What The Studies Say

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Rocky Flats Right To Know meeting
April 25, 2018

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Topics

- Context-setting
- Offsite soil studies
- Public health studies
- Reflections

Topics

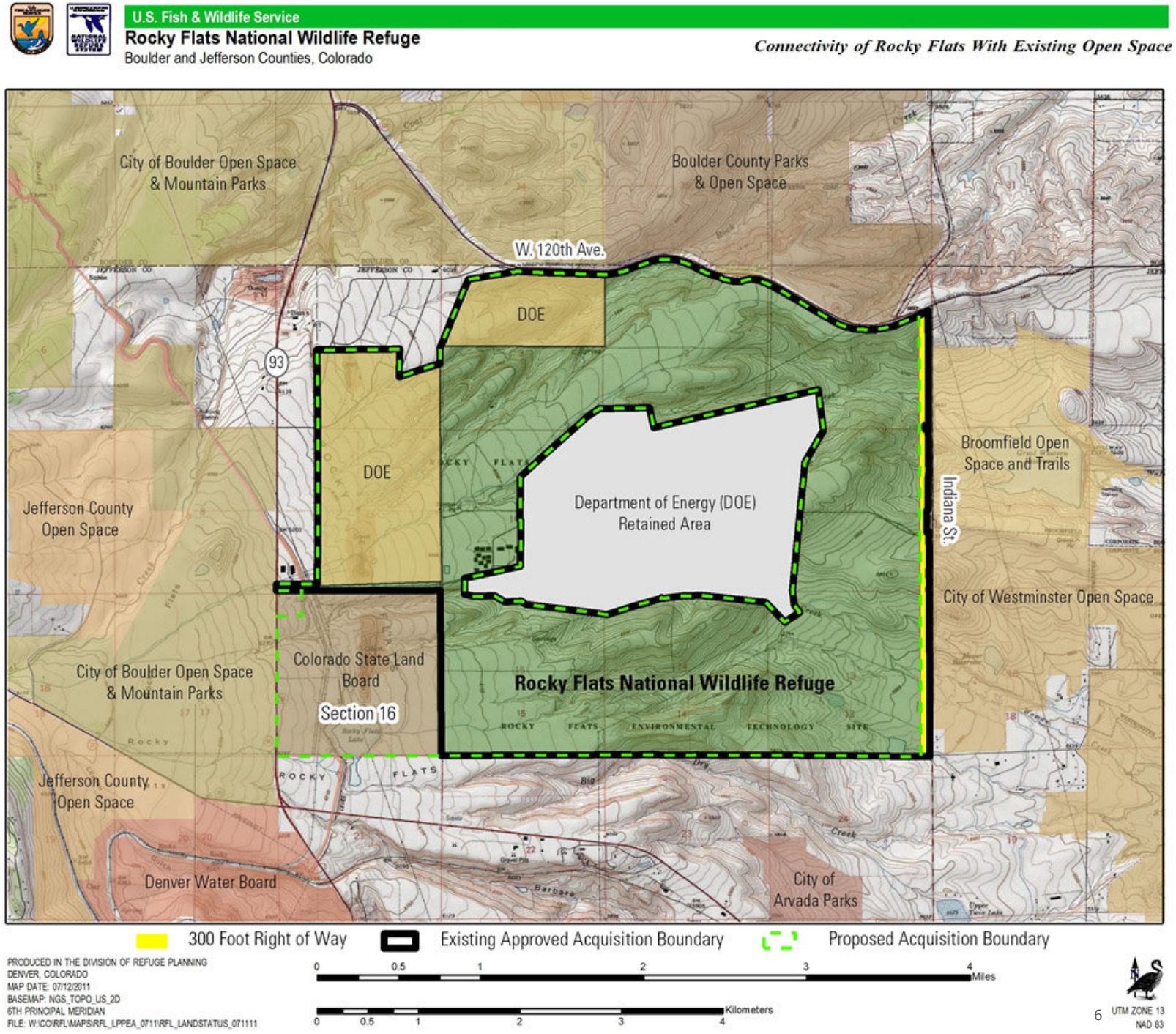
- Context-setting
  - A unique local problem
  - Plutonium
  - Units of measure and conversion
  - Background radiation
  - The contamination sources at Rocky Flats
- Offsite soil studies
- Public health studies
- Reflections

Context

- We have a very unique and very local problem
- There is no place like Rocky Flats anywhere else in America
  - Proximity to metropolitan area
  - Upwind and upslope location
  - Mission and history
  - Contamination cocktail
- People are moving here, buying expensive houses, getting sick and dying, having their lives hugely impacted. We're about to open the refuge to the public, and build a parkway through contaminated soil. It's all so senseless.
- We need to own this problem, and make sensibility prevail
  - We can't do much about what's past, but at least let's not exacerbate the problem

The Big Picture

- DOE Retained Area (grey) is roughly the former Plant industrial area; remediated
- Refuge area (green) is roughly the former Plant buffer zone; NO CLEANUP
- Together the industrial area and buffer zone comprised the Plant site
- Outside the buffer zone are offsite areas; NO CLEANUP



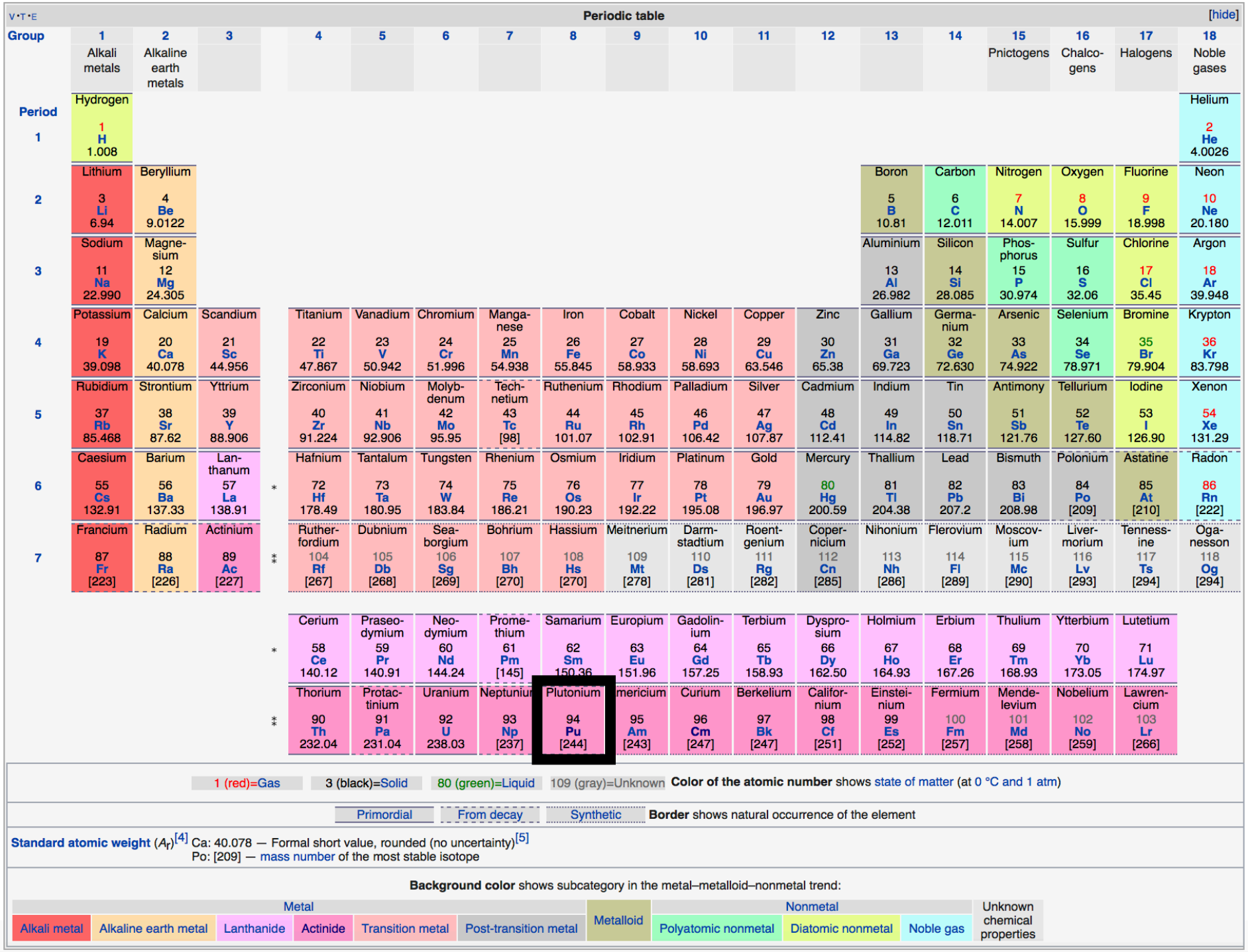
Metric Prefixes

trillion
billion
million
thousand
thousandth
millionth
billionth
trillionth

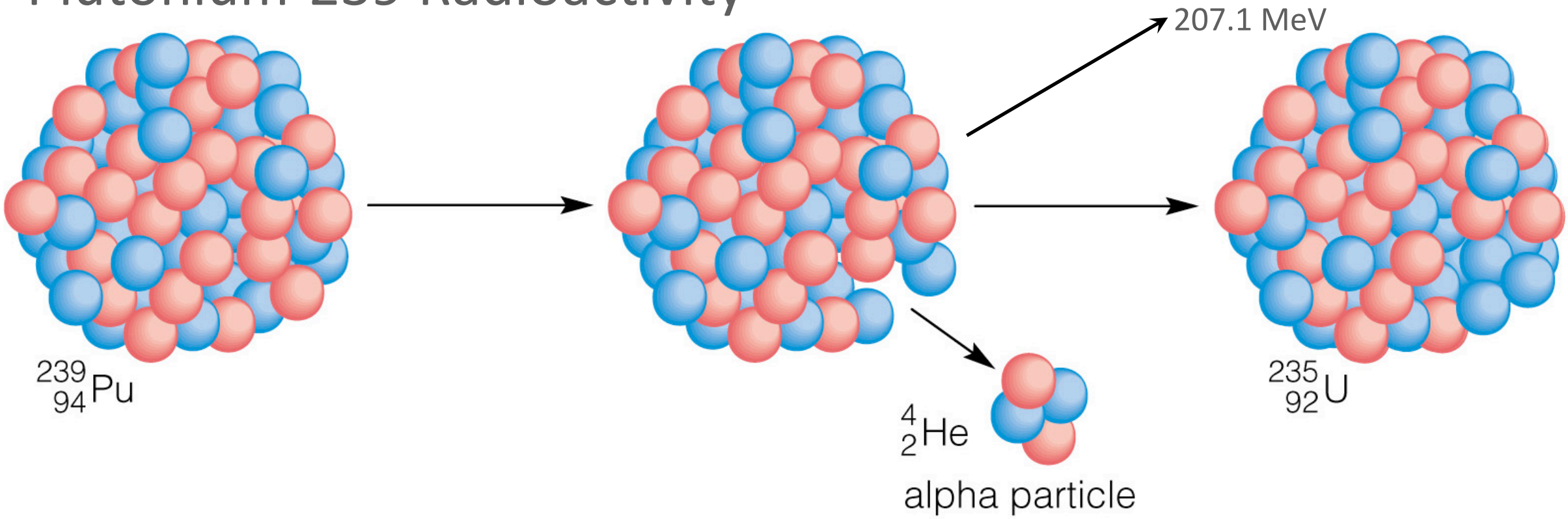
Metric prefixes in everyday use			
Text	Symbol	Factor	Power
exa	E	1 000 000 000 000 000 000	10^{18}
peta	P	1 000 000 000 000 000	10^{15}
tera	T	1 000 000 000 000	10^{12}
giga	G	1 000 000 000	10^{9}
mega	M	1 000 000	10^{6}
kilo	k	1 000	10^{3}
hecto	h	100	10^{2}
deca	da	10	10^{1}
(none)	(none)	1	10^{0}
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	µ	0.000 001	10^{-6}
nano	n	0.000 000 001	10^{-9}
pico	p	0.000 000 000 001	10^{-12}
femto	f	0.000 000 000 000 001	10^{-15}
atto	a	0.000 000 000 000 000 001	10^{-18}

Plutonium

- The actinide with 94 protons
- Decay product of Uranium-238
- Pu has 20 isotopes ^{228}Pu to ^{247}Pu
  - Different numbers of neutrons; mass
  - Main ones: 238-244
- ^{239}Pu is fissile
- Pure-enough ^{239}Pu is weapons-grade



Plutonium-239 Radioactivity



- A quantity of ^{239}Pu with activity of 1 disintegration per second is a Bequerel (Bq)
- 1 Bq of ^{239}Pu is 435pg, 1.087T atoms (“specific activity”, activity per mass)
- The half life of ^{239}Pu – when half the quantity has disintegrated – is 24,100 years

If My Math Is Right

- Plutonium density is 19.86 grams (0.7 ounces) per cubic centimeter
  - 23 cubic centimeters weighs one pound
- CDPHE says respirable Pu-laden dust is 3-10 micro-meters (microns) in size
  - For comparison, a human hair is ~60 microns in diameter
- One cubic micron of ^{239}Pu = 19.86pg = 0.046 Bq = 49.65×10^{9} (billion) atoms
- A 10-micron cube of ^{239}Pu = 19.86ng = 45.558 Bq = 49.65×10^{12} (trillion) atoms
- Every three-micron ^{239}Pu cube inhaled would have 1.34 trillion atoms and would emit an alpha particle more than every second in the body
- Every ten-micron ^{239}Pu cube inhaled would have 50 trillion atoms and would emit alpha particles 46 times per second in the body

Isotope Ratios

- A sample of Pu contains multiple isotopes (written ^{239,240}Pu) in some ratio
- Different sources have different isotope ratios

Source	**Ratio of Plutonium-240 to Plutonium-239 (^{240}Pu : ^{239}Pu)**
Global fallout	0.155 (for every ^{240}Pu atom there are 6.45 ^{239}Pu atoms)
Rocky Flats	0.061 (for every ^{240}Pu atom there are 16.39 ^{239}Pu atoms)

- Rocky Flats Pu is more “weapons-grade” (more pure ^{239}Pu) than fallout Pu
- This is important because the isotope ratio tells you the sample’s source

Units of Measure, and Conversions

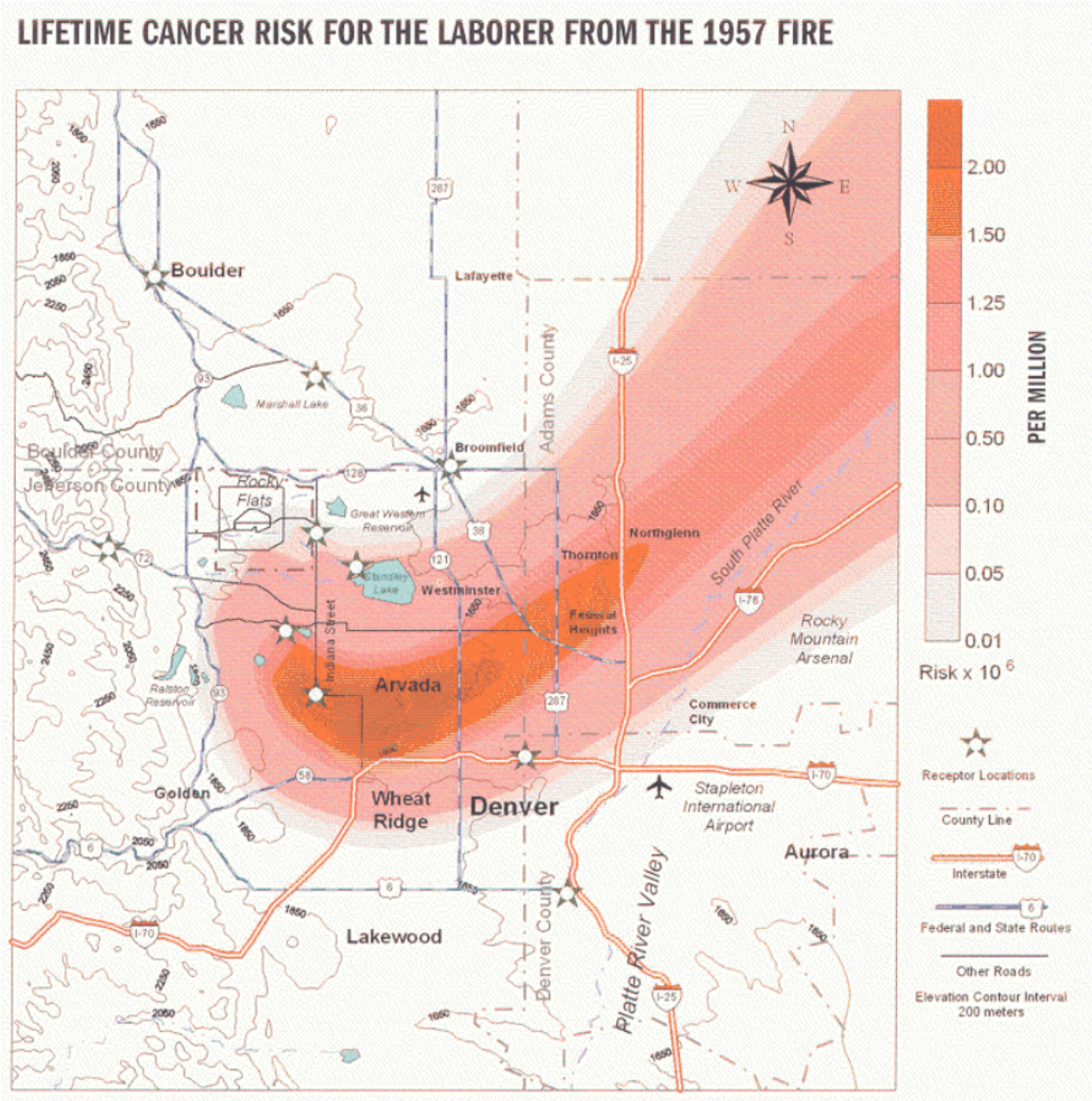
- Measures of (radio) activity, or quantity:
  - Curie, disintegrations per minute, Becquerel
  - 1 Bq = 60 dpm
  - 1 Ci = 3.7×10^{10} Bq= 2.22×10^{12} dpm
  - 1 pCi = 0.037 Bq = 2.22 dpm
- Measures of “concentration” or “inventory”:
  - (radio) activity per mass or surface area of soil
  - dpm/g, Bq/kg, Bq/m^2, Ci / km^2
  - How many grams of soil are in a square meter?
    - Assuming RF soil density of 1.5g/cm^3, a square meter of soil one centimeter deep weighs 15kg (33 lbs.)

What Number to Use for ^{239}Pu Background Radiation?

- I've seen numbers ranging from 0.01 dpm/g to 0.08 dpm/g in Colorado soil
- It's important for characterizing contamination level as a multiple of background (the more background assumed, the lower the multiple)
- CDPHE uses 0.08 dpm/g
- Martell found 0.0434 dpm/g at Boyd Lake (Loveland, CO), so I use that

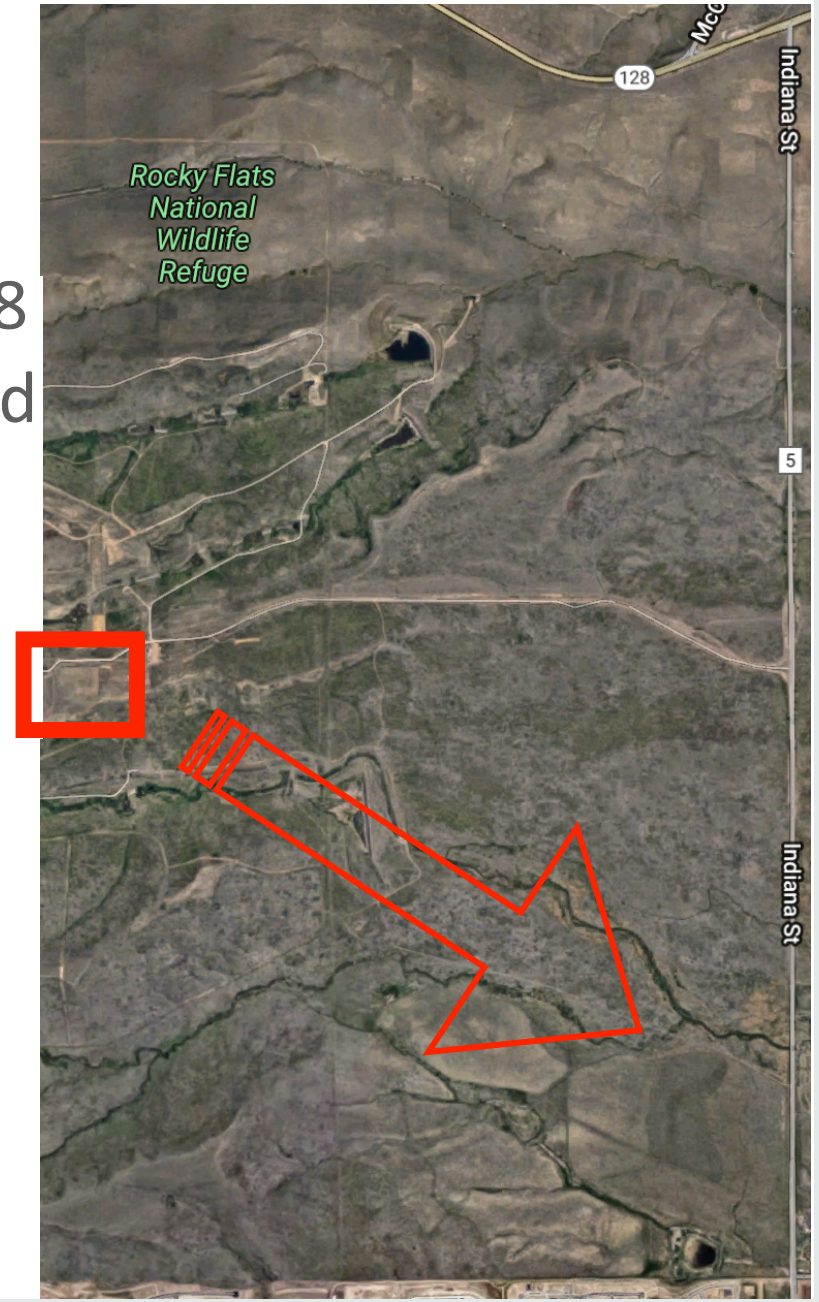
The 1957 Fire

- September 11-12, 1957
- Blew out HEPA filters in Pu buildings
- Destroyed smokestack air monitors
- Spewed Pu-laden smoke plume over NW Metro area for 13 hours

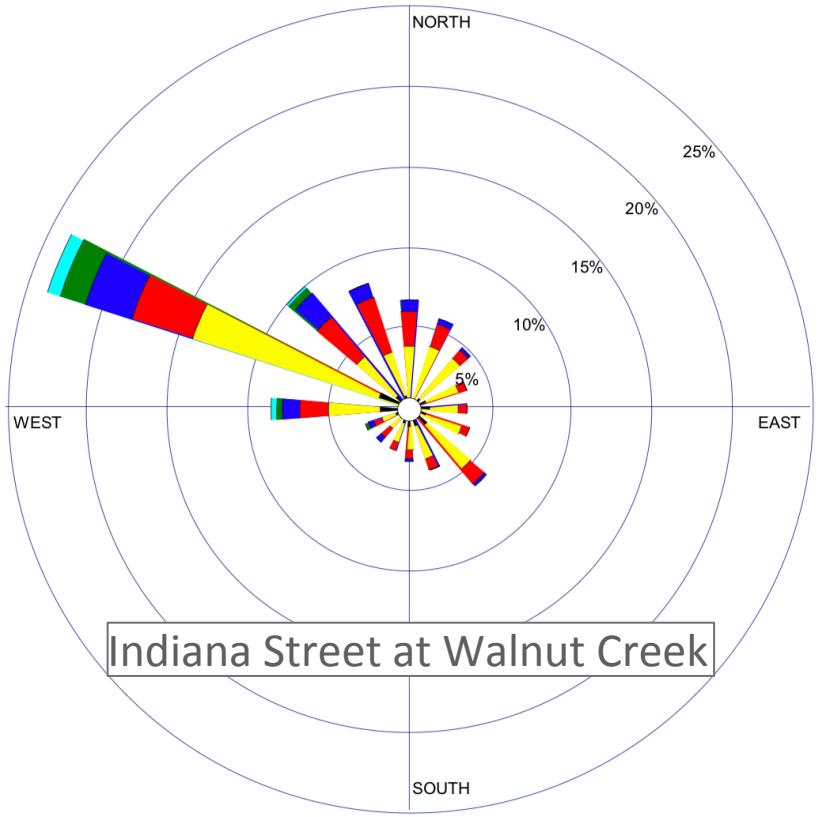


The 903 Area

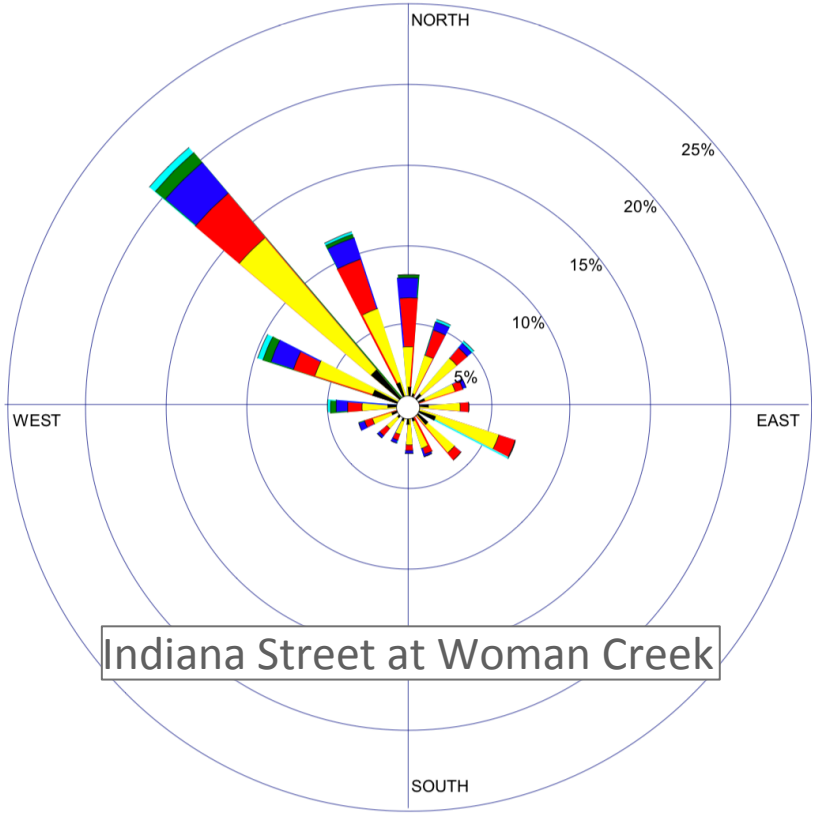
- 3,572+ drums Pu-laden oil stored in field 1958-1968
- Leakage seen 1959; by 1962 60% of drums corroded
- Leakage, 1968 cleanup contaminated soil, rabbits
- Estimated 86+ grams Pu released to environment
- Prevailing winds blew Pu-laden soil southeast



Rocky Flats Wind Roses



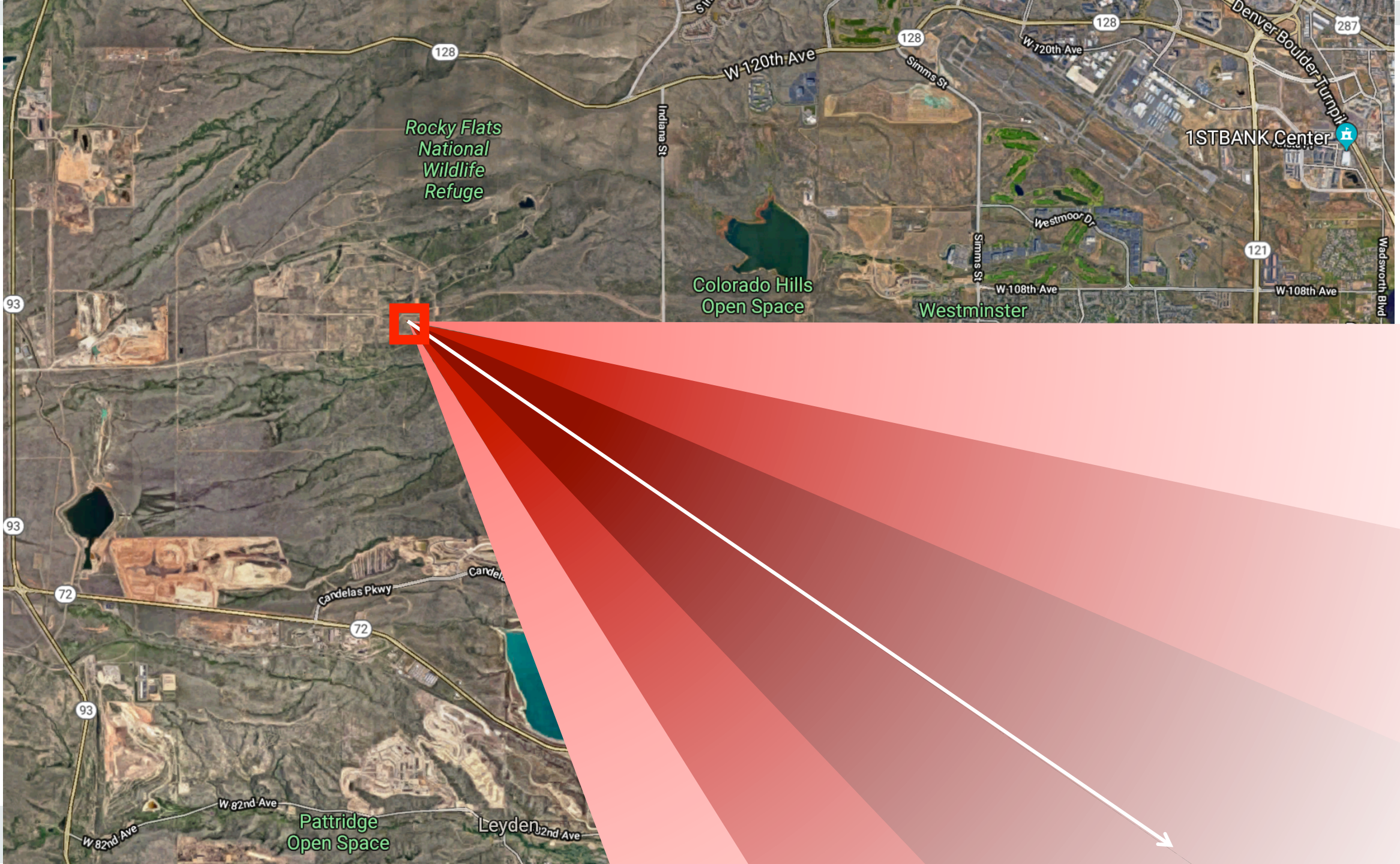
Indiana Street at Walnut Creek



Indiana Street at Woman Creek

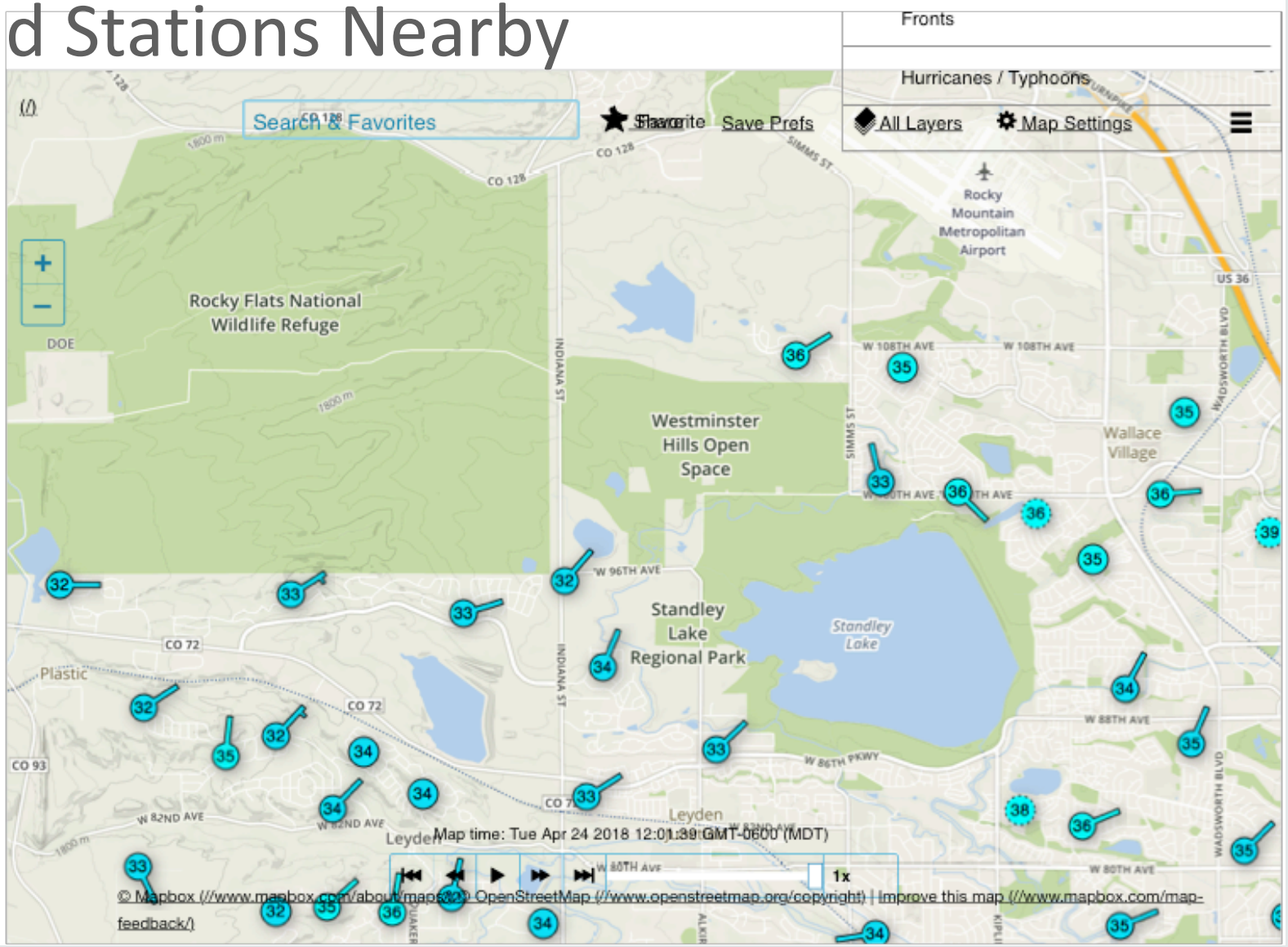
- Bars are direction wind blows FROM
- Longest bar is most frequent direction
- Colors show wind speed frequencies
- 2001 data from onsite stations

< 5 mph 5 - 10 mph 8 - 13 mph 13 - 20 mph 20 - 25 mph > 25 mph


Rocky Flats
National
Wildlife
Refuge
Colorado Hills
Open Space
Westminster
1STBANK Center
W 120th Ave
Simms St
Indiana St
Westmoor Dr
W 108th Ave
Wadsworth Blvd
Denver Boulder Turnpike
Candelas Pkwy
W 82nd Ave
Pattridge
Open Space
Leyden
128
121
287
93
72

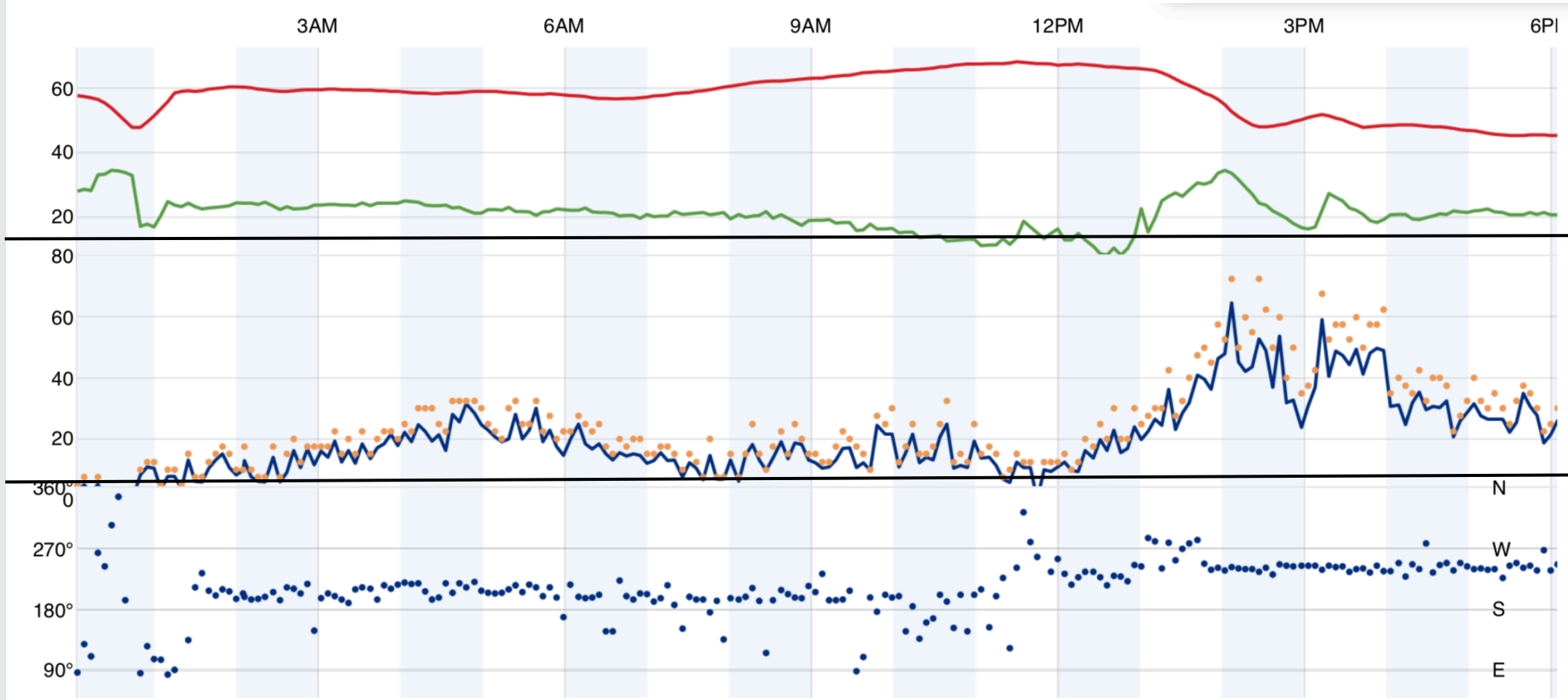
Weather Underground Stations Nearby

- wunderground.com
- Drilling down, you can see wind history graphs



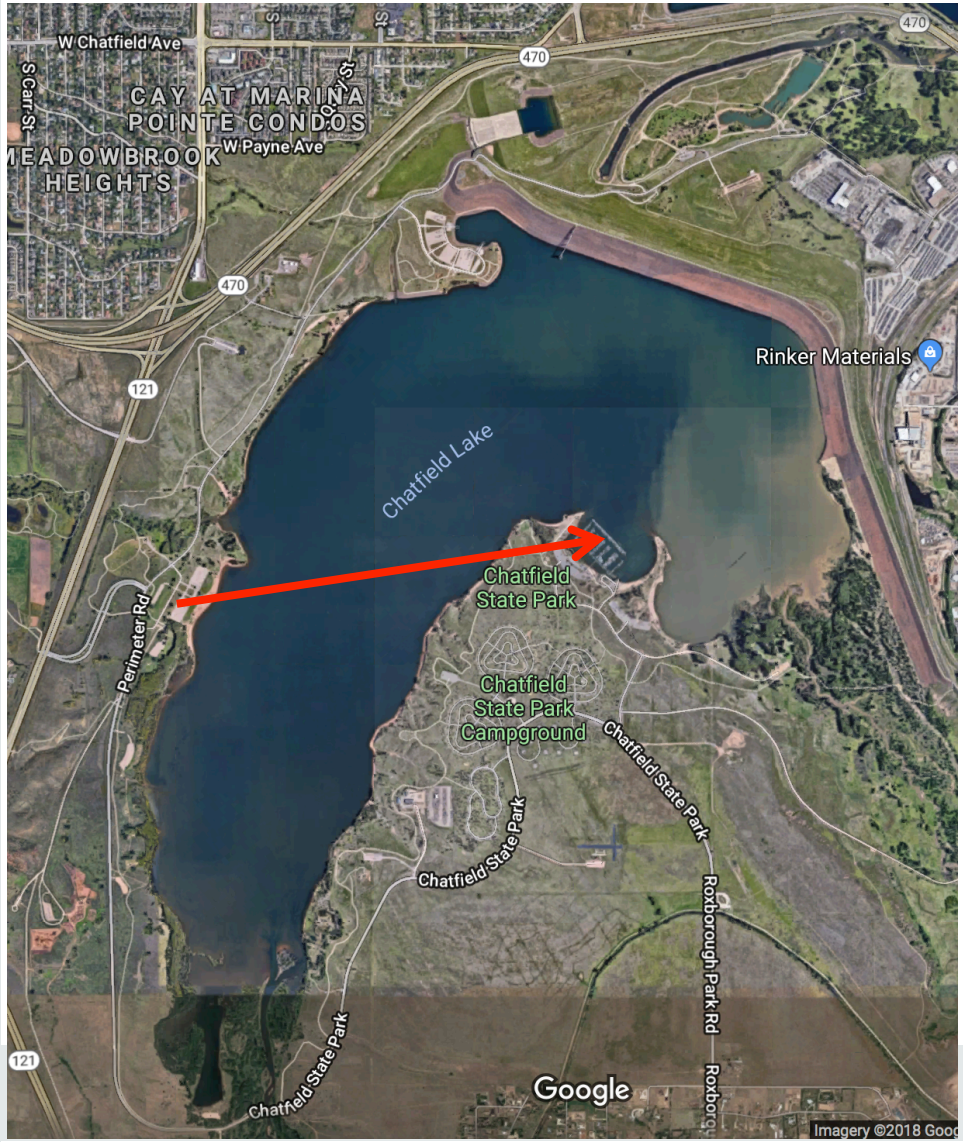
High Wind Event April 17th, 2018

A Rising Star Equestrian Center, 96th & Indiana



- Temperature and dewpoint
- Wind speed
  - dots = gusts
- Wind direction

Blowing Dust, April 17, Chatfield



- Big earth movers completely tearing up west shore of Chatfield Reservoir for expansion
- Dust from west shore over a mile away blew onto deck of my boat in marina

Blowing Dust, April 12, Westbound C-470

Topics

- Context-setting
- Offsite soil studies
- Public health studies
- Reflections

Offsite Soil Studies: Martell & Poet, January 1970

- First offsite independent soil testing, prompted by 1969 Mother's Day fire
- Reported in 1/13/70 letter to AEC Chairman. Follow-up reports 2/24/70 to public, Environment 12:4 May 1970, Health Physics vol. 23 (Oct. 1972).
- Most measurements in top 1cm of soil. "The depth distribution of plutonium in soil from the Jeffco Airport area indicates comparable concentrations at all levels down to 5 inches depth, the maximum depth sampled."

Location	Concentration	x Background*
NW corner Indiana Street & Walnut Creek (sample area A)	1.29 dpm/g	30x
SW corner Indiana Street & Woman Creek (sample area B)	13.50 dpm/g	311x
SE corner Simms & Highway 128 (sample area I)	1.72 dpm/g	40x
NW corner 100th & Alkire (sample area N)	1.34 dpm/g	31x

*Using 0.0434 dpm/g as background

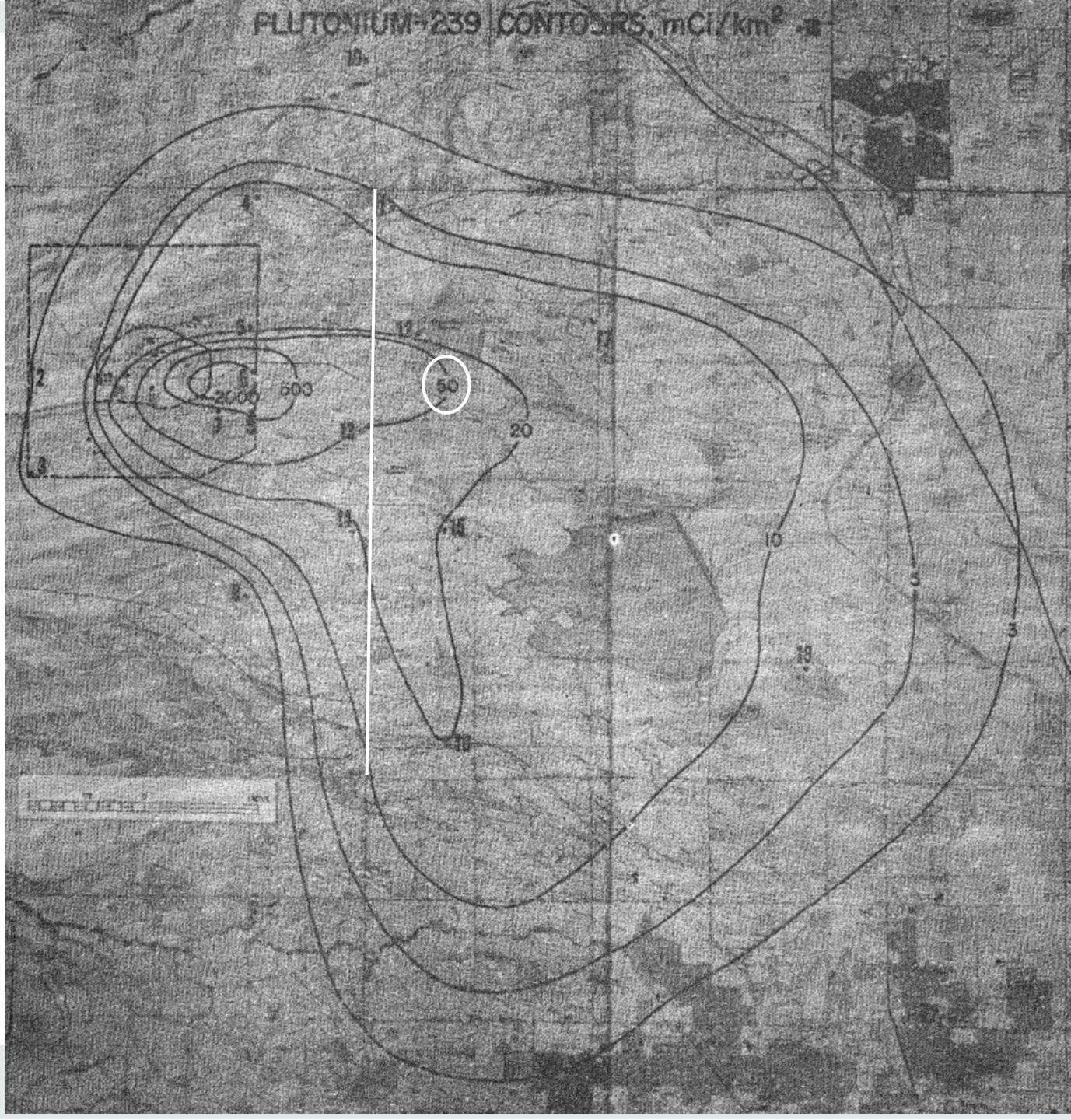
Offsite Soil Studies: Krey & Hardy, August 1970

- Study by AEC scientists commissioned in response to Martell & Poet
- Measurements integrated through 20” deep soil cores
- Produced famous map of plutonium activity contours in mCi/km^2
- Confirmed 903 area as primary source of plutonium contamination
- Converted activity to concentration, largely agreed with Martell & Poet

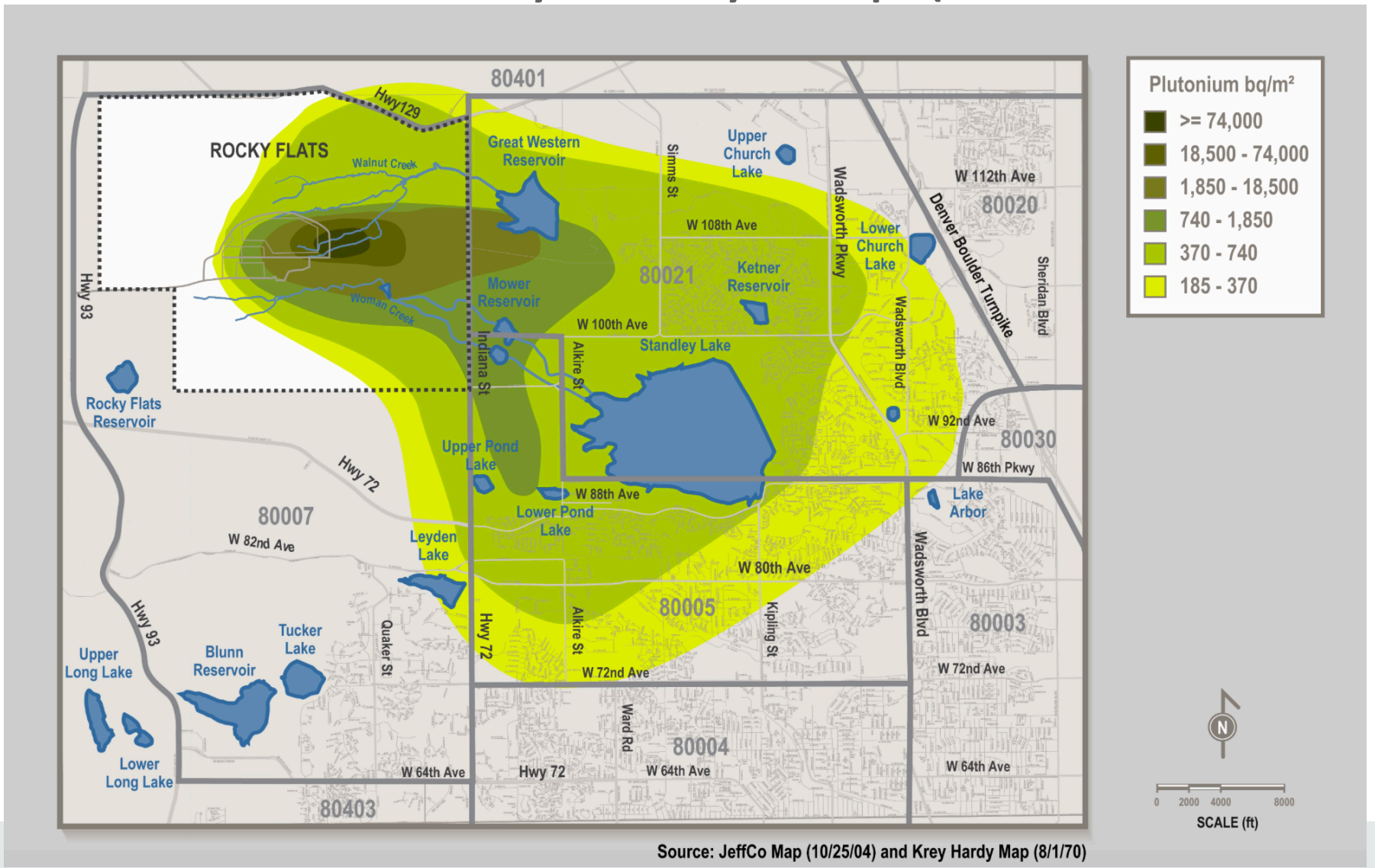
Location	Concentration	x Background
Just west of Great Western Reservoir (sample 12)	2.14 dpm/g	49x
West of Indiana Street halfway between 96th and East Gate (sample 13)	0.56 dpm/g	13x
West of Indiana Street just south of 96th (sample 14)	0.52 dpm/g	12x
NW corner 82nd and Alkire (sample 16)	0.48 dpm/g	11x

Original Krey Hardy Map

- Note it's in mCi/km^2
- White line is Indiana Street
- Circled number is 50 mCi/km^2
  - Isopleth is 171x background
- Lowest isopleth is 3mCi/km^2
  - Equals 10x background
  - Extends east of US 36, south of 64th



The Infamous Krey Hardy Map (Enhanced Version)

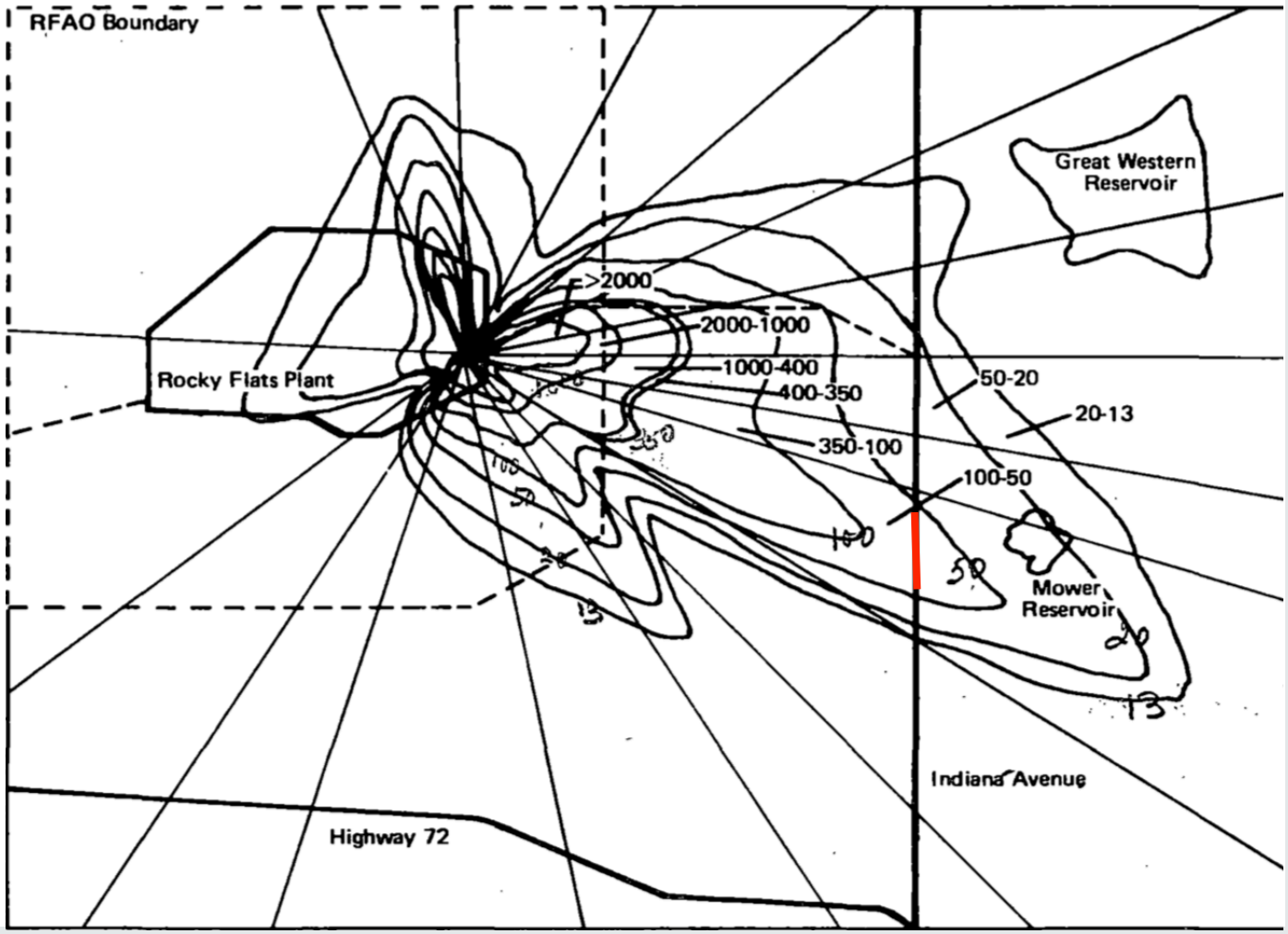


Source: JeffCo Map (10/25/04) and Krey Hardy Map (8/1/70)

- Note it's in units of Bq/m^2
- I've checked the conversions
- It leaves out the lowest isopleth from the original

Offsite Soil Studies: The Seed Report, July 1971

- Dow commissioned August 1970 after Martell, Krey/Hardy
- Dow's own Health Physics department did soil analysis
- Findings consistent with Martell, Krey/Hardy, contour map claimed more accurate
- Sectors/contours centered@903
- 50-100 mCi/km^2 band across Indiana is 171-341x background
- 13 mCi/km^2 is 44x background



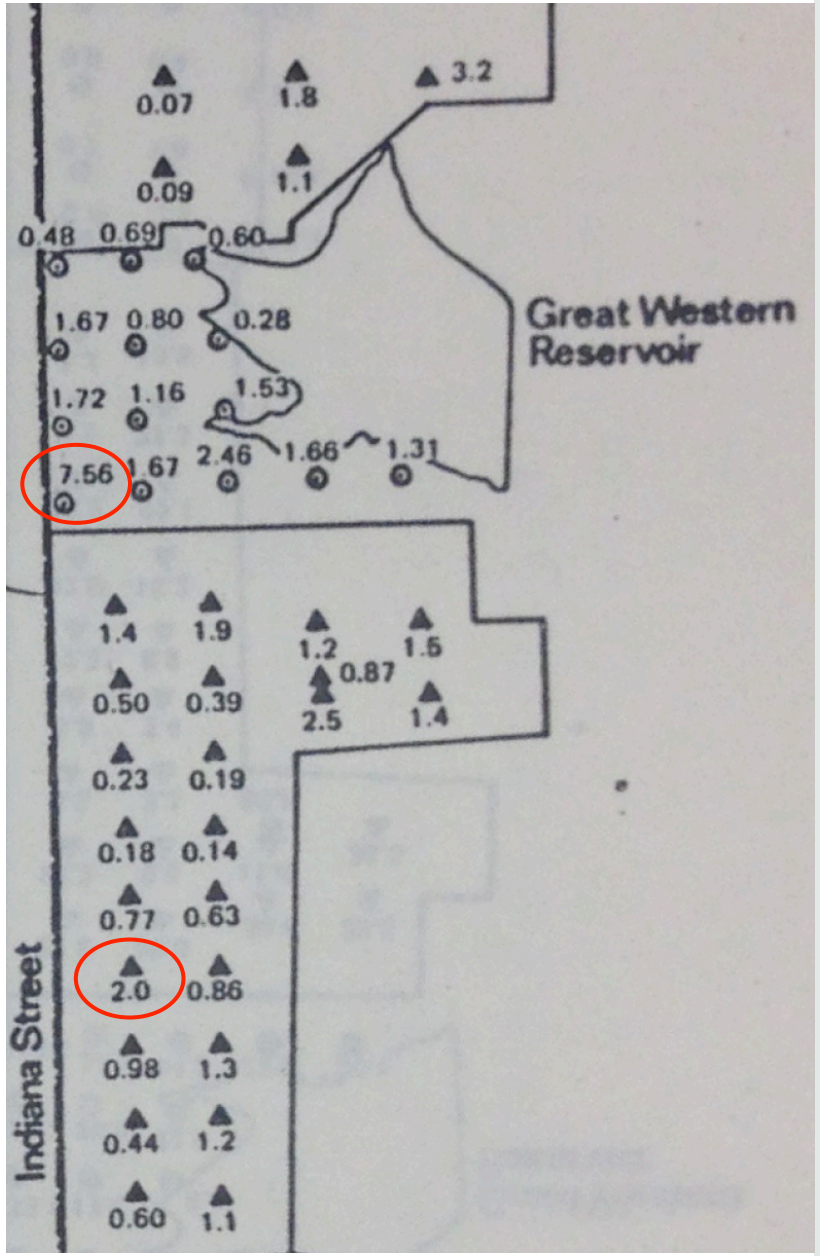
Offsite Soil Studies: Dr. Carl Johnson, 1976

- Reported in Science Magazine, August 1976
- Collected surface soil with clean brush
- All samples in proposed residential areas just east of Indiana Street

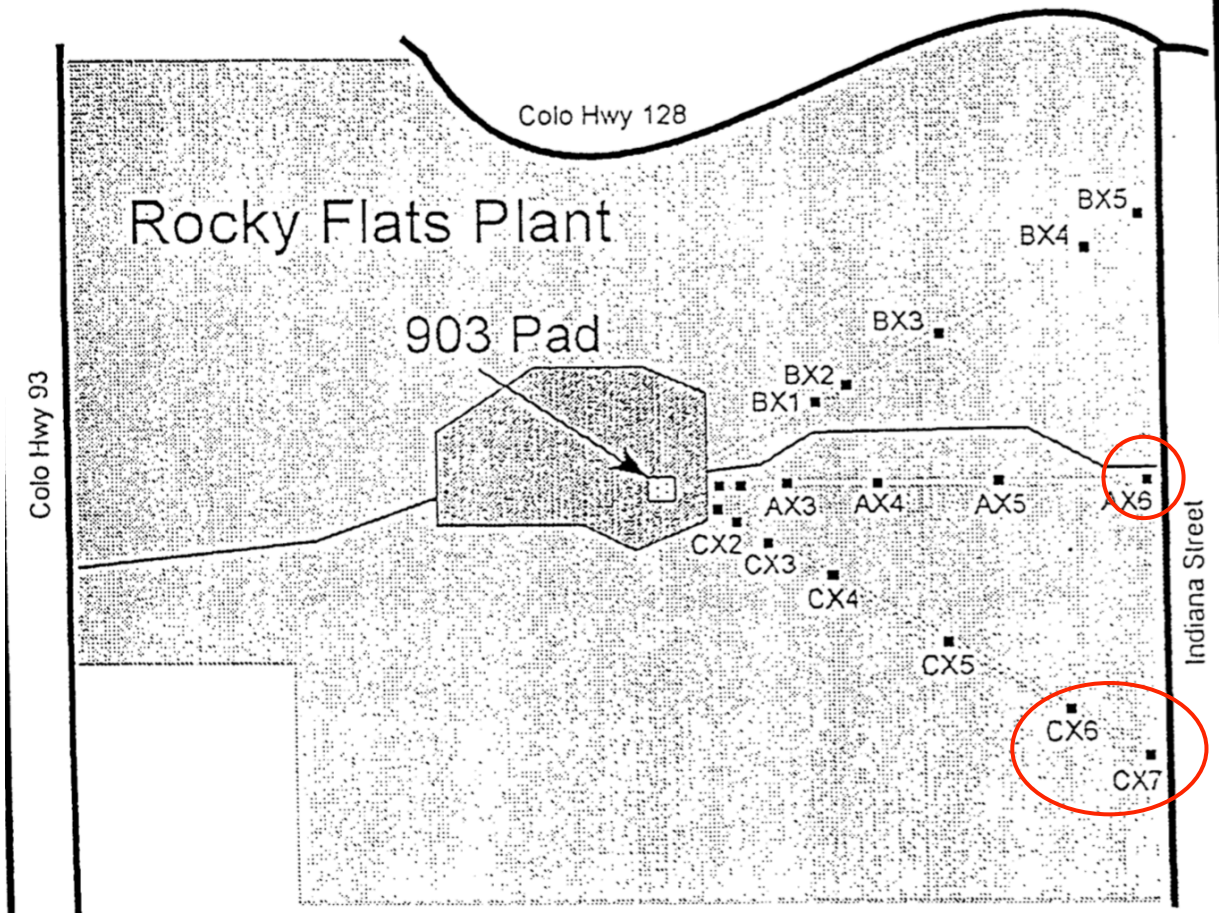
Location	Concentration	x Background
Section 7 (Indiana to Alkire, 104th to 112th)	14.1 dpm/g	325x
Section 18 (Indiana to Alkire, 96th to 104th)	2.96 dpm/g	68x
Section 19 (Indiana to Alkire, 88th to 96th)	0.23 dpm/g	5x
Section 8 (Alkire to Simms, 104th to 112th)	0.72 dpm/g	17x

Offsite Soil Studies: Illsley & Hume, 1979

- Two employees of Rockwell International
- Report prepared in response to *Church v. US*
- Sampled at 71 locations outside plant boundary
- Numbers at right are dpm/g
- 7.56 dpm/g near East Gate is 174x background
- 2.0 dpm/g farther south is 46x background



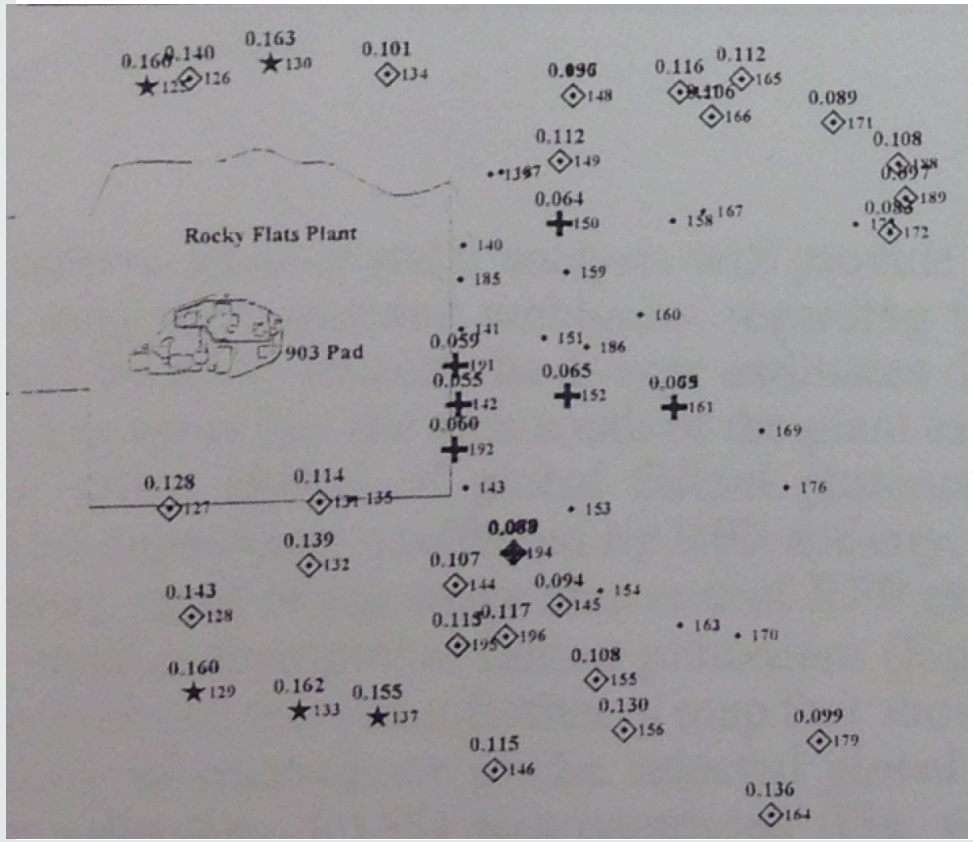
Offsite Soil Studies: Webb, Stone, Ibrahim, Whicker 1994



- "The Spatial Distribution of Plutonium in Soil Near the Rocky Flats Plant"
  - Colorado State University Dept. of Radiological Health Sciences
- 211x background at location AX6
- 100x background at location CX6
- 40x at location CX7 in 12-15" deep soil
- Thanks Dale Simpson

Offsite Soil Studies: Iggy Litaor, 1998

- “Plutonium Contamination in Soils in Open Space and Residential Areas Near Rocky Flats, Colorado”, Health Physics 17:1, January 1998

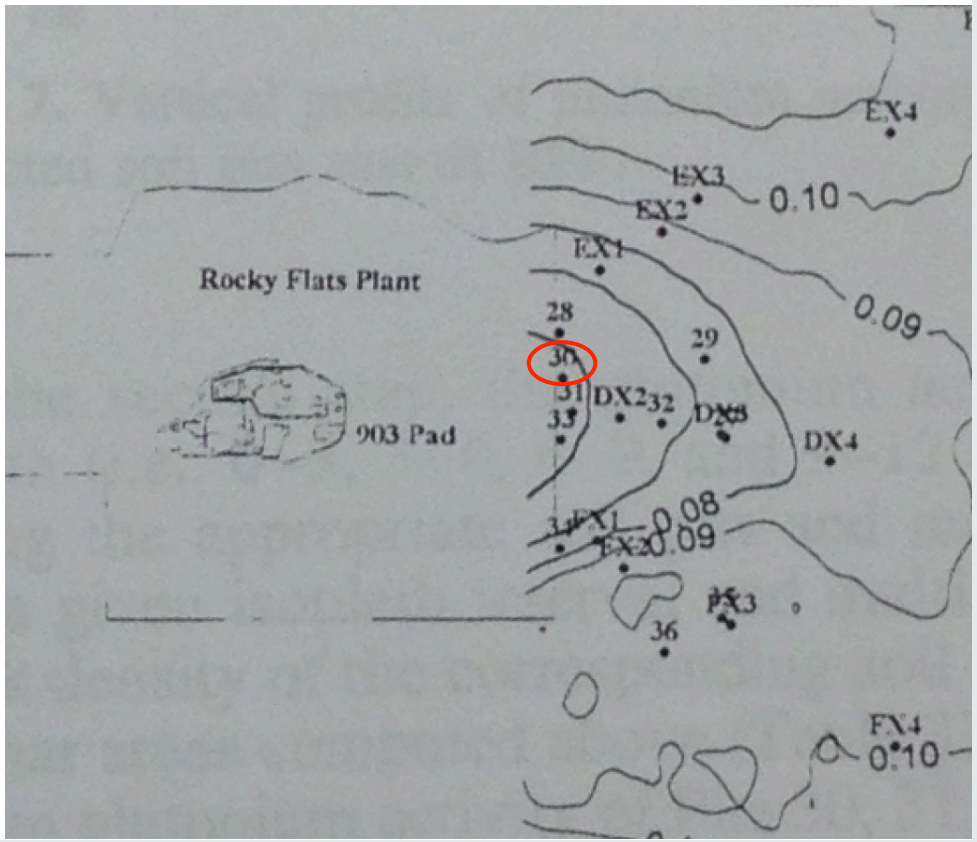


Location	x Background
28	73x
30	111x
142	17x
191	10x
192	8x

Numbers at left are ^{240}Pu:^{239}Pu isotope ratios

RF plutonium has ratio 0.05

Global fallout has ratio 0.16



Offsite Soil Studies: Margulies, Schonbeck et.al. 2004

- Journal of Environmental Radioactivity 75:2 (2004)
- Conclusions:
  - "1. Our results do not demonstrate a substantial bias in past sampling studies at Rocky Flats due to differences in methods of collection (such as sample depth), preparation, or analysis of soil samples for ^{239,240}Pu. Samples collected to a depth of 5 cm could, however, yield results somewhat lower than those collected to 3 cm in undisturbed locations."
  - "3. Results in this paper correlate well with concentrations and distribution of ^{239,240}Pu reported by previous investigators and summarized and analyzed by Litaor et. al. (1995). Overall, data collected in this study were consistent with prior results in areas known to have been affected by past releases. Activity of ^{239,240}Pu in soil close to the eastern edge of the Rocky Flats Plant boundary was 10–100 times higher than average background from fallout."

Offsite Soil Studies: ATDSR, November 2010

- Agency for Toxic Substances and Disease Registry, www.atsdr.cdc.gov
- Toxicological Profile for Plutonium, November 2010, pp.176-177
- "Soil samples collected at the RFETS during 1992–1994 were reported to range from 1.1 Bq/kg (30 pCi/kg) offsite to 57 Bq/kg (1,500 pCi/kg) onsite."
  - RFETS = Rocky Flats Environmental Technology Site, the plant renamed after closure
  - 30 pCi/kg is 15x background
- "The highest off-site concentration of ^{239,240}Pu observed during a remedial investigation was 6,500 pCi/kg. A separate sampling study conducted in the 1990s at 42 locations adjacent to RFETS measured ^{239,240}Pu concentrations in soil ranging from 0.22 to 14.80 Bq/kg (5.9-400 pCi/kg) (Litaor 1999)."
  - 6,500 pCi/kg is 150x background, and 400 pCi/kg is 9x background

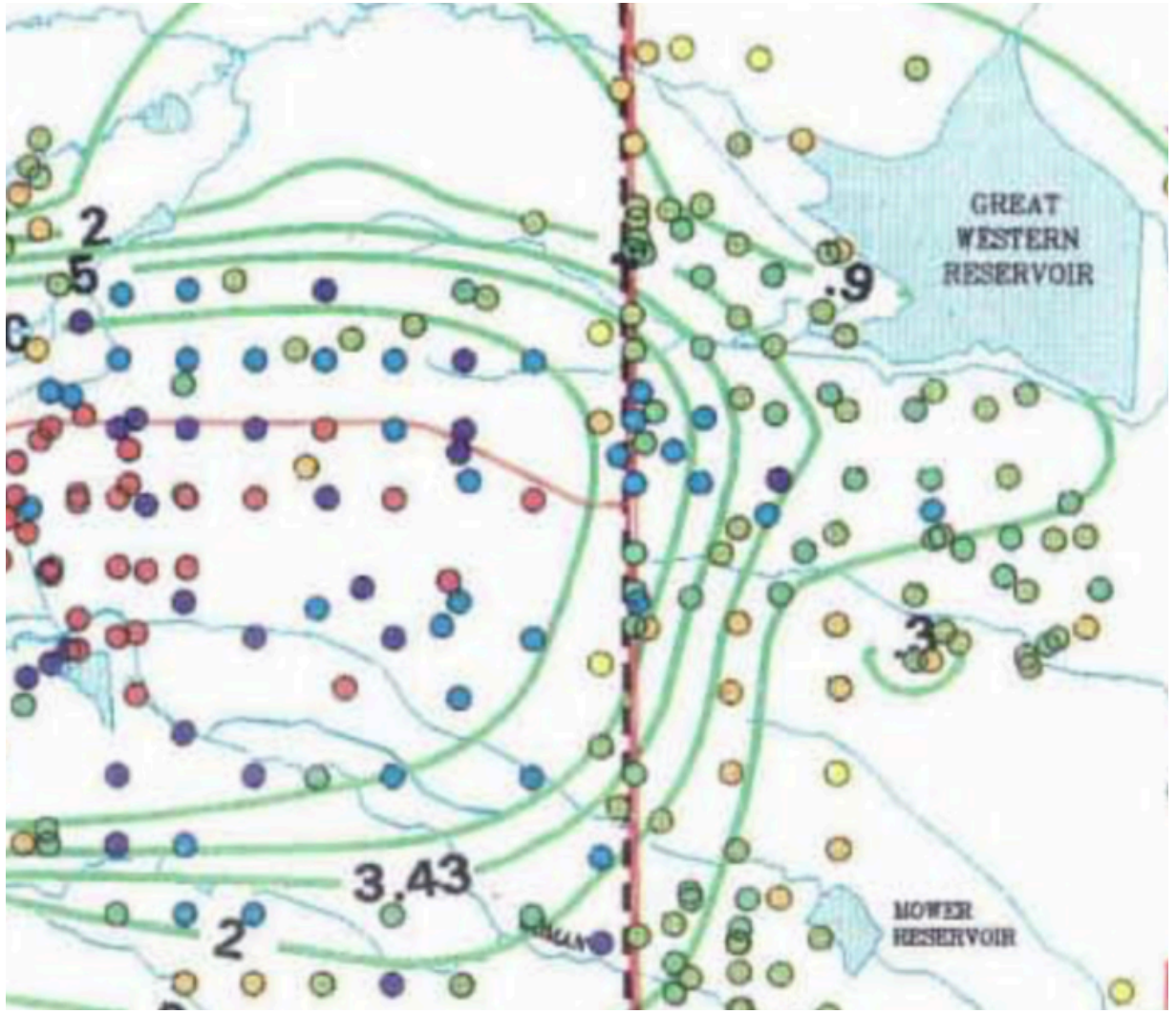
Offsite Soil Studies: Marco Kaltofen, 2012

- Independent study commissioned by LeRoy Moore; 50 samples analyzed
- “All locations with plutonium were on the RoW paralleling Indiana Street”
- Plutonium concentrations faithful to Krey/Hardy report, 41 years later
- “plutonium losses equal to plutonium inputs in Indiana Street area”

Location	Concentration	x Background
Just west of Indiana, west of Great Western Reservoir (sample 50S)	30 pCi/kg	1.5x
Just west of Indiana, west of Mower Reservoir (sample 23S)	126 pCi/kg	6x
Just west of Indiana at 96th (sample 5S)	1,579 pCi/kg	81x
NW corner Indiana Street and Highway 72 (sample 10S)	270 pCi/kg	14x

Offsite Soil Studies: CDPHE 2013

- Presentation to RFSC 2/4/2013
- No action in offsite areas
- Isopleths at right in pCi/g
  - 5 pCi/g = 256x background
  - 2 pCi/g = 102x background
  - 0.9 pCi/g = 46x background
- Averaging the Plutonium activity, as on p.6, neglects the risk of hotspots
- CDPHE also increased sample depth over time, thus increasing dilution



Indiana Corridor Contamination

Multiples of Background Radiation

C	CDPHE 2013	>10x
H	Krey & Hardy 1970	>50x
I	Illsley & Hume 1979	>100x
J	Johnson 1976	>200x
K	Kaltofen 2012	>300x
L	Litaor 1998	>500x
M	Martell & Poet 1970	
S	Seed 1971	
W	Webb et.al. 1994	

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Low-Level Radiation Effects

- “Cancer is the major latent harmful effect produced by ionizing radiation and the one that most people exposed to radiation are concerned about. The ability of alpha, beta, and gamma radiation to produce cancer in virtually every tissue and organ in laboratory animals has been well-demonstrated. The development of cancer is not an immediate effect. Radiation-induced leukemia has the shortest latent period at 2 years, while other radiation induced cancers have latent periods >20 years. The mechanism by which cancer is induced in living cells is complex and is a topic of intense study. Exposure to ionizing radiation can produce cancer at any site within the body; however, some sites appear to be more common than others, such as the breast, lung, stomach, and thyroid.”
- https://www.atsdr.cdc.gov/toxprofiles/tp143.pdf, p.D-9

Public Health Studies: Dr. Carl Johnson, 1981

- Dr. Johnson was Jefferson County Health Director; was ousted in political maneuver
- Conducted and published first epidemiological study of area residents, by census tract
  - "Cancer Incidence in an Area Contaminated with Radionuclides Near a Nuclear Installation", Ambio, Vol. 10, No. 4, (1981) − a peer-reviewed Swedish medical journal
- "Cancer incidence in males was 24% higher, and in females, 10% higher in the most contaminated suburban area (population 154,170) (nearest the plant), compared to the unexposed area (population 423,870)."
- "The excess cases of cancer were mostly leukemia, lymphoma and myeloma and cancer of the lung, thyroid, breast, esophagus, stomach and colon, a pattern similar to that observed in the survivors of Hiroshima and Nagasaki."
- "Cancer of the gonads (especially the testes), liver, and, in females, pancreas and brain contributed to the higher incidence of all cancers in areas near the plant."

Public Health Studies: Stephen Chinn, September 29, 1981

- “The Relation of the Rocky Flats Plant and Other Factors to 1969-1971 Cancer Incidence in the Denver Area”
- Research report prepared by plaintiffs’ counsel in *Church vs. United States*
- Chinn worked for Fairfield & Woods, consulted with experts in academia, used same cancer database and census tract approach as Dr. Carl Johnson
- Used multiple regression analysis (MRA) to account for confounding effects
- “Measures of exposure to Rocky Flats were determined by MRA to be the most correlated to total cancer risk of about 50 variables tested.”
- Most important factor in increased cancer risk was direction from plant
- Second most important factor was Pu in soil (isopleth; distance from plant)

Public Health Studies: Dr. John Cobb, December 10, 1981

- Chair of Preventative Medicine Department at CU School of Medicine
- Appointed to Lamm-Wirth Task Force on Rocky Flats
- PI on long-running EPA study of Pu in deceased downwinders' bodies
- Took liver, lung tissue at autopsy of 519 downwinders and control group
- Analyzed liver and lung tissue for Pu content vis-à-vis control group
- Amount of Pu in downwinders very small; barely more than control group
- But, importantly, isotope analysis showed RF Pu in downwinders' tissue
- How did Rocky Flats plutonium get into downwinders' livers and lungs?

Public Health Studies: Crump et.al., 1984-1987

- DoE-funded study titled “Statistical Analyses of Cancer Incidence Patterns in the Denver Metropolitan Area in Relation to the Rocky Flats Plant” later published in American Journal of Epidemiology
- Reproduced results of Dr. Carl Johnson’s 1981 study
- Then factored in distance of victim from state capitol; an approach later criticized by Ph.D. epidemiologist Dr. Richard Clapp as “highly unorthodox”
- This study also included the unexposed city of Boulder
- Dr. Johnson published responses to this study in 1987, in American Journal of Epidemiology and elsewhere, stating Crump’s approach is not valid

Public Health Studies: Dr. Richard Clapp, 2005

- Plaintiffs' expert witness in *Cook vs. Rockwell*, report admitted 11/9/2005
- Dr. Clapp has a Ph.D. in epidemiology and a Masters in Public Health, and is expert on effects of low-dose ionizing radiation
- Dr. Clapp reviewed all previous Rocky Flats public health studies by Johnson, Chinn, and Crump et.al., calling the latter "highly unorthodox"
- Dr. Clapp analyzed bone and lung cancer in more recent 14 years than previous studies; found 29% greater lung risk in isopleths closest to plant

Public Health Studies: CDPHE Cancer Studies

- CDPHE conducted Rocky Flats -related studies in 1998 and 2016/2017
- These studies have a variety of methodological flaws
  - Seven of 10 “Regional Statistical Areas” in the 1998 study were largely unexposed
  - The RSAs are too large-grained to detect increases by census tract
  - Many important cancers (e.g. testicular, ovarian, thyroid) were not studied
  - Studies based on population estimates, not counts
- These studies focused on cancer; not other e.g. neurological health issues
- The 2016/2017 studies had similar flaws
  - Using irrelevant zip codes
  - Omitting rare cancers

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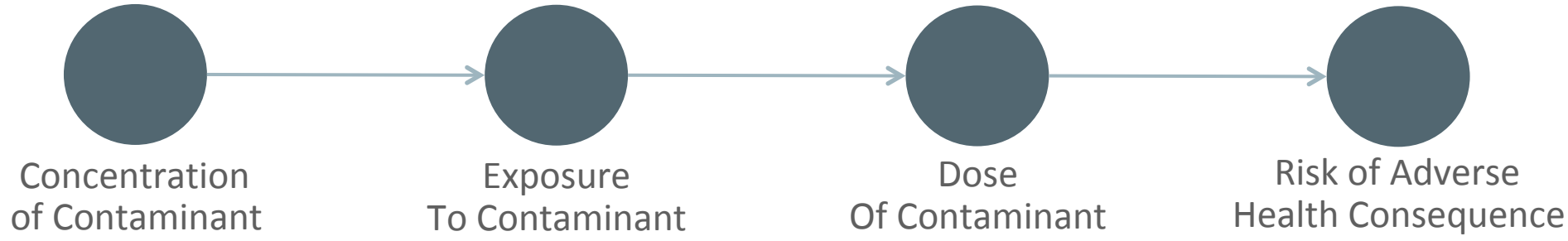
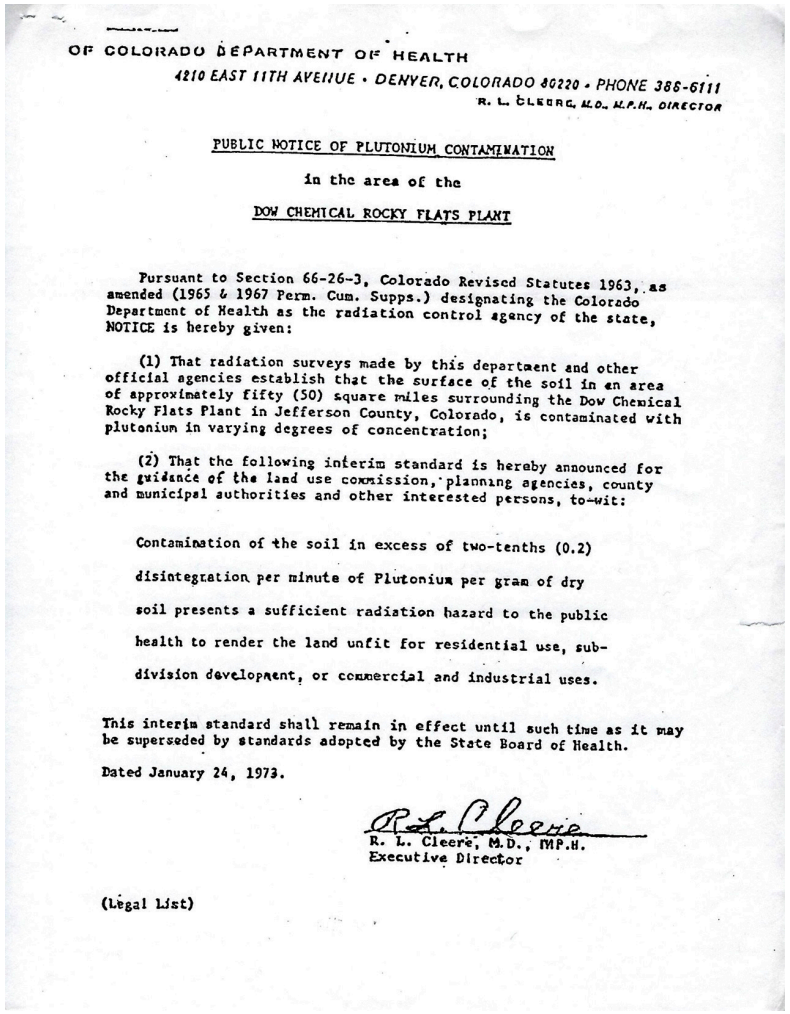
- Offsite soil studies
- Public health studies
- Reflections

Models and Estimates and Soil Standards etc.



- CDPHE's Pu soil concentration averaging is inappropriate and irresponsible
  - It neglects the danger posed by hotspots
  - Which could invalidate dose assumptions
  - What if a child inhales hotspot dust?
- What if the models and estimates and assumptions are wrong?
- Our knowledge of radiation health effects is constantly evolving
- What if the limits provided by regulations are too lax?

Colorado's Pu Soil Standards Changed Arbitrarily



OF COLORADO DEPARTMENT OF HEALTH
4210 EAST 11TH AVENUE · DENVER, COLORADO 80220 · PHONE 388-6111
R. L. CLEERE, M.D., M.P.H., DIRECTOR

PUBLIC NOTICE OF PLUTONIUM CONTAMINATION

in the area of the

DOW CHEMICAL ROCKY FLATS PLANT

Pursuant to Section 66-26-3, Colorado Revised Statutes 1963, as amended (1965 & 1967 Perm. Cum. Supps.) designating the Colorado Department of Health as the radiation control agency of the state, NOTICE is hereby given:

(1) That radiation surveys made by this department and other official agencies establish that the surface of the soil in an area of approximately fifty (50) square miles surrounding the Dow Chemical Rocky Flats Plant in Jefferson County, Colorado, is contaminated with plutonium in varying degrees of concentration;

(2) That the following interim standard is hereby announced for the guidance of the land use commission, planning agencies, county and municipal authorities and other interested persons, to-wit:

Contamination of the soil in excess of two-tenths (0.2) disintegration per minute of Plutonium per gram of dry soil presents a sufficient radiation hazard to the public health to render the land unfit for residential use, subdivision development, or commercial and industrial uses.

This interim standard shall remain in effect until such time as it may be superseded by standards adopted by the State Board of Health.

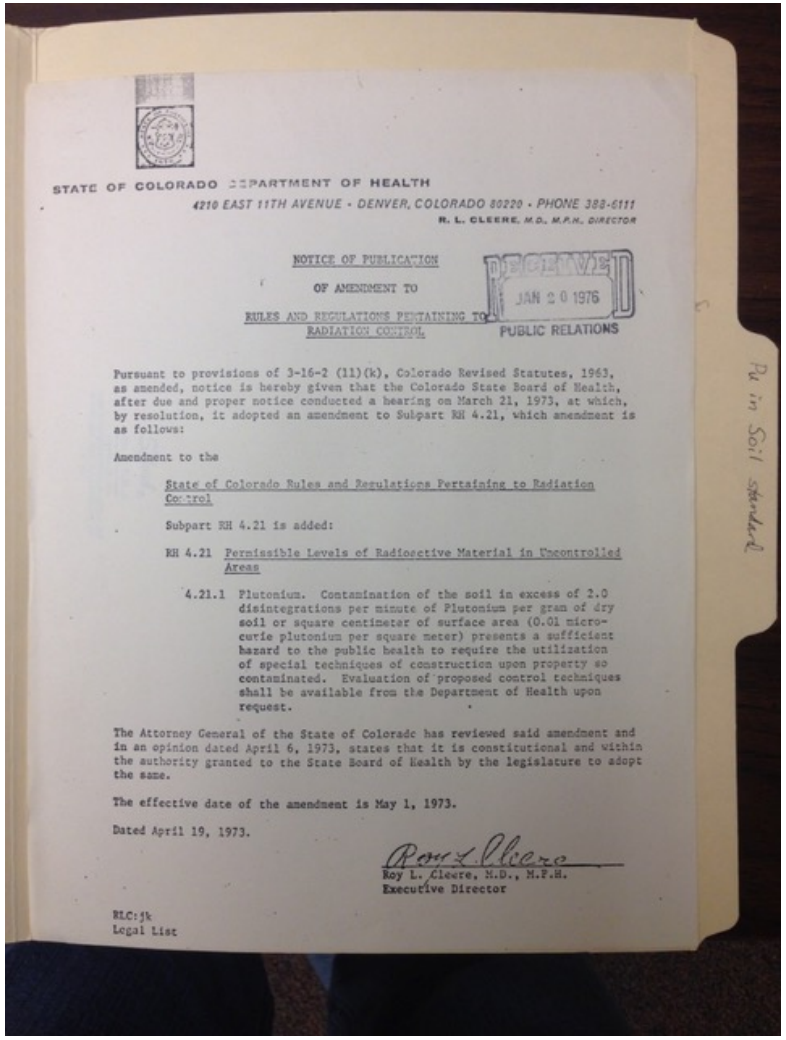
Dated January 24, 1973.

R. L. Cleere

R. L. Cleere, M.D., M.P.H.
Executive Director

(Legal List)

- 1/24/73 CDH Director R.L. Cleere set standard at 0.2 dpm/g
  - "soil in an area of 50 square miles surrounding the plant is contaminated"
  - "contamination in excess of 0.2 dpm/g renders land unfit for residential use"
- 4/19/73 Cleere upped the standard to 2.0 dpm/g
  - "contamination in excess of 2.0 dpm/g requires special techniques of construction"



STATE OF COLORADO DEPARTMENT OF HEALTH
4210 EAST 11TH AVENUE · DENVER, COLORADO 80220 · PHONE 388-6111
R. L. CLEERE, M.D., M.P.H., DIRECTOR

NOTICE OF PUBLICATION
OF AMENDMENT TO
RULES AND REGULATIONS PERTAINING TO
RADIATION CONTROL

RECEIVED
JAN 20 1976
PUBLIC RELATIONS

Pursuant to provisions of 3-16-2 (11)(k), Colorado Revised Statutes, 1963, as amended, notice is hereby given that the Colorado State Board of Health, after due and proper notice conducted a hearing on March 21, 1973, at which, by resolution, it adopted an amendment to Subpart RH 4.21, which amendment is as follows:

Amendment to the

State of Colorado Rules and Regulations Pertaining to Radiation Control

Subpart RH 4.21 is added:

RH 4.21 Permissible Levels of Radioactive Material in Uncontrolled Areas

4.21.1 Plutonium. Contamination of the soil in excess of 2.0 disintegrations per minute of Plutonium per gram of dry soil or square centimeter of surface area (0.01 microcurie plutonium per square meter) presents a sufficient hazard to the public health to require the utilization of special techniques of construction upon property so contaminated. Evaluation of proposed control techniques shall be available from the Department of Health upon request.

The Attorney General of the State of Colorado has reviewed said amendment and in an opinion dated April 6, 1973, states that it is constitutional and within the authority granted to the State Board of Health by the legislature to adopt the same.

The effective date of the amendment is May 1, 1973.

Dated April 19, 1973.

Roy L. Cleere

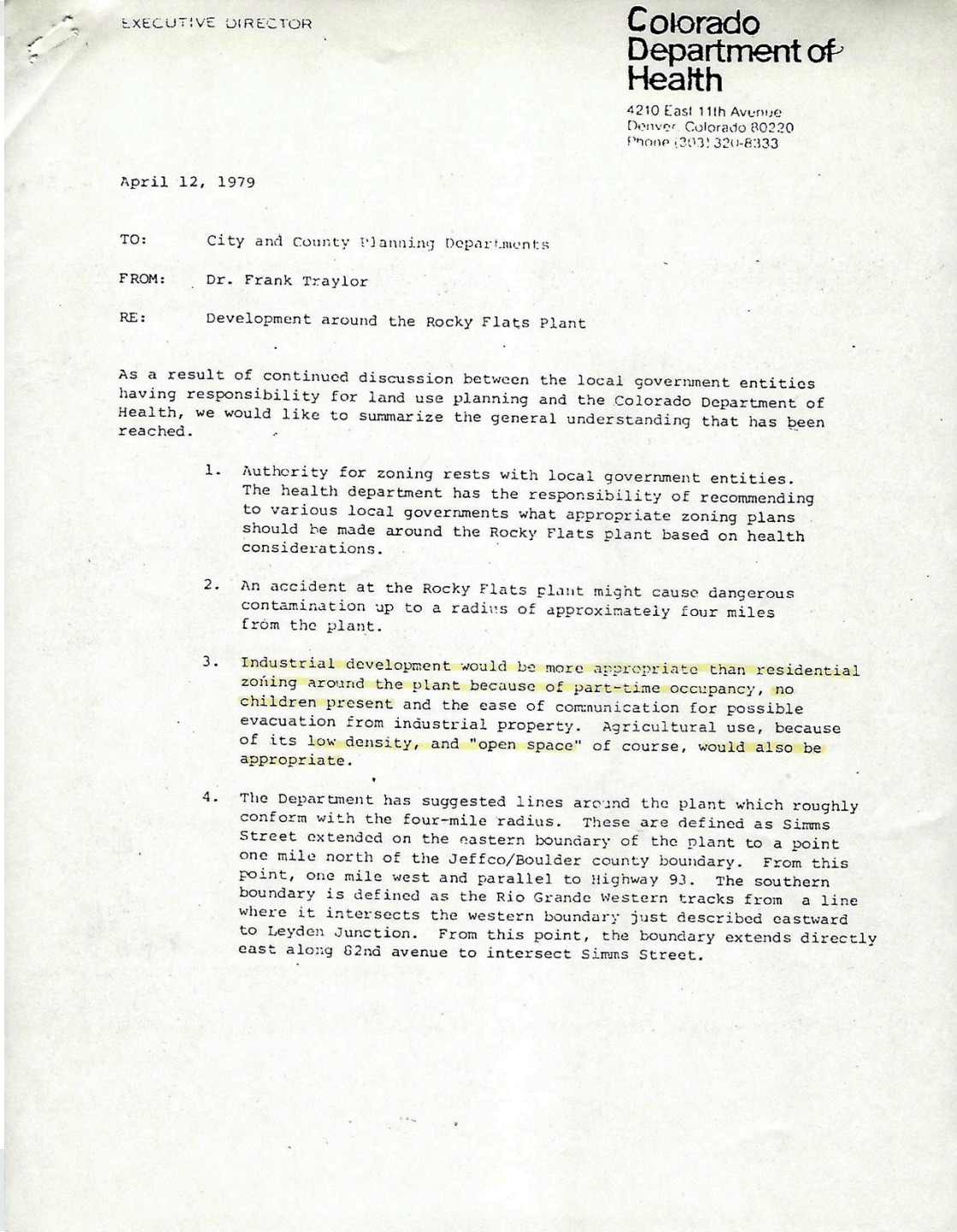
Roy L. Cleere, M.D., M.P.H.
Executive Director

RLC:jk
Legal List

Pu in Soil standard

Dr. Frank Traylor's Blue Line, 1979

- In 1979, then-Director of the Colorado Department of Health (now called CDPHE) Dr. Frank Traylor wrote a memo recommending to local governments that there be NO NEW RESIDENTIAL DEVELOPMENT, from a land use planning and zoning perspective, between Highway 93 and Simms Street, Highway 72 and Highway 128.



EXECUTIVE DIRECTOR

Colorado Department of Health

4210 East 11th Avenue
Denver, Colorado 80220
Phone (303) 320-8333

April 12, 1979

TO: City and County Planning Departments

FROM: Dr. Frank Traylor

RE: Development around the Rocky Flats Plant

As a result of continued discussion between the local government entities having responsibility for land use planning and the Colorado Department of Health, we would like to summarize the general understanding that has been reached.

1. Authority for zoning rests with local government entities. The health department has the responsibility of recommending to various local governments what appropriate zoning plans should be made around the Rocky Flats plant based on health considerations.

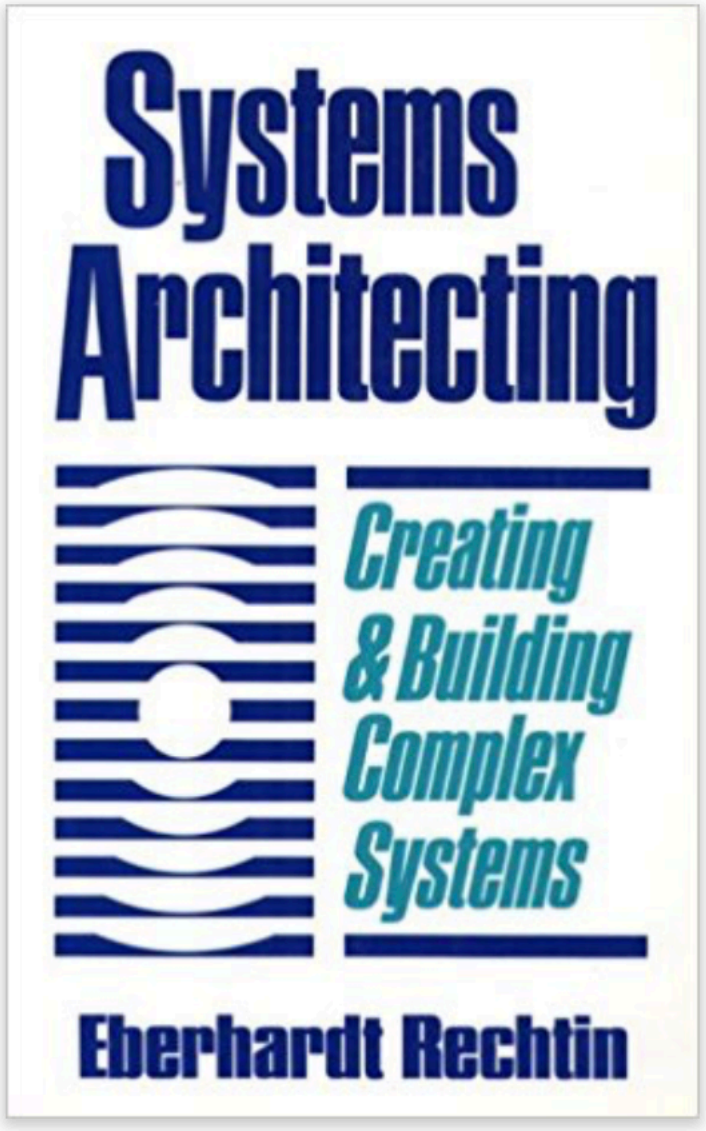
2. An accident at the Rocky Flats plant might cause dangerous contamination up to a radius of approximately four miles from the plant.

3. Industrial development would be more appropriate than residential zoning around the plant because of part-time occupancy, no children present and the ease of communication for possible evacuation from industrial property. Agricultural use, because of its low density, and "open space" of course, would also be appropriate.

4. The Department has suggested lines around the plant which roughly conform with the four-mile radius. These are defined as Simms Street extended on the eastern boundary of the plant to a point one mile north of the Jeffco/Boulder county boundary. From this point, one mile west and parallel to Highway 93. The southern boundary is defined as the Rio Grande Western tracks from a line where it intersects the western boundary just described eastward to Leyden Junction. From this point, the boundary extends directly east along 82nd avenue to intersect Simms Street.

Measurement Overrides Modeling

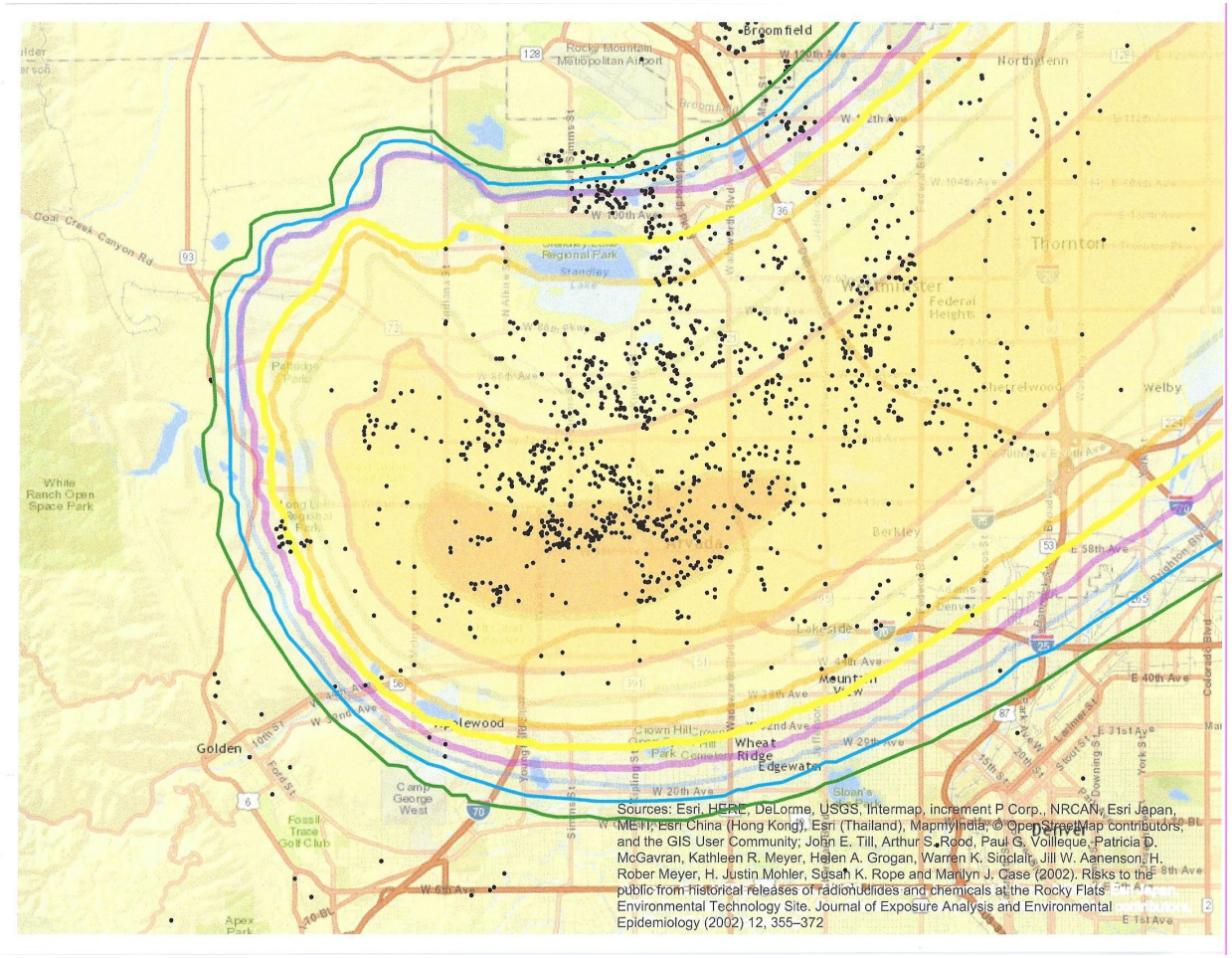
- “A model is not reality.”
- “A model is an abstraction of what the participants think (and hope) the end system and its environment will look like. What actually results is almost always different.”
- “Before the flight, it’s opinion. After the flight, it’s obvious.”
- ***Measurements of cancer incidence in the downwind population put the lie to CDPHE’s risk models***
- ***Dose reconstruction studies are irrelevant; pale in comparison to public health monitoring***

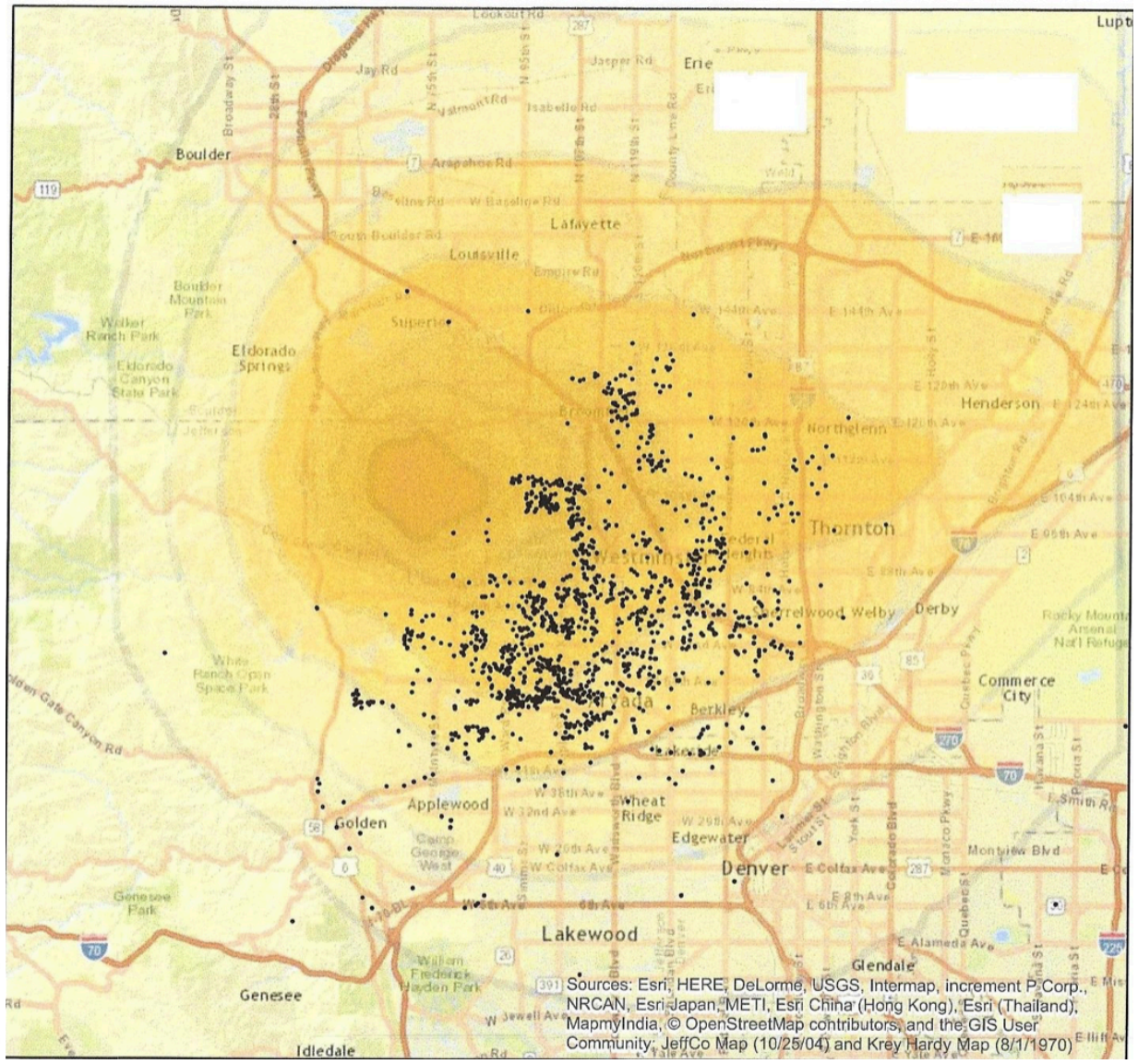


MSU Health Survey Preliminary Results

- Within the 1,745 completed surveys for the 64-year time period, there were 848 cases of cancer
- 414 of those cases (49%) were “rare” (meaning fewer than 15 cases per 100,000 people).
- The US rate for “rare” cancers is 25 percent. We have twice that rate.
- The most common cancers in this study, in order of prevalence, are breast, thyroid, prostate and colon
- Thyroid cancer ranks 9th in prevalence nationally, but 2nd in the health survey results

MSU Health Survey Geo-Plots





Answering the Causality Question

- For cancer victims, excise the primary tumor if possible (posthumously, even)
- Analyze the malignant tissue for plutonium, Rocky Flats isotope ratio
- This was done for Kristen Haag (ashes) and Lloyd Mixon (tumors) as documented in Dark Circle; both found plutonium in ashes / tumors

Qualifications Comparison

- Dr. Edward Martell – West Point graduate, PhD. in Radiochemistry, studied effects of radiation on humans from 1950s nuclear bomb tests in Pacific
- Dr. Carl Johnson – Ohio State MD, Berkeley MPH, Army Reserve Colonel. Specialized in radiation and epidemiology.
- Dr. John Cobb – University of Colorado Medical School Department Chair, professor of Preventative Medicine
- Dr. Richard Clapp – Boston University PhD. Epidemiologist, Harvard MPH, Director Massachusetts Department of Health Cancer Registry
- CDPHE Rocky Flats oversight directors (DOE-funded)
  - Al Hazle – CSU BS Agriculture, salesman, herdsman, mountain guide
  - Carl Spreng – BYU MS Geology, oil & gas industry exploration geologist

It’s Up To Us

“I have yet to see an agency study itself and turn itself in.”

Former US Representative from Colorado, Pat Schroeder, quoted in Jerry Brown, “Rocky Flats Study Should Be Given to Outside Experts, Schroeder Says,” Rocky Mountain News, August 18, 1979.

What Can You Do?

- Take an interest in the issue and history. Educate yourself.
- Contact elected officials with concerns over the refuge and the parkway
- Ask elected officials to support independent review of existing studies, performing new soil and health studies. ***Express no confidence in CDPHE.***
- Lobby for signage around the refuge
- Lobby for unsealing the records of Special Grand Jury 89-2
- Have sick downwinders complete Rocky Flats Downwinders' health survey
  - http://rockyflatsdownwinders.com/health-survey/
- Put sick downwinders' doctors in touch with Dr. sashstiles@gmail.com
- Argue the issue in public forums – persuade people of the risk and danger