BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

RECEIVED
CLERK'S OFFICE
JAN 05 2009
STATE OF ILLINOIS
Pollution Control Board

CITY OF JOLIET,	)	
	)	
Petitioner,	)	
	)	
v.	)	PCB 09-025
	)	(Permit Appeal-Water)
ILLINOIS ENVIRONMENTAL	)	
PROTECTION AGENCY,	)	
	)	
Respondent.	)	

NOTICE OF FILING

TO: See Attached Service List

PLEASE TAKE NOTICE that on January 5, 2009, we filed with the Office of the Clerk of the Pollution Control Board the attached **MOTION TO SUBSTITUTE**, a copy of which is served upon you.

Respectfully submitted,

THE CITY OF JOLIET

By: ______________________
One of Its Attorneys

Dated: January 5, 2009

Roy M. Harsch, Esq.
Yesenia Villasenor-Rodriguez, Esq.
Drinker Biddle & Reath LLP
191 North Wacker Drive - Suite 3700
Chicago, Illinois 60606
(312) 569-1441 (Direct Dial)
(312) 569-3441 (Facsimile)

THIS FILING IS BEING SUBMITTED ON RECYCLED PAPER

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

RECEIVED
CLERK'S OFFICE
JAN 05 2009
STATE OF ILLINOIS
Pollution Control Board

CITY OF JOLIET,	)	
	)	
Petitioner,	)	
	)	
v.	)	PCB 09-025
	)	(Permit Appeal-Water)
ILLINOIS ENVIRONMENTAL	)	
PROTECTION AGENCY,	)	
	)	
Respondent.	)	

MOTION FOR SUBSTITUTION

The CITY OF JOLIET (hereinafter, "Joliet"), by its attorneys, Drinker Biddle & Reath LLP, submits this Motion for Substitution. In support, Joliet states the following:

1. On January 2, 2009, Joliet submitted its witnesses pre-hearing narrative testimony as required by the Hearing Officer's order.

2. Due to holidays, certain witnesses were unable to make final changes to their respective narrative submissions prior to the filing deadline on January 2, 2009.

3. Since the above filing, Mr. Dennis Duffield of Rogina & Associates, Ltd. and Dr. Richard Toohey of Oak Ridge Associated Universities have requested to substitute their previously submitted testimony with the narrative testimony enclosed herein. There are no substantive changes made to this testimony, only minor typographical corrections.

4. Additionally, we have found minor typographical errors in the testimony of Mr. Harold Harty and Mr. Eli Port. Again, there were no substantive changes made only minor typographical corrections.

5. Mr. Harold Harty's corrected narrative testimony is enclosed herein as Attachment A.

6. Mr. Dennis Duffield's corrected narrative testimony is enclosed herein as Attachment B.

7. Mr. Eli Port's corrected narrative testimony is enclosed herein as Attachment C.

8. Dr. Richard Toohey's corrected narrative testimony is enclosed herein as Attachment D.

9. Based on the above, Respondent will not be prejudiced by this request.

10. Attorney for Respondent has been notified of this request and has no objections.

WHEREFORE, for all the foregoing reasons, Joliet respectfully requests that the Hearing Officer grant this Motion to Substitute these four corrected narrative testimony statements for those previously filed on January 2, 2009.

Respectfully submitted,

THE CITY OF JOLIET,
Petitioner,

By: Y. Villasenor-Rdz
One of its Attorneys

Dated: January 5, 2009

Roy M. Harsch, Esq.
Yesenia Villasenor-Rodriguez, Esq.
Drinker Biddle & Reath LLP
191 North Wacker Drive - Suite 3700
Chicago, Illinois 60606
(312) 569-1441 (Direct Dial)
(312) 569-3441 (Facsimile)

CERTIFICATE OF SERVICE

I, the undersigned, certify that I have served the attached Joliet's Amended Witness List, by First Class Mail, postage pre-paid on January 5, 2009. See Attached List.

Yesenia Villasenor-Rodriguez

THIS FILING SUBMITTED ON RECYCLED PAPER

Service List
PCB 09-25 (Permit Appeal – Water)

Gerald Karr
Senior Assistant Attorney General
69 West Washington – Suite 1800
Chicago, IL 60602

John T. Therriault
Illinois Pollution Control Board
James R. Thompson Center
100 W. Randolph Street – Suite 11-500
Chicago, IL 60601

Bradley P. Halloran
Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 W. Randolph Street – Suite 11-500
Chicago, IL 60601

Illinois Environmental Protection Agency
Division of Legal Counsel
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

CH01/ 25278763.1

WRITTEN TESTIMONY OF
HAROLD HARTY

IN THE MATTER OF
City of Joliet v. Illinois EPA
PCB 09-25

Before the Illinois Pollution Control Board
Bolingbrook, Illinois
January 13, 2009

My name is Harold Harty. My business address is 1021 McKinley, Joliet, Illinois. I have been employed by the City of Joliet for the past 34 years. In the last 28 years, I have been the Plant Operations Superintendent in charge of three (3) wastewater treatment plants. I hold an Illinois Class 1 Wastewater Treatment Plant Operator's License and an Illinois Class B Water Treatment Plant Operator's License.

In 1982, the City of Joliet started the Land Application Program for the disposal of bio-solids from the wastewater treatment plants. We felt at that the time that recycling bio-solids to be used as fertilizer was the best use for this material. Our bio-solids program has been in operation since then and has met or exceeded all requirements set by the Illinois Environmental Protection Agency ("IEPA") and the United States Environmental Protection Agency ("U.S. EPA") standards. We started this program to assure proper disposal, and have closely followed all of the applicable environmental requirements. As a result, Joliet has never received a warning letter or any other complaint regarding its sludge disposal operations.

From the start of the program we recognized that Joliet would need a knowledgeable City representative to interact with those whose land would be used. We needed someone that had an established relationship with landowners/growers. Joliet understood that we would needed to gain acceptance of the program. Joliet therefore decided to contract with a trained Agronomist to meet these needs. From the start, our Agronomist recorded the application rates and monitored loadings for each field that received Joliet's bio-solids. During the early years, the number of allowable applications were limited by copper and zinc loads due to their concentration in the bio-solids. With the continuing proper implementation of pre-treatment, bio-solids applications are now controlled by nitrogen and phosphorus.

From the start of this program, Joliet used an independent Agronomist to do all of the field-testing required by the permit we received from the IEPA which authorized the land application of our bio-solids. This contractor set the agronomical rates to accommodate to the field conditions and to ensure that the proper amounts of bio-solids are applied to the fields. Exhibit ____ is a statement from our current Agronomist, Mr. Daniel Fiedler of Land Treatment Alternatives, Inc., which provides some additional information regarding our bio-solids disposal program which he oversees.

EXHIBIT
Attachment A

Our bio-solids are generated in our treatment plants from the treatment of sanitary sewage. Sludge settles in plant clarifiers and is directed to digesters at each plant. Bacteria in the digesters reduce the amount of organic matter and stabilize the sludge for land application. The bio-solids are collected in the anaerobic digesters at our two older plants and in the aerobic digester at our newer Aux Sable plant. The bio-solids are transferred to storage tanks at each plant site.

Our bio-solids program uses an annual agreement with each landowner/grower whose fields have been identified by our Agronomist as potential fields for the contract period. The Agronomist identifies the specific field for application and establishes the rate of application. All farmers are informed of what is in our bio-solids and sign a User Information Sheet form accepting the bio-solids. The landowner/grower must sign this form that identifies the analysis of the sludge and the crop to be grown and the yield goal.

The hauling and land application is contracted by public bid to licensed applicators who are independent of the Agronomist. The Applicator provides tank trucks to transport liquid sludge from plants to each specific field in the program. Each truck holds approximately 5500 gallons per load. The Applicator provides fertilizer applicators with chisel plows mounted with injectors to apply the biosolids below the ground surface in the top 12 inches of soil. The application rates established by the Agronomist and agreed to in writing by the landowner/grower are utilized. The percentage of solids of the sludge applied and the gallons applied are recorded to verify application rates. The Agronomist adds the current application to the records of the total applied to a given field. Total loadings are compared to U.S. EPA and IEPA allowed loadings to assure compliance.

This program has grown throughout the years to where we are applying bio-solids to about 1,000 acres/year. There has always been more demand for the bio-solids then we have ever produced. Farmers know the value of our product to their operation as an alternative to commercial fertilizer, which has steadily increased over the years.

Although the growers recognize the fertilizer value, they also recognize the additional compaction of the soil in the field which potentially reduces yield. To encourage acceptance of sludge in the spring, growers are paid $50 per acre for the right to apply the bio-solids and up to an additional $50 per acre is paid if the crop yield is less than the five year average yield for that field. Wet soil in the spring leads to more compaction than a mid-summer application on a dry field.

The City of Joliet's Land Application Program has become a model for others to follow. This program has merit in that we are recycling this product to the best use of technology. The only alternative would be to landfill, which has no benefit to the environment. This program and the City of Joliet have always completed everything the IEPA has regulated and will continue to do it in the future.

The continuation of the land application program will allow an on-going recycling effort and keep this material out of the landfill. In order to landfill this sludge, it would have to be dried, requiring the construction of specific drying facilities and tipping fees would have to be paid. These additional costs will be covered in the narrative testimony of Mr. Dennis Duffield.

The first time that we received a permit from IEPA that contained a limitation on Radium was in permit 2006-SC-4784 issued in October 2006. We were immediately concerned because it only allowed for a total accumulative increase of radium to exceed a level of 0.1 pico curies per gram from the application of sludge. We were told by our Agronomist and consultants that the number of applications would be limited to only one application. With this severe limitation, our Agronomist felt that it would be very difficult, if not impossible, to get landowners/growers to agree to be part of our program. They simply would not want to be bothered with the program and the potential interference with their farming operations for such limited benefit. Accordingly, we began a series of discussions with the IEPA to attempt to reach agreement to raise the permitted level. (Record at R-6 through R-96). These efforts will be described in greater detail by Mr. Duffield.

In summary, while we were able to get IEPA to issue permit 2006-SC-4784-2 which raised allowable the total accumulative increase limit to 0.4 pico curies per gram, we were still concerned because this level still would limit the number of applications to four from the higher rate that is currently only being limited by the nutrient loadings of the bio-solids. This would eventually mean that more and more land would be needed to be identified by our Agronomist and signed up to be part of the program. This would also mean that the distances to these fields from our three plants would increase. This would result in increased hauling costs and greater emissions from the trucks. While we were grateful that IEPA agreed to increase the Radium level to 0.4 pico curies per gram because it allowed our Agronomist to continue to work with existing landowners/growers to gain additional applications, such a value still limited the total number of applications. Our consultants and experts continued to say that there was no real need for this low of a limit.

Therefore, Joliet continued to have discussions with IEPA; and, we agreed to request a formal modification to our permit to change the limit to 1.0 pico curies per gram and supply all of the supporting information our consultants and experts had developed to support the request. A permit modification was filed which was received by IEPA on July 30, 2008.(Record at R-1) By letter dated September 12, 2008, the IEPA denied the permit modification request.(Record at R-1 through R-2) Joliet filed the present appeal on October 17, 2008. We are here today to challenge the IEPA decision and we will show through the testimony of our consultants and experts that the decision is without merit and should be reversed by the Illinois Pollution Control Board.

CH01/ 25275549.2

WRITTEN TESTIMONY OF

RICHARD E. TOOHEY, PH.D., CHP

IN THE MATTER OF

City of Joliet v. Illinois EPA
PCB 09-25

Before the Illinois Pollution Control Board
Bolingbrook, Illinois
January 13, 2009

My name is Richard E. Toohey. I hold a Ph.D. degree in nuclear physics from the University of Cincinnati (1973) and I am certified in comprehensive practice by the American Board of Health Physics (1992, recertified 1996, 2000, 2004.) My current position is Director of Dose Reconstruction Programs for Oak Ridge Associated Universities in Oak Ridge, Tennessee. These programs are supported by the National Institute of Occupational Safety and Health ("NIOSH") and by the Defense Threat Reduction Agency ("DTRA") to gather exposure data and provide estimates of radiation doses received by workers in the nuclear weapons complex and military personnel present at atmospheric nuclear weapons tests. For the year August, 2008 through July, 2009, I am the President of the Health Physics Society, the U.S. professional society for specialists in radiation protection, with almost 6,000 members. I am also a member of the National Council on Radiation Protection and Measurements ("NCRP"), a Congressionally chartered organization of 100 members that is charged with advising the federal government on radiation protection standards, measurement techniques, radiation exposures and health risks. From 1973 to 1987, I was a staff scientist at the Center for Human Radiobiology at Argonne National Laboratory, participating in the study of the effects of radium on exposed humans, primarily women who worked as luminous dial painters in the 1920's. I have previously testified before the Illinois Pollution Control Board ("Board") on the health effects and risks of radium in drinking water on many occasions, involving variance petitions from communities in Northern Illinois, including the City of Joliet.

The current issue before the Board is a petition by the City of Joliet to appeal the denial of its permit modification request by the Illinois Environmental Protection Agency ("IEPA") which would have allowed the disposal of radium-containing waste sludge from the treatment of drinking water by application to agricultural land, resulting in a total accumulative increase of radium not to exceed 1.0 picocuries per gram (pCi/g) of soil. This level exceeds that in a memorandum of understanding between the IEPA and the Division of Nuclear Safety of the Illinois Emergency Management Agency ("IEMA-DNS") that was originally set at 0.1 pCi/g, but as I understand, is now 0.4 pCi/g in draft form.

The federal standards for radiation exposure to members of the public from environmental levels of radioactive materials resulting from technological uses, such as waste disposal, include a dose limit of 15 mrem per year under United States Environmental Protection Agency ("U.S. EPA") regulations, 25 mrem per year under United Stated Nuclear Regulatory Commission ("U.S. NRC") regulations, and 100 mrem per year under United Stated Department of Energy ("U.S. DOE") regulations. The dose parameter used in these regulations is the total effective dose equivalent ("TEDE"), more recently referred to as effective dose, which includes external exposure to penetrating radiation (gamma rays) plus any internal exposure resulting from the inhalation or ingestion of radioactive materials. In addition, the internal component of the dose is integrated for a period of 50 years post intake, but assigned to the year of intake. The important thing to note is that the limits are for dose, because potential risks to human health from radiation exposure are assumed to be directly proportional to the radiation dose received. The secondary or derived limits for such quantities as the concentration of a radioactive isotope in drinking water, in air, or in soil are calculated by means of a pathway analysis, which determines the dose coefficient, i.e., the dose per unit concentration of a given isotope in a given environmental medium. The concentration limit is then that concentration which results in the dose limit, when all pathways are included; this is equal to the dose limit divided by the dose coefficient for all pathways.

In the case of disposal of radium-containing sludge on agricultural land, the pathways to be considered include direct gamma-ray exposure, inhalation of the radioactive material or its radioactive decay products, and ingestion of the radioactive material by direct ingestion of soil, or ingestion of foodstuffs or water which have absorbed the radioactive material from the soil. The radioactive isotopes to be considered in this case are Ra-226 and Ra-228 and their decay products, which include the gamma-ray emitting isotopes Pb-214, Bi-214, and Pb-210 from Ra-226, and Ac-228, Pb-212, Bi-212, and Tl-208 from Ra-228. Each radium isotope also produces a gaseous decay product: Rn-222 from Ra-226, and Rn-220 from Ra-228. The isotope Rn-220 has a very short half-life, only 55 seconds, and so does not build up to appreciable levels. In contrast, the isotope Rn-222 has a 3.64-day half-life, and can move through soils into the living space of a house built on the soil; this isotope is in fact the contributor of most (about 70%) of the effective dose from Ra-226 in soil. However, if the topsoil containing the Ra-226 is removed before house construction, then this pathway no longer exists. In addition, in a suburban environment, drinking water and the majority of foodstuffs typically do not come from the homeowner's property, and so the ingestion pathways for food and water are also not applicable. Based on the pathway analyses previously submitted by the City of Joliet, I calculate a dose coefficient of 25 mrem per year per pCi/g of combined Ra-226 and Ra-228 in soil including all pathways, and a dose coefficient of 7 mrem per year per pCi/g combined radium if the Rn-222 inhalation and the foodstuff and water ingestion pathways are excluded. Taking a conservative dose limit of 10 mrem per year, the all-pathway analysis would result in a concentration limit of 0.4 pCi/g, while the restricted pathway analysis would result in a concentration limit of 1.4 pCi/g. Under the restricted pathways, a concentration of 1.0 pCi/g would produce an annual dose of 7 mrem.

To put this dose in perspective, the average U.S. resident receives an annual dose of about 300 mrem per year from naturally occurring sources, of which 200 mrem result from the average indoor level of Rn-222, about 1.0 pCi/liter of air. In addition the average U.S. resident receives another 240 mrem from man-made sources, predominately medical uses. Twenty years ago, the average annual radiation dose from medical procedures was about 60 mrem, but it has since increased to about 240 mrem, primarily from computed axial tomography ("CAT") scanning and fluoroscopically guided interventions, such as coronary angioplasty; consequently, the annual average radiation dose in the U.S. is about 540 mrem, including both natural background radiation and man-made (medical) sources. The average background concentration of Ra-226 in soil in the U.S. is about 1 pCi/g, but this can vary by a factor of 10 or more in either direction depending on the underlying geology of the soil; the average in Illinois soils is about equal to the U.S. average (1.0 pCi/g.) In comparison, the concentration of Ra-226 in granite countertops can be as high as 100 pCi/g or more. Interestingly enough, most phosphate fertilizer comes from phosphate rocks which contain from 50 to 200 pCi Ra-226 per gram; although most of the radium is removed in the processing, a typical radium concentration in fertilizer is 27 pCi per gram phosphate (P_2O_5), so if a fertilizer is 10% phosphate, the Ra-226 concentration would be 2.7 pCi/g. Thus the normal agricultural application of fertilizer also increases the background concentration of Ra-226 in soil.

In setting standards for radiation exposure of the public, the effect of concern is cancer induction, and the U.S. EPA and other agencies apply what is called the linear no-threshold ("LNT") model. Briefly, this model assumes that there is no threshold, that is, there is no level of exposure below which the effect can not occur; consequently, any exposure, no matter how small, is assumed to carry some risk of the effect. Secondly, the model assumes that the risk is linear, or directly proportional to the dose. As an example, consider a group of 10,000 people, each of whom receives a dose of 1 rem, or 1,000 mrem. Under these circumstances, the cancer risk model used in radiation protection predicts that there would be 5 cases of radiation-induced cancer, in addition to a background incidence of 4,000 cancers without any radiation exposure. If the radiation dose were reduced to 200 mrem each, then there would be 1 radiation-induced cancer. If the dose were reduced to the level proposed for radium-bearing sludge disposal, i.e., 7 mrem per year, then we could expect 1 radiation-induced cancer to occur from about 30 years of exposure. Currently there is no way to predict which of the 10,000 exposed persons would be the one to incur the radiation-induced cancer, if indeed one were to occur. Regulators use this model to extrapolate from the observed risk at high levels of exposure, where we actually have human data, to a calculated risk at low levels of exposure, such as might occur from radium-containing sludge.

According to the International Commission on Radiological Protection ("ICRP"), the risk coefficient used to estimate cancer risk is 5% per 100 rem, or 0.0005 per rem, or 0.0000005 per mrem, so the assumed risk from 10 mrem per year is 0.000005, or 5 chances in 1 million per year. This risk coefficient is based in large part on the follow-up of the Japanese atomic bomb survivors, with corrections made for differences in dose rate (instantaneous vs. prolonged), radiation types, and background cancer rates in the Japanese and U.S. populations. Other studies of exposed human populations are also relevant to the radium-bearing sludge issue, especially the follow-up studies of radium workers and, for Rn-222 exposure, uranium miners.

The data from the observed incidence of bone cancer in radium dial workers do not match the predictions of the LNT model. In my previous testimony, I showed that the radium dial painter data fit a different model, known as a quadratic model, and that the predictions of the LNT significantly over-estimate the risk of cancer induction at low levels of exposure. Later analyses of the data on the radium dial painters by Dr. Robert Thomas showed that the data are in fact best fit by a cubic model, even farther away from the LNT model. One reason for this change is that the estimated intakes of radium by the dial painters were previously underestimated. Thus, the same number of observed cancers was caused by higher radium intakes; consequently, regardless of which model is used, the risk per unit intake necessarily declines. Dr. Robert Rowland, formerly the director of the Center for Human Radiobiology, has summarized the Argonne radium studies in his book "Radium in Humans: A Review of U.S. Studies" (ANL/ER-3, 1994.) The bottom line, however, is that the radium dial painter data show that the LNT model yields a gross over-estimate of the cancer risk from radium intakes. In addition, the dose and risk calculations in the RESRAD program include a high leukemia risk, based on the observed leukemia incidence in A-bomb survivors. However, there is no excess leukemia observed in the human radium workers, and so the RESRAD program over-estimates the true risk from Ra-226 exposure.

The risk of lung cancer from Rn-222 exposure is based on long-term studies of uranium miners exposed to high concentrations of radon in the mines. Based on these data, the U.S. EPA considers radon exposure to be the second-leading cause of lung cancer, after tobacco smoking, responsible for some 15,000 cases of lung cancer per year. However, what U.S. EPA fails to emphasize is that 90% of these cancers will occur in smokers. The uranium miner data clearly show that smoking and radon exposure act in a multiplicative fashion; the incidence of lung cancer in uranium miners who smoked was about ten times that in non-smoking miners. As smoking incidence continues to decrease in the U.S. population, the risk of cancer from radon exposure will also decrease. Of course, if radium-containing soil is removed from agricultural land prior to house construction, there is no risk from radon above background levels.

There are three basic principles of radiation protection: justification, limitation and optimization. The principle of justification states that any radiation exposure must convey some benefit to an individual or to society as a whole in order to compensate for the assumed risk. The principle of limitation states that for a given type of exposure situation, there should be an upper limit that is not exceeded except in exceptional circumstances. The principle of optimization states that actual exposures should be held as far below the limit as reasonably achievable, taking into account economic and societal considerations.

The benefit of medical radiation exposure is usually obvious in terms of diagnosis or treatment, but the benefits of other exposures may be more difficult to quantify. In the case of radium-bearing sludge disposal, the benefits could include lower cost of waste disposal for the municipality generating the sludge, and improvement of soil parameters for the farmer. The risk however, may fall on a future occupant of the site, who was not a recipient of any benefit. Ironically, the risk to this individual arises from the risk reduction to the users of Joliet's municipal water supply from removal of radium from their drinking water. If the occupant of the site were a drinking water consumer, the risk from the soil radium would be much less than the risk from consuming the drinking water containing the radium. The principle of limitation is reflected in the U.S. EPA standard of 15 mrem per year from environmental releases of radioactive materials, or in the limit of 10 mrem per year from radium-bearing sludge disposal proposed by the IEPA. The principle of optimization comes in when considering the costs of sludge disposal by application to agricultural land vs. disposal in a landfill, if the radium concentrations are acceptable for landfill disposal, or in a radioactive waste repository, if the radium concentrations exceed the limits for a landfill. Optimization balances risk vs. the cost of avoiding the risk; in the case at hand, the risk from an additional dose of 7 mrem per year is minimal; this level of dose is well within the natural variation of background radiation doses across the U.S. and the world. It would also seem logical that because the risk from Rn-222 can be eliminated by removal of top soil before housing construction, and that this practice is already required by municipal building codes, it would be within the purview of IEPA to also recognize this practice or possibly require this practice in areas where radium-bearing sludge has been deposited.

It is a fact that it costs money to remove an environmental risk, and the total amount of money available to a municipality from tax revenues is limited. Buildings and roads must be maintained, schools and police and fire departments must be operated, and numerous other claims on the taxpayers' dollars exist. It is up to the taxpayers, through their elected representatives, to determine the proper allocation of funds. We use risk analysis to estimate the risks of various environmental hazards, so that informed decisions can be made as to whether or not they are large enough to demand expenditure of public funds to correct. The IEPA has the legal responsibility to make this determination and, like the U.S. EPA, uses the LNT model to estimate the magnitude of the risks. This approach has been endorsed and supported by both U.S. and international bodies concerned with setting standards for radiation exposure, including the NCRP and the ICRP.

In 1976, when the U.S. EPA issued its interim standards for radioactivity in drinking water, the maximum permissible concentration was set to be 5 pCi per liter for combined Ra-226 and Ra-228; this level is still in effect. On July 18, 1991, U.S. EPA published in the Federal Register a notice of proposed rule-making for the final standards on radioactivity in drinking water that would increase the permissible levels for radium to 20 pCi per liter for Ra-226 and Ra-228 separately. U.S. EPA made this recommendation because of better data available on risk modeling; previous U.S. EPA risk calculations had included a large risk of leukemia induction, based on the experience of the atomic-bomb survivors, while the improved risk estimates lowered the leukemia risk to levels more consistent with the actual human data from radium workers. Unfortunately, Congress' renewal of the Safe Drinking Water Act prevented U.S. EPA from increasing the permissible levels of radium. Had U.S. EPA been able to do so, the problem of disposal of radium-bearing sludge would never have developed, because Joliet would not have been required to remove radium from its well water supply. In my testimony before the PCB some 15 years ago, I advocated 20 pCi per liter of Ra-226 as a reasonable level, even granting the LNT model used by U.S. EPA, and warned that setting the level at 5 pCi/L would result in unnecessary costs for treatment and waste disposal, which is the situation Joliet faces today.

Nevertheless, the science has not changed; it is clear from the human data that the LNT model is conservative, that is, it overestimates the actual risk. Consequently, the calculated risk from disposal of radium-bearing sludge on agricultural land at a level that results in a radiation dose of 10 mrem per year or less is an extreme upper limit on the true risk, which may well be zero. The disposal of radium-bearing sludge on agricultural land with a total accumulative increase of radium not to exceed 1.0 pCi/g of soil satisfies all three of the basic principles of radiation protection: justification, limitation, and optimization. Therefore, the petition of the City of Joliet should be granted and the permit sent back to the IEPA to reissue accordingly.

CH01/ 25278334.2

WRITTEN TESTIMONY OF

DENNIS L. DUFFIELD

IN THE MATTER OF

City of Joliet v. Illinois EPA
PCB 09-25

Before the Illinois Pollution Control Board
Bolingbrook, Illinois
January 13, 2009

My name is Dennis L. Duffield. My business address is 93 Caterpillar Drive, Joliet IL, 60436. I was granted a Bachelor's of Science in Civil Engineering by Bradley University in Peoria, IL in 1972 I am currently employed as Project Manager for Rogina and Associates, Ltd.

Prior to my employment at Rogina and Associates, I was employed by the City of Joliet for 26 years. For all but the first four months of employment with the City of Joliet, I was responsible for the planning, design, construction and operations of the municipal water and wastewater systems. I served as the Director of Public Works and Utilities for 25 years.

During this time, Joliet was required to address the issues concerning radium in drinking water, a new radium water quality standard and overly restrictive limitations on the disposal of biosolids (wastewater treatment plant residuals) containing radium. I believe that it is important that the Illinois Pollution Control Board ("Board") understand the history and background of radium regulations in order to be able to properly assess and decide the issue presented in this appeal. Accordingly, I will first present a review of the regulatory process and the impact it had on Joliet's sludge disposal program. I am hopeful that this will allow the Board to understand the impact that this appeal will have on Joliet and ultimately the regulated community here in Illinois.

Radium Regulation

The 1976 Safe Drinking Water Act and the public water supply regulations that the United States Environmental Protection Agency ("U.S. EPA") adopted pursuant thereto created a maximum contaminant level for combined radium 226 and radium 228. This level was 5.0 pico-curies per liter. Upon the implementation of this maximum contaminant level, the Public Water Supply Division of the Illinois Environmental Protection Agency ("IEPA") arranged for the analysis of water from drinking water systems in Illinois. Joliet was included in this initial sampling. However due to numerous delays in the analysis of the samples, Joliet was not notified of an exceedence of this standard until 1985.

EXHIBIT
Attachment B

IEPA/IDNS Memorandum of Agreement

Without providing any advance notice to those entities that operate either water supplies or wastewater treatment plants and without providing any ability to comment, the IEPA and the Illinois Department of Nuclear Safety entered into a Memorandum of Agreement (Record at R-336 through R-339) in 1984 which set forth the responsibilities of both agencies with respect to the disposal and use of sludge resulting from the treatment of water or sewage containing naturally occurring radium from ground water. This agreement limited the land application of bio-solids containing radium to assure that the increase in soil concentration be limited to 0.1 pico-curies per gram. The majority of my testimony addresses IEPA's first stated basis for the denial of Joliet's requested permit modification which is this Memorandum of Agreement

Notice of Drinking Water Violation

Joliet received notice from the IEPA in 1985 that the Joliet Public Water Supply must be brought into compliance with the Safe Drinking Water Act's maximum contaminant level for combined radium 226 and radium 228.

Joliet's Actions

After conducting a study, it was determined that the best solution for Joliet was to construct a new water supply using the Kankakee River as a source.

The land acquisition necessary for the new water supply and the preparation of plans and specifications were proceeding until 1991. On July 18, 1991, the United States Environmental Protection Agency ("U.S. EPA") formally proposed a new maximum contaminant level for radium. This proposal allowed a concentration of 20 pico-curies per liter of radium 226 and 20 pico-curies per liter of radium 228. If this proposal was approved by U.S. EPA, Joliet would have come into compliance without any new construction. Joliet, as did many other communities in Northern Illinois which used the same deep well aquifers, stopped work on the Kankakee River Project pending a decision on the new proposal.

Stakeholder's Meeting

For years following the initial proposal, there was very limited public activity by the U.S. EPA on the radium proposal until a Stakeholder's Meeting was scheduled and held on December 11 - 12, 1997 at the Hyatt Regency Crystal City 2799 Jefferson Davis Highway Arlington, VA 22202. There is a record of the meeting at http://www.epa.gov/safewater/ndwac/sum_radn.html.

I attended the meeting on behalf of Joliet. Also present at the meeting from Illinois were Gerald Bevers of the City of DeKalb and Roger Selburg, Manager, Division of Public Water Supplies, IEPA.

One of the topics of discussion at the meeting was the generation of radium water treatment residuals and their disposal. Sanitary sewers were listed by U.S. EPA as an acceptable alternative for disposing of water treatment plant residuals.

In discussions at that time with Roger Selburg, I was advised that the radium residuals could be discharged to the sanitary sewer as the radium was already being discharged to the sanitary sewer prior to treatment. Radium was pumped from the deep wells, into user's homes and then discharged to the sanitary sewer. With the implementation of radium treatment to meet drinking water regulations, radium would be pumped from the deep wells, then treated to provide homeowners with water meeting standard and that water discharged to the sanitary sewer. The radium removed by the water supply treatment could also be discharged to the sanitary sewer. The total amount of radium pumped from the deep wells would reach the wastewater treatment plant unchanged using either approach.

Notice of Data Availability, Proposed Rule

On April 21, 2000, the U.S. EPA published a Notice of Data Availability and Proposed Rule for Radium that took me, and many in both the regulatory and regulated community, by complete surprise. U.S. EPA proposed that combined radium 226 and 228 should not exceed 5.0 pico-curies per liter. This was almost identical to the original 1976 rule.

Final Rulemaking

After receiving comments from the public, U.S. EPA issued a final rule on December 7, 2000. This rule was scheduled to become effective on December 8, 2003. It was essentially the same rule that had been proposed earlier in 2000. This rule essentially left in place the requirement of combined radium 226 and radium 228 to be below 5.0 pico-curies per liter.

Joliet's Response to Rulemaking

Joliet had grown greatly since 1985 and the original intake and treatment plant was no longer properly sized to meet Joliet's growing demand. A new intake site on the Kankakee River was selected and work began with the Illinois Department of Natural Resources, Division of Water Resources to obtain a withdrawal permit at the new site.

Soon thereafter based on the anticipated difficulty in obtaining a withdrawal permit from the Kankakee River, Joliet elected to perform an additional study to determine what would be the best source and treatment for Joliet.

A team of three consulting engineers and Joliet staff was assembled to review the new technologies available for radium removal, proven technologies and a Kankakee River based supply. Contact was made with the Illinois State Water Survey to determine the continued availability of water from the deep sandstone aquifer.

The results of this study were as follows:

1. Water from the deep aquifer will be available for 25 to 100 years according to information provide by the Illinois State Water Survey. Joliet interpreted this information as a reason to invest in additional deep wells instead of the Kankakee River Project.

2. The selected treatment technique was Co-precipitation of Radium with Hydrous Manganese Oxide.

This report was completed in August of 2003. Joliet proceeded immediately to select a consulting engineer and pilot testing of the hydrous manganese treatment.

IEPA Actions

Faced with a growing amount of knowledge concerning the discharge of waste water from communities using deep well aquifers containing natural radium, the IEPA filed a radium water quality standard rulemaking on January 13, 2004. This rulemaking was accepted by the Board and docketed as R2004-021. The IEPA proposed that the water quality standard for radium be eliminated in the general use standards and that a water quality standard of 5.0 pico-curies per liter upstream of a food processing plant intake or public water supply intake be established. As a review of the record from this proceeding will show, I was actively involved through out this rulemaking proceeding.

This rule making started on January 13, 2004 and was completed on March 15, 2006. The rule that was finally adopted by the Board in this proceeding varied greatly from the IEPA proposed and included the following water quality standards:

1. GENERAL USE WATER QUALITY STANDARDS
   The annual average radium 226 and 228 (STORET number 11503) combined concentration must not exceed 3.75 pico-curies per liter (pCi/L).

2. PUBLIC AND FOOD PROCESSING WATER SUPPLY STANDARDS
   Radium 226 and 228 (STORET number 11503) combined concentration must not exceed 5 pico-curies per liter (pCi/L) at any time.

Information from the Rulemaking Process

During the course of the hearings concerning the proposed rule, Joliet first became aware of the 1984 Memorandum of Agreement between the IEPA and the Illinois Department of Nuclear Safety concerning land application of residuals. I immediately recognized the potential impact that this twenty year old document could have and begun to try to sort out an approach that Joliet could follow and an approach that the IEPA could support. After talking about the potential impact of the Memorandum of Agreement with various IEPA personnel, I prepared a letter to Jeff Hutton dated April 9, 2004 providing an analysis of land application of wastewater treatment plant residuals containing radium (Record at R-294 through R-304). I sent the letter to Jeff Hutton because he was the focal point for sludge regulation and permitting at the IEPA. As stated in the letter, I was concerned that the impact of land application had not been considered although communities were committing to water treatment techniques to comply with the combined radium 226 and radium 228 to be below 5.0 pico-curies per liter drinking water standard that resulted in residuals being discharged to the wastewater treatment plant

IEMA-DNS Response

IEPA forwarded Joliet's April 2004 letter to the Illinois Emergency Management Agency, Division of Nuclear Safety ("IEMA-DNS") for review and comment. Due to a re-organization of state government, the nuclear safety function had been placed under the Illinois Emergency Management Agency. IEMA-DNS sent IEPA their review of the Joliet request in a letter dated May 10, 2004 to Al Keller. (Record at R 292-293) The comments received from IEMA-DNS were directed at Joliet' request to make five applications of biosolids to a given field. IEMA-DNS viewed this as "unrestricted land application of radium contaminated sewage sludge" that would create sites requiring land use restrictions.

The other major item in the IEMA-DNS comments was that DNS thought that Joliet may be in violation of the Memorandum of Understanding by land applying sludge that increased the soil radium concentration by greater than 0.1 pico-curies per gram.

Joliet's Response to the IEMA-DNS comments

First it is not possible for Joliet to violate the Memorandum of Agreement as this document in not an enforceable rule as it was entered into without public notice and opportunity for comment. Second, while it states on its face the IEPA is to take certain actions, it is uncontroverted that IEPA never included any requirements in the Joliet land application permit that limited the quantity of radium applied to farm fields until October of 2006 some twenty two years after it was signed. Joliet is not aware of any other permit with limits that predate its October 2006 permit. Since Joliet was not a party to the inter-agency agreement, it was not possible to violate it directly.

Joliet's Subsequent Action

On February 28, 2005, Joliet again submitted a new proposal for land application. This submittal is found in the Permit Record at R-104 through R-291. To prepare this submittal, Joliet had gathered a team of water supply engineers, wastewater treatment engineers, a consulting agronomist and a health physicist.

The proposal is found in the Permit Record at R104 through R-291. Although the proposal addressed the increase in radium concentration in the soil, the basis for the proposed 1.0 pico-curie per gram increase was the radiation dose received from this increase. .

The proposal was based on the Memorandum of Agreement, Paragraph 7 which provides for alternative disposal methods when it is economically infeasible to comply with other paragraphs and the radon exhalation rate from the alternate disposal method is less than 5.0 pico-curies per square meter.

Joliet employed RSSI, a consulting health physics firm to perform dose modeling of the application procedure to determine the dose to future residents of the currently agricultural land. RSSI used the RESRAD model to determine dose. The RESRAD computer code was developed in 1987 by the Environmental Assessment Division at Argonne Laboratory and has undergone numerous revisions since. The code was used to predict the dose of radiation resulting from Joliet's land application program.

The inputs for radium concentration in sludge were the concentrations measured in the sludge from the Joliet Eastside Wastewater Treatment Plant and the Joliet Westside Wastewater Treatment Plant. The models provided for 8 applications of sludge over 20 years and 9 applications of sludge over 22 years.

RSSI used inputs provided by the City of Joliet to replace the default inputs. The input information was based on the number of homes per acre, size of home, type of foundation and the normal practice of removing expansive topsoil prior to construction.

All models had results that residents would receive less than 10 milli-rems per year. Results are included in the record.

The second part of the submittal included a report entitled "Evaluation of Radium Removal Impacts to Sludge Handling at the Eastside and Westside Wastewater Treatment Facilities" prepared by Clark Dietz, Inc. The report compared the costs of the current program of land application of liquid sludge to agricultural land with the costs of drying the sludge and landfill disposal. Page 10 (R288) provides Clark Dietz Inc.'s recommendation to continue with land application. This recommendation is supported by a comparison of life cycle costs for land application and landfill disposal.

The present value cost for the current land application program was $9,618,513 based on 2004 dollars. For landfill disposal, the present value cost was $44,766,028. Landfill disposal increases the cost to Joliet by more than 4 times. Annual operating costs increase more than 3.5 times. This cost would directly impact the users of the system that would have to generate an additional $1, 700,000 per year.

Part three of the submittal was a calculation of a cost to benefit ratio for the program. Since the savings to Joliet for a land application in lieu of landfill disposal was $36,147,515, this was treated as a benefit. It was adjusted for 25 years and increased to $40,140,326. The costs were developed using the Nuclear Regulatory Commission's published costs for additional radiation exposure of $2,000 per person-rem for 1995. This cost was adjusted for inflation to $2,500 per person-rem in 2004 using the consumer price index. Based on the additional 884.3 person-rem of radiation exposure, a cost of $2,210.745 was developed. A benefit to cost ratio using $40,140,326 as the benefit and $2,210,745 as the cost was developed. This ratio was 18.16. This indicates to me that the benefits clearly outweigh the costs for Joliet.

The fourth and final part of the submittal was the calculation of recommended increase in background radium concentration. Using 10 milli-rems per year as the limiting dose, and the dose from a single application of sludge from the Joliet Westside Wastewater Treatment Plan as 1.48 milli-rems per application, it was determined that 6.76 applications could be made to given field. 6.76 application of sludge with a 0.15 pico-curies per gram increase in background per application results in an increase in background of 1.01 pico-curies per gram. In real life, applications would have to be limited to 6 as it is not possible to make 0.76 of an application. This would result in an increase in background of 0.90 pico-curies per gram.

IEMA-DNS Response (Record R-98 through R101)

Joliet did not receive a direct response from IEMA-DNS. Their response was directed to the Permit Section of the Division of Water Pollution Control. These comments were provided to Joliet in a May 25, 2005 letter from Al Keller. It was requested that Joliet respond to the comments and provide copies of the response to both IEPA and IEMA-DNS.

Although the record does not include direct discussions with IEMA-DNS, Joliet met with IEMA-DNS to discuss the proper modeling approach to the issues raised. My calendar at Joliet has been eliminated, but I remember going to Springfield with Eli Port to meet with Rich Allen at his office in 2005. Many of the issues raised by IEMA-DNS concerning permit limitations are normally handled by IEPA for other constituents in sludge.

Sludge Application Permit Renewal with Radium Limitation

In October 2006, IEPA renewed Joliet's permit for Land Application of Sewage Sludge, Permit Number 2006-SC-4784. This permit contained Special Condition 2; Sludge applied to land under this permit shall not cause the total accumulative increase of Radium 226 and Radium 228 in soil to exceed 0.1 pico-curies per gram. limiting radium concentration for the first time. Joliet determined that this condition would have the effect of limiting Joliet Westside Plant Sludge to one application per field. The single application of sludge to a field would disrupt the normal fertilizer program use by growers with very slight reduction in costs. This would result in the break down of Joliet's sludge application program. Because Joliet thought this was an unworkable situation, Joliet contacted IEPA to begin to discuss a means of revising this condition.

In response to a formal request seeking an extension of the permit appeal time deadline, IEPA submitted a Request for Ninety Day Extension of Appeal Period on behalf of IEPA and Joliet on November 16, 2006 which was docketed by the Board as PCB 07-38. A copy of this document is found as Exhibit ___. As anticipated by this filing, Joliet continued to have discussions with IEPA as to how develop an agreeable means to allow Joliet to carry out its Sludge Disposal Program recognizing the IEPA's need to regulate radium.

Meeting about the 0.1 pico-curies per gram limitation

On January 24, 2007 Joliet met with IEPA and IEMA concerning this limitation of 0.1 pico-curies per gram. (Record at 92-94) During the course of the meeting, Rich Allen of IEMA-DNS performed a "sum of the fractions" calculation and determined that 0.4 pico-curies per gram could be supported. The sum of the fractions method is used for a mixture of radionuclides. The concentration of radium 226 is divided by the allowable concentration and the concentration of radium 228 is divided by the allowable concentration and the sum of those two fractions cannot exceed 1.

At the meeting, it was agreed that Joliet would receive 0.4 pico-curies per gram on a revised permit based on an anticipated revision to the Memorandum of Agreement by IEPA and IEMA-DNS. Other communities would also receive the 0.4 pico-curies per gram limitation on their permit renewals.

IEPA list of communities (Record at R95-R96)

The record includes a listing of the anticipated site life for radium applied to increase the background radium by 0.4 pico-curies per gram for various communities. It clearly demonstrates that Joliet is not the only community adversely impacted by this limitation. Channahon, Crystal Lake #3, Geneva, Huntley East, Huntley West, Kewanee, Lake in the Hills, Monmouth Main, and Yates City are other impacted communities.

January 24, 2007 Meeting with IEPA, IEMA and Joliet (Record at R-92 through R-94)

The January 24, 2007 meeting was intended to determine the appropriate model for determining the allowable increase in radium above background.

IEMA-DNS's Rich Allen indicated that IEMA had two concerns, the allowable dose and correct field application.

An allowable dose of 10 milli-rems per year was agreed upon by all present according to the meeting record prepared by Jeff Hutton. With this agreement in hand and based on previous work that had been performed by Joliet, I knew that a program limiting the dose to a future resident of land that had received sludge should not be a problem. Previous modeling had shown that 10 milli-rems per year was easily achieved with the assumption that no radium bearing soil remained directly under the house.

At this meeting IEMA-DNS was concerned that an individual that violated the building code would become a risk for additional radiation. Rogina and Associates, Ltd. had performed a telephone survey of communities in Will and Kendall County to confirm that all building codes in place required removal of topsoil prior to construction.

Rich Allen of IEMA-DNS did not think that Joliet was spending enough to deal with its radium sludge. My recollection is that a discussion led to Joliet investigating the blending of Eastside and Westside Sludge at an additional cost to limit the increase in background.

I clearly left the meeting with the understanding that Joliet would prepare a report that addressed the allowable dose, the dose resulting from various application scenarios and confirm that building codes require topsoil removal. As an interim step to allow Joliet to continue to be able to manage its Sludge Application Program, IEPA agreed to raise the limit in Special Condition 2 to 0.4 pico-curies per gram. Joliet would appeal this limit and move forward to develop the supporting information to allow the IEPA to consider a higher limit.

Sludge Application Permit Modification

As was agreed upon at the January 24, 2007 meeting, Joliet allowed the place holder appeal in PCB 07-38 to expire which resulted in Board dismissal. On February 16, 2007 the IEPA issued a modification to Joliet's Land Application of Sewage Sludge, Permit Number 2006-SC-4784 which included a revised Special Condition 2 to read "Sludge applied to land under this permit shall not cause the total accumulative increase of Radium 226 and Radium 228 in soil to exceed 0.4 pCi/g." Joliet filed an appeal of this permit on March 21, 2007 which was docketed as PCB 07-94 by the Board. A copy of this appeal is found as Exhibit ____. Following this appeal the parties continued to work as agreed to in the January 24, 2007 meeting and IEPA did not proceed to file the Record in that case.

Report "Land Application of Radium Bearing Biosolids"(Record at R-39 through R-91)

At the direction of the City of Joliet, Rogina & Associates, Ltd. prepared a report entitled "Land Application of Radium Bearing Biosolids". This report was intended to address the issues raised at the January 24, 2007 meeting. What follows is a summary of the report which I believe may help the Board in its review.

The objective of the study as stated in the report was to propose a basis for criteria to be included in a revised IEPA-IEMA DNS Memorandum of Agreement. The criteria must allow for the continuation of land application of radium bearing bio-solids to provide crop nutrients at a reasonable cost to the wastewater agency and protect the public health of future residents of the land.

Current regulations for biosolids are intended to protect the public health. The regulations address vector and pathogen control and limit cumulative loadings of specific pollutants. The regulations are entitled "The Standards for the Use or Disposal of Sewage Sludge" (Title 40 of the Code of Federal Regulations Part 503).

Radium is not included the federal regulations, but is addressed by IEPA's implementation of the memorandum of agreement with IEMA-DNS. The current agreement provides for 0.1 pico-curies per gram increase in radium.

The anticipated impact of sludge application on agricultural land is the future conversion of the land to residential use. Public health protection would require that the dose of radiation from the application be limited to protect the public health of the future residents.

At the meeting of January 24, 2007, IEPA and IEMA-DNS had discussed allowable dose and agreed on 10 milli-rems per year.

Modeling is used to estimate the radiation dose. The RESRAD computer code was used for this purpose.

IEMA-DNS used RESRAD with the assumption that the home was built on radium bearing topsoil to determine for radium 226 a soil guideline of 0.23 pico-curies per gram and for radium 228 a soil guideline of 0.15 pico-curies per gram. To account for both raionuclides being presenting sludge, IEMA-DNS used the sum of the fractions based on equal parts radium 226 and radium 228 to determine the combined soil guideline of 0.4 pico-curies per gram.

The City of Joliet compared their program to the IEMA-DNS modeling and determine that modeling specific to the Joliet program was necessary. Inputs to RESRAD were adjusted to account for the Joliet program. Key inputs adjusted were as follows:

1. Removal of radium bearing soil

   The local regulation for the construction of homes is through the local building code. Building codes typically require removal of topsoil prior to construction. Joliet has historically applied bio-solids in four counties.Rogina & Associates, Ltd. surveyed communities to determine their code requirements and none allowed construction on topsoil. The summary of the survey is found at R-42

2. Food Sources

   The inputs were based on purchased vegetables, dairy products and seafood.

Appendix B includes a side by side comparison of inputs used by IEMA-DNS and Joliet.

Calculation of the dose was performed by RSSI, a radiation safety and radiological health consulting firm. Eli Port, principal health physicist is provided separate testimony.

The direction given to RSSI was to estimate the radiation dose that would result to a future on-site resident from the current Joliet program and alternate methods proposed by Joliet. RESRAD was used to estimate the dose from each application alternative using an application rate of 3.5 dry tons per acre and the following concentrations in sludge:

Eastside Wastewater Treatment Plant	Westside Wastewater Treatment Plant
Radium 226 7.9 pico-curies per gram	Radium 226 17.6 pico-curies per gram
Radium 228 9.0 pico-curies per gram	Radium 228 26.2 pico-curies per gram

The RESRAD program was also to be run for an alternative using the IEMA-DNS inputs, and model a house being built on topsoil. This was to run only for the alternative that demonstrated the highest dose.

Radon resulting from the decay of radium was to be included in the dose. The results will be discussed later in this testimony.

The land application of biosolids provides nutrients for growing corn and soybeans. Biosolids are applied at rates that match the agronomic need of the crop. Corn requires nitrogen for development. Biosolids are a source of nitrogen. Nitrogen in biosolids is normally between 1% and 6% on a dry weight basis. Commercial fertilizers provide between 11% and 82% nitrogen. Biosolids from the Joliet Eastside Wastewater Treatment Plant have averaged 2.07% nitrogen over the three year period ending in 2006.

The biosolids from the Joliet Westside Wastewater Treatment Plant have averaged 3.5% over the same period.

The low proportion of nitrogen in Joliet Eastside Wastewater Treatment Plant biosolids has caused the liquid biosolids to be unable to provide the required nitrogen application rate because the soil cannot absorb the large quantity of liquid.

Phosphorus is another crop need. Biosolids generally contain between 0.8 and 6.1% phosphorus compared to commercial fertilizer with 8-24% phosphorus.

Joliet's land application program is operated using contract services under the direction of the Plant Operations Division. The contract agronomist is responsible for coordinating the availability of land with grower/land owners, providing Joliet with a list of available sites for inclusion in the documents for bidding the application contract, performing the necessary soil tests, performing the necessary biosolids analysis, determining the application rate acceptable to the landowner/grower, providing direction to the land application contractor concerning application rates and coordination with the grower/landowner. Land Treatment Alternatives provides these services under a professional services agreement with the City of Joliet that is renewed annually.

Contract application services are awarded through a competitive bidding process on an annual basis. The contractor provides transportation and application a unit price per gallon.

Land is currently made available to either the Joliet Eastside Wastewater Treatment Plant or the Joliet Westside Wastewater Treatment Plant. The Aux Sable Creek Wastewater Treatment Plant had its first land application in 2007. and was not included in the report.

Sites used by the Joliet Eastside Wastewater Treatment Plant are sites with good access and within a reasonable distance of the plant. In 2006 these sites averaged 4.3 miles from the plant.

The same criteria applies to the Joliet Westside Wastewater Treatment Plant that had an average distance of 2.5 miles in 2006.

Application rates vary from 0.7 dry tons per acre to 5.8 dry tons per acre. For the three year period ending 2006, the normal application rate is 3.5 dry tons per acre. Radium concentrations in the biosolids were 7.9 pico-curies per gram radium 226 and 9.0 pico-curies per gram radium 228 for the Joliet Eastside Wastewater Treatment Plant based on the average of four samples collected between October 22, 2003 and February 7, 2007. Based on an application rate of 3.5 dry tons per acre, the increase in concentration in the soil is 0.014 pico-curies per gram radium 226 and 0.016 pico-curies per gram radium 228.

For the Joliet Westside Wastewater Treatment Plant, the radium concentration in the biosolids is 17.6 pico-curies per gram for radium 226 and 26.2 pico-curies per gram for radium 228. At the 3.5 dry ton per acre application rate, the increase in soil concentration is 0.031 pico-curies per gram radium 226 and 0.047 pico-curies per gram radium 228.

To address the issues raised by IEMA-DNS, alternative land application programs were investigated. The application of biosolids on a particular pattern was proposed as one alternative and the application of biosolids blended from Joliet Eastside Wastewater Treatment Plant and Joliet Westside Wastewater Treatment Plant was proposed as the other alternative.

Pattern application provided for a field to receive 1 application of Joliet Westside Wastewater Treatment Plant biosolids followed by two applications of Joliet Eastside Wastewater Treatment Plant biosolids. Costs were developed for this alternative using he information in the "Evaluation of Radium Removal Impacts on Sludge Handling at the Eastside Wastewater Treatment Plant and the Westside Wastewater Treatment Plant. These costs were adjusted by the consumer price index to 2006. The additional mileage necessary to transport the biosolids to fields was based on $4.69 per loaded mile taken from the "United States Department of Agriculture 4th Quarter 2006 Grain Truck Cost Report". No adjustment was necessary as the report was based on 2006.

Blended biosolids provided for the application of biosolids blended from the Joliet Eastside Wastewater Treatment Plant and Joliet Westside Wastewater Treatment Plant biosolids. This program would be operated as follows:

> A biosolids mixing/ storage tank would be constructed at the Joliet Eastside Wastewater Treatment Plant
>
> Biosolids produced at the Joliet Westside Wastewater Treatment Plant would be trucked to the Joliet Eastside Wastewater Treatment Plant and pumped into the tank
>
> Biosolids produced at the Joliet Eastside Wastewater Treatment Plant would be added to the tank at the ratio of two parts Joliet Eastside Wastewater Treatment Plant biosolids to 1 part Joliet Westside Wastewater Treatment Plant biosolids.
>
> The mixing equipment would be operated to create a well mixed blend of biosolids.
>
> Biosolids would be trucked to the regular disposal sites of the Joliet Eastside Wastewater Treatment Plant.

The costs of transportation from the Joliet Westside Wastewater Treatment Plant to the Joliet Eastside Wastewater Treatment Plant were based on the $4.69 per loaded mile.

Landfill disposal was the final alternative. The previous study by Clark Dietz served as the basis for the study of the alternative. Costs were adjusted to 2006 using the Engineering News Record construction cost index for new construction and the consumer price index for operating costs.

The comparison of alternatives required development of the radium concentration in the blended biosolids. The radium 226 concentration was 11.08 pico-curies per gram and the radium 228 concentration was 14.69 pico-curies per gram. The quantities of biosolids applied from each plant were determined from 2004, 2005 and 2006 applications. Transportation costs for the current program, pattern application and blended alternatives were developed.

Implementation issues were reviewed for each alternative. Pattern application could be implemented without additional capital expenses. Application rates would require adjustment, no other implementation issues were considered.

Blended biosolids required the construction of a new mixing/storage tank at the Joliet Eastside Wastewater Treatment Plant. The construction cost of the tank, associated piping, mixing pumps and nozzles was estimated to cost $2,000,000. The anticipated design and construction was anticipated to require two years.

Landfill disposal capital requirements were included in the Clark Dietz, Inc. report. Design and construction also requires two years.

Costs were compared with the resulting present values

Current Program	$10,264,662
Pattern Application	$11,310,437
Blended Application	$13,188,567
Landfill Disposal	$48,083,408

Radiation doses with topsoil removed were also compared for all the alternatives except Landfill Disposal

The results were as follows:

Current Program Eastside 10 applications	2.3 milli-rems per year
Current Program Westside 10 applications	5.25 milli-rems per year
Pattern Application 9 applications	3.03 milli-rems per year
Blended Biosolids 10 applications	3.27 milli-rems per year

All of the programs provide less than the 10 milli-rems per year agreed by IEPA and IEMA-DNS. All these alternatives provide the nutrients to the crops that are expected from land applications. Site life is long enough to allow grower/landowners to maintain the fertility of the soil.

One of the other tasks that was requested of RSSI was to determine the dose if the topsoil was left in place under the house. RSSI reported that the dose from 10 applications of biosolids from the Joliet Westside Wastewater Treatment Plant is 15.36 milli-rems per year. This dose occurs the first year after the 10 application and declines over time. Dr. Port and Dr. Toohey will address the public health issues related to 15.36 milli-rems per year dose.

The issue of land application of biosolids with a radium concentration greater than 50 pico-curies per gram was also addressed in the report. I recommend that any new inter-agency Memorandum of Agreement provide a specific procedure for review and criteria for approval of land application of material with a concentration greater than 50 pico-curies per gram. The dose to a future resident has been used to determine the criteria for land application for biosolids with a concentration less than 50 pico-curies per gram and dose would be appropriate criteria for biosolids with a concentration greater than 50 pico-curies per gram. The number of applications would have to be reduced to control the dose to a future resident.

The report conclusions are as follows:

- 10 applications of biosolids form the Joliet Westside Wastewater Treatment Plant does not result in exposure greater than 10 milli-rems per year to future residents

- For homes built that do not follow local building codes and have topsoil under the home, the anticipated dose for 10 applications of biosolids from the Joliet Westside Wastewater Treatment Plant is 15.35 milli-rems per year.

- The cumulative radium concentration in soil can exceed the 0.4 pico-curies per gram limit proposed by IEMA-DNS

- The dose from a soil concentration increase of 0.780 pico-curies per gram is 5.25 milli-rems per year. An additional increase in soil concentration is possible and the dose to future resident would still be less than 10 milli-rems per year.

- Programs that do not require the removal of topsoil from beneath the house should be limited to 0.4 pico-curies per gram increase in soil concentration.

- Bio-solids with a concentration less than 100 pico-curies per gram may be land applied without a special review.

On June 29, 2007, I sent a copy of the Rogina & Associates, Ltd. Report entitled "Land Application of Radium Bearing Biosolids to Jeff Hutton and IEMA-DNS. (Record at R39).

Jeff Hutton Analysis (Record at R-35 through R37)

Jeff Hutton of IEPA wrote a memorandum summarizing his comments from Joliet's June 2007 submittal. Mr. Hutton provided 10 specific comments and also made conclusions.

1. Comment number 1 addressed the fact that Joliet approaches the radium issue on the number of applications allowed while the IEPA is only concerned with assuring that radium dose is kept below a safe limit. Joliet is concerned with the number of applications because grower/landowners are concerned about the number and timing of applications to assure that Joliet's program is compatible with the fertilizer program than is used by the grower. Too few applications just disrupt a grower's fertilizer program with very limited reduction in cost.

2. The significant differences in Joliet's and IEMA-DNS's allowable soil concentrations are the second comment. The 0.4 pico-curies per gram is not the result of RESRAD modeling, but of the "sum of the fractions' calculation performed by IEMA.

3. Comment number 3 is concerned with building construction practice. The discussion concerns whether or not the topsoil is removed prior to construction of a home. Joliet's survey of communities and counties, common practice and a telephone survey of builders performed by IEPA all indicate that topsoil is removed prior to construction.

4. Mr. Hutton comments the IEMA-DNS's inputs appear to be based on a resident farmer rather than suburban development.

5. The food sources for Joliet and IEMA-DNS are different. IEMA-DNS appears to use a homeowner that drank milk produced on site, ate meat grown on sites and consumed vegetables grown on site. Suburbanites don't normally have a milk cow and grow meat and poultry on site.

6. Mr. Hutton commented that Joliet assumed that residents would drink water from the public water supply, while many well and septic subdivisions are developed in Northern Illinois. The well and septic subdivisions make IEMA-DNS's approach valid. It should be noted that I am not aware of a single well and septic subdivision that has developed on land that has received Joliet biosolids. All the development that I recall has developed on the public water supply.

7. There is a significant difference in the way that Joliet and IEMA-DNS handled background radium. Mr. Hutton's comment is that the only concern about the land application program was the increase above background.

8. Mr. Hutton extrapolated the dose based on larger increases in soil concentration. If Joliet applied biosolids up to the 1.0 pico-curies per gram proposed limit, the dose would be 6.7 milli-rems per year for homes where the topsoil was removed. If the topsoil was not removed, the dose would increase to 19.7 milli-rems per year at a soil concentration of1.0 pico-curies per gram. It should be noted that Joliet's proposal is that programs that do not remove topsoil should be limited to 0.4 pico-curies per gram. An individual that did not comply with the building code would risk higher exposure.

9. The limitation on applying biosolids with a concentration of greater than 50 pico-curies per gram drew Mr. Hutton's next comment. Mr. Hutton does not see a problem with the sludge concentration as long as the increase in soil concentration is not exceeded. Mr. Hutton notes that only three communities have reported concentrations approaching 50 pico-curies per gram. The communities are Joliet, Channahon, and Huntley. Other facilities that have not reported the radium concentration in their biosolids may also have high concentrations.

10. Mr. Hutton notes that Mike Klebe of IEMA-DNS was concerned that radium applications are not tracked by a central authority. If fields receive biosolids from multiple wastewater plants, no one may be monitoring the accumulated radium. Mr. Klebe proposed a record keeping central authority and Mr. Hutton indicated that a tracking system may be necessary. Joliet will not apply biosolids to a field that has received biosolids from other facilities. This practice was not developed for radium, but for other chemical constituents to avoid a problem determining the source of a particular chemical.

The conclusion to Mr. Hutton's memo indicates that 1.0 pico-curies per gram above background limitation and the removal of the topsoil under the structures would be protective of human health. He further states that this the limitation allowed by Wisconsin.

A tracking data base is proposed by Mr. Hutton to avoid over-application.

Mr. Hutton concludes that an allowable increase of 1.0 pico-curies per gram with topsoil removed should be proposed by IEPA.

Apparently a presentation was made to IEMA-DNS. Mr. Klebe of IEMA-DNS indicated to Mr. Hutton that IEMA-DNS has gone as far as they think they can by allow 0.4 pico-curies per gram. Mr. Hutton's observation is that the 0.4 pico-curies per gram is based on extremely conservative factors that do not appear to reflect the real world situation.

Mr. Hutton identified inputs to the model that reflect the real situation. He also stated that IEPA should request that Joliet and IEMA-DNS should run the RESRAD model using the same inputs to determine the dose resulting from an increase of 1.0 pico-curies per gram.. IEMA-DNS and IEPA should review Joliet's proposal after the models are completed was the last recommendation of Mr. Hutton.

IEMA-DNS Response to Joliet's Submittal (Record at R-33 and R-34) and Joliet's Response?

IEMA-DNS responded on August 13, 2007 in a letter to Mr. Toby Frevert. One of their comments was that Joliet misinterpreted the IEMA computer modeling. This may be correct. IEMA-DNS did obtain significantly different results than Joliet's health physicist.

IEMA-DNS is correct that Joliet took issue with IEMA-DNS's failure to consider the removal of topsoil prior to construction. IEMA-DNS claims that Joliet provided no documentation stating this requirement or documentation of procedures used by building inspectors to verify the topsoil removal. This demonstrates IEMA-DNS's separation from the real world. The International Building Code is a model building code that has been adopted throughout most of the United States. In the Midwest, it replaced the BOCA code that had been in use for many years. Both of these codes require the removal of topsoil. Building Inspectors require a visual inspection for a foundation. As a part of the foundation inspection, they visually observe that the topsoil has been removed. No particular note is made because the foundation would not be allowed to proceed if topsoil is still present.

IEMA-DNS claims that Joliet did not provide input or output files so that IEMA-DNS could verify the results. Inputs are listed in the report. Output files were not provided because IEMA-DNS has the ability to independently verify the results using the same RESRAD program.

IEMA-DNS takes the position that as a result of the increase to 0.4 pico-curies per gram, that Joliet would have to modify their program to meet this limit. IEMA-DNS apparently failed to consider that at the same meeting, it was agreed that 10 milli-rems per year was an acceptable dose. As a result, Joliet chose to continue to pursue a soil concentration that would match the 10 milli-rems per year dose. IEMA-DNS also misinterprets the blending and pattern application results. Both of these options had increases in cost from programs that were not good public policy. If 10 milli-rems is an acceptable dose, I don't believe that additional expenses to achieve doses less than 10 milli-rems represent funds that are well spent.

IEMA-DNS again raised the question of Joliet exceeding the 0.1 pico-curies per gram limitation in the inter-agency memorandum of agreement. Joliet 's and other communities land application permits did not include a radium limitation for may years. Joliet's first radium limitation was 0.1 pico-curies per gram in the fall of 2006. In early 2007, that was increased to 0.4 pico-curies per gram. One application of Joliet Westside Wastewater Treatment Plant biosolids does not exceed the 0.1 pico-curies per gram limit. The reason that Joliet only had four sample results was that no sampling requirement was implemented in the earlier permits.

August 14, 2007 Meeting

IEPA, IEMA-DNS and Joliet met again on August 14, 2007. The meeting was intended to resolve open issues and receive a review of Joliet's report. When IEMA-DNS arrived, they provided the August 13, 2007 response to Joliet's report which either IEPA or Joliet had seen. This was the first meeting that IEMA-DNS was not represented by Rich Allen as he was no longer working at IEMA-DNS.

The meeting did not go well. IEMA-DNS felt that the Joliet report did not look at alternatives to the land application program. Joliet did not see IEMA-DNS giving good consideration to the current program that met the agreed 10 milli-rems per year dose. IEMA-DNS seemed to take the approach that 0.4 pico-curies per gram had been approved at the previous meeting and that no further increase was possible.

Joliet left the meeting with the idea that IEMA-DNS had reached their limit for adjustment to the soil concentration.

It was agreed that RSSI and IEMA-DNS would meet and compare inputs to the RESRAD program.

IEPA Requested Information from IEMA-DNS to clarify points from the August14,2007 meeting.

Jeff Hutton sent a Memo to Mike Klebe dated December 3, 2007 in which he asks questions concerning the modeling of dose response(Record at R 32):

1. What soil concentration was used in the IEMA-DNS model, 7.1, 1.0 or 0; 4 pico-curies per gram

2. Were food inputs part of the IEMA-DNS model?

3. What is the dose of an individual for an increase in the background of 1.0 pico-curies per gram with topsoil removed and no food inputs.?

4. What is the dose of an individual for an increase in background of 1.0 pico-curies per gram without the topsoil being removed and no food inputs?

IEMA-DNS/RSSI Coordination

Following the August 2007 meeting, IEMA-DNS and RSSI met and compared inputs to the RESRAD program. They obtained similar results for similar inputs.

James E Eggen Letter of December 22, 2007 (Record R-26-R28)

Mr. Eggen wrote a letter that summarized Joliet's approach to resolving the issues. He identified IEMA-DNS's refusal to accept that topsoil is removed prior to building construction as a major issue. He also indicated that IEMA-DNS and RSSI had met and IEMA-DNS agreed with the RESRAD results and said they would further review the data. After this discussion, IEMA-DNS drafted a revised memorandum of agreement based on 0.4 pico-curies per gram.

Mr. Eggen's conclusion was that IEMA-DNS and Joliet will not be able to come to a conclusion. Mr. Eggen encouraged IEPA to make an analytical interpretation of the City's data and set a logical level of radium concentration.

This appeared to be Joliet's only option, since IEMA-DNS was not demonstrating a willingness obtain a workable solution.

Meeting between IEPA and IEMA-DNS (Record at R-23 and R-24)

In an effort to move the discussion, IEPA scheduled a meeting with IEMA on February 26, 2008. Marcia Wilhite, Manager, Bureau of Water, Sanjay Sofat, IEPA Attorney, Roger Selburg, Manager , Division of Public Water Supplies, Alan Keller, Manager, Division of Water Pollution Control, Permit Section and Jeff Hutton, Permit Engineer went to the IEMA-DNS offices. IEMA-DNS was represented by Louise Michels and Michael Klebe.

The meeting notes indicate that the IEMA-DNS representatives would not be identified as "senior management".

Marcia Wilhite went over the major points on the agenda.

1. the hearing process for a Joliet permit appeal,

2. the status of the memorandum of agreement

3. technical issues.

Sanjay Sofat explained the Board's permit appeal hearing process.

The discussion of the technical issues and memorandum of agreement proceeded. Mr. Klebe indicated that slab on grade construction was a very conservative approach. Mr. Klebe stated that 0.4 pico-curies per gram is IEMA-DNS's "comfort number". Higher limits would require soil monitoring which is an item that IEMA-DNS does not want to do.

Mr. Klebe also provided the information that if the topsoil is removed, IEMA-DNS's model results in 5.8 milli-rems per year exposure.

Mr. Klebe further indicated that Nuclear Safety does not want radium applied to land and 0.4 pico-curies per gram is what they would allow.

The statement of Mr. Klebe don't appear to represent a position of a state agency interested in providing safety and allowing the reuse of nutrients. IEMA-DNS was present at the meeting of January 24, 2007 where it was agreed that 10 milli-rems per year was a safe dose. IEMA-DNS is ignoring the 10 milli-rems per year and arbitrarily deciding on a lesser dose.

Request for Permit Modification Received July 30, 2008 (Record at R-6 through R-8)

As was discussed with IEPA, Joliet filed a Motion to Withdraw Permit Appeal in PCB 2007-094 which was granted by the Board. A Copy of this Motion is found as Exhibit __. There after Joliet requested on July 29, 2008 a modification to permit No 2006-4784-2 concerning land application of biosolids. The reporting of radium results was requested to be extended to 90 days after sampling and the allowable increase of radium concentration over background was requested to be 1.0 pico-curies per gram in lieu of the limitation of 0.4 pico-curies per gram contained in Special Condition 2..The permit modification included the original Rogina & Associates, Ltd. Report entitled "Land Application of Radium Bearing Biosolids and Addendum 1 thereto.

Addendum 1 Land Application of Radium Bearing Biosolids (Record at R-9 through R-21)

This addendum updated the quantities of biosolids applied, the radium concentration measured in the sludge and confirmed the amount of Joliet Eastside Wastewater Treatment Plant biosolids to the amount of Joliet Westside Wastewater Treatment Plant biosolids. The conclusions in the original report concerning allowable applications did not change.

IEPA Meeting and Permit Notes

IEPA and the City of Joliet met on August 28, 2008 to determine the best procedure for handling Joliet's pending permit modification request.

The agreed procedure included the following:

1. IEPA would forward Joliet's request to IEMA-DNS.

2. The monitoring change would be acceptable, but the increase to 1.0 pico-curies per gram was unlikely to be approved.

Joliet was concerned about the following:

1. Did IEPA have anything in writing about 10 milli-rems per year being acceptable?

2. Would IEMA-DNS be at the hearing?

3. It was important for IEMA-DNS to be notified and provided with the documentation.

Subsequent to the meeting, IEPA summarized their information for a permit decision. The discussion items are as follows:

1. The request would allow the application of radium containing sludge that would raise the level to 1.0 pico-curies per gram above background.

2. The sampling frequency would be changed to quarterly due to the time required for laboratory analysis.

The notes indicate that the change is sampling frequency is acceptable. The notes also indicate that the increase to 1.0 pico-curies per gram would be in violation of the memorandum of agreement between IEPA and IEMA-DNS.

The proposed actions were listed as follows:

1. Deny the request for an increase above background

2. Approve the request for monitoring change using a separate log number.

Denial Letter (Record at R-1)

The final document is the denial letter that IEPA sent to Joliet. It lists the reason for denying the permit as the memorandum of agreement between the IEPA and IEMA-DNS which limits the increase in soil radium to 0.1 pico-curies per gram.

Review and Summary Comments

Without regard to the information presented by Joliet, IEPA believed it was required to deny Joliet's request for an increase in the quantity of radium that could be applied with biosolids. The land application of biosolids has been a program that IEPA has encouraged as a disposal method. With this permit denial, it now appears that IEPA is no longer interested in land application.

IEPA and IEMA-DNS prepared a memorandum of agreement in 1981 without giving the regulated community the right to review and comment upon it. The procedures for modeling radiation dose have change tremendously since that time. The RESRAD computer model was not developed until 1987 and has been modified since 1987.

If 10 milli-rems per year is an acceptable dose, why is there such reluctance to allow programs that implement an acceptable dose? IEPA has been relying on IEMA-DNS to provide technical information. IEMA-DNS apparently has decided that no explanation of their decision to limit the increase to 0.4 pico-curies per gram is necessary as none has been provided to IEPA and none is set forth in the Permit Record. IEMA stated to IEPA that the removal of topsoil results in a dose of less than 60% of the 10 milli-rems dose.

It is common practice to rely on citizens to follow laws and regulations. IEPA accepts that local building codes and sound construction practice require removal of top soil before construction. IEMA-DNS seems convinced that buildings are routinely built without removing the topsoil as required by building codes. The modeling performed by RSSI and IEMA-DNS has shown that the dose from the failure to remove the topsoil is not extremely large. Ten applications of biosolids from the Joliet Westside Wastewater Treatment Plant would result in a dose of 15.35 milli-rems per year if the topsoil is left beneath the house. Most new construction in the Joliet area is a part of a 40 acre or larger subdivision. Common practice in developments of this size is to strip the topsoil from the site and place it in stockpiles during the grading and construction of the site. When the homes are ready for occupancy, the topsoil is spread on the lawn areas around the home. The City of Joliet Building Department reports that construction of home without obtaining permit is very rare. Dave Mackley, Director of the Department reports that in the 23 years that he has worked in Joliet that no one has attempted to build a home without a building permit. This has provided the opportunity for proper inspections including topsoil removal

The 0.1 pico-curies per gram limit will require Joliet to dispose of the biosolids in a landfill. The present value of a landfill disposal program is 4.7 times the cost of land application. This seems to me as waste of public funds.

As Dan Fiedler indicated in his attachment to Harold Harty's testimony, sampling of fields have indicated that variations in background radiation are greater than the 1.0 pico-curies per gram that is of concern today.

The Second Stated Basis for the Denial of the Modification Request

IEPA cites a failure to comply with 35 Ill. Admin. Code Section 309.241 Standards for Issuance as the other basis for its decision to deny Joliet's permit modification request. This rule reads as follows:

> Section 309.241 Standards for Issuance
>
> a) The Agency shall not grant any permit required by this Subpart B, except an experimental permit under Section 309.206, unless the applicant submits adequate proof that the treatment works, pretreatment works, sewer, or wastewater source will be constructed, modified, or operated so as not to cause a violation of the Act or of this Subtitle and
>
> b) If the Agency has promulgated, pursuant to Section 309.262, criteria with regard to any part or condition of a permit, then for purposes of permit issuance proof of conformity with the criteria shall be prima facie evidence of no violation. However, non-conformity with the criteria shall not be grounds for permit denial if the condition of subsection (a) of this section is met.

There is nothing in the Permit Record which supports this determination other that a reliance on the Memorandum of Agreement. The record is completely devoid of any concern or allegation of a violation of the Act or any applicable regulation. Joliet's land application program follows the applicable environmental requirements concerning set backs from streams, roads and buildings to prevent any potential violation of the Act or the regulations. Joliet has completely and consistently complied with all applicable permitting requirements related to land application. Apart from the Memorandum of Agreement, IEPA has not cited any criteria related to radium in either the Act or the regulations adopted by the Board, or its own rules for that matter, because none have ever been enacted or adopted.

Conclusion

This permit appeal represents an opportunity to support a continuing re-use program without adverse impacts on the general public. The alternative is to require the expenditure of public funds for very limited change in the environment.

The requested change to Condition 2 to allow an increase above background of 1.0 pico-curies per gram results in a dose that the parties agree is protective of the public health and should be approved. There is nothing in the record to support the IEPA's decision to deny the request based upon the Memorandum of Agreement or Section 309.241.

CH01/ 25277506.1

WRITTEN TESTIMONY OF

Eli Port

IN THE MATTER OF

City of Joliet v. Illinois EPA
PCB 09-25

Before the Illinois Pollution Control Board
Bolingbrook, Illinois
January 13, 2009

I am Eli A. Port. I hold a Master of Science degree in Health Physics from Northwestern University's Environmental Health Engineering program. I am a Plenary Member of the Health Physics Society and I am certified by the American Board of Health Physics in comprehensive practice. Health Physics is a scientific and professional discipline which specializes in occupational and environmental radiation safety. Certification by the American Board of Health Physics indicates that a professional has met requirements for academic training and professional experience, and has passed an examination designed to test competence in this field of radiation protection.

For the past 33 years, I have been employed by RSSI, 6312 West Oakton Street, Morton Grove, Illinois and I am RSSI's president. Founded in 1976 as Radiation Safety Services, Inc, RSSI provides a wide range of occupational and environmental radiation protection services to clients in industry, business, government, medicine, education and law. RSSI provides program support to major corporations, not-for-profit research and academic institutions, and governmental agencies. In my work, I have provided radiation dose modeling for accident reconstruction, to demonstrate compliance with Federal and State occupational and environmental dose limits, and to determine pathways and public dose associated with spills and releases at nuclear power plants. I have developed United States Environmental Protection Agency ("U.S. EPA") approved work plans and strategies to mitigate radium contamination in soil to U.S. EPA limits prior to development for residential use.

I have been asked by the City of Joliet ("Joliet") to study the potential health effects from naturally occurring radionuclides in waste water treatment sludge to support its efforts to continue its program to use this material on agricultural lands. The primary radionuclides of concern in sludge are the isotopes of radium ("Ra") and their decay products. Radium is a naturally occurring radioactive element, present in rock and soil and it may be found in groundwater. The more common isotopes of radium are Ra-226 and Ra-228. Ra-226 is the most important in terms of radiological health effects because of its decay kinetics and metabolism. Ra-226 and Ra-228, collectively referred to as radium, both decay by emitting alpha particles to two series of naturally occurring radionuclides. Where radium is referred to in this testimony, it means the combined Ra-226 and Ra-228.

EXHIBIT
C

Surface water usually has low radium concentrations, but groundwater concentrations can be significant. Water drawn from deep bedrock aquifers may contain concentrations of radium that exceed regulatory standards. In Joliet, and in most of Northern Illinois, high radium concentrations result from the presence of radium in the aquifers from which water supplies are withdrawn for public water supply.

Radium in drinking water may pose a radiological health hazard. About one-fifth of ingested radium is taken up by the body and the balance is excreted in feces. Some of the absorbed radium is subsequently excreted in urine. In the body, radium, a group IIA alkali earth element, behaves like other elements in the group, such as calcium, and is deposited primarily in bone cortex.

The internally deposited radium emits alpha particles that damage tissues adjacent to the decaying atoms. Radium is not known to cause adverse health effects at levels typically found in drinking water, diet, or the environment. The curie ("Ci") is the unit used to quantify radioactive material. A subunit of the curie, the picocurie ("pCi") is used in describing small quantities of radioactive material in environmental radiation protection. Studies of humans find that body burdens in excess of 10 μCi result in an increased incidence of malignant disease.

The U.S. EPA has established a maximum contaminant level (MCL) of 5 picocuries per liter (pCi/l) for radium in public water supplies. The MCL for radium has been set well below levels for which health effects have been observed and is assumed by the U.S. EPA to be protective of public health. Public water supply systems whose radium concentrations exceed 5 pCi/l are not known to be inherently unsafe, but are required to notify the public. These systems must also evaluate ways to reduce the radium concentrations in their water to comply with the MCL.

The radium concentration in the Joliet water supply prior to treatment to remove radium is between 6 pCi/l and 10 pCi/l, exceeding the current MCL. Joliet now treats water to remove radium from drinking water in the supply system and transfers the radium to sewage treatment sludge. The radium bypasses human consumption and total amount of radium remains unchanged from historic values. Sludge is made available for agricultural application to exploit its nutrient content. The application of the sludge to land adds the radium in the sludge to the radium naturally in the soil or resulting from the prior applications of phosphate fertilizer.

In 2004, The City of Joliet has asked RSSI to model the increase in background dose to occupants of homes built on former agricultural land whose soils had been beneficially amended using sludge from waste water treatment plants.- RSSI selected the Argonne National Laboratory's RESidual RADioactivity (RESRAD) Model, to assess the dose associated with residual radioactive material. RESRAD computes potential annual dose exposure to radioactive material in soil, and concentrations of radionuclides in air, surface water, and ground water resulting from the activity in soil.

RESRAD was developed to provide a scientifically based answer to the question "how clean is clean" and to provide useful tools for evaluating human health risk from residual contamination. RESRAD is used as a tool to evaluate radiologically contaminated sites and to support cost-benefit analyses that can help in decision-making.

RESRAD is widely used by government agencies in modeling dose from residual radioactive material in the environment and the Illinois Emergency Agency's ("IEMA's") Division of Nuclear Safety used the RESRAD model in determining dose from radium on agricultural land converted to residential development.

RESRAD allows for the setting of many parameters including radionuclide concentrations in soil, geologic characteristics, irrigation and run off, exposure and ingestion pathways, food production on the land, and building design, construction and use. The exposure pathways used by RSSI in the RESRAD modeling for land treated with sludge were direct external dose from the contaminated soil, and internal dose from inhalation of airborne radionuclides including radon progeny. The RESRAD model used by RSSI does not consider pathways that would not be likely in future urban or suburban residential use of land.

The variables used as inputs were provided by the City of Joliet or, where data were not available, are RESRAD default values. Applications of sludge were at rates and using techniques specified by the City's agronomist. Radium concentrations were typical of the sludge from the City's plants. The City's consultant and former Director of Public Works has conducted a survey of applicable municipal codes and county ordinances and reported that known codes and ordinances require the removal of topsoil prior to construction. Accepted building techniques for houses to be constructed on land when converted to residential use also include removal of topsoil, whether the house is slab-on-grade or has a basement. In the model, the only interface with amended soil is where topsoil is brought up against a basement wall or outside the home.

RESRAD calculates that the maximum annual dose results from nine sludge applications of sludge adding 0.058 pCi/g Ra-226 and 0.091 pCi/g Ra-228 to the soil at each application. The nine applications increase the total radium concentration by 1.34 pCi/g and result in an annual dose less than 9 mrem per year. Nine mrem is less than one tenth the difference between the annual external natural background radiation in Joliet, 125 mrem/yr, and Denver, 250 mrem. Nine mrem is one-quarter to one-third the annual dose from naturally occurring radionuclides in food, 30 mrem-35 mrem, and less than one-twentieth the annual dose from radon in the average US home, 200 mrem. In 2007, RSSI performed additional modeling using different application patterns and mixing depth. A resulting soil concentration of approximately half the 2004 values resulted in approximately half the dose, demonstration that the resulting dose is relatively insensitive to the depth radium is mixed in soil.

IEMA performed RESRAD modeling using a higher concentration of radium in soil than could result from the Joliet program. IEMA very conservatively used parameters that included residents producing all of the fruit, vegetables, grain, meat, dairy, poultry, fish and shellfish they consumed. The IEMA model was based living in a house built on agricultural topsoil, a practice the City's consultant reported is inconsistent with modern building codes and practices. The very conservative IEMA model predicted a maximum 175 mrem. When the soil concentration used by IEMA is adjusted to the realistic concentration used by RSSI, the resulting maximum annual dose drops to 25 mrem to residents who produce all of the fruit, vegetables, grain, meat, dairy, poultry, fish and shellfish they consumed and live in a house built on agricultural topsoil.

IEMA requires that when land is released for unrestricted use, the residual radioactivity, excluding isotopes of radon, and their progeny, that is distinguishable from background radiation does not result in a dose to an average member of the critical group that exceeds 25 mrem per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). The ALARA philosophical principal in radiation protection means making every reasonable effort to maintain exposures to radiation as far below dose limits in a manner that is practical and consistent with the purpose for which an activity is undertaken, taking into account the state of technology, the economics of improvements in relation to the state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations.

Where doses are low, ALARA balances benefits and costs. ALARA does not mandate the lowest possible doses below the limits in standards and regulations. The U.S. EPA uses an Applicable or Relevant and Appropriate Requirement (ARAR) of 5 pCi/g combined radium in soil above the background concentration of radium in soil for unrestricted residential use. In its analyses, the U.S. EPA uses an average radium concentration of 2.1 pCi/g in soil.

The Health Physics Society's Position Statement "Radiation Risk in Perspective", (attached as Exhibit X) states, "...for populations in which almost all individuals are estimated to receive a lifetime dose of less than 10 rem above background, collective dose is a highly speculative and uncertain measure of risk and should not be used for the purpose of estimating population health risks." At 9 mrem per year, 1,100 years would be required to accumulate a 10 mrem dose.

The maximum annual dose of 9 mrem includes the dose from radon. The calculated dose resulting from the application of sludge is low when compared with the dose from other natural sources. As a professional, I find that this dose to be ALARA. When the benefits to municipalities and farmers are considered, attempting to reduce the dose by inhibiting the application of sludge is not consistent with the ALARA principal. To be conservative, I recommend that application programs be continued providing that no program be permitted to add more than 1 pCi/g of combined radium to soil in a field during the life of the program. This ALARA limit is only 20% of the U.S. EPA's ARAR for any use, including residential.

H:\HOME\400001 Health Physics\Joliet\Eli Port Narrative r1.doc
CH01/ 25278540.1

WRITTEN TESTIMONY OF

RICHARD E. TOOHEY, PH.D., CHP

IN THE MATTER OF

City of Joliet v. Illinois EPA
PCB 09-25

Before the Illinois Pollution Control Board
Bolingbrook, Illinois
January 13, 2009

My name is Richard E. Toohey. I hold a Ph.D. degree in nuclear physics from the University of Cincinnati (1973) and I am certified in comprehensive practice by the American Board of Health Physics (1992, recertified 1996, 2000, 2004.) My current position is Director of Dose Reconstruction Programs for Oak Ridge Associated Universities in Oak Ridge, Tennessee. These programs are supported by the National Institute of Occupational Safety and Health ("NIOSH") and by the Defense Threat Reduction Agency ("DTRA") to gather exposure data and provide estimates of radiation doses received by workers in the nuclear weapons complex and military personnel present at atmospheric nuclear weapons tests. For the year August, 2008 through July, 2009, I am the President of the Health Physics Society, the U.S. professional society for specialists in radiation protection, with almost 6,000 members. I am also a member of the National Council on Radiation Protection and Measurements ("NCRP"), a Congressionally chartered organization of 100 members that is charged with advising the federal government on radiation protection standards, measurement techniques, radiation exposures and health risks. From 1973 to 1987, I was a staff scientist at the Center for Human Radiobiology at Argonne National Laboratory, participating in the study of the effects of radium on exposed humans, primarily women who worked as luminous dial painters in the 1920's. I have previously testified before the Illinois Pollution Control Board ("Board") on the health effects and risks of radium in drinking water on many occasions, involving variance petitions from communities in Northern Illinois, including the City of Joliet.

The current issue before the Board is a petition by the City of Joliet to appeal the denial of its permit modification request by the Illinois Environmental Protection Agency ("IEPA") which would have allowed the disposal of radium-containing waste sludge from the treatment of drinking water by application to agricultural land, resulting in a total accumulative increase of radium not to exceed 1.0 picocuries per gram (pCi/g) of soil. This level exceeds that in a memorandum of understanding between the IEPA and the Division of Nuclear Safety of the Illinois Emergency Management Agency ("IEMA-DNS") that was originally set at 0.1 pCi/g, but as I understand, is now 0.4 pCi/g in draft form.

EXHIBIT
D

The federal standards for radiation exposure to members of the public from environmental levels of radioactive materials resulting from technological uses, such as waste disposal, include a dose limit of 15 mrem per year under United States Environmental Protection Agency ("U.S. EPA") regulations, 25 mrem per year under United Stated Nuclear Regulatory Commission ("U.S. NRC") regulations, and 100 mrem per year under United Stated Department of Energy ("U.S. DOE") regulations. The dose parameter used in these regulations is the total effective dose equivalent ("TEDE"), more recently referred to as effective dose, which includes external exposure to penetrating radiation (gamma rays) plus any internal exposure resulting from the inhalation or ingestion of radioactive materials. In addition, the internal component of the dose is integrated for a period of 50 years post intake, but assigned to the year of intake. The important thing to note is that the limits are for dose, because potential risks to human health from radiation exposure are assumed to be directly proportional to the radiation dose received. The secondary or derived limits for such quantities as the concentration of a radioactive isotope in drinking water, in air, or in soil are calculated by means of a pathway analysis, which determines the dose coefficient, i.e., the dose per unit concentration of a given isotope in a given environmental medium. The concentration limit is then that concentration which results in the dose limit, when all pathways are included; this is equal to the dose limit divided by the dose coefficient for all pathways.

In the case of disposal of radium-containing sludge on agricultural land, the pathways to be considered include direct gamma-ray exposure, inhalation of the radioactive material or its radioactive decay products, and ingestion of the radioactive material by direct ingestion of soil, or ingestion of foodstuffs or water which have absorbed the radioactive material from the soil. The radioactive isotopes to be considered in this case are Ra-226 and Ra-228 and their decay products, which include the gamma-ray emitting isotopes Pb-214, Bi-214, and Pb-210 from Ra-226, and Ac-228, Pb-212, Bi-212, and Tl-208 from Ra-228. Each radium isotope also produces a gaseous decay product: Rn-222 from Ra-226, and Rn-220 from Ra-228. The isotope Rn-220 has a very short half-life, only 55 seconds, and so does not build up to appreciable levels. In contrast, the isotope Rn-222 has a 3.64-day half-life, and can move through soils into the living space of a house built on the soil; this isotope is in fact the contributor of most (about 70%) of the effective dose from Ra-226 in soil. However, if the topsoil containing the Ra-226 is removed before house construction, then this pathway no longer exists. In addition, in a suburban environment, drinking water and the majority of foodstuffs typically do not come from the homeowner's property, and so the ingestion pathways for food and water are also not applicable. Based on the pathway analyses previously submitted by the City of Joliet, I calculate a dose coefficient of 25 mrem per year per pCi/g of combined Ra-226 and Ra-228 in soil including all pathways, and a dose coefficient of 7 mrem per year per pCi/g combined radium if the Rn-222 inhalation and the foodstuff and water ingestion pathways are excluded. Taking a conservative dose limit of 10 mrem per year, the all-pathway analysis would result in a concentration limit of 0.4 pCi/g, while the restricted pathway analysis would result in a concentration limit of 1.4 pCi/g. Under the restricted pathways, a concentration of 1.0 pCi/g would produce an annual dose of 7 mrem.

To put this dose in perspective, the average U.S. resident receives an annual dose of about 300 mrem per year from naturally occurring sources, of which 200 mrem result from the average indoor level of Rn-222, about 1.0 pCi/liter of air. In addition the average U.S. resident receives another 240 mrem from man-made sources, predominately medical uses. Twenty years ago, the average annual radiation dose from medical procedures was about 60 mrem, but it has since increased to about 240 mrem, primarily from computed axial tomography ("CAT") scanning and fluoroscopically guided interventions, such as coronary angioplasty; consequently, the annual average radiation dose in the U.S. is about 540 mrem, including both natural background radiation and man-made (medical) sources. The average background concentration of Ra-226 in soil in the U.S. is about 1 pCi/g, but this can vary by a factor of 10 or more in either direction depending on the underlying geology of the soil; the average in Illinois soils is about equal to the U.S. average (1.0 pCi/g.) In comparison, the concentration of Ra-226 in granite countertops can be as high as 100 pCi/g or more. Interestingly enough, most phosphate fertilizer comes from phosphate rocks which contain from 50 to 200 pCi Ra-226 per gram; although most of the radium is removed in the processing, a typical radium concentration in fertilizer is 27 pCi per gram phosphate (P_2O_5), so if a fertilizer is 10% phosphate, the Ra-226 concentration would be 2.7 pCi/g. Thus the normal agricultural application of fertilizer also increases the background concentration of Ra-226 in soil.

In setting standards for radiation exposure of the public, the effect of concern is cancer induction, and the U.S. EPA and other agencies apply what is called the linear no-threshold ("LNT") model. Briefly, this model assumes that there is no threshold, that is, there is no level of exposure below which the effect can not occur; consequently, any exposure, no matter how small, is assumed to carry some risk of the effect. Secondly, the model assumes that the risk is linear, or directly proportional to the dose. As an example, consider a group of 10,000 people, each of whom receives a dose of 1 rem, or 1,000 mrem. Under these circumstances, the cancer risk model used in radiation protection predicts that there would be 5 cases of radiation-induced cancer, in addition to a background incidence of 4,000 cancers without any radiation exposure. If the radiation dose were reduced to 200 mrem each, then there would be 1 radiation-induced cancer. If the dose were reduced to the level proposed for radium-bearing sludge disposal, i.e., 7 mrem per year, then we could expect 1 radiation-induced cancer to occur from about 30 years of exposure. Currently there is no way to predict which of the 10,000 exposed persons would be the one to incur the radiation-induced cancer, if indeed one were to occur. Regulators use this model to extrapolate from the observed risk at high levels of exposure, where we actually have human data, to a calculated risk at low levels of exposure, such as might occur from radium-containing sludge.

According to the International Commission on Radiological Protection ("ICRP"), the risk coefficient used to estimate cancer risk is 5% per 100 rem, or 0.0005 per rem, or 0.0000005 per mrem, so the assumed risk from 10 mrem per year is 0.000005, or 5 chances in 1 million per year. This risk coefficient is based in large part on the follow-up of the Japanese atomic bomb survivors, with corrections made for differences in dose rate (instantaneous vs. prolonged), radiation types, and background cancer rates in the Japanese and U.S. populations. Other studies of exposed human populations are also relevant to the radium-bearing sludge issue, especially the follow-up studies of radium workers and, for Rn-222 exposure, uranium miners.

The data from the observed incidence of bone cancer in radium dial workers do not match the predictions of the LNT model. In my previous testimony, I showed that the radium dial painter data fit a different model, known as a quadratic model, and that the predictions of the LNT significantly over-estimate the risk of cancer induction at low levels of exposure. Later analyses of the data on the radium dial painters by Dr. Robert Thomas showed that the data are in fact best fit by a cubic model, even farther away from the LNT model. One reason for this change is that the estimated intakes of radium by the dial painters were previously underestimated. Thus, the same number of observed cancers was caused by higher radium intakes; consequently, regardless of which model is used, the risk per unit intake necessarily declines. Dr. Robert Rowland, formerly the director of the Center for Human Radiobiology, has summarized the Argonne radium studies in his book "Radium in Humans: A Review of U.S. Studies" (ANL/ER-3, 1994.) The bottom line, however, is that the radium dial painter data show that the LNT model yields a gross over-estimate of the cancer risk from radium intakes. In addition, the dose and risk calculations in the RESRAD program include a high leukemia risk, based on the observed leukemia incidence in A-bomb survivors. However, there is no excess leukemia observed in the human radium workers, and so the RESRAD program over-estimates the true risk from Ra-226 exposure..

The risk of lung cancer from Rn-222 exposure is based on long-term studies of uranium miners exposed to high concentrations of radon in the mines. Based on these data, the U.S. EPA considers radon exposure to be the second-leading cause of lung cancer, after tobacco smoking, responsible for some 15,000 cases of lung cancer per year. However, what U.S. EPA fails to emphasize is that 90% of these cancers will occur in smokers. The uranium miner data clearly show that smoking and radon exposure act in a multiplicative fashion; the incidence of lung cancer in uranium miners who smoked was about ten times that in non-smoking miners. As smoking incidence continues to decrease in the U.S. population, the risk of cancer from radon exposure will also decrease. Of course, if radium-containing soil is removed from agricultural land prior to house construction, there is no risk from radon above background levels.

There are three basic principles of radiation protection: justification, limitation and optimization. The principle of justification states that any radiation exposure must convey some benefit to an individual or to society as a whole in order to compensate for the assumed risk. The principle of limitation states that for a given type of exposure situation, there should be an upper limit that is not exceeded except in exceptional circumstances. The principle of optimization states that actual exposures should be held as far below the limit as reasonably achievable, taking into account economic and societal considerations.

The benefit of medical radiation exposure is usually obvious in terms of diagnosis or treatment, but the benefits of other exposures may be more difficult to quantify. In the case of radium-bearing sludge disposal, the benefits could include lower cost of waste disposal for the municipality generating the sludge, and improvement of soil parameters for the farmer. The risk however, may fall on a future occupant of the site, who was not a recipient of any benefit. Ironically, the risk to this individual arises from the risk reduction to the users of Joliet's municipal water supply from removal of radium from their drinking water. If the occupant of the site were a drinking water consumer, the risk from the soil radium would be much less than the risk from consuming the drinking water containing the radium. The principle of limitation is reflected in the U.S. EPA standard of 15 mrem per year from environmental releases of radioactive materials, or in the limit of 10 mrem per year from radium-bearing sludge disposal proposed by the IEPA. The principle of optimization comes in when considering the costs of sludge disposal by application to agricultural land vs. disposal in a landfill, if the radium concentrations are acceptable for landfill disposal, or in a radioactive waste repository, if the radium concentrations exceed the limits for a landfill. Optimization balances risk vs. the cost of avoiding the risk; in the case at hand, the risk from an additional dose of 7 mrem per year is minimal; this level of dose is well within the natural variation of background radiation doses across the U.S. and the world. It would also seem logical that because the risk from Rn-222 can be eliminated by removal of top soil before housing construction, and that this practice is already required by municipal building codes, it would be within the purview of IEPA to also recognize this practice or possibly require this practice in areas where radium-bearing sludge has been deposited.

It is a fact that it costs money to remove an environmental risk, and the total amount of money available to a municipality from tax revenues is limited. Buildings and roads must be maintained, schools and police and fire departments must be operated, and numerous other claims on the taxpayers' dollars exist. It is up to the taxpayers, through their elected representatives, to determine the proper allocation of funds. We use risk analysis to estimate the risks of various environmental hazards, so that informed decisions can be made as to whether or not they are large enough to demand expenditure of public funds to correct. The IEPA has the legal responsibility to make this determination and, like the U.S. EPA, uses the LNT model to estimate the magnitude of the risks. This approach has been endorsed and supported by both U.S. and international bodies concerned with setting standards for radiation exposure, including the NCRP and the ICRP.

In 1976, when the U.S. EPA issued its interim standards for radioactivity in drinking water, the maximum permissible concentration was set to be 5 pCi per liter for combined Ra-226 and Ra-228; this level is still in effect. On July 18, 1991, U.S. EPA published in the Federal Register a notice of proposed rule-making for the final standards on radioactivity in drinking water that would increase the permissible levels for radium to 20 pCi per liter for Ra-226 and Ra-228 separately. U.S. EPA made this recommendation because of better data available on risk modeling; previous U.S. EPA risk calculations had included a large risk of leukemia induction, based on the experience of the atomic-bomb survivors, while the improved risk estimates lowered the leukemia risk to levels more consistent with the actual human data from radium workers. Unfortunately, Congress' renewal of the Safe Drinking Water Act prevented U.S. EPA from increasing the permissible levels of radium. Had U.S. EPA been able to do so, the problem of disposal of radium-bearing sludge would never have developed, because Joliet would not have been required to remove radium from its well water supply. In my testimony before the PCB some 15 years ago, I advocated 20 pCi per liter of Ra-226 as a reasonable level, even granting the LNT model used by U.S. EPA, and warned that setting the level at 5 pCi/L would result in unnecessary costs for treatment and waste disposal, which is the situation Joliet faces today.

Nevertheless, the science has not changed; it is clear from the human data that the LNT model is conservative, that is, it overestimates the actual risk. Consequently, the calculated risk from disposal of radium-bearing sludge on agricultural land at a level that results in a radiation dose of 10 mrem per year or less is an extreme upper limit on the true risk, which may well be zero. The disposal of radium-bearing sludge on agricultural land with a total accumulative increase of radium not to exceed 1.0 pCi/g of soil satisfies all three of the basic principles of radiation protection: justification, limitation, and optimization. Therefore, the petition of the City of Joliet should be granted and the permit sent back to the IEPA to reissue accordingly.

CH01/ 25278334.2