University of Idaho
College of Mines & Earth Resources
Department of Geology
Moscow, Idaho/83843

January 29, 1979

Mr. Ross Scarano
Nuclear Material Safety & Safeguards
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ross:

This letter constitutes my response to your request for an analysis of the Cotter Corporation document entitled, "Investigations Related to the Migration of Raffinates From the Existing Cotter Tailings Impoundments". The report was prepared by W. A. Wahler and Associates, Palo Alto, California.

Wahler and Associates present a thorough description of the shallow ground water contamination problem at the Cotter property site. The report concludes that the major zone of ground water contamination at the site is the shallow ground water flow system in the surficial deposits. Most of the corrective measures proposed in the report are designed to alleviate the shallow ground water contamination problem. It should be noted, however, that a deeper zone of contamination probably exists at the site. But only limited data are available for analysis of the deeper problem. The major data point is the Wolf Park mine shaft which has now been filled. Data in Table A-5, Table A-14 and Table A-15 suggest that contamination of the water in the mine shaft increased steadily until at least 1973. Table A-5 does not contain data for post-1973. The mine shaft can be viewed as a well and it is the deepest well in the vicinity of the Cotter site. It undoubtedly intersects many of the

aquifers from which other wells in the area withdraw water. It also is continuous with the horizontal workings of the abandoned coal mine workings which underlie the site. It is reasonable to conclude that the contamination in the Wolf Park mine shaft has entered the high permeability coal mine openings and the aquifers intersecting the shaft in which pumping has created a gradient from the shaft toward the wells in the aquifers. Additional discussion of this problem is presented subsequently. The following comments apply to specific portions of the Wahler report as identified by page number. They should be viewed in the context of the statement presented above.

The last paragraph on Page II-7 describes the roll of the shallow bedrock fracture system on the entry of perched water from the alluvium into the bed rock. It would seem likely that the same fracture system has been the conduit for conducting waste water to the Wolf Park mine shaft as mentioned previously. Paragraph 4 on Page II-2 states that the pump test conducted in the wells indicate that seepage through the rock is primarily along fractures. These fractures may also be interconnected with some of the mined out coal seams in the vermejo formation which Wahler and Associates note as being intersected by at least two wells. These fractures, the Wolf Park shaft and mined out openings may explain the quality of water in the wells at stations 5, 11 and 43. Page II-6, Paragraph 4, notes that the waters in these wells associated with coal seams differ from the waters produced by the other wells in the vermejo formation. The water quality data listed in Table IV for these wells do not differ significantly from the water quality data listed in Table III for the Random House well which Wahler and Associates conclude to be contaminated by raffinate. Therefore, it seems likely that the water in the coal seams

of the vermejo formation may very well reflect the presence of a dilluted raffinate which has been transported to them via the fracture system from the ponds, along the Wolf Park mine shaft, along mined out coal seams, and through aquifers intersecting one or more of these openings. This conclusion is supported by Page III-19 of the report where it is concluded that the wells at stations 38, 39, 40 and 42 contain raffinate. Well 40 is the Random House well. Wells 38 and 42 are listed in Table II as being drilled in the vermejo formation. Some of the data which substantiate Wahler's claim are presented in Table IX, Page III-18.

It is difficult to argue with the conclusion that wells 38, 39, 40 and 42 are contaminated by waste water. Only the flow path which has transported raffinate to the wells is in question. Wahler and Associates address this question in Chapter IV. This is in essence the only section of the report with which I would take issue. Wahler and Associates conclude that the deep flow path is unlikely. They base this conclusion in part on the fact that fractures are unlikely to extend to the depth required for the migration of raffinate to the wells. I would suggest that fractures are not required at these depths because the Wolf Park mine shaft prior to filling would have been the predominant hydraulic connection to all permeable units, including abandoned coal workings, down to a depth of 1000 feet. Wahler and Associates discount this release pathway because if it were operative, they say, greater lateral dispersion than has been observed would have taken place. This is not necessarily the case, especially if the flow paths in the recharge area are fracture controlled. Raffinate could have travelled from the mine shaft to wells 38, 39, 40 and 42 with

little or no lateral dispersion. Figures 5 through 10 indicate that very little dispersion has occurred in the contaminated shallow flow system.

In addition, the raffinate may or may not have travelled up-dip to reach the wells. Hydrostratigraphic units need not necessarily coincide with the orindary stratigraphic units and structural units shown in Figure 12. Hydraulic connection among hydrostratigraphic units can occur horizontally or vertically across inclined stratigraphic units. In other words, bedding planes need not be aquicludes nor aquifers. This is the reason for distinguishing stratigraphic units from hydrostratigraphic units. This is particularly true if fracturing is the major control on permeability distribution.

This reasoning leads to the conlcusion that raffinates may be present in any of the permeable beds or abandoned coal workings which intersect the Wolf Park mine shaft. There are insufficient data in proper locations to discount or prove this hypothesis conclusively. Wahler and Associates indicate on Page IV-2 that the vertical control on data collection is poor in that it is limited to the relatively deep drilled wells at stations 36 and 41, neither of wh ch has been tested with desired frequency. I would point out also that wells 36 and 41 are not located properly to monitor the contaminated plume as identified by contamination in shallower wells. A tremendous dispersion pattern would be required to spread a plume to the locations of wells number 36 and 41. This dispersion has not occurred in the shallow system, as indicated by the longitudinal nature of the plume shown in Figures 5 through 10. Therefore, there is no reason to assume that it would have occurred in the deeper system. Thus, we must conclude that if contamination of deeper aquifers

has occurred, it would not have been perceived by the monitoring network available at the time of the Wahler report except in the Wolf Park mine shaft. A monitoring network in which the wells penetrate deeper permeable units intersecting the now filled mine shaft and the abandoned coal mine workings would be required to determine whether a body of contaminated ground water lies at depth beneath the Cotter property and adjacent to it. To date, we know only that well number 42 located down gradient from the source at a depth of 150 feet bottomed in the vermejo formation is contaminated and we know that the Wolf Park mine shaft was contaminated. These data suggest the existence of a deep body of contaminated ground water but as noted above, they are not sufficient to prove this hypothesis conclusively.

Chapter V of the Wahler report deals with remedial actions. Page V-2 proposes the use of trenches to intercept shallow degraded water moving toward the Soil Conservation Service reservoir. These trenches are necessary to intercept shallow ground water flow but they will have no effect on ground water moving at a depth a few feet below the trenches unless the trenches themselves are bottomed on an impermeable horizon. Such a stratum does not exist at the site. In addition, the trenches will have no impact on vertical leakage beneath the impoundment area. Therefore, it is important to determine whether or not vertical flow to deeper strata is occurring beneath the impoundment area. If leakage to deeper horizons via vertical flow is in fact occurring, corrective measures should include a well withdrawal system or isolation of the contaminated portion of the ground water flow system. Wahler and Associates propose a limited well withdrawal system on Page V-2. They propose that observation wells

1 and 2 be used as "pump back" wells. They are already being pumped at rates of 2 and 5 gallons per minute respectively. However, these wells are shallow (less than 100 feet in depth) and can only be expected to remove contaminated water from the shallowest portion of the flow system. Fortunately, other data presented in the report demonstrate that these wells are located in the portion of the affected area most contaminated by seepage from the present tailings pond. Nevertheless, these wells cannot be expected to have any significant impact on the plume of contaminated water extending out toward Lincoln Park. These wells will have no impact at all on any contaminated zones at depths greater than about 125 feet.

In summary, the proposed remedial action program is a logical approach to alleviating the shallow ground water contamination that has occurred at the Cotter site although the program may not recover all the contaminated water. The proposed remedial action program is not free of risks or uncertainties and as Wahler and Associates point out on Page V-5, even if the water in the Soil Conservation Service reservoir returns to acceptable limits as a result of the seepage collection scheme, it may still take some time for the water quality in the affected areas to return to normal. However, the remedial action program will have little or no impact on the decontamination of water below the depth of the trenches. The trenches are simply not designed to intercept water moving through ground water flow systems at appreciable distances below their depths. Collection wells are required for this purpose. Therefore, the Nuclear Regulatory Commission and the State of Colorado must make a decision regarding the extent to which they wish to have the deeper

portions of the ground water flow system delineated and subsequently decontaminated if further investigation reveals deeper contamination. Either issue requires the drilling of additional wells because none of the wells located in the area are appropriate for monitoring or pumping of the deeper portion of the ground water flow system. Additional wells, if drilled, should be designed to intersect aquifers cut by the Wolf Park mine shaft and they should be designed to intersect any workings of the abandoned coal mine underlying the site such as the ones previously mentioned.

The following comments refer to the monitoring program discussed in Chapter VI of the Wahler report.

I. The U.S. Nuclear Regulatory Commission "Proposed Branch Position for Operational Radiological Environmental Monitoring Programs for Uranium Mills" states under Section III-B that:

1. Ground water samples from the tailings disposal area monitor wells should be analyzed for dissolved natural uranium, thorium 230, radium 226, lead 210, and polonium 210 monthly for the first year and quarterly thereafter, and

2. Ground water samples from wells used for drinking water or irrigation should be analyzed quarterly for total natural uranium, thorium 230, radium 226, lead 210 and polonium 210.

The Wahler report on Page VI-1 states that the following constituents and properties will be measured in the monitoring program: Natural uranium, molybdenum, selenium, arsenic, lead, chloride, radium 226, sulphate and specific conductivity. This list should be altered to include all the elements listed in

the NRC branch position paper. Thorium 230, lead 210, and polonium 210 are missing from the Wahler list. Particular attention should be paid by the analyst to the measurement of dissolved and total constituents as stated in the NRC branch position paper.

II. The new observation well mentioned on Page VI-1 which is to replace the now filled Wolf Park mine shaft should be sampled from each permeable unit and each abandoned coal mine working that it intersects. If this is done, those permeable horizons which have been contaminated by raffinate migration through the Wolf Park mine shaft can be identified and corrective measures taken, or these units can be restricted with respect to exploitation. It is not satisfactory to sample the well as a single homogenous unit as the mine shaft was sampled because some "average" value of concentrations will be measured. These values do not provide very useful information with respect to identification of contaminated horizons. The withdrawal of contaminated water cannot proceed efficiently unless contaminated units are identified and pumped exclusively.

III. The U.S. Nuclear Regulatory Commission branch position paper entitled "Suggested Contents of Applications for Licenses Authorizing Small Scale or Research and Development Processing of Uranium Ores", dated February 27, 1978, states under Section C-2-3-2, entitled "Groundwater" that the "regional and local ground water aquifers, formations, sources and sinks should be described." The recharge potential, the hydraulic gradients and seasonal variations in ground water levels are required also. Wahler and Associates monitoring program has satisfied this objective for the shallow flow system and for most of the horizontal gradient (at least for the potentiometric surface) but it has not

done so for vertical gradients nor for the aquifers, sources, sinks and gradients in the portion of the flow system below a depth of about 150 feet. Thus, the monitoring leaves the question of vertical flow paths and contamination at depth largely unanswered.

Courses of action open to the NRC and the State of Colorado are as follows:

1. Take no action and let Cotter proceed with its shallow ground water decontamination program. This option gambles that no deep ground water contamination exists, or, if it does exist, that it poses no threat to surrounding users.
2. Require Cotter to drill deep monitoring wells under a carefully designed plan in order to determine the precise depth of ground water contamination that exists at the site. The locations, depths, and zones of withdrawal of these wells should be selected very carefully. Borehole geophysics should be utilized in the wells to correlate hydrostatigraphic units and their continuity, or the lack of it, so that withdrawal of contaminated water (3rd option) can be implemented if it is deemed necessary. This monitoring system would constitute a mechanism for definitely proving or disproving the existence of deep contaminated ground water. It also would provide a basis for the decision of whether to take corrective measures or to allow any contaminated water to remain in the flow system.
3. Require Cotter to delineate all contaminated ground water as in option 2 but require that corrective withdrawal mechanisms be implemented.
4. With respect to the shallow contaminated ground water, the options are to accept Wahler and Associates proposed trench interception scheme, along

with the two wells pumping at 2 and 5 gallons per minute, or to require additional withdrawal wells at the end of the contaminated tongue shown in Figures 5 through 10. NRC and the State of Colorado should realize that the trench collection scheme proposed by Wahler and Associates is unlikely to withdraw all the contaminated ground water. I believe the applicant is already aware of this fact.

I might point out that Wahler and Associates ground water consultant informed me recently that additional deep wells are being considered and that a second report is near completion. If I can be of further assistance, please let me know.

Sincerely,

Roy E. Williams

Roy E. Williams, Ph.D
Hydrogeologist
Idaho Registration #10

REW:dg