

Session 2: Experience with Stakeholder Dialogue in Complex Radiological Protection Situations

“Development of release criteria for contaminated areas: experience from the US Rocky Flats situation”

John E. Till, PhD

Risk Assessment Corporation

NEA/IRPA: Stakeholder Dialogue Webinar—
Experience and Lessons for Young and Old Experts
and Researchers February-March 2016



The RAC Team



Building Trust and Credibility in Environmental Risk Assessment

- **Must be based on data and science**
- **Must be transparent**
- **Must be effectively communicated**
- **Must be earned**
- **Must go beyond what is expected**

Rocky Flats Environmental Technology Site

(2,525 ha ~ 6,240 a)

Denver, 26 km

Arvada,
Westminster,
Broomfield, 10 km

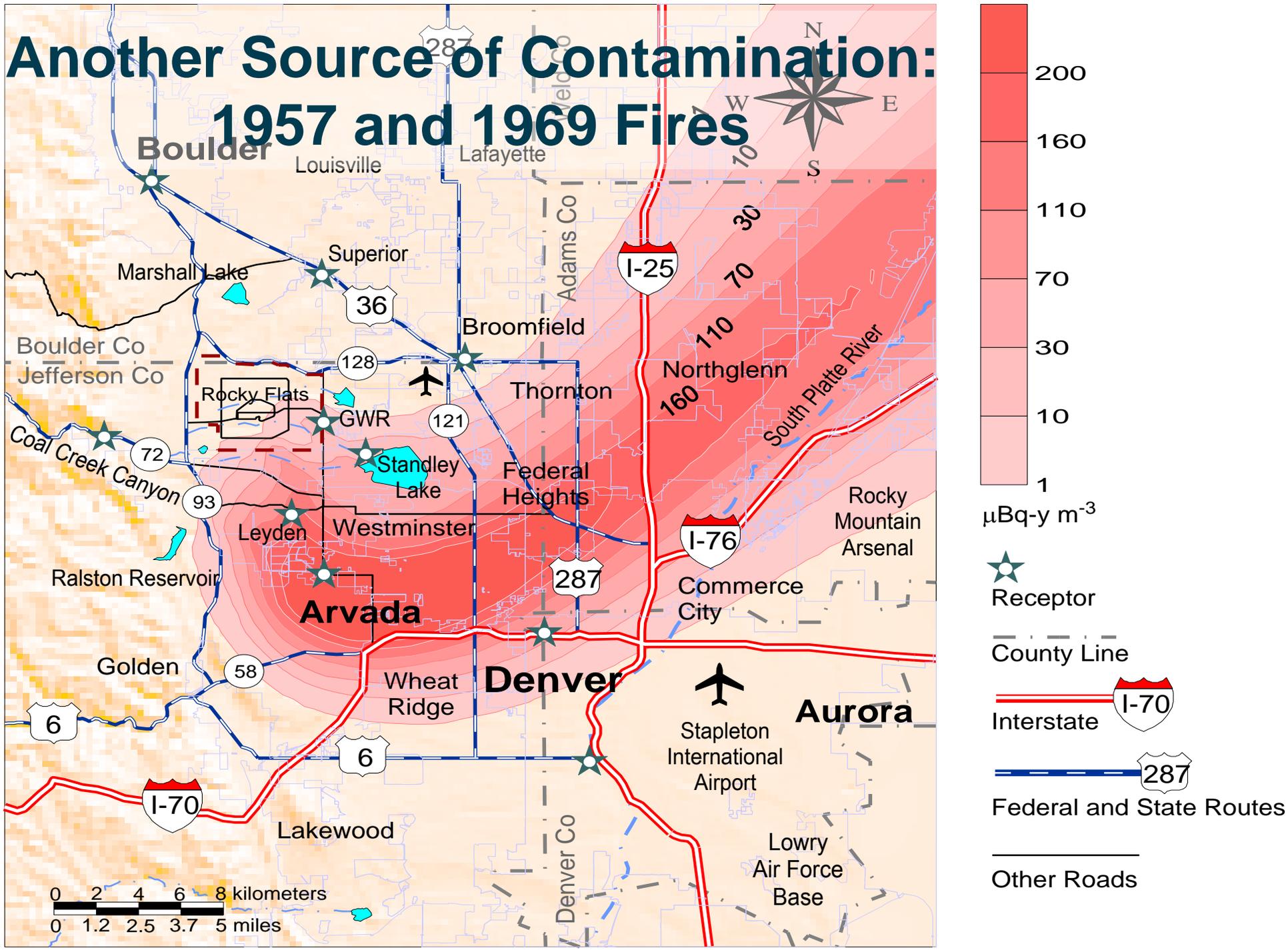
What is the future of the site?



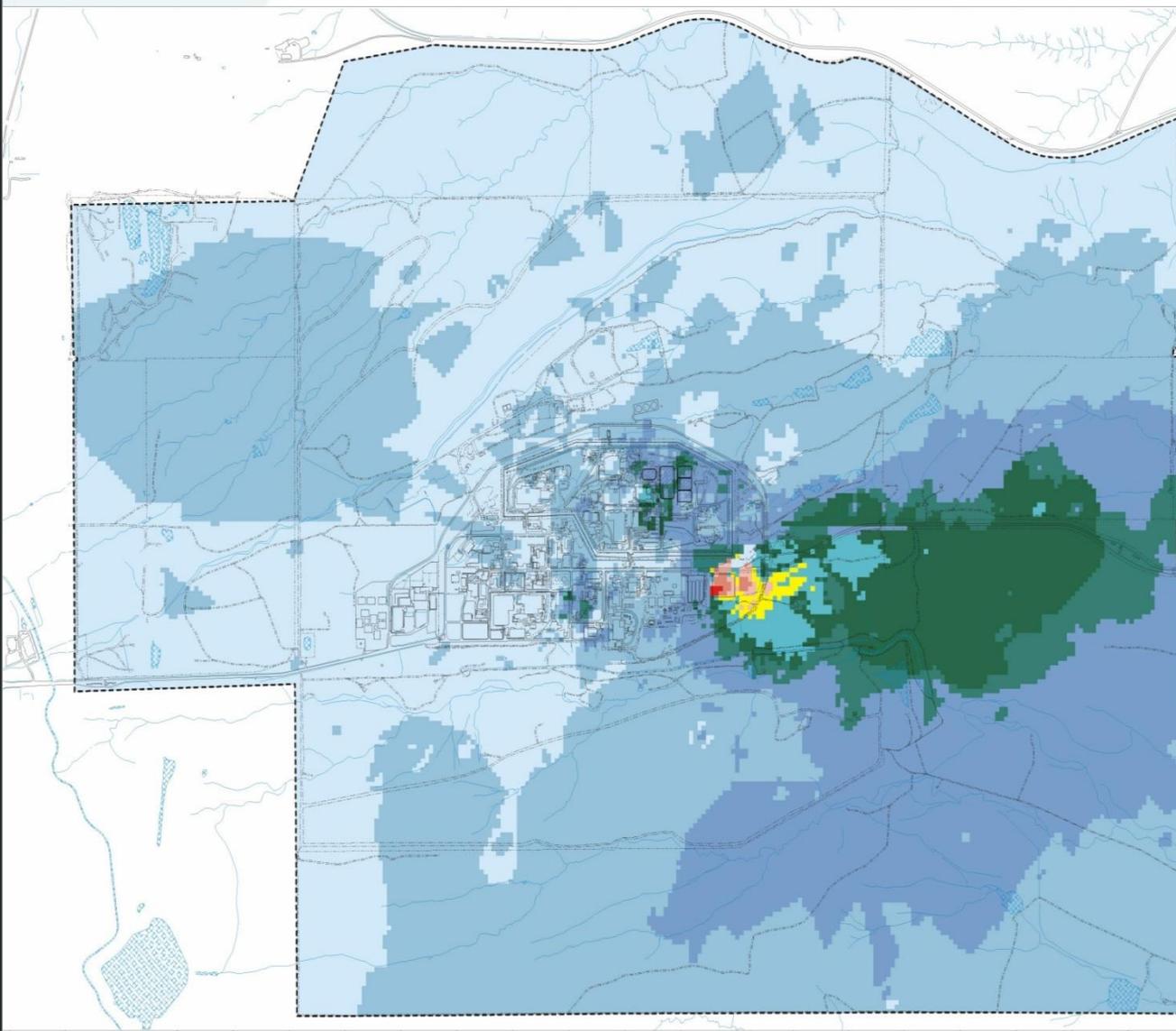
The Primary Source of Plutonium Was from Leaking Barrels Containing Waste



Another Source of Contamination: 1957 and 1969 Fires



Plutonium in Soil at the Rocky Flats Site Prior to Cleanup



Bq kg⁻¹



Study Objective

- **To estimate the levels of plutonium and other actinides in soil released from Rocky Flats such that subsequent human exposure during future use of the site does not result in levels of radiation dose that exceed specified limits**
- **These activity levels are called Radionuclide Soil Action Levels or RSALs**

Requirements

- **Project supported by Citizen's Advisory Board (Grant provided by DOE)**
- **0.15 mSv per year dose constraint**
- **Unrestricted use of the land**
- **1000 year time frame**
- **Use of available site specific data**
- **Account for uncertainties**

We Did Not Take into Account

- **Cost of cleanup**
- **Risk (operational) associated with cleanup**
- **Institutional controls**

Radionuclide Soil Action Level Oversight Panel



Soil Action Levels Used at Different Sites

Location	Pu-239 soil action level (Bq/kg)	Dose (mSv)
Hanford	1300	0.15
Nevada Test Site	12,000	0.78
Johnston Atoll	629	0.20
Palomares	~45,500	1.0

Exposure Scenarios



Exposure Scenarios

Parameter	Resident rancher	Infant of rancher	Child of rancher
Dose constraint (mSv)	0.15	0.15	0.15
Time on the site (h y ⁻¹)	8760	8760	8760
Time indoors onsite(%)	60	90	75
Breathing rate (m ³ y ⁻¹)	10800	1900	8600
Soil ingestion rate (g y ⁻¹)	75	75	75
Irrigation water source	na	na	na
Onsite drinking water	na	no	no
Fraction food homegrown	1	0	1

$$RSAL = \frac{D_{\text{lim}}}{DSR}$$

Where:

- ***RSAL* = radionuclide soil action level**
- ***D_{lim}* = annual dose limit (0.15 mSv)**
- ***DSR* = dose to source ratio (mSv per Bq kg⁻¹)**



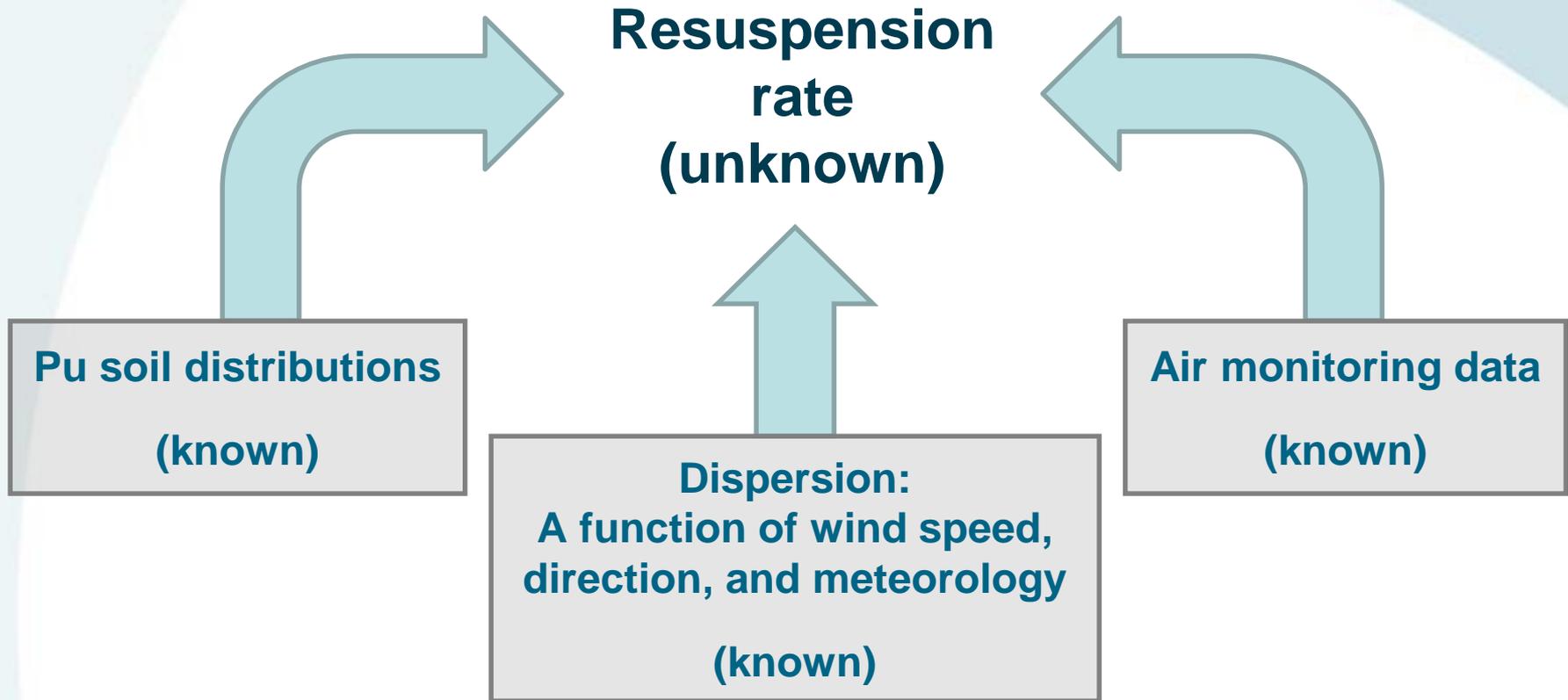
The Process

- 18 month schedule
- Monthly meetings
- Workshops to focus on specific issues (uncertainty, scenario parameters, models)
- RSAL panel selected by Citizen's Advisory Board (scientists and non-scientists)
- Panel had voting authority (majority)

Resuspension of Plutonium Contaminated Soils was a Dominant Pathway



Resuspension Model

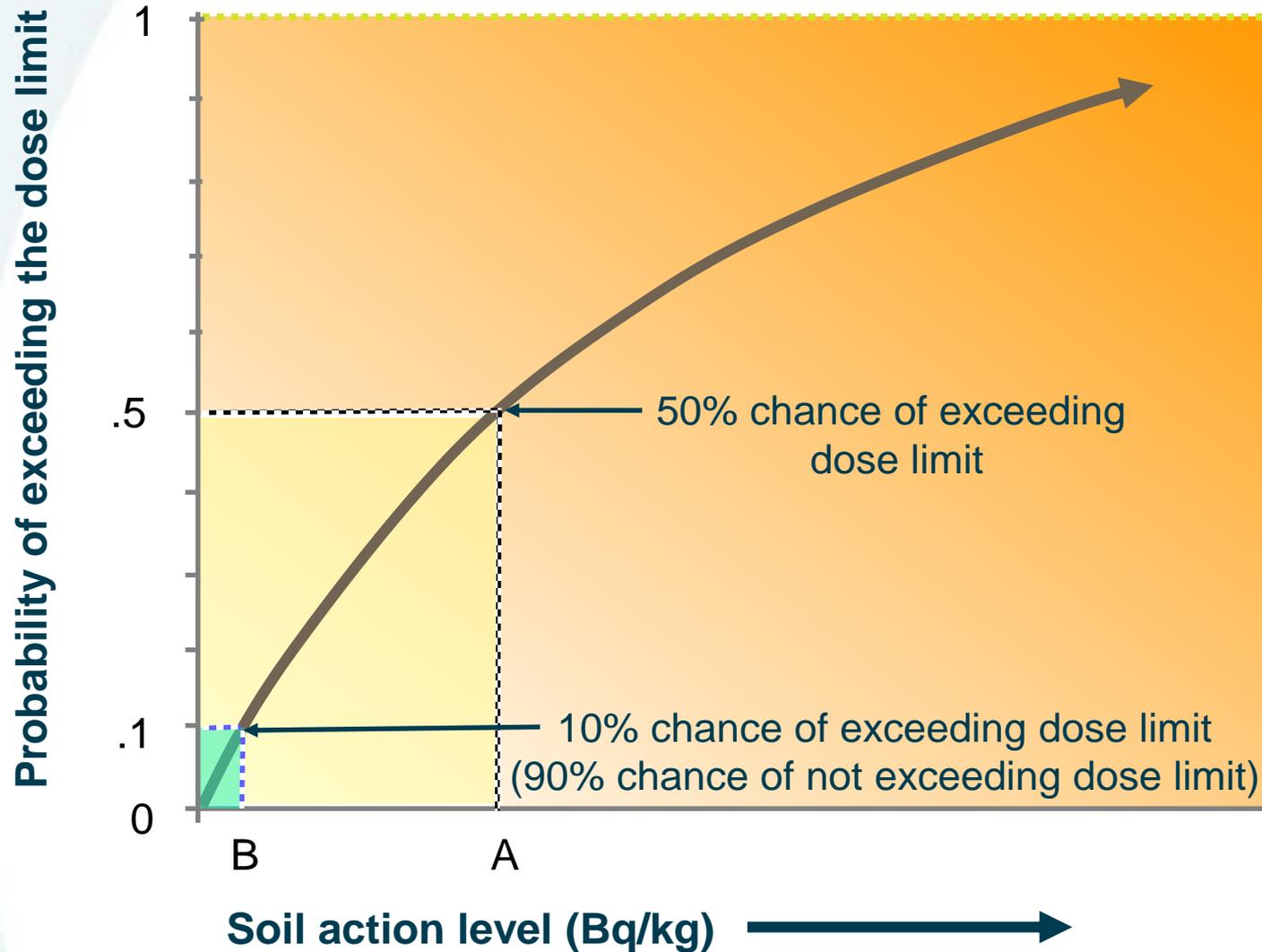


A resuspension rate was determined using data available for plutonium concentration in soil and measurements of plutonium in air.

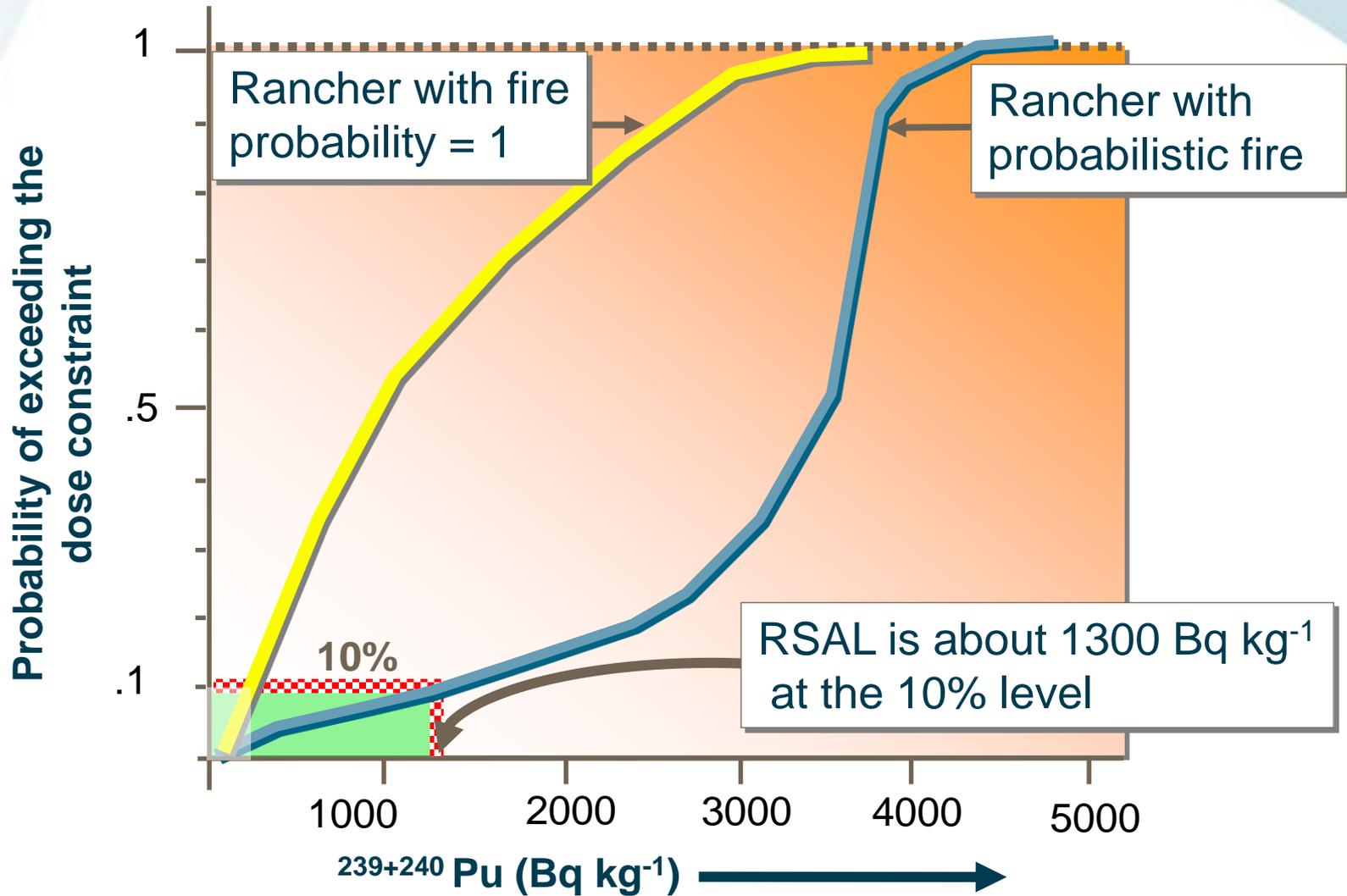
A Prairie Fire Could Significantly Increase Exposure

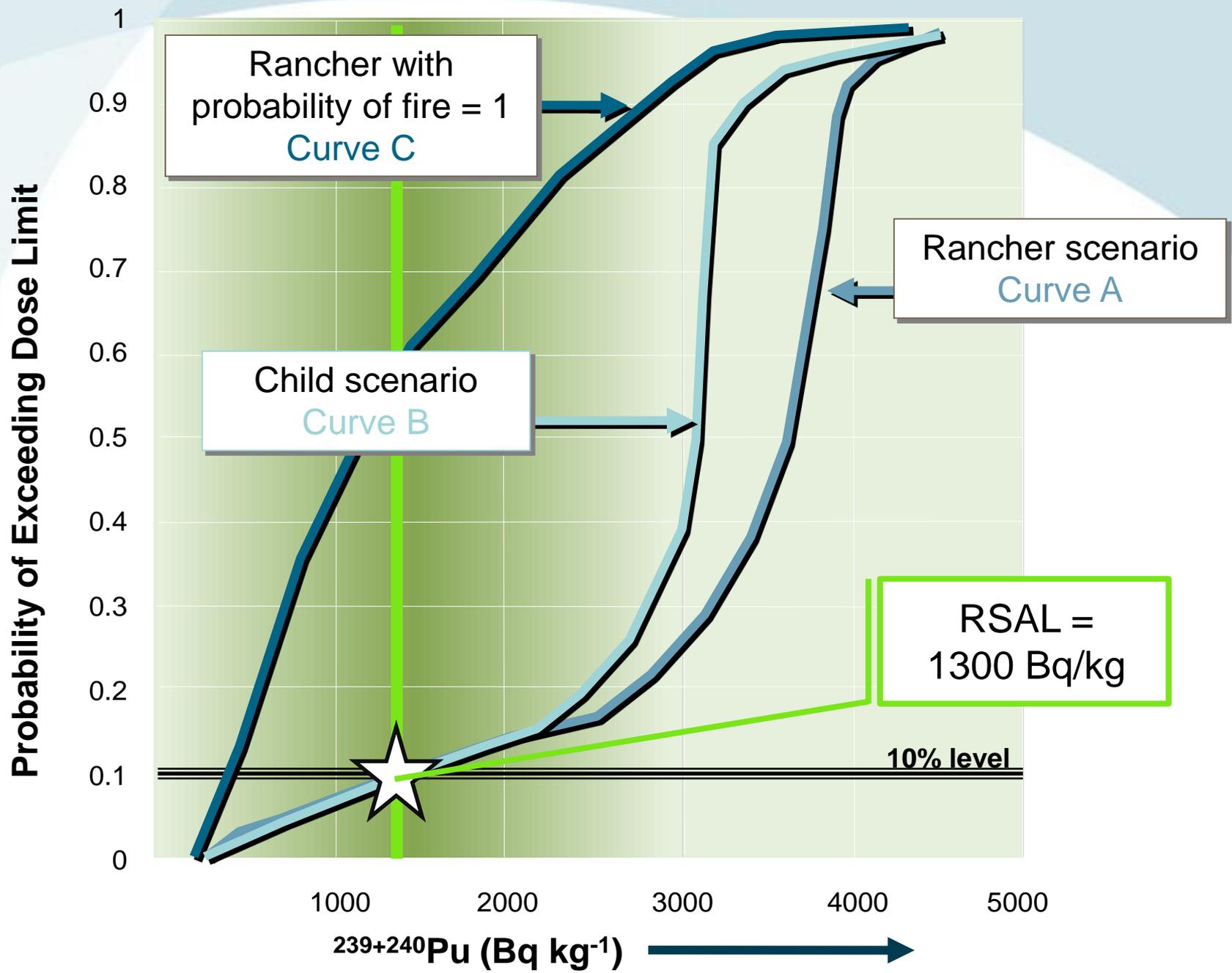


Probability Curve



Scenario 1 – Rancher





Probability of Exceeding Dose Limit

Rancher with probability of fire = 1
Curve C

Child scenario
Curve B

Rancher scenario
Curve A

RSAL =
1300 Bq/kg

10% level

$^{239+240}\text{Pu}$ (Bq kg^{-1})

- **The Radionuclide Soil Action Level Panel recommended the cleanup level to be implemented at the Rocky Flats Environmental Technology Site be ~ 1300 Bq/kg**
- **The actual level used was ~ 1,800 Bq/kg**



Rocky Flats National Wildlife Refuge: An Example of Successful Stakeholder Dialogue in Complex Situations

