Executive Summary of Draft Results

Buckman Direct Diversion Project Independent Peer Review

Prepared for the

Buckman Direct Diversion Project Board

by ChemRisk, LLC

with AMEC Earth and Environmental

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Overall Conclusions of the Independent Peer Review

This document summarizes the draft findings of the Independent Peer Review (IPR) conducted on behalf of the Buckman Direct Diversion (BDD) Board. The IPR conclusions are as follows:

- There will be no health risk to people drinking water from the BDD system.
- Chemical and radionuclide levels in the Rio Grande are within acceptable drinking water standards, and/or are naturally occurring.
- LANL contributes very little, if any, chemicals or radionuclides to the Rio Grande during normal base-flow conditions.
- Pharmaceuticals and endocrine disrupting compounds are not present in the Rio Grande at levels that warrant a concern.
- Stormwater discharge from LANL does not pose a health risk.
- There are no contributions from LANL groundwater to the Buckman well field.

The Buckman Direct Diversion Project

The BDD is a regional water supply project co-owned by the City of Santa Fe and Santa Fe County. It diverts water from the Rio Grande to an advanced drinking water treatment plant located southwest of Santa Fe. The water treatment plant will provide up to 60 percent of the annual water supply for more than 100,000 residents of Santa Fe County, and deliver as much as 15 million gallons per day of treated drinking water. Components of the BDD system include a diversion structure on the Rio Grande, a sand removal facility, two raw water booster stations, two treated water pump stations, and 25 miles of pipelines for raw and finished water.

Water for the BDD system is taken from the Rio Grande at a point on the river's eastern descending bank about 11 miles northwest of the Santa Fe city limits and about 3.5 miles downstream from where New Mexico Route 502 crosses the river at Otowi Bridge. The BDD diversion structure is located about three miles east of Los Alamos National Laboratory (LANL), which occupies about 36 square miles of property on the Pajarito Plateau, on the western side of the river, and has operated (under various names) since 1943. The BDD water intake structure is located about three miles downstream of the confluence of Los Alamos Canyon and the Rio Grande.

Initiation of the Buckman Direct Diversion Independent Peer Review

In February, 2002, a formal agreement became effective between the U.S. Forestry Service (USFS), the U.S. Bureau of Land Management (BLM), the U.S. Bureau of Reclamation, and three applicants proposing to build the BDD. These applicants were the City of Santa Fe, Santa Fe County, and Las Campañas − an unincorporated, master-planned community located between Santa Fe and the BDD diversion point. Three years later, in 2007, the Final Environmental Impact Statement (FEIS) for the BDD Project was issued. In February, 2008, USFS and BLM approved the BDD as the selected alternative by way of publishing a record of decision (ROD).

At an October 4th, 2007 meeting, the BDD Board voted unanimously to request that the U.S. Department of Energy (DOE) and LANL fund and implement a number of actions and specific programs to protect public water supplies. In a November 1st, 2007 letter to DOE and LANL environmental officials, the Chair of the BDD Board presented six specific requests to LANL. One of these six requests was to provide funding for the BDD Board to conduct an independent peer review (IPR) by qualified experts with regard to possible LANL contamination of Santa Fe City and County public drinking water sources. On July 17th, 2009, a request for proposals (RFP) was published, with responses due on September 16, 2009. Responses were reviewed by a panel that included one public member, who was appointed by the BDD Project Board. On November, 5th, 2009, the BDD Board approved a $200,000 contract with ChemRisk, LLC (ChemRisk) to perform the IPR, and the work was funded by a DOE grant.

Independent Peer Review Team

ChemRisk, a leader in human health risk assessment and evaluation of historical operations at U.S. nuclear weapons plants, subcontracted with AMEC Earth and Environmental, a consulting firm with expertise in New Mexico hydrology, hydrogeology and geochemistry. Together, ChemRisk and AMEC form the IPR team.

Objectives of the Buckman Direct Diversion Project Independent Peer Review

The BDD Board's main objective for the IPR was to obtain an independent analysis and synthesis of existing information to support a description of potential tap water health risks and to prepare public risk communication summaries for a technical and lay audience. The IPR team's work centered on the following two topics:

Assessment and Characterization of Potential Health Risks from Chemicals and Radionuclides in Tap Water

The IPR scope of work included an emphasis on the tap water pathway and a consideration of all chemicals and radionuclides in Rio Grande water that could be diverted into the BDD. The IPR team was tasked with characterizing the tap water chemical and radionuclide exposures and risks by comparing them to other exposures and risks that occur as part of everyday life.

The IPR team also evaluated "non-traditional" constituents in the water, such as personal care products and pharmaceuticals, as well as possible endocrine disruption effects from some of the constituents. The possibility of "synergistic effects" (i.e., one constituent causing another to be more toxic than typical) was also assessed.

Analysis of Potential Future Impacts on Santa Fe Tap Water Quality from Contaminants Associated with LANL Sediments and Ground Water

The Rio Grande surface water data samples used in these analyses were collected during base-flow conditions i.e., when storms were not occurring. Some storm events, though, could result in contaminant discharge from LANL into the Rio Grande (at the Los Alamos Canyon confluence three miles upstream of the BDD intake). As part of its scope of work, the IPR team estimated the magnitude of these impacts, and evaluated potential impacts to Rio Grande water quality resulting from contaminated groundwater discharge from LANL.

Identifying and Gathering Relevant Information

Following a comprehensive review of existing data, reports, and published scientific literature, the IPR team identified technical reports issued by LANL and NMED, the RACER database, and the LANL Water Quality Database as being the most useful for the IPR's purposes. Although the RACER database was the primary source of surface water quality measurements in the Rio Grande, information from RACER was also compared to, and cross-checked against, information from the Water Quality Database, the USGS National Water Information System, and selected samples from detailed data packages.

Identifying the Constituents of Interest (COIs)

Summary of the COI Identification Process:

- All chemicals and radionuclides measured in water samples collected at either the Buckman or Otowi Bridge locations since 2000 were considered; all of these samples contained *unfiltered and untreated water.*
- 35 chemicals and 15 radionuclides were identified as COIs.

- For all COIs, sufficient data were available for conducting statistical analyses and health risk assessment calculations.

The surface water data identified for use in the risk assessment consisted of unfiltered samples collected at either the Buckman sampling locations (near the BDD intake) or upstream at the Otowi Bridge. Samples collected since the year 2000 were considered, and, since that time, 11 sampling events occurred at the Buckman locations, and 22 sampling events occurred at the Otowi Bridge locations. The Otowi Bridge sampling locations are upstream of the Los Alamos Canyon, which is the site where contaminated water and sediments might discharge from LANL during storm events. Hence, surface water samples from the Otowi Bridge locations provide a measure of “regional background” constituent levels, since these samples do not contain any contributions from LANL.

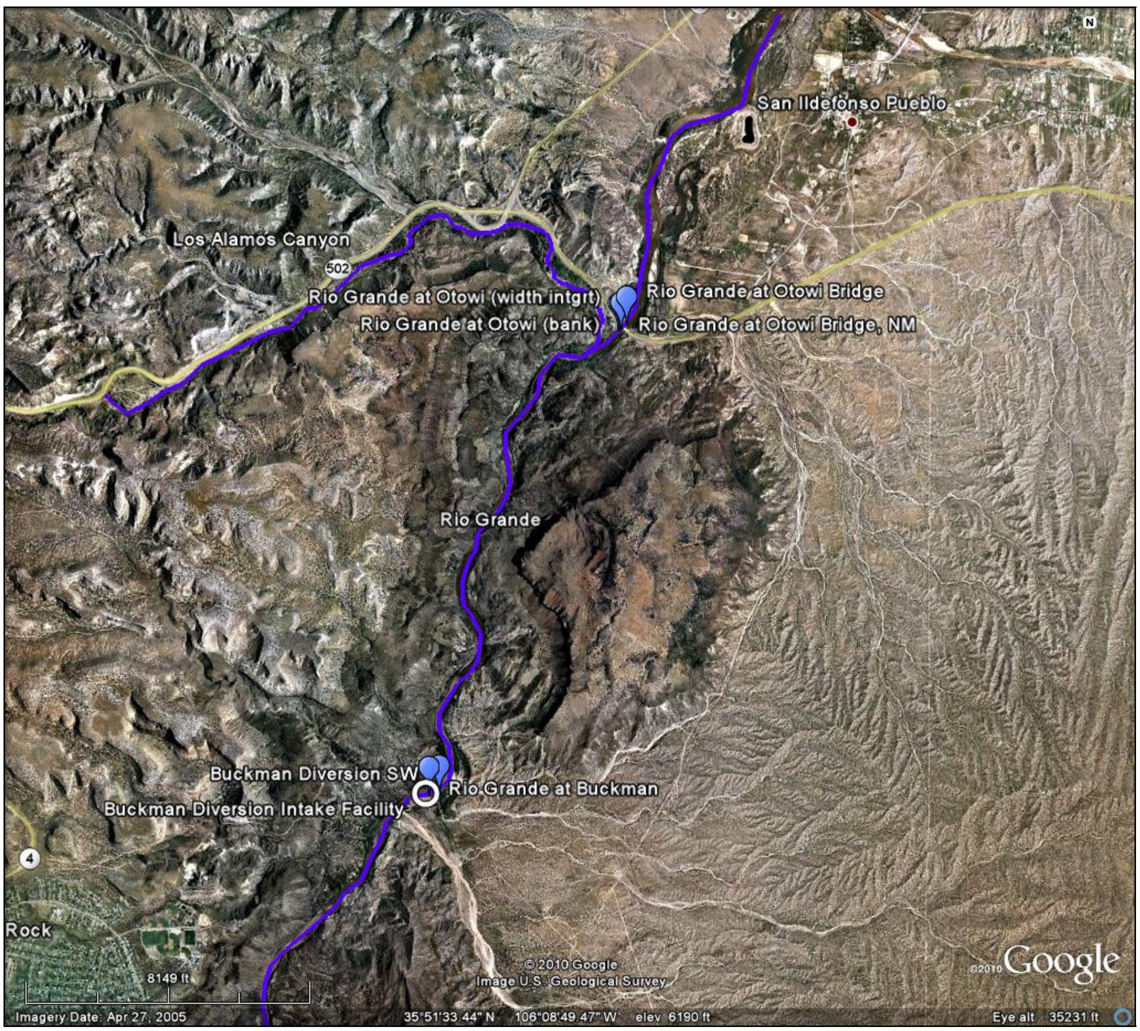

Figure 1. The Buckman and Otowi Bridge sampling locations relative to the location of the BDD intake (represented by a white circle) and Los Alamos Canyon.

All detected chemicals and radionuclides were included in the risk evaluations if they possessed human health toxicity criteria, as established by regulatory agencies such as the U.S. Environmental Protection Agency (USEPA). After the available measurement results were analyzed, 35 chemicals and 15 radionuclides were identified as COIs for the IPR human health risk evaluation. The chemical COIs are as follows:

- Acetone
- Aluminum
- Ammonia
- Antimony
- Arsenic
- Barium
- Beryllium
- Bis(2-ethylhexyl) phthalate
- Boron
- Cadmium
- Chloromethane
- Total Chromium
- Cobalt
- Copper
- Cyanide
- DDE
- Fluoride
- delta-BHC
- Iron
- Lead
- Manganese
- Mercury
- Molybdenum
- Nickel
- Nitrate – Nitrite as Nitrogen
- OCDD
- Perchlorate
- Total PCBs
- Selenium
- Silver
- Strontium
- Thallium
- Uranium
- Vanadium
- Zinc

The radionuclide COIs are as follows:

- Americium-241
- Lead-214
- Plutonium-238
- Plutonium-239
- Potassium-40
- Radium-226
- Radium-228
- Strontium-90
- Thorium-228
- Thorium-230
- Thorium-232
- Tritium
- Uranium-234
- Uranium-235
- Uranium-238

<u>Use of Untreated River Water Data in the Tap Water Risk Assessment</u>

Any type of water that is used as a drinking water source requires some type of treatment to reduce the levels of suspended particulates, dissolved materials, and biological contaminants before it can be supplied to the public as tap water. Water that has not been treated is referred to as untreated water, or raw water. It is important to recognize that the levels of chemicals and radionuclides used to evaluate the potential health risks in this assessment correspond to raw, untreated water from the Rio Grande.

As described in the independent analysis conducted by Dr. Kerry Howe (2008), once the Rio Grande water enters the BDD intake, it will be directed to a sediment removal facility and pump station, and then to a water treatment facility. At the treatment facility, the water will undergo conventional treatment methods including additional sediment removal and disinfection, and advanced treatment methods to further reduce contaminant levels and to polish off the "finished" water. The finished, or treated, water is then subject to water testing and the levels of specific contaminants must be below drinking water standards in order for it to be considered safe to drink. Accordingly, the COI levels used in this analysis are overestimates of the actual amount of COIs in tap water that would be consumed by Santa Fe residents. As such, the risk evaluation is very conservative.

Evaluating LANL as a Potential Source of Constituents of Interest in Rio Grande Surface Water

Summary of COI Source Analysis

- LANL does not contribute to base-flow COI levels in the Rio Grande surface water.

COIs in the Rio Grande may be present because of 1) naturally occurring sources, 2) sewage outfalls and surface run-off from contaminated properties (i.e., LANL), and, 3) fallout from nuclear weapons testing. In the IPR analysis, all sources unrelated to LANL discharges are referred to as "regional background."

Of primary interest to the IPR team was whether LANL discharges have impacted the base-flow water quality in the Rio Grande; to assess this possible impact, the levels of COIs measured in the Rio Grande downstream of LANL (at the Buckman locations) were statistically compared to those measured upstream at Otowi Bridge. In every case, for each COI, the concentrations downstream of LANL were *not statistically greater* than those upstream of LANL. Some of these comparisons are shown in Figure 2.

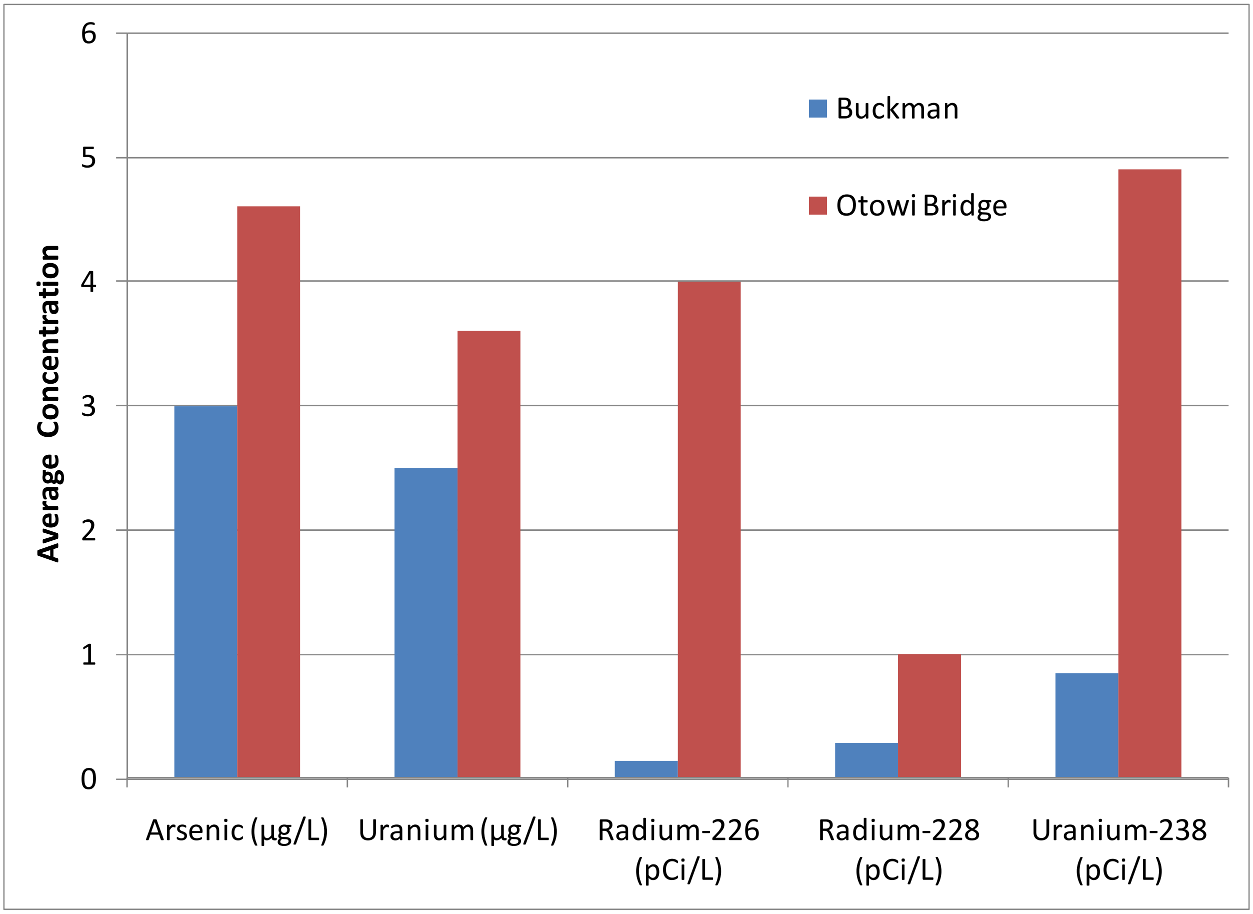

Figure 2. Comparison of average concentrations for select chemicals and radionuclides at the Buckman and Otowi Bridge locations.

This analysis indicates that LANL has not, and does not, contribute to the presence of COIs in the Rio Grande during base-flow conditions, and that the COI levels measured in the Rio Grande are representative of regional background. The regional background levels of all the COIs appear to be due primarily to naturally occurring sources.

Comparing Constituents of Interest Concentrations at Buckman to Drinking Water Standards

Summary of Constituents of Interest Comparisons to Drinking Water Standards

- For all of the 50 COIs except U-234, *untreated and unfiltered water* at the Buckman locations met drinking water standards.
- This comparison is very conservative, since drinking water standards apply to *finished, treated* water suitable for consumption, and the samples taken from the Rio Grande were *untreated and unfiltered.*

The COIs measured in Rio Grande river water at the Buckman sampling location were compared to drinking water standards. Drinking water standards exist for each of the COIs in the form of enforceable regulations or guidelines. For this comparison, the primary standards used were the USEPA Maximum Contaminant Levels (MCLs), which are legally enforceable drinking water standards for public drinking water systems. For COIs that not covered by MCLs, non-enforceable drinking water guidelines were used for comparison purposes. The average COI concentrations at the Buckman sampling locations were below drinking water standards; the only exception was Uranium-234 (U-234). It is important to understand, however, that U-234 also exceeds the drinking water guideline at numerous locations far upstream on the Rio Grande(>12 miles), indicating that regional background levels of U-234 typically exceed the drinking water guideline**.**

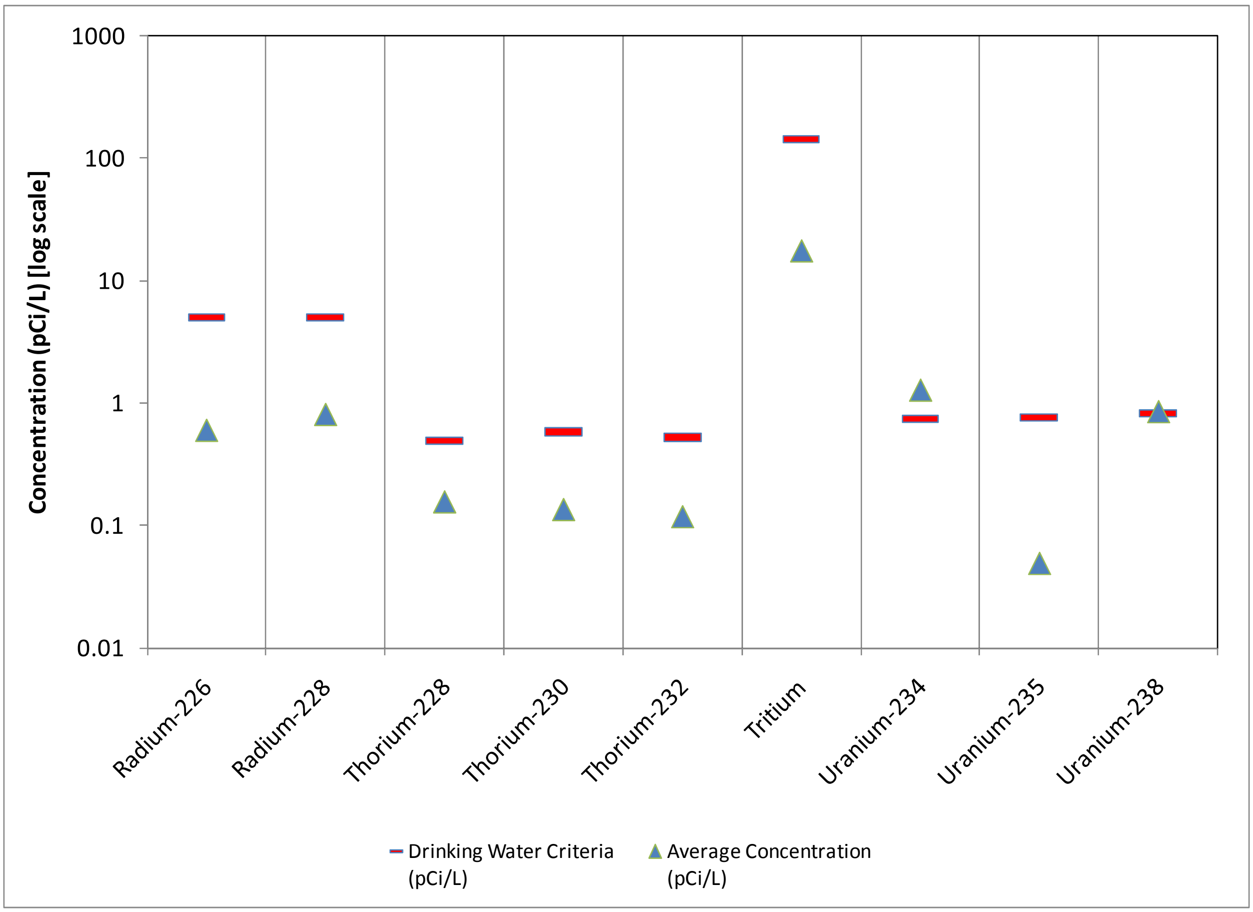

Figure 3. Comparison of average surface water concentrations for select radionuclide COIs to their associated drinking water standards.

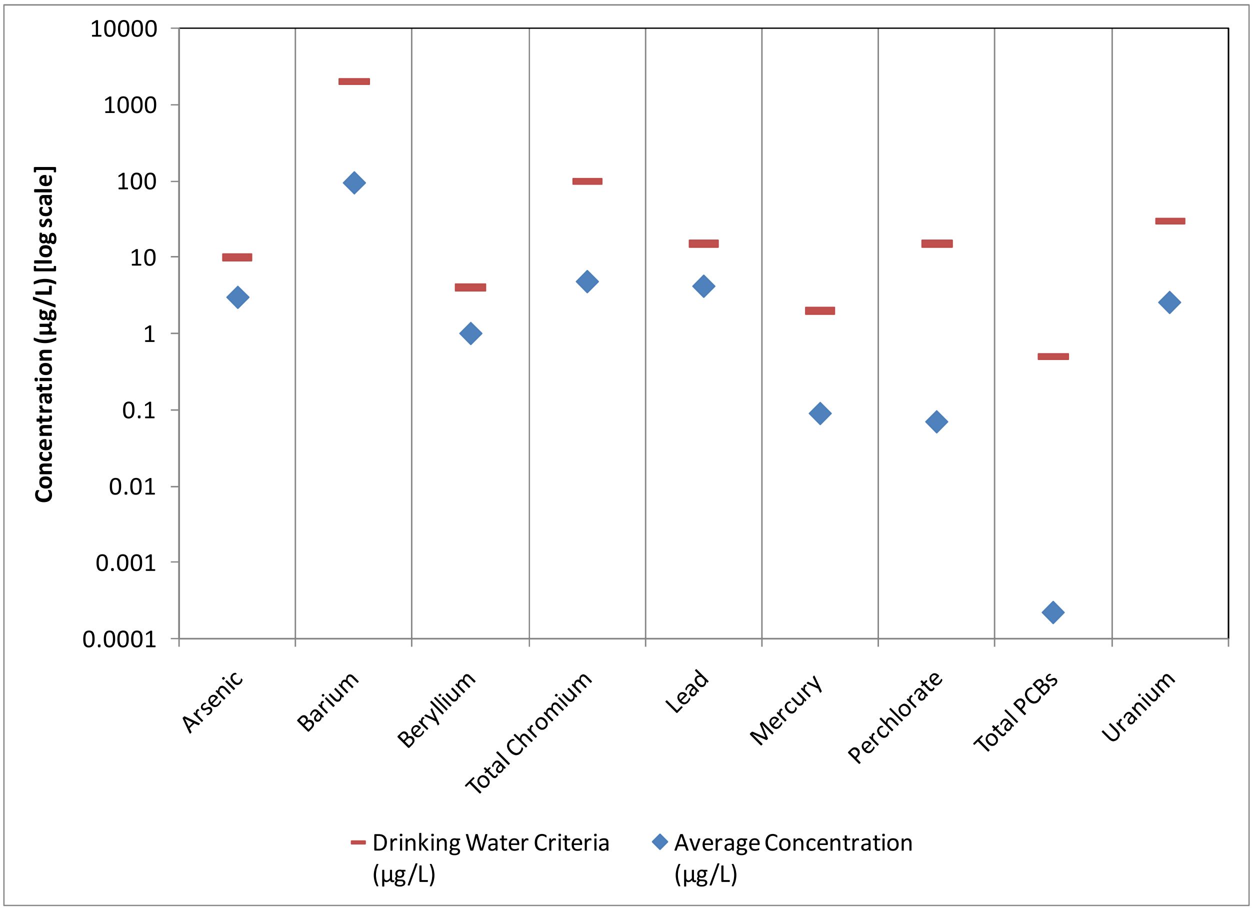

Figure 4. Comparison of average surface water concentrations for select chemical COIs to their associated drinking water standards.

It is also worth noting that NMED is currently revising its "Standards for Interstate and Intrastate Surface Waters" (20.6.4 NMAC) to include new water quality criteria for five radionuclides (americium-241, cesium-137, plutonium-239/240, strontium-90, and tritium). These five standards apply to the stretch of the Rio Grande between Otowi and Buckman only. They are not tap water criteria; instead they are "applicable to the public water supply use for monitoring and public disclosure purposes only." These standards are not yet final; however, the currently proposed values are much higher than the COI levels in the unfiltered Rio Grande samples for americium-241, plutonium-239/240, strontium-90, and tritium (cesium-137 is not a COI).

Human Health Risk Assessment

Summary of Health Risk Assessment Findings

- There is no health risk to Santa Fe region residents drinking BDD project tap water.
- None of the COIs are known to have synergistic effects with respect to cancer or noncancer health endpoints.

The IPR team conducted a risk assessment for a residential user of tap water according to current USEPA exposure and risk assessment guidance. Adults and children were evaluated for specific age groups that best reflect how behavioral and physiological factors are expected to change with age, and to comply with recent USEPA guidelines for children regarding early life exposure to chemicals with known mutagenic modes of action.

The following tap water-related exposure pathways were evaluated:

- Tap water as drinking water (including cooking with tap water),
- Watering home or locally grown produce,
- Taking a bath,
- Showering,
- Hand washing, and
- Swimming and/or hot tub use.

<u>Use of Conservative Risk Assessment Methodologies</u>

The IPR team employed conservative risk assessment methodologies so that potential health risks would not be underestimated, and incorporated locally-based exposure factors when possible (e.g., using swimming pools, ingesting home-grown produce). Exposures and health risks were quantified for both central tendency (typical) and "reasonable maximum exposure" (upper bound) scenarios to a range of exposure estimates. A 70-year lifetime of daily exposure was assumed, and age-specific exposure factors were employed for a variety of age groups. For each age group, exposure parameters were determined for factors including body weight, duration of residence, tap water ingestion rates, shower duration and frequency, swimming duration and frequency, and home grown produce ingestion rates.

The most meaningful results of the health risk assessment are those for the central tendency (CT) evaluations, as they are most representative of typical exposures that would be expected from using local tap water, while still being conservative (i.e., assuming a lifetime of daily exposure). Hence, the discussion below focuses on the risk estimated for the CT. However, it is important to note that, in general, the upper-bound, "reasonable maximal exposure" (RME) risk estimate is only marginally higher than the CT estimate because of the many conservative assumptions used to derive the CT estimates.

Defining Hypothetical Exposure Scenarios

Several hypothetical exposure scenarios were evaluated. The scenarios differ only in terms of the levels of COIs estimated to be present in the residential tap water at the point of exposure (i.e., the home). The scenarios are as follows:

1) COIs are present at levels recently measured in *unfiltered and untreated* water samples from the Rio Grande.

2) Radionuclide COIs are present at levels recently measured in the Rio Grande, except for plutonium, americium, uranium, and gross alpha-emitting radioactivity, which are assumed to be 95% removed by the water treatment processes.

3) Radionuclide COIs are present at levels recently measured in the Rio Grande, except for gross alpha-emitting radioactivity and dissolved uranium, which are assumed to be present at levels produced by the Buckman well field as measured by the City of Santa Fe.

The primary purpose of evaluating these various scenarios was to provide a basis for comparing the estimated health risks associated with untreated Rio Grande water (Scenario #1 above) to other scenarios involving either some level of water treatment (Scenario #2 above) or to using existing, alternative sources of tap water (Scenario #3). The IPR team also assessed the theoretical risk that would result from assuming that all COIs were present in the Rio Grande at their respective USEPA MCLs (or other drinking water standard, if no MCL existed). The purpose of that analysis was simply to provide a benchmark measure of the potential risks associated with consuming maximally acceptable levels of the various contaminants. The health risk findings for each scenario are summarized below.

Theoretical Cancer Risks and Noncancer Hazards Associated With Chemical and Radionuclide Constituents of Interest Levels Recently Measured in Untreated and Unfiltered water in the Rio Grande

Two health endpoints are typically evaluated in a health risk assessment: theoretical increased cancer risk, and noncancer hazard.

The benchmark of "maximally acceptable cancer risk," as defined by the USEPA and other agencies, is the range of 1 in 1,000,000 to 1 in 10,000 (which can be presented as 0.000001 to 0.0001 or also as 1×10^{-6} to 1×10^{-4}). Risk in this range is understood to be acceptable, while risk below this range is understood to be negligible. The "background risk" of cancer in the U.S. is about 20%, so an increased risk of 1×10^{-4} is the same as saying that someone's risk of getting cancer has increased from 20% to 20.01%.

The two graphs below summarize the theoretical cancer risks for chemicals and radionuclides. Six COIs fall within the USEPA maximally acceptable health risk range: arsenic, potassium-40 (K-40), radium-226 (Ra-226), radium-228 (Ra-228), uranium-234 (U-234), and uranium-238 (U-238). Theoretical cancer risks for the remaining individual COIs are negligible (i.e., less than 1×10^{-6}, or 1 in 1,000,000).

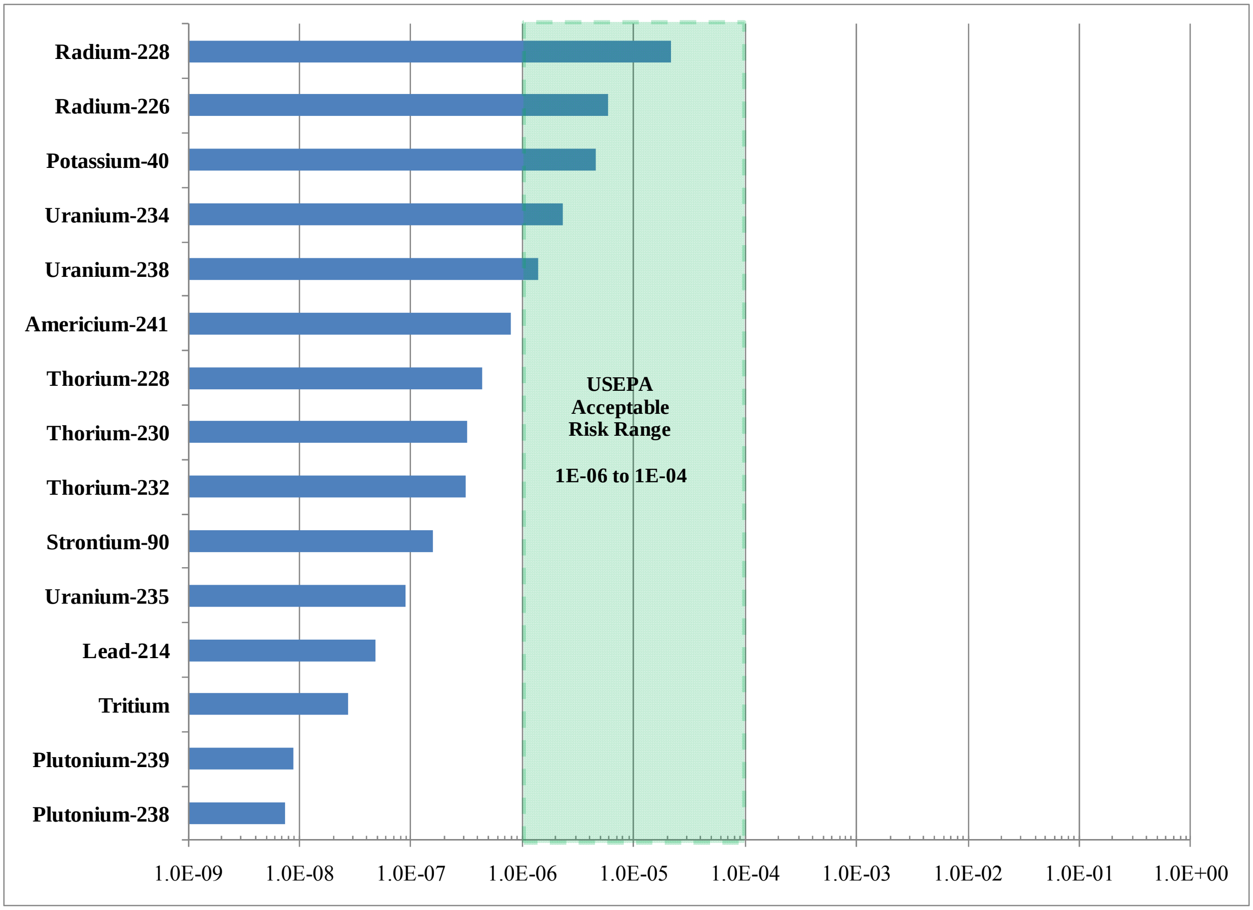

Figure 5. Estimated increased cancer risk associated with radionuclide COIs.

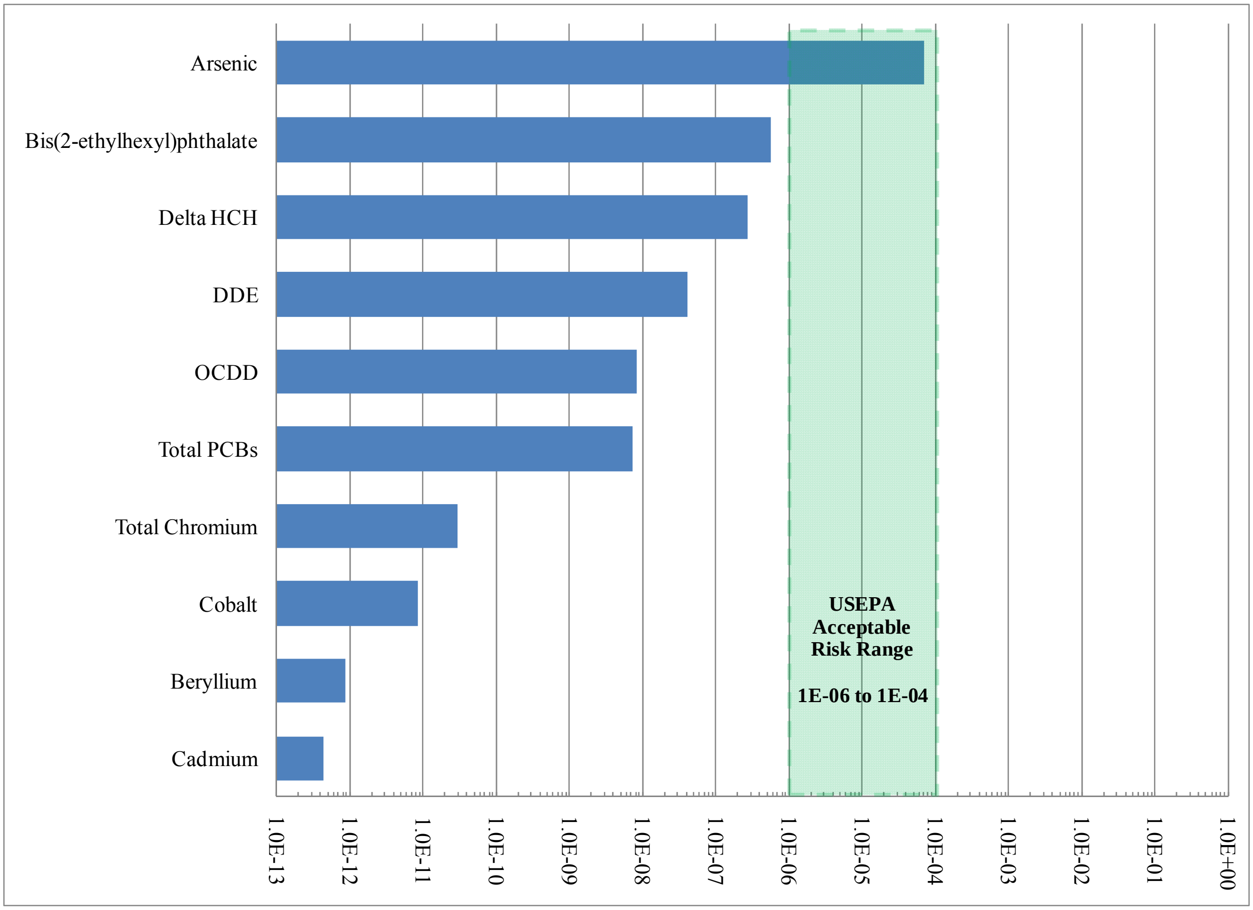

Figure 6. Estimated increased cancer risk associated with chemical COIs.

The total theoretical increased cancer risk from all chemical and radionuclide COIs combined is 1 in 10,000, (i.e., risk is increased 0.01% above the background cancer rate), which is at the upper end of the acceptable risk range. Hence, this analysis indicates that consuming *unfiltered and untreated* Rio Grande water does not pose an unacceptable cancer risk. The pie chart shown in Figure 7 summarizes the contributions of the different COIs to the total risk.

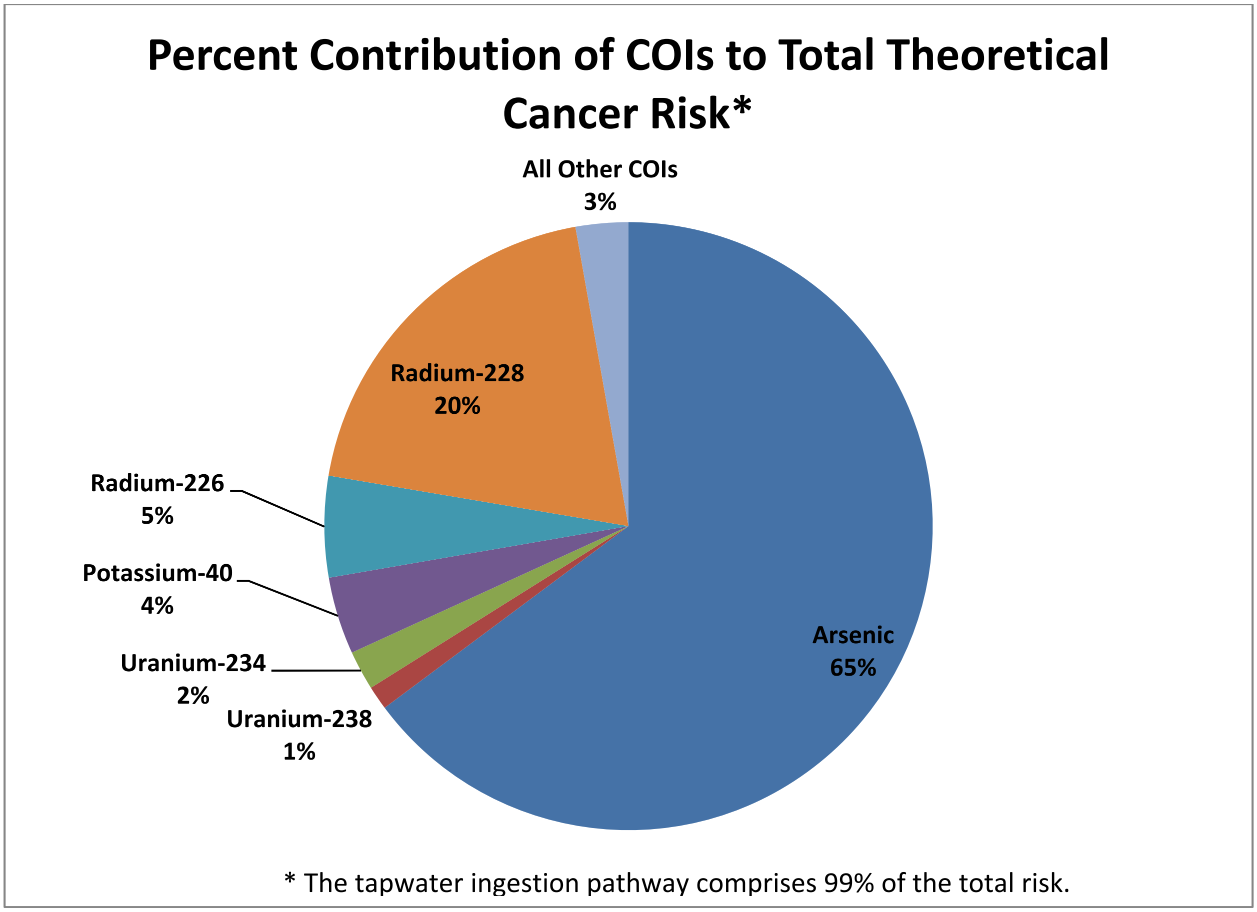

Figure 7. Percent contribution of the different COIs to the total estimated risk.

The primary pathway of exposure for each COI is tap water ingestion; none of the other exposure pathways contribute significantly to the estimated cancer risk.

Arsenic is the primary contributor (65%) to the theoretical cancer risk. It is therefore important to remember that arsenic levels in untreated Rio Grande water are below drinking water criteria, and are similar to levels measured regionally and throughout the U.S. Specifically, arsenic occurs naturally in soil and rocks, and is released to groundwater and surface water through erosion, dissolution, and weathering. Arsenic is widely distributed in public water systems throughout the U.S., with typical concentrations ranging from 1 to 5 µg/L; this range is similar to the concentrations measured in untreated Rio Grande surface water. Furthermore, these theoretical risks are based on *untreated and unfiltered* water samples; in reality, the BDD water treatment plant is expected to be effective in removing arsenic.

Similarly, concentrations of Ra-226, and Ra-228 (which comprise 25% of the theoretical risk) at the Buckman sampling location were always lower than their respective drinking water criteria, and are similar to levels measured elsewhere in the U.S. Ra-226 and Ra-228 occur within the natural decay series for U-238 and Th-232, respectively. Radium isotopes can reach surface water from a variety of environmental sources essentially by leaching from soil, rocks, and sediment into precipitation, and, finally, into surface water.

Theoretical noncancer hazards associated with chemical Constituents of Interest levels recently measured in untreated and unfiltered water in the Rio Grande

Noncancer hazards are assessed by determining the "hazard index;" if the hazard index is less than 1.0, there is no noncancer hazard. The graph below summarizes the estimated noncancer hazards for individual chemicals.

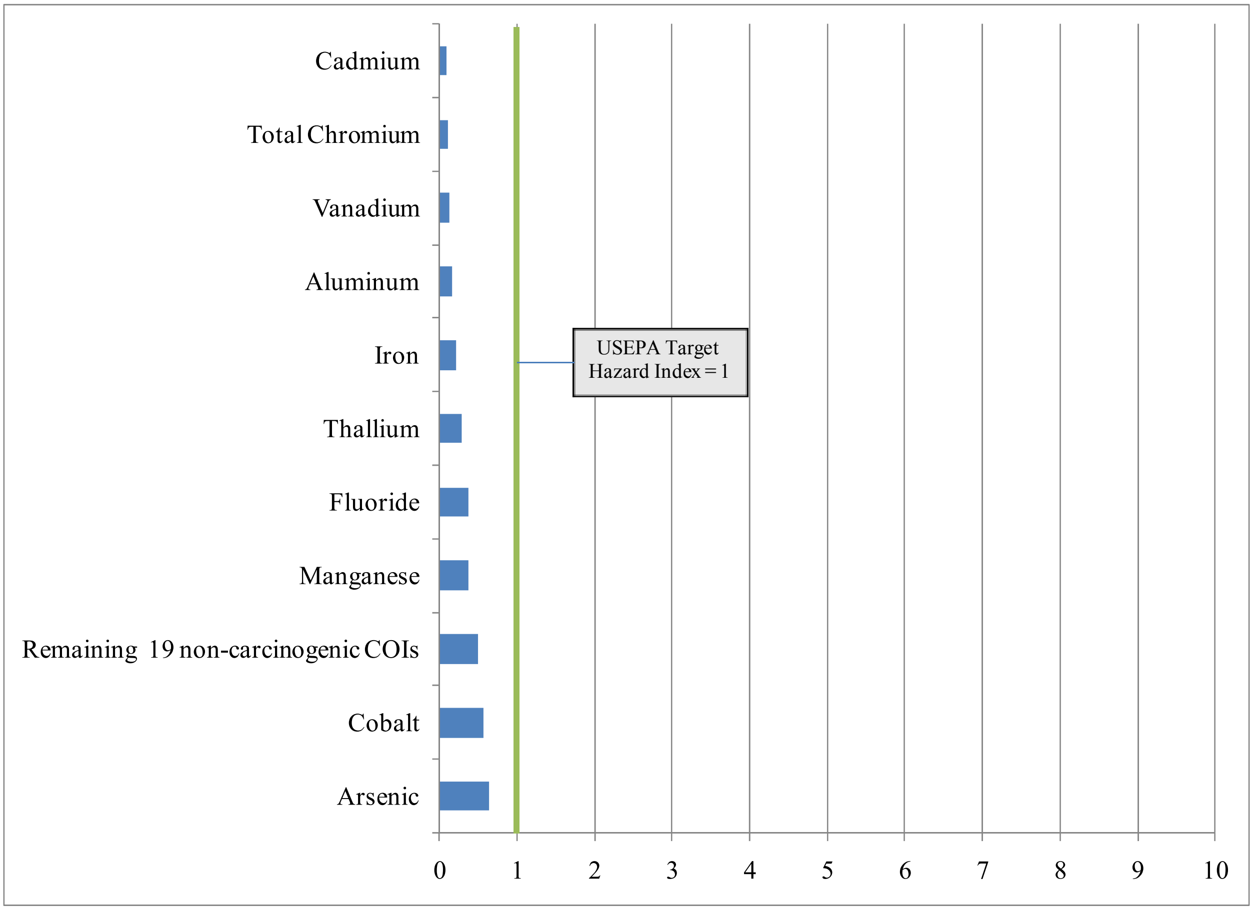

Figure 8. Estimated Hazard Indices for Chemical COIs.

None of these values exceeded the value of 1.0, indicating that there is no noncancer hazard associated with consuming *untreated and unfiltered* water from the Rio Grande.

Considering the conservative nature of the assumptions used in this assessment, and the fact that the BDD water treatment plant is expected to remove a substantial portion of these COIs in the water it receives, the IPR team has concluded that using the Rio Grande as a tap water source will not pose a health hazard to Santa Fe region residents.

Theoretical cancer risks following 95% removal of the plutonium, americium, uranium, and gross alpha-emitting radioactivity

When 95% removal for these isotopes was applied to recent concentrations measured in the Rio Grande, the estimated cancer risks for those isotopes decreased by 95%, as would be expected. However, because other naturally-occurring radionuclides contribute to the total theoretical cancer risk (K-40, Ra-226, and Ra-228, as discussed above) the radionuclide risk decreases by only approximately 12% in this treatment scenario. In reality, the BDD water treatment plant is expected to be effective at removing COIs other than just plutonium, americium, and uranium; thus the overall risk from the radionuclide COIs will likely decrease by much more than 12% (from the untreated scenario above) as a result of water treatment.

Theoretical radionuclide cancer risks based on recent measurements of gross alpha activity and dissolved uranium in Buckman well water

The estimated radionuclide cancer risk increased about 3-fold under this assumption [from 3 x 10^{-5} (3 in 100,000) under “current levels” to 9 x 10^{-5} (9 in 100,000) for the Buckman well water assumption], because of the fact that the gross alpha and uranium levels measured in the Buckman well field are higher than in the Rio Grande. Figure 9 below compares the total radionuclide risk for each of the three scenarios:

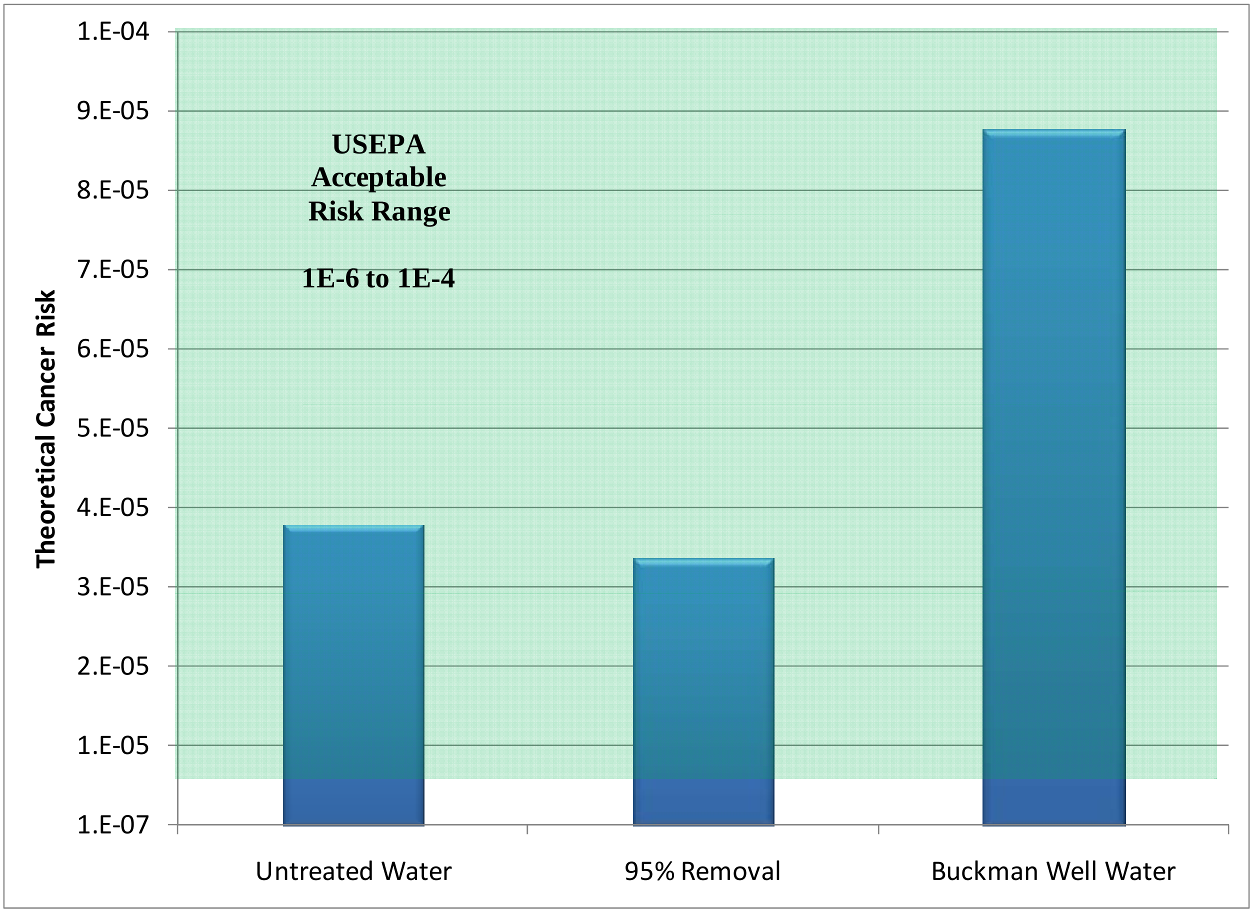

Figure 9. Comparison of theoretical risks for radionuclide COIs between the untreated and unfiltered surface water samples, 95% removal of gross alpha radioactivity, and Buckman well water analyses.

The theoretical risk for each scenario falls within the EPA maximally acceptable range.

Theoretical risk assuming each Constituents of Interest is present at levels equivalent to the USEPA Maximum Contaminant Levels or other drinking water standards

The total theoretical cancer risk under this assumption is 3×10^{-4} (3 in 10,000). Again, ingesting arsenic in tap water is the primary contributor to the total cancer risk. This scenario is a "worst case" scenario that is highly unlikely to actually occur, and is included simply for comparison purposes. The graph below compares the total radionuclide risk from "COIs are present at current levels in the Rio Grande" to "COIs are present at drinking water standards."

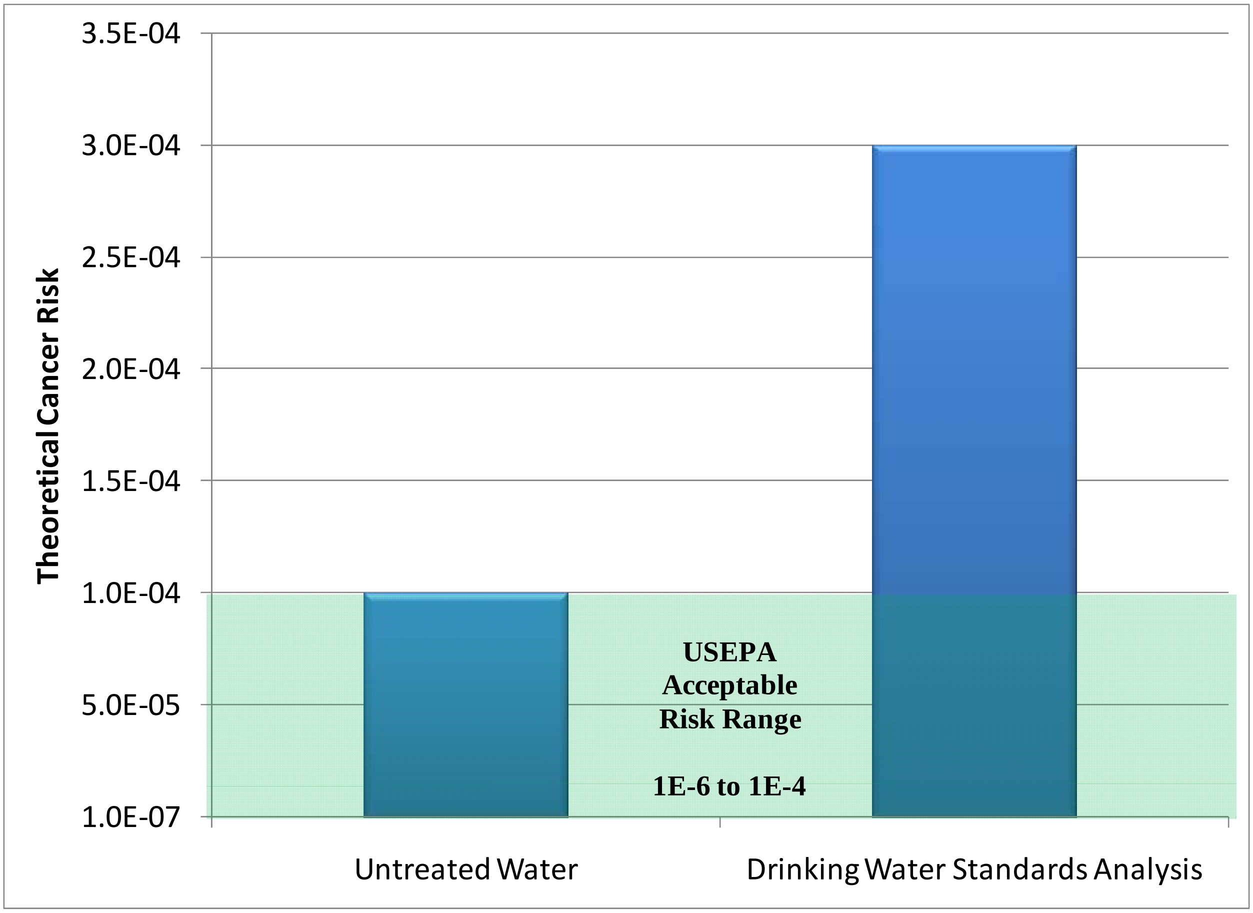

Figure 10. Risk comparison for chemical and radionuclide COIs found in the Rio Grande water to drinking water standards.

<u>Comparing Theoretical Constituents of Interest Risks to Risks of Everyday Activities</u>

The theoretical cancer risk estimates described above indicate the probability of contracting cancer as a result of being exposed to COIs in the Rio Grande (under the assumptions defined in each scenario). These theoretical risks can be put into perspective by comparing them to the risks of everyday activities, as illustrated in the following graphic.

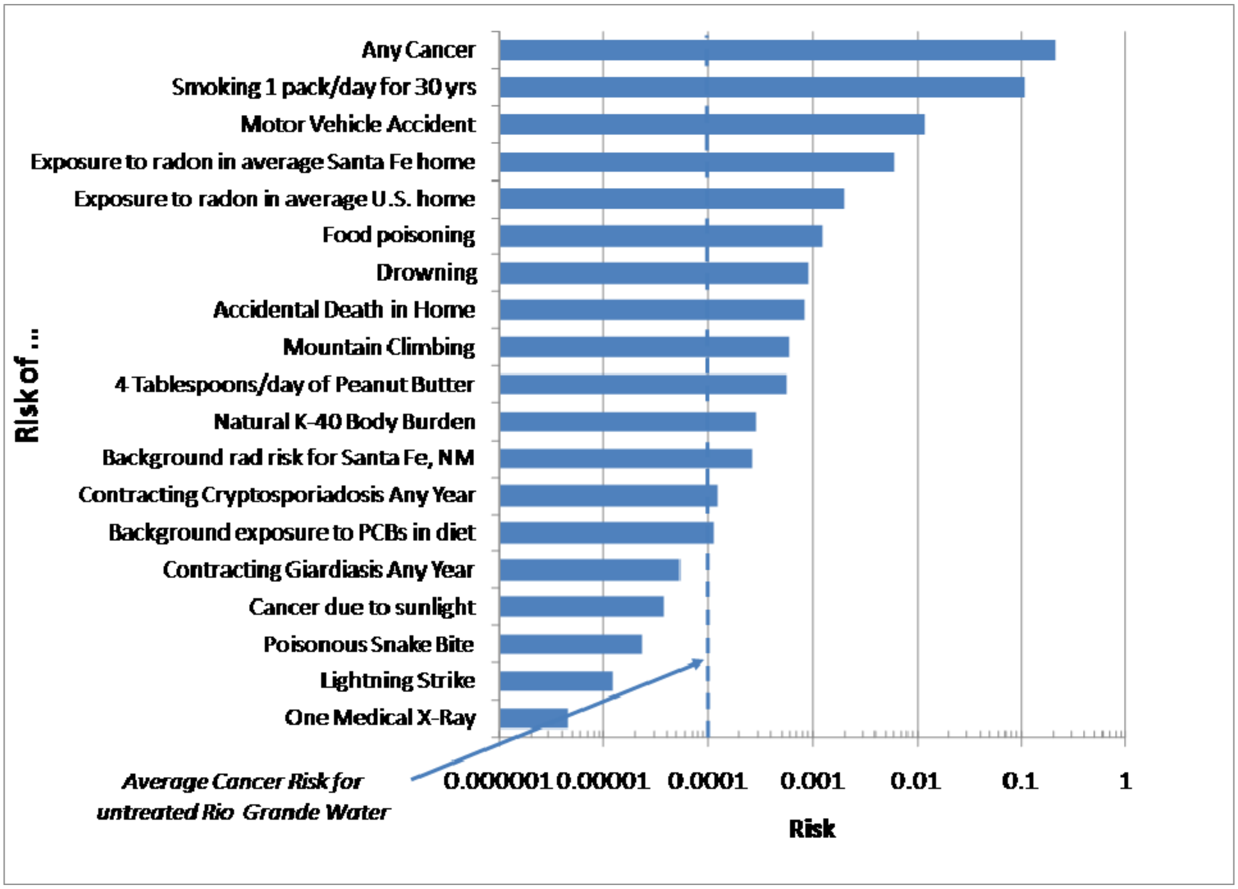

Figure 11. Comparison of risk associated with exposure to the COIs in the Rio Grande to risks from everyday activities.

As an example, the theoretical cancer risks associated with consuming untreated and unfiltered Rio Grande water are less than those associated with radon exposure in the typical Santa Fe residence. A more detailed comparison to such "everyday risks" is presented below.

Comparing radionuclide Constituents of Interest "effective doses" to radiation doses from everyday activities

The IPR team also calculated an annual "effective" radionuclide COI dose for the tap water ingestion pathway. The effective dose can be directly compared to the ubiquitous radionuclide exposures that occur because of naturally occurring radiation or various diagnostic and therapeutic medical procedures.

In 2009, the National Council on Radiation Protection and Measurements published a report entitled *Ionizing Radiation Exposure of the Population of the United States* (NCRP Report 160). In this report, NCRP estimated that the effective dose per individual in the United States for 2006 was 610 mrem. The two largest contributors to dose are natural background radiation and diagnostic and therapeutic medical procedures; each contributes to approximately 50% of the total effective radiation dose for the average U.S. citizen. Much smaller contributions (< 1%) are attributable to occupational, industrial, and consumer exposure.

With respect to exposure to ubiquitous background radiation, the NCRP calculated an arithmetic mean of 310 mrem per individual in the United States, and identified the largest contributions of background radiation as resulting from inhaling radon and thoron gas (228 mrem; 73%). Smaller contributions come from cosmic radiation (33 mrem; 11%), ingesting naturally occurring radionuclides (29 mrem; 9%), and being externally exposed to naturally occurring radiation (21 mrem; 7%). To put these findings into perspective, the annual effective radiation dose for an adult ingesting untreated water from the Rio Grande was calculated to be 1.6 mrem, over 150 times smaller than the effective dose received from natural background radiation for individuals in the United States.

The following figure compares the effective annual dose from drinking unfiltered Rio Grande water to those doses associated with various background sources:

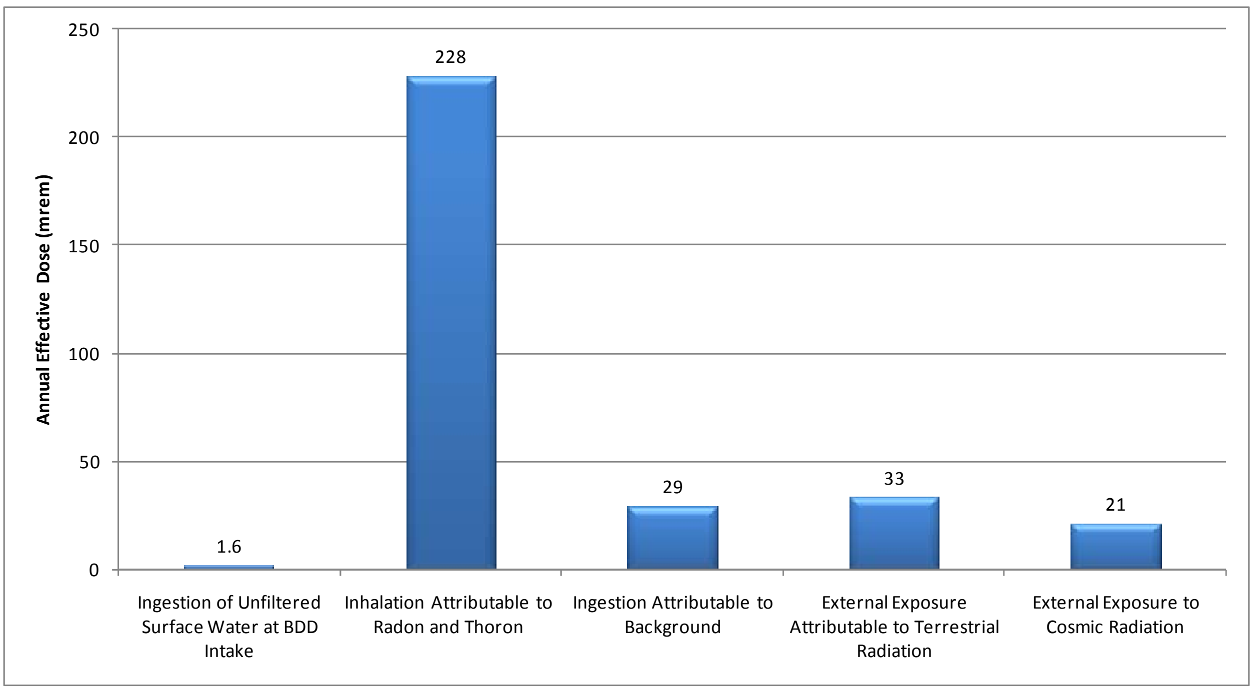

Figure 12. Comparison of the radionuclide dose estimated for COIs found in the Rio Grande water to other background doses of radiation.

Radiation exposure during medical procedures is the other major contributor to the annual effective radiation dose. The annual effective dose from medical procedures was estimated by the NCRP to be 300 mrem, with the largest contributions coming from computed tomography (CT) scans (147 mrem; 49%), nuclear medicine (77 mrem; 26%), interventional fluoroscopy (43 mrem; 14%), and conventional radiography and fluoroscopy (33 mrem; 11%). Again the average effective dose to patients from practical diagnostic and therapeutic procedures involving radiation are much greater than the annual effective dose for an adult ingesting untreated water from the Rio Grande.

The following figure compares the effective annual dose from drinking unfiltered Rio Grande water to those associated with various medical sources:

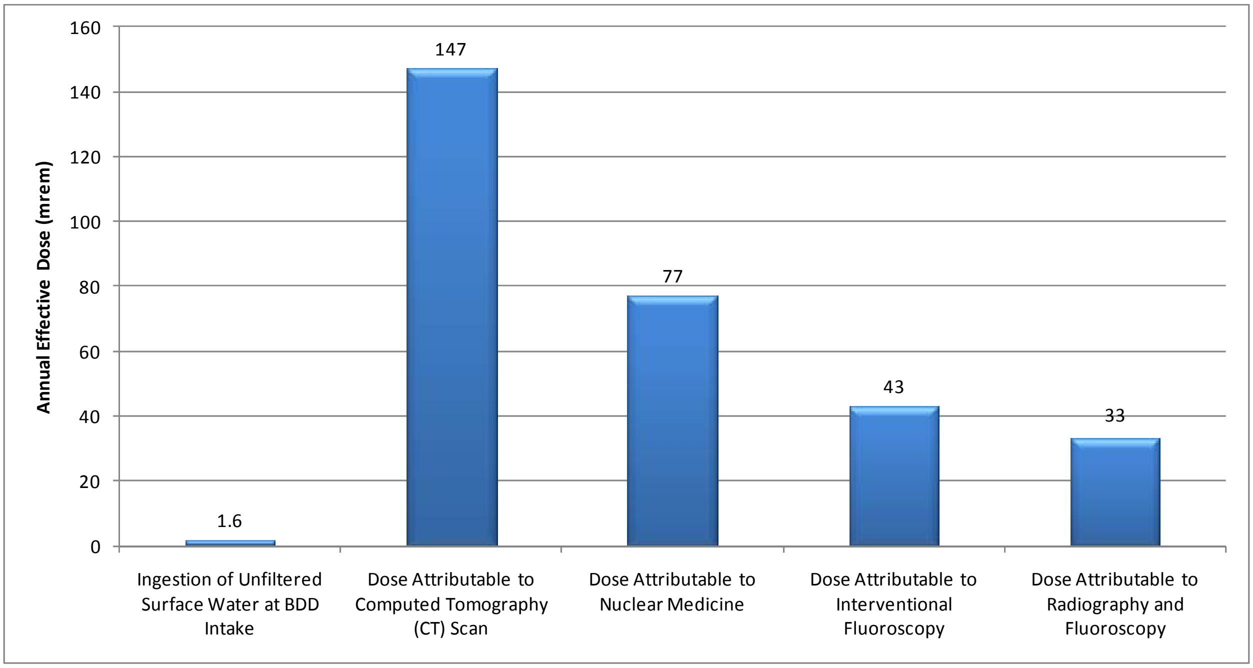

Figure 13. Comparison of the radionuclide dose estimated for COIs found in the Rio Grande water to doses of radiation from common medical procedures.

Analysis of Pharmaceuticals, Personal Care Products, and Endocrine Disrupting Compounds

- It is unlikely that levels of endocrine disrupting compounds recently measured in the Rio Grande would lead to any health effects for anyone using BDD tap water.

- Pharmaceuticals have rarely been detected in the Rio Grande, and the detected levels measured to date are too low to be a health concern.

Because there are no major metropolitan areas in the watershed of the upper Rio Grande, pharmaceuticals have rarely been detected in the Rio Grande, and the detected levels measured to date are too low to be a health concern.

Analyses for personal care products (perfumes, detergents, etc.) have not been conducted in the Rio Grande but, because of the aforementioned lack of residential development in the upstream watershed, these products are not expected to be present in the Rio Grande, and, even if they were, they would certainly not be found at levels that would warrant a health concern.

Some of the COIs considered in this analysis are thought to be potential endocrine disrupting compounds (DDE, perchlorate, PCBs, lead, cadmium, and mercury). Average levels of these COIs as found in the water, though, did not exceed their respective drinking water standards. The risk evaluations performed by the IPR team considered non-carcinogenic health effects, including 13 potential health endpoints ranging from hair loss to central nervous system effects. These included effects that can be associated with endocrine disruptors, such as developmental effects and immune system/thyroid effects. In no case did the hazard indices for central tendency exposures to infants based on levels recently measured in the Rio Grande exceed 1.0 for health endpoints attributed to endocrine disrupting compounds. That being the case for infants, the most sensitive age group, it is unlikely that levels of endocrine disrupting compounds recently measured in the Rio Grande would lead to any health effects for anyone using BDD tap water, particularly when taking into account the fact that the BDD water treatment plant is expected to effectively remove many of these compounds.

Analysis of Potential Synergistic Effects

The main public health concerns with mixtures are that interactions of mixture components may lead to toxicities not seen with individual components and that a mixture may be synergistic, i.e., that its potency may be much greater than expected based on knowledge of the components. In these situations the mechanism underlying the toxicity of concern includes one or more interactions of mixture components. It should be noted that it is equally as likely that a mixture will have the opposite effect, and the potency of a combination of chemicals will be less than one would expect looking only at single components (antagonistic). To the knowledge of the IPR team, none of the potential COI combinations in this risk assessment have known synergistic effects in humans.

Potential Future Impacts on Santa Fe Tap Water Quality from Contaminants Associated with LANL Sediments and Ground Water

Summary of Potential Stormwater and Ground Water Impacts from LANL

- Stormwater discharge from LANL is episodic, and does not pose a health risk.
- Contaminated groundwater at LANL does not impact the water quality at the BDD intake.

Contaminated Sediment Transport Pathways

Surface sediments in the Rio Grande downstream of the Los Alamos Canyon discharge point do not contain elevated levels of COIs; this finding suggests that:

1. Previous Los Alamos Canyon discharges have not resulted in the current-day presence of contamination above levels of concern in the active Rio Grande riverbed sediments above the BDD intake, and

2. Because the active Rio Grande bed sediments above the BDD intake are not contaminated above levels of concern, any contaminated sediments that reach the BDD intake are far more likely to be caused by storm-related discharges from LANL than suspension of Rio Grande bed sediments.

The IPR team developed COI concentration estimates that might exist in the Rio Grande at the Los Alamos Canyon confluence during storm events that result in significant sediment discharge. The team estimated that if storm events discharge contaminated sediments into the Rio Grande, the resulting COI levels in the Rio Grande will exceed normal base-flow levels by several orders of magnitude, for several hours at the most.

The IPR team did not attempt to estimate COI levels 3 miles downstream at the BDD intake following an episodic storm event because an early notification system is being put in place that will allow BDD personnel to cease water diversion when a storm flow comes through Los Alamos Canyon. Even if any of the storm water discharge were to make it into the BDD system, it would encounter a treatment system highly effective at removing particle-bound contaminants and some dissolved contaminants, such as arsenic, uranium, and chromium. Plans for systems are currently being established for monitoring once the BDD system is operational. The IPR team understands that additional stations will be in place that will perform automatic collection of stormflow samples in series following recognition of each runoff event in Los Alamos Canyon. In addition, both NMED and BDD will collect samples from the Rio Grande at Buckman when Los Alamos Canyon stormwater is flowing to the Rio Grande.

Contaminated Groundwater Transport Pathways

Contaminated Regional Aquifer (RA) groundwater is found under the Los Alamos Canyon watershed, as well as under Sandia Canyon and Mortandad Canyon. There are potential groundwater transport pathways that can convey contaminated water to the BDD reach of the Rio Grande. LANL has not reported groundwater contamination in the RA monitoring wells closest to the Rio Grande over the river reach of interest; however, RA monitoring wells in the

RA along this reach are scarce and/or off-gradient to the BDD reach, with most located a large distance from the Rio Grande.

The IPR team developed a calculation spreadsheet to determine mixing ratios (dilution factors) along the reach of interest under varying Rio Grande base flows and aquifer discharges. The contaminant concentrations used were derived from those provided in LANL reports for only those contaminants that exceeded screening levels. When the flow calculations were linked to contaminant concentrations in groundwater, the concentrations near the BDD system were determined in a conservative manner.

The results indicate that, under very conservative assumptions based on data currently available from LANL, all analyzed contaminants of groundwater origin would be diluted to below levels of regulatory concern.