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C.C.A.T

Colorado Citizens Against ToxicWaste, Inc.

PO Box 964, Canon City, CO 81215

January 4, 2010

Mr. Reid Rosnick
Radiation Protection Division (6608J)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
Via email: Rosnick.Reid@epamail.epa.gov

Dear Mr. Rosnick,

When the citizen stakeholders met with you in our public meeting on June 30, 2009, in Canon City, Colorado, a number of issues of concern were raised. In response to my concern that you did not mention any of the issues during your December 3, 2009, conference call with interested parties, you sent me an e-mail asking that I kindly put those public issues from the June 30 meeting in MS Word format, and send them to you for addition in the draft minutes posted on the EPA website. You also assured me that you would pass them along to the workgroup members for individual review. As part of the EPA workgroup review we ask and expect that our issues be addressed and that we receive a formal response from EPA regarding these issues.

This document (see ***Attachment***) is intended to capture and present to you public issues from the June 30, 2009, meeting with you in Canon City. Our understanding of regulations, and information gathered since that time, have modified some of those concerns, which are included. We will also be attaching to this document the CCAT Power Point presentation from which these issues were lifted so that your workgroup members can have maximum context from which these issues were derived.

We are also including additional resource documentation which we find relevant to our issues and to your workgroup gaining further understanding and appreciation for our conviction that our issues are very much worthy of answers from your workgroup's review efforts based upon relevant science.

We would be more than willing, and would appreciate any opportunities to have further discussion with you or any of your workgroup subject matter experts regarding this matter of utmost importance to us. We want there to be no confusion regarding what our issues are and what we are asking and expecting EPA to address on our behalf in Subpart W and Method 115 review being undertaken.

Thank you for your willingness and cooperation in accepting and addressing these issues.

/S/ Paul D. Carestia
Director, CCAT Board

Copy To: Travis E. Stills, EMLC

Attachment

Public Issues, Concerns, Recommendations from June 30, 2009 EPA Meeting in Canon City, Colorado

Including Additional Comments

1. **The Current Radon Flux Standard of 20 pCi/m^2-sec**

   a. In 1980 the NRC recommended that the standard be 2 pCi/m^2-sec.
      i. **Why was that recommendation not adopted?**
      ii. **Will its relevance be considered as part of the current Subpart W review?**

   b. **How does this Radon Flux Standard compare with standards in other countries where uranium mining and milling are prevalent?**

2. **1989 Risk Assessment**

   a. A 1989 risk assessment was the basis for the current radon flux standard. Over 20 years have passed and considerably more data, science, understanding, and experience should be available.
      i. **Case in point:** Actual data has been collected at the Cotter mill over the last two decades that contradicts facts about Cotter used in the 1989 Risk Assessment.
      ii. There are a very limited number of impoundment ponds falling under regulations for pre-1989 facilities, eliminating any reason to ignore actual data.
      iii. **A new risk assessment needs to be undertaken, will it?**
      iv. **If not, why not?**

3. **Sources of Radon Flux Applicable and Required for Measurement**

   a. **Subpart W defines an operational impoundment as:** "being used for the continued placement of new tailings or is in stand-by status for such placement. An impoundment is in operation from the day that tailings are first placed in the impoundment until the day that final closure begins."

      i. **Case in Point:** Cotter Mill has a Primary and Secondary Impoundment. Measurements were not required of Cotter by EPA, until October 2009, for the Secondary Impoundment, though it has not met the definition of "stand-by status," nor has it been closed or disposed. Radon flux tests should have been required annually over the last two decades. When a test was finally done in 2007, radon flux was above the allowed limit.

ii. **Case in Point:** Cotter Mill had an unlined "old tailings" pond area from which tailings were removed around 1984 and placed in the lined Secondary Impoundment. In an effort to remediate persistent contaminated groundwater, another 233,000 cubic yards of material were excavated from this area in 2008. The "old tailings" pond area was not restored to background levels of radon, yet no radon flux measurements are ever taken there as part of measuring the total radon flux emanating from the Cotter Mill site.

b. **Subpart W and Method 115 should be designed and written to account for and measure all major sources of radon flux:** Total radon flux and hence radon concentration coming from a mill site is the sum of all major, known sources (e.g. waste repositories, ore pads, etc.) and should not just be from one tailings impoundment. Doing anything less is not protective of the public health and welfare. The units for radon flux are pCi/m^2-sec. The total radon from the Cotter Mill site is dependent upon **ALL** of the square meters from which **above background** levels of radon gas are exhausted.

   i. **Case in point:** A June 25, 2009, Notice of Violation (see ***Reference – 1***) from the Colorado Department of Health and Environment (CDPHE) to Cotter underscores the problem of radon emissions from an ore pad.

   ii. This issue must be addressed through explicit changes incorporated into Subpart W and Method 115.

4. **Method 115 - Number of Canisters Placed for Radon Flux Measurement, and Exposed Tailings Acreage**

   a. **Current Regulation** states that impoundments constructed after 1989 are to be no larger than 40 acres and that at any given time there are to be no more than two in operation. Current regulations further state that there shall be no more than 10 acres of tailings "exposed." We believe that radon flux from impoundments existing prior to 1989, exempt from the above, have been inadequately evaluated and addressed.

      i. **Case in Point**: Cotter Mill Primary Impoundment based upon 2008 data:
         1. 107 acres total, **NOT 40 acres**
         2. 56 acres dirt covered
         3. 34 acres exposed, **NOT 10 acres**
         4. 17 acres water covered

      ii. **Case in point**: Method 115 allows existing impoundments to have more than 10 acres of exposed tailings. Additional Cotter Mill Primary Impoundment data:
         1. 2007: 29 acres exposed tailings
         2. 2008: 34 acres exposed tailings
         3. 2009: no data until March 2010 even though measurements were taken in July 2009!

b. **For "Existing Impoundments" greater than 40 acres: The number of canisters required for thorough radon flux measurement must be scaled to the total acreage to account for the fact that varying conditions exist at each specific mill site, and to conform with public protection found in other areas of these regulations.**

c. **For "Existing Impoundments" greater than 40 acres: The amount of exposed tailings should not be allowed to exceed 10 acres in order to provide equal protection to all citizens whether living near an existing (pre-1989) tailings impoundment, or a newer impoundment. We believe this to be an environmental justice issue.**

5. **Calculation of Weighted Average Radon Flux**

   a. Including water covered acreage in the weighted average formula causes radon flux to be understated by adding 0 pCi/m^2-sec of radon flux to the components in the average calculation, while adding the water covered acreage to the denominator in the average calculation.

      i. The assumption that tailings covered by water do not allow radon transfer into the atmosphere needs careful, scientific review.

         1. How does climate, particularly our windy Colorado climate, alter the assumption? We understand that the current assumption is based upon perfectly still water coverage of some minimum depth.
         2. Churning, agitated water releases radon gas. We believe this to be a known fact.
         3. ***Surface water hydrology considerations in predicting radon releases from water-covered areas of uranium tailings ponds (Nielson and Rogers, 1986)*** accompanying this documentation (see ***Reference – 2***), provides scientific evidence and should be carefully reviewed and considered. Based upon laboratory measurements, its conclusion is that radon flux coming off of water surfaces is as great as radon flux from saturated beach areas.

   b. **Weighted average formula** needs critical scientific re-examination.

      i. As currently defined it understates true amount of radon flux.

      ii. **Either fully account for radon released from water due to climate/winds (diffusion and advection) or eliminate water covered acreage from equation completely. It is neither appropriate, nor accurate, to include acres covered by water in the weighted average formula and attribute zero radon flux to water covered tailings.**

         1. We would further argue that weather conditions vary for the geographic locations where uranium mill impoundments are located

and thus these varying weather conditions affect radon flux emissions from water covered tailings. If water-covered tailings are to be included as part of any future regulation then those regulations should have radon flux measurement requirements that include site specific weather data to determine radon flux from water covered tailings.

a. As a further note, there are only two uranium mills licensed to operate in the entire United States at this time, and maybe 2 to 3 impoundments that are still not decommissioned. It is not likely that such site specific requirements would place a significant, costly additional responsibility upon the industry.

6. Current Method 115 Measurement Technology

a. Method 115 currently utilizes PVC canisters which are subject to weather conditions, temperature, etc. There are other technologies in existence today that overcome these short-falls and could provide for more reliable and more frequent radon flux measurements. Given the small number of uranium mills in the United States, the cost to the industry of using the most advanced measurement technology is not high relative to the public welfare and safety.

b. The best available measurement technology should be required as part of any new regulations placing priority on public health and welfare over cost to the industry.

7. Subpart W - prescriptive actions lacking when radon flux averages approach regulatory limits

a. EPA July 1991 "Guidance on Implementing the Radionuclide NESHAPS" should be mandatory, not a guidance:

- **i.** Guidance recommends more frequent tests when a facility is near the standard.
- **ii.** Measurements only accurate to within 10%

b. Case in point: Cotter 2008 Primary Impoundment average radon flux: 19.7pCi/m^2-sec

- **i.** Colorado State regulators argue Cotter is within the limit!
- **ii.** This is too close!
- **iii.** More frequent testing was not initiated by EPA or CDPHE, although it was requested by citizens.

c. Subpart W must contain specific, required actions when radon flux is close to the limit.

8. "Radon Flux" versus "Radon Concentration at the Mill Perimeter"

a. Controversy exists regarding the relationship between radon flux and radon concentration measured at the mill perimeter

- **i. Case in Point**: Cotter Mill radon flux measurements for Primary Impoundment **increased** 230% from 2006-2008 to 19.7 pCi/m^2-sec. Radon concentration measured at perimeter **decreased** 30% from 2006-2008! Makes absolutely no sense to logic or reason.

ii. **EPA in concert with NRC must review radon concentration at the perimeter and its relationship to radon flux**
    1. Review should cover measurement methods, procedures, sample sizes, calculations, effective effluent limits, and how far one should be from a radon source in order to reliably measure background radon.
    2. Two independent scientists on two different occasions have questioned radon measurements at the Cotter mill perimeter.

9. **Annual Subpart W radon flux test reporting requirement for March 31st of the year following the test is extremely problematic**

    a. Too much time elapses between the actual taking of radon flux measurements and the reporting of results, and prevents timely control and mitigation of any radon flux results near or above the 20pCi/m^2-sec standard.
        i. Case in point: Cotter's Method 115 annual test, and most tests done at other impoundments, occurs during the most arid time of the year to avoid interference by rainfall and to supposedly result in a most conservative measurement. Cotter's test is generally done in June or July, which means the results are not reviewed by CDPHE or EPA for another 9-10 months.
        ii. Case in point: Requiring an annual test at the Cotter impoundments is non-representative of yearly radon flux due to changing water coverage and evaporative conditions during any given year. CCAT's PPT presentation (see ***Reference – 3***) on June 30, 2009, illustrated this problem with photos of the impoundments over a period of years, and within a year's time, and showed significant changes from year to year and within a year of the amount of water covered acreage for Cotter Mill Primary Impoundment.

    b. **Subpart W should require radon flux reports to be submitted within 45-60 days of the test, and should require testing more than once a year.**

10. **Subpart W/Method 115 review should require Environmental Fate Analysis**.

    a. Where are these radon emissions going?

    b. How is the radon plume characterized?

11. Cotter Evaporation Ponds

- **a.** While the Cotter Mill is not an ISL facility, they too have evaporation ponds that can vary significantly in water coverage throughout a year and contribute to radon flux. Soil samples MRA1 and MRA2 taken from Cotter's Evaporation Cell #8 in 2002 show high concentrations of Alpha emitting material (see ***Reference – 4***). The test procedures and collection requirements requested by EPA in the May 5, 2009, letter are certainly more thorough than any annual testing performed at the Cotter Mill. An average of two charcoal canisters per each of Cotter's evaporation ponds over a 24-hour period once a year certainly is not as representative of radon flux emissions as the requested procedure would be, nor does it measure radon at 1, 2 or 3 meters above the pond (see ***Reference – 5).*** Results of this sort of radon testing would answer many radon questions from citizens living near a tailings impoundment with evaporation ponds.

- **b.** It was extremely disappointing to hear EPA seemingly unconcerned that Cotter objected to the measurements they were asked to provide regarding their evaporation ponds on the grounds that they were not an ISL facility. It is difficult to understand why an acid or alkaline leach conventional mill, especially those close to a large population, would be held to a lesser standard of investigation than an ISL facility. **Cotter should be required to provide the requested information.**

<u>References</u>

1. CDPHE, June 30, 2009, *Notice of Violation* to Cotter, including concerns over radon flux.
2. Nielson, K. K. and Rogers, V. C. 1986, *Surface Water Hydrology Considerations in Predicting Radon Releases From Water-covered Areas of Uranium Tailings Ponds.*
3. CCAT Power Point Presentation from the June 30, 2009 Meeting in Canon City, Colorado.
4. *Cotter Corp. Canon City Mill Main Impoundment As-Built Drawing of Evaporation Cells and Dewatering-Drain System*, Soil Samples, 2002.
5. *Cotter Corp. Canon City Milling Facility Primary Tailings Impoundment Radon Flux Test Canister Locations (July, 2008),* Map.

STATE OF COLORADO

Bill Ritter, Jr., Governor
James B. Martin, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

http://www.cdphe.state.co.us

Colorado Department
of Public Health
and Environment

Mr. John Hamrick
Vice President of Milling Operations
Cotter Cañon City Milling Facility
P.O. Box 1750
Cañon City, CO 81215-1750

Subject: Notice of Violation

This letter is a Notice of Violation of certain requirements of Title 25, Article 11, CRS, Colorado Radioactive Materials License Number 369-01, and the State of Colorado *Rules and Regulations Pertaining to Radiation Control* (the Regulations). It is based on the findings of the annual inspection of the radiation management program conducted May 4 through 6, 2009 at the Canon City Milling Facility.

1. License Condition (LC) 8.7 requires the licensee's management and radiation safety officer shall take prompt and appropriate action to correct known deficiencies in the facility's procedures, processes, equipment, and site conditions.

   Contrary to this requirement, the Emergency Response Plan Procedure, ER 010 did not have updated CDPHE emergency contact information. This was fixed at time of inspection.

   Cotter shall ensure that the emergency response contact information is correct in the Emergency Response Procedure.

2. LC 23 requires that the licensee shall conduct management of liquids and solids at the facility as described in Cotter's *Site Liquids and Solids Material Management Plan*.

   Contrary to this requirement, the pH in the primary impoundment fell below a value of 4.0 numerous times in 2008 and 2009. Cotter was cited for this issue for excursions that happened in 2007; therefore this is a repeat violation.

   Cotter shall adjust protocols and methods to address this requirement and reflect those adjustments in the *Site Liquids and Solids Material Management Plan*.

CCAT Reference-1

Items of Concern:
In addition to the violations cited above, the following Items of Concern were noted:

1. Written operating procedures shall be maintained for all routine operations and shall incorporate at a minimum, responsibilities, operating instructions and safety precautions. These include, at a minimum, Cotter's *Radiation Protection Program Procedures*, *Site Safety Manual*, *Site Security Manual, Laboratory Procedures Manual, Site Liquids and Solid Materials Management Plan,* and the *Quality Assurance Program Plan*.

   The Integrated Safety Management process was adopted at Cotter through SOPs SPA 12 and 13 and approved by the Division in January 2009. Cotter needs to incorporate the provisions of Integrated Safety Management into its plans and procedures, as well as complete an update to the Radiation Safety Procedures Manual.

2. LC 22.9 requires Cotter to implement and maintain Department-approved controls for limiting the release of radon and radioactive particulates from all waste repositories and ore piles.

   Cotter is using a sprinkler system to mitigate particulate and radon releases from the Primary Impoundment. The radon flux report for 2008 came very close to exceeding the release limits. Cotter shall ensure that the sprinkler system is adequate as well as adopting other measures (e.g., soil cover) to ensure that releases of radon and radioparticulates from the Primary Impoundment are ALARA, taking into consideration the desire to reduce water levels in the Primary Impoundment per LC 29.4.3.

3. LC 8.2.2 requires a hazard analysis which includes an ALARA evaluation, for each proposed system weighing merits of the proposed system(s) against potential alternative operating systems or technologies, as appropriate.

   Numerous items in the hazard analysis were determined to be ALARA by Cotter through limiting access to the area or postponing remediation until BFSU, or before start up. Cotter must address those areas now that a determination has been made to not go into decommissioning. In addition to areas that have elevated gamma exposure rates and considerable surface contamination, numerous areas of the mill are simply full of excess equipment that needs to be moved out of the buildings.

4. LC 8.6.1 requires in part that the licensee shall implement engineering controls to maintain all releases of radioactive materials into the environment to levels that are As Low As Reasonably Achievable (ALARA), and LC 8.7 states the licensee's management and radiation safety officer shall take prompt and appropriate action to correct known deficiencies in the facility's procedures, processes, equipment, and site conditions.

   Gamma exposure rates at the inactive ore pad adjacent to the guard shack are not ALARA, and remain elevated despite not using this pad for more than 2 years. The Division has noted this for three consecutive inspection reports.

Cotter shall either remediate this pad or place an interim cover over the pad to reduce gamma exposure rates and radon flux from residual radioactive material left in the base of the pad. Failure to address this pad during the next inspection period may result in a violation.

5. Section 10.2.3 of Part 10 of the Radiation Regulations requires that form R-15 Notice to Employees be posted by each licensee. Cotter has numerous copies of this posting around the facility. All Notice to Workers and Emergency call lists must have the current CDPHE emergency contact number. Unfortunately, the current Form R-15 has the old emergency contact number for CDPHE. In case of an emergency, the correct contact numbers need to be correct on this form, just as they need to be correct in the Emergency Response Procedure.

   Since our poster does not have the correct number, the licensee must post the correct number in all areas where it is required. CDPHE will provide new posters with the proper contact number when they are printed.

In addition, the following recommendations are provided for your consideration:

1. Birds are nesting and leaving droppings that are not being controlled in the buildings that are locked down. This may cause a health hazard when the buildings are accessed. This is not a radiation issue, but is of concern to CDPHE.

2. Since the Emergency Response procedure relies on the PA system, it should be tested on a periodic basis and maintained in operable condition.

3. Care should be taken to ensure that purge water above standards not discharged to ground surface.

Your written response must be submitted within thirty (30) days of receipt of this letter and must include: (1) a detailed description of the corrective actions which have been taken to achieve compliance; (2) plans to achieve compliance with the requirements which cannot be remedied within thirty (30) days; and (3) other relevant information. Any proposed compliance schedules or plans to achieve full compliance after thirty days must specifically include implementation deadlines for each of the key components of the plan. If these deadlines are not met, this will provide the Division a basis, without further notice, to institute proceedings for suspension, revocation or modification of your license, as provided in RH 3.23 of the Regulations.

As required by RH 10.2 of the Regulations, this Notice must be posted so as to permit individuals engaged in licensed activities to observe it on the way to or from any particular licensed activity location to which the document applies. Any acknowledgment to this report by the licensee shall be posted within five (5) working days after dispatched by the licensee. Such documents shall remain posted for a minimum of five (5) working days or until actions correcting the violations have been completed, whichever is later.

If you have any questions concerning this letter, please contact Mr. Phil Egidi of this Division at (970) 248-7162 or phil.egidi@state.co.us..

Sincerely,

Ed Stroud

Ed Stroud, Compliance Lead
Radioactive Materials Unit
Radiation Management Program
Hazardous Materials and Waste Management Division

ES:pve

CC:
Jim Cain (RSO)
Phil Egidi
Edgar Ethington
Mark Dater
James DeWolfe

Precise Reference:

Nielson, K K and Rogers, V C, 1986, *Surface water hydrology considerations in predicting radon releases from water-covered areas of uranium Tailings ponds*. Proc. "8th Annual Symposium on Geotechnical & Geohydrological Aspects of Waste Management", Geotechnical Engineering Program – Colorado State University & A A Balkema, Fort Collins, Colorado, USA, February 5-7, 1986, pages 215-222.

Surface water hydrology considerations in predicting radon releases from water-covered areas of uranium tailings ponds

KIRK K.NIELSON & VERN C.ROGERS
Rogers & Associates Engineering Corp., Salt Lake City, Utah, USA

1 INTRODUCTION

In assessing the releases of radon (Rn-222) from uranium mill sites, the radon escaping from water-covered surfaces of the tailings pond has traditionally been ignored (NRC 1980a, NRC 1980b, NRC 1981). This has been justified by radon diffusion calculations, which suggest that radon cannot penetrate more than a few centimeters of water because of its very low diffusion coefficient (10^{-5} cm^2s^{-1}). The tailings pond is not a motionless body of water, however, and considerable water movement occurs over time periods comparable with the half-life of radon (3.8 days). Therefore, significant advective transport of radon may occur, rendering the pond less effective than previously thought for containing radon gas.

In a recent study for EPA on radon releases from active uranium mills, we examined the potential for advective transport of radon through tailings pond waters along with other radon sources in the mill environment (Rogers et al., 1985). This paper summarizes the parts of the study that dealt with radon releases from the tailings pond area, and discusses the nature and mechanisms of the radon releases from water-covered areas. A reference tailings impoundment is described according to several distinct physical regions, and the conditions affecting radon transport in each are described. Since radon transport through ponded water has not previously been modeled in detail, simple laboratory experiments were conducted to approximate the characteristic transport parameters. The results of these experiments were then used with parameters describing the tailings pond to assess the overall magnitude of radon release expected from the water-covered pond region. The significance of radon releases from the water-covered areas was estimated by comparison to radon fluxes from other, exposed tailings surfaces.

2 REFERENCE TAILINGS IMPOUNDMENT

A reference tailings impoundment that approximates actual impoundments is first defined to illustrate three characteristic regions with distinctly different physical properties that affect radon transport. The reference impoundment also provides a basis to estimate the magnitude of radon releases from tailings ponds. The impoundment contains a central, water-covered pond area, surrounded by a water-saturated beach area, and an unsaturated beach area. Tailings enter the impoundment via a slurry pipeline from the mill, and are depleted in emanated radon for the first few days due to complete radon releases during milling. The total mass of new depleted tailings entering the impoundment is insignificant compared to the total mass in the impoundment, however, so the total radon release rate is relatively constant. Since the slurry pipeline delivers both coarse (sandy) and fine (slime) tailings, the sands tend to accumulate near the pipeline, while the slimes are carried further into the center of the pond. The slurry pipe is typically moved to different positions around the edge of the impoundment, so that the sandy tailings typically comprise most of the saturated and unsaturated beach areas, and the slimes accumulate in the center pond area. The radon source materials and diffusion characteristics in the pond, saturated, and unsaturated areas are thus different, and are described in terms of nominal parameter values to permit estimates of their relative impacts on radon releases.

The unsaturated beach areas are considered to be comprised exclusively of tailings sands, and to be sufficiently above the water level that they are well-drained and similar to surrounding sandy soils in moisture content. Radon originating in these regions is defined in terms of the radium content for the sands, which is typically much lower than that for the slimes. Once radon gas is emanated into the interstitial pore space of the sands, it diffuses according to the characteristics already known and modeled for unsaturated soils and tailings (Rogers et al., 1984a), and is dominated by diffusive transport mechanisms. Advective transport by air or vapor currents in unsaturated regions such as the tailings beaches has been examined and is considered insignificant (Rogers et al., 1983). Accordingly, radon fluxes are computed for the unsaturated beaches as

$$J = 10^4 \, R \rho E \sqrt{\lambda D} \qquad (1)$$

where

J = radon flux from the exposed tailings surface ($pCi\ m^{-2} s^{-1}$)
R = tailings radium content ($pCi\ g^{-1}$)
ρ = bulk tailings density ($g\ cm^{-3}$)
E = radon emanation coefficient for tailings (dimensionless)
λ = radon decay constant ($2.1 \times 10^{-6}\ s^{-1}$)
D = diffusion coefficient for radon in the tailings pore space ($cm^2\ s^{-1}$)

The saturated beach areas are considered to be comprised of approximately 70 percent sands and 30 percent slimes, reflecting the limited mixing of slimes in this part of the tailings mass. Although this area of the impoundment is variable and more difficult to define in terms of physical extent, its diffusion characteristics are more distinct in being saturated by water. Despite wave action over the saturated beach areas, advective transport in the interstitial volume is probably limited to only the top few centimeters, as defined by the wave-pond elevation difference. The radon source term for the saturated beaches is modeled as a weighted average of the respective radium contents of the sands and slimes (70/30 ratio) multiplied by their respective emanation coefficients. Transport of emanated radon to the atmosphere, neglecting liquid advection in the top wave-affected layer, is dominated by diffusion through the saturated interstitial space, with a typical diffusion coefficient on the order of 10^{-5} $cm^{-2}s^{-1}$ (Rogers et al., 1984a).

The tailings beneath the pond area are assumed to be comprised of approximately 50 percent sands and 50 percent slimes. In this region the radon source term is similarly computed as a weighted average of the respective radium contents of the sands and slimes (50/50 ratio) multiplied by their respective emanation coefficients. Movement of emanated radon to the atmosphere includes advective as well as diffusive transport, since considerable water movement occurs within the pond over time periods comparable to the half-life of radon. The movement is partly caused by surface wind currents, thermal gradients, mechanical disturbance from the mill discharge pipe, and biological disturbances (animals, birds, etc.). In addition, radon release from the radium dissolved in the water must now be considered separately, since the water is physically separated by significant distances from the solid tailings material. For analyzing the pond area, radon releases were divided into three components:

1. Radon originating from solid tailings under less than 1 m of water.
2. Radon originating from solid tailings under greater than 1 m of water.
3. Radon from the dissolved radium in the pond water.

The one meter depth is chosen to partition the surface water, where turbulant movement is pronounced and often visible, from deeper layers, where advection is minimal. Although actual advective currents probably decrease continuously with depth, this partitioning conveniently defines a "rapid release" zone for radon and a deeper decay-limited transport zone.

3 LABORATORY MEASUREMENTS AND RESULTS

In order to quantify radon releases from the above pond sources, several parameters were measured in the laboratory, using a sample of slime tailings from the Rifle, Colorado UMTRAP site. The measured parameters included the solubility of the tailings radium and the transport coefficient for radon through "undisturbed" columns of water in the laboratory. In order to interpret the radon transport experiments, radium contents, emanation coefficients, and related tailings parameters were also measured. The key tailings parameters are summarized in Table I.

TABLE I

Characteristics of Tailings used as Radon Sources

R = 4628 pCi/g Ra-226
E = 0.25 pCi Rn-222 released per pCi Ra-226
Porosity = 0.66 in test columns
Solubility = 35 pCi/liter Ra-226 in separated column water.

The slime tailings sample was oven dried, and 200-gram aliquots were weighed into each of four Boyoucos soil test cylinders. Seven hundred ml of water were added to each cylinder, after which they were stirred and allowed to settle and equilibrate for at least 22 days. The settled tailings occupied the bottom 8.9 cm of the 5.9 cm diameter glass cylinders, and the water layer comprised an average height of 19.4 cm above the tailings. Radon flux measurements were then made from the water surfaces after first circulating fresh air over the undisturbed water. After the radon flux measurements, the water was carefully siphoned from the columns without disturbing the tailings layers. Additional radon flux measurements were then made from the bare, saturated tailings. The radon flux measurements utilized both the accumulator can and charcoal canister techniques (Rogers et al., 1984b). The accumulator can measurements gave a ten-minute average flux, and the charcoal canister measurements gave a 24-hour average flux. The results were averaged and reported in terms of a mean and standard deviation.

The results of the laboratory measurements are presented in Table II. The relatively high radon fluxes penetrating 19.4 cm of water indicated clearly that molecular diffusion did not account for the observed radon transport through the columns. Despite precautions to avoid agitation and vibrations, advective transport (probably thermally induced) dominated the observed radon flux, which would have been nearly four orders of magnitude lower with only diffusive transport in undisturbed water. The removal of the water (not disturbing the tailings) allowed measurement of the bare radon flux from the saturated tailings, and gave evidence that the advective forces acting in the water cover were not active in the saturated tailings region. Instead, the low diffusion coefficients typical of water-saturated pore space were found to be typical.

TABLE II

RADON FLUXES MEASURED FROM BARE AND WATER COVERED TAILINGS SURFACES (mean ± S.D.)

Undisturbed water, Accumulator Can	75 ± 19
Undisturbed water, Charcoal Canister	68 ± 7
Bare, saturated tailings, Accumulator Can	84 ± 21

The results of the laboratory flux measurements were compared with values obtained using the RAECOM computer code (Rogers et al., 1984a). Using the radium content, emanation coefficient, and porosity from Table I, the RAECOM code gave a computed radon flux of 83 pCi $m^{-2}s^{-1}$ using its default (correlation) value for the diffusion coefficient in the saturated tailings. This compares well with the mean measured flux value of 84 pCi $m^{-2}s^{-1}$ and also supports the selection of 4×10^{-5} cm^2s^{-1} for the radon diffusion coefficient in the submerged tailings. Further RAECOM analyses of the 17 percent attenuation provided by the undisturbed water indicated that the effective transport coefficient for the water layer was on the order of 0.003 cm^2s^{-1}. The dissolved radium content measured from the water layers and shown in Table I, gives negligible contribution to the measured fluxes, but gives a nominal solubility parameter for evaluating the reference tailings impoundment.

4 APPLICATIONS AND DISCUSSION

In applying the Laboratory data to estimate radon releases from submerged tailings, the high uncertainties and lack of lab/field experiment correspondence preclude quantitative accuracy from being associated with the conclusions. However, the lab data conclusively show that non-diffusive transport can dominate radon movement, even in visually "undisturbed" water columns. Since surface turbulence is invariably visible in tailings ponds, we infer that greater advective transport occurs in the pond surface layers. In the absence of turbulence data for either the deep or shallow pond water, we qualitatively associate the measured laboratory transport coeffecient with possible transport characteristics of the deep ($\gg$1m) impoundment water.

For the shallow ($\ll$1m) impoundment water, extrapolations of visual dye movement tests indicate advective velocities may exceed 1-2 mm/minute, resulting in virtually no radon containment by the surface water. If shallow water movement is sufficient to remove radon from the tailings-water interface and transport it to the atmosphere in a short time (several hours), the radon flux from the shallow tailings is nearly as great as that from similar bare saturated tailings, hence no significant radon attenuation is considered.

For tailings at depths greater than one meter, the radon transport properties of the pond water are considered to follow the Laboratory value of 0.003 cm^2s^{-1} up to the 1-meter depth, above which no further attenuation occurs. For dissolved radium, the same water motion that facilitates rapid radon release from the shallow water also allows release of all radon generated in the top meter of the pond. Thus, the applicable flux equation for radon from the top meter of water over the deep fraction of the pond and for the average half-meter of water over the shallow fraction is

$$J_d = 10^6 K_s R \lambda (1 - 0.5 f_s) \qquad (2)$$

where

K_s = ratio of radium in solution to radium in tailings solids ($g\ cm^{-3}$).

f_s = fraction of pond area with less than 1 meter depth.

Radon generated from dissolved radium below one meter is transported according to the 0.003 cm^2s^{-1} coefficient up to the one meter depth, where it is rapidly released to the atmosphere. The three radon sources, shallow tailings, deep tailings, and dissolved radium, are added to obtain a simplified estimate for the average flux from the tailings pond,

$$J = 10^4 R \rho E \sqrt{\lambda D} [f_s + (1-f_s)A] + 10^6 K_s R \lambda (1 - 0.5 f_s) \qquad (3)$$

where

A = attenuation factor for deep water.

The attenuation factor, A_t, is determined from RAECOM calculations, or it can also be approximated by

$$A_t = \exp [-\sqrt{\lambda / D_{tr}} (x_p - 100)] \qquad (4)$$

where

D_{tr} = effective stagnant water transport coefficient (cm^2s^{-1})
X_p = average pond depth for areas greater than 1 meter deep (cm)

In order to estimate radon releases from a tailings impoundment, numerous site-specific parameters must be defined. Some, such as ore grade, area of the impoundment surfaces, etc. are readily known or measurable, while others, such as diffusion coefficients, are usually unknown without specific measurements. Table III presents nominal values for some of the required parameters for the present estimates. Other values, such as emanation coefficients, moistures and diffusion coefficients for the unsaturated tailings, were based on site-specific data (Rogers et al., 1985).

TABLE III

Tailings Parameters used in Radon Transport Calculations

	Submerged Tailings	Saturated Tailings	Unsaturated Tailings
Sand/slime ratio	50/50	70/30	100/0
Bulk density ($g\ cm^{-3}$)	1.55	1.57	1.60
Porosity	.40-.42	.39-.41	.38-.40
Moisture Saturation	1.0	1.0	.33-.57
Surface Area (m^2)	4.0E5	2.0E5	9.0E4

For calculating radon emissions from the unsaturated, sandy tailings at the outer edges of the impoundment, equation 1 was used to obtain the normalized radon fluxes in Table IV. The radon release is normalized to account for the typical 4:1 ratio of radium activity in the slimes compared to that in the sands, and also to account for their bulk density difference as defined in Table I. The resulting data in Table IV are thus normalized to the average radium in the original ore not just for the sands alone. It should also be emphasized that the use of specific fluxes presupposes a fixed diffusion coefficient in the source material, and thus does not have general application to areas in which moistures or diffusion coefficients are greatly different.

TABLE IV
Specific Radon Fluxes Computed for Six State Milling Regions for Three Parts of a Uranium Tailings Impoundment
($pCi\ m^{-2}s^{-1}/pCi\ g^{-1}$)

	State						
Tailings	CO	NM	TX	UT	WA	WY	Mean
Unsaturated	0.42	0.76	0.23	0.29	0.29	0.43	0.40
Saturated Beach	0.036	0.062	0.031	0.027	0.031	0.035	0.037
Pond	0.020	0.033	0.019	0.017	0.019	0.021	0.022

For the mixed tailings in the saturated beach areas, Table IV gives the corresponding specific fluxes assuming a 70/30 mass ratio of sands/slimes, and assumes a combined mean density of 1.57 gcm^{-3}. The resulting average specific fluxes are again normalized to the average radium content of the original ore.

For the ponded areas of the tailings, is was assumed that one-fourth of the pond area was less than one meter deep, and that the tailings are 50/50 sands/slimes. The value of K_s (NRC 1980) is 8.92E-4 g/ml. The diffusion coefficient for tailings measured in the laboratory was similar to the predicted value from earlier correlations, and so the correlation value of 4.0E-5 cm^2s^{-1} was used. A lower-bound estimate of the diffusion coefficient for deep water was obtained from the laboratory measurement, D_{tr} = 0.003 cm^2s^{-1}. This value was used in RAECOM calculations (Rogers et al., 1984a) to obtain an average attention factor of A_t = 0.17, which was used in the analysis. The resulting normalized radon fluxes from the water-covered tailings using equation (3), and dividing by R, are shown by state in Table IV.

In order to assess the relative importance of total radon releases for the three tailings regions, a reference uranium mill is defined to process one with an average grade of 0.1 percent U_3O_8. Its tailings impoundment is also defined to have the surface areas shown in Table III. The resulting total radon releases, expressed in Ci/day for each tailings region in the six states are summarized in Table V. The total radon releases vary from 0.9 to 2.3 Ci/day, and are dominated (69%) by the unsaturated sandy tailings, as might be expected. Although the submerged tailings account for only 17% of the total, they are much more important than previously estimated. Although to be regarded qualitatively, this study suggests that rado mitigation by submerging tailings in the pond water may be much less effective than has been previously assumed. From the specific fluxes in Table IV, it is seen that saturating or submerging the tailings is still effective in significantly reducing radon fluxes by an order of magnitude, but that the advantage of additional water over the saturated tailings is proportionately reduced.

TABLE V

Summary of Total Radon Emissions from the Reference Tailings Impoundment in Six States (Ci/day)

Tailings	State						
	CO	NM	TX	UT	WA	WY	Mean
Unsaturated	0.92	1.66	0.50	0.63	0.63	0.94	0.88
Saturated Beach	0.18	0.30	0.15	0.13	0.15	0.17	0.18
Pond	0.19	0.32	0.19	0.17	0.19	0.20	0.21
Total	1.29	2.28	0.84	0.93	0.97	1.31	1.27

REFERENCES

U.S. Nuclear Regulatory Commission, "Final Generic Environment Impact Statement on Uranium Milling," NUREG/CR-0706, 1980a.

U.S. Nuclear Regulatory Commission, "Final Environmental Impact Statement Related to the Operation of the Gas Hills Project," NUREG-0702, 1980b.

U.S. Nuclear Regulatory Commission, "Environment Assessment Related to the Operations of Hansen Uranium Mill Project," NUERG-0749, 1981.

V.C. Rogers, K.K. Nielson and G.B. Merrell, "The Effects of Advection on Radon Transport Through Earthen Materials," U.S. Nuclear Regulatory Commission Report NUREG/CR-3409, 1983.

V.C. Rogers and K.K. Nielson, "Radon Attenuation Handbook for Uranium Mill Tailings Cover Design," U.S. Nuclear Regulatory Commission Report NUREG/CR-3533, 1984a.

V.C. Rogers, et al., "Radon Flux Measurement and Computational Methodologies," U.S. Department of Energy Report UMTRA-DOE/AL-2700-201, 1984b.

V.C. Rogers, K.K. Nielson, F.K. Anderson and R.B. Klein, "Radon Emissin from Operating Uranium Mill Facilities," Salt Lake City: Rogers & Assoc. Engineering Corp. Tech. Infor. Memorandum TIM-8469/4-1, February, 1985.

Citizen Stakeholder Input to EPA Review and Rulemaking of NESHAP Subpart – W

June 30, 2009
Canon City, Colorado

CCAT Reference-3

Who We Are

- Members Colorado Citizens Against ToxicWaste Inc (CCAT)

- Sharyn Cunningham, B.S. Psychology, Regis University
  - Co-Chair-Person: CCAT
  - Lincoln Park Resident

- Paul Carestia, M.S.E.E. Northwestern University, MBA University of Chicago
  - Board of Directors CCAT
  - Lincoln Park Resident
  - Lincoln Park Business Owner

CCAT Presentation Overview

- **Cotter Uranium Mill & Lincoln Park**
  - Historical Perspective
  - Lessons learned
- **Issues to address and rules to draft**
  - EPA review process
  - Method 115
  - Radon Flux
- **Closing Remarks**

History and Lessons Learned

- 1958 – Cotter Uranium Mill Built – Unlined Impoundments
- 1960's – Cattle with Molybdenum Toxicity – Well Contamination
- 1965 – Tailings Impoundments Flood into Lincoln Park
- 1972 – Soil Conservation Dam built
- 1978 to 1979 – New Impoundments Built
  - Against advice of EPA and NRC due to close proximity to a population
  - Excavation Encountered Nineteen Springs
  - CDPHE requested tracer test 1979 – Not performed
- 1984 – National Priorities List Superfund Site
- 2007 – First EPA Five Year Review – Lincoln Park 4,000 Pop.

History and Lessons Learned
WATER

Protect the Community

- Subpart W and associated regulations need additional requirements for monitoring radium, uranium, molybdenum and radon in groundwater at uranium recovery sites, and properties adjacent to these sites.

History and Lessons Learned
WATER

- **Radon travels in water**
  - Radon from Radium – High concentrations at Impoundments and Mill Site
  - Dissolves in water and can travel up to 5 Km
  - Released through turbulence – Sprinklers, Showers, Faucets, Wind
  - Lincoln Park and off-site wells are not tested for radon
  - Only a handful of wells on and offsite are tested for Radium
- **Permeable Reactive Treatment Wall (PRTW)**
  - 1.5 to 3.0 gpm – from mill site into Lincoln Park
  - PRTW built in 2000 – Failure announced in 2003
  - Cut Off Wall or Barrier
  - High concentrations of Uranium in wells below the PRTW
  - CCAT requested tracer test at impoundment, and then PRTW - Denied

History and Lessons Learned
WATER

- **Lincoln Park Well Water Use Surveys**
  - 1989 – First Survey   2008 – Second Survey
  - 7 Families used wells for *Personal Consumption* – One above Moly MCL
  - 2008 – many properties transferred in the Lincoln Park Water Use Area
  - Institutional Controls – Only new well applicants are informed
  - EPA decision – Next Five Year Review adequate for checking well use

- **Off-Site Well Monitoring**
  - 1990s – 10 Wells tested   2003 - 10 wells were added again
  - No continuity for analysis or assessments
  - On and off-site wells are still above radioactive limit of 30 ug/L Uranium
  - Case in point: 2008 - Golf Course well 2.7 mg/L = 2,700 ug/L Uranium

History and Lessons Learned
WATER

- **Impoundment Ponds**
  - Liner constructed over 19 Springs
  - CDPHE confirmed leakage in 2007
  - Well #379 – High Concentrations of Uranium and Molybdenum
    Not tested for Radium or Radon
  - CDPHE required Cotter to dry the impoundments
  - No Win Situation – Water causes leakage – Drying increases radon emission rate

Cotter Corporation
Canon City Milling Facility

Water Monitoring Report
3rd Quarter 2008

Lab#	Sample		RADIONUCLIDES															
			Ra226D		Ra226S		Th230D		Th230S		Pb210D		Pb210S		Po210D		Po210S	
	Date	Loc.	pCi/L	D.L.	pCi/L	D.L.	pCi/L	D.L.	pCi/L	D.L.	pCi/L	D.L.	pCi/L	D.L.	pCi/L	D.L.	pCi/L	D.L.
08-44355	09/10/08	372																
08-44250	07/24/08	379																
08-43940	08/07/08	379																
08-44255	08/26/08	379																
08-44338	09/10/08	379																
08-44381	09/10/08	379																
08-44382	09/10/08	380																
08-44809	09/17/08	380																
08-44383	09/10/08	381																
08-44810	09/17/08	381																
08-44107	08/22/08	382																
08-44384	09/10/08	382																
08-44109	08/22/08	383																
08-44385	09/10/08	383																
08-44108	08/22/08	384																
08-44386	09/10/08	384																
08-44387	09/10/08	385																
08-44004	08/13/08	526																
08-44242	09/03/08	563																
08-44243	09/03/08	564																
08-44244	09/03/08	565																
08-44245	09/03/08	566																
08-44306	09/08/08	711A																
08-44307	09/08/08	712B																
08-43791	07/25/08	710 C																
08-44308	09/08/08	710C																
08-44356	09/10/08	800																
08-44357	09/10/08	801																
08-43946	08/08/08	802																
08-44358	09/10/08	802																
08-43708	07/15/08	803																
08-44359	09/10/08	803																
08-43707	07/15/08	804																
08-44360	09/10/08	804																
08-43595	07/09/08	805																
08-44361	09/10/08	805																
08-43603	07/10/08	806																
08-44362	09/10/08	806																

History and Lessons Learned
WATER

- **Subpart W – Maximum Concentrations for Groundwater**
  to Part 192.32, to 264.92, to264.93, to 264.94, to AEA Sec 84, UMTRCA Sec 108

  500 Meters from disposal area and/or outside the site boundary

  - Subpart D of Part 192 – Title II Uranium Mills (Operating)
    - Ra-226 – Maximum Concentration Limit 5 pCi/L
    - Uranium and Molybdenum – Listed Hazardous Constituents
    - No limit or maximum concentration for Uranium or Molybdenum in groundwater

- **Subpart A of Part 192 – Title I Uranium Mills (Inactive)**
    - Uranium – Maximum Concentration Limit 30 pCi/L
    - Molybdenum – Maximum Concentration Limit 0.10 mg/L

- **Subpart W must set Maximum Concentrations** for Uranium and Molybdenum in Groundwater at Title II, Operating Uranium Mills, and be included directly in Subpart W for easy reference.

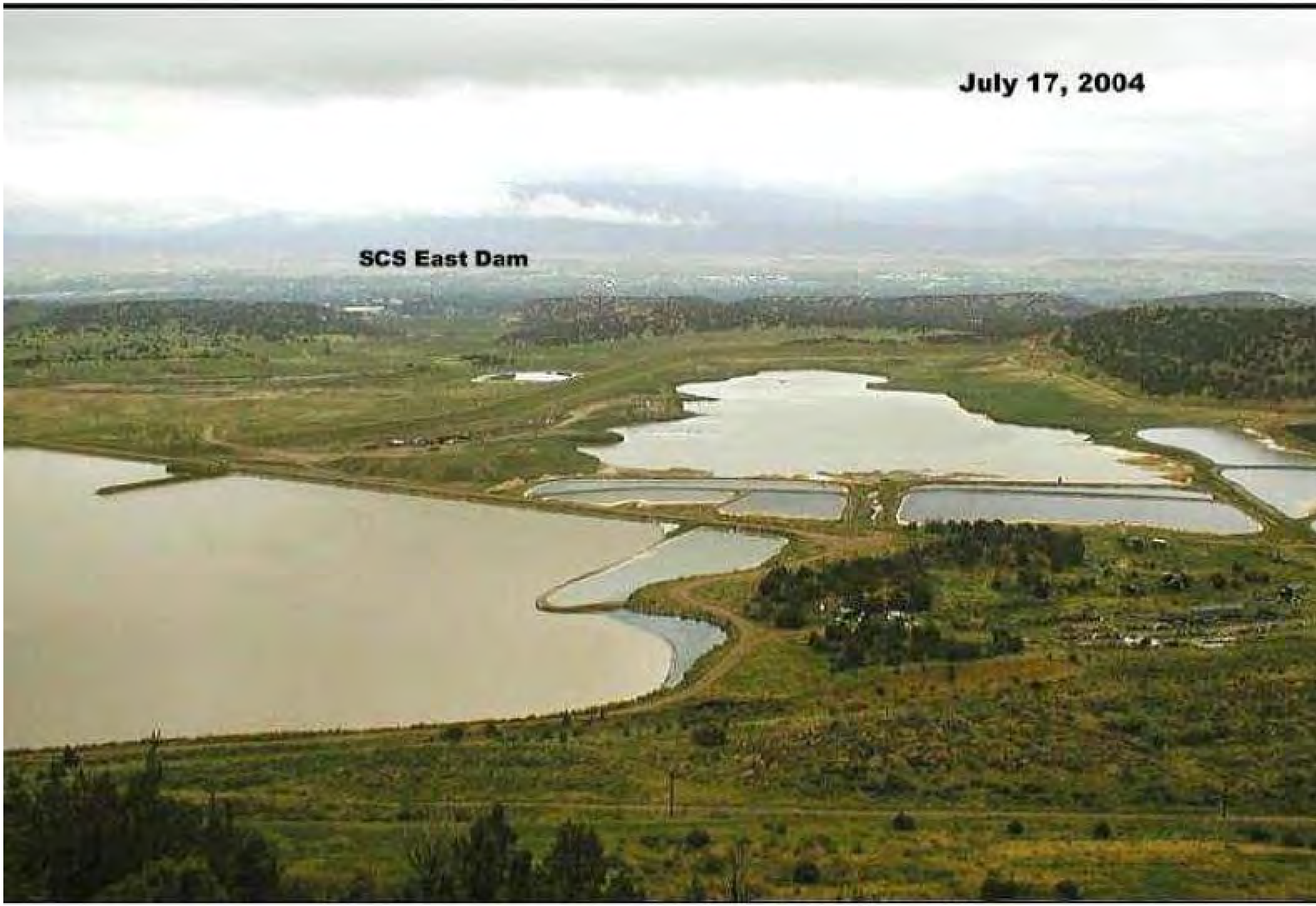
Protect the Community

- Subpart W and associated regulations need additional requirements, and updated requirements, for monitoring radon at uranium recovery sites, and properties adjacent to these sites.

History and Lessons Learned
AIR

- **Radon travels through air**
  - Radon is produced from uranium in soils or mill/mine tailings.
  - Within 3.8 days, radon-222 decays to form very small solid radioactive particles that can attach to dust particles which can remain suspended or settle onto surfaces.
  - When inhaled, the particles irradiate the lung and are linked to an increase in the risk of respiratory tract cancers.
- **Impoundments and Radon Monitoring**
  - Water coverage varies dramatically over the years
  - Regulations apply to an ideal mill – with only 10 acres exposed tailings

Cotter Impoundments December 2002

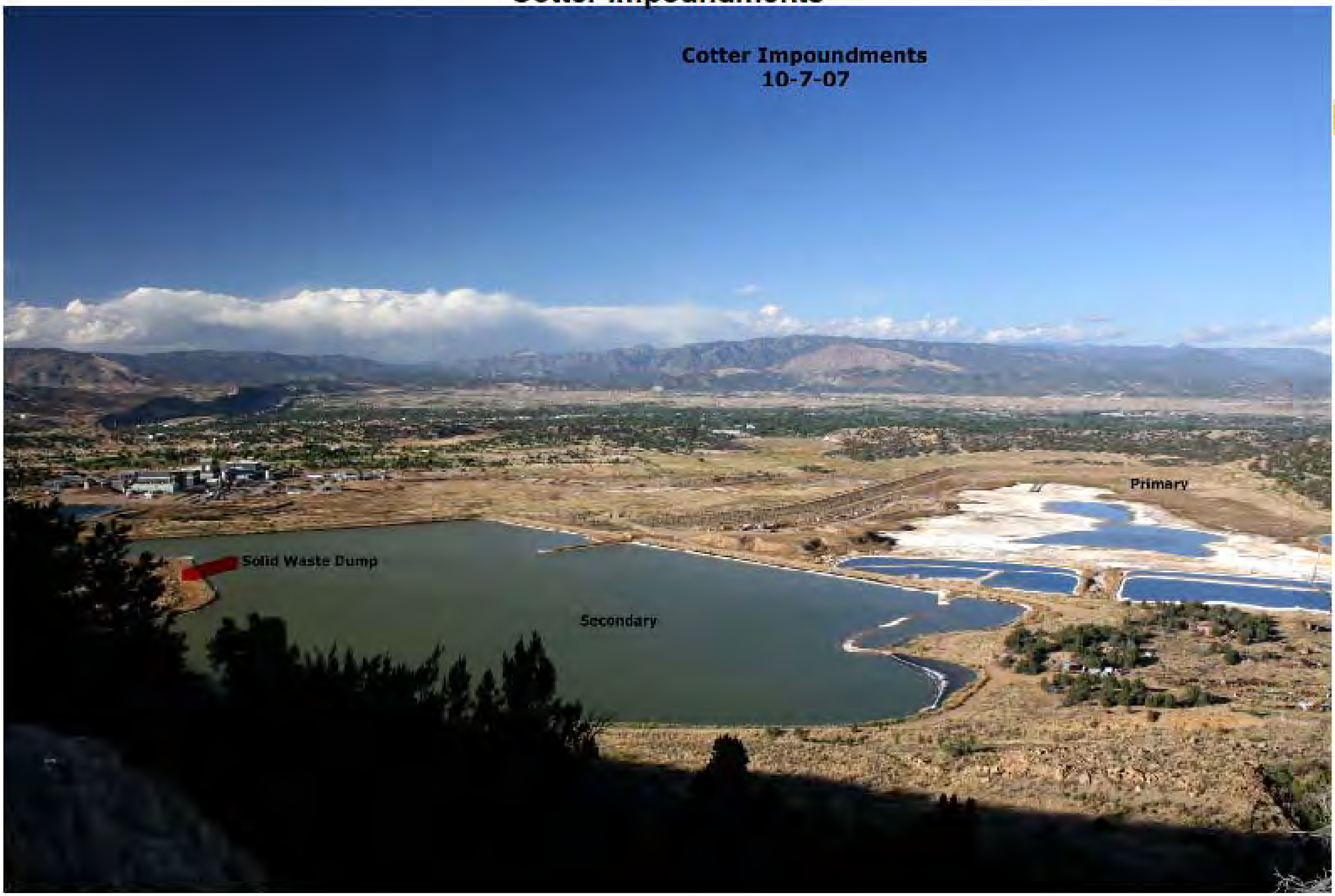


Impoundment Ponds

June 21, 2005

Cotter Impoundments

Cotter Impoundments



Cotter Impoundments

Cotter Impoundments

History and Lessons Learned
AIR

- **1989 – Subpart W & EPA Authority Over NESHAPS Regulation**
  - Email 11-26-07: CDPHE asks EPA who has authority over NESHAPS.
  - Email 11-26-07: EPA response from Robert Duraski

"We do have authority, for some reason we were telling people that it was delegated to Colorado. I was told that we only receive the cover letters from the flux test at Cotter.... I believe all we need to do to correct this in Colorado is to obtain copies of the past test...,"

Robert Duraski, EPA Region 8.

Protect the Community

- The new Risk Assessment for review of Subpart W, Method 115, and associated regulations, must consider lessons learned from Lincoln Park and the Cotter Uranium Mill.

History and Lessons Learned
RISK ASSESSMENT

- **Risk Assessments – Use Industry Generated Data**
  - Risk is determined by Industry data
  - Industry hires consultants at Uranium Mills, not EPA or CDPHE
  - Industry determines dose to the public
  - Epidemiological Studies are rarely, if ever, used

- **Cotter Uranium Mill Laboratory**
  - 2005: Cotter ordered to employ an outside laboratory
  - (CDPHE NOV 4-12-05) "*...numerous deficiencies have been identified with the procedures...determining radioactive material content in effluents, environmental monitoring, and dose assessment for...members of the public. The cumulative effect of the laboratory deficiencies renders the laboratory results unacceptable,*".
  - 2007 – Order lifted
  - No community faith in Cotter data or assessments prior to 2004

History and Lessons Learned
RISK ASSESSMENT

- **Cancer Surveys**
  - When inhaled, radon particles irradiate the lung and are linked to an increase in the risk of respiratory tract cancers.
  - Lincoln Park 1995: 2 more cases of lung cancer – results would have been statistically significant.
  - 8 more cases of lung cancer than expected – based on Metro Denver
  - Residents are not tracked – newcomers are included.
  - No cancer survey since 1995 (14 years).
  - While drying impoundments and exposed tailings increase radon emission rates.

- **Agency for Toxic Substances and Disease Registry**
  - Public Health Assessment pending (20 years late).
  - 1965 tailings flood – should be part of the equation of exposure.
  - ATSDR would not ask for NRC/AEC records.

History and Lessons Learned
RISK ASSESSMENT

Environmental Impact Statements

- **1979:** National Wildlife Federation requested an EIS for the Cotter Mill license per the National Environmental Protection Act (NEPA) from NRC.
- **1979:** NRC responds – they will perform an EIS per NEPA.
- **The EIS was never performed.**
- **Ken Weaver, CDPHE, 2002:** *"Cotter has previously done a 1984 and 1996 Environmental Report but not a formal Environmental Assessment… (revised statute) uses the term environmental assessment without tying it directly to other definitions, either in Colorado rules or federal NEPA EA procedures,"* (Maywood Hearing Transcript Notes, 2002).
- Cotter's Environmental Assessment of 2003 – "alternate feed stock"
- **2002:** EPA Marcinowski letter to NRC states that allowing "alternate feed" processing at uranium mills should require an EIS or full NEPA review.

- **Our community is skeptical of Risk and Environmental Assessments.**

Opening Remarks
Paul Carestia

- Not against uranium mining or milling
- Against any step in the chain close to people and their communities
- No regulation will prevent process failures, mistakes, violations
  - No or small fines of no consequence
  - Public takes the direct, everlasting impact - not the industry, not the regulators
- Lincoln Park living proof as are at least 1300 other Superfund Sites

Opening Remarks

- Question sanity, legality, sensibility of allowing uranium facility to continue operation on a Superfund Site
  - Insult to public and community
  - Shows lack of regulatory integrity and disregard for damage inflicted
- No license renewals, no refurbish, no rebuild, no reopen without first restoring the environment and the surrounding community
- If the companies don't clean up their contamination
  - shut them down!
  - Stop threats in close proximity to people from imperfect processes, regulations, and enforcement

Opening Remarks

- Uranium industry does not belong in people's backyards!
- Please take this message to Lisa Jackson
- Continuing to license Cotter Mill prolongs what should have been addressed **25** years ago when Lincoln Park became a Superfund Site!

Method 115

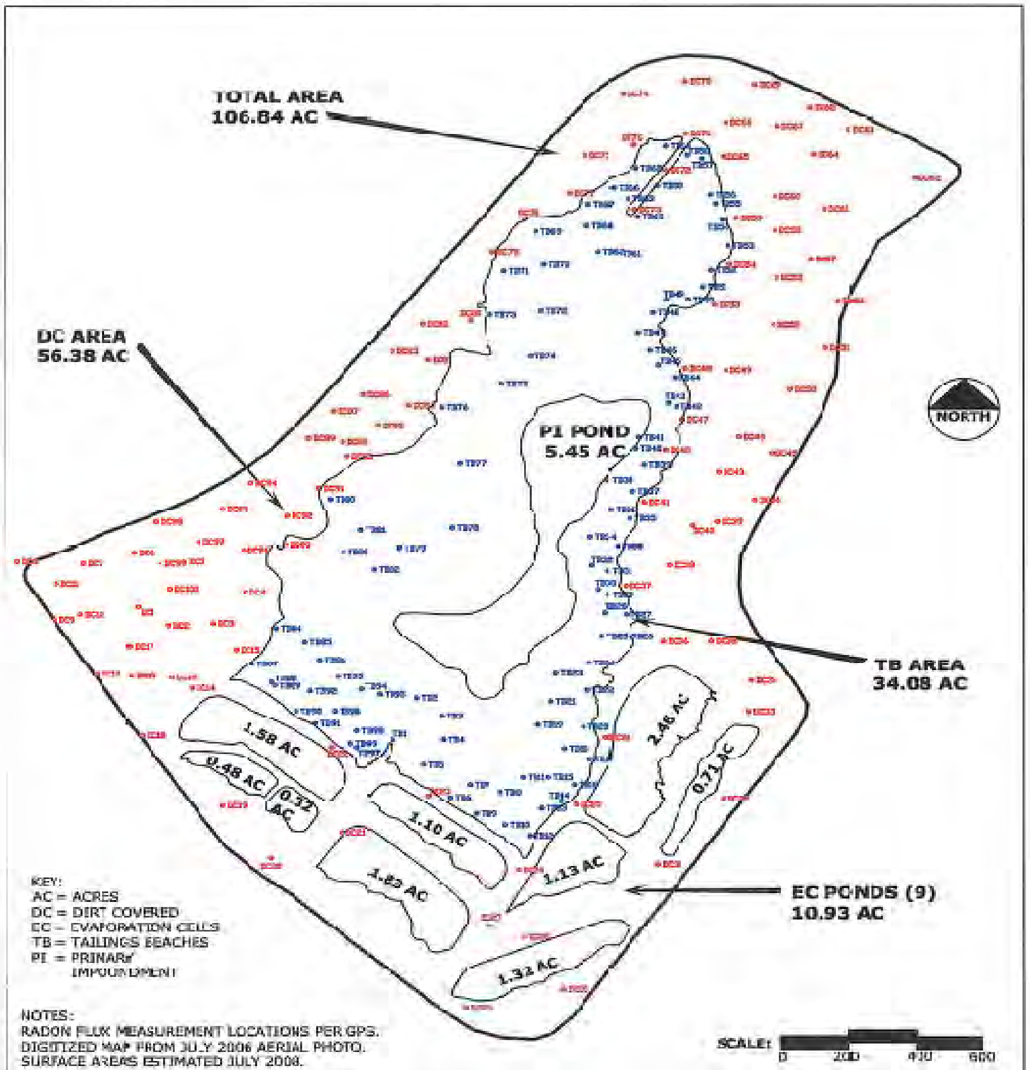
- **Radon Flux Limit - 20 pCi/m^2-sec**
  - 1980 NRC recommendation: 2 pCi/m^2-sec. What happened to recommendation?
  - 1989 EPA risk assessment set today's standard
    - Please place risk assessment on EPA website?
    - 20 years have passed - **undertake new risk assessment**
  - How does US compare to other countries?

Method 115

- **Subpart W defines an operational impoundment as:** "being used for the continued placement of new tailings or is in stand-by status for such placement. An impoundment is in operation from the day that tailings are first placed in the impoundment until the day that final closure begins".
  - **Case in Point:** Cotter Mill has Primary and Secondary Impoundment. Measurements not required for the Secondary Impoundment
  - **Case in Point:** Cotter Mill "old tailings" area not restored to background. No radon flux measurements ever taken
- **Amend Method 115** to account for and measure all major sources!

Method 115

- **Number of canisters placed for radon flux measurement**
  - **Regulation**: 40 acre impoundment, maximum of 2 in operation, 10 acres "exposed" - require 100 canisters per region/area.
  - **Case in Point**: 2008 Cotter Mill Primary Impoundment:
    - 107 acres total
    - 56 dirt covered
    - 34 exposed
    - 17 water covered
    - 100 canisters placed on dirt covered and exposed
    - less than 1/2 the required coverage based upon regulation
  - **Impoundments greater than 40 acres**: canisters must be scaled to acreage. For Cotter Mill: 268 canisters per region/area (107/40)



COTTER CORPORATION
CANON CITY MILLING FACILITY
PRIMARY TAILINGS IMPOUNDMENT
RADON FLUX TEST CANISTER LOCATIONS (2008)

Figure 2

Date: July 2008
Drawn by: RMD
File: LowSpotRadon-2008Sketch.dwg

Method 115

- **Stop “grand-fathering” and exempting operators**
  - Force compliance to regulations
  - Public health and environment at risk!
  - **Case in point**: why is Cotter Mill allowed more than 10 acres of exposed tailings on Primary Impoundment?
    - 2007: 29 acres
    - 2008: 34 acres
    - 2009: no data until 3/2010!
  - Regulations **meaningless** if not enforced!

Method 115

- **Calculation of Weighted Average Radon Flux**
  - **Including water covered acreage in formula** causes radon flux to be understated
  - **Assumption**: tailings covered by water do not allow radon transfer into the atmosphere
    - How does climate, particularly our windy Colorado climate alter assumption?
    - Fact: churning, agitated water releases radon gas
  - **Weighted average formula** needs careful scientific re-examination
    - Currently understates true amount of radon flux
    - Either fully account for radon released from water due to climate/winds or eliminate water covered acreage from equation

Method 115

- **Prescriptive actions lacking when measurements approach regulatory limit**
  - EPA July 1991 "Guidance on Implementing the Radionuclide NESHAPS" should be mandatory, not guidance
  - Guidance states **more frequent tests**
- **Measurements only accurate to within 10%**
- **Case in point**: 2008 Primary Impoundment: 19.7pCi/m^2-sec.
  - Colorado State regulators argue Cotter is within the limit!
  - We say too close!
- **Subpart W must contain specific actions** when radon flux is close to the limit

Method 115

- **"Radon Flux" versus "Radon Concentration at the Mill Perimeter"**
  - **Controversy** about relationship between radon flux and radon concentration measured at the mill perimeter
  - **Case in Point**: Cotter Mill radon flux measurements for Primary Impoundment **increased** 230% 2006-2008 to 19.7 pCi/m^2-sec. Radon concentration measured at perimeter **decreased** 30% 2006-2008! Makes absolutely no sense to logic or reason.
  - **EPA must review radon concentration at the perimeter** as well
    - methods, procedures, sample sizes, calculations, effective effluent limits
    - something is wrong!
    - 2 independent scientists questioned measurements at mill perimeter
  - Subpart W/Method 115 review should require **Environmental Fate Analysis**. Where are radon emissions going?

Closing Remarks

- You came to hear, to make it "REAL"
- Thank you for your valuable time
- Public must be heard more loudly than the industry or lobbyists
- We expect nothing less
- In the end people and community most impacted , especially by failures

COTTER CORP. CANON CITY MILL MAIN IMPOUNDMENT AS-BUILT DRAWING OF EVAPORATION CELLS AND DEWATERING-DRAIN SYSTEM

1" = 350'

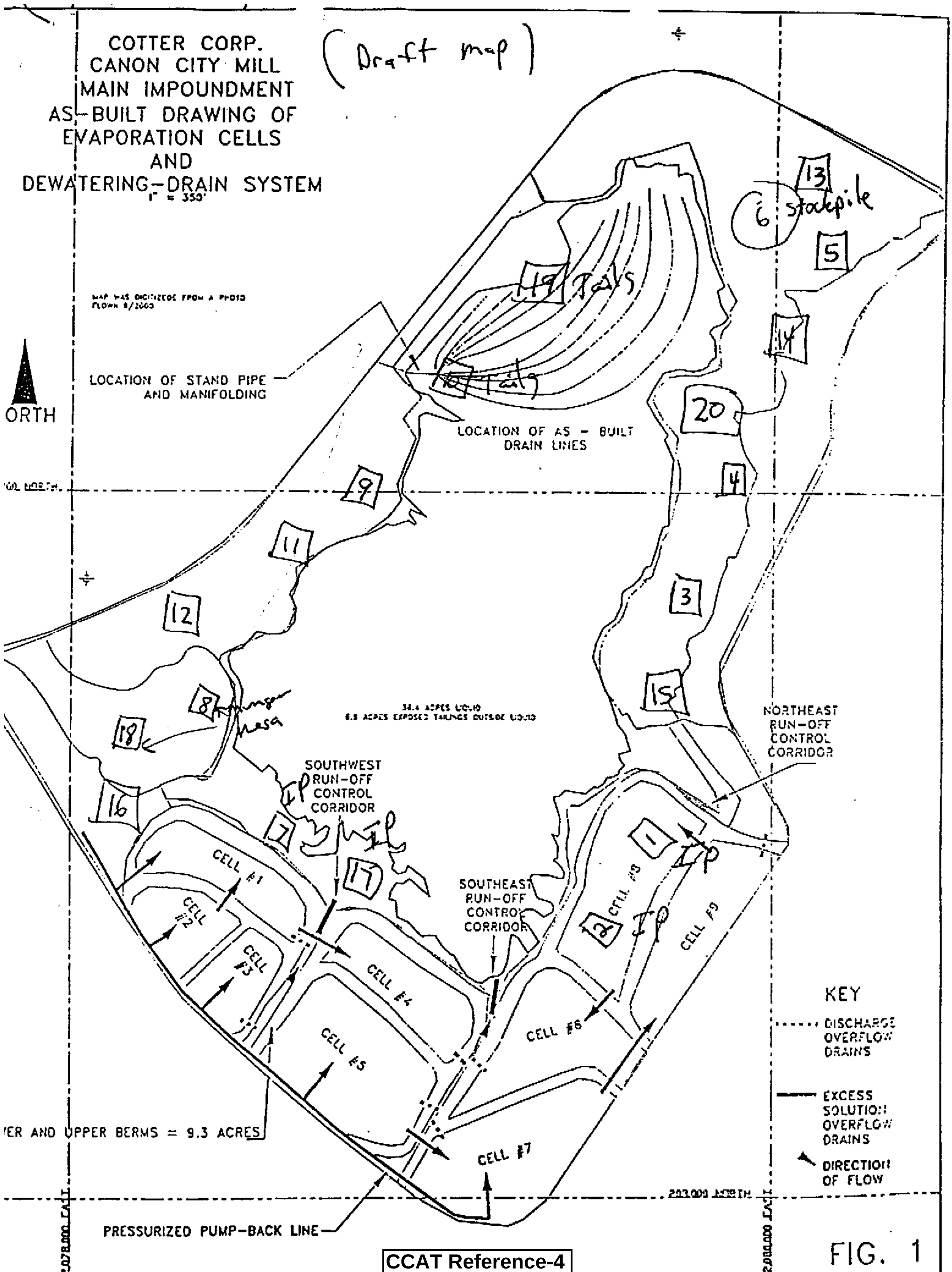
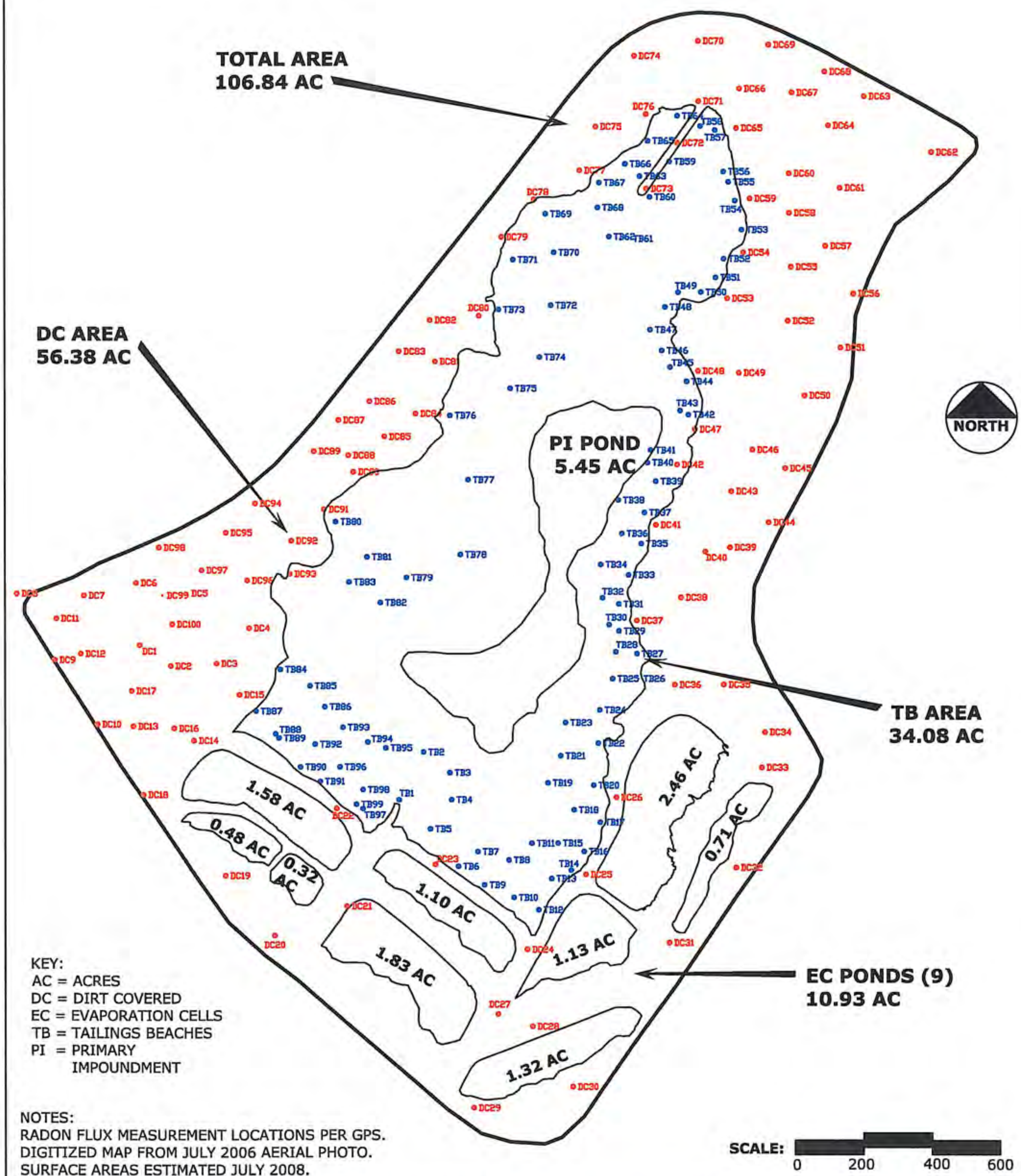


FIG. 1

CCAT Reference-4

MILDOS Risk Assessment Soil Samples and Results

SampleId	Date	Time	Lab#	Alpha Result	Units	Uranium Result	Units	Remarks
MRA-1	1/28/02	1400	CC13283	11297.8	pCi	77.57	µg/G	Iron Precip Material (Cell 8)
MRA-2	1/28/02	1410	CC13284	6766.2	pCi	70.355	µg/G	Iron Precip Material (Cell 8)
MRA-3	1/28/02	1425	CC13285	124.1	pCi	10.216	µg/G	
MRA-4	1/28/02	1440	CC13286	122.8	pCi	6.52	µg/G	
MRA-5	1/28/02	1455	CC13287	516.9	pCi	84.11	µg/G	
MRA-6	1/28/02	1510	CC13288	180	pCi	13.571	µg/G	Stock Pile Material
MRA-7	1/28/02	1525	CC13289	1002.7	pCi	872.985	µg/G	Iron Precip/Lime Material
MRA-8	1/28/02	1540	CC13290	605.8	pCi	22.755	µg/G	Munger Mesa Material
MRA-9	1/28/02	1550	CC13291	92.6	pCi	21.535	µg/G	
MRA-10	1/28/02	1600	CC13292	4349.6	pCi	356.325	µg/G	Tails Material
MRA-11	1/29/02	1230	CC13293	199	pCi	27.905	µg/G	
MRA-12	1/29/02	1245	CC13294	1166.4	pCi	48.565	µg/G	
MRA-13	1/29/02	1255	CC13295	140	pCi	19.695	µg/G	
MRA-14	1/29/02	1310	CC13296	879.7	pCi	224.44	µg/G	
MRA-15	1/29/02	1320	CC13297	52	pCi	4.85	µg/G	
MRA-16	1/29/02	1335	CC13298	597.2	pCi	41.2	µg/G	
MRA-17	1/29/02	1345	CC13299	570.7	pCi	216.115	µg/G	Iron Precip/Lime Material
MRA-18	1/29/02	1355	CC13300	201.2	pCi	10.173	µg/G	Munger Mesa Material
MRA-19	1/29/02	1410	CC13301	5144.3	pCi	732.18	µg/G	Tails Material
MRA-20	1/29/02	1430	CC13302	437.9	pCi	87.2	µg/G	



COTTER CORPORATION **CANON CITY MILLING FACILITY** **PRIMARY TAILINGS IMPOUNDMENT** **RADON FLUX TEST CANISTER LOCATIONS (2008)**	Figure 2 Date: July 2008 Drawn by: RMD File: LowSpotRadon 2008Sketch.dwg

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