Umetco docket 40-8999

The State
of Wyoming

Department of Environmental Quality

Jim Geringer, Governor

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Mr. Curtis O. Sealy
UMETCO Minerals Corporation
P.O. Box 1029
Grand Junction, Colorado 81502-1029

Ms. Elaine Brummett
Nuclear Regulatory Commission
Mail Stop T7J9
Washington, D.C. 20555

Re: Review of the UMETCO Minerals Corporation's (Umetco's) ACL Application, TFN 3 1/258

Dear Mr. Sealy and Ms. Brummett:

The Land Quality Division (LQD) of the Wyoming Department of Environmental Quality has reviewed Umetco's ACL application, and a copy of the review is attached. Several concerns remain, the most critical of which are:

- the effectiveness of the Long-Term Maintenance Area if in-situ uranium mining occurs within that area;
- the impact of elevated sulfate concentrations in two 'hot spots' (and increasing sulfate concentrations elsewhere) on the predictions of contaminant migration;
- whether the proposed change in ambient conditions 'blurs' naturally occurring water quality differences with man-made impacts.

It is my understanding that Umetco has contacted the LQD Lander Office to continue discussion of the first issue, and during that meeting, we can discuss other aspects of the LQD review, if necessary.

If you have any questions or need additional information, please call.

Sincerely,

Richard A. Chancellor

Richard A. Chancellor,
Administrator
Land Quality Division

cc (w/ attachment):
Georgia A. Cash, LQD
Mark Moxley, LQD
Kevin Fredericks, WQD
Russell Edge, DOE
Milton Lammering, EPA
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NM3501 public

WDEQ/LQD Technical Review Comments
Application for Alternate Concentrations Limits
Umetco - TFN 3 1/258 - April 2000

REVIEW SUMMARY

The Umetco Minerals Corporation (Umetco) submitted an application to the Nuclear Regulatory Commission (NRC) to establish Alternate Concentration Limits (ACLs) for ground water, as part of the company's plan for closure of their uranium mill tailings impoundments. A variety of radiological and non-radiological contaminants were introduced into the ground water due to leakage from the tailings impoundment. Umetco's efforts to remove and control migration of these contaminants have proven effective in reducing contaminant concentrations, and Umetco has compiled a significant amount of information on the area mining history as part of their evaluation of subsurface conditions for the ACL application. However, based on review of the information in the ACL application, the Wyoming Department of Environmental Quality/ Land Quality Division believes there are several items of concern that need to be resolved.

- The area Umetco proposes to transfer to the U.S. Department of Energy (DOE) for long-term maintenance includes Mine Unit No. 5 in Power Resources Inc.'s (PRI's) proposed Gas Hills In-Situ Leach (ISL) Uranium Operation. Including an ISL operation with the DOE area is unusual, in part because ISL depends on changes to the ground water conditions, raising questions on:
  - How will responsibilities for collection and analysis of geohydrologic and water quality information before and during any ISL operations be shared by Umetco, PRI, and DOE? For example, the characteristics of North Thunderbird Fault, which may act as barrier to ground water flow from the tailings area to Mine Unit No. 5, have not yet been tested;
  - How will responsibilities for excursions, incursions, and ground water restoration in Mine Unit No. 5 be determined?
  - One of the proposed Points of Exposure (POE) is within Mine Unit No. 5. Considering the changes that will occur within the unit, how will a different POE location be selected?; and
  - Because of extensive historical exploration drilling, how will improperly abandoned drill holes that may affect ground water flow be detected and reworked?

- Elevated sulfate concentrations (>10,000 milligrams/liter) occur in two 'hot spots', one near the Above Ground Tailings Impoundment (AGTI) and one near the A-9 Repository. Also, several other wells show increasing sulfate concentrations, and these elevated concentrations need to be addressed by:
  - Additional monitoring near the AGTI 'hot spot';
  - Evaluation of the benefits of continued remediation of the 'hot spots';
  - Updating the predictions of contaminant migration with the elevated concentrations; and
  - Calculating/estimating a mass balance for the tailings leakage and remediation.

- Rather than changing 'ambient' concentrations, the evaluations of impacts should rely more heavily on delineating differences in downgradient conditions (already completed in part).

- Because of elevated sulfate concentrations in wells near two of the three drainages that extend north from the AGTI, data should be collected on:
  - Depth and saturation of alluvial deposits and sediment quality at intervals along the channels;
  - Well construction and lithology of wells adjacent to drainages; and
  - Incorporation of these wells in the proposed long-term monitoring plan.

- 'Record keeping' items that can be readily addressed include:
  - Updating the analytical results to include the AGTI tailings;
  - Compiling a list of the well 'histories';
  - Applying for State Engineer permits for the long-term monitoring wells.

MEMORANDUM

TO: Mark Moxley, District II Supervisor
FROM: Roberta N. Hoy, Geohydrologist
DATE: April 10, 2000
RE: Review of Umetco ACL Application - TFN 3 1/258

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1.0 INTRODUCTION

In February 1999, Umetco Minerals Corporation (Umetco) submitted an application to the Nuclear Regulatory Commission (NRC) for Alternate Concentration Limits (ACLs) for ground water, as part of the company's plan for closure of their uranium tailings impoundments in central Wyoming (Figure 1). ACLs for ground water are designed to be set on a parameter-by-parameter basis to allow variation from specific standards at a Point of Compliance (POC) while still ensuring protection of human health and the environment at a Point of Exposure (POE). A map of the site, showing the site boundaries and the locations of the POCs and POEs proposed to NRC, is included as Figure 2. At Umetco's site, there are two 'sets' of POCs and POEs because of the presence of two ground water flow regimes, one to the west and one to the southwest.

The ACL application addressed standards for water quality parameters of concern to the NRC, specifically radionuclides and select toxic metals[1], and water quality standards for non-radiological parameters which are also of concern to the Wyoming Department of Environmental Quality (WDEQ). Umetco also compiled information on historic activities, both within and in areas adjacent to the Umetco site to: (a) demonstrate some of the difficulties encountered in analyzing the tailings impacts; (b) justify some of approaches used to analyze the tailings impacts (e.g., re-evaluation of ambient water quality conditions); and (c) illustrate water quality variations (e.g., changes in oxidation/reduction distribution) as a result of the historic activities.

During review of the ACL application, submitted to the Land Quality Division (LQD) of the WDEQ in April 1999, the LQD found five items of concern. The first is the inclusion of a portion of Power Resources Inc.'s (PRI's) proposed Gas Hills Uranium In-Situ Leach (ISL) Project in the area that Umetco is requesting to turn over to the U.S. Department of Energy (DOE) for long-term maintenance (Figure 2).[2] Supplemental information on this topic was received in January 2000, but concerns remain. The second is the presence of 'hot spots' and increasing sulfate concentrations in portions of the Umetco site. The third is the extent of the changes Umetco proposes for evaluating ambient ground water conditions, and the fourth is the influence of the three drainages extending north from the northern portion of the Umetco site. Each of the first four items are discussed in more detail in the following sections. The fifth item relates to clarification of the application record. Suggestions for resolution of all five items are included in the last section of this review. Because the LQD has somewhat different concerns and review approach than NRC, general differences between the reviews are outlined in following section.

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[1] For the western flow regime, the radionuclides include Gross Alpha, Lead-210, and Radium-226 and 228, and the metals include Arsenic, Beryllium,, Nickel, Selenium, and Uranium. For the southwestern flow regime, the radionuclides include Gross Alpha, Lead-210, Radium-226 and 228, and Thorium-230, and the metals include Beryllium, Nickel, and Uranium.

[2] The State of Wyoming had the option for accepting title to this site, once the NRC license was terminated, but declined the option (letter of 7/15/94 from D. Hemmer to J. Virgona). Therefore, the federal agency which will take title is the U.S. Department of Energy (DOE).

2.0 REVIEW FOCUS

The NRC's review process for ACL applications is outlined in their January 1996 Staff Technical Position Paper titled "Alternate Concentration Limits for Title II Uranium Mills". The LQD's concerns in review of mine-related ground water issues are outlined in the Wyoming Statutes (W.S. §35-11-401 *et seq.*), LQD's Rules and Regulations, and general guidelines (e.g., Guideline 8 - Hydrology).

2.1 Focus of the LQD Review. The LQD's primary concern in review of this (and other) ACL applications is that the long-term water quality in the vicinity of this site support proposed post-mining land uses. Therefore, this review focuses on proposed land and water uses. Another LQD concern in this review is that the technical support is adequate for the proposed ACLs. Therefore, this review focuses on the site characterization and assumptions used to predict long-term water quality conditions.

Land & Water Uses. The land use within the Long-Term Care Boundary will be controlled by the DOE, once the NRC's requirements for site closure have been met. However, the LQD believes that land use outside this boundary should not be restricted. The available water supply, even close to the boundary, should be of sufficient quality to support the same uses the water was used for prior to tailings disposal and any other uses for which the water could have been used prior to tailings disposal, based on Class-of-Use standards set by the WDEQ Water Quality Division (WQD) (Section 6.0 and Appendix A). Therefore, LQD considers the primary ground water restoration goal to be baseline conditions and the secondary goal to be 'class-of-use'.

The prior land use at this site, and the long-term land use proposed by Umetco (except in the immediate vicinity of the tailings and heap leach areas), is livestock and wildlife grazing (Umetco 1997-98 Annual Report to LQD, Page 4-1, & Union Carbide Corp. 1973 Conversion Report to LQD, Page 47). In this instance, however, there is now a complicating factor - a proposed in-situ uranium mine to the south of the Umetco site. In fact, the southern portion of Umetco's proposed Long-Term Care Area overlaps the northern portion of PRI's proposed ISL project - as shown on Figure 2, much of PRI's proposed Mine Unit No. 5 lies within Umetco's proposed Long-Term Care Boundary. Therefore, the concern becomes whether the Umetco and PRI operations are compatible and whether long-term concerns can be met through restoration/reclamation.

Site Characterization & Assumptions. Many mining-related activities in Wyoming began before, or about the time, regulations were developed for site characterization and reclamation. Therefore, characterization of the pre-mining ('baseline') site conditions and conditions during the early stages of tailings disposal are generally limited. As a result, the predictions of long-term ground water conditions are often based on assumptions about site conditions before and during tailings disposal. In addition, the predictions must also be based on 'simplified' conditions because of mathematical limitations. Therefore, the LQD considers evaluation of the assumptions and conditions on which the predictions are based a critical aspect of the review.

In the tailings site assessments that the LQD has reviewed, the long-term influence of the tailings on ground water quality has generally been predicted using a series of computer models. The series usually includes: (a) a ground water flow model to determine flow directions and rates; (b) a model of the geochemical attenuation; and (c) a chemical transport model, based upon results of (a) and (b). Within this series, a variety of approaches have been used to characterize the future site conditions for the 'set-up' of the models. Neither the NRC or LQD specify 'correct' approaches for characterizing these conditions. However, if the LQD believes the approach used is a less conservative approach than other possible approaches, the LQD considers the potential impacts of the less conservative approach.

2.2 Differences between LQD & NRC Reviews. As noted in the first section, the parameters of concern to the federal and state agencies differ. Other differences also occur, most of which are attributable to three factors: (1) the predominantly rural setting in Wyoming; (2) the anti-degradation provisions of the Wyoming statutes; and (3) water rights concerns. For example, with respect to the first factor, the LQD has not considered risk assessment a suitable approach for ground water issues to date because the LQD does not believe the available risk assessment methods adequately address items such as: low population; unrestricted future use; and environmental versus human risks. With respect to the second factor, the LQD has not considered natural attenuation, when it is dependent *solely* on dilution, as a suitable reclamation approach.

Similarly, with respect to water rights (the third factor), the LQD would prefer that the ground water even within the Long-Term Care Boundary be returned to pre-mining and milling conditions. However, the LQD also recognizes that access to this area will be restricted, i.e., the LQD believes the federal institutional controls that will be in place when the site is transferred to the DOE are sufficient to prevent access to the contaminated ground water within the Long-Term Care Boundary. However, at the site boundaries, the LQD has not considered reliance solely on state institutional controls, such as restrictions on well permits from the Wyoming State Engineer's Office, as a suitable approach. In other words, 'extension' of water use restrictions beyond the Long-Term Care Boundary is not considered appropriate. The state statutes are considered anti-degradation statutes and require returning "an area of land affected by mining to use for grazing, agricultural, recreational, wildlife purpose, or any other purpose of equal or greater value", using water treatment if necessary (W.S. §35-11-103(e)(i)).

3.0 UMETCO SITE CONDITIONS

The Umetco site is in Fremont and Natrona Counties, about sixty miles east of Riverton, Wyoming (Figure 1). Of the nine sites in the State regulated under Title II of the Uranium Mill Tailings Radiation Control Act (UMTRCA, 42 USC §7901 *et seq.*), this is one of the older sites. Mill operations began in 1960 and were shut down in 1984, although disposal of material from other sites continued after the Umetco mill had ceased operations. The site conditions and history are well described in the ACL application; however, for easier reference, a brief description of the site history and subsurface conditions are included in this review.

3.1 History of Tailings Disposal & Remediation Efforts, & Heap Leach Operations. Three areas at Umetco's Gas Hills Site were used for tailings disposal: (1) the Above Ground Tailings Impoundment (AGTI); (2) the A-9 Repository; and (3) the North and South Evaporation Ponds (Figure 2). The AGTI consists of a series of earth-filled dams used from 1960 until 1979 (Figure 2). The A-9 Pit was mined out prior to 1979, and the A-9 Repository was constructed by placing a 3-foot compacted clay layer in the pit. From 1979 through 1984, tailings were disposed of in the A-9 Repository, and liquids were decanted from this area to the North and South Evaporation Ponds. In 1988, tailings from the Riverton UMTRCA Title I site were disposed of in the A-9 Repository, and wastes from in-situ uranium mines and from the Gas Hills mine and mill site were also placed in the A-9 Repository. The clay-lined North and South Evaporation ponds were used for liquids decanted from the A-9 repository and for ground water pumped for control/remediation of the tailings leakage.

Remediation efforts included several sets of extraction and injection wells in the vicinity of both the AGTI and A-9. Although the AGTI was put into use before A-9, remediation efforts actually began earlier at A-9. In 1983, Umetco began pumping a series of wells at A-9, and wells were added to this system in 1989, 1993, and 1996. The water from these wells was discharged to the South Evaporation Pond until 1991, and after 1991, the water was treated by ion exchange/reverse osmosis (IX/RO). The treated water was injected into the Wind River Aquifer to help 'flush' contaminants through the aquifer beneath A-9. The brine from the IX/RO was discharged into Pond GHP1. Injection was discontinued in 1996, and since then, the water from the extraction wells has been discharged to evaporation ponds (including the new GHP2 Pond).

At the AGTI, remediation efforts started in 1990 with a series of extraction/injection wells to the west of the AGTI and near its center. (One extraction well was also installed to the north of the AGTI to control movement of the recharge mound beneath the AGTI.) All but two extraction and two injection wells were abandoned in 1996/97 so Umetco could cover the AGTI per NRC requirements. Before 1996, water pumped from the vicinity of the AGTI was treated by IX/RO. Since 1996, the water has apparently been discharged to the evaporation ponds.

Three heap leach operations were also located close to the tailings disposal sites (Figure 2). These operations were in use from 1963-1967, 1973-78, and 1979-1987, respectively, and consisted of leach areas underlain by gravel and perforated pipe which was in turn underlain by a 1-foot layer of compacted clay.

3.2 Overview of Hydrogeologic Conditions. The Umetco site is located in an area informally known as the Gas Hills Uranium District because of the relatively large amount of uranium mined from the area since the late 1950s. Throughout this area (including the Umetco site), the Wind River Formation is the principal ore-bearing zone, and it consists primarily of material deposited in alluvial fans systems. The formation is composed primarily of lenses and layers of sandstones, siltstones, claystones, and conglomerates, and the uranium occurs in roll front deposits within the formation. The two aquifers which are usually of concern have historically been referred to as the Upper and Lower Wind River Aquifers, separated by a mudstone layer. The Upper Wind River Aquifer is usually

unconfined. Depending on ground water occurrence relative to the mudstone layer, the Lower Wind River Aquifer may be confined or unconfined. Figure 3 is a generalized north-south hydrogeologic cross-section through the Umetco site.

In the ACL application, Umetco suggests differentiating ground water conditions on the basis of flow regimes, rather than strictly on lithology, based on ground water flow directions and geochemical conditions along the flow paths. Using this differentiation, two flow regimes were defined at the site - the western and southwestern flow regimes. The western flow regime underlies the northern portion of the site, in the vicinity of the Above Grade Tailings Impoundment. Most of this regime is within the Lower Wind River Aquifer. The southwestern flow regime underlies the southern portion of the site, in the vicinity of the A-9 Repository for tailings. Most of this regime is in the Upper Wind River Aquifer; however, in the area where the two regimes are closest (near the south end of the AGTI, Figure 2.10 in the ACL application), the Lower Wind River Aquifer is apparently also included.

Umetco's proposed differentiation brings the evaluation in the ACL application closer to the type of evaluation used in the ISL operations, such as that proposed by PRI. The emphasis in the ISL evaluations is differentiating between mineralized and unmineralized zones to design the layout of production and injection wells in a given wellfield and the associated monitoring systems. The LQD's concerns about consistency in addressing impacts from uranium industry, whether ISL mining, conventional mining, or tailings disposal, are outlined in the following section and Section 6.0.

4.0 OVERLAP OF UMETCO & PRI OPERATIONS

In December 1997, PRI submitted an application to the LQD for a mining permit for an ISL operation, and review of PRI's application has been conducted under Temporary Filing Number (TFN) 3 5/93. When Umetco subsequently submitted their ACL application (TFN 3 1/258), a situation was created not common at tailings sites in Wyoming - activities on properties adjacent to tailings sites are often of concern (e.g., potential impacts from the Petrotomics site on the Pathfinder 2/8 Reservoir), but it is rare for activities to be proposed within the 'DOE area'. This situation raises both technical and regulatory concerns.

4.1 Area & Vertical Extent of Overlap. PRI's proposed Gas Hills ISL Project covers an extensive area to the south-southwest of the Umetco site. Within this area, five separate mine units are proposed. These mine units are numbered one through five, in the approximate order in which PRI has indicated they will be developed. Of these five, only Mine Unit No. 5 is of concern with respect to Umetco's ACL application because of its proximity to the southern portion of the Umetco tailings and because of Umetco's proposal to include that Mine Unit in the DOE Long Term Maintenance Area.

The lithologic nomenclature used by Umetco in the original ACL application differs from nomenclature used by PRI in their ISL application. In January 2000, Umetco submitted an addendum to their ACL application, discussing the correlation between the Umetco and PRI nomenclatures. In essence, the Lower Wind River Aquifer identified by Umetco is the same unit as the East Canyon Conglomerate identified by PRI, and the Upper Wind River Aquifer identified by Umetco includes PRI's 'numbered'

sand layers, such as the '50 Sand' that PRI proposes to mine in Mine Unit No. 5 (PRI Mine Permit Application to LQD, February 1998, TFN 3 5/93, Pages D5-11&12 & OP-48).

4.2 Technical & Regulatory Concerns. The primary technical concerns relate to the increased potential for contaminant migration from the Umetco site to PRI's wellfield(s) within Mine Unit No. 5 when PRI is mining that unit and the impact that 'increased' migration could have on mining efficiency and restoration success. ISL mining depends upon injecting lixiviant into the ground water to change the oxidation/reduction conditions and thus 'mobilize' uranium. The ground water is then pumped out and treated for removal of the uranium. To help prevent migration of 'mobilized' materials (e.g., uranium, selenium, and other metals), ISL operations are conducted under 'bleed' conditions, i.e., the pumping rate exceeds the injection rate by 10% or less. Once mining is completed, ISL restoration may include ground water 'sweep', in which wells are pumped to 'pull back' impacted water that may have moved outside the production/injection area during mining, and 'reverse osmosis' (RO), in which water pumped from the mined area and treated prior to reinjection. (During RO, the 'bleed' rate may be increased up to 20%.) Therefore, throughout mining and restoration, a wellfield acts as 'sink' for ground water flow. It is not clear whether Umetco's analysis of the movement of water from the tailings took into account the presence of this potential 'sink' in the southwest flow regime.

When ISL operations began in Wyoming, one of the primary regulatory concerns was prevention of 'excursions' in which injected fluids migrate outside the wellfield during mining. More recently, however, concerns have been raised about the impact of 'incursions' during mining and/or restoration (e.g., letter of February 5, 1999 from G.Cash to P.Hildenbrand on PRI Highlands B Wellfield). It is the LQD's position that if an ISL operator has 'moved' previously affected ground water to an area where it would not have 'moved' under natural conditions, or if an ISL operator has significantly accelerated the rate of movement of the previously affected ground water, then the operator is required to restore that ground water (e.g., Comment 3.27 in the LQD's 2nd Round Technical Comments of June 2, 1999 on PRI's proposed Gas Hills ISL Project).

This decision is based on concerns about mining efficiency and long-term water quality. With respect to mining efficiency, an 'incursion' may adversely affect oxidation/reduction reactions and change the uranium processing reactions. With respect to water quality, 'pulling' previously impacted ground water to an area to which it would not have migrated could impact water rights, attenuation mechanisms, and other factors both within the ISL wellfield and between the wellfield and the source of the previously impacted ground water.

Although ground water in Umetco's southwest flow regime would apparently 'move' to the area of PRI's proposed Mine Unit No. 5, the ground water and contaminant migration rates have apparently only been evaluated for 'non-mining' conditions. Also, as outlined in the following section, there are some concerns with the 'initial conditions' used in evaluations of migration rates. An important feature which could also the impact migration directions and rates is the North Thunderbird Fault, but this impact has apparently not yet been assessed. Because of these limitations, it is difficult to compare the potential impacts with and without the ISL operation.

5.0 'HOT SPOTS' & INCREASING SULFATE CONCENTRATIONS

To date, the LQD has reviewed the hydrogeologic conditions at five of the nine Title II tailings disposal sites (including the Umetco site) in the State. In these reviews, the LQD has relied heavily upon evaluation of graphs of concentration versus time for select parameters to determine if historic changes in water quality support the assumptions and predictions about site conditions. To assist the LQD in these evaluations, Umetco provided the more recent water quality data electronically, and the LQD obtained previous data from Annual Reports and other permit documents filed by Umetco over the years. For consistency with other ACL reviews, the LQD has focused on review of sulfate concentrations (keeping in mind the limitations noted by Umetco about using sulfate (Pages 2-6 & 2-7 of the ACL application)). Two results of the evaluation were of concern.

5.1 'Hot Spots'. Two 'hot spots', in which sulfate (SO_4) concentrations are in excess of 10,000 milligrams/liter (mg/l), were noted. One of these 'spots' appears to coincide with the AGTI, as illustrated by the graph of sulfate vs. time in Well HW-4 (Figures 5 & 6). The other 'spot' appears to coincide with the A-9 Pit and is best illustrated by the graph of sulfate vs. time in Well GW-3 (Figures 7, 8a&b). The presence of these 'hot spots' raises two questions. The first is whether the evaluations of contaminant transport, which are based on lower concentrations, underestimate the long-term concentration changes. The second is whether the proposed long-term monitoring network is adequate for tracking the migration of the 'hot spots'.

5.2 Impacts of Increasing Concentrations on ACL Characterization. In several wells, sulfate concentrations have been increasing over the short and/or long term, although not as rapidly in Wells HW-4 and GW-3. As a result, analyses of lateral and vertical contaminant movement may not be 'conservative'.

5.2.1 *Lateral Movement.* In their analyses of lateral contaminant migration, Umetco used the more conservative approach of a 'continuing' source; however, in the wells selected as representative of 'initial conditions', sulfate concentrations have shown an apparent increase over time. In the western flow regime, the 'initial conditions' were based on concentrations in Wells MW-1 and MW-21A, and in the southwestern flow regime, the 'initial conditions' were based on concentrations in Wells GW-7 and GW-8 (Page B4-2 of the ACL application).

Well MW-1 has been monitored since tailings disposal was on-going. The early sulfate data from this well shows considerable variation and high concentrations (Figure 9a), although once tailings disposal ceased and ground water remediation began, the concentrations dropped below the WQD Class III Limit (Figure 9b). More recently, however, there has been an apparent, continuing increase in the sulfate concentrations (Figure 9c). Even though the trend analysis is not necessarily 'rigorous', it raises concerns that the 'initial conditions' used in evaluation of the contaminant migration may be too low over the long term. The data records for Wells MW-21A, GW-7, and GW-8 are much shorter than that of Well MW-1 (Figures 10a, 11a, and 12a, respectively). Well MW-21A showed declining concentrations until an apparent upward trend beginning in 1997 (Figures 10b&c). Of greater concern

are the recent, rapid increases in sulfate concentrations in Wells GW-7 and GW-8 (Figures 11b&c and 12b&c, respectively). If these trends increase, then the 'initial conditions' used in evaluation of contaminant migration may prove to be too low.

5.2.2 *Vertical Movement.* The deeper portions of the Wind River Aquifer, in which reducing conditions are considered to predominate, were not included in the ACL evaluation (Pages 2-7 & 2-8 of the ACL Application). However, comparison of the conditions in some of the deeper wells indicates that continued monitoring of these deeper wells may be necessary to ensure that unanticipated conditions do not develop. Figures 13a & 13b include graphs of sulfate concentrations vs. time in several of the deeper wells at the Umetco site. The sulfate concentrations shown on Figure 13a are relatively low (less than 800 mg/l); however, the concentration in at least one well (Well MW-28) to the north of the AGTI is increasing. The sulfate concentrations in Well DW-3 (Figure 13b) are considerably higher than the sulfate concentrations in Wells DW-2 and DW-3 (Figure 13b) and the other 'deeper' wells shown on Figure 13a. The occurrence of these higher sulfate concentrations beneath the 'hot spot' at Well HW-4 (Figure 6) is of concern. Also, the concentration appears to be increasing slightly over time, indicating that the elevated concentrations in that vicinity may not be solely due to differences in oxidizing and reducing conditions.

6.0 EVALUATION OF AMBIENT CONDITIONS

LQD's primary concerns on Umetco's approach to this item are: the breadth of the proposed change; the need to ensure consistency in approaches for regulating water quality impacts among various uranium operations; and the sites selected as representative of ambient conditions.

6.1 Breadth of Proposed Change & Consistency Concerns. In most areas of uranium mineralization in Wyoming, there is considerable natural variation in water quality between oxidized and reduced areas, with the poorer water quality generally occurring in the ore zone. Therefore, there is also considerable variation in the WQD 'Class-of-Use' in and around areas of uranium mineralization. What Umetco proposes can be thought of as 'blurring the line' between areas of naturally-occurring poorer water quality and areas of man-made impacts, which may have degraded better quality water. Distinctions which can no longer be detected in 'upgradient' areas because of extensive mining-related disturbances, are 'extended' downgradient to relatively undisturbed areas where natural variation is still discernable.

ISL operations provide an example of how the natural variations in water quality are taken into consideration. Before mining, ground water is classified by the WDEQ Water Quality Division (WQD) on the basis of use and, if the water is not in use, then available water quality data is averaged and compared with WQD standards (Appendix A). Classification of the ground waters of the State of Wyoming has historically been done on a *well-by-well* basis by WQD (unless an entire aquifer is being classified which is usually done only for drinking supply purposes). More recently, to address the natural variations in water quality at in-situ mines, LQD and WQD have allowed the operators to distinguish between the ground water in the ore zone and ground water outside the ore zone. As a result, the water quality data from wells within the ore zone (i.e., within the actual wellfield) is

averaged to determine the pre-impact classification and thus the restoration criteria. *However,* outside the ore zone (i.e., at the monitor well ring around the wellfield) , the restoration criteria is still on a well-by-well basis. As outlined in Section 4.2, for an in-situ operator to request a variation in restoration requirements for a given wellfield (or portion thereof) because of an historic, unregulated impact, the operators must demonstrate that the previously impacted ground water would have migrated to the wellfield area, within reasonable time period, *even if* in-situ mining did not occur.

Umetco's proposal fails to take into account the fact that it is still possible to distinguish areas of naturally occurring poorer quality water downgradient of the tailings areas. The locations selected in Section 5.0 'mix' different geochemical environments, such as those mapped out both upgradient and downgradient of the tailings area. While some of those environments may have been 'mixed' due to mining and related activities, downgradient of the areas of impact those environments can still be differentiated. Also, Umetco's proposal does not address the impacts from their operations, other than the tailings disposal. In other words, any impacts from mining, backfilling, heap leach, or related activities conducted by Umetco 'post-law' must be addressed. Therefore, the ambient water quality cannot be 'downgraded' as part of the tailings evaluation if Umetco has not addressed their other impacts prior to the assessment of the ambient water quality.

6.2 Site Selection. The LQD believes the water quality data from several of the selected locations should not be used to evaluate ambient conditions. The VECA-2 Well, which PRI had intended to use as a 'baseline' well for their Gas Hills Project, was abandoned by PRI because of concerns about casing integrity (Table 6-3-1 in PRI Mine Permit Application, TFN 3 5/93; letter of August 12, 1997 from P. Hildenbrand (PRI) to M. Moxley (LQD)). Well MW-27 has shown a gradual increase in sulfate concentrations over the last several years. Given the proximity of this well to the AGTI and the probability of vertical contaminant movement (Section 5.2.2), use of the more recent concentrations in this well to establish ambient water quality seems inappropriate. The records for Wells MW-76, LA-5, LA-6, and LA-7 are relatively short; therefore, it is difficult to determine whether the apparent increasing trend in some of the wells is significant. The sampling records for the Lincoln, Cole 80, and Iron Springs are extensive; however, due to time and budget considerations, the LQD did not compile these records to determine if any long-term trends were evident.

7.0 NORTHERN DRAINAGES

The three drainages of concern, which extend north from the AGTI, are East Canyon Creek and two of its tributaries, Carbide Draw and an unnamed draw to the west of Carbide Draw (Figure 2). Comparison of sulfate concentrations in two wells along those drainages with sulfate concentrations in other wells in the vicinity indicates that the sulfate concentrations in those two wells are considerably higher than concentrations in other wells in the vicinity (Figure 6). In Well MW-20, along East Canyon Creek, sulfate concentrations are on the order of 3000 mg/l of sulfate, and in Well MW-70A, along the unnamed drainage, sulfate concentrations are on the order of 4000 to 4500 mg/l of sulfate (Figure 6). Leakage from the pond to the alluvial channel is known to have impacted conditions in the vicinity of Well MW-20 (Dames & Moore, Inc. "Evaluation of Ground Water Contamination - Existing Tailings Impoundment", prepared for Union Carbide Corp., June 1979). No similar evaluations were found for Carbide Draw or the unnamed drainage, although they may have been overlooked.

The primary concern is that historic seepage from the tailings to the alluvial channels resulted in accumulation of the contaminants of concern in the sediments along portions of these drainages. These sediment accumulations may be continuing sources of contaminants, resulting in the consistently elevated concentrations in Wells MW-20 and MW-70A in comparison with deeper wells and wells farther from the drainages. Even though the top of the screen in both of these wells may be below the bottom of the alluvium, the extent of the gravel pack above the screened intervals is not known.

8.0 LQD SUGGESTIONS FOR RESOLUTION OF CONCERNS

For the five items of concern noted in Section 1.0, the LQD is suggesting some options to help resolve the concerns. LQD's primary considerations in developing these suggestions are the importance of ground water in the State and the potential for access to contaminated ground water. Although access will be restricted within the DOE Long-Term Care Boundary, the presence of contaminated ground water within that boundary leads to concerns about: (a) the potential for contaminated ground water to migrate outside the Long-Term Care Boundary; and (b) the potential for a change in conditions along the perimeter of the boundary which could induce migration of contaminated ground water outside of the boundary.

8.1 Overlap of Umetco & PRI Operations. It is LQD's understanding that communication among DOE, NRC, Umetco, and PRI about the 'overlap area' is underway and that additional communication, including a meeting with LQD, is planned. The following suggestions are general and are meant to highlight LQD's concerns in reviewing the Umetco and PRI plans.

1) a) When ISL permit applications are submitted, they contain general hydrologic and baseline water quality data for the permit area as a whole and more detailed information about the initial wellfield(s) the operator plans to develop. More detailed information about subsequent wellfield(s) is submitted for LQD review and approval prior to development of those wellfields. Therefore, PRI's permit application includes commitments to submit a Hydrologic Testing Proposal and subsequent Hydrologic Test Document for each mine unit for LQD review prior to approval of mining in that unit. The application mentions features in the vicinity of Mine Unit No.5, e.g., the Thunderbird-Rox Mine and the Thunderbird Faults, that will be taken into consideration in developing the Testing Proposal. However, the application predates (and therefore does not include), detailed information about the proposed Umetco Long-Term Care Area and proposed POE monitoring wells. Similarly, because the operation plans for Mine Unit No. 5 are conceptual at present, the Umetco ACL application does not contain any detail about the impact of Mine Unit No. 5 on the contaminant migration predictions.

PRI and Umetco need to work out necessary sharing of information so the combined impacts of both operations can be adequately evaluated. PRI and Umetco also need to work out contingency plans should the actual impacts differ from the projected impacts.

b) The characteristics of the North Thunderbird Fault, in particular its influence on ground water flow, should be determined as soon as possible. If the fault acts as a barrier to flow, then it may be possible to use the fault to 'separate' PRI and Umetco impacts. If the fault acts as a conduit, then it may be necessary to establish monitoring locations other than those proposed.

2) Significant water flow and quality changes occur within a wellfield during ISL operations. Therefore, the location of the proposed POE in the southwest flow regime, should not be within any production/injection areas in Mine Unit No. 5. Also, it should not be located within any of the associated monitor well rings around these areas, as the monitor rings are designed to detect any excursions from the production/injection areas (and may also be needed to detect 'incursions').

3) The potential consequences of limited wellfield restoration should be discussed with DOE. To date, none of the commercial wellfields in the state have completed restoration. If a similar situation arises in Mine Unit No. 5, then conditions within and at the boundaries of the Long Term Care Area may change from the conditions anticipated when the area is established.

4) Exploration drilling has been extensive in the Gas Hills Uranium District. PRI's ISL application includes a map of abandoned drill hole locations (Plate D5-17E), and there are numerous locations within the proposed DOE Long-Term Maintenance Area. Because of the number of such locations, the potential for improperly abandoned holes should be considered. In addition, historic plugging methods usually included only surface plugs, not plugging at depth to prevent cross-contamination.

8.2 'Hot Spots" & Increasing Sulfate Concentrations. The LQD does not disagree with the methods Umetco used to evaluate contaminant distribution over time. However, the LQD is concerned that some of the assumptions and conditions used in these methods do not adequately reflect conditions in the field. As a result, most of the suggestions relate to changes in monitoring and re-evaluating earlier results using updated information.

'Hot Spots'

5) Additional monitoring locations downgradient of the northern 'hot spot' need to be established. Well HW-3 is about 1200 feet to the southwest of Well HW-4, but ground water in the vicinity of Well HW-4 may flow more to the west than southwest (Figure 2.10 in the ACL application).

6) The benefits of continued remediation of these 'hot spots', as opposed to continued remediation on a larger scale, should be evaluated. Umetco may be able to significantly reduce long-term concerns if these 'hot spots' are eliminated.

7) The impact of these 'hot spots' on the predictions of contaminant migration discussed in ACL needs to be discussed. If necessary, the predictions may need to be rerun.

8) A mass balance, including the leakage from the tailings, the ground water pumped for remediation, and the water re-injected for remediation, should be calculated. This could help determine the extent of the 'hot spots' and the impact of increasing concentrations elsewhere on the projections of contaminant distribution.

Increasing Sulfate Concentrations

9) The impact of the increasing concentrations (noted in several wells near both the AGTI and A-9) on the predictions of contaminant migration discussed in ACL needs to be discussed. If necessary, the predictions may need to be rerun.

8.3 Evaluation of Ambient Conditions. The LQD believes that, within areas of uranium mineralization, considerable attention needs to be given to the scale at which various assessments are completed, to avoid creation of extensive 'sacrifice' areas. The change proposed by Umetco 'blurs' the line between areas of better and poorer water quality, even though such areas can be (and were) distinguished downgradient of the tailings area.

10) The LQD suggests that Umetco not use the proposed ambient conditions. Rather, the LQD suggests that Umetco rely more on identifying those areas that may be impacted by contaminant migration from the tailings area and determining whether those areas are within ore zones or previously impacted areas.

8.4 Northern Drainages. Three suggestions are included to help determine the impact(s) along these drainages: additional field study; compilation of additional well and drainage information; and continued and/or expanded monitoring.

11) Additional field study is suggested to evaluate whether historic seepage from the tailings resulted in elevated contaminant concentrations in sediments along the three drainages extending north from the AGTI. First, the depth and degree of saturation of alluvial deposits should be determined at two locations along each of the three channels of concern. This would preferably done during spring snowmelt when the potential for saturation is probably greatest, and samples of any alluvial water encountered should be analyzed for the parameters of concern and general water quality criteria. (It would also be helpful to have photographs of the drainages from about four locations, starting near the tailings and working downstream, along each drainage.) Second, at each of the two locations along the drainages, a 'composite' sediment sample should be collected from the deeper sediments encountered at each location and analyzed for the parameters of concern and general quality criteria.

12) Compilation of additional well and drainage information is suggested to evaluate the potential for vertical migration from the drainage channels. Additional information on well construction (e.g., extent of gravel pack) and lithology would be helpful in evaluation of the source(s) of the elevated sulfate concentrations. Also, any historic documentation of tailings seepage or natural surface water flow along these drainages would be helpful.

13) Continued monitoring is suggested to ensure that contaminant concentrations in the wells of concern do not increase over time. Also, depending on the results of the additional field study, installation of additional wells along the drainages may be necessary to ensure that contaminated ground water does not migrate off-site.

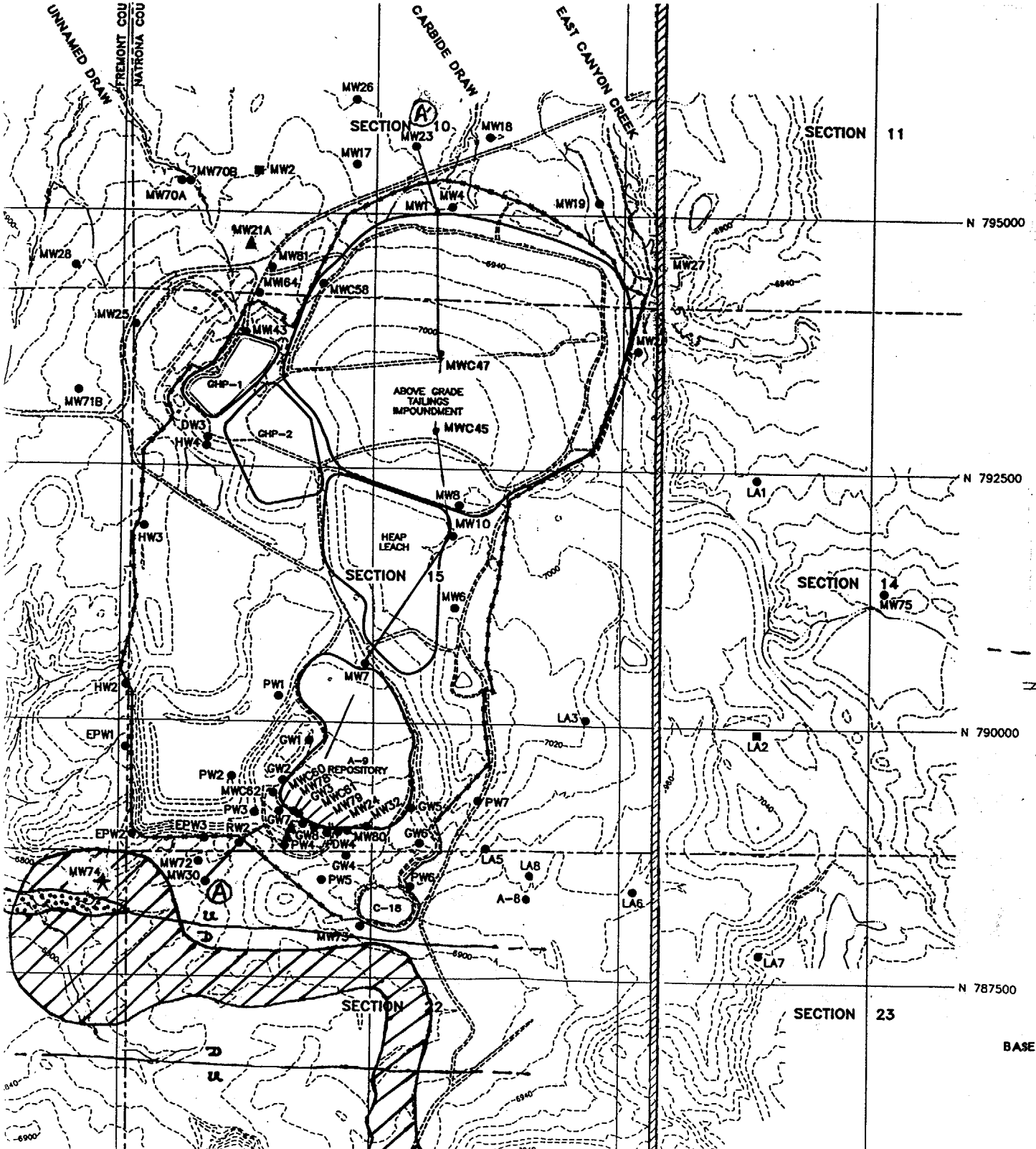
8.5 'Record Keeping'. During review of the ACL application, three items were noted that LQD recommends be included in the ACL application or a supplement to it. These items will make it easier to use the ACL application as a reference for information that is otherwise 'scattered' throughout LQD's files. A fourth item is included as a reminder if plans proceed to incorporate PRI's Mine Unit No. 5 in the DOE Long-Term Maintenance Area.

14) Although the ACL application includes analytical results for the A-9 tailings (Table 2.1 of the ACL application), similar analyses were not included for the AGTI. Reference is made to analytical results for "seepage" from the AGTI (Page 2-6, 1st ¶ in the 'Chemical Composition' section & Table 2.3 of the ACL application). However, these results show considerable 'dilution' in comparison with available results for the AGTI tailings (e.g., Table 3 on Page 20, Dames & Moore, Inc. "Evaluation of Ground Water Contamination - Existing Tailings Impoundment", prepared for Union Carbide Corp., June 1979). Therefore, although the results on Table 2.3 are probably useful for relative percentages of various parameters, available AGTI tailings analyses should be included so the magnitude of the concentrations are also representative.

15) It would be helpful to have a list of all wells installed over the years by Umetco and the fate of each well. For example, Well PW-3 was reportedly replaced by Well PW-3A, but it is not clear when the replacement occurred and whether the new wells 'mirrored' the old well. Similarly, Well MW-12 was reportedly destroyed and the decision was made not to replace it, but it is not clear why that decision was made.

16) All the wells Umetco plans to leave for long-term monitoring must be permitted with the Wyoming State Engineer's Office (SEO). In recent review of the SEO records, it appeared that permits had been obtained for only a few of the Umetco wells. (Preferably all the wells should be permitted, whether Umetco plans to leave them or not, but at a minimum, the wells that will be left for long-term monitoring must be permitted.)

17) The LQD and the operators also need to ensure that the Adjudication Files for PRI's TFN 3 5/93 and Umetco's LQD Permit 349C are updated with information about the Long Term Care Area once the area is established. The Adjudication File for each mine operation contains information about surface and mineral ownership and consent and is used to ensure that the appropriate entities are notified of items such as changes to those permitted mining activities (if of sufficient magnitude) and unanticipated impacts that could adversely impact over or underlying and neighboring interests. Given the unusual circumstances, additional information may need to be incorporated into this file.



LEGEND

- (A) – (A') — LOCATION OF GENERALIZED HYDROGEOLOGIC CROSS-SECTION (FIGURE 3)
- GW2 ● — MONITOR WELL LOCATION
- MW77 ★ — PROPOSED POINT OF EXPOSURE MONITOR WELLS
- LA2 ■ — BACKGROUND WELLS AS SPECIFIED IN LICENSE SUA-648
- GW8 ▲ — POINT OF COMPLIANCE MONITOR WELLS
- RESTRICTED AREA BOUNDARY (FENCE)
- SECTION LINE
- N 787500 — UMETCO SITE 2500' GRID SYSTEM
- 7000 — SURFACE CONTOUR LINE
- UNPAVED ROAD
- SURFACE WATER
- PRI'S PROPOSED MINE UNIT NO. 5
- THUNDERBIRD-ROX UNDERGROUND MINE
- FAULT (NORTH & SOUTH THUNDERBIRD)
- PROPOSED BOUNDARY DOE LONG-TERM MAINTENANCE AREA

NOTES:

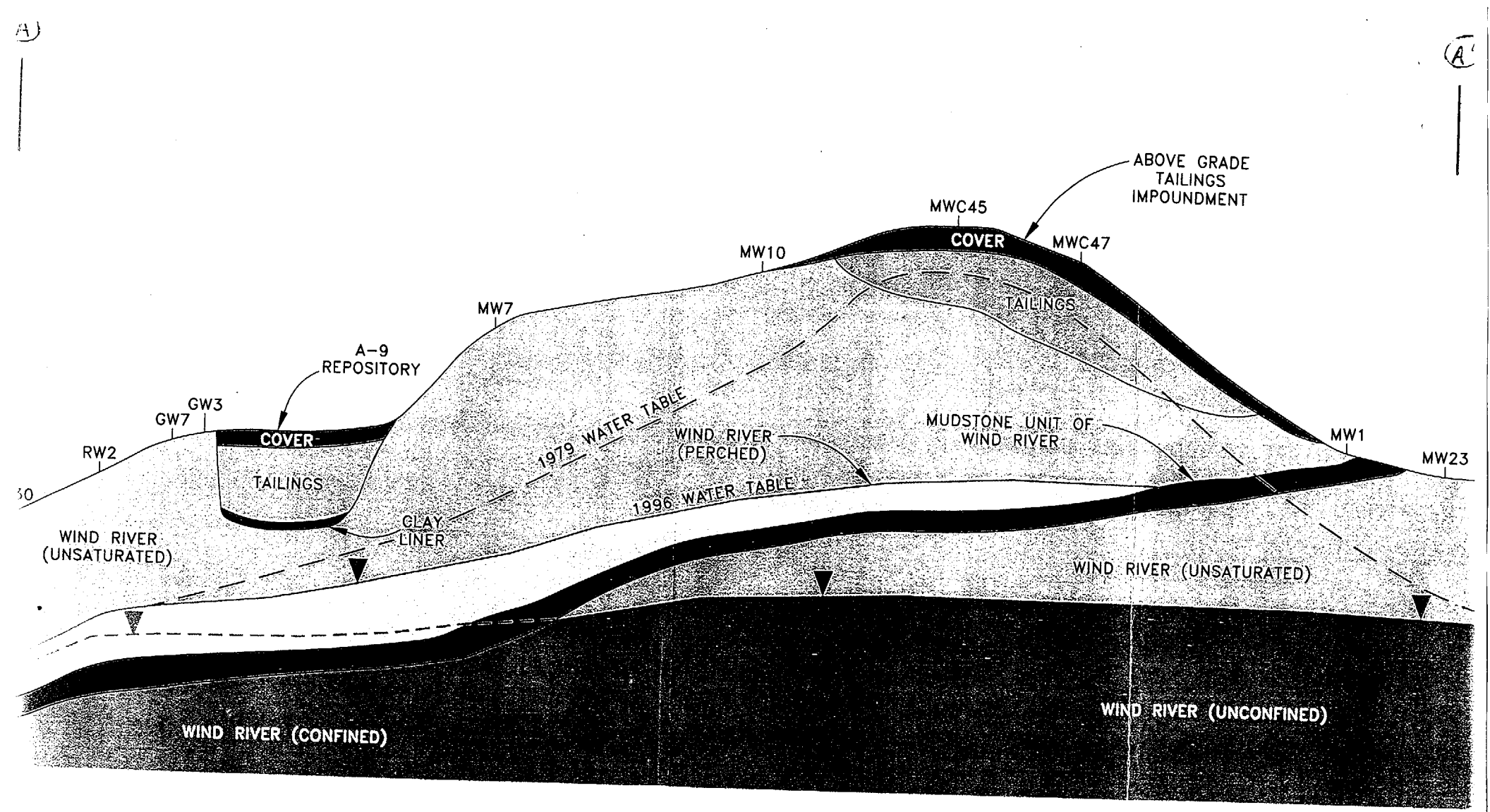
1). SURFACE CONTOURS FROM 1997 AERIAL MAPPING BY DATA MAPPING.

2). SECTIONS SHOWN ALL FROM TOWNSHIP 33 NORTH, RANGE 89 WEST OF THE SIXTH PRINCIPAL MERIDIAN.

BASE MAP IS FIGURE 1.18 FROM UMETCO'S 2/99 ACL APPLICATION.

FIGURE 2

SITE MAP



N

1000'

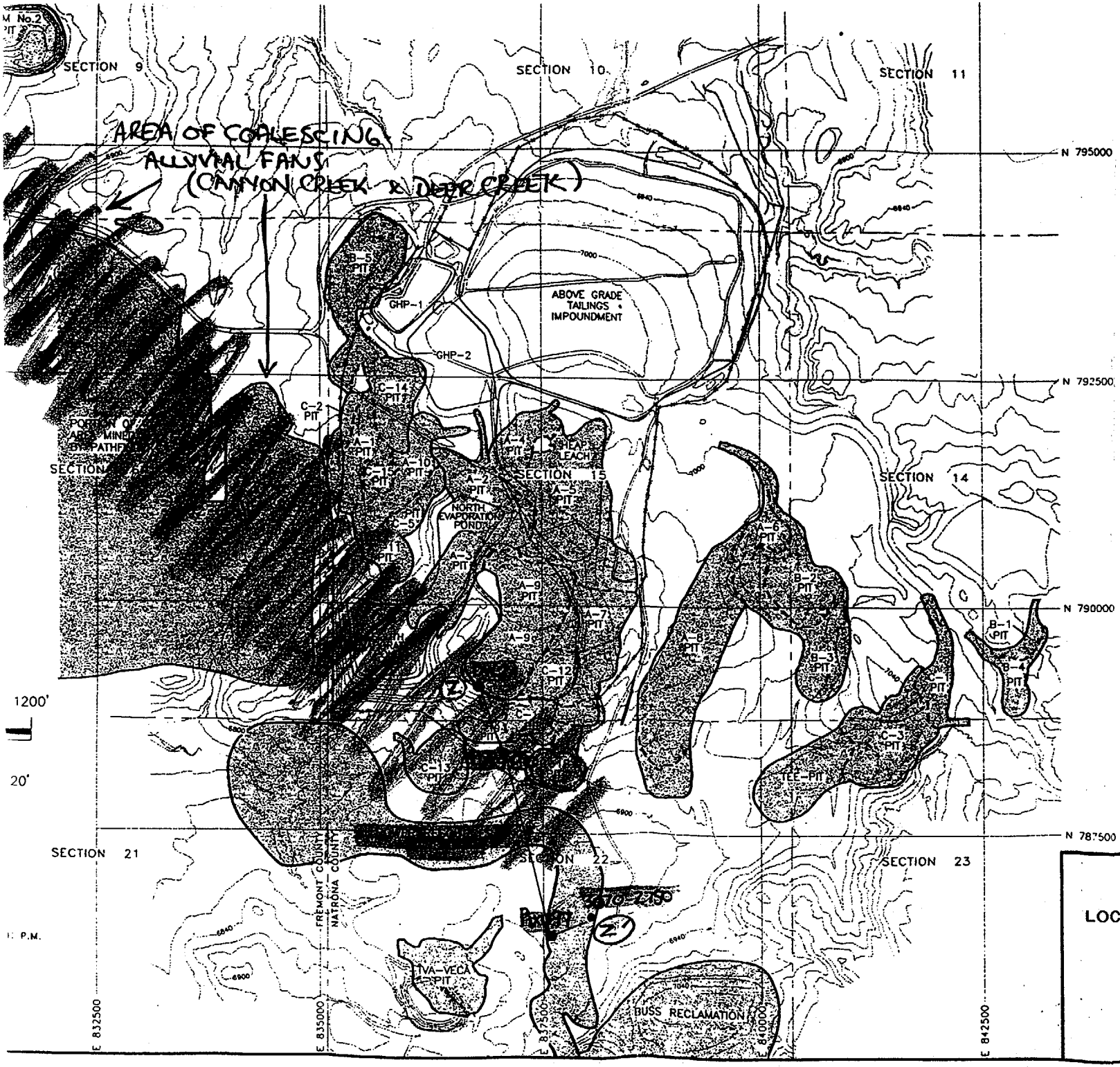
NTAL
FEET

FIGURE 3

GENERALIZED
HYDROGEOLOGIC CROSS-SEC

UMETCO GAS HILLS TAILINGS

SOURCE: FIGURE 1.17 IN UMETCO'S 2/99 ACL APPLICATION.



SOURCE: EXHIBIT 2 IN UMETCO'S 1/00 ACL SU

FIGURE 4a

LOCATION OF UMETCO/PRI CROSS-SEC

UMETCO GAS HILLS TAILINGS SITE

UMETCO - TFN 3 1/258 FEBRUARY 2000