

# ROCKY FLATS STEWARDSHIP COUNCIL

P.O. Box 17670  
Boulder, CO 80308-0670  
www.rockyflatssc.org

(303) 412-1200  
(303) 600-7773 (f)

Jefferson County -- Boulder County -- City and County of Broomfield -- City of Arvada -- City of Boulder  
City of Golden -- City of Northglenn -- City of Thornton -- City of Westminster -- Town of Superior  
League of Women Voters -- Rocky Flats Cold War Museum -- Rocky Flats Homesteaders  
Nancy Newell

## MEMORANDUM

**TO:** Chris Hanson & Joe Cirelli, Town of Superior Board of Trustees  
**CC:** Rocky Flats Stewardship Council  
**FROM:** David Abelson & Rik Getty  
**SUBJECT:** Summary of impacts to Rocky Flats resulting from the 2013 flood and 2015 precipitation  
**DATE:** September 15, 2015  
Revised December 10, 2015

---

This memo replies to your two emails in which you ask about the impacts on Rocky Flats of two weather-related events.

Your September 2015 email posed two questions:

1. What impacts did the September 2013 rains have on Rocky Flats?
2. What are the impacts resulting from the above-average precipitation in the first six months of 2015?

In response to our draft September 15<sup>th</sup> memo to you, in late November you posed three additional questions:

1. Was the site infrastructure and its collection and treatment systems designed to deal with excessive rainfall of the magnitude experienced in 2013? If not, what were the consequences of any failures and what should be done to prevent such failures in the future?
2. We have heard that the site experienced “sheet flooding” that may have resulted in water leaving the site and crossing Indiana Avenue without going through the designed collection and measuring systems. If that was the case, what were the consequences and what can be done to prevent this in the future?
3. Why [is] independent, ongoing testing of the site and contiguous lands is not part of the standard protocol. The site is dynamic, not static. Why not monitor it as such?

We have not changed the text of our draft September 15<sup>th</sup> memo. We address your follow-on questions separately near the end of the memo. We encourage the Town to also direct these questions to DOE, CDPHE, EPA and USFWS.

## Summary

1. Since long before closure through today, including the September 2013 flood, water flowing off-site has met all applicable water standards, including the plutonium standard which is 100 times more protective than the applicable federal drinking water standard.
2. Problems persist at the original landfill, the former dump that sits above Woman Creek in the DOE-controlled lands. There have not been any water quality impacts resulting from these problems, but both short-term and long-term responses are needed.

## 2013 Flood

Rocky Flats received less water (around 9" of rain) and experienced far less damage than the communities to the north, particularly Boulder and Lyons. There is very little infrastructure at Rocky Flats, and the engineered controls DOE installed as part of the closure project held up despite the heavy rain.

That said, Rocky Flats did experience some impact.

1. Water treatment systems: There are three groundwater treatment systems. The increased groundwater flows following the 2013 September rains damaged some of the equipment in the underground treatment vaults, but repairs were quickly made.
2. Surface water sampling systems: There are eight automated sampling stations along Walnut and Woman creeks, 11 surface water grab-sampling locations, and 88 groundwater monitoring wells. For two related reasons, data gaps exist in some of the surface water samples. First, some of the collection bottles at the automated surface water monitoring stations filled up quickly due to the large amount of stream flows. Because site personnel were unable to access the site for a few days, some samples were not collected. In addition, two sampling stations on Woman Creek were damaged during the flood, which rendered them unable to collect additional samples until DOE contractors were able to access the site. (More below)
3. Plutonium exceedance: Sampling location GS051, a surface water sampling location in the DOE-controlled lands, recorded elevated levels of plutonium in excess of the applicable standard. The highest reading during this period was on October 4, 2013, but the value quickly receded by October 7<sup>th</sup>. This monitoring point has been and remains a priority focus for the Stewardship Council as levels dating to 2009 have periodically exceeded the standard. (While the standard is exceeded at this point, at the regulatory points of compliance, the standards continue to be met.)
4. Original Landfill: There has been slumping primarily on the eastern edge of the landfill, with some other impacts on the western edge. Neither has resulted in water quality impacts, though remedial actions and long-term management are needed.
5. Power systems: There is no line power, and there was no damage to the solar powered generating equipment.
6. Roads: There are no paved roads, only dirt/gravel roads, and many of them sustained only minor damage.

We toured Rocky Flats following the flood. We found that the site held up remarkably well, far better than our neighborhoods. There were some noticeable high water marks, but not any

gullying that we could identify, and no real visual impact. The worst area hit was in the northwest portion of the Rocky Flats National Wildlife Refuge, adjacent to the NREL site.

#### Off-site plutonium movement

During both the September 2013 event and at all times since completion of the remedial actions in October 2005, all water leaving Rocky Flats has met stringent water quality standards. For plutonium, the site-specific standard is 100 times more protective than the applicable federal drinking water standard. That does not mean that water is free of any contamination, including plutonium; it simply means that the stringent standards for water flowing off of Rocky Flats are being met.

While the standards have been met, what is harder to calculate is the amount of plutonium (known as “load”) that moved off-site during the flood. To help answer this question, one key data point comes from soil sampling that the Woman Creek Reservoir Authority, an authority comprised of Westminster, Northglenn and Thornton, completed in 2014. The Authority sampled soil sediments in the floor of the Woman Creek Reservoir, a reservoir sited just east of Indiana Street that interrupts flow from Woman Creek.

The Woman Creek Reservoir came on-line in 1996. Sampling indicates that the risk levels for plutonium found in the Reservoir soil sediments are lower than levels on the land prior to the creation of the Reservoir. Specifically, background soil plutonium levels due to atmospheric nuclear weapon testing from the 1940’s to 1960’s are around 0.05 – 0.06 picoCuries of plutonium per gram of soil (pCi/g). The sediments and bore samples from the three Reservoir holding cells showed plutonium levels below background levels. Further, more than half of the sediment/bore samples were below the analytical detection limit of 0.02 pCi/g. This data tells us that since the Reservoir was excavated in 1996 and water from Woman Creek began flowing into it, only a small amount of plutonium has run off of Rocky Flats in this drainage.

There is no similar data for Walnut Creek, which also flows through Rocky Flats.

#### **Impacts of 2015 rain**

As previously mentioned, water leaving Rocky Flats continues to meet the applicable water quality standards. The biggest impact of 2015 precipitation (both snow and rain) concerns stability issues with the soil cover on the original landfill.

The original landfill was a 1950’s-era hillside dump consisting of mainly construction debris with some other waste forms. It was closed in 1968 when the present landfill was opened. The original landfill is sited on a 15 degree, south-facing slope on the north side of Woman Creek. The remedial action required the installation of a two-to-three foot soil cover. Berms were installed across the face of the landfill to direct surface runoff to the east and west perimeter channels. A soil buttress was also placed across much of the bottom of the landfill. There are water monitoring points below and downstream of the landfill, testing both water moving across and through the landfill.

Since 2007, there have been instances of slumping and subsidence on the face of the landfill. An extensive geotechnical investigation identified a root cause with the landfill—namely, a layer of

organic matter which sits atop a stone layer underlies the landfill. When sufficient surface water or upgradient groundwater infiltrates this organic layer, it results in movement of the landfill, which is expressed on the surface a cracks/fissures/slumps. The wet 2015 spring resulted in the largest surface movement to date. Extensive repairs have been made to the face of the landfill. The major focus was to re-direct more water off the face of the landfill to the two perimeter channels.

Next steps with the landfill

DOE has hired a geotechnical engineer to evaluate the landfill and propose interim actions. The agency is next preparing to issue an RFP to hire a firm to further evaluate the landfill and develop long-term options. The Stewardship Council will be briefed on those longer-term options at its February 2016 meeting.

.....

Addendum: Responses to November 27, 2015 questions

**November 2015 question:**

- 1. Simply put, was the site infrastructure and its collection and treatment systems designed to deal with excessive rainfall of the magnitude experienced in 2013? If not, what were the consequences of any failures and what should be done to prevent such failures in the future?**

Response: We put this question to Carl Spreng with CDPHE, who in turn reached out to DOE. Carl explains that protecting against the impacts of a 100 year flood was part of the final site remedy. He notes that effort involves the development of the functional channels, rock channels designed to help move water from large precipitation events through the Central Operable Unit (the DOE-retained lands). Additional flood mitigation efforts were implemented, including work at the ash pits waste disposal trenches.

DOE offered the following:

Besides the land configuration design (Functional Channels), the dam breaches and the Landfill closures were designed and constructed to urban drainage standards, CDPHE requirements, or greater. The final land configuration project was intended to promote sheet flow vs channel flow in all except the heavy precipitation events. The functional channels were designed and constructed to facilitate flow of water resulting from the heavy events, while minimizing erosion across the landscape. The intent was to minimize sediment transport and deposition, while maintaining protection from the heavy precipitation events.

Regarding the consequences of the impacts on the treatment systems, DOE has modified those systems (all treat contaminated groundwater) since closure. The Stewardship Council is regularly briefed on the changes and resulting monitoring data. The issues at the treatment systems and changes that have been made are not directly linked to the two precipitation events, but address a broader set of issues.

As for system failures, we believe the greatest impact was to the two surface water quality monitoring stations that were knocked off-line for part of the September 2013 flood.

**November 2015 question:**

- 2. We have heard that the site experienced “sheet flooding” that may have resulted in water leaving the site and crossing Indiana Avenue without going through the designed collection and measuring systems. If that was the case, what were the consequences and what can be done to prevent this in the future?**

Response: There are a few things to consider in answering this question. First, sheet flooding across the Central Operable Unit. As noted in the response above, in order to minimize erosion on these lands, the remedies are designed to promote sheet flooding, except in high-precipitation events.

Second, for the lands that now comprise the Rocky Flats National Wildlife Refuge, there clearly was sheet flooding, and water did cross Indiana Street. The agencies have no way of knowing how much water moved via sheet flow, how much water bypassed the monitoring systems, or how much contamination might have been carried off-site.

Third, DOE, CDPHE and EPA released the refuge lands for any and all uses. That means from a regulatory standpoint as it pertains to contamination, sheet flow, including water moving off-site, is not an issue of concern for the agencies. (Restrictions on land use are found in the Rocky Flats refuge authorizing legislation and in U.S. Fish and Wildlife Service’s organic act and agency regulations. Those restrictions are not related to residual contamination found on the Refuge.)

That said, as framed in the question, the potential consequences or impacts of sheet flow are a concern to some. As noted earlier in this memo, water quality standards were met throughout the flood, and the areas where the water is tested is where the majority of the contamination that would move via water is found. The contaminant levels across the buffer zone are low, and in many places are indistinguishable from background levels. Given the aforementioned soil testing the Woman Creek Reservoir Authority conducted following the 2013 flood, we presume, but certainly don’t know, that any contamination that might have moved off-site via sheet flow would show similarly negligible levels of contamination, well within the applicable risk ranges.

Regarding what can be done to prevent sheet flow exiting the refuge lands, we recommend putting that question to USFWS, CDPHE, EPA and DOE. We are not civil engineers and thus cannot speculate what it would take to capture sheet flow coming off the refuge lands.

**November 2015 question #3:**

- 3. Why [is] independent, ongoing testing of the site and contiguous lands is not part of the standard protocol. The site is dynamic, not static. Why not monitor it as such?**

Response: The answer to the question is rooted in federal law, specifically CERCLA. The decision to require ongoing testing derives from environmental analyses and the corresponding record of decision that formalizes the agencies' final decision. There are two key decisions that pertain to this question—1996 and 2006.

The 1996 record of decision to de-list the off-site lands from the CERCLA National Priorities List does not require ongoing soil sampling. That decision was made based on the contamination levels and corresponding risk to human health and the environment. The 2006 record of decision signaled the end of site remediation activities, with the exception of ongoing groundwater treatment. That decision requires ongoing water quality monitoring both on-site and for water leaving the DOE lands, but does not require any ongoing soil testing either on-site or off-site. That decision likewise allowed the agencies to cease air quality monitoring. In both the 1996 and 2006 decisions, the agencies could have required soil sampling, air quality monitoring, and additional water quality monitoring had they found it necessary to implement the applicable decision.

In general, the reason to monitor and sample is to evaluate compliance with current regulations and identify trends that might result in future regulatory violations. That's the primary basis for the current water quality monitoring regime at Rocky Flats. With air quality monitoring, the reason that program ceased is a bit complex, but in short, air monitoring both on-site and off-site during active remediation did not indicate any negative impacts. DOE, CDPHE and EPA decided that with the cleanup completed and the main contamination sources gone, there was no need to continue air quality monitoring. (The Stewardship Council was briefed on this decision at the time it was made, and will again discuss it in 2016.)

Finally, with soil sampling, the reason to require ongoing testing is two-fold: (1) if there is some determination that prior soil sampling activities were deficient and not representative of actual conditions, or (2) there is reason to believe that contamination moved off-site at levels that would exceed regulatory values for surface soil concentrations. To date, no one has presented any information to suggest that either one of these triggers applies. In fact, the Rocky Mountain Peace and Justice Center's 2010 soil sampling of off-site locations confirms the results of the many prior soil sampling activities.

Responses to 2013 Superior Town Hall Meeting: In April 2013, State Senator Jeanne Nicholson held a Rocky Flats public meeting with CDPHE in Superior. Two questions posed to CDPHE speak to this question. The following are CDPHE's written replies.

**Question #1 to CDPHE: There is a lot of debate as to whether it is safe. If it is so safe as you contend, why not test it now as soil is being disturbed all around the refuge to ensure public health, after all that is what CDPHE is tasked to do?**

CDPHE Response: Additional sampling is not required because vast amounts of data regarding plutonium contamination at and near Rocky Flats have already been gathered. These data demonstrate that the area where plutonium contamination exceeds background levels is limited to a fairly small area immediately east of the former plant entrance on Indiana Street. Even the highest level of plutonium contamination recorded off-site poses

a minimal risk – the odds of a resident developing cancer as a result of exposure to this level of residual plutonium are about three in a million. In comparison, about 1 in 2 men will develop cancer during their life, as will about 1 in 3 women.

During characterization and remediation projects at the Site, about 1.3 million analyses were compiled from approximately 7,230 surface soil sample locations and from about 15,890 subsurface soil samples. These samples are reported in the RI/FS report ([http://www.lm.doe.gov/Rocky\\_Flats/Regulations.aspx](http://www.lm.doe.gov/Rocky_Flats/Regulations.aspx)), which was compiled to support a Comprehensive Risk Assessment and the final remedy decision.

The average concentration of plutonium in the surface soil of the Refuge portion of the Site is 1.1 picocurie (trillionths of a curie) per gram (pCi/g): a concentration that equates to an excess cancer risk below one in a million for any exposure scenario. There is essentially no plutonium in the subsurface soils of the Refuge. Because of these very low concentrations, no remediation was required in the Refuge portion of the Site.

Substantial off-site sampling has also been conducted over many years by many different entities and these studies have shown generally consistent results. The most extensive off-site sampling was done as part of the CERCLA/RCRA investigation that covered a 38-square mile area to the north, east and south of Rocky Flats known as Operable Unit 3. During this investigation, 144 surface soil samples were collected from 61 different 10-acre sample plots. Only 19 of these plots showed plutonium concentrations above background levels; the rest were below background. Of the 19, only one had a plutonium concentration that exceeded 1 pCi/g (this sample result was 2.95 pCi/g). An additional 190 sub-surface samples were obtained from 11 different trenches dug as part of the investigation. The subsurface investigation demonstrated that off-site plutonium contamination quickly declines with depth, and reaches background levels within about four inches of the surface.

The Operable Unit 3 study included the results from a 1991 sampling effort that collected 47 samples from soils directly east of the former east entrance to Rocky Flats. One of these samples recorded the highest level of plutonium ever observed in any off-site sample - 6.5 pCi/g. Under a residential use scenario (the most protective scenario), a plutonium concentration of 6.5 pCi/g equates to a risk of about  $3 \times 10^{-6}$  (that is, a three in a million chance of developing cancer as a result of a lifetime of exposure to contamination at this level). The cleanup goal at Superfund sites is to achieve a residual cancer risk somewhere between one in ten thousand and one in a million, so a three in a million risk is considered quite protective. The State's radiation dose limit for the public is 25 millirem per year (mrem/yr). The Total Effective Dose Equivalent to a resident from 6.5 pCi/g is 0.026 mrem/yr – well below the state's limit. The results for off-site areas are in a three-volume report of the investigation of Operable Unit 3 (Off-Site Areas). The first volume of the report can be accessed via the Administrative Record for Rocky Flats at: [http://www.lm.doe.gov/cercla/documents/rockyflats\\_docs/OU03/OU03-A-000465.pdf](http://www.lm.doe.gov/cercla/documents/rockyflats_docs/OU03/OU03-A-000465.pdf)

Several other sampling efforts have produced similar results. For example, an independent Citizens' Environmental Sampling Committee performed a soil and sediment

sampling study in 1996. The 78 samples collected ranged in concentration from background up to 4.5 pCi/g. The study concluded that these results “are consistent with the numerous other studies of off-site soils and sediments conducted by a variety of agencies over the years.” You can find a link to this document on Colorado Dept. of Public Health & Environment's (CDPHE) web page at: <http://www.cdphe.state.co.us/hm/rf/index.htm>.

**Question #17 to CDPHE: Do you monitor surrounding areas, not just “on-site?”**

CDPHE Response: Routine air, ground water and surface water monitoring began at the time the Site was established; air monitoring ended in 2007. In addition to the site contractors, the Colorado Department of Public Health and Environment began monitoring air, water and soil around Rocky Flats on a regular basis in July 1970. The Public Health Service, and later the Environmental Protection Agency, monitored the air and water in the vicinity of Rocky Flats beginning in April 1960. Monitoring was also carried out by the cities of Westminster and Broomfield. Other environmental media were sampled because they were considered potential exposure pathways or to characterize them for cleanup.

a.) Soil – About 1.3 million soil analyses determined the extent of soil contamination and based on these data, contaminated soil was removed from the site. Confirmation samples assured state and federal regulators that residual contamination on-site and off-site are below regulatory limits and therefore, soil sampling is no longer conducted.

b.) Sediments – Sampling in on-site ponds determined the extent of sediment removal. Very low levels of plutonium in Great Western Reservoir and Standley Lake sediments did not require removal. Surface water leaving the site is continuously monitored and is now routed around these reservoirs.

c.) Vegetation – Vegetation data from routine monitoring and special studies provided information on how radioactivity was spread out around Rocky Flats.

d.) Wildlife – Several studies examined animal tissues to understand if any animal species were being contaminated. A U.S. Fish & Wildlife Service study concluded that the small amount of radionuclides in tissues from deer at Rocky Flats was similar to the amount in tissues from deer taken elsewhere in Colorado.

e.) Ground Water – Hundreds of wells defined the concentrations and extent of contamination in ground water (solvents and uranium) and four treatment systems are currently treating the affected plumes. About 100 wells are currently being monitored on-site.

f.) Surface Water – At this time, this water is monitored before it leaves the central area controlled by DOE and at several upstream locations.

g.) Air – After decades of collecting air samples both on-site and off-site, air monitoring has been discontinued by all three agencies. Even while dust was being stirred up during cleanup of the most contaminated areas on-site, the amounts measured at the sampling stations were well below national and state standards.

Please let us know what questions you have.