

Response to “Rocky Flats: Myths and Misunderstandings,” February 5, 2018.  
CDPHE Report to the Rocky Flats Stewardship Council  
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In the Declaration of Independence Thomas Jefferson said governments derive “their just powers from the consent of the governed.” Hence, this response to the recent CDPHE declaration of “myths and misunderstandings” about Rocky Flats. There are many reasons for doubting the “myths and misunderstandings” of CDPHE, not least that CDPHE does not have the consent of the governed. CDPHE lists 20 “myths and misunderstandings.” The following responds to some of CDPHE’s 20 items (with their number), but not all. Then it adds items from the history that CDPHE ignores.

**1. DOE pays CDPHE:** The CDPHE report says this is ordinary procedure that does not affect what CDPHE says or does. However, the record of CDH/CDPHE with the public is not good. CDH knew about the 1957 fire and the drums at the 903 area that leaked plutonium into the soil, but it did not reveal what it knew to the public. The beginning of public knowledge about dangers associated with Rocky Flats began with revelations by NCAR scientist Ed Martell after the 1969 fire.

**3. Sealing Grand Jury records:** After the FBI raid and the Grand Jury investigation the documents reviewed by the Grand Jury were sealed by the federal court. But during the cleanup, Senator Mark Udall offered to let the CDPHE and EPA see the sealed documents. The public was eager to learn what had been hidden and to get a better cleanup if the evidence suggested it should happen. But CDPHE and EPA chose not to review the evidence. I’ve wondered if they declined to review these documents because a review would show the need for a more expensive cleanup, and a secret deal had been made with Congress that put a limit on what could be spent on the cleanup.

**4. A small dose of ionizing radiation:** The CDPHE report supposedly refutes the notion that a small dose of ionizing radiation can be harmful. The 2006 BEIR VII study of the National Academy of Sciences concluded that any exposure to ionizing radiation is potentially harmful. But stronger data comes from the “father of health physics,” the late Karl Z. Morgan, long-time head of Oak Ridge National Laboratory. In an interview with Robert Del Tredici, he said radiation specialists first thought there was a threshold below which radiation would do no harm – “a safe level of radiation.” By about 1949 he and most other specialists “realized that there really wasn’t a so-called safe level of exposure.” They adopted the linear no-threshold approach to setting exposure standards, on the assumption that harm from radiation increases as the dose increases and decreases as it decreases. This linear approach remains the guiding principle for official bodies that set standards, such as the National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiation Protection (ICRP).

Later Morgan and colleagues – including Britain’s foremost radiation specialist, Alice Stewart – rejected the linear approach in favor of “a ‘supralinear’ hypothesis which fits the data more appropriately.” He said that “down at the low doses you actually get more cancers per person-rem than you do at the high doses. Now, I’m not saying that you get more cancers at these low doses than at high doses. I’m saying that damage per unit dose is greater at these low doses. And that’s true in part because the high levels will more often kill cells outright, whereas low levels of exposure tend to injure cells rather than kill them and it is the surviving, injured cells that are the cause for concern.” He told Del Tredici, “all the standard-setting bodies in the world today set these standards on the assumption that there is no safe level of radiation exposure. So the question is not: What is a safe level? The question is: How great is the risk? All exposure subjects you to some risk. . . . These forms of damage don’t show up immediately. With exposure to radiation you don’t feel the sense of pain that you often do when you burn yourself. But the damage shows up in a serious and dramatic way some years later when the results are diagnosed as cancer. That is why I think it behooves us to find out more accurately what these risks are.” (Del Tredici, *At Work in the Fields of the Bomb*, NY: Harper & Row, 1987, pp. 132-34)

Regarding the idea that standards protect us, the words of Ulrich Beck are pertinent. He says, “Whoever *limits* pollution has also *concurred* in it.” Exposure standards “may indeed prevent the very worst from happening, but they are at the same time ‘blank checks’ to poison nature and humankind *a bit*.” (Beck, *Risk Society*, translated by Mark Ritter, London: Sage Publications, 1992, p. 64)

**5. Inhaling even one particle of plutonium:** According to the CDPHE report, “Research has shown that a person would have to inhale large amounts of plutonium-contaminated dust to have a significant radiation exposure.” This flies in the face of what Karl Morgan, ‘father of health physics,’ said, as noted in 4. above. It is

true, as the CDPHE report says, that radioactivity levels at Rocky Flats are well below regulatory standards. But look again at 4. and you will see that any exposure can be harmful. Is not the duty of CDPHE to protect people from harm from radiation, especially children. They admit there's a risk, but say the risk is minor. Karl Morgan would not agree. Nor would Columbia University scientist Tom K. Hei and colleagues. A close look at their article, "Mutagenic effects of a single and exact number of particles in mammalian cells," *Proceedings of the National Academy of Sciences*, vol. 94, April 1997, cited by CDPHE on p.22, shows that they studied effects of exposure to a single plutonium alpha particle on both hamsters and humans, including miners of uranium and other radioactive substances. The group did a later study – "The Ionizing Radiation-Induced Bystander Effect: Evidence, Mechanism, and Significance," January 2013 – that showed harm to nearby cells not directly hit by radiation – the "bystander effect."

**6. Plutonium most dangerous substance known:** Physicist Fritjof Capra of the University of California, Berkeley, said, "Plutonium, the most dangerous of the radioactive byproducts is also the most long-lived; it remains poisonous for at least 500,000 years . . . more than one hundred times longer than all of recorded history. . . . Less than one-millionth of a gram – an invisible dose – is carcinogenic. One pound, if uniformly distributed, could potentially induce cancer in every person on earth." (Capra, *The Turning Point*, NY: Simon & Schuster, 1982, pp. 245-247)

**7. Locations of subsurface contamination are unknown:** CDPHE says that no subsurface contamination locations are known. But this is not true. Former Rocky Flats worker, Jerry San Pietro had heard from his uncle, who also worked at Rocky Flats, of a map showing deeply buried material – so deep that the largest Caterpillar tractor digging a trench for waste would not be visible. San Pietro and a colleague asked for permission to see the map but were denied until they threatened to make a FOIA request for it. One day they were suddenly told to come to a certain room on the site where they would be allowed 10 minutes to see the map. They could not bring a camera or writing equipment. The only thing they could take from the visit to the map was memory. During the cleanup, San Pietro contacted EPA and CDPHE asking them to look for the map so they could remove the deeply buried waste. When the agencies declined, he contacted various authorities, including members of Congress. There was no response. Details can be found in San Pietro's interview in the Rocky Flats oral history collection at the Boulder Public Library.

**8. Inadequate sampling:** CDPHE/CDH or some party they relied on took many samples, but the number of samples doesn't matter if the method failed to show accurate results related to public health. For example, shortly after Carl Johnson, MD, became director of Jefferson County Health Department, County Commissioner Joanne Paterson asked him if the Commissioners should approve a housing development on land east of Rocky Flats. CDH had already approved the project, but Paterson wasn't convinced. In the spring of 1975 Johnson and two USGS colleagues sampled dust for plutonium, because Johnson was convinced inhaling dust was the likeliest way to be exposed to tiny airborne plutonium particles. Dust samples taken at 25 locations showed plutonium concentrations, on average, 44 times greater than what had been measured at the same locations in previous surveys using the CDH method of whole-soil samples collected to a variety of depths. Several of the readings exceeded previous ones by 100 times or more, one by 285 times. The County Commissioners decided against the housing development.

In October 1975 Johnson formally proposed that, for purposes of assessing health risk, the state set a new standard based on plutonium in respirable dust on the surface of the soil. "The coarser materials which are not inhaled and retained," he pointed out, "have no bearing on the actual hazard to health and serve only to dilute the amount of radioactivity found by analysis, and may yield a spurious low concentration of plutonium that is misleading." To resolve the dispute between Johnson and CDH, the state brought Karl Z. Morgan (mentioned in 4. above) to Colorado to get his opinion. He agreed with Johnson. Colorado officials, having gotten from Morgan the advice they sought, chose to ignore it. (For more detail on Johnson and the state, see my "Democracy and Public Health at Rocky Flats" at

[http://docs.wixstatic.com/ugd/cff93e\\_5d3b6b6a12204505a3bc0fd2e2f504eb.pdf](http://docs.wixstatic.com/ugd/cff93e_5d3b6b6a12204505a3bc0fd2e2f504eb.pdf)

The CDPHE report briefly mentions surface water sampling on p. 7. Results of current sampling are readily published by the DOE Legacy Management site. But there's a little known piece of this story, a report prepared for the Actinide Migration Evaluation (AME) that maintains that cleanup of plutonium in the soil at Rocky Flats even to 10 picocuries per gram (10 pCi/g), as recommended by citizens (RMPJC), rather than the 50+ actually adopted, would result in conditions of either a 10-year or a 100-year storm in failure at certain downstream areas to meet the Colorado State standard for plutonium in surface water of 0.15 picocuries per liter (0.15 pCi/L). The author said further that nothing can be done to prevent this problem, because the source of the plutonium cannot be found. (Kaiser-Hill Co., T. E. Hakonson, Report

Another question: Was plutonium in surface water in excess of the state standard released in the September 2013 flood? We don't know, because at the height of the flood the sampling equipment did not work.

Plutonium bq/m<sup>2</sup>

- >= 74,000
- 18,500 - 74,000
- 1,850 - 18,500
- 740 - 1,850
- 370 - 740
- 185 - 370

Source: JeffCo Map 10/25/04 and Krey Hardy Map 8/1/70

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deposited there in 1970 was either still present or it had been replaced by plutonium later blown there from the site – neither a very happy reality. The Krey-Hardy map shows that the route proposed for the Jefferson Parkway (dotted red line) passes through the most contaminated area on the edge of the site. The 30 square-mile class area of contaminated property in the Cook v. Dow & Rockwell lawsuit was defined by the Krey-Hardy map. In the settlement of the case in 2016, the jury concluded that plutonium in the soil plutonium of those who brought the lawsuit will be harmful essentially forever.

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**11-12. High Volume air samplers and Continuous air monitoring:** Meteorologist W. Gale Biggs, in the 1980s was appointed by Governor Roy Romer to assess air monitoring at Rocky Flats. Among the things he learned are these:

- The majority of emissions (60-99%) are “fugitive” – plutonium from the soil picked up by the wind and carried elsewhere. This happened with the 903 leaks.
- Plutonium particles in fugitive emissions can be either small or large.
- The average size of particles in ductwork in plant buildings was very small, 0.045 microns.
- The average size of a human hair is about 50 microns.
- Particles released from the stack (such as those found in snow by Harvey Nichols) are tiny – probably smaller than 0.01 microns – because they have passed through several banks of filters.
- After emission from the stack, some small particles attach to larger airborne particles, such as pollen or organic matter, the size of which may range from about 15 to several hundred microns.
- Larger particles drop to the ground before they reach air monitors at the site perimeter and thus are not monitored. Some were deposited in the buffer zone.
- Smaller particles that reach monitors can pass through without being monitored.
- Thus the air monitors fail to monitor much of the emitted airborne plutonium.
- Small particles probably travel some distance before settling.
- The population was exposed to airborne plutonium before it settled.
- By means of the “alpha-recoil effect,” a process that continues indefinitely, radiation decay of plutonium generates enough energy to blast a piece of plutonium off the particle.
- Due to alpha recoil, particles decrease in size and increase in number. Most of these tiny particles can pass through the filters of the monitors and thus are not measured. They can be readily picked up by wind and more readily inhaled.
- For all the reasons cited, the amount of plutonium emitted was not measured and could not be known.
- Though the most dangerous exposure is from airborne pathways, we cannot estimate the extent of the health problem because we do not know the emissions.

Aware that wind at Rocky Flats distributes particles of plutonium on the surface of the soil, Biggs criticizes government agencies for ending sampling of airborne particles after the cleanup. For more, see

<http://www.rockyflatsnuclearguardianship.org/blank?lightbox=i0fhh>

**13. Plutonium surface soil action levels inadequate:** CDPHE says the final surface soil action levels established at Rocky Flats – 50 pCi/g – are adequate. Consider the following action levels in pCi/g at other sites: Enewetok Atoll – 40; Johnston Atoll – 14; Hanford Site – 34; Fort Dix, NJ – 8; Livermore National Laboratory – 10. Most of these sites are well below the 50 at Rocky Flats. The only site with a higher number (200) is the Nevada Test Site, where bombs exploded repeatedly and there is scant population nearby.

**18. Missing plutonium:** CDPHE says there’s no evidence that plutonium from Rocky Flats was dumped at the Lowry Landfill southeast of Denver. But on April 12, 16, and 19 of 2001 Pulitzer Prize winning author Eileen Welsome, with the assistance of environmentalist Adrienne Anderson, published a series of three carefully documented articles in the Denver weekly *Westword*, providing details about the illegal dumping of a large quantity of plutonium from Rocky Flats at the Lowry Landfill, about 30 miles from Rocky Flats.

According to Welsome, most of the large corporations in the Denver area and many smaller ones, disposed of many kinds of waste there. After Lowry Landfill was named a Superfund site in 1994, the polluters scrambled to escape high costs for what they had done, while also working behind the scenes and off the record to avoid publicity. A coalition of the larger corporations wanted to make Rocky Flats operators pay a high fee to clean up the radioactive materials dumped there. But, with the complicity of the EPA and the City of Denver (which for years owned the site), they reversed themselves, paid fees to get immunity from future charges related to the radionuclides, and worked out a “cleanup” scheme to reduce the quantity of plutonium and other toxins buried at Lowry. Their solution for the plutonium was to move it in liquid form more than 15 miles (as the crow flies) through city sewer lines to the Metro Wastewater Reclamation District plant just south of where the South Platte River flows under Interstate 270 in north Denver. Sewer lines are not authorized to transport radioactive material, so this was – and continues to be – clandestine. In the summer of 2000 the plutonium-contaminated waste began flowing from the Lowry Superfund site at a rate of 20 to 25 gallons a minute, or about 30,000 gallons per day. This flow of radioactive liquid will continue for 50 years or longer, until the plutonium is no longer at Lowry. Once the plutonium-bearing liquid waste reaches the Wastewater plant it is treated. The cleaner water is released into the South Platte, the

heavier plutonium-bearing sludge (“biosolids”) is trucked 50 miles east and spread as fertilizer on farmland, and the remaining mildly contaminated water is used to irrigate parks, school yards and parkways in Denver. The large polluters included the two major newspapers, the *Denver Post* and the former *Rocky Mountain News*, neither of which ever carried a story critical of the contamination at Lowry Landfill.

Not surprisingly, Rocky Flats authorities denied that radionuclides from the plant were ever dumped at Lowry Landfill. But according to Welsome, several drivers of tank trucks admitted that they delivered liquid waste from Rocky Flats to Lowry Landfill. Also, police officers said they saw some of the deliveries, and trucking company records confirm that the transport happened. A letter addressed by a coalition of the polluters to EPA shows alarmingly high levels of plutonium and americium at numerous wells drilled at the site. EPA denies that such a letter exists, but both Welsome and Anderson had copies. The level of denial about what’s present at Lowry Landfill is well nigh universal among the polluters. But when denial meets documentation, documentation prevails. Welsome and Anderson provided the documentation. The extent of the denial makes this perhaps the greatest single environmental scandal in Colorado history

**19. Plants and animals are negatively impacted:** The CDPHE report says on p. 49 that there is “no observed animal mortality.” But apparently no one is looking closely. In 1996 ecologist Shawn Smallwood, hired to testify in the Cook v. Rockwell case, came to Rocky Flats three times to study burrowing animals on the site. According to his testimony in court, he found 18 species of borrowing animals, some that burrow to a depth of 16 feet. They take things on the surface down and bring to the surface whatever is buried, including plutonium. They disturb 11 to 12% of surface soil on the site in any given year. The plutonium, which at Rocky Flats is only partially remediated down to a depth of 6 feet and is not remediated at all below that level, is being constantly re-circulated in the environment. What is now buried is likely some day to be brought to the surface for wider dispersal by wind, water, fires or other means. Though the CDPHE report says on p. 8 that residual contamination at Rocky Flats is within regulatory limits, there are no limits for contaminants below 6 feet. Burrowing animals can be expected to bring some of these contaminants to the surface, where they can be picked up and re-distributed by the wind common at the area.

Former Rocky Flats worker, Jim Kelly, often spoke of the “hot rabbits” on the site. Who really knows the condition of the wildlife at Rocky Flats? Deer killed along the roads around Rocky Flats typically are contaminated with plutonium. Smallwood says he was surprised to learn that no genetic studies were ever performed on wildlife at Rocky Flats or any other DOE facility. Hermann J. Muller received the Nobel Prize in medicine in 1924 for his discovery of genetic mutations in fruit flies exposed to radiation. Toward the end of his life he published an article on the genetic effect of radiation exposures in humans. Though radiation exposures may cause birth defects, far more serious are the cumulative effects of exposures “over a virtually unlimited period.” The damage to posterity will be massive. “Therefore the hereditary damage should be the chief touchstone in the setting of ‘permissible’ or ‘acceptable’ dose limits . . . We must learn, through experience, to tackle our problems of today that affect tomorrow in a truly responsible way – one that our successors will thank us for.” (Muller, “Radiation and Heredity,” *American Journal of Public Health and the Nation’s Health*, vol. 54, January 1964.) Of course the genetic harm Muller says happens with humans will happen with the animals that don’t wear clothes, perhaps to a greater degree.

## **POINTS IGNORED BY CDPHE**

**A. Those exposed are excluded from setting exposure standards:** I was on two NCRP committees from 1999 until 2004. At the 2004 annual meeting in Washington I and two colleagues gave a presentation in which we urged the NCRP to include affected parties, such as workers and nearby residents, in studying radiation health effects and setting exposure standards. Our appeal was published (Lisa Ledwidge, LeRoy Moore and Lisa Crawford, “Stakeholder Perspectives on Radiation Protection,” *Health Physics*, vol. 87, no. 3, Sept. 2004). The NCRP rejected our proposal. They function like a medieval priesthood that has granted itself the right to decide the fate of people exposed to radiation. In Colorado, a state where many are exposed to plutonium and other radionuclides, health officers employed by the State have made no effort to get NCRP to involve affected parties in setting exposure standards.

**B. Danger from background radiation:** An important figure in the history of Rocky Flats is the late Edward Martell, radiochemist at Boulder’s National Center for Atmospheric Research (NCAR). Until he told the public about plutonium releases from Rocky Flats, there was very little awareness of what was done at the plant and that it posed a local hazard. Neither officials from Rocky Flats or the Colorado Department of Health



(CDH) informed the public of this danger. Going beyond Morgan's claim that low doses of radiation can prove more harmful than high doses, Martell focused on the danger of natural background radiation. Many cancers, he said, are due "to lifetime exposures to natural background radiation." Those who ignore the adverse role of naturally occurring radiation, he noted, find it easy to allow additional exposure from human-made sources. Given what Martell and Morgan showed, no radiation should be added to natural background. Radiation exposure standards do not prevent harm. Why unnecessary exposure? In the face of such risk, we must follow the precautionary principle. On Martell, see my "Democracy and Public Health at Rocky Flats" (2012) at [http://docs.wixstatic.com/ugd/cff93e\\_5d3b6b6a12204505a3bc0fd2e2f504eb.pdf](http://docs.wixstatic.com/ugd/cff93e_5d3b6b6a12204505a3bc0fd2e2f504eb.pdf)

**C. Actinide Migration Evaluation (AME):** Does plutonium in the soil migrate? In the wet May of 1995, Rocky Flats soil scientist M. Iggy Litaor, with monitoring instruments set up in the soil at the site, found rapid movement of plutonium. Despite this widely reported finding, the AME concluded that plutonium in the soil at Rocky Flats is "relatively immobile." This view was adopted by DOE, EPA and CDPHE in setting the cleanup standards for Rocky Flats. Research done elsewhere, in the U.S. as well as in Russia, is that plutonium migrates. Annie B. Kersting of the Livermore Laboratory in California, who has probably researched this topic more than anyone else, insists that plutonium moves. (For a critique of the AME work, see my "Science Compromised in the Cleanup of Rocky Flats," on line at [http://docs.wixstatic.com/ugd/cff93e\\_3cbba79a1210448f942ac8f158425566.pdf](http://docs.wixstatic.com/ugd/cff93e_3cbba79a1210448f942ac8f158425566.pdf)

**D. The legacy of increased alpha radiation:** The amount of alpha radiation given off by material in the Rocky Flats environment actually increases with time, thanks to the presence in the original bomb-grade material of a small quantity (0.4%) of plutonium-241 (Lamm-Wirth Task Force on Rocky Flats, Final Report, October 1975). Plutonium-241 has a half-life of 14.3 years. As it decays, it becomes americium-241, an alpha emitter with a half-life of 460 years. In about 75 years, after five half-lives, the alpha activity of the rapidly decaying americium-241 equals half the activity of the plutonium-239 in the original mix of material purified for bomb production. (S. E. Poet and E. A. Martell, "Plutonium-239 and Americium-241 Contamination in the Denver Area," *Health Physics*, vol. 23, Oct. 1972, p. 545) This means that, for a period of time beginning around 2030 and tapering off after 2065 the total alpha radiation emitted by plutonium and americium remaining in the Rocky Flats environment will be at a level 50% higher than this same material emitted when it was first deposited in the environment.

**E. The "Risk-based cleanup" at Rocky Flats:** The "cleanup" done at Rocky Flats and held out as the model for other sites is what DOE calls a "risk-based cleanup" or "risk-based end state." In sum, this approach entails tailoring cleanup to a legally compliant risk level. The Rocky Flats "cleanup" exposes the wildlife refuge worker to a level of risk that complies with Superfund law. Thus, future use, the cleanup scenario, legal compliance, and limited funding all come together in a "cleanup" called "safe and compliant." DOE's "risk-based" approach fails to take into account all risks. We must consider unpredictable human or natural actions that may radically alter conditions at a site. A key intent of the "risk-based" approach is to comply with the law, that is, with applicable radiation exposure standards. But standards change from time to time, usually in the direction of greater stringency as more is learned about adverse health effects of radiation exposure. (Catherine Caufield, *Multiple Exposures: Chronicles of the Radiation Age*, NY: Harper & Row, 1989)

Those who set exposure standards calculate risk according to averages rather than according to the danger posed to the most vulnerable members of a population. The risk of harm to everyone who actually gets sick or dies due to an exposure is obviously 100%, while the risk to others is 0%. Calculating risk according to some average thus applies to neither group.

The weakness of the averaging approach for calculating risk is especially evident in the way standards for plutonium exposure are set. If plutonium lodges in the body, as typically it does, the alpha radiation it emits repeatedly bombards surrounding cells. This continuing onslaught makes alpha radiation far more harmful per unit dose than penetrating radiation like gamma or X-rays. To account for the difference, agencies such as the International Commission on Radiological Protection (ICRP) refer to the "relative biological effectiveness" (RBE) of alpha emitters. Assessing the potential harm to different organs and for different disease end-points, ICRP arrived at an average RBE for alpha emitters of 20. This means that on average alpha radiation inside the body is 20 times more harmful than gamma radiation of the same dose. This is a substantial increase, but, because 20 is an average, for some body organs and for certain cancers as well as for some individuals the actual RBE is even higher, sometimes much higher. A detailed report on this issue done as part of the Rocky Flats dose reconstruction study shows that the RBE for plutonium ranges from as

low as 1 for leukemia to as high as 375 for some bone cancers with other cancers ranged between (Risk Assessment Corporation, *Assessing Risks of Exposure to Plutonium, Final Report*, CDPHE, Feb. 2000, pp. 6-40). Despite this huge range, ICRP recommends to organizations that set standards for exposure to plutonium that they use 20 as the RBE. (ICRP Publication 26, Oxford: Pergamon Press, 1977; and ICRP Publication 60, Oxford: Pergamon Press, 1990) This implies that, on average, exposure to alpha radiation from plutonium is 20 times more risky than exposure to gamma radiation.

The agencies that calculated the Rocky Flats cleanup standards followed the established pattern and used an RBE of 20 for plutonium. By using this number they underestimated the risk of harm that could result from plutonium exposure to certain organs of the body or to given individuals, including of course a possible individual refuge worker who may be particularly vulnerable without realizing it. Doing more to protect the vulnerable would alter the level of cleanup. Doubling the plutonium RBE to 40 would reduce the surface soil standard by half from 50 to 25 pCi/g. Doubling the RBE again to 80 would drop the surface cleanup level to 12 pCi/g (I owe this insight about the effect of RBE doubling to John Till of Risk Assessment Corporation). There may, however, be much more at stake than protecting a relatively small number of vulnerable individuals. M. A. Kadhim and colleagues working with Eric G. Wright of the Medical Research Council at Harwell, Oxfordshire, England, concluded that the RBE for chromosomal damage resulting from a single plutonium alpha particle traversing a cell is "effectively infinite" due to possible permanent pollution of the human gene pool. (Kadhim et al, "Transmission of chromosomal instability after plutonium alpha-particle irradiation," *Nature*, 335, Feb. 20, 1992, pp. 738-740) Wright calls this "radiation-induced genomic instability." Rob Edwards in an article on this subject quotes Jack Little of the Harvard School of Public Health: "Genomic instability changes our way of thinking about how radiation damages cells and produces mutations." Some researchers think it may offer a "plausible mechanism" for explaining illness other than cancer, illnesses so elusive that epidemiology is "powerless" to detect any relationship between their incidence and exposure to radiation. Keith Baverstock, a senior radiation specialist with the World Health Organization, and Wright believe people "should be more wary of low-level radiation. If genomic instability is causing unpredictable disease, and if some people are genetically predisposed to it, the regulatory system starts to look inadequate." (Rob Edwards, "Radiation Roulette," *New Scientist*, Oct. 11, 1997, pp. 37-40) Even setting aside genomic instability, those who calculate risk for the purpose of establishing standards for permissible exposure are willing to allow fatalities and disabilities. For some anonymous persons, legal compliance may prove a sentence of premature death. In the trenchant words of Ulrich Beck, a foremost European critic of what he calls "risk society" (quoted in 4. above), exposure standards "may indeed prevent the very worst from happening, but they are at the same time 'blank checks' to poison nature and humankind a bit." (Beck, *Risk Society: Towards a New Modernity*, trans. Mark Ritter London: Sage, 1992, p. 64.)

Risk as defined within the closed culture of the nuclear establishment gets written into law as standards for permissible exposure. The resultant regulations then are enforced as if morality and legality were identical. But the foundational concept of risk itself has been created out of whole cloth without input from affected populations, much less their direct participation in decision-making. (Moore, "Lowering the Bar," *Bulletin of the Atomic Scientists*, May-June 2002, 28-36; see at [http://docs.wixstatic.com/ugd/cff93e\\_0d1d35fb8d8140698e530f1095352eb3.pdf](http://docs.wixstatic.com/ugd/cff93e_0d1d35fb8d8140698e530f1095352eb3.pdf)) The studied indifference to the earthly fate of portions of humankind, to say nothing of other life forms, is startling. Suffice to say that DOE's risk-based approach to cleanup is a human product and that, as such, it needs scrutiny. When it is scrutinized, it doesn't bear up very well.

**F. The State of Colorado sets a meaningless standard for plutonium in soil:** In response to all these revelations about plutonium released from the plant into off-site areas, Colorado was the first state with a DOE nuclear weapons plant to set a standard for plutonium permitted in off-site soil. In January 1973 Colorado stated that land where plutonium contamination exceeds 0.2 disintegrations per minute per gram of soil (dpm/g) is "unfit for residential use, subdivision development, or commercial and industrial uses." (R. L. Cleere, "Public notice of plutonium contamination in the area of the Dow Chemical Rocky Flats Plant," Signed R. L. Cleere, Executive Director, CDH, January 24, 1973) But this strict rule did not last. Less than two months later the state increased by tenfold the amount of plutonium to which exposure was allowed, from 0.2 dpm/g to 2.0 dpm/g. And it lifted its prohibition against residential, commercial, or industrial uses in areas where contamination did not meet the new standard; hereafter it would merely require "special techniques" for construction in these areas, such as plowing plutonium under. ("Amendment to the State of Colorado Rules and Regulations Pertaining to Radiation Control, Subpart RH 4.21.1," Adopted Colorado State Board of Health, March 21, 1973) Thus, the standard was completely gutted of its original provisions for public health. In 1975, Martell criticized the state standard for being at least 20 times too high and not

protective of public health. (Martell, “Basic considerations in the assessment of the cancer risks and standards for internal alpha emitters,” at the public hearings on plutonium standards, US EPA, Denver 1975, pp. 17, 20) Nonetheless, the revised standard remains in effect today, allowing residential development very near the site. To the state government, economic growth is more important than protecting public health.

**G. The State’s Misleading Soil Sampling practice:** In enforcing its new standard for plutonium in soil in areas east of the site, CDH employed from the outset a sampling method that thwarted its ability to locate places where the plutonium concentration exceeded the standard. Rather than analyzing specific samples for their radiation content, CDH divided the area to be sampled into large sectors, then calculated the average plutonium concentration in each sector by compositing all the soil collected from twenty-five samples taken from within that sector. (Jonathan Love, “Rocky Flats Soil Plutonium <sup>239+240</sup> Survey from 1970 to 1991,” Denver: CDH, 1994). This approach may show average distribution in large areas, but it dilutes particular points where readings are high by averaging them with lower readings making identification of hot spots impossible.

CDH’s soil sampling also misrepresented reality in that over time its samples were collected to increasingly greater depth. This diluted the material measured and gave the impression that the quantity of plutonium in the soil was steadily decreasing. An internal study criticized this practice and showed that plutonium concentrations in soil around Rocky Flats had changed little from 1970 until 1991 (Richard H. Jones and Yiming Zhang, “Spatial and temporal analysis of the Rocky Flats soil plutonium data,” Denver: CDH, September 19, 1994). For public health assessments, CDH eventually adopted the practice of compositing samples taken from the top quarter-inch of soil within a given area, continuing in shallow surface soil the method criticized in the previous paragraph. The words of German analyst Ulrich Beck quoted earlier (p. 2) are apt: “Whoever limits pollution has also concurred in it.” Standards for “permissible” exposure “may indeed prevent the very worst from happening, but they are at the same time ‘blank checks’ to poison nature and humankind a bit.” (Beck, *Risk Society: Towards a new modernity*, trans. Mark Ritter, London: Sage, 1992, p. 64)

**H. Rocky Flats Downwinders:** At noon on Downwinders Day of Remembrance, January 22, 2016. Tiffany and Nick Hansen gathered a crowd at the steps of the State Capitol in Denver to formally inaugurate the Rocky Flats Downwinders. The project is collecting names and information from anyone who lives or ever lived downwind of Rocky Flats and suspects physical ailment(s) may be due to exposure to plutonium or other toxins released from Rocky Flats. The RF Downwinders contracted first with Professor Carol Jensen of Metro State in Denver, then with Professor Bonnie Kite at the University of Denver to compile a full record of information shared by people. More recently Sasha Stiles, MD, works with them. Tiffany and Rick Hansen, their colleagues and a host of others hope to get compensation that has never been available to people downwind of Rocky Flats whose health was harmed by exposure to material released from the plant.

On November 21, 2016, Rick Hansen wrote CDPHE asking for data from the Colorado Central Cancer Registry from 1980 to the present showing the incidence of thyroid cancer and “rare cancers” among people downwind of Rocky Flats versus the general population. A few days later CDPHE published a new study with a map with shading for the study area (see Figure 1). Based on this study, CDPHE claimed that there is no difference in cancer incidence between people exposed to radiation released from Rocky Flats and people who are not exposed.

The CDPHE map misrepresents the area of plutonium contamination and thus possible cancer. In the 1970s P. W. Krey of the AEC collected samples throughout the Denver Metro Area to see where plutonium released from Rocky Flats had been deposited. His map shows clearly downwind exposure areas (see Figure 2). Note the contrast between where Krey found contamination and the CDPHE shaded study area. The shaded area includes large non-contaminated spaces and omits large contaminated spaces (such as most of Denver and nearby suburbs). The CDPHE study greatly diminishes Rocky Flats cancer incidence by including data from non-contaminated regions and excluding data from contaminated ones.



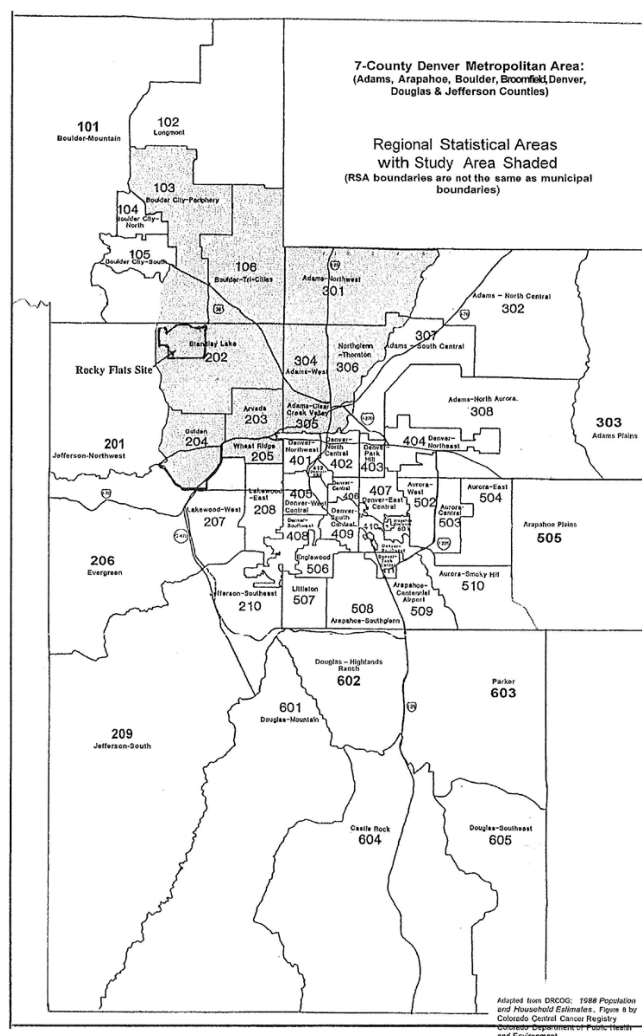


Figure 1: CDPHE 's map, with shaded study area.

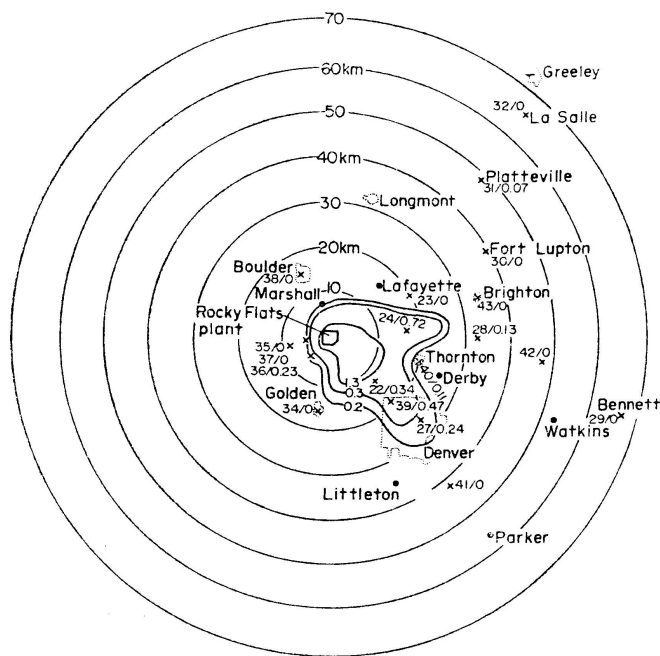


Figure 2: Map from Krey, "Remote plutonium contamination and total inventories from Rocky Flats," *Health Physics*, 1976, vol. 1, pp. 209-214.

This misrepresentation is not new. In 1998 CDPHE issued a report claiming that those living near Rocky Flats have no higher incidence of cancer than people elsewhere in the metro area (Colorado Central Cancer Registry, *Ratios of Cancer Incidence in Ten Areas Around Rocky Flats, Colorado Compared to the Remainder of Metropolitan Denver, 1980-89 with Update for Selected Areas, 1990-95*, Denver: CDPHE, 1998). This mixing of populations exposed to plutonium with populations not exposed is like their response to the Downwinders.

**I. Needed studies that never happened:** John (Jock) Cobb of the University of Colorado medical faculty did an EPA sponsored study of lung, liver and bone in cadavers at several hospitals in Denver and one in Pueblo. All the bodies had plutonium from global fallout, but those from the Denver area had high concentrations of identifiably Rocky Flats plutonium, with the contents higher the closer the person lived to Rocky Flats. Others recommended full health studies of live people in the Denver area. Here are three examples:

- In 1982, Ed Martell said that the plutonium in the soil east of Rocky Flats “involves risks that are sufficiently serious that only epidemiological studies of the next several generations of people living in that area can really find out what is going on.” (Martell, Interviewed by Robert Del Tredici, 1982)
- In 1996 nurses at the University of Colorado medical center conducted a community needs assessment and concluded that community-based epidemiological studies should occur in areas affected by Rocky Flats. (N. J. Brown et al, *Rocky Flats community needs assessment report*, Denver: UCHSC School of Nursing, 1996, p. 46)
- Boston University epidemiologist Richard W. Clapp performed a small epidemiological study in which he found excessive incidence of lung and bone cancers in areas near Rocky Flats. He concluded that “the most recent data are indicative of an ongoing health effect and support the need for surveillance of the incidence of cancer and other diseases on a continuing basis in the exposed communities.” (Clapp, Report submitted 13 November 1996 for plaintiff’s counsel in *Cook vs. Dow Chemical and Rockwell International*, United States District Court, District of Colorado) He, like Martell, thought only epidemiological studies repeated over several generations in the contaminated area would help us “really find out what is going on.”

The programs that Clapp, Martell and the nurses proposed have not taken place. Indeed, there has never been any direct health study or medical monitoring of people who live in areas shown by AEC scientists to be contaminated with plutonium released from Rocky Flats. Hence, no one really knows the actual health effects of living in such areas. Why has not CDPHE supported such studies instead of insisting that the area downwind of Rocky Flats and the Wildlife Refuge is “safe”? Data from such studies would demonstrate the truth.

**J. CDPHE and the Wildlife Refuge:** Wes McKinley was foreman of the grand jury that spent nearly 3 years reviewing evidence of alleged environmental crime at Rocky Flats collected by the FBI in its 1989 raid on the plant. McKinley is under court order not to reveal what he learned about conditions at Rocky Flats, but he objects to opening the Wildlife Refuge to the public. He got himself elected to the state legislature hoping this would give him a chance to do something about Rocky Flats. He introduced a bill that would provide to visitors information about dangers on the site before they entered it. CDPHE openly opposed McKinley’s “informed consent” bill.

**K. Unexpected words:** During the cleanup, responsible parties held an all-day public meeting on a Saturday at a hotel in a suburban community a few miles northeast of Rocky Flats. At a break in the afternoon a scientist from EPA’s lab in Las Vegas took me aside to say that he had visited most of DOE’s nuclear weapons sites. At these sites EPA and state authorities typically work closely with the public so they can address DOE with one voice, but here at Rocky Flats the EPA and the Colorado Department of Public Health and Environment work closely with DOE so they can address the public with one voice.