NOTICE

All drawings located at the end of the document.

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protecting the environment

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January 18, 1996

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C S Dayton
Kaiser-Hill, L L C
P O Box 464
Golden, Colorado 80402-0464

TRANSMITTAL OF THE NOTES ON THE CLEANUP STANDARDS MEETING (KH00003NS1A) – JEL-010-96

Action None required

Enclosed are the notes taken at the Cleanup Standards Meeting of January 5, 1996 Meeting attendees are listed

The next meeting was held January 11, 1996 and notes are being prepared for submittal

John E Law

John E Law, P E
Remediation Manager
Sitewide Actions

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Notes on Cleanup Standards Meeting
January 5, 1996

The working group developing a site-wide groundwater strategy and cleanup standards for RFETS met on Friday, January 5, 1996 at Rocky Flats The meeting was held from 8 30 am until 2 00 and was mediated by personnel from Keystone CDPHE, DOE, Kaiser-Hill and RMRS representatives attended, however, due to the government shut down, Lou Johnson of EPA participated via speaker phone The attached agenda was loosely followed, and the discussions for each subject are summarized below

Attendees

Todd Barker	Keystone	Tim Lovseth	RMRS
Sara Stokes	Keystone	Sandy Marek	CDPHE
Judy Bruch	CDPHE	Elizabeth Pottorff	CDPHE
Chris Dayton	K-H	Annette Primrose	RMRS
Rick Di Salvo	DOE	Rick Roberts	RMRS
Susan Evans	RMRS	Joe Schieffelin	CDPHE
Tom Greengard	SAIC	Dave Shelton	K-H
Purna Halder	DOE	Mary Siders	RMRS
John Hopkins	RMRS	Steve Slaten	DOE
Lou Johnson	EPA (on phone)	Carl Spreng	CDPHE
John Law	RMRS		

Opening Remarks
Keystone is able to participate as CDPHE assisted in keeping them running Keystone reminds us that the Principals will be meeting on January 10-11 and will need a report on our progress

RCRA Closures
Joe Schieffelin presented the CDPHE viewpoint that the cleanup and closure of RCRA units will be special cases and will not use the cleanup action levels and standards developed by this group Under RCRA, all hazardous waste that escaped from the RCRA units must be accounted for and managed due to the cradle to grave management requirements for RCRA hazardous waste Corrective actions can be handled using the negotiated cleanup standards, however closure needs to meet the substantive requirements for closure

The discussion continued after 10 00 am to allow participation by DOE's Rick Di Salvo

Uranium/Nitrate Discussion
Mary Siders (RMRS) presented information on background levels of radionuclides in groundwater including the attached memo In summary, RFETS lies in an area with elevated background levels for uranium The background levels for the South Platte River Basin are 40 pCi/l In addition, Jefferson County's evaluation of groundwater in Coal Creek area showed very high levels of uranium with a mean of 175 pCi/l

At RFETS, in the uncontaminated Rock Creek Drainage, used for the background report, uranium amounts increases down gradient, but the ratio between isotopes remains the same At the plant, the plant contribution cannot be differentiated, but the uranium ratios present indicate that there has been an impact by the Solar Ponds However, levels contributed are lower than background activities The question was raised whether it makes any sense to clean up below background activities

CDPHE/Joe Schieffelin was uncomfortable allowing RFETS to contribute uranium into the system Elizabeth Pottorff stated that drinking water must be treated regardless of whether your facility created the problem or not Other facilities within the state must discharge clean water when pumped, even though they did not cause the problem Since RFETS is not pumping, she stated that if you're treating water for other reasons, then you must make sure that the discharge meets the requirements

Todd Barker of Keystone asked if this was again the issue as to whether all uses apply for surface water and if this issue can be resolved The group continued the discussion and Mary Siders pointed out that the risk based chronic standard was an order of magnitude higher than the background levels

Dave Shelton reminded the group that we were discussing the ITS and the impact on water quality The issue concerns whether the ITS water needs to be collected and treated, and what is the impact on surface water There is no doubt that uranium was added to groundwater by the Solar Ponds The question is "Is this a level of contamination that will cause degradation of surface water?"

John Hopkins pointed out that we do have some levels of nitrates and uranium in the water However, to save funds, we are trying to eliminate the need for Building 374 By February, we have to know whether we will be required to treat metals and uranium Adding a de-nitrification facility will cost around $5 million capital cost ($20 million life cycle) if the continued treatment of these low levels is required

The nitrate levels are decreasing with time (see attached) When Option B is in place, and the stream standards are reclassified to agricultural use, the ITS water will be pumped to the STP and will meet the 100 mg/l standards Pumping to the STP will dilute the nitrates, will eliminate algae blooms in the A-series ponds, and will maintain the capacity in the A-series ponds for other purposes

Carl Spreng pointed out Broomfield also wants the drinking water classification removed so that they can sell this water for irrigation purposes However, they will be sending their waste water effluent to Great Western also

John Hopkins asked if RFETS could be permitted to not treat the nitrates as these won't be a problem when the drinking water classification is removed This answer is required very soon Judy Bruch of CDPHE asked if the STP water contained other analytes that required treatment Joe Schieffelin asked specifically about cadmium John Hopkins mentioned that the ITS contained uranium below groundwater background levels, and that cadmium was not mobile and was not seen in the ITS water

John Law stated that there is a February deadline to decide how the ITS water will be treated When Option B is in place, there will be no need to treat nitrates However, there is a six month time between when B374 is no longer available and when Option B is in place Does it make sense to spend $5 million to treat water for only 6 months?

Joe Schieffelin felt that as long as the treatment system was installed, RFETS should continue to run it until 100 mg/l could be met without dilution Dave Shelton asked if the standards were changed now, would CDPHE allow RFETS to discharge ITS water Joe replied that ITS water could only be discharged if it was below 100 mg/l at the pump site Dave stated whether we agree or disagree, that no matter what the stream standards are, it is clear that CDPHE would require treatment of water with nitrates above 100 mg/l at the ITS

Joe Schieffelin gave his opinion (philosophy) that there was some wheeling and dealing room about nitrates depending on the level of source control taken That regardless of the associated risk, concentrations or toxicity, if RFETS steps up to the plate and removes hazardous waste to maximum extent practicable, then the groundwater plume may not need to be remediated CDPHE believes that the nitrates are hazardous waste due to the mixture rule

Steve Slaten inquired as to what is source removal to the maximum extent possible? Joe Schieffelin stated that this was prevention of further release Control minimize and/or eliminate hazardous waste as required by regulations This means source control Chris Dayton and John Law asked if this means capping, slurry wall, etc done in accordance with the priority list The answer was yes, but that the ITS could then not be turned off

Karen Wiemelt asked why RCRA regulations applied to nitrate Joe replied that this was due to the mixture rule Karen stated that RFETS does not agree with CDPHE on this and Joe acknowledged that fact

Dave Shelton felt that this is a timing issue Decisions need to be made now and the possibility exists that a treatment plant must be built now in order to meet the time table

John Law requested clarification about the need to treat uranium in the ITS water CDPHE staff asked for time to look into this issue

CDPHE stated firmly that nitrate standard of 100 mg/l must be met at the ITS Steve Slaten stated that if the water was pumped to the STP, that it would meet the 100 mg/l standard There would be a 6 month problem prior to getting the drinking water standard lifted

The nitrate level was reported to be 200-300 mg/l at the ITS sump now There may be a problem during times of low surface water flow and high ground water levels Judy Bruch asked that by using effluent from the STP, could the 100 mg/l standard be met for nitrate and was assured that 100 mg/l could be met However, 10 mg/l may not be met for the next 5 to 10 years After that, the cap over the area will probably limit the groundwater flow

Uranium in the ITS water was discussed Elizabeth Pottorff thought that groundwater background levels should not be compared against the ITS water which CDPHE considers surface water Judy Bruch stated that ambient, existing surface water standards must be met Elizabeth Pottorff mentioned that EPA was proposing a uranium standard of 20 to 30 pCi/l Steve Slaten asked if it was reasonable to propose a risk based standard to the WQCC Elizabeth and Judy both felt that this was worth a try Some merit exists for a risk based uranium standard consistent the plutonium and americium standards Chris Dayton pointed out that the PPRG for residential with swimming was $8\ 25 \times 10^2$ pCi/l with the drinking water PPRG 1 pCi/l

Judy suggested that the group work together and petition the WQCC to change the standard to the real ambient background Chris Dayton suggested determining the surface water background and ambient levels for all rads John Law agreed Sandy Taschio stated that ambient equaled average and the background values would be upstream values Standards should be based on average values

Joe Schieffelin will check internally with CDPHE staff to see if contamination below background values will be acceptable His gut feeling is that these will not be acceptable Steve Slaten agrees that RFETS did add some low level contamination, however, is this amount enough to justify spending millions of dollars to remediate?

Dose-based Soil Action Levels

The discussion on the soil action levels was deferred as the right CDPHE staff were not present However, Joe Schieffelin relayed a rad control concern that the proposed rad standard was not being applied correctly He thought that Bill Fraser at EPA had the same concern Lou Johnson was not aware of this The group agreed to arrange for a separate group consisting of CDPHE rad control, Bill Fraser and EPA rad personnel and Kaiser-Hill staff to meet on this separately

CDPHE RCRA Closure Proposal

The attached hand out was provided Joe Schieffelin cautioned the group that this was not the single text This section was only meant to deal with IAG RCRA units which are those that everyone knew could not be permitted These IAG RCRA units need RCRA closure and cleanup The current plan to remediate OU 7 does seem to meet the closure performance standards

Rick Di Salvo pointed out that EPA would have the responsibility for OU 7 to ensure that substantive requirements of RCRA were met Joe Schieffelin and Lou Johnson agreed Keystone got confirmation that this proposal did not negate the single regulatory contact agreement

Joe Schieffelin discussed the fact that extensive regulations that cover closure and that CDPHE believes cleanup/action levels do not apply to RCRA IHSSs These would be just covered by closure regulations For example, OU 7 would require little action based on the risk levels However, the current plan for RCRA closure requires a cap, leachate collection and a slurry wall These are not risk based, but meet the substantive requirements of RCRA

Rick Di Salvo felt that there was a meeting of minds on OU 7 which may not occur on other units Within closure standards, there is the ability to apply an approach to monitor and restrict access There is discretion to apply risk based standards

Joe felt that this required further discussion The OU 4 closure must be in-place with a cap or clean closure There must be a final RCRA cap However, for an unspecified interim period, there could be an asphalt cap The purpose is to control releases to the maximum extent practicable

Joe stated that soils below the risk-based standards for residential use and groundwater and surface water below promulgated standards are not considered hazardous waste John Law asked if two different standards are being proposed, one for RCRA, one for non-RCRA and where these apply Joe said that hazardous waste applies only to RCRA units If drinking water doesn't apply, this won't be used Lou Johnson said that EPA closes RCRA units using performance standards

Dave Shelton said that if within the Industrial Area, risk based and performance based standards can be applied next to each other This is a difficult situation which the RFCA negotiations were trying to fix by not treating similar contamination differently

Joe said that the group needs to change subsurface and surface soil action levels to ensure that further releases are prevented This opens the door to more remediation options

Rick Di Salvo asked if it is worth treating RCRA and non-RCRA separately and spending money that is not justified Why does CDPHE feel that there is no flexibility in applying RCRA

John Law asked if this issue made sense given that the group was to establish the technical basis for cleanup While this is a legal and political reality, it does not make technical sense

Dave Shelton recommended that the discussion be passed to another working group Joe Schieffelin thought that even though this is not a technical issue, that regulatory implications of the cleanup levels were always known Keystone asked if this subject was able to be reviewed by this group Joe did want the group to recognize the RCRA closure proposal as acceptable and that it be included in the single text document to delineate this document's limitations CDPHE does not believe that action levels apply to RCRA units

Steve Slaten wanted group consensus that this issue affects the document, and that it should be elevated Joe Schieffelin still feels that anything after 1980 (land based units) must have RCRA closure John Law asked if this drives groundwater monitoring to be unit specific, but Joe was not sure

Dave Shelton asked the group to look at the practical implication We need to look at regulations ourselves for amount of discretion that is available However, this would be a different group Rick Di Salvo and Dave will look at this issue and bring it to the attention of another working group

Keystone reminded the group that it should only look at the flexibility of Joe's suggestion Rick Di Salvo stated that if other group can work this issue out, then this group shouldn't spend the time There are major cost implications if a cap is now required for a building since it contained a RCRA tank Keystone then recommended that this be set aside for at least one week until the other group comes to a decision Dave Shelton wanted the group to look at the implications If these are large, the issue must be escalated quicker

Keystone asked if each group could look at practical implications by next week. John Law said that the implications are that Solar Ponds cleanup could be driven by RCRA to spend $140M on a minor problem Do we go back to the solution for a 1,000 year cap? Can a soil and vegetative cap suffice?

Joe Schieffelin stated that RFETS must minimize release of hazardous waste and to look at what is being done in the Solar Ponds Area to see if this is ok. There is an opportunity to incorporate or extend planned diversions and caps done for ASP for pennies on the dollar John Law pointed out that it could cost $5 million or more to extend the cap over the Solar Ponds Joe Schieffelin said that this was just pennies

Rick Di Salvo asked if this is because CDPHE feels there is no flexibility in RCRA because there is no value in this action Joe disagreed with that

Dave Shelton pointed out that this was a collision between RCRA/CERCLA - CERCLA does not make you spend money that doesn't improve the remedy Joe Schieffelin said that the remedy was not adequate to meet substantive requirements of RCRA Rick Di Salvo said that we all need the flexibility to say don't mechanically follow the regulations when there are no benefits Joe felt that this is when technical impracticability applies

Keystone asked if further discussion should be done off line? Steve Slaten asked that the group imagine the implications and bring this issue back next week. John Law asked whether to price a RCRA cap or price a vegetative cover? Joe replied that the Solar Ponds would require a 1,000 year cap, however the under drain may not be needed and would provide some savings Since there is a 1,000 year cap over the proposed CAMU, this could be extended John pointed out that a soil and vegetative cap would save money, but Joe thought it was cheaper to extend the CAMU cap next door

Joe Schieffelin urged the group not to discount clean closure of units, then leaving the groundwater plume The plumes from each RCRA unit are a special case but he was not sure CDPHE would play this card As long as the source is isolated, the plume may be dealt with on ER priority list and the groundwater standards may or may not be different Closure manages hazardous waste Recognize that RFETS cannot clean to MCL, but RFETS can control to minimize spread by performing source removal With a commitment to do best technical job to eliminate sources, there may be flexibility to deal with groundwater differently

Chris Dayton stated that it was not clear-cut how to do source removals and/or management Joe said that dealing with past release is difficult When source control is effectively accomplished, to avoid one up and 3 downgradient wells, RFETS could propose leak detection at the edge of the Industrial Area After source control for trenches, then existing wells may be sufficient

John Law said that then there would not be different groundwater standards for RCRA and CERCLA Joe felt that would be acceptable in return for good, technically adequate source control Dave Shelton asked if CDPHE felt that source control is <u>not</u> adequate for RCRA Joe said yes and neither for CERCLA

Subsurface soil cleanup levels Joe Schieffelin mentioned that the rest of CDPHE did not agree with the action levels developed by the working group and that there must be a better job of source control The sources may continue to release at the action levels calculated at 100 x MCL for source The text must be changed to state that if source is capable of releasing, it must be managed

John Law stated that this is moving away from risk approach towards a performance approach Steve Slaten felt that the working group progress had just been blown out the window Dave Shelton felt that this just blew the Vision out the window Joe Schieffelin replied that the working group got lost by interpreting Vision wording, not the intent

Chris Dayton asked for clarification on the Vision intent Joe Schieffelin said that there are increasing inconsistencies within the document However, in the executive summary, the Principals agree to protect groundwater and surface water and to make the land safe for open space and industrial uses Rick Di Salvo pointed out that in the document it says to protect groundwater to protect surface water Joe replied that up front it says protect groundwater and surface water

Dave Shelton pointed out that you can weave the argument you want He asked the group to decide on the fundamental disagreement, and expressed concern over the continued viability of the group Joe did not agree Keystone inquired as to why Joe did not agree Joe said that adding two sentences to soil and subsurface soil text would resolve the issue The sentences would add that cleanup levels would prevent the further release of hazardous constituents

Chris Dayton explained that the goal was to protect surface water, and source removal would be focused on removal of large problems such as free product Susan Evans and John Law wondered if the change in wording would require a return to residential standards

Dave Shelton stated that everyone agreed to not just protect surface water, but in addition to perform source removals to make sure that we do the right thing Then CDPHE must feel that the threshold is not stringent and does not force us to do enough work To ensure no continuing release, RFETS must pick up, vitrify, or install a slurry wall The practical implication is an enormous amount of additional work.

Susan Evans would like to have the no continuing release quantified No continuing release is impossible and it would not be possible to establish a cleanup standard Source evaluation, modeling, and a mini-RI must be done for each source Joe Schieffelin felt that this was no different than what we were going to do anyway John Law said that the prior action levels defined what was going to be a problem

Joe Schieffelin asked how long DOE plans to maintain the site If not past a few years, then you don't have a leg to stand on Rick Di Salvo said that even if there is no injury to the environment, then monitoring will continue Dave Shelton said that if waste is left, then the federal government is always on hook for this site Joe said that unless institutional controls are around for 1,000 years, he will not agree Dave Shelton felt as long as society feels this is important, that the site will be managed

Steve Slaten asked whether the CDPHE concern was that if RFETS leaves bad stuff and later, no one cares, we should clean it up now Is this Joe's concern? Joe said yes, this is going on at Hanford now

Rick Di Salvo said that no one knows Hanford at this meeting However, is the concern that application of standards does not leave an acceptable risk? Can we agree that the existing monitoring system will indicate whether standards are ok?

The discussion ended with no resolution on this topic

Plutonium from the Temporary Treatment Facility (TTF)
The attached handout was presented and John Hopkins discussed how Building 374 will be shut down soon and the design for the TTF must start in February The reverse osmosis process will add $72 M to the budget if lower levels of plutonium in the effluent are required below 15 pCi/l However, when Option B is in place, there will be no pathway to drinking water

The handout was discussed in great detail and will be extensively revised In the discussion, John Hopkins clarified that the handout would be used to discuss the issue with stakeholders and that it was meant to be a representation of the costs and benefits of the various proposals CDPHE does not want anything going to the public from the working group that contains any option except the 0 15 pCi/l proposal

Keystone stated that the issue on the TTF will go to the coordination group and the group needed to develop options to frame this issue The discussion then ended

Next Steps

1 Keystone will present a summary of what was discussed today by Monday
2 The discussion of surface soil and sediment maps will be deferred to the next meeting These maps will summarize the extent contamination above action levels These maps were available after the meeting
3 Carl Spreng will get the point of compliance text to everyone soon
4 Joe Schieffelin will provide a copy of the Hanford interim ROD for the 100 area. Apparently, the state got the short end of the stick on this ROD
5 The revised single text will be provided by CDPHE on Monday It will clarify and define the differences between action levels, standards and cleanup levels The areas where timing is important will be identified

Next Meeting

Wednesday, January 10, 1996 all day at EPA or CDPHE depending on the government shutdown The meeting topics will be

- review of the single text
- options for nitrate treatment levels
- background/ambient levels of rads in surface water
- discussion of RCRA closure proposal

TOPICS FOR THE CLEANUP STANDARDS GROUP MEETING
JANUARY 5, 1996, ROCKY FLATS T130D

Topic		Approximate Time on Topic
1	RCRA Closure	15 min
2	Uranium/Nitrate Discussion	40 min
3	15 mrem Dose Exposure	15-20 min
4	Pu for the TTF	20-30 min
5	Surficial soils/sediment/surface water map	30 min ?
6	Other Groundwater Issues?	?
7	Review Single Text	rest of time

MEMO

DATE: January 4, 1995

TO: J K Hopkins, RMRS, Bldg T-893B, x4974

FROM: M A Siders, RMRS Hydrogeology, Bldg T-893B, x4330

SUBJECT: **URANIUM IN BACKGROUND GROUNDWATER AT ROCKY FLATS**

1.0 INTRODUCTION

Rocky Flats Plant lies within the drainage basin of the South Platte River According to the Code of Colorado Regulations (5 CCR 1002-8), uranium (all isotopes combined) in all waters of the South Platte River Basin should not exceed 40 pCi/L or the naturally occurring (i e , background) level, whichever is greater In addition, there are site-specific standards for uranium (all isotopes combined) in Rocky Flats waters (5 pCi/L for Woman Creek, 10 pCi/L for Walnut Creek) However, these standards were established without the benefit of background data for uranium in Rocky Flats groundwater

Standards based on human health risks are also available Acute and chronic limits for uranium (all isotopes combined) include a factor for water hardness Surface-water discharges from Rocky Flats typically have a hardness value of about 180 mg/L, which results in an acute limit of about 3 mg/L and a chronic limit of about 1 9 mg/L for total uranium

Background data for the Rocky Flats Plant were collected from 1989 through 1992, as part of the sitewide background characterization, results of this study are presented in the Background Geochemical Characterization Report (BGCR) (DOE, 1993) Data are provided for dissolved and total metals, dissolved and total radionuclides, and major anions and water-quality parameters, as well as for organic compounds Evaluations and data for groundwater, surface water, sediments, and subsurface soils are presented in the BGCR

2.0 GEOCHEMISTRY OF URANIUM AND ITS RELATION TO THE GEOLOGIC ENVIRONMENT OF ROCKY FLATS

Uranium is a multivalent element (+2, +3, +4, +5, +6), but only the +4 and +6 states are of relevance in geologic systems Of all rock types, uranium is most abundant in granites (average = 5 ppm) and shales (average = 3 5 ppm) (Krauskopf, 1979) Uranium is only slightly soluble in the reduced U^{+4} state, however, more oxidized forms (U^{+6}) or anionic species present at high pH are much more soluble Dissolved uranium complexes with carbonate and sulfate, which may facilitate transport, carbonate-bearing solutions are excellent solvents for uranium The solubility of U^{+6} is greatly increased by the formation of anionic carbonate complexes In general, uranium is least soluble in reducing environments and most soluble in alkaline, oxidizing environments

The geologic setting of Rocky Flats includes granitic clasts contained within alluvial deposits that overlie Cretaceous-age claystones, siltstones, and sandstones of the Arapahoe and Laramie Formations (EG&G, 1995a) Precambrian igneous, metamorphic, and metasedimentary rocks exposed in Coal Creek Canyon are the source of clasts contained in the Rocky Flats Alluvium, on which is formed one of the oldest soils along the Colorado Front Range Pedogenic horizons enriched in calcium-carbonate deposits, known as caliche, are found in the shallow subsurface across the site, especially within soils formed on the Rocky Flats Alluvium Significant quantities (25 to 80 percent by volume) of caliche are present in some stratigraphic intervals of the Rocky Flats Alluvium As noted above, carbonate-bearing solutions solubilize uranium

One study that evaluated uranium distributions in waters and sediments of the Front Range speculated that " higher uranium concentrations in water samples are probably due to leaching of uraniferous strata in the Pierre and Laramie formations " (Bolivar et al , 1978) This same study noted that the granites of the Front Range " are known to be rich in uranium ," and that the South Platte River is " anomalously rich in uranium compared to most other rivers of its size " In short, the types of rocks in the Rocky Flats area (claystones of the Laramie Formation and Precambrian granites), the presence of nearby uranium ore (i e , the Schwartzwalder mine), and a generally alkaline and oxidizing environment in the near-subsurface, contribute to the likelihood that high and variable concentrations of uranium in Rocky Flats groundwater may exist

3.0 URANIUM IN BACKGROUND GROUNDWATER AT ROCKY FLATS

Uranium isotopes in samples of unfiltered groundwater collected from the upper hydrostratigraphic unit (UHSU) exhibit a wide range of activities (pCi is a unit of activity, not concentration) The ordered listing of data and summary statistics from the BGCR (see Table 1) show that, although the combined mean activities of uranium in background groundwater are less than the state standard of 40 pCi/L, the standards are exceeded in at least one background well (B205589) Well B205589 lies along the Rock Creek drainage just south of Highway 128 This well, along with all other background wells, sits outside the area in which groundwater could possibly be impacted by releases from the Rocky Flats Plant (Figure 1)

Statistical calculations performed on the BGCR data for uranium isotopes (see Table 1) yield normal upper tolerance limits (UTLs) that far exceed the state standard of 40 pCi/L The values for lognormal UTLs are even higher than the normal UTLs Concentrations of naturally occurring chemicals exhibit a tendency to form lognormal distributions, so the normal UTLs are likely to underestimate the upper range of background activities Despite the possibility of underestimation, the more conservative normal UTLs are presented here and in the BGCR

In addition to BGCR data, evaluations provided in the Groundwater Geochemistry Report (EG&G, 1995b) show a geochemical evolution in the composition of shallow groundwater along flow paths at Rocky Flats For the Rock Creek area, concentrations/activities of major ions and uranium isotopes show a marked increase along the flow path (Figure 2) This increase may be related to increasing levels of dissolved carbonate (which complexes with uranium to increase the solubility of uranium), or to naturally occurring accumulations of uranium in the Rock Creek drainage Well locations for the Rock Creek flow path are shown in Figure 3

The large variability shown for levels of uranium in background groundwater is not surprising, considering the inherent heterogeneity of geologic materials and the presence of ore-grade uranium deposits (Schwartzwalder mine near Ralston Reservoir) within 10 miles of the Rocky Flats Plant In addition, a recent study performed by the Jefferson County Health Department (Moody and Morse, 1992) found high levels of uranium in the groundwater of Coal Creek Canyon This study compiled data for groundwater samples collected from 33 domestic wells in Coal Creek Canyon Uranium (total) ranged from 1 3 to 1,200 pCi/L, with a mean and standard deviation of 174 9 and 339 1 pCi/L, respectively

4.0 SUMMARY AND RECOMMENDATIONS

The range of activities for uranium isotopes in potentially contaminated groundwater at Rocky Flats does not exceed that seen for background groundwater, with the exception of three wells adjacent to the Solar Evaporation Ponds (wells 2886, 05093, and 05193) Site-specific background studies (DOE, 1992, DOE, 1993), in addition to an investigation by the Jefferson County Health Department (Moody and Morse, 1992), indicate high levels of naturally occurring uranium in the groundwater of Rocky Flats and nearby areas Despite these anomalously high background levels, if the background activities for uranium isotopes reported in the BGCR (DOE, 1993) are converted to mass units of mg/L and added together, the mean and maximum uranium concentrations are 0 0327 and 0 3029 mg/L, respectively — well below chronic limit of 1 9 mg/L (DOE, 1995a)

Although it is clear that the Platte-basin and site-specific standards for uranium in groundwater are exceeded by naturally occurring uranium, it is likely that the Rocky Flats Plant has contributed some uranium to the local groundwater However, based on the background studies discussed above, the extent of this contribution does not exceed the maximum contribution from natural sources

As discussed in the BGCR (DOE, 1993), the ratios of relative activities of uranium-234 to uranium-238 are approximately 0 09 in depleted uranium, 1 06 in natural uranium, 5 74 in power-reactor fuel, and a higher ratio for weapons-grade uranium (Note that the analytical method used for Rocky Flats sample does not resolve uranium-233 from uranium-234, so they are reported together) The Rocky Flats BGCR (DOE, 1993) reported a range of 1 19 to 2 43 for uranium isotope ratios in background groundwater and stream water, ratios that are above 3 0 or below 1 0 suggest the presence of artificially enriched (more uranium-235) or depleted (less uranium-235) uranium In contrast with the background range of ratios given in the BGCR, the 1994 RCRA Report for Rocky Flats (DOE, 1995b) reported uranium ratios ranging from 0 34 to 18 5 for UHSU groundwater at the Solar Evaporation Ponds (Operable Unit 4)

So, although the likely presence of Rocky Flats uranium may be suggested by the isotopic ratio of $^{234}U/^{238}U$, there is no exact method for determining the proportions of Rocky Flats uranium and naturally occurring uranium at a given site The proportion of Rocky Flats uranium cannot be determined because both enriched and depleted uranium were used at Rocky Flats and the exact isotopic compositions for both are unknown (or classified information) In addition, the amounts of both types of uranium that were released to the environment are unknown What is known is that anomalously high levels of uranium are present in geologic materials and groundwater in the Denver Basin and along the Colorado Front Range, with ore-grade uranium deposits within 10 miles of the Rocky Flats Plant (see Bolivar et al , 1978)

The spotty occurrence of high levels of uranium is a characteristic of naturally occurring uranium in Jefferson County, including the Rocky Flats area (DOE, 1993, Morse and Moody, 1992, Bolivar et al , 1978) Because it is futile to attempt to remediate uranium to levels that are below those of background, the current site-specific standards should not be used as remediation goals Based on background data for Rocky Flats, the following standards are recommended

Uranium-233+234 (unfiltered sample)	145 pCi/L
Uranium-235 (unfiltered sample)	5 2 pCi/L
Uranium-238 (unfiltered sample)	114 pCi/L
Uranium-233+234 (filtered sample)	75 pCi/L
Uranium-235 (filtered sample)	1 9 pCi/L
Uranium-238 (filtered sample)	53 pCi/L

These proposed standards are the normal UTL values calculated for data from the BGCR (DOE, 1993) The calculation and use of UTLs is given in EPA guidance for RCRA reporting (EPA, 1992) The UTL values for uranium isotopes in both unfiltered and filtered samples of groundwater are presented here for comparative purposes In terms of groundwater transport of radionuclides and other metals, only the dissolved portion is of relevance, the pore size, permeability, and composition of the substrate will dramatically affect the movement of any groundwater constituent This is unlike transport in surface water, where the total (i e , dissolved + suspended) fraction is transported along with water flow (Note that "dissolved" is operationally defined as that fraction that can pass through a 0 45-micron membrane filter) All groundwater standards should specify the type of sample (filtered or unfiltered) to which they apply

5.0 REFERENCES

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TABLE 1 - ORDERED LISTING OF DATA FOR URANIUM IN BACKGROUND GROUNDWATER

File C:\HOPKIN01 TAB

Data for Uranium Isotopes in Unfiltered Background Groundwater from the UHSU
Data from the Background Geochemical Characterization Report (DOE, 1993)

December 22, 1995

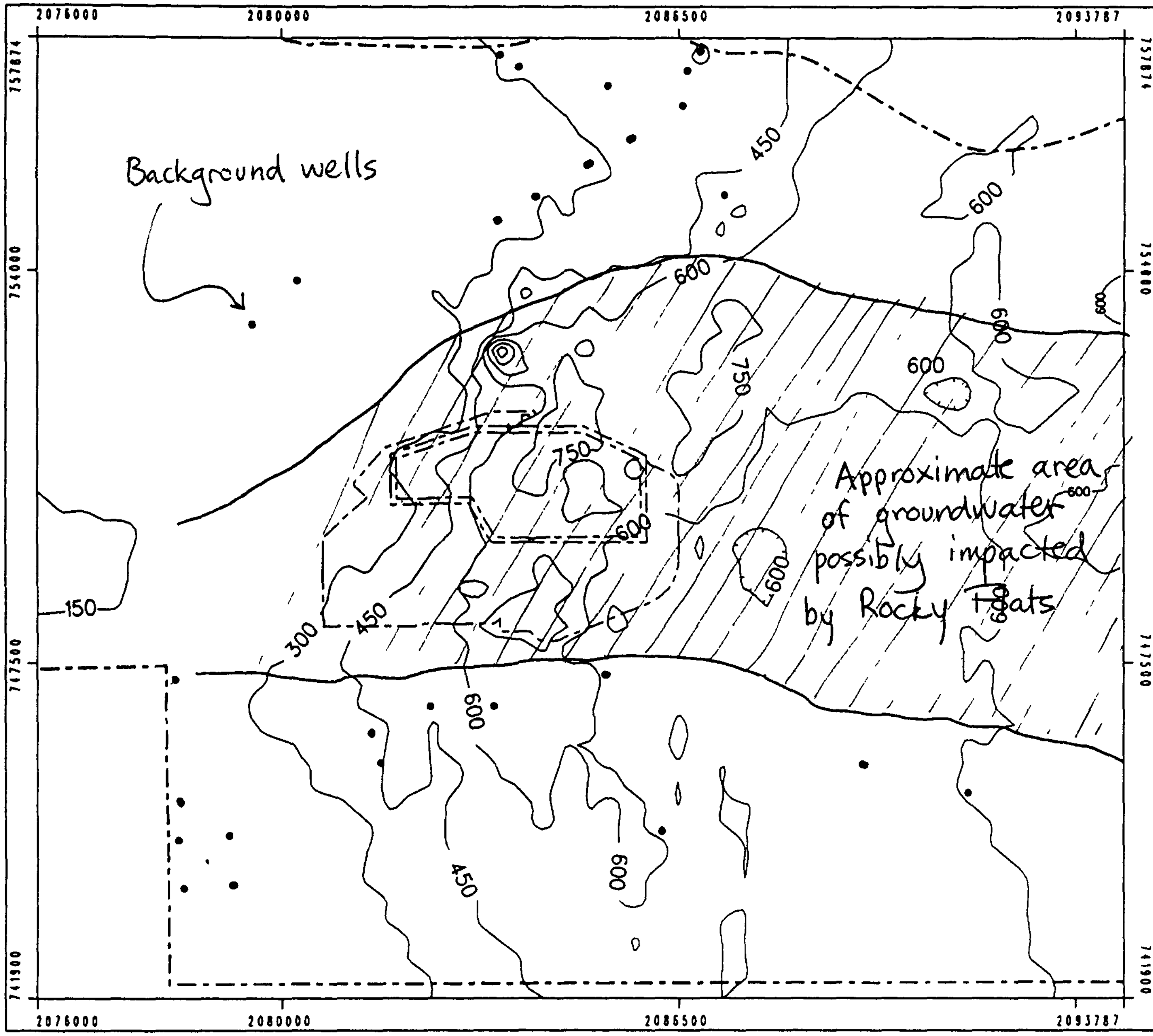
OBS	LOCATION	SAMPLE	SDATE	ANALYTE	RESULT	UNITS	QUAL	ERROR	RL	VAL	GEOLOGY
1	B200589	G-0589-0607-02-1310	06/07/90	URANIUM-233,234	0 000	PCI/L		0 1323	0 320	A	RFA
2	B405586	G-5586-0607-02-1331	06/07/90	URANIUM-233,234	0 064	PCI/L		0 1253	0 300	A	RFA
3	B102289	G-1889-0514-02-1209	05/14/90	URANIUM-233,234	0 100	PCI/L		0 2100	0.600		VFA
4	B400489	G-0489-0608-02-0920	06/08/90	URANIUM-233,234	0.108	PCI/L		0 2123	0.500	A	RFA
5	B405789	G-4889-0530-02-1510	05/30/90	URANIUM-233,234	0 130	PCI/L		0 1700	0.600		RFA
6	B200689	G-0689-0608-02-1320	06/08/90	URANIUM-233,234	0 181	PCI/L		0 1806	0.420	A	RFA
7	B200889	G-0889-0606-02-0915	06/06/90	URANIUM-233,234	0 353	PCI/L		0.2368	0 270	A	RFA
8	B200589	GW00270IT	08/21/90	URANIUM-233,234	0.368	PCI/L		0.2080	0 000		RFA
9	B400489	GW00247IT	08/15/90	URANIUM-233,234	0 455	PCI/L		0 2550	0.000		RFA
10	B200789	G-0789-0607-02-0940	06/07/90	URANIUM-233,234	0 608	PCI/L		0 4083	0.320	A	RFA
11	B102289	GW00332IT	08/30/90	URANIUM-233,234	0 677	PCI/L		0 2640	0 000		VFA
12	B400389	G-0389-0611-02-1025	06/11/90	URANIUM-233,234	0.872	PCI/L		0 5429	0 310	A	RFA
13	B202589	G-2189-0601-02-1220	06/01/90	URANIUM-233,234	1.100	PCI/L		0 4600	0 600		VFA
14	B400189	G-0189-0606-02-1115	06/06/90	URANIUM-233,234	1 246	PCI/L		0 5613	0.250	A	RFA
15	B400389	GW00273IT	08/21/90	URANIUM-233,234	1 330	PCI/L		0 4100	0.000		RFA
16	B302889	G-2489-0522-02-1025	05/22/90	URANIUM-233,234	1 540	PCI/L		0 6100	0 600		VFA
17	B405489	G-4589-0521-02-1445	05/22/90	URANIUM-233,234	1 830	PCI/L		0.6100	0 600		WCS
18	B405489	GW00118IT	08/15/90	URANIUM-233,234	1 930	PCI/L		0 4400	0 000		WCS
19	B201589	G-1389-0604-02-1500	06/05/90	URANIUM-233,234	2 405	PCI/L		1 1250	0 590	A	COL
20	B302989	G-2589-0523-02-1125	05/23/90	URANIUM-233,234	2 470	PCI/L		0 7500	0 600		VFA
21	B402689	G-2289-0507-02-0903	05/08/90	URANIUM-233,234	2 510	PCI/L		0 8100	0 600		VFA
22	B302889	GW00125IT	08/10/90	URANIUM-233,234	2 650	PCI/L		0 7200	0 000		VFA
23	B305389	G-4489-0521-02-1123	05/25/90	URANIUM-233,234	4 440	PCI/L		1 1400	0 600		WCS
24	B305389	GW00137IT	08/09/90	URANIUM-233,234	5 020	PCI/L		0 9900	0.000		WCS
25	B203289	G-2889-0612-02-0917	06/13/90	URANIUM-233,234	5 120	PCI/L		1 1900	0 600		WCS
26	B203589	G-3089-0612-02-1133	06/13/90	URANIUM-233,234	6 930	PCI/L		1 5300	0 600		WCS
27	B201089	G-0989-0605-02-1510	06/06/90	URANIUM-233,234	12 490	PCI/L		2 5715	0 390	A	COL
28	B201189	GW00249IT	08/17/90	URANIUM-233,234	13 400	PCI/L		1 8000	0 000		COL
29	B201189	G-1089-0604-02-1000	06/05/90	URANIUM-233,234	13 960	PCI/L		2 0000	0 600		COL
30	B201189	GW03275IT	07/30/92	URANIUM-233,234	14 000	PCI/L	B	1 9000	0 056		COL
31	B304889	G-4089-0523-02-1445	05/24/90	URANIUM-233,234	17 170	PCI/L		3 0000	0 600		WCS
32	B304889	GW00132IT	08/09/90	URANIUM-233,234	17 500	PCI/L		2 2000	0 000		WCS
33	B205589	GW03280IT	07/30/92	URANIUM-233,234	120 000	PCI/L	BX	12 0000	0 110		COL
34	B205589	G-4689-0604-02-1205	06/05/90	URANIUM-233,234	129 670	PCI/L		13 2900	0.600		COL
35	B205589	GW00250IT	08/17/90	URANIUM-233,234	164 000	PCI/L		22 0000	0 000		COL
36	B203289	G-2889-0612-02-0917	06/13/90	URANIUM-235	-0 020	PCI/L		0 0200	0 600		WCS
37	B302889	G-2489-0522-02-1025	05/22/90	URANIUM-235	-0 010	PCI/L		0 0100	0 600		VFA
38	B405489	G-4589-0521-02-1445	05/22/90	URANIUM-235	-0 010	PCI/L		0 0100	0 600		WCS
39	B102289	G-1889-0514-02-1209	05/14/90	URANIUM-235	0 000	PCI/L		0 2900	0 600		VFA
40	B200589	G-0589-0607-02-1310	06/07/90	URANIUM-235	0 000	PCI/L		0 1602	0 380	A	RFA
41	B200689	G-0689-0608-02-1320	06/08/90	URANIUM-235	0 000	PCI/L		0 2144	0 510	A	RFA
42	B200789	G-0789-0607-02-0940	06/07/90	URANIUM-235	0 000	PCI/L		0 1602	0 380	A	RFA
43	B400389	G-0389-0611-02-1025	06/11/90	URANIUM-235	0 000	PCI/L		0 1591	0 380	A	RFA
44	B400489	G-0489-0608-02-0920	06/08/90	URANIUM-235	0 000	PCI/L		0 2556	0 610	A	RFA
45	B202589	G-2189-0601-02-1220	06/01/90	URANIUM-235	0 040	PCI/L		0 0900	0 600		VFA
46	B405789	G-4889-0530-02-1510	05/30/90	URANIUM-235	0 040	PCI/L		0 1000	0.600		RFA
47	B400189	G-0189-0606-02-1115	06/06/90	URANIUM-235	0 066	PCI/L		0 1289	0 310	A	RFA
48	B200889	G-0889-0606-02-0915	06/06/90	URANIUM-235	0 071	PCI/L		0 1401	0 330	A	RFA
49	B405586	G-5586-0607-02-1331	06/07/90	URANIUM-235	0 077	PCI/L		0 1516	0 360	A	RFA
50	B302989	G-2589-0523-02-1125	05/23/90	URANIUM-235	0 080	PCI/L		0 1200	0 600		VFA
51	B405489	GW00118IT	08/15/90	URANIUM-235	0 174	PCI/L		0 1290	0 000		WCS
52	B402689	G-2289-0507-02-0903	05/08/90	URANIUM-235	0 180	PCI/L		0 2000	0 600		VFA
53	B203589	G-3089-0612-02-1133	06/13/90	URANIUM-235	0 190	PCI/L		0 2300	0 600		WCS
54	B102289	GW00332IT	08/30/90	URANIUM-235	0 208	PCI/L		0 1900	0 000		VFA
55	B302889	GW00125IT	08/10/90	URANIUM-235	0 227	PCI/L		0 2160	0 000		VFA
56	B200589	GW00270IT	08/21/90	URANIUM-235	0 255	PCI/L		0 1720	0 000		RFA
57	B304889	G-4089-0523-02-1445	05/24/90	URANIUM-235	0 290	PCI/L		0 3000	0 600		WCS
58	B400389	GW00273IT	08/21/90	URANIUM-235	0 310	PCI/L		0 2210	0 000		RFA

59	B201189	G-1089-0604-02-1000	06/05/90	URANIUM-235	0 370	PCI/L		0 2500	0.600		COL
60	B305389	G-4489-0521-02-1123	05/25/90	URANIUM-235	0 370	PCI/L		0 3000	0.600		WCS
61	B201089	G-0989-0605-02-1510	06/06/90	URANIUM-235	0.401	PCI/L		0.3963	0.470	A	COL
62	B201189	GW03275IT	07/30/92	URANIUM-235	0 440	PCI/L	BJ	0.2700	0 056		COL
63	B304889	GW00132IT	08/09/90	URANIUM-235	0 524	PCI/L		0.2120	0 000		WCS
64	B201589	G-1389-0604-02-1500	06/05/90	URANIUM-235	0 613	PCI/L		0.6156	0 710	A	COL
65	B400489	GW00247IT	08/15/90	URANIUM-235	0 667	PCI/L		0 3060	0 000		RFA
66	B201189	GW00249IT	08/17/90	URANIUM-235	0 668	PCI/L		0.2760	0 000		COL
67	B305389	GW00137IT	08/09/90	URANIUM-235	0 751	PCI/L		0 3310	0 000		WCS
68	B205589	G-4689-0604-02-1205	06/05/90	URANIUM-235	3 420	PCI/L		0 8700	0 600		COL
69	B205589	GW03280IT	07/30/92	URANIUM-235	4 900	PCI/L	BX	1 1000	0 002		COL
70	B205589	GW00250IT	08/17/90	URANIUM-235	6 290	PCI/L		1 7100	0 000		COL
71	B200589	G-0589-0607-02-1310	06/07/90	URANIUM-238	0 000	PCI/L		0.1323	0.320	A	RFA
72	B200689	G-0689-0608-02-1320	06/08/90	URANIUM-238	0 000	PCI/L		0 1772	0.420	A	RFA
73	B405586	G-5586-0607-02-1331	06/07/90	URANIUM-238	0 000	PCI/L		0 1249	0 300	A	RFA
74	B200889	G-0889-0606-02-0915	06/06/90	URANIUM-238	0 059	PCI/L		0 1157	0.270	A	RFA
75	B400489	G-0489-0608-02-0920	06/08/90	URANIUM-238	0 108	PCI/L		0 2123	0 500	A	RFA
76	B200589	GW00270IT	08/21/90	URANIUM-238	0 170	PCI/L		0 1400	0.000		RFA
77	B400489	GW00247IT	08/15/90	URANIUM-238	0 334	PCI/L		0 2220	0.000		RFA
78	B400389	G-0389-0611-02-1025	06/11/90	URANIUM-238	0 335	PCI/L		0.2679	0 310	A	RFA
79	B102289	GW00332IT	08/30/90	URANIUM-238	0 389	PCI/L		0 1970	0 000		VFA
80	B405489	GW00118IT	08/15/90	URANIUM-238	0 947	PCI/L		0 2930	0 000		WCS
81	B400189	G-0189-0606-02-1115	06/06/90	URANIUM-238	0 975	PCI/L		0 4481	0.250	A	RFA
82	B400389	GW00273IT	08/21/90	URANIUM-238	1 040	PCI/L		0 3700	0 000		RFA
83	B200789	G-0789-0607-02-0940	06/07/90	URANIUM-238	1 418	PCI/L		0 6982	0 320	A	RFA
84	B201589	G-1389-0604-02-1500	06/05/90	URANIUM-238	1 772	PCI/L		1 0664	0 590	A	COL
85	B302889	GW00125IT	08/10/90	URANIUM-238	2 080	PCI/L		0.6300	0 000		VFA
86	B305389	GW00137IT	08/09/90	URANIUM-238	3 790	PCI/L		0 8400	0 000		WCS
87	B201089	G-0989-0605-02-1510	06/06/90	URANIUM-238	6 951	PCI/L		1 7334	0 390	A	COL
88	B201189	GW00249IT	08/17/90	URANIUM-238	8 220	PCI/L		1 2600	0 000		COL
89	B201189	GW03275IT	07/30/92	URANIUM-238	9 300	PCI/L	B	1 5000	0 034		COL
90	B304889	GW00132IT	08/09/90	URANIUM-238	10 600	PCI/L		1 4000	0 000		WCS
91	B205589	GW03280IT	07/30/92	URANIUM-238	82 000	PCI/L	BX	8 6000	0 002		COL
92	B205589	GW00250IT	08/17/90	URANIUM-238	108 000	PCI/L		15 0000	0 000		COL

These data available on diskette in the 1993 Background Geochemical Characterization Report (DOE, 1993)
The ERROR variable is the 95-percent upper confidence limit (UCL), based on analytical uncertainty
The RL variable is the reporting (i.e , detection) limit reported for the analysis
The GEOLOGY variable indicates the geologic unit in which the monitoring well is screened (RFA = Rocky Flats Alluvium, COL = colluvium, VFA = valley-fill alluvium, and WCS = weathered claystone bedrock)

SUMMARY STATISTICS FOR URANIUM ISOTOPES IN SAMPLES OF UNFILTERED GROUNDWATER
(BASED ON BGCR DATA)

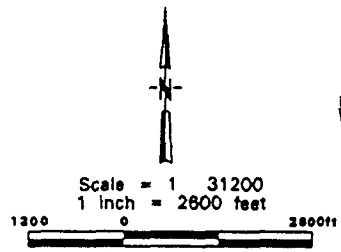
Isotope	N	Min	Max	Mean	SD	99/99-UTL	Units	Tol Factor
Uranium-233,234	35	0 00	164 0	15 62	38 75	144 83	pCi/L	3 3344
Uranium-235	35	-0 02	6 29	0 62	1 38	5 23	pCi/L	3 3344
Uranium-238	22	0 00	108 0	10 84	27 73	114 17	pCi/L	3 7267



EXPLANATION

- Lines of Equal Concentrations (hachures indicate local low)
- *Contour configuration represents estimated values based on kriging analysis
- • Background Wells
- Industrial Area and Security Zone Boundaries
- Buffer Zone Boundary

Contour Interval = 150 mg/L



Scale = 1 : 31200
1 inch = 2600 feet

State Plane Coordinate System
Colorado Central Zone
Datum NAD27

FIGURE 1

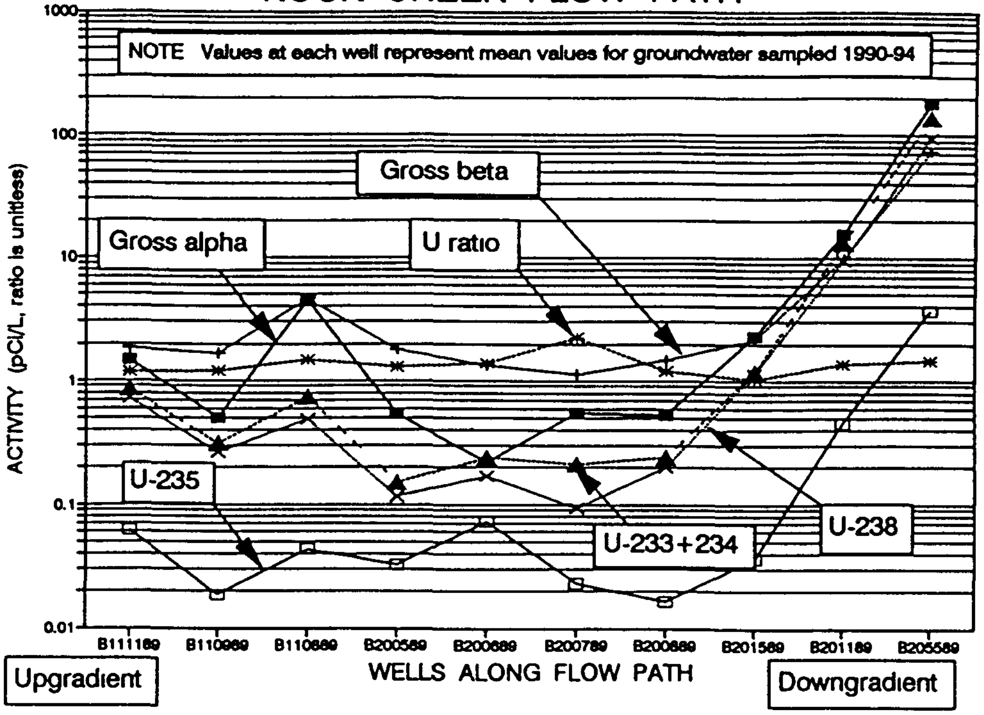
EG&G ROCKY FLATS
Rocky Flats Site, Golden, Colorado

Kriged Isoconcentration Map of Bicarbonate in the Upper Hydrostratigraphic Unit

Groundwater Geochemistry Report

January 1995	Figure 6-5

ROCK CREEK FLOW PATH



INDUSTRIAL AREA FLOW PATH

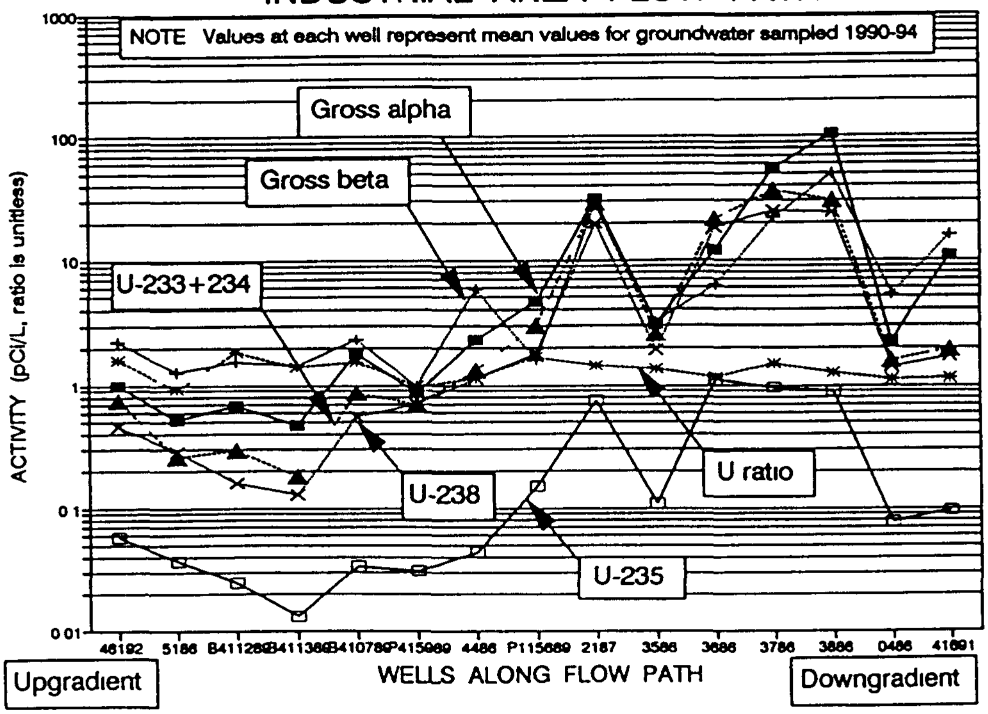


FIGURE 2

EG&G ROCKY FLATS Rocky Flats Site Golden Colorado	Activities of dissolved uranium isotopes, gross alpha and gross beta, as well as the uranium-234/238 ratio	Groundwater Geochemistry Report Date January 1995 — Figure 5 -16

M\ES\Gdwr Geochemistry Figs\5-16 impt\12\9\95

4 0 SUBSURFACE SOIL

4 1 Action levels for subsurface soil are protective of

A human exposure appropriate for uses described in the Conceptual Vision document,

B surface water standards via ground water transport, and

C ecological exposure appropriate for uses described in the Conceptual Vision document

4 2 Action Levels The subsurface soil action levels have been calculated using a two-tier approach

A Tier I

1 All subsurface soils capable of leaching volatile organic compounds to groundwater at concentrations greater than or equal to 100 x MCLs

2 Contaminant-specific Tier I action levels have been determined using a soil/water partitioning equation and a dilution factor from EPA's <u>Draft Soil Screening Guidance</u> (1994) These derived values and the parameters used to derive them are listed in Table 4-1 The subsurface media characteristics for these calculations are based on site-specific data or conservative values where representative site values cannot be determined Where subsurface characteristics in a particular area within RFETS differs significantly from those chosen as representative of the entire site, those alternate values should be used

3 No Tier I action levels have been determined for non-volatile contaminants due to their generally limited mobility in soil

B Tier II

1 Human exposure to subsurface soil is envisioned only in the Industrial Area (Area 1 of Conceptual Vision) Therefore, Tier II action levels protective of human exposure are calculated on the basis of <u>Construction Worker</u> exposure This includes dermal contact with and direct ingestion of subsurface soils, inhalation of particulates and VOCs, and external irradiation The attached Tables 5-1 through 5-5 provide the equations and parameters used to calculate the subsurface soil action levels Table 5-6 presents the calculated action levels derived for this exposure scenario **Possible non-consensus exists concerning how a 15 mrem/year dose limit might be applied**

2 Additional subsurface soil may need to be remediated or managed to protect surface water quality via ground water transport or ecological resources **and/or prevent continuing release of hazardous constituents from the contaminated soil via any mechanism** Subsurface soil presenting unacceptable ecological risks (HI ≥ 1) identified using the approved ecological risk assessment methodology will be evaluated for remediation or management

4 3 Action Determinations

A <u>Tier I</u> When contaminant levels in subsurface soil exceed Tier I action levels, subsurface soil source removals will be triggered These removals will be accomplished through accelerated actions

B <u>Tier II</u> When contaminant levels in subsurface soil exceed Tier II action levels or when an action is necessary to protect surface water or ecological resources **and/or prevent continuing release of hazardous constituents from the contaminated soil via any mechanism,** a process to identify, evaluate, and implement efficient, cost-effective, and feasible remediation or management actions will be triggered

1 Actions may be implemented by means of an accelerated action or addressed as necessary in the ROD for the affected area

2 Actions taken to protect construction workers in the Industrial Area exposure may include remedial actions or the creation of institutional controls *[An implication of the Conceptual Vision is that there will be a cost associated with the remediation or management of areas in the Industrial Area that will be made available for future industrial use]*

3 Where remedial actions to protect ecologic resources can be implemented without damaging other ecologic resources, remediation and/or management actions will be implemented

C Appropriate remedial or management actions will be determined through this evaluation process on a case-by-case basis, and may include the removal, treatment, disposal, or in-place stabilization of contaminated subsurface soils

D Single geographically isolated data points of subsurface soil contamination above the Tier I or Tier II action levels will be evaluated for potential source magnitude These single points will not necessarily trigger a source removal, remedial, or management action, depending on the source evaluation

E The need to excavate below the water table for source removal actions will be determined on a case-by-case basis

F Any accelerated actions will be taken in accordance with the Conceptual Vision document and incorporated into the Environmental Priority List

Rationale for Preventing Continued Release from Soil Contamination

1 Maintaining consistency and integrity in our RCRA and CERCLA cleanup programs as they have been, and continue to be, applied throughout the State

2 Consistency with the intent of the agreed upon premises in the Vision

3 Allows for a cleanup that has a chance of ultimate success, rather than a guarantee of long- and very long-term continuing DOE responsibilities

4 It is the right thing to do

5 Will have greater public acceptance

How will we measure success???

We have flexibility in placement of compliance/remedy performance points Since ground water will be the usually impacted media, we can either set up a low "MCL-multiple" for modelling purposes, or set up a monitoring network some distance from the IHSSs where ground water standard exceedances would be measured For instance, a ground water monitoring network set up at the edge of the IA for all sources within the IA might be OK (This would be for post-remedial compliance/remedy performance monitoring)

PRELIMINARY DRAFT
FOR DISCUSSION ONLY
DO NOT REFERENCE
1/5/96

STREAM STANDARDS FOR RADIONUCLIDES AND THEIR IMPACT

The table below summarizes the major issues and impacts of the various proposed stream standards for radionuclides at the Rocky Flats Environmental Technology Site It assumes that the final resolution of the plutonium standard will set the pattern for other Atomic Energy Act-regulated radionuclides, such as americium

	Stream Standard for Pu = 0 15 pCi/L	Stream Standard for Pu = 1 5 pCi/L	Stream Standard for Pu = 15 pCi/L***
Basis	CDPHE proposal based on 3 times current ambient standard	10 times previous column	Statewide standard for plutonium, currently in effect and used as ARAR
Environmental Impact	Baseline release	Addition of ca 10 to 15 microCi/yr to baseline release from Site	Addition of ca. 100 to 150 microCi/yr to baseline release from Site
Technology Required to Meet Standard	Chemical Precipitation, Bone Char, Reverse Osmosis, and Evaporation	Chemical Precipitation, Bone Char, Reverse Osmosis, and Evaporation	Chemical Precipitation and Bone Char Treatment
Cost Differential to Increase Treatment Level	Base Case plus $72 Million over life cycle	Base Case plus $72 Million over life cycle	Base Case
Reliability of Rad Removal Technology in Meeting Standard	Moderate	High	High
Risk Assessments			
to General Public via Water Supply*	1×10^{-6}**	1×10^{-5}	1×10^{-4}
to General Public via Recreational Use of Buffer Zone	3×10^{-10}	3×10^{-9}	3×10^{-8}
to Operators at Wastewater Plant	Low	Low	Low

* The Water Supply Risk pathway will not be applicable at the time of implementation for the Alternate Water Treatment Systems because Option B will be in place, eliminating the commingling of RFETS runoff with drinking water supplies

** Risk of excess cancer death varies depending on underlying assumptions

*** Proposed duration of 4 to 8 years

6 0 - RCRA Closure

Certain IHSSs at RFETS must be remediated in such a way as to meet the substantive requirements of RCRA closure These IHSSs include IHSS 104 (Solar Ponds), IHSS 107 (Present Landfill), OU 9 tanks, and OU 10 storage pads

RCRA was promulgated with one over-riding intent to manage hazardous waste from cradle to grave For this reason, units that have treated, stored, or disposed of hazardous waste ("regulated units") must proceed through RCRA closure All hazardous waste and hazardous waste residues from these units must be appropriately managed and controlled As opposed to RCRA corrective action, this is not a risk-based decision Rather, it is a decision based on accounting for the hazardous waste

It follows, then, that regulatory requirements for closing land-based hazardous waste units are not action-level or cleanup-level based Instead, the requirements are performance based The general closure performance standards are presented in Section 265 111 of the regulations (All of the "closure" IHSSs at RFETS will be closed under Part 265 Part 264 applies to permitted units) This section states

> **§ 265 111 - Closure performance standard**
>
> The owner or operator must close the facility in a manner that
>
> (a) Minimizes the need for further maintenance, and
>
> (b) Controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere, and
>
> (c) Complies with the closure requirements of this subpart including, but not limited to, the requirements of §§ 265 197 *(tanks)*, 265 228 *(surface impoundments)*, 265 258 *(waste piles)*, 265 280 *(land treatment units)*, 265 310 *(landfills)*, 265 351 *(incinerators)*, 265 381 *(thermal treatment units)*, 265 404 *(chemical physical and biological treatment units)*, and 265 1102 *(containment buildings)*

Section 265 111 does not distinguish between "clean" and "dirty" closure However, the subsections listed in 265 111(c) above do make this distinction for each type of unit Clean closure allows the unit to exit the regulatory realm while dirty closure requires continuing maintenance, management, and care

Closure units at RFETS include only tanks, surface impoundments, landfills, and container storage areas Therefore, each of these unit types is dealt with in more detail in the following sections

Tanks

Besides Section 265 111, requirements delineated in Section 265 228 apply to the closure of the Solar Ponds This section reads

> **§ 265 197 Closure and post-closure care**
>
> (a) At closure of a tank system, the owner or operator must remove or decontaminate all waste residues, contaminated containment system components (liners, etc) contaminated soils, and structures and equipment contaminated with waste and manage them as hazardous waste, unless § 261 3(d) of these regulations applies The closure plan, closure activities, cost estimates for closure, and financial responsibility for tank systems must meet all of the requirements specified in Subpart G of this part and Part 266 of these regulations
>
> (b) If the owner or operator demonstrates that not all contaminated soils can be practicably removed or decontaminated as required in paragraph (a) of this section, then the owner or operator must close the tank system and perform post-closure care in accordance with the closure and post-closure care requirements that apply to landfills (§ 265 310)

In addition, the purposes of closure, post-closure, and financial responsibility, such a tank system is then considered to be a landfill, and the owner or operator must meet all the requirements for landfills specified in Subpart G of this part and Part 266 of these regulations

(c) If an owner or operator has a tank system that does not have secondary containment that meets the requirements of § 265 193(b) through (f) and is not exempt from the secondary containment requirements in accordance with § 265 193(g), then

(1) The closure plan for the tank system must include both a plan for complying with paragraph (a) of this section and a contingent plan for complying with paragraph (b) of this section

(2) A contingent post-closure plan for complying with paragraph (b) of this section must be prepared and submitted as part of the permit application

(3) The cost estimates calculated for closure and post-closure care must reflect the costs of complying with the contingent closure plan and the contingent post-closure plan, if those costs are greater than the costs of complying with the closure plan prepared for the expected closure under paragraph (a) of this section

(4) Financial assurance must be based on the cost estimates in paragraph (c)(3) of this section

(5) For the purposes of the contingent closure and post-closure plans, such a tank system is considered to be a landfill, and the contingent plans must meet all of the closure, post-closure, and financial responsibility requirements for landfills under Subpart G of this part and Part 266 of these regulations

The practical implications of these regulations on the Solar Ponds are as follows

1) Clean closure can only be accomplished through complete removal or decontamination of all contaminated material No hazardous waste can be left behind in or out of the unit
2) Dirty closure requires capping
3) Dirty closure requires leak detection and ground water monitoring Detected leaks or detections of contaminants in ground water trigger mitigating actions The mitigating actions can be administered through a decision document or an order
4) Dirty closure triggers post-closure care normally administered by a post-closure permit At RFETS, this will be handled by the appropriate decision document Nevertheless, when post-closure begins and a permit would have been issued, the substantive requirements of Part 264 (requirements for permitted units) will apply Part 264 includes more stringent ground water monitoring requirements and defines upper limits for contaminants in ground water as well as points of compliance
5) All soil contamination must be addressed through closure, but contaminated ground water can be addressed through corrective action However, because any ground water plume contains hazardous waste it must be remediated or managed, regardless of concentration

Surface Impoundments - The Solar Ponds

Besides Section 265 111, requirements delineated in Section 265 228 apply to the closure of the Solar Ponds This section reads

§ 265 228 - Closure and post-closure care

(a) At closure, the owner or operator must

(1) *Clean Close* - Remove or decontaminate all waste residues contaminated containment system components (liners, etc), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and manage them as hazardous waste unless § 261 3(d) of these regulations applies, or

(2) *Dirty Close* - Close the impoundment and provide post-closure care for a landfill under Subpart G *(general closure and post-closure requirements)* and § 265 310 *(closure and post-closure for landfills)*, including the following

(i) Eliminate free liquids by removing liquid wastes or solidifying the remaining wastes and waste residues,

(ii) Stabilize remaining wastes to a bearing capacity sufficient to support the final cover; and

(iii) Cover the surface impoundment with a final cover designed and constructed to

(A) Provide long-term minimization of the migration of liquids through the closed impoundment,

(B) Function with minimum maintenance,

(C) Promote drainage and minimize erosion or abrasion of the cover;

(D) Accommodate settling and subsidence so that the cover's integrity is maintained, and

(E) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

(b) In addition to the requirements of Subpart G and § 265 310, during the post-closure care period, the owner or operator of a surface impoundment in which wastes, waste residues, or contaminated materials remain after closure in accordance with the provisions in paragraph (a)(2) of this section must

(1) Maintain the integrity and effectiveness of the final cover including making repairs to the cover as necessary to correct the effects of settling, subsidence, erosion, or other events

(2) Maintain and monitor the leak detection system in accordance with § 265 221(c)(2)(iv) and (3) *(design and operating requirements)* of these regulations and § 265 226(b) *(monitoring and inspecting requirements)* and comply with all other applicable leak detection system requirements of this part,

(3) Maintain and monitor the ground water monitoring system and comply with all other applicable requirements of Subpart F *(ground water monitoring)* of this part, and

(4) Prevent run-on and run-off from eroding or otherwise damaging the final cover

The practical implications of these regulations on the Solar Ponds are as follows

1) Clean closure can only be accomplished through complete removal or decontamination No hazardous waste can be left behind in or out of the unit Clean closure via removal for surface impoundments has been further described by EPA in the March 19, 1987 federal register, pages 8704 - 8709

2) Dirty closure requires capping The regulatory language here is exactly the same as is used in the landfill closure regulations This means that the technical design and performance requirements of the cap would be the same as that required for a landfill (a "RCRA Cap")

3) Dirty closure requires leak detection and ground water monitoring Detected leaks or detections of contaminants in ground water trigger mitigating actions The mitigating actions can be administered through a decision document or an order

4) Dirty closure triggers post-closure care normally administered by a post-closure permit At RFETS, this will be handled by the appropriate decision document Nevertheless, when post-closure begins and a permit would have been issued, the substantive requirements of Part 264

(requirements for permitted units) will apply Part 264 includes more stringent ground water monitoring requirements and defines upper limits for contaminants in ground water as well as points of compliance

5) All soil contamination must be addressed through closure, but contaminated ground water can be addressed through corrective action However, because any ground water plume contains hazardous waste it must be remediated or managed, regardless of concentration The nitrates in the soils and ground water are considered a hazardous waste due to the mixture rule

Landfills

Besides Section 265 111, requirements delineated in Section 265 310 apply to the closure of landfills This section reads

§ 265.310 Closure and post-closure care

(a) *(Assumes dirty closure or closure in-place)* At final closure of the landfill or upon closure of any cell, the owner or operator must cover the landfill or cell with a final cover designed and constructed to

(1) Provide long-term minimization of migration of liquids through the closed landfill,

(2) Function with minimum maintenance,

(3) Promote drainage and minimize erosion or abrasion of the cover,

(4) Accommodate settling and subsidence so that the cover's integrity is maintained, and

(5) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present

(b) After final closure, the owner or operator must comply with all post-closure requirements contained in §§ 265 117 through 265 120 *(post-closure requirements)* including maintenance and monitoring throughout the post-closure care period The owner or operator must

(1) Maintain the integrity and effectiveness of the final cover, including making repairs to the cover as necessary to correct the effects of settling, subsidence, erosion, or other events,

(2) Maintain and monitor the leak detection system in accordance with § 264 301(c)(3)(iv) and (4) *(leak detection)* of these regulations and § 265 304(b), and comply with all other applicable leak detection system requirements of this part,

(3) Maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of Subpart F *(ground water monitoring)* of this part,

(4) Prevent run-on and run-off from eroding or otherwise damaging the final cover, and

(5) Protect and maintain surveyed benchmarks used in complying with § 265 309 *(surveying and recordkeeping)*

The practical implications of these regulations on landfills at the site are as follows

1) Clean closure can only be accomplished through complete removal or decontamination No hazardous waste can be left behind in or out of the unit In fact, the regulations assume that no landfill will be removed and, therefore, skip directly to dirty closure requirements

2) Dirty closure requires capping

3) Dirty closure requires leak detection and ground water monitoring Detected leaks or detections of contaminants in ground water trigger mitigating actions The mitigating actions can be administered through a decision document or an order
4) Dirty closure triggers post-closure care normally administered by a post-closure permit At RFETS, this will be handled by the appropriate decision document Nevertheless, when post-closure begins and a permit would have been issued, the substantive requirements of Part 264 (requirements for permitted units) will apply Part 264 includes more stringent ground water monitoring requirements and defines upper limits for contaminants in ground water as well as points of compliance
5) All soil contamination must be addressed through closure, but contaminated ground water can be addressed through corrective action However, because any ground water plume contains hazardous waste it must be remediated or managed, regardless of concentration

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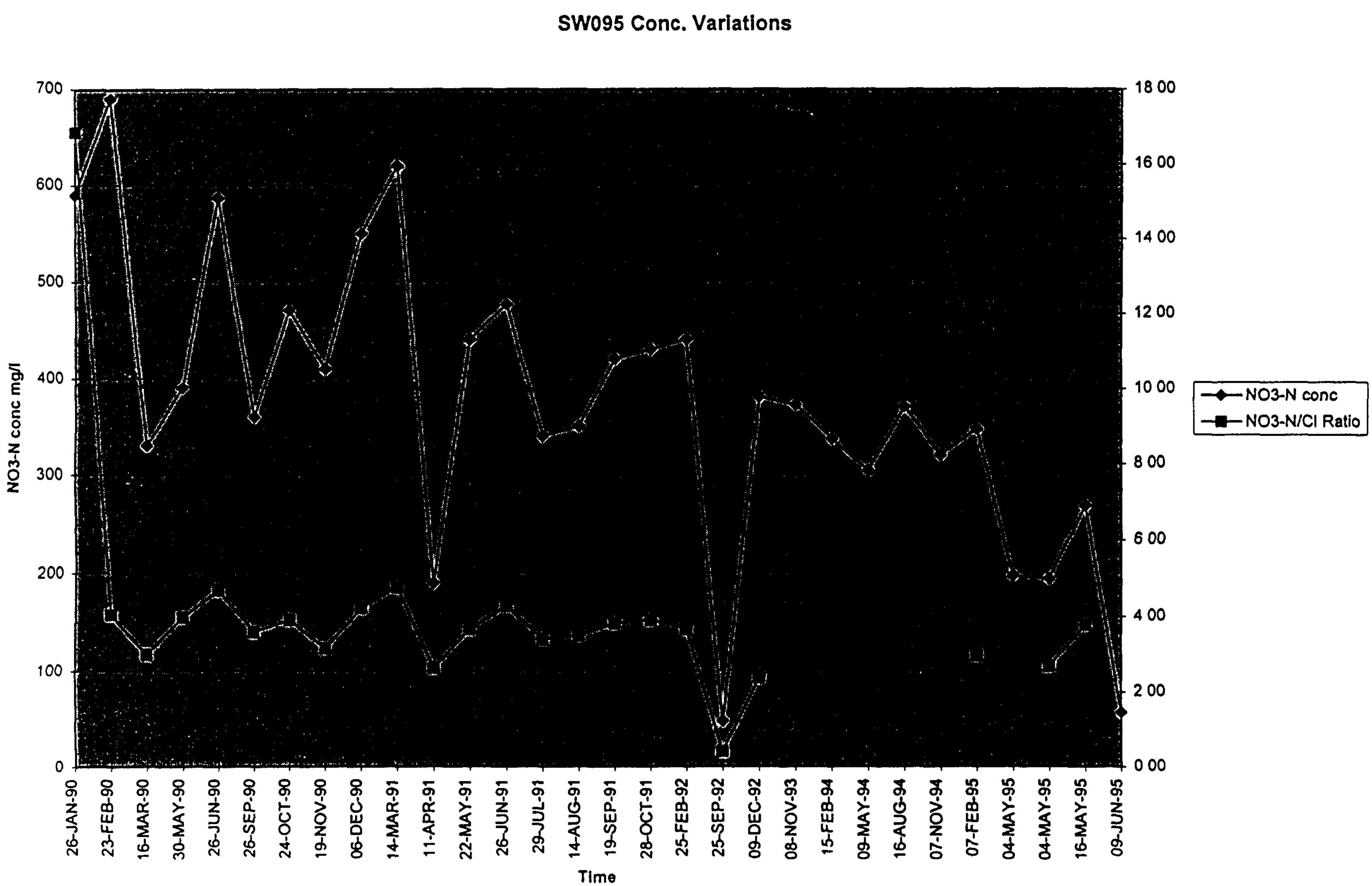
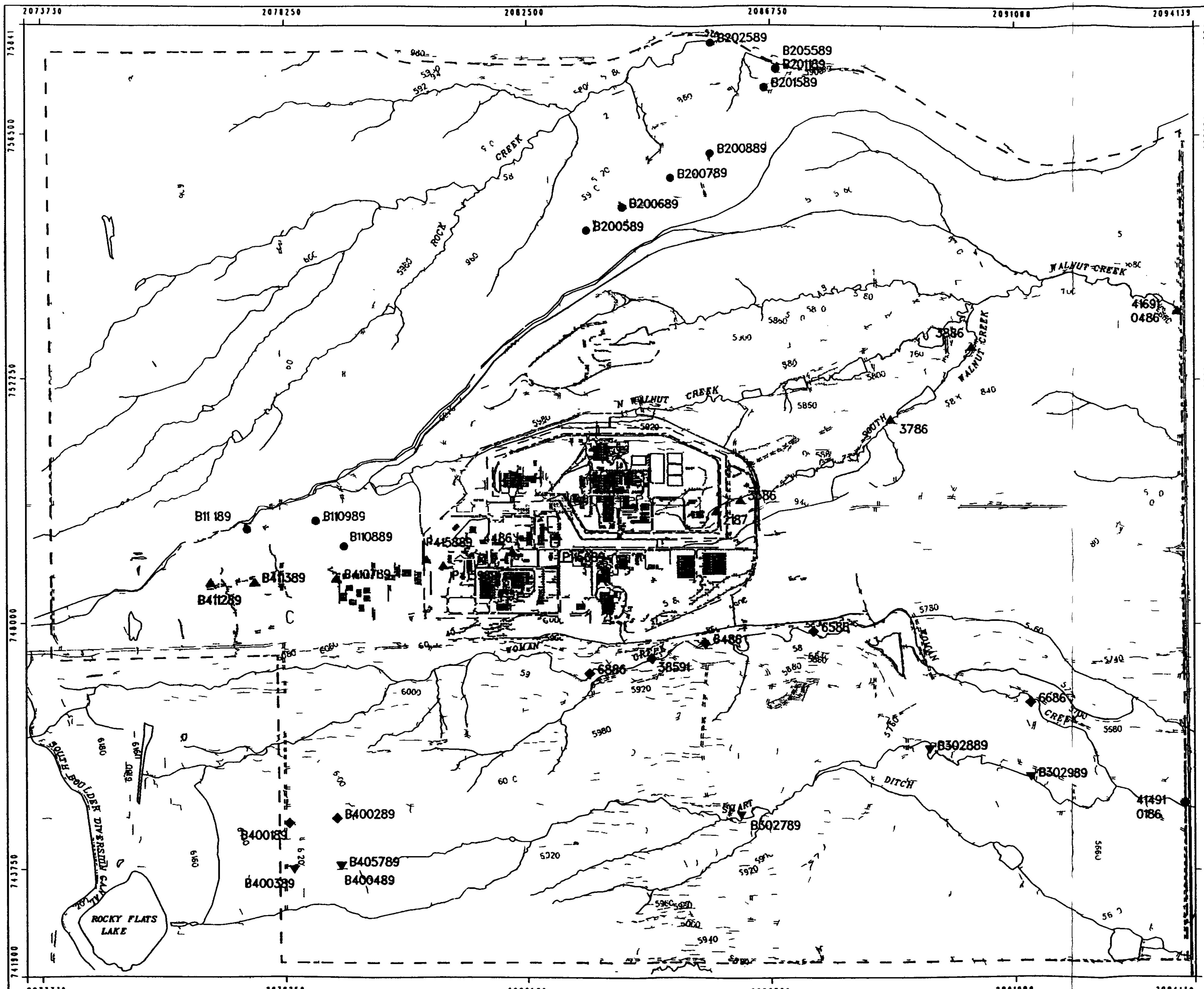
ITS Sump



Could pump to WTP for dilution



EXPLANATION

- ● Rock C ek Flow Path
- ▲ I dustrial Area Flow Path
- ◆ Woman Creek Flow Path
- ▼ Souther Flow Path
- Streams,Ditches, and Drainages
- Paved Roads
- Dirt Roads
- Industrial Area and Secu ity Zone Bounderies
- Buffer Zon Boundary
- Surface Water Impoundm nt
- Buildings
- Individual Hazardous Substance Sites

Scale 1 20400
1 Inch = 1700 f t

Stat Plane Coordinat Syst m
Colorado Central Zone
Datum NAD27

EG&G ROCKY FLATS

Rocky Flats Site Golden Colorado

Monitoring Wells Along Four UHSU Flow Paths

FIGURE 3

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