediments, crayfish and fish tissue, macroinvertebrates, and vegetation. Groundwater and drinking water tasks for Phase II were reported separately. The macroinvertebrate report was also conducted and completed separately, but has been included as an attachment to this report.

Background

The uranium mill (sometimes referred to as the Susquehanna mill) operated near the city of Riverton from 1958 to 1963, using both acid and alkaline milling methods. Sulfuric acid for milling operations was produced at an on-site facility, which is still in operation today. Approximately one million (1,000,000) cubic yards of contaminated mill tailings were stockpiled for 25 years on the site which comprises approximately 70 acres.

During surface remediation activities in the 1980's, approximately 1.8 million (1,800,000) cubic yards of contaminated material were removed from the site and transported to the Gas Hills Disposal Site. Surface remediation was completed in November, 1989, however, DOE modified the Remedial Action Plan and allowed some areas below the water table contaminated with Thorium-230 to remain in place.

Groundwater in the Wind River Aquifer below and downgradient of the site was and continues to be contaminated as a result of the milling operations, waste storage, and contamination left in place. Numerous documents prepared by the DOE provide substantiation that the contaminated groundwater plume exists. According to DOE, contaminated groundwater in the surficial aquifer, and the hydraulically connected semi-confined aquifer, is flowing southeast from the site and is discharging to the Little Wind

River. The DOE contends that the deeper confined aquifer has not been affected by the contamination from the site.

DOE Groundwater Compliance Strategy

The groundwater compliance strategy for the Riverton UMTRA site is outlined in the DOE Groundwater Compliance Action Plan (GCAP) and the Site Observational Workplan (SWOP). DOE is the agency responsible for UMTRA site management and cleanup, however, EPA is responsible for certifying DOE compliance with the UMTRA groundwater regulations in 40 CFR Part 192.

The DOE groundwater compliance strategy consists of natural flushing and annual monitoring over a 100-year time period, combined with institutional controls to prevent contact with contaminated groundwater. According to DOE, required institutional controls include construction of a water line for residents using potentially affected wells (completed in 1998), a well drilling moratorium, and groundwater use restrictions.

Summary of Phase I Findings

The results of the Phase I Data Audit completed by Maxim Technologies indicate many serious concerns with the DOE GCAP. Concerns directly related to the Phase II tasks associated with this report include:

- Modifications to the Surface Remediation Action Plan which allowed soils with elevated Thorium-230 concentrations to remain in place in the saturated zone.
- The potential environmental harm associated with the elevated Thorium-230 levels was not adequately determined.
- The DOE modeling system did not account for the heterogeneity of the groundwater system, especially the existence of paleochannels.
- The question of interactions between groundwater flow and the level of the Little Wind River was not considered.
- Evaporation and dilution of the contaminated groundwater and the affected surface water was not addressed.
- All of the appropriate COPC were not considered.
- The COPC identified were not adequately evaluated.
- Synergistic effects between COPC were not addressed.

- DOE failed to consider exposure pathways other than groundwater.
- The environmental evaluation regarding aquatic life and human consumption of aquatic life was inadequate.
- There is a general lack of sediment data.
- Human exposure to contaminated groundwater/surface water at the Oxbow Lake was not addressed.
- DOE is only monitoring groundwater and other concerns such as surface water, aquatic life, sediments, vegetation, and land use changes are not addressed.

Other concerns and issues regarding the Data Audit summary were listed and addressed in the Groundwater/Source Water Phase II Report prepared by Steven Babits.

Phase II Goals and Tasks

Based on the Maxim Technologies report, a list of action items relating to surface water, vegetation, sediments, and aquatic life was developed. Concern was focused on the ecological and human health impacts of exposure to these potentially contaminated media. The tasks completed for the Phase II UMTRA Surface Water, Sediment, and Biota (vegetation and aquatic life) Project were:

1. Identify appropriate sampling sites and biota (aquatic life and vegetation) which will assist in identifying potential human exposure to contaminated water and other environmental media.
2. Determine constituents/parameters to be analyzed for surface water, sediment, and biota.
3. Collect field samples of surface water, sediments, and biota within the UMTRA site area.
4. Collect field samples of surface water, sediments, and biota outside the immediate UMTRA site area for use as "baseline" or uncontaminated references.
5. Determine if any surface water samples exceed the Maximum Contaminant Levels (MCLs) provided in the Safe Drinking Water Act (SDWA) and/or exceed the existing state and proposed water quality standards under the Clean Water Act.
6. Compare data from "background" samples with those from within/downstream of

the known area of contamination.

7. Determine if institutional controls should be developed for environmental media other than groundwater – i.e., surface water, sediments, and biota.

8. Prepare Phase II surface water, sediment, and biota assessment final report.

Phase II Results and Findings

Task 1: Identification of Sampling Sites and Biota for Data Collection

The identification and selection of sampling sites was undertaken by a group of WREQC employees and contractors who are very familiar with the UMTRA site and the lower reaches of the Little Wind and Big Wind Rivers. Figure 1 identifies the sampling sites for all media – surface water, sediment, crayfish, carp and vegetation. Several sampling sites were located at existing surface water sampling stations established by the U.S. Geological Survey (USGS) and the WREQC Water Quality Program. These existing stations have a large volume of chemical and physical water quality data associated with them which may be used in future investigations concerning the UMTRA site.

Photographs of all sites are provided in Attachment A.

Sites 1 and 2 (UMTRA#1 and UMTRA#2) are located on the Little Wind River mainstem immediately upstream and downstream of the USGS gaging station G36. This site is considered a background or unimpacted site, as it is at least 4 air miles away and upstream/upwind of the UMTRA site.

Site 3 (UMTRA#3) is located on the Popo Agie River, just upstream from the USGS/WREQC water quality monitoring station G42. This site is also considered a background/unimpacted site due to its distance away and direction from the UMTRA project area.

Site 4 (UMTRA#4) is located on the Little Wind River immediately upstream of where the cutoff channel for the Oxbow Lake takes off from the main channel on the north bank
of the river. Because of its location in the immediate vicinity of the Oxbow Lake and the discharge of the contaminated groundwater plume, this site cannot be considered a distinct background or nor a definitive potentially impacted site.

Site 5 (UMTRA#5) is the previously mentioned Oxbow Lake. This waterbody is located within the floodplain, and as its name implies is a remnant of the Little Wind River's original channel, prior to 1994. In 1994 high water eroded the river's bank and the lake was formed. DOE has identified the Oxbow Lake as an area where the contaminated groundwater plume is exposed to the surface. For this and other reasons this surface water feature was determined to be of special interest. Many photographs have been taken of this site and the data collection activities which have occurred there

for this project. Attachment A contains several of these photographs.

A Site 6 (UMTRA#6) was not developed because the pre-labeled sample bottles for that site were used for storage and transport of crayfish.

Site 7/8 (UMTRA #7-8QA1) is located at the constructed wetland along Highway 138, on the eastern edge of the UMTRA site. This site was chosen because it was one of the few areas where surface water is accessible within the Riverton UMTRA Project Area. The location of the wetland on the eastern edge of the identified contaminated groundwater plume was another reason for choosing it as a sampling site. The wetland was created in 1998 as a mitigation site for wetlands disturbed or lost during the construction of the public water supply extension into the UMTRA Project area. This site was subject to two separate ("split") samples for quality control purposes.

This site is located directly adjacent to an pre-existing wetland, which occupies a surface paleo-channel of the Big Wind River. This channel extends from north of Goes in the Lodge Road, south to Highway 138, a distance of approximately one half mile.

Site 9 (UMTRA#9) is located on the Little Wind River, approximately one half mile downstream of Site 4. This site was chosen as a potentially impacted site due to its location downstream and down gradient from the Oxbow Lake and the contaminated groundwater plume. The site is located just upstream of the Highway 789 bridge over the Little Wind River, south of the city of Riverton.

Site 10 (UMTRA#10) is located on the Big Wind River upstream and northwest of the Riverton UMTRA site. This location is considered up-gradient of the contaminated groundwater plume and therefore may be considered a "background" site for the purposes of this project. The site is accessed off the north end of Red Crow Lane.

Sites 11 and 15 (UMTRA#11 and UMTRA#15) are located on the Big Wind River at the highway crossing just south of the city of Riverton. This site coincides with the USGS/WREQC water quality monitoring station G22.

NOTE: (Samples were collected at this site twice because it was the only accessible segment of the Big Wind River which was not frozen over in December, 2002. Anchor ice was observed at the site, and many other locations both on and off the Reservation in western Wyoming at this time.)

Due to the undetermined extent of the contaminated groundwater plume, this site may be considered a potentially contaminated site or a background site. Samples were collected in September ("Site 11" and December ("Site 15"), respectively.

Site 12 (UMTRA#12) is located on a drainage ditch along Highway 138 (17 Mile Road) immediately across from the St. Stephens Cemetery. This ditch flows year-round as a result of both the discharge from the Peak Sulfur Company facility and because it intercepts the shallow surficial aquifer in the area. This site was chosen as a potentially

impacted sampling location.

Sites 13 and14 (UMTRA#13-14QA2) are located in a pond in an historical gravel pit operation, near the northeast corner of the Riverton UMTRA site. This site was chosen because of the potential impact from the contaminated groundwater plume and the exposure of surface water. This was also the second quality assurance sample location for this Phase II project.

It was recently discovered that this pond has been stocked by the landowner with a variety of fish for eventual consumption. This site may therefore represent a potential pathway of direct human consumption of contaminated fish tissue.

Site 16 (UMTRA#16) is located on the Big Wind River at the historic Wind River Rendezvous Site just south of the city of Riverton. This site was selected as a downstream, potentially impacted sampling site, as it is unknown whether the contaminated groundwater plume discharges toward the Big Wind River immediately upstream of this site.

Sites 17 and 18 (UMTRA#17-18) is located on the Little Wind River near the bridge on the Sand Draw Road, Highway 135 at the USGS gaging and WREQC water quality monitoring station. This site is located about one mile downstream of Site 9 (UMTRA#9). The third surface water quality assurance sample was collected at this site.

Task 2. Determine appropriate constituents/parameters to be analyzed for surface water, sediment, and biota/tissue samples

After reviewing existing DOE documents, considering recommendations developed by Maxim Technologies in their Data Audit completed for Phase I of the is project, and discussions with the manager of the analytical laboratory, it was determined that 26 constituents would be analyzed for this phase of the project. Most of the parameters were chosen following review of the DOE document Baseline Risk Assessment of Groundwater Contamination at the Uranium Mill Tailings Site near Riverton, Wyoming which identified 24 COPCs which exceeded background concentrations.

Tasks 3. and 4. Collect field samples of surface water, sediments, and biota (from within and outside) the UMTRA site area.

As noted above, the sample collection activities for this project were designed to determine the effects of the contaminated groundwater plume on the various environmental media – surface water, sediments, and biota.

Surface water samples were collected following the standard operating procedures of the WREQC Water Quality Program. These procedures were modified somewhat to

collect samples from wetlands (Oxbow Lake/Site 5) and the active gravel mining operation where flowing water (stream or river) was not present. At these three sites surface water samples were collected using a long handled dipper with a liter container attached to the end (Photo #16). A composite sample was taken (at least 10 separate liter containers of water per site) with the samples treated identically to regular surface water samples once in the 20-liter carboy.

a. Sediment samples were collected at Sites 1-10 (no Site 6). As there were no established sediment collection procedures for the WREQC Water Quality Program, methods were utilized following USGS and the analytical laboratory recommendations. Composite samples were taken, with at least 10 subsamples taken per site.

b. Biota (carp, crayfish, and vegetation) was sampled using a variety of techniques. Carp were collected by snagging, using rod and reel and a large treble-hooked spoon (Photo #14). Samples were preserved and shipped to the analytical laboratory using methods outlined in the EPA's Office of Science and Technology National Study of Chemical Residues in Lake Fish Tissue QAPP document (Photo #15).
Vegetation was collected by methods suggested by the analytical laboratory. A backhoe was used to collect entire specimens of brush or small trees (Photo #18). A sanitized set of clippers or bow saw was used to collect specific parts or sections of the vegetation for shipment to the laboratory.

During field reconnaissance of the project area, many shells of one species of freshwater mussel were observed at numerous sites. It was initially planned to collect live specimens and have these analyzed along with the carp and crayfish samples, however, no live specimens could be found. Shells from the dead mussels could have been used for analysis, but determining the original location of the (live) mussels was not possible.

Photo # 20 is a photograph of a live freshwater clam observed during a synoptic survey of the Little Wind River.

Tasks 5. and 6. Determine if any samples exceed the Safe Drinking Water Act MCLs or the State/Tribal water quality standards; compare background and downstream constituent levels.

Tables 2 – 15 summarize the analytical laboratory data resulting from the surface water, sediment and biota/tissue samples collected as part of Phase II. The following are brief descriptions of these tables accompanied by brief discussions of the results with regards to exceedances of SDWA MCLs and/or exceedances of the existing State, and proposed Tribal, water quality standards. These criteria were used because the Little Wind River and the Big Wind River have an applicable drinking water use designation (2AB) by both the State and the Tribes. Additionally, comparisons of background sites

with downstream or potentially impacted sites are provided. Tables 2 – 15 summarize the both the field parameter and analytical laboratory data resulting from the surface water, sediment and biota/tissue samples collected as part of Phase II.

SURFACE WATER

Table 2. UMTRA Phase II Surface Water Sampling, Sites Multi-Parameter Field Instrument Results – Field Parameters

This table summarizes the data collected using the WREQC Water Quality Program's multi-parameter monitoring instrument – termed the "YSI" for its manufacturer, Yellow Springs Instruments. QA samples were not "collected" as the YSI takes instantaneous readings, there fore Sites 8, 14, and 18 are not included for data analysis purposes.

The most noticeable results discerned from this table are the high readings for specific conductance and extremely low dissolved oxygen readings at the West Side Irrigation Ditch site (Site 12), an elevated pH reading at the constructed wetland (Site 7/8), and the high chlorides reading from the gravel pit (Site 13/14). Also Site 4 on the Little Wind River exhibited a significantly lower pH level than most other sites.

The ammonia readings for Sites 4, 5 (Oxbow Lake), and 7/8 (constructed wetlands) were an order of magnitude greater (10 times) than most other sites.

Turbidity readings were somewhat inconclusive, as the reviewer was present during sampling and observed disturbance of the sediment during sampling in the Oxbow Lake and is convinced that this may have significantly increased this reading.

Table 3. UMTRA Phase II - Surface Water Sampling Sites Laboratory Analytical Results (in milligrams per liter) - Major Ions

This table provides the results of the surface water samples analyzed for the nine major ions. Only three of the major ions have applicable MCLs - chloride (Cl), fluoride (Fl), and sulfate (SO_4). There were no exceedances of the chloride or fluoride criteria.

The sulfate criteria (250 mg/L) were exceeded in 13 of 17 samples. Both background and downstream sites displayed elevated sulfate levels. Only sites on the Big Wind River – both background and downstream – were not subject to exceedances of the sulfate criteria. The highest recorded level of sulfate (988 mg/L) was sampled from the ditch that contains the Peak Sulfur NPDES discharge water.

Table 4. UMTRA Phase II - Surface Water Sampling Sites Laboratory Analytical Results (in milligrams per liter) - Total Metals

This table provides the results of the surface water samples analyzed for the 12 total metals. 8 of the 12 metals have associated MCLs - aluminum (Al), arsenic (As), iron (Fe), manganese (Mn), nickel (Ni), selenium (Se), uranium (U), and zinc (Zn).

Of particular note and concern is the fact that the only exceedance of the uranium MCL (.003 mg/L) was recorded in a sample taken from the Oxbow Lake. This sample was approximately10 times higher (.311 vs. 0.127) than the next highest recorded sample value recorded from Site 4 on the Little Wind River – a site nearly adjacent to the Oxbow Lake site.

Other results included 11/17 samples analyzed for aluminum exceeded the MCL.

The highest recorded value was recorded from Site 12 - the ditch containing the Peak Sulfur discharge. The value (1.37 mg/L) was more than twice the level of the next closest value (0.644 mg/L) recorded from Site 4.

The arsenic MCL (.01 mg/L) was exceeded only twice – both from the same site – the constructed wetland (Sites 7 and 8), which also served as a QA sample site. These exceedances were just above the MCL - .012 mg/L.

The iron MCL (0.3 mg/L) was exceeded in 9 of 16 samples. The highest recorded value (2.17 mg/L) again from Site 12 – the Peak Sulfur discharge. This value was approximately 3 times greater than the next highest recorded value taken from Site 4 on the Little Wind River.

Table 5. UMTRA Phase II - Surface Water Sampling Sites Laboratory Analytical Results (in picoCuries per liter)(pCi/L) - Total Radionuclides

This table summarizes the radionuclides data for surface water samples. The most significant result from this analysis was that the Oxbow Lake exhibited a Gross Alpha level more than 10 times greater than any other site. This level (57.7 pCi/L) was almost 4 times higher than the SDWA Gross Alpha MCL (15 pCi/L). This is of concern because the Little Wind River and its adjacent wetlands have been assigned a drinking water use (2AB), under the current State of Wyoming classification which the Reservation is following. It should be noted that Gross Alpha was detected at all sites analyzed.

Lead-210 and Polonium-210 were not detected in any samples collected. Thorium-230 was only detected from the Little Wind River at Site 17/18 at its crossing of the Sand Draw Highway (G45).

Radium-226 was detected in 7 of 16 samples, with the highest level (1.3 pCi/L) measured from the constructed wetland (Site 13/14). All sites with detectable Radium-226 levels were considered downstream/potentially impacted sites.

SEDIMENT

Table 6. UMTRA Phase II - Sediment Sampling Sites; Laboratory Analytical Results (in milligrams per kilogram) - Major Ions

This table summarizes the results of the analytical laboratory sediment analysis for major ions. As with the other sediment data, a full set of sites was not analyzed.

The most significant results from these data were the significantly higher levels of calcium, magnesium, potassium, sodium, and sulfate measured in samples from the constructed wetland (Sites 7/8) and the Oxbow Lake (Site 5).

The sulfate level measured at the Oxbow Lake was more than 18 times higher than the next highest level measured from any site other than the constructed wetland. The Oxbow Lake sulfate level was four times higher than the level measured in the constructed wetland.

Table 7. UMTRA Phase II – Sediment Sampling Sites Laboratory Analytical Results (in milligrams per kilogram) - Total Metals

This table summarizes the analytical laboratory sediment analyses for total metals. As with the other sediment data, a full set of sites was not analyzed.

The most significant results were the significantly higher levels of metals measured in the Oxbow Lake (Site 5), the constructed wetland (Site7/8) and the Little Wind River just upstream from the Highway 789 crossing (Site 9).

The aluminum levels measured in the Oxbow Lake were nearly twice as high as the next highest measured levels – from the constructed wetland – and more than four times higher than any other site.

Arsenic levels in the Oxbow Lake (Site 5) and the Little Wind River (Site 9) were about twice those measured from all other sites.

Manganese, nickel, strontium, vanadium, and zinc levels were also significantly higher in the Oxbow Lake and the constructed wetland than all other sites.

Table 8. UMTRA Phase II – Sediment Sampling Sites Laboratory Analytical Results (in picoCuries per gram) (pCi/g) - Total Radionuclides

This table summarizes the analytical laboratory sediment analyses for radionuclides. As with the other sediment data, a full set of sites was not analyzed.

Gross Alpha, Gross Beta, Polonium-210, Radium-226, Radium-228, and Thorium-230 levels were not conclusive, as levels measured from background sites (Sites 1, 2, ~~and~~ 3) were similar to, or actually higher than, levels measured at potentially impacted sites.

Lead-210 was not detected from samples at 7 out of 10 sites. The three sites which had detectable levels were Oxbow Lake (Site 5), constructed wetland (Site 7/8), and the West Side Irrigation Ditch.

The most significant result of these analyses was the level of uranium in the Oxbow Lake (Site 5) compared to all other sites. Levels were 5 times higher than the next closest measured level in the constructed wetland (Site 7/8) and 10 times higher than any other sites.

CRAYFISH

Table 9. UMTRA Phase II – Crayfish Sampling Data; Laboratory Analytical Results (in milligrams per kilogram) – Inorganic Constituents

This table summarizes the analytical laboratory analyses of crayfish tissue for inorganic constituents. These data represent only two sites, the Oxbow Lake (Site 5) and an area of the Little Wind River (Site 4 and app. 300 yards downstream).

The most obvious and significant result of these analyses is that the sample from Oxbow Lake exceeded the sample from the Little Wind River for 15 of the 21 constituents. Of particular note is the level of uranium in the Oxbow Lake sample was 10 times higher than the level measured in the Little Wind River sample. Aluminum, chloride, iron, nickel, and vanadium levels were all approximately 5 times higher in the Oxbow Lake sample, as compared to the Little Wind River sample.

Table 10. UMTRA Phase II – Crayfish Sampling Data; Laboratory Analytical Results (in μCi/kg) – Total Radionuclides

This table summarizes the analytical laboratory analyses of crayfish tissue for Radionuclides. As noted immediately above, these data represent only two sites, the Oxbow Lake (Site 5) and an area of the Little Wind River (Site 4 and app. 300 yards downstream).

These data are somewhat inconclusive, as the sample from the Little Wind River site exhibited higher levels of Lead-210 than the sample from the Oxbow Lake site and neither had detectable levels of Thorium-230.

The sample from the Oxbow Lake site did exhibit higher levels of Polnium-230 and Radium-226, however, these differences appear to be relatively insignificant.

CARP

Table 11. UMTRA Phase II – Carp Sampling Data; Laboratory Analytical Results (in milligrams per kilogram) – Inorganic Constituents and Table 12. UMTRA Phase II – Carp Sampling Data; Laboratory Analytical Results (in μCi/kg) - Total Radionuclides

These two tables summarize the analytical laboratory analyses of the carp tissue data. Samples were only collected from the Oxbow Lake (Site 5). No samples were collected or analyzed for a comparative analysis of data.

VEGETATION

Table 13. UMTRA Phase II - Vegetation Sampling Data; Laboratory Analytical Results (in milligrams per kilogram) - Major Ions

This table summarizes the analytical laboratory vegetation analyses for major ions. Samples were collected from the Oxbow Lake area (Site 5) and from an area near Site 1, on the Little Wind River. Samples of cottonwood (*Populus* sp.), willow, (*Salix* sp.), and Russian olive (*Elaeagnus angustifolia*) were collected at each site.

Bromine was not detected from any sample.

Calcium levels were very similar between sites, with willow samples exhibiting higher levels than the other two species.

Chloride was not detected in the background sample from the Little Wind River (Site 1), however, chloride was detected from the Oxbow Lake site sample.

Fluoride was not detected from any vegetation sample.

The willow background sample exhibited the highest level of magnesium – approximately 1.5 higher than the level recorded in the Oxbow Lake willow sample, the next highest level recorded.

Potassium levels were very similar both within and between sites.

Silica levels were generally higher (on average) in samples from the Oxbow Lake site.

Sodium levels are significantly higher in the Oxbow Lake site samples. Sodium was not detected in the two Russian olive samples from the Little Wind River site.

Sulfate levels are significantly higher in Oxbow Lake samples. Sulfate was not detected in the two Russian olive samples from the Little Wind River site.

Table 14. UMTRA Phase II –Vegetation Sampling Data; Laboratory Analytical Results (in milligrams per kilogram) - Total Metals

This table summarizes the analytical laboratory vegetation analyses for total metals. These data are inconclusive, as samples from the background site (Site 1) exhibited higher levels than the Oxbow Lake site for six of the total 12 metals analyzed; whereas the Oxbow Lake site exceeded levels for 5 of the 12 metals analyzed. One metal, boron, was not detected in any samples.

Table 15. UMTRA Phase II –Vegetation Sampling Data: Laboratory Analytical Results (in μCi/kg) – Total Radionuclides

This table summarizes the analytical laboratory vegetation analyses for radionuclides. The background site (Site 1) exceeds the Oxbow Lake site for 2 (Gross alpha and Radium-226) of the 5 radionuclides analyzed. It should be noted however that the other 3 radionuclides (Lead-210, Polonium-210, and Thorium-230) measured in the Oxbow Lake site vegetation samples were not detected in the Little Wind River vegetation samples.

Task 7. Determine if institutional controls should be developed for environmental media other than groundwater – i.e., surface water, sediments, and biota.

As the results from the immediately preceding sections indicate, there appear to be several areas within the project area which may warrant the development and implementation of new institutional controls to prevent public access to both surface water and sediment. In particular, it appears that the Oxbow Lake (Site 5), the constructed wetland (Site7/8), and the West Side Irrigation ditch may be providing unrestricted access to contaminated surface water and surficial sediments.

Vegetative analyses were fairly inconclusive and more data need to be collected on other vegetative types – i.e., forbs and grasses versus shrubs and small trees. Forbs and grasses would better represent the preferred food of livestock which in turn may be directly ingested by humans.

Task 8. Prepare Phase II surface water, sediment, and biota assessment final report.

This report serves as the completion of Task 8.

Summary of Results

1. There appears to be potentially significant surface water pollution at several sites including the Oxbow Lake, West Side Irrigation Ditch, and the constructed wetland. While the Oxbow Lake has been identified and known as a potential point of contact with contaminated surface water, the other two sites may indicate that the groundwater plume is greater in extent than DOE has suggested. These sites may also indicate that there is mound of groundwater under the UMTRA site and may be following preferential pathways such as paleo-channels.
2. Sediments from the Oxbow lake, west Side Irrigation Ditch, and the constructed wetland (Sites 7/8) exhibit elevated levels of some major ions, metals, and radionuclides, when compared to most other sites.
3. Crayfish samples from the Oxbow Lake exhibit elevated levels of many COPC (including uranium), when compared to another site on the Little Wind River, however, levels of radionuclides appear to indicate little or no difference between the sites.
4. Carp tissue samples were only collected from the Oxbow Lake (Site 5) and have not been compared to other fish tissue data.

5. Vegetation tissue data are somewhat inconclusive, however, some radionuclides measured from Oxbow Lake samples were not even detected in the background site samples. Shrubs and small trees were analyzed; the correct vegetative types may be forbs and grasses, to adequately determine uptake by livestock.

Recommendations

Based upon the limited data available, it is recommended that the WREQC Water Quality Program locate funds in order to:

1. Collect additional data on crayfish and carp tissue, sediments, and vegetation.
2. Further define/delineate the polluted shallow aquifer and its exposure in surface waters, i.e. wetlands and streams – Oxbow Lake and other natural and constructed wetlands, gravel pits, and streams.
3. Establish effective institutional controls to prevent access to potentially impacted surface waters.

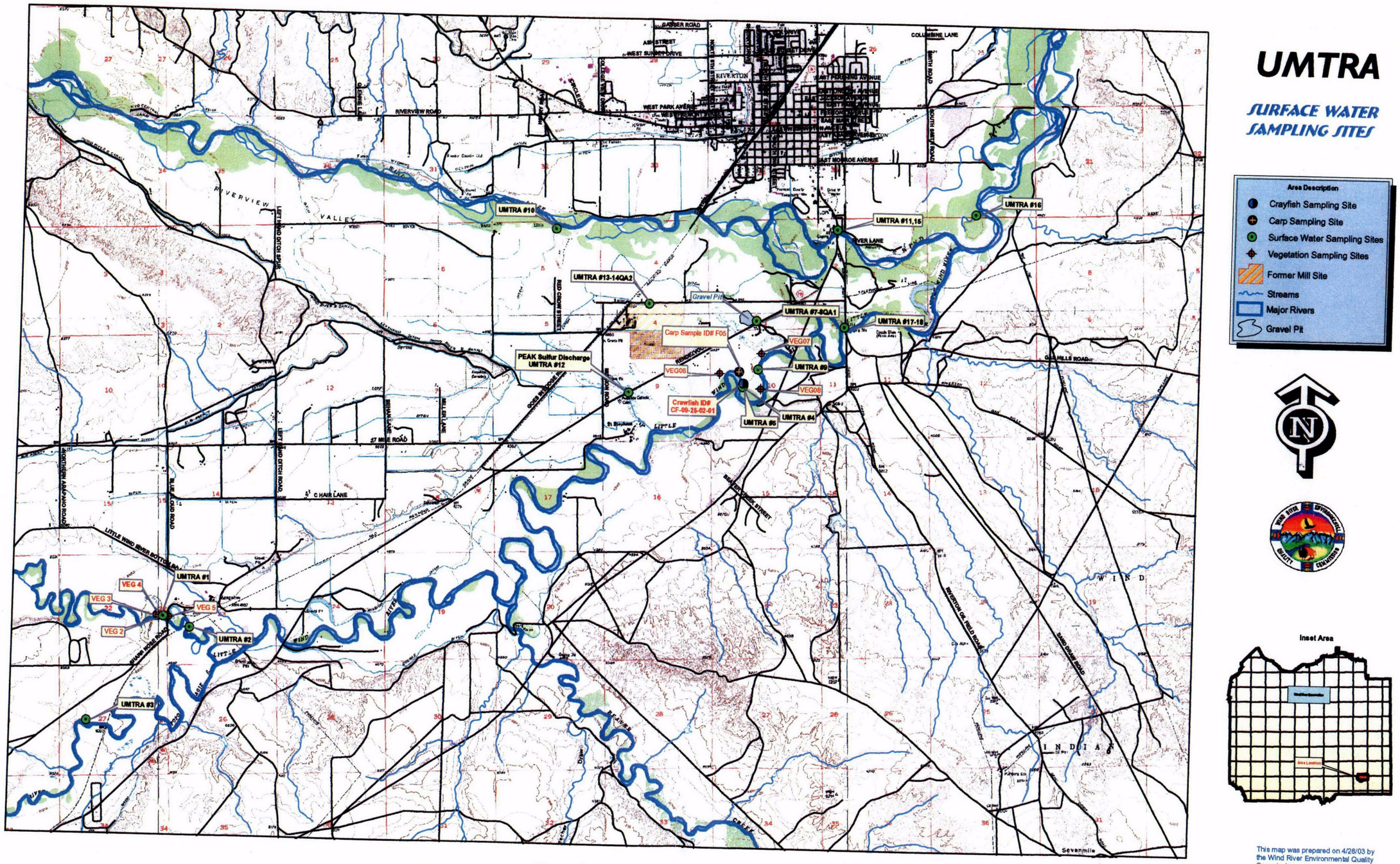

UMTRA
SURFACE WATER SAMPLING SITES
Area Description
Crayfish Sampling Site
Carp Sampling Site
Surface Water Sampling Sites
Vegetation Sampling Sites
Former Mill Site
Streams
Major Rivers
Gravel Pit
UMTRA #10
UMTRA #13-14QA2
UMTRA #11,16
UMTRA #16
UMTRA #7-8QA1
UMTRA #17-18
Carp Sample ID# F05
PEAK Sulfur Discharge UMTRA #12
VEG07
VEG06
VEG08
UMTRA #9
UMTRA #5
UMTRA #4
Crawfish ID# CF-09-25-02-01
UMTRA #1
VEG 4
VEG 3
VEG 5
VEG 2
UMTRA #2
UMTRA #3
RIVERTON
RIVERVIEW ROAD
RIVERVIEW VALLEY
LEFT HAND DITCH DRIVE
LEFT HAND DITCH ROAD
BLUE GRASS ROAD
WILSON HOME ROAD
LITTLE WIND RIVER BOTTOMS RD
C HAIR LANE
37 MILE ROAD
WEST PARK AVENUE
EAST PARK AVENUE
EAST MONROE AVENUE
COLUMBINE LANE
SOUTH MAIN STREET
SOUTH 3RD STREET
RIVER LANE
GAS HILLS ROAD
RIVERTON GAS FIELD ROAD
SAND DRAW ROAD
WIND
INDIAN
Sevenmile
Inset Area
This map was prepared on 4/28/03 by the Wind River Environmental Quality Commission.

Figure 1.

UMTRA Phase II

Surface Water, Sediment, and Biota

Tables

Table 1. Surface Water, Sediment, and Biota Sampling Locations

Site Number, Name, and Description	Figure 1 Location Number	Background (B) or downstream (DS) of UMTRA Site*
UMTRA 1:Little Wind River above steel bridge	1	B
UMTRA 2: Little Wind River below steel bridge @G36	2	B
UMTRA 3: Little Wind River below old RR crossing below G36	3	B
UMTRA 4: Little Wind River just upstream from Oxbow Lake	4	B/DS
UMTRA 5: Oxbow Lake	5	DS
UMTRA 7: Constructed Wetland on highway 138	7/8	DS
UMTRA 8: Constructed Wetland on highway 138 – QA sample	7/8	DS
UMTRA 9: Little Wind River just upstream from highway 789	9	DS
UMTRA 10: Wind River - end of Red Crow Lane	10	B
UMTRA 11: Wind River @ G22/highway 789	11	DS
UMTRA 12: drainage ditch/Peak Sulphur discharge	12	B/DS
UMTRA 13: Gravel pit @ ne corner of UMTRA site	13/14	B/DS
UMTRA 14: Gravel pit @ ne corner of UMTRA site - QA sample	13/14	B/DS
UMTRA 15: Wind River @ G22/highway 789	11/15	DS
UMTRA 16: Wind River @ Rendezvous site	16	DS
UMTRA 17: Little Wind River @ G45/Sand Draw highway	17	DS
UMTRA 18: Little Wind River @ G45 – QA sample	17/18	DS

* Sites designated as B/DS have not been adequately identified as being either background or down stream sites

Table 2. UMTRA Phase II - Surface Water Sampling Sites – Multi-Parameter Field Instrument Results – Field Parameters

Site #		Air Temp (^{0}F)	Water Temp (^{0}F)	Specific Conductance (microsiemens)	TDS (mg/L)	Salinity (Parts per thousand)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	pH	NH_4 (mg/L)	NO_3 (mg/L)	Cl (mg/L)	Turbidity
1		70	64	1,105	0.718	0.55	122	11.63	8.38	0.228	0.618	8.875	16.2
2			62	1,116	0.725	0.56	122.9	11.95	8.24	0.214	0.381	9.203	14.7
3			64	1,200	0.8	0.6	112.5	10.62	8.78	0.2	0.4	7.2	38.3
4			61	1,200	0.8	0.6	--	--	7.57	2.9	0.04	1.4	38.3
5			64	1,700	1.1	0.8	--	--	8.17	2.1	0.09	5.3	71.8
7			57	1,800	1.2	1.0	87.5	8.94	9.06	2.2	0.3	17.98	10.7
8			--	--	--	--	--	--	--	--	--	--	--
9			54	1,100	0.7	0.5	107.1	11.33	8.43	0.6	0.08	2.4	20.4
10			55	--	0.3	0.2	107.6	11.34	8.6	0.4	--	0.9	26.6
11			32	514	0.3	0.2	91.3	13.3	8.12	0.09	--	--	24.9
12			40	2,701	1.8	1.4	8.4	1.02	7.73	0.2	--	51.3	50.9
13			36	1,577	1.03	0.8	93.7	12.71	7.94	0.2	--	102.6	15.2
14			--	--	--	--	--	--	--	--	--	--	--
15			50	322.3	--	0.2	--	--	7.98	--	--	--	--
16			48	355.4	--	0.5	--	--	8.10	--	--	--	--
17			43	594	--	0.5	--	--	8.12	--	--	--	--
18			--	--	--	--	--	--	--	--	--	--	--

Values in bold blue (e.g. 122) indicate that this was the highest value recorded for that constituent.
Values in bold red (eg. 7.57) indicates that this was the lowest value recorded for that constituent.
-- No data available or QA Site
* Sediments disturbed in Oxbow Lake

C02

Table 3. UMTRA Phase II - Surface Water Sampling Sites Laboratory Analytical Results (in milligrams per liter) - Major Ions

Site #		Br	Ca	Cl (MCL=250)	Fl (MCL=4)	Mg	K	Si	Na	SO_4 (MCL= 250)
1		ND	96.5	13.0	0.6	52.1	5.3	9.34	87.8	**382**
2		--	--	--	--	--	--	--	--	**389**
3		ND	120	11.6	0.4	50.3	4.8	10.7	91.7	**398**
4		ND	108	13.6	0.5	48.5	5.7	12.2	112	**420**
5		ND	--	71.2	--	49.4	7.8	9.68	224	**574**
7		ND	27.4	49.8	0.7	88.8	14.2	15.4	279	**527**
8		ND	27.8	49.5	0.7	**90.2**	**14.4**	15.7	284	**515**
9		ND	112	10.2	0.4	47.0	4.7	10.6	91.4	**378**
10		ND	55,4	3.4	0.4	17.0	3.9	17.6	24.6	61.4
11		ND	63.5	6.1	0.4	18.2	3.1	18.6	27.5	70.0
12		ND	42.7	12.1	**0.8**	9.4	2.4	20.2	**576**	**988**
13		ND	**122**	97.2	0.4	42.5	6.2	10.3	164	**523**
14		ND	110	**101**	0.4	38.2	5.4	9.23	148	**526**
15		ND	52.9	5.8	0.4	15.7	2.6	16.1	19.2	59.7
16		**0.87**	61.4	5.8	0.4	17.6	2.9	**16.8**	26.7	66.4
17		ND	105	9.2	0.4	38.4	2.7	10.4	61.9	**281**
18		ND	101	9.6	0.4	37.0	3.9	10.2	70.0	**285**

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)
Values in bold red (eg. **382**) indicates exceedances of Maximum Contaminant Levels. (MCLs) provided in Laboratory Analytical Reports
Values in bold blue (e.g. **122**) indicate that this was the highest value recorded for that constituent. MCL may or may not have been exceeded; refer to MCL at top of column
-- No data available

Table 4. UMTRA Phase II - Surface Water Sampling Sites Laboratory Analytical Results (in milligrams per liter) - Total Metals

Site #	Al (MCL=0.2)	As (MCL=0.01)	B	Fe (MCL=0.3)	Mn (MCL=0.05)	Mo	Ni (MCL=0.1)	Se (MCL=0.05)	Sr	U (MCL=0.03)	V	Zn (MCL=5.0)
1	0.14	0.002	0.17	0.181	0.07	0.003	0.002	0.002	1.45	0.0112	0.004	0.003
2	--	--	--	--	--	--	--	--	--	--	--	--
3	**0.427**	0.002	0.18	**0.402**	**0.09**	0.001	0.002	0.002	1.57	0.0102	0.003	0.004
4	**0.644**	0.002	0.17	**0.657**	**0.16**	0.003	0.002	0.001	1.42	0.0127	0.004	0.005
5	**0.525**	0.004	0.17	**0.543**	**0.36**	**0.018**	0.004	**0.003**	0.582	**0.311**	0.008	0.004
7	0.134	**0.012**	**0.27**	0.149	**0.12**	0.004	0.003	0.002	0.169	0.0117	0.008	0.003
8	0.144	**0.012**	**0.27**	0.155	**0.12**	0.004	0.003	0.002	0.176	0.0111	**0.009**	0.003
9	**0.379**	0.002	0.16	**0.416**	**0.07**	0.002	0.002	**0.003**	1.38	0.0107	0.004	0.003
10	**0.522**	0.002	ND	**0.412**	0.03	0.001	0.001	0.002	0.358	0.0042	0.006	0.002
11	**0.534**	0.003	ND	**0.369**	0.022	0.001	ND	0.002	0.24	0.0046	0.005	ND
12	**1.37**	0.010	0.17	**2.17**	**0.079**	0.006	**0.011**	0.002	0.16	0.0048	0.008	**0.014**
13	0.053	0.003	ND	0.051	0.041	0.005	0.002	0.002	0.97	0.0091	0.005	ND
14	0.059	0.003	ND	0.050	0.038	0.005	0.002	0.003	0.87	0.0087	0.005	ND
15	**0.550**	0.003	ND	**0.380**	0.021	0.002	0.002	ND	**3.16**	0.0032	0.007	ND
16	**0.251**	0.003	ND	0.168	0.012	0.001	0.001	ND	0.76	0.0051	0.006	ND
17	**0.375**	0.002	ND	**0.319**	0.040	0.002	0.002	0.001	0.65	0.0095	0.005	ND
18	**0.381**	0.001	ND	0.295	0.040	0.002	0.003	ND	0.62	0.0096	0.004	ND

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)
Values in bold red (eg. **0.427**) indicates exceedance of Maximum Contaminant Levels in Safe Drinking Water Act. (MCLs) also provided in Laboratory Analytical Reports
Values in bold blue (e.g. **1.37**) indicate that this was the highest value recorded for that constituent – MCL may or may not be exceeded – see top of column for MCL
- - Data not available

Table 5. UMTRA Phase II - Surface Water Sampling Sites Laboratory Analytical Results in picoCuries per liter (pCi/L) - Total Radionuclides

Site #	Gross Alpha (MCL=15)	Pb-210	Po-210	Ra-226	Th-230
1	4.4	ND	ND	ND	ND
2	- -	- -	- -	- -	- -
3	3.0	ND	ND	ND	ND
4	4.8	ND	ND	ND	ND
5	**57.7**	ND	ND	ND	ND
7	3.0	ND	ND	ND	ND
8	3.3	ND	ND	ND	ND
9	2.5	ND	ND	ND	ND
10	1.9	ND	ND	ND	ND
11	3.0	ND	ND	0.6	ND
12	4.0	ND	ND	0.7	ND
13	2.2	ND	ND	**1.3**	ND
14	3.9	ND	ND	0.9	ND
15	2.5	ND	ND	0.8	ND
16	1.9	ND	ND	ND	ND
17	3.6	ND	ND	0.6	**0.6**
18	3.6	ND	ND	0.9	ND

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)
Number in bold red (eg. **0.2**) indicates exceedances of Maximum Contaminant Levels in the Safe Drinking Water Act. (MCLs) provided in Laboratory Analytical Reports
Values in bold blue (e.g. **57.7**) indicate that this was the highest value recorded for that constituent – MCL may or may not be exceeded – see top of column for MCL
- - Data not available

Table 6. UMTRA Phase II - Sediment Sampling Sites; Laboratory Analytical Results (in milligrams per kilogram) - Major Ions

Site #		Br	Ca	Cl	Fl	Mg	K	Si	Na	SO_4
1		6.7	12,500	72	**14.4**	4,850	664	1,280	292	49
2		ND	14,100	38	5.4	3,890	492	1,220	ND	63
3		ND	13,400	30	5.2	4,400	806	1,420	ND	70
4		**6.8**	8,030	42	10.3	1,220	204	947	ND	75
5		ND	30,200	45	9.5	**12,800**	4,170	1,530	322	**1,730**
7		ND	61,300	117	ND	12,200	2,750	**1,750**	1,140	335
8		ND	**67,400**	**145**	ND	**12,800**	**2,880**	1,660	**1,350**	413
9		ND	11,500	60	ND	2,550	769	1,490	ND	95
10		ND	17,800	19	ND	6,600	444	1,130	536	44

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)

Values in bold blue (e.g.**67,400**) indicate that this was the highest value recorded for that constituent.

COC

Table 7. UMTRA Phase II – Sediment Sampling Sites Laboratory Analytical Results (in milligrams per kilogram) - Total Metals

Site #	Al	As	B	Fe	Mn	Mo	Ni	Se	Sr	V	Zn
1	6,060	1.91	46	17,700	275	0.37	13.5	0.29	36.3	33.6	27.0
2	4,060	1.87	33	10,800	186	0.40	6.18	0.63	46.7	21.1	18.2
3	6,120	2.01	38	13,500	263	0.23	7.46	0.44	49.3	22.9	22.9
4	2,370	2.15	25	8,960	300	0.19	3.80	0.33	28.0	9.47	10.2
5	**27,000**	4.11	**71**	**21,400**	398	0.52	**30.1**	0.64	102	**47.8**	**54.5**
7	15,200	2.38	50	14,900	780	**0.94**	25.4	0.47	273	37.8	40.5
8	15,800	2.47	48	14,600	**862**	0.90	25.5	0.71	**318**	39.3	41.6
9	5,340	**4.88**	22	7,650	190	0.24	6.10	**0.79**	55.0	25.4	16.3
10	6,380	1.00	26	9,620	158	0.17	13.6	0.16	78.5	24.5	17.5

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)

Values in bold blue (e.g. **4.88**) indicate that this was the highest value recorded for that constituent.

Table 8. **UMTRA Phase II – Sediment Sampling Sites Laboratory Analytical Results in picoCuries per gram (pCi/g) - Total Radionuclides**

Site #	Gross Alpha	Gross Beta	Pb-210	Po-210	Ra-226	Ra-228	Th-230	U
1	**3.8**	25.2	ND	**3.9**	**1.7**	0.7	0.3	0.75
2	3.0	26.5	ND	2.6	1.3	0.6	0.2	0.59
3	1.4	23.1	ND	ND	1.0	0.8	0.3	0.80
4	1.0	19.7	ND	1.2	0.9	0.7	0.2	0.43
5	3.0	**29.4**	0.64	ND	1.5	1.0	0.3	**9.23**
7	1.6	22.5	**0.77**	1.1	1.1	0.8	**0.4**	1.82
8	1.3	22.0	ND	ND	1.2	0.8	0.3	2.03
9	1.4	19.2	ND	3.0	1.2	0.8	0.2	0.70
10	ND	17.1	ND	ND	0.5	ND	0.10	0.39
12	3.2	- -	0.5	0.3	0.5	**12.3**	**0.4**	- -

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)

Values in bold blue (e.g. **29.4**) indicate that this was the highest value recorded for that constituent.

- - Data not available

Table 9. UMTRA Phase II – Crayfish Sampling Data; Laboratory Analytical Results (in milligrams per lkilogram) – Inorganic Constituents

Sample Site	Al	As	B	Br	Ca	Cl	Fl	Fe	Mg	Mn	Mo	Ni	K	Se	Si	Na	Sr	SO4	U	V	Zn
Oxbow Lake	**308**	**0.88**	ND	23.3	**27,800**	**11,100**	ND	**230**	**696**	**31.2**	ND	**0.69**	**1,840**	**1.06**	**566**	**1,580**	**129**	776	**0.55**	**0.84**	16.6
Little Wind River	60.6	0.52	ND	**25.1**	16,300	2,070	ND	49	475	25.4	**0.09**	0.19	1,830	0.63	340	1,560	121	**1,010**	0.05	0.17	**17.0**

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)

- - Data not available

Values in bold blue (e.g. **308**) are highest value recorded for that constituent

Table 10. UMTRA Phase II – Crayfish Sampling Data; Laboratory Analytical Results (in *u*Ci/kg) – Total Radionuclides

Sample Site	Lead-210	Polonium-210	Radium-226	Thorium-230
Oxbow Lake	ND	**4.36E-03**	**1.9E-04**	ND
Little Wind River	**9.95E-05**	3.90E-03	1.4E-04	ND

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)

- - Data not available

Values in bold blue (e.g. **9.95E-05**) are highest value recorded for that constituent

Table 11. UMTRA Phase II – Carp Sampling Data; Laboratory Analytical Results (in milligrams per lkilogram) – Inorganic Constituents

Carp Sample Number*	Al	As	B	Br	Ca	Cl	Fl	Fe	Mg	Mn	Mo	Ni	K	Se	Si	Na	Sr	SO_4	U	V	Zn
#1	**95.8**	**0.17**	ND	12.9	8,800	**2,450**	ND	**95**	330	3.68	ND	0.17	1,640	1.00	**456**	**1,460**	**30.1**	535	**0.22**	0.23	35.1
#2	16.1	ND	ND	ND	3,880	1,440	ND	27	252	1.27	**0.07**	ND	**2,410**	0.82	102	731	14.0	498	0.07	0.15	36.6
#3	46.9	0.08	ND	**14.1**	**8,850**	2,240	ND	83	**345**	**6.81**	ND	**0.67**	2,320	**1.39**	278	1,200	28.2	**2,700**	**0.22**	**0.26**	**45.8**

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)

Values in bold blue (e.g. **95.8**) are highest value recorded for that constituent

* All carp samples taken from Oxbow Lake

Table 12. UMTRA Phase II –Carp Sampling Data; Laboratory Analytical Results (in *u*Ci/kg) – Total Radionuclides

Carp Sample Number*	Lead-210	Polonium-210	Radium-226	Thorium-230
#1	ND	9.84E-04	**3.5E-05**	ND
#2	ND	ND	ND	ND
#3	**1.99E-04**	**1.41E-03**	ND	ND

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)

Values in bold blue (e.g. **1.99E-04**) are highest value recorded for that constituent

* All carp samples from Oxbow Lake

Table 13. UMTRA Phase II - Vegetation Sampling Data; Laboratory Analytical Results (in milligrams per kilogram) - Major Ions

Vegetation Sample Location and Number		Br	Ca	Cl	Fl	Mg	K	Si	Na	SO_4
Oxbow Lake #1 (cottonwood)		ND	804	121	ND	258	**1,160**	72	266	718
Oxbow Lake #2 (Russian olive)		ND	1,460	**161**	ND	376	928	**123**	70	**1,080**
Oxbow Lake #3 (willow)		ND	2,010	61.1	ND	395	621	72	181	105
Oxbow Lake #4 (willow)		ND	**3,390**	105	ND	339	992	101	**277**	240
Background #1 (Russian olive)		ND	480	ND	ND	257	1,060	82	ND	ND
Background #2 (Russian olive)		ND	650	ND	ND	321	916	76	ND	ND
Background #3 (willow)		ND	2,900	ND	ND	**569**	949	46	136	238
Background #4 (cottonwood)		ND	1,860	ND	ND	309	892	54	56	ND

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)

Values in bold blue (e.g. **3,390**) are highest value recorded for that constituent

Table 14. UMTRA Phase II –Vegetation Sampling Data; Laboratory Analytical Results (in milligrams per kilogram) - Total Metals

Vegetation Sample Location and Number	Al	As	B	Fe	Mn	Mo	Ni	Se	Sr	U	V	Zn
Oxbow Lake #1 (cottonwood)	21	0.06	ND	44	3.8	**0.25**	0.37	0.07	5	0.17	0.24	2.87
Oxbow Lake #2 (Russian olive)	107	0.09	ND	156	7.6	**0.25**	**0.70**	0.08	13	**0.19**	0.54	7.29
Oxbow Lake #3 (willow)	41	ND	ND	59	3.7	ND	0.32	**0.14**	13	ND	0.27	19.4
Oxbow Lake #4 (willow)	35	0.06	ND	77	7.6	ND	0.62	0.12	16	0.25	0.37	**36.9**
Background #1 (Russian olive)	28.1	ND	ND	45	2.66	0.12	0.22	ND	6.95	ND	0.23	3.19
Background #2 (Russian olive)	79.1	ND	ND	120	4.30	ND	0.32	ND	7.66	ND	0.34	2.92
Background #3 (willow)	**273**	**0.17**	ND	**354**	**12.6**	ND	0.57	ND	**24.4**	0.18	**0.78**	17.6
Background #4 (cottonwood)	29.3	ND	ND	44	2.42	ND	0.15	ND	19.6	ND	0.17	6.82

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)
Values in bold blue (e.g. **273**) are highest value recorded for that constituent

Table 15. UMTRA Phase II –Vegetation Sampling Data; Laboratory Analytical Results (in *u*Ci/kg) – Total Radionuclides

Vegetation Sample Location and Number	Gross Alpha	Lead-210	Polonium-210	Radium-226	Thorium-230
Oxbow Lake #1 (cottonwood)	2.65E-04	**1.1E-04**	**1.05E-03**	ND	**2.4E-05**
Oxbow Lake #2 (Russian olive)	9.42E-04	ND	6.12E-04	ND	ND
Oxbow Lake #3 (willow)	3.58E-04	ND	ND	ND	ND
Oxbow Lake #4 (willow)	3.42E-04	ND	ND	ND	ND
Background #1 (Russian olive)	1.44E-04	ND	ND	ND	ND
Background #2 (Russian olive)	2.28E-04	ND	ND	ND	ND
Background #3 (willow)	**1.77E-03**	ND	ND	**2.0E-05**	ND
Background #4 (cottonwood)	1.2E-04	ND	ND	ND	ND

ND – Not detected at the reporting limit (detection and reporting limits provided in Laboratory Analytical Reports – Attachment C)

Values in bold blue (e.g. **1.77E-03**) are highest value recorded for that constituent

Attachment A

Project Photographs

List of Photographs

Photo #1:	UMTRA Site 1	-	Little Wind River
Photo #2:	UMTRA Site 2 -	Little Wind River	
Photo #3:	UMTRA Site 3 -	Popo Agie River	
Photo #4:	UMTRA Site 4 -	Little Wind River	
Photo #5:	UMTRA Site 5	-	Oxbow Lake
Photo #6:	UMTRA Site 7/8	-	Constructed Wetland
Photo #7:	UMTRA Site 9	-	Little Wind River
Photo #8:	UMTRA Site 10	-	Big Wind River
Photo #9:	UMTRA Sites 11/15	-	Big Wind River
Photo #10:	UMTRA Site 12	-	Westside Irrigation Ditch
Photo #11:	UMTRA Site 13/14	-	Gravel Pit Pond
Photo #12:	UMTRA Site 16	-	Big Wind River
Photo #13:	UMTRA Site 17/18	-	Little Wind River
Photo #14:	Snagging and collection of carp at Oxbow Lake		
Photo #15:	Carp collected at Oxbow Lake		
Photo #16:	Dipper on pole used for sediment and surface water composite samples from standing waterbodies		
Photo #17:	Frog observed at UMTRA Site 2, Little Wind River		
Photo #18:	Backhoe used for excavation of vegetation samples		
Photo #19:	Crayfish observed at UMTRA Site 2, Little Wind River		
Photo #20:	Clam observed in Little Wind River, upstream of UMTRA Project Area		

Photo #1: UMTRA Site 1 - Little Wind River

Background Site

Photo taken looking downstream (east)

Location: Just upstream of G36

Photo #2: UMTRA Site 2 - Little Wind River

Background Site

Photo taken looking downstream (southeast) from north bank

Location: Just downstream of G36

Note: low beaver dam is visible in top center of photo

Photo #3: UMTRA Site 3 - Popo Agie River

Background Site

Photo taken looking downstream from north bank

Location: just upstream of G42

Photo #4: UMTRA Site 4 - Little Wind River

Undetermined if Background or Impacted Site

Photo taken looking upstream (west) from north bank

Location: just upstream of Oxbow Lake

Photo #5: UMTRA Site 5 - Oxbow Lake

Impacted Site

Photo taken looking east

Note: channels made by carp can be observed in sediments in foreground

Photo #6: UMTRA Site 7/8 - Constructed Wetland

Potentially Impacted

Photo taken looking east from south bank

Location: Adjacent to Rendezvous Road

Photo # 7: UMTRA Site 9 - Little Wind River

Potentially Impacted Site

Photo taken looking downstream (north) from south bank

Location: Just upstream of Highway 789 bridge

Photo #8: UMTRA Site 10 - Big Wind River

Expected Background Site

Photo taken looking downstream (northeast) from south bank

Location: ½ mile north of end of Red Crow Lane

Photo #9: UMTRA Sites 11/15 - Big Wind River

Potentially Impacted Site

Photo taken looking upstream (west) from north bank

Location: Bridge on Highway 789, at south edge of Riverton

Photo #10: UMTRA Site 12 - Westside Irrigation Ditch

Expected Impacted Site

Photo taken looking upstream (north) from Rendezvous Road

Location: Adjacent to north side of Rendezvous Road

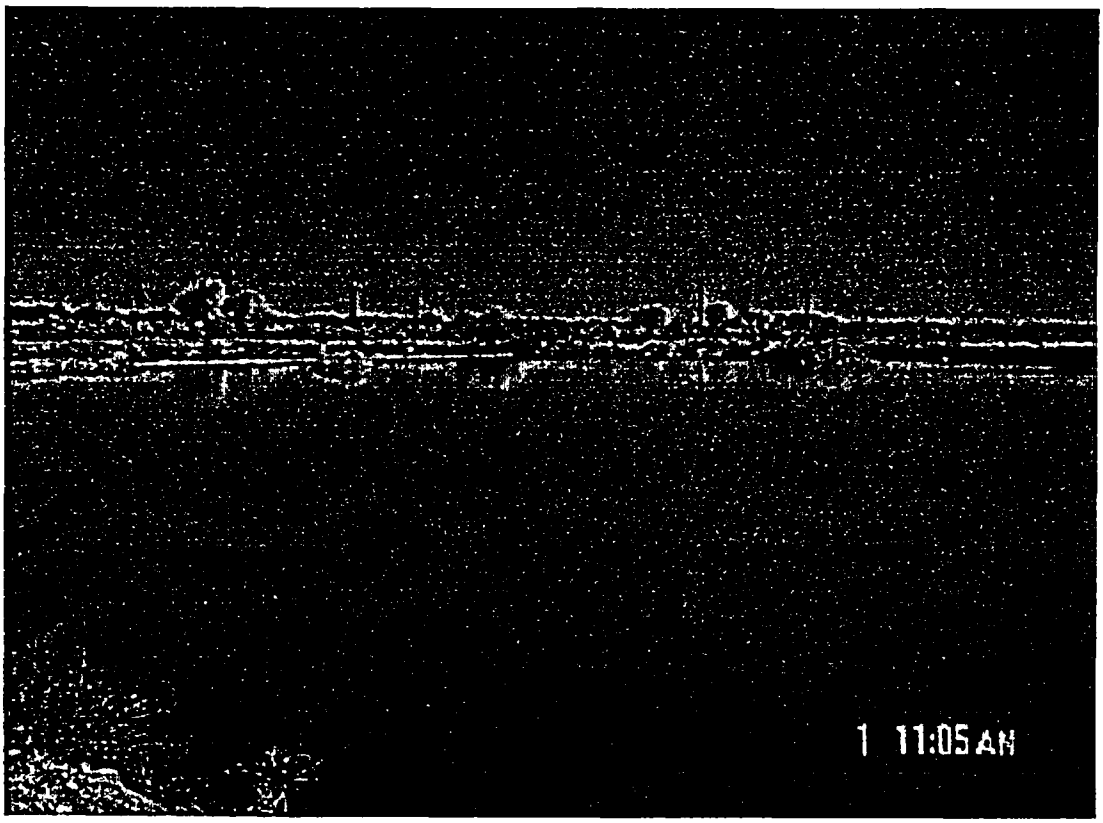


Photo #11: UMTRA Site 13/14 - Gravel Pit Pond

Expected Impacted Site

Photo taken looking northeast from southwest corner of pit

Location: Immediately northeast of Peak Sulfur, to north of Goes In Lodge Road

Photo # 12: UMTRA Site 16 - Big Wind River

Potentially Impacted Site

Photo taken looking

Location: Riverton Rendezvous Site

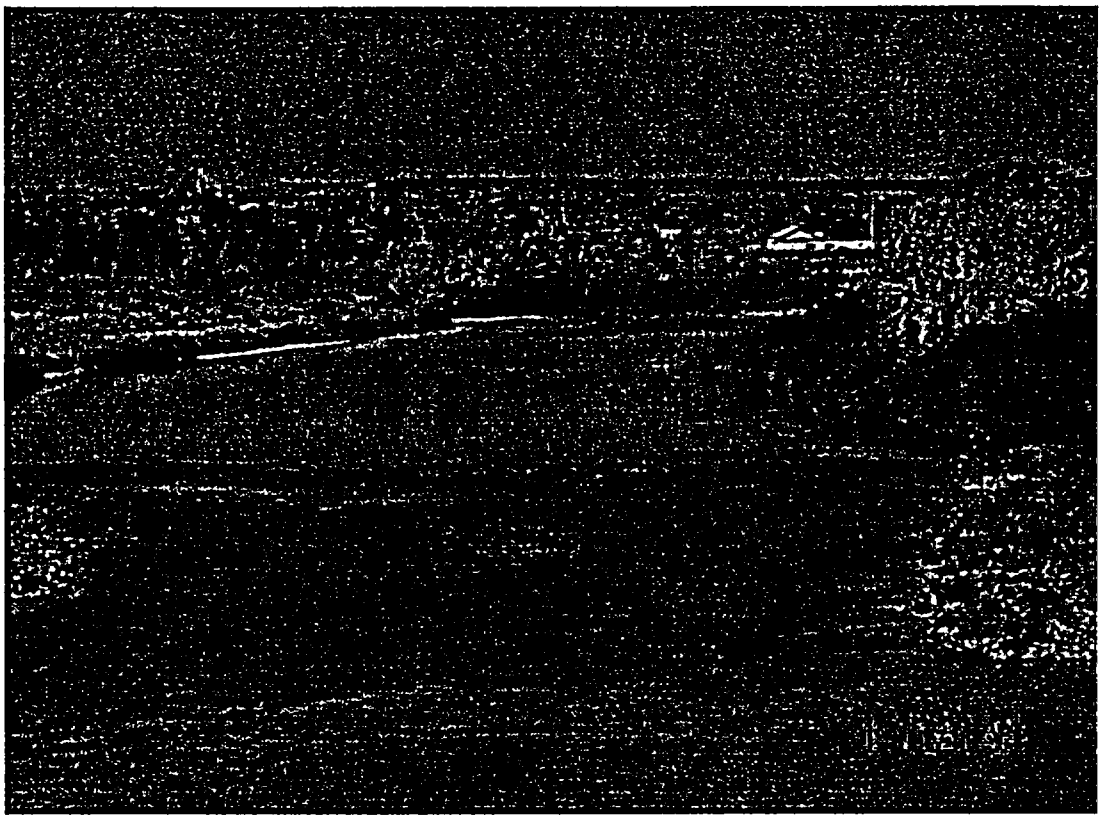


Photo # 13: UMTRA Site 17/18 - Little Wind River

Potentially Impacted Site

Photo taken looking upstream (northwest) from Sand Draw Highway

Location: G45

Photo #14 : Snagging and collection of carp at Oxbow Lake

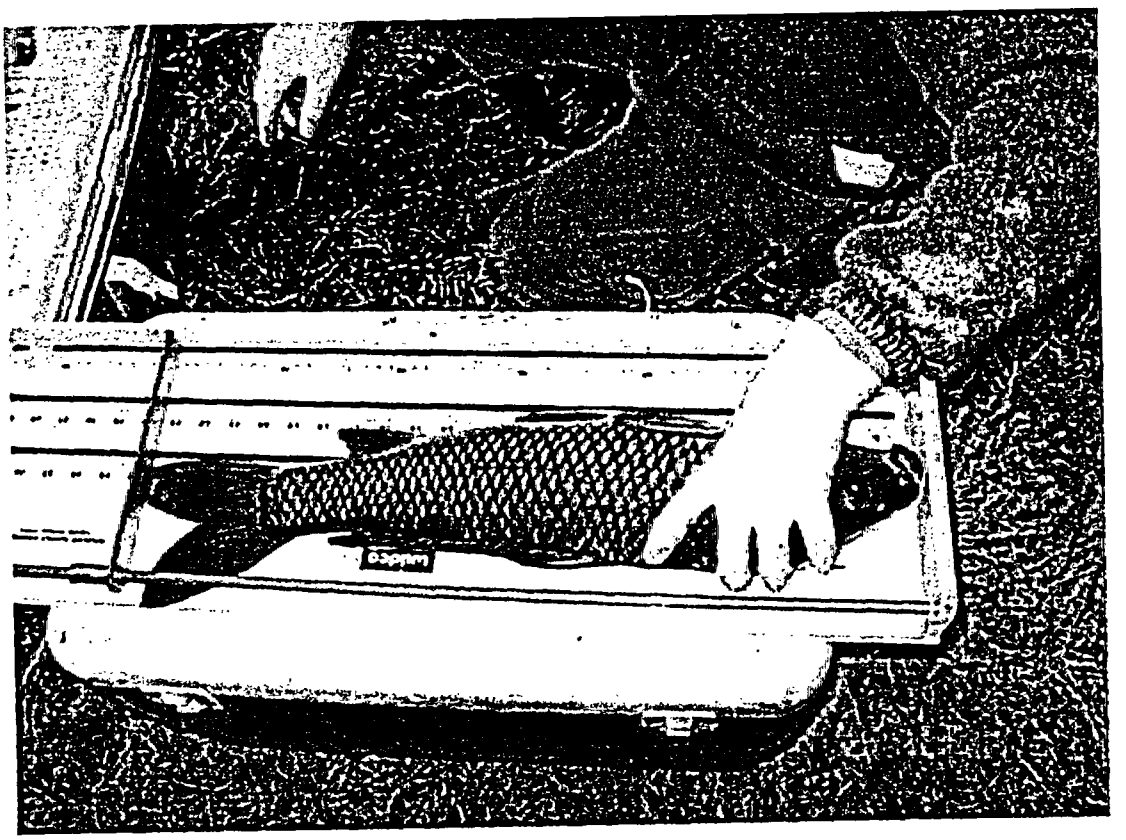


Photo #15 : Carp collected at Oxbow Lake

Photo #16 : Dipper on pole used for sediment and surface water composite samples from standing waterbodies

Photo #17: Frog observed at UMTRA Site 2, Little Wind River

Photo #18: Backhoe used for excavation of vegetation samples

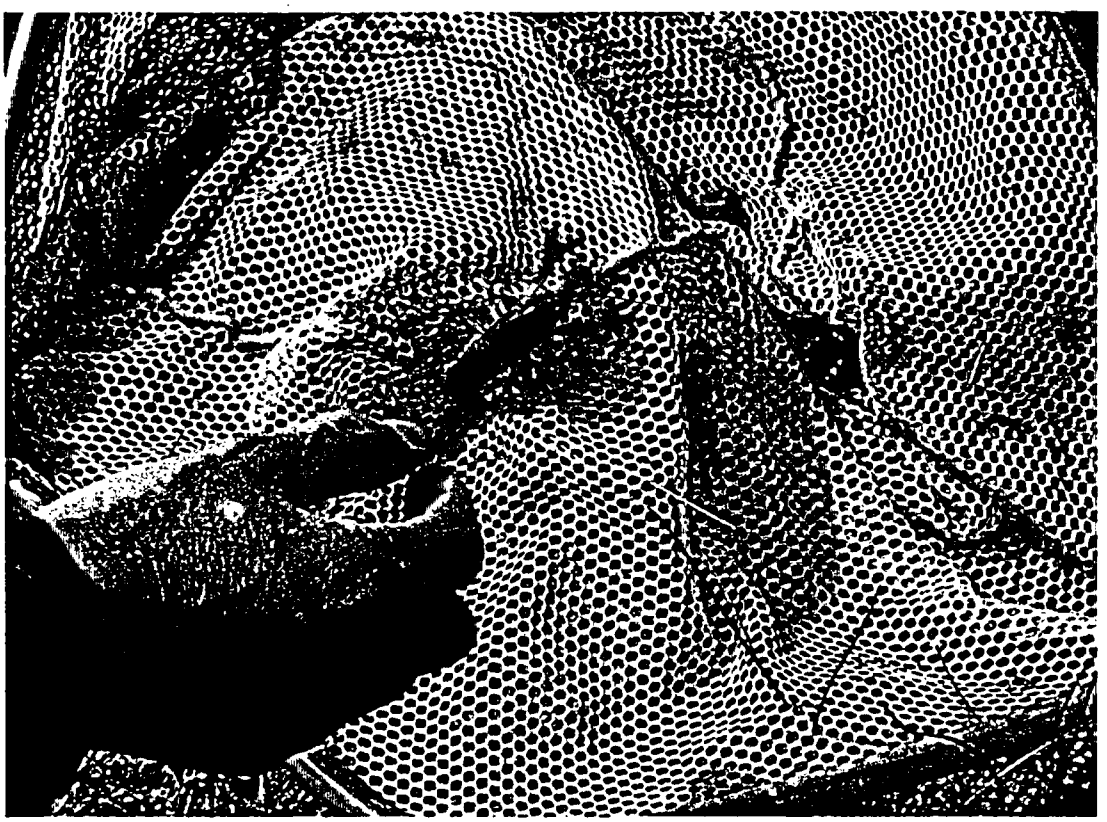


Photo # 19: Crayfish observed at UMTRA Site 2, Little Wind River

Photo #20: Clam observed in Little Wind River, Upstream of UMTRA Project Area

UMTRA Chironomid Deformity Study (2002)
A Rapid Biological Assessment of a contaminated ground water plume.

Oct. 1,02

By theWind River Environmental Quality Commission (WREQC)
(Aragon,D., Babits, S., Haire, D., McGill, E., Shakespear, T., and Shoutis, A.)

Background: This report is part of a larger study (Haire, D., 2003 Final version in progress) on the possible biological effects of a contaminated ground water plume where it interfaces with surface water in an oxbow pond and nearby riparian areas. Please see this larger study for a complete history and background.

Purpose: An investigation of larval chironomid menta and ligula deformities (mouth parts and teeth) was done at the Riverton Uranium Mill Tailings Site during the summer of 2002. This study was conducted in an effort to evaluate the sediments of a contaminated oxbow pond for possible organism geno and tetrato toxicity. We feel biological assessments of the contaminated ground water plume that has been identified by the Department of Energy (USDOE Sept. 1998) is warranted, and an important tool in evaluating the potential health risks for the people living in this area. This study was investigative, of a quick, inexpensive survey nature, and not statistically rigorous. A more thorough study, involving developmental instability concepts (See Tracy, M. 1995) and statistically rigorous methodology (more samples so that estimates of true population means can be made) is proposed even though the results of this survey do not show " a smoking gun ". Related studies do indicate continued contamination problems at the site. (Babbits, S. and Haire, D. 2003. Final Report in progress)

Rationale: The contaminated plume has many identified constituents including arsenic, sulfates, and the radioactive isotopes left over from the yellow cake uranium process. The disintegration series for U-238, the ore in question, shows that even though the radioactive levels may not be high, they do represent very long periods of time for increased risk.
The introduction of the paper by Hudson and Ciborowski (1995) explains the importance of using biological indicators when assessing these kind of potential, multiple, chemical problems. Fig. 3 on the next page shows a normal *Chironomus dilutus* mentum, and two deformed menta in figures 4 and 5. These kinds of deformities are used in assessing the potential biological effects of the site, and especially for contaminated sediments where these organisms live (Hudson and Ciborowski, 1995, Hamilton and Saether, 1971, see also Warwick, Vermeulen, and Zinchenko in lit. cited).

Methods: Chironomids were collected from the contaminated sediments of Oxbow pond I (Fig. I, 7 and ½ min. USGS map). One hundred larvae of a *Chironomus dilutus*, and 100 individuals of a second species, (*Tanypus stellatus*, a predator species) were collected, sorted, identified, cleared, and mounted on microscope slides. Larvae were cleared in KOH and mounted on

microscope slides using CMC–10. Larvae with menta and ligula deformities are counted and a percentage of deformed larvae is calculated.

A second oxbow pond, upstream, from the contaminated plume, was identified and used as a control to determine background deformity levels. Fig. II shows the Arapahoe school oxbow that serves as this background control. The same species and instars of *Chironomus* that were collected in the UMTRA Oxbow Pond were also be collected from this control oxbow, but individuals of the predator species, *Tanypus* could not be found. Again, 100 individuals were collected, cleared and mounted and deformity percentages calculated. A 5% or more increase in deformities at the polluted site from the control oxbow indicate potential serious ecological problems and the need for a much more thorough investigation.

Water Bear Consulting aided the WREQC staff in the collecting, identification and microscope slide work.

Fig. I UMTRA Mill Tailings site and Oxbow Pond I Study

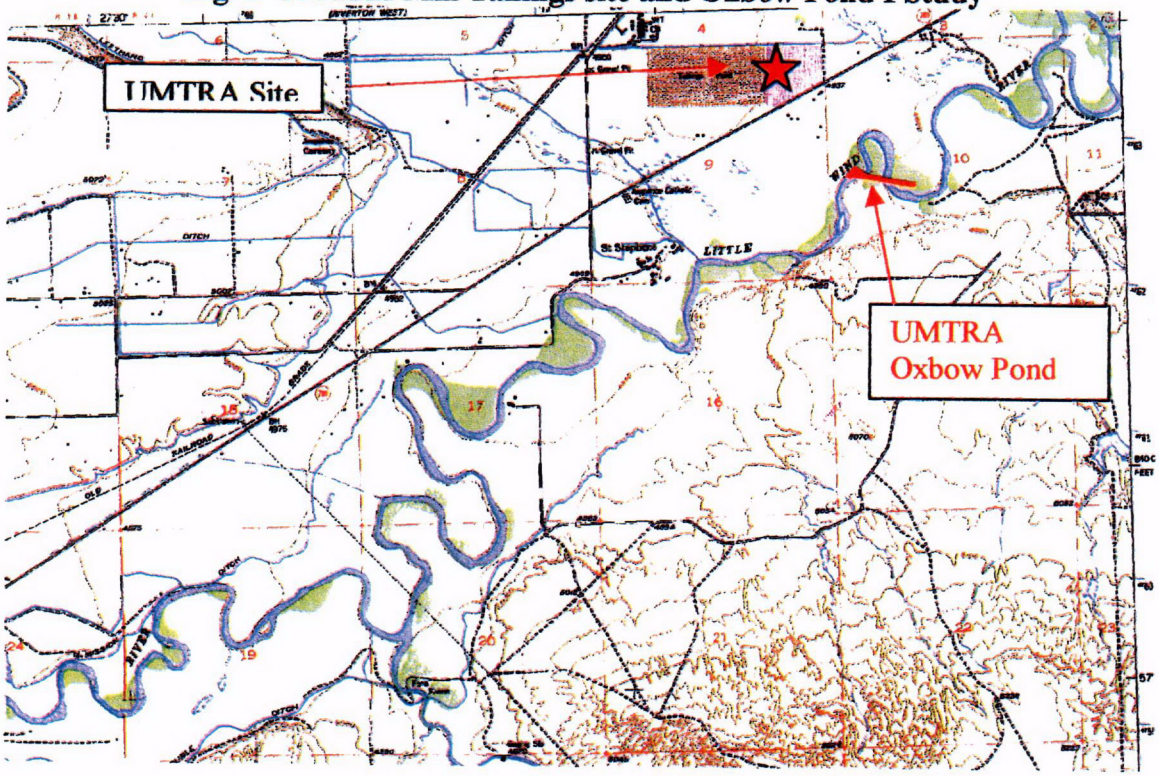
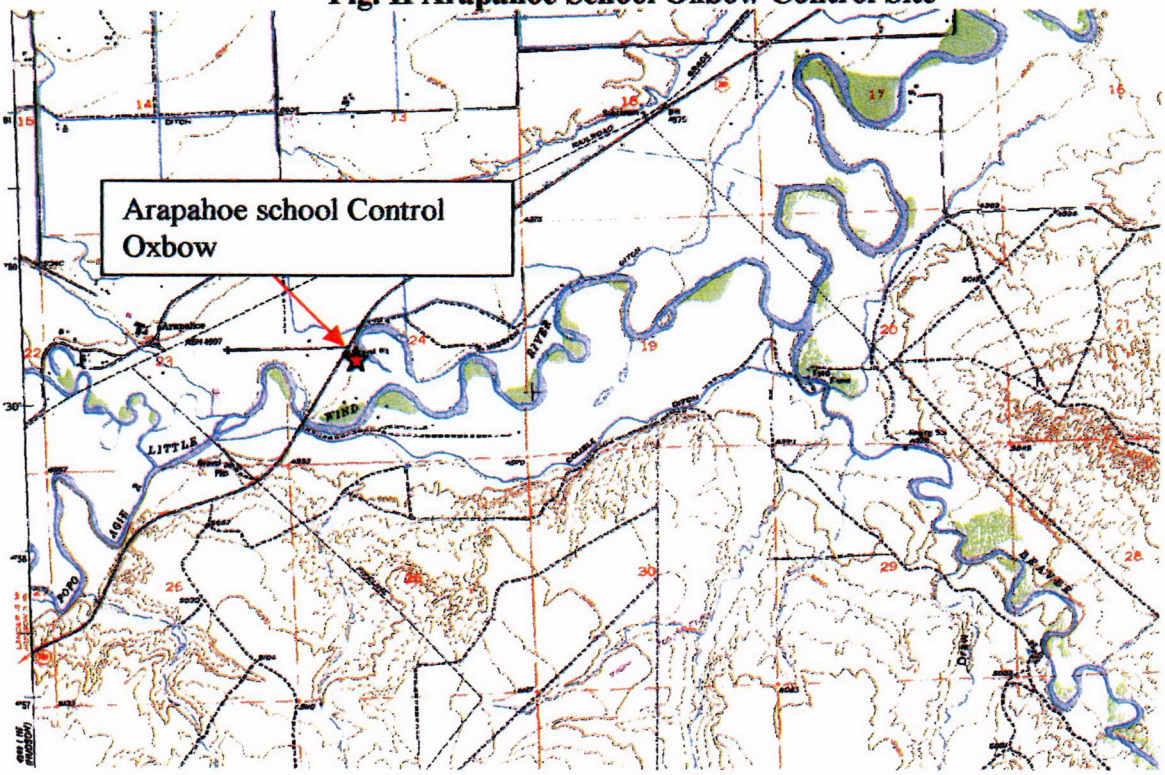


Fig. II Arapahoe School Oxbow Control Site



Equipment and Costs:

Collecting Equipment (WREQC equipment).....no cost
Microscope..(Water Bear Consulting scope).....no cost
Dissecting scope (Water Bear Consulting scope).....no cost
Slides, mounting media, KOH, cover slips, hot plate, acid, etc.....$500
Labor (2 days collecting, 1 day identification and sorting, 4 days
clearing heads and making slides, 1 day measurements and counting
defortmities, 2 days report writing) $3200
transportation.....$128

Total=$3828

Time Frame

The proposed work was to be done the second and third weeks of June, 02, but conflicts moved the collecting into Aug., 2003. This was less than ideal, as *T. stellatus* were just hatching and the UMTRA pond was at very low levels and threatening to dry up totally. If this study is to be repeated in a more vigorous manner, it would be best to collect the individuals for the study in April, just when the ice on the ponds has melted and 4th instar larvae of *C. diltus* can be collected.

Results

One Hundred *Chironomus dilutus* larvae were collected, cleared, and mounted on slides from the UMTRA oxbow and 100 larvae of the predator, *Tanypus stellatus* were also collected. The oxbow pond near the Aapahoe school was selected as the control oxbow for background deformity levels. One hundred *C. dilutus* larvae were collected, cleared, and mounted, but the predator chironomid could not be located in this oxbow or any of the other nearby oxbows.

Fig. 1 shows a normal *C. dilutus* mentum with a symmetrical trifid median tooth and larger partially fused 1st and 2nd lateral teeth.

One larvae from the UMTRA oxbow (Fig. 2, with an extra tooth on the right side of the trifid median tooth) and one larvae from the control oxbow (Fig. 3, the trifid median tooth with a large new growth on the left side) showed a gross mentum deformity. All worn , broken, or otherwise slight or ambiguous deformities were identified as normal individuals. Only clear and distinct deformities, such as fused, missing, extra, strong asymmetry, misshapen teeth with smooth edges, or a combination of these traits were counted as deformed individuals (Dickman et al., 1992).

Both the UMTRA oxbow and the control oxbow had 1% of the larvae with gross deformities, which is a normal deformity background rate (Martinez,E.A., 2002).

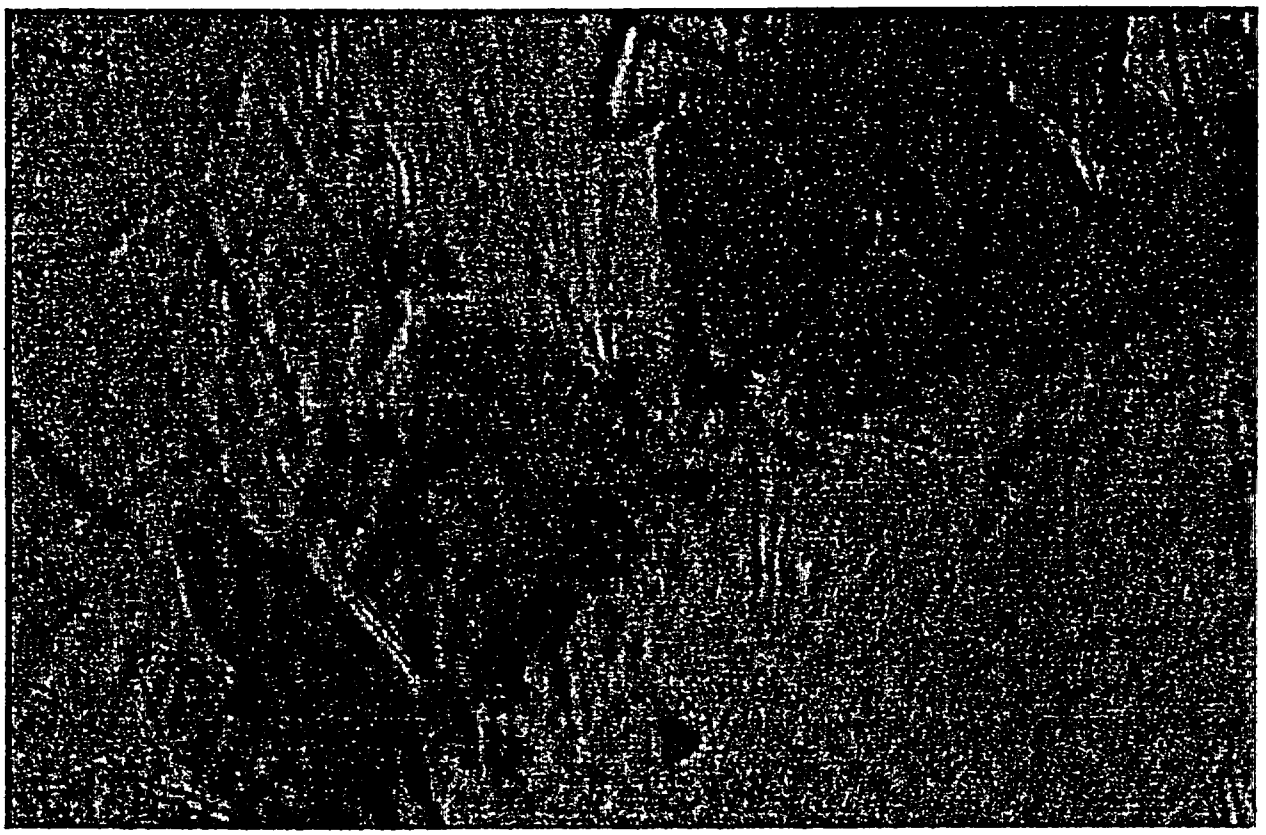
Conclusions

The purpose of this study was to do a very quick, inexpensive, evaluation of the sediments of the UMTRA oxbow in an effort to discover if gross contamination was present and affecting the Chironomid biota. A "smoking gun" was not discovered as high deformity levels in the oxbow chironomids was not exhibited. This does not mean that contamination is not present or affecting these or other biota. Indeed, higher than background levels of contaminats were present in crayfish (*Oronectes virilis*) tissues (Haire, D. per. com., 2003). One hundred individuals is too small a sample, and a larger, more statistical sample will need to be collected and analyzed before any reasonable conclusions can be made. We recommend doing this, since many other problems with the contaminated ground water plume are surfacing in related investigations (S. Babbits, and D. Haire 2003. UMTRA Final Report, in progress)

Fig. 3 A normal *Chironomus dilutus* mentum at 10x

Fig. 4 Deformed mentum with extra tooth on the right side of the median tooth at 40x. From the UMTRA oxbow, slide IXF

Fig. 5 Deformed mentum with extra growth on the left side of the trifid mediam tooth at 40x. Arapahoe school control oxbow slide IIIG



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