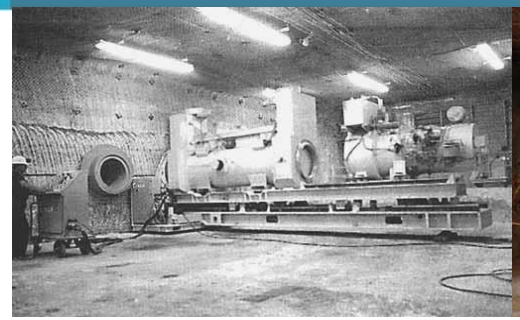
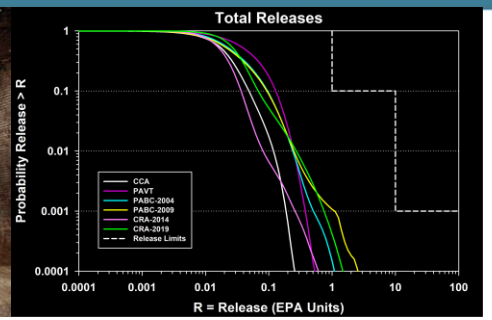
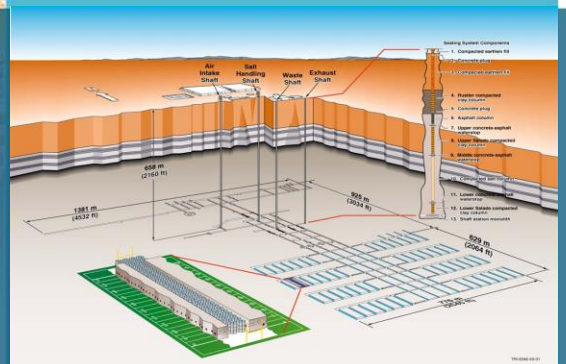
Summary of Changes to WIPP Performance Assessment for the Replacement Panels Planned Change Request





Sarah Brunell and Seth King

August 2024



SAND2024-10624PE

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The Waste Isolation Pilot Plant (WIPP) Performance Assessment

Long-term WIPP repository performance is demonstrated via Performance Assessment (PA)

PA answers three questions about the repository system:

1. What can happen after permanent closure?
2. How likely is it to happen?
3. What can result if it does happen?

And one question about the analysis:

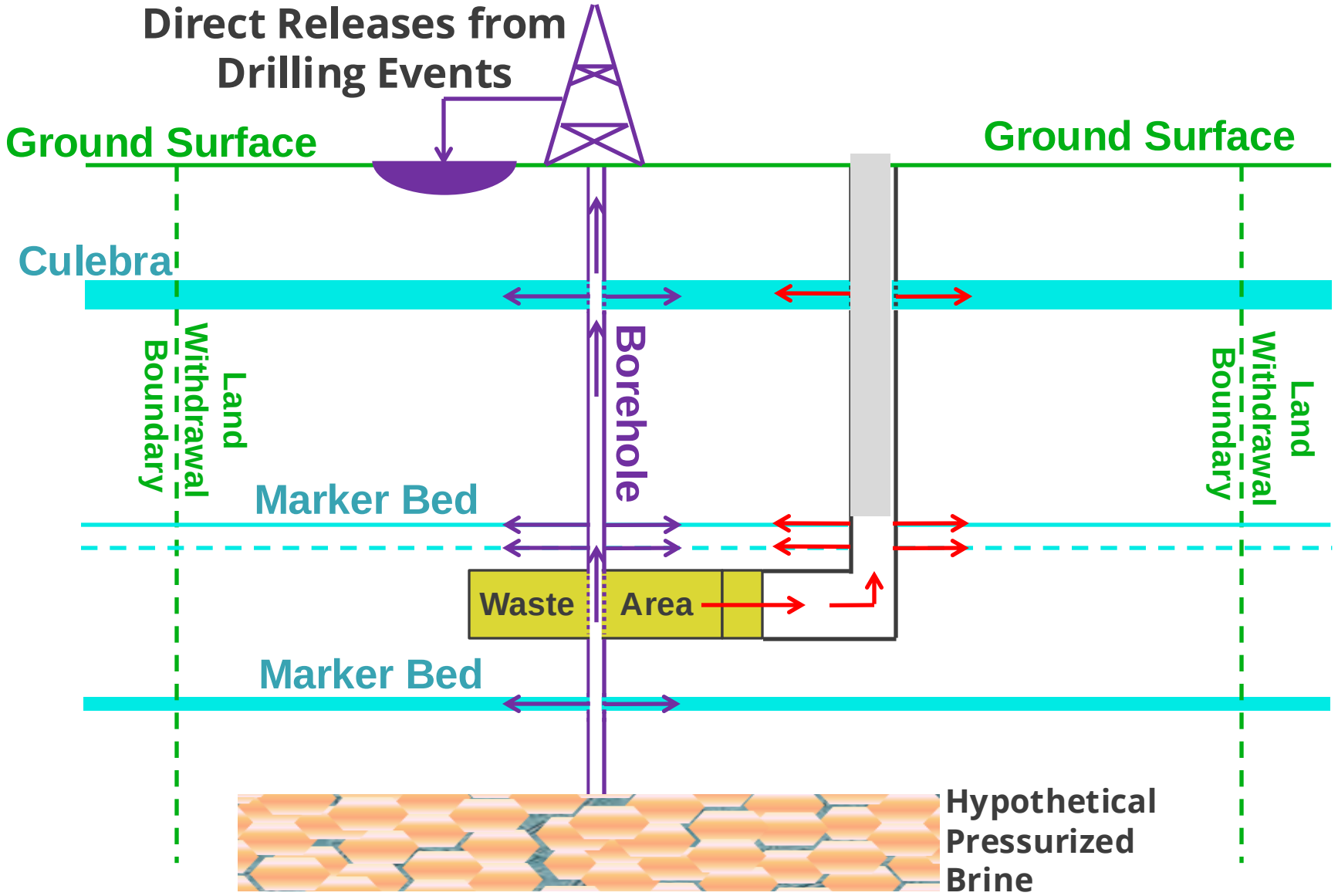
4. What level of confidence can be placed on the estimate? (What is the uncertainty in the analysis)

WIPP Performance Assessment

PA estimates potential radionuclide releases from the WIPP repository over a 10,000-year regulatory timeframe for two scenarios.

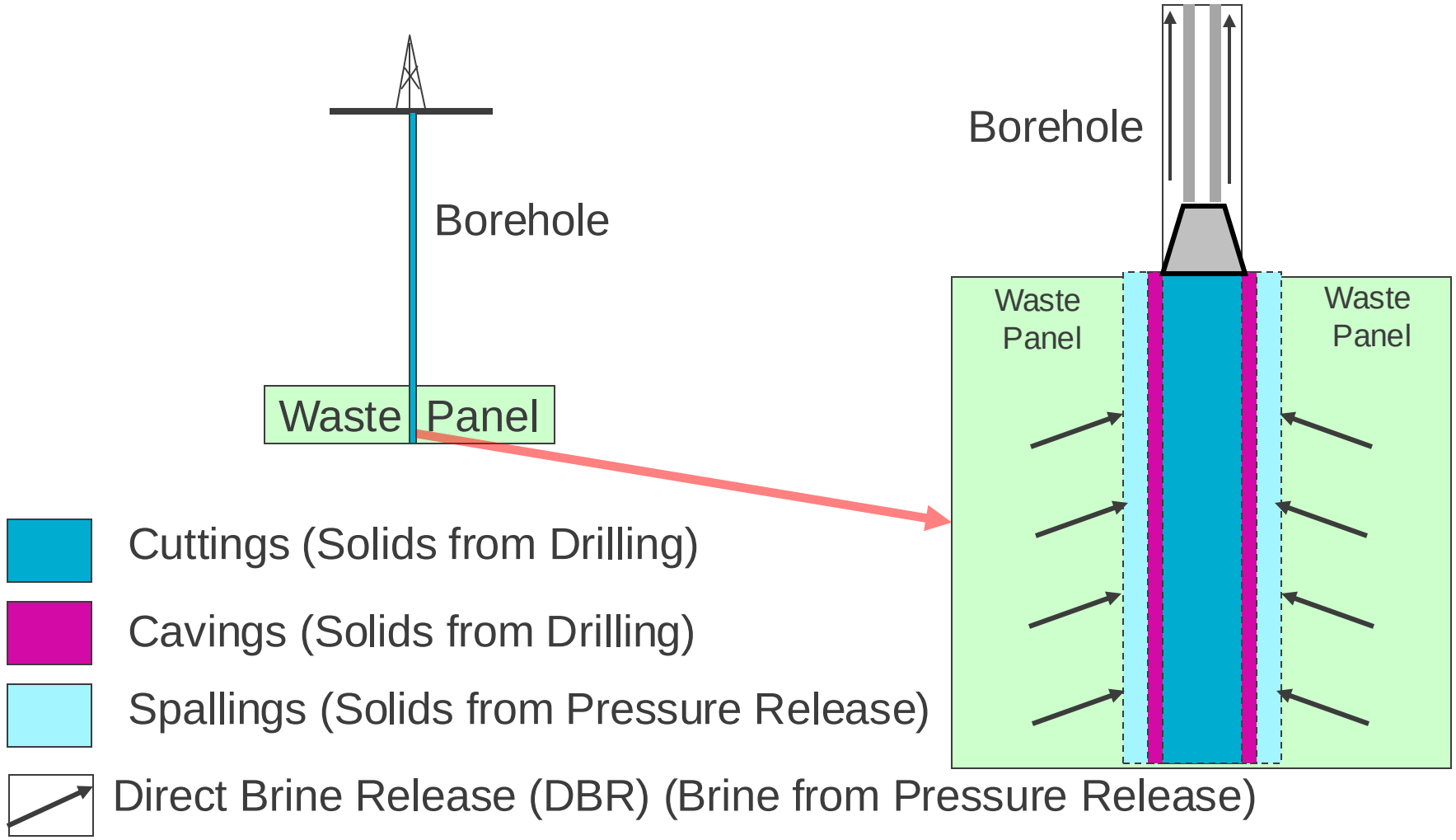
- **Undisturbed Repository Performance**
  - Models salt creep with fluid flow and waste degradation processes.
  - Results for the Replacement Panels Planned Change Request (RPPCR) indicate there are no releases to the accessible environment from the undisturbed repository.
- **Disturbed Repository Performance**
  - PA is required to consider inadvertent and intermittent drilling and mining for resources.
  - Inadvertent human intrusion is the only mechanism hypothetically capable of releasing radionuclides to the accessible environment.
  - RPPCR releases are less than the compliance limits.

Release Pathways in WIPP PA



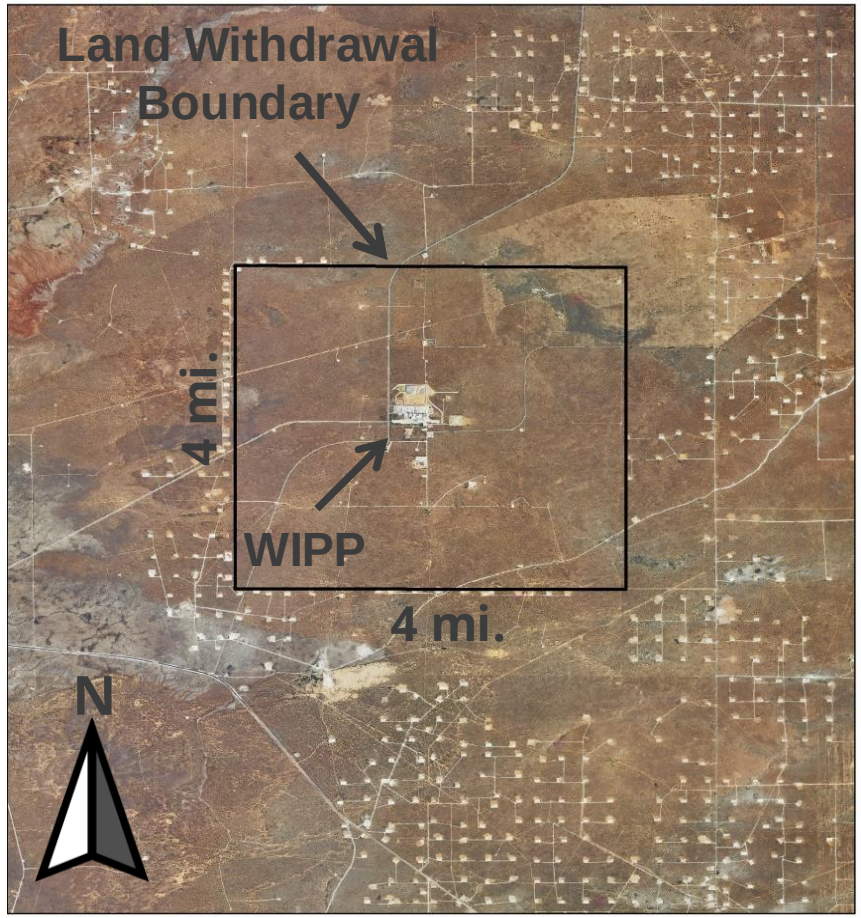
Direct Release Mechanisms

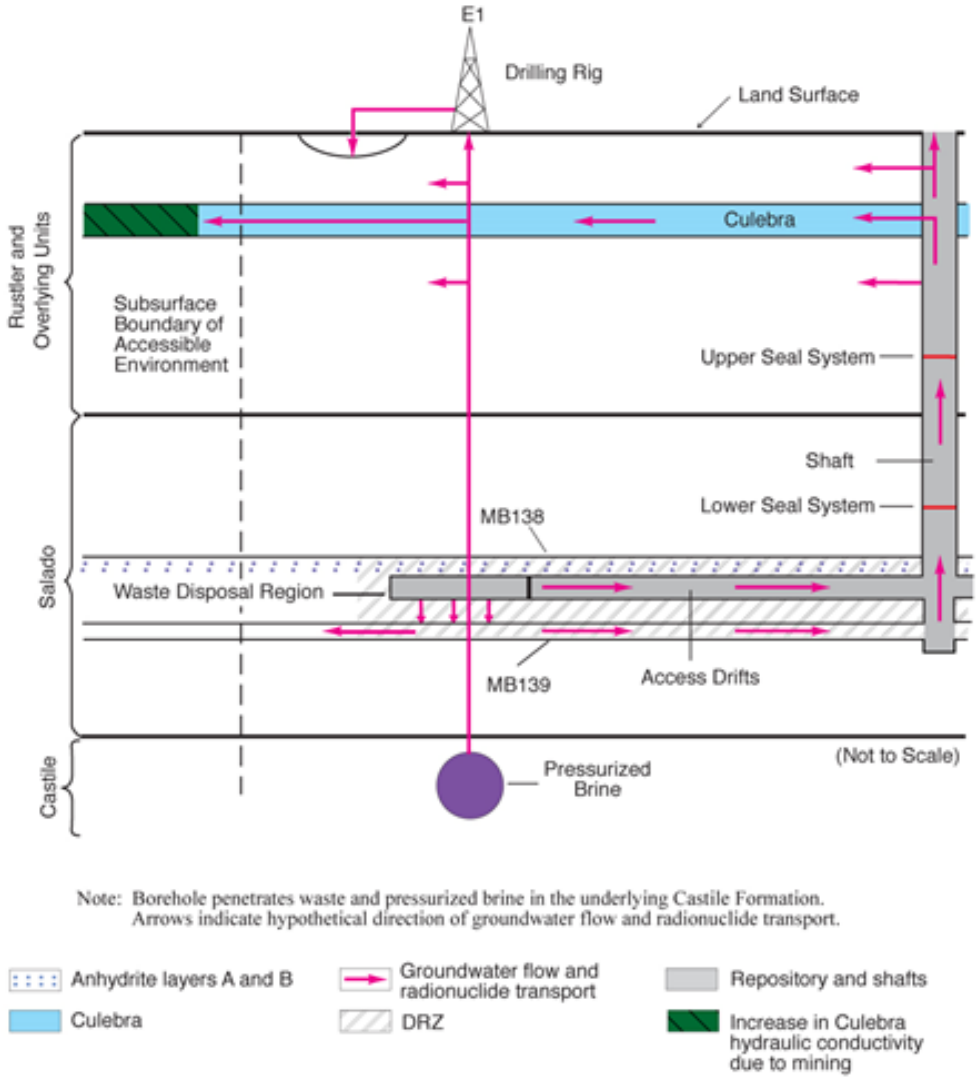
Direct releases comprise short-term releases, and are the main contributor to total releases.



Long-Term Direct Release Mechanism Considered in WIPP PA

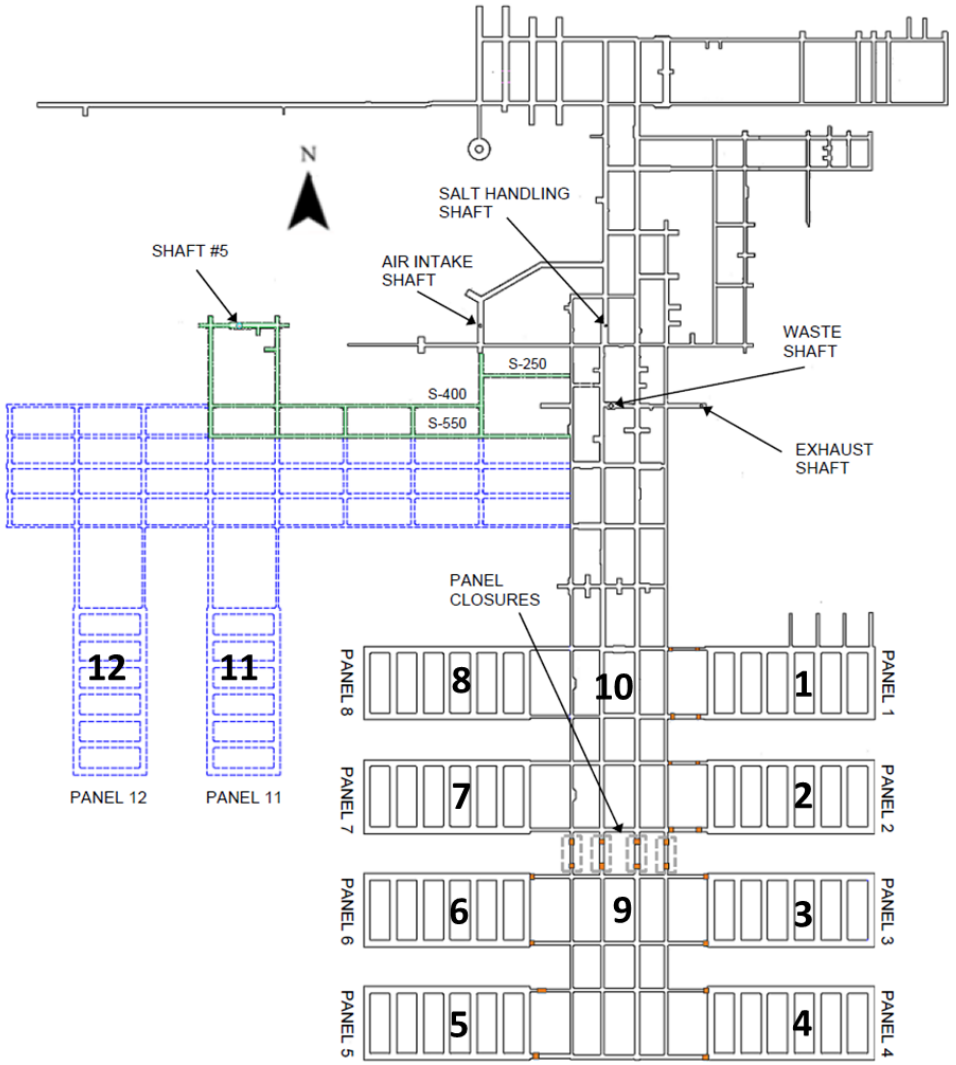
Radionuclide transport through groundwater comprise long-term releases.





Replacement Panels Planned Change Request

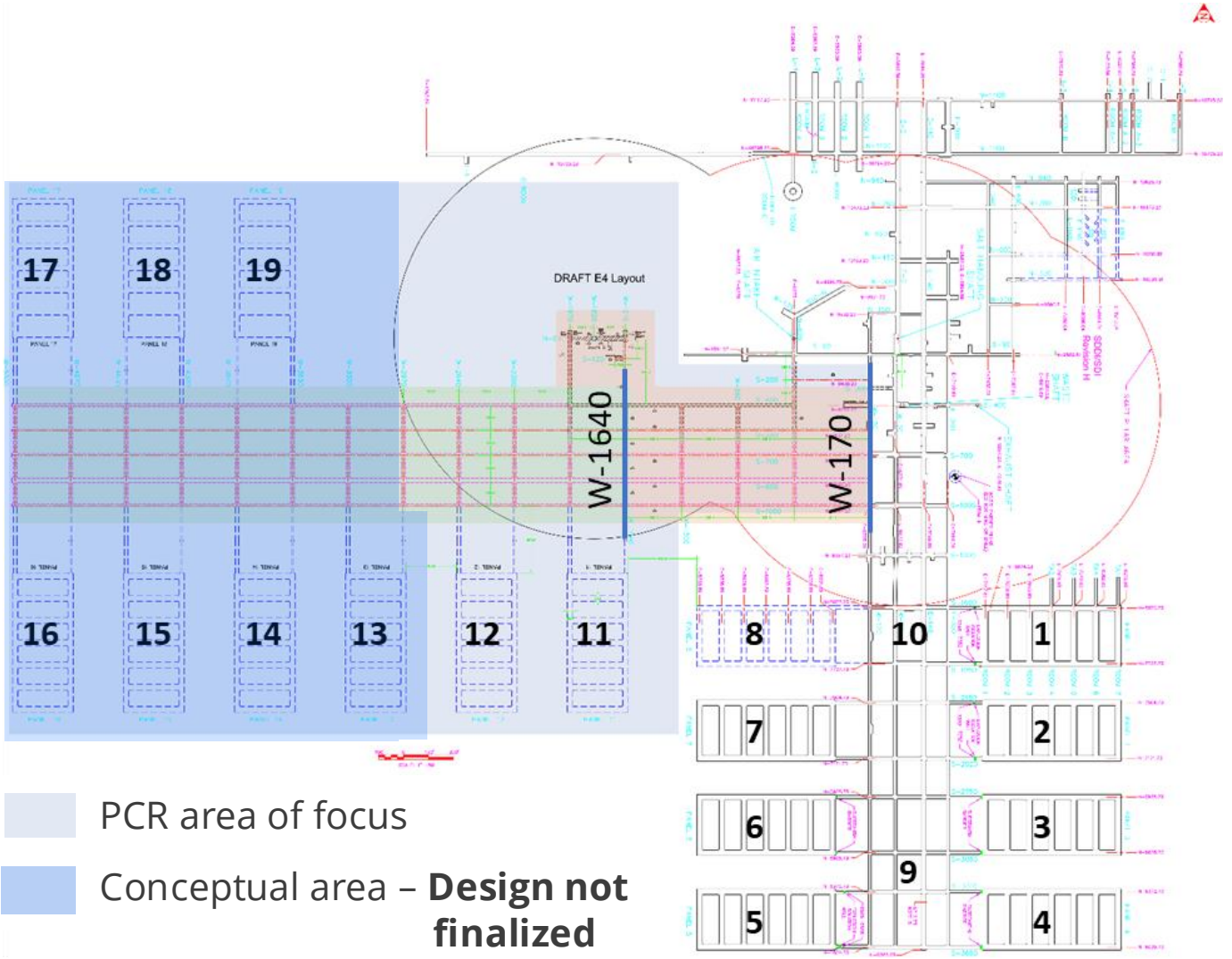
- Replacement Panels 11 and 12 are intended to recover disposal capacity lost due to operational constraints.
- DOE formally requested approval for replacement Panels 11 and 12 via a Planned Change Request (PCR), submitted March 12, 2024.
- The Replacement Panels Planned Change Request Performance Assessment (RPPCR PA) demonstrates continued compliance of the repository with EPA containment requirements.



12-Panel PCR, 19-Panel Performance Assessment

- Panel 11 and Panel 12 will not provide enough storage capacity for the full volume of waste authorized by the Land Withdrawal Act
- Based on an EPA request in a letter to DOE dated April 2021, and with concurrence from CBFO, a PA analysis was executed based on the anticipated repository design at closure

DOE is currently only seeking approval for Panel 11 and Panel 12



WIPP APPA Changed Conceptual Models Peer Review

- **Conceptual Model –** how important features, events, and processes are represented in PA.
- Repository changes required updates to 3 conceptual models.
  - **Disposal System Geometry** – dimension of the repository and surrounding areas.
  - **Repository Fluid Flow** – fluid in the waste, fluid flow between the Salado and shafts, fluid flow between the repository and intrusion boreholes.
  - **Direct Brine Release** – representation of repository in the DBR model.
- Proposed changes to conceptual models require the approval of a peer review (40 CFR Part 194.27).
- WIPP Additional Panels Performance Assessment (APPA) Changed Conceptual Models Peer Review happened in July, 2021.
- Peer review found the proposed updates are adequate to calculate radionuclide releases.

Model Parameterization in the RPPCR PA

A number of changes/refinements are included in the RPPCR PA, relative to the CRA-2019 PA, in addition to the planned changes to the repository footprint.

Changes to accommodate waste Panels 11 – 19:

- Parameters related to the updated repository area and volume.
- Computational grids for Salado flow and DBR models.
- Additional release points added to the Culebra transport models.

Standard updates:

- Drilling rate
- Plugging pattern probabilities
- Inventory
  - Radionuclides
  - Waste materials
  - Organics
- Radionuclide solubilities and their associated uncertainty

Model Parameterization in the RPPCR PA

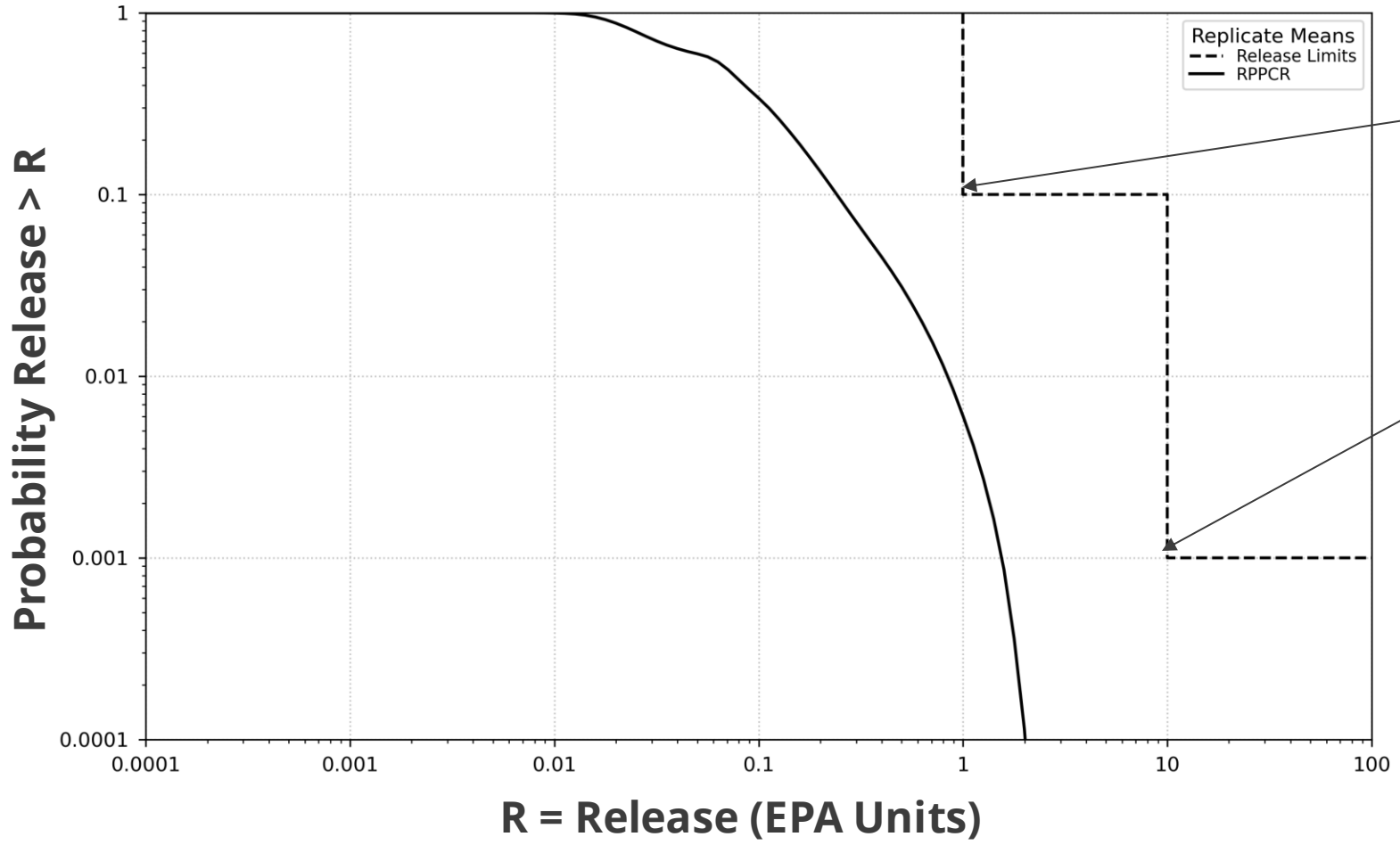
Additional Changes:

- Castile brine reservoir model
- Borehole permeability parameter distribution
- Updated method of calculating iron surface area
- Thermodynamic database
- Recalibrated Culebra T-Fields
- Actinide oxidation state model is extended to accommodate actinide-specific oxidation state distributions
- Salado flow model is updated with a new model of creep closure

Mean Total Release CCDF

The total release Complementary Cumulative Distribution Function (CCDF) curve is the measure of compliance. Releases are compared to regulatory release limits.

RPPCR PA Total Releases



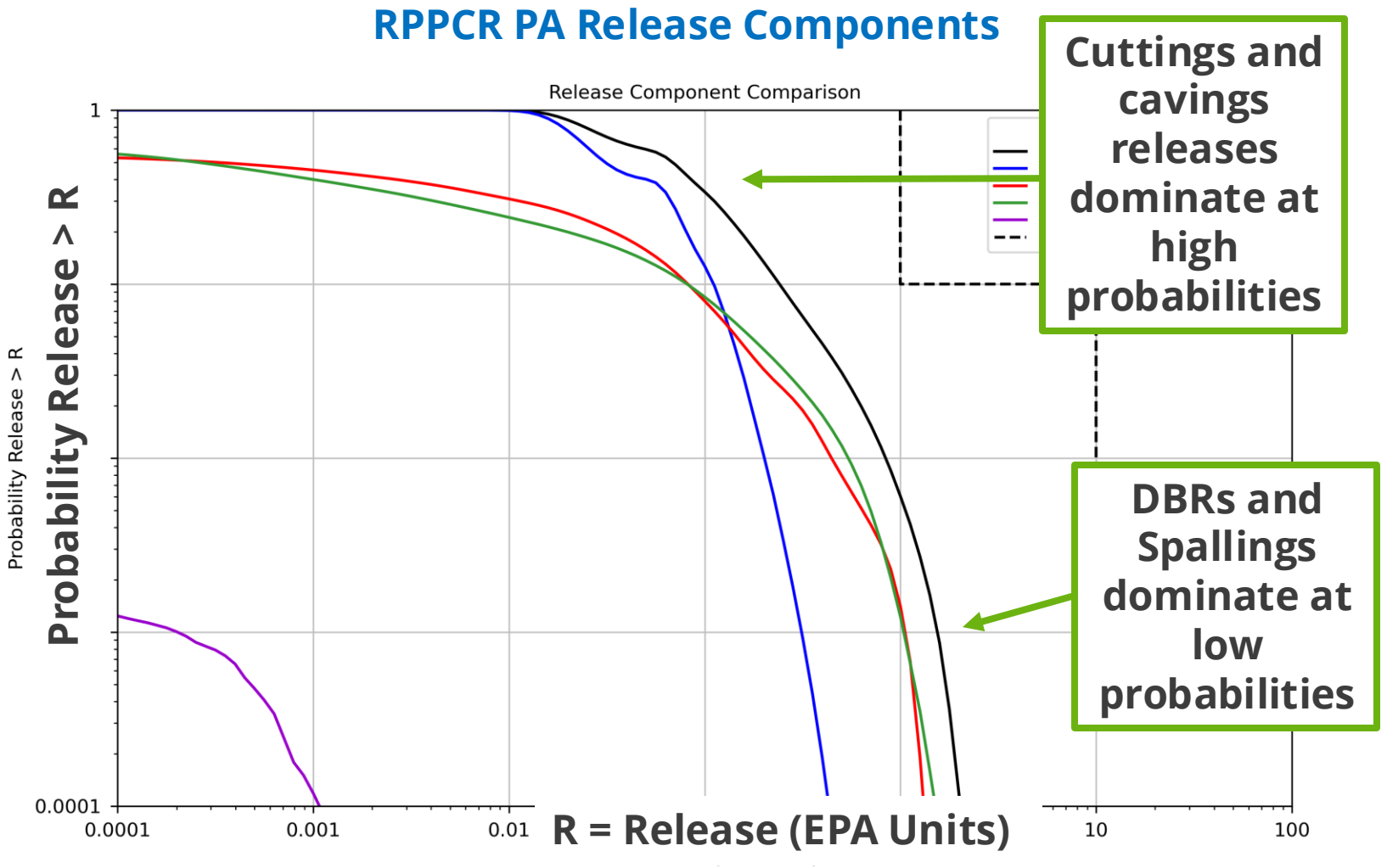
Less than 1 chance in 10 of exceeding 1 EPA unit

Less than 1 chance in 1000 of exceeding 10 EPA units

RPPCR PA Compliance Curve

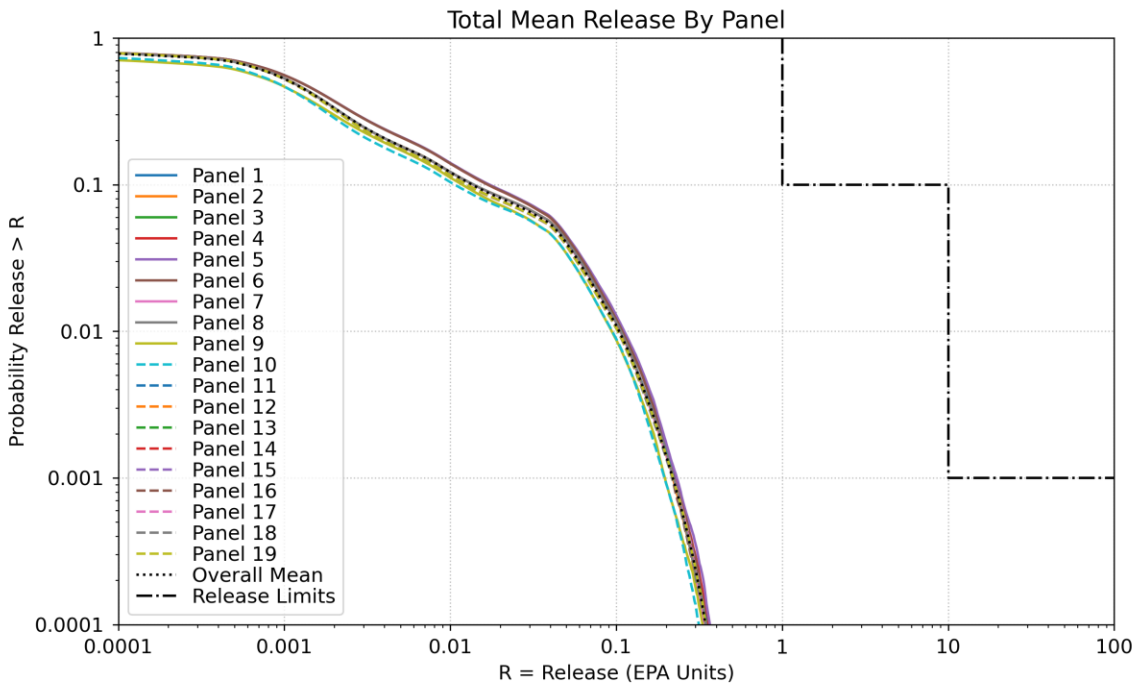
CCDFs for Each Release Mechanism

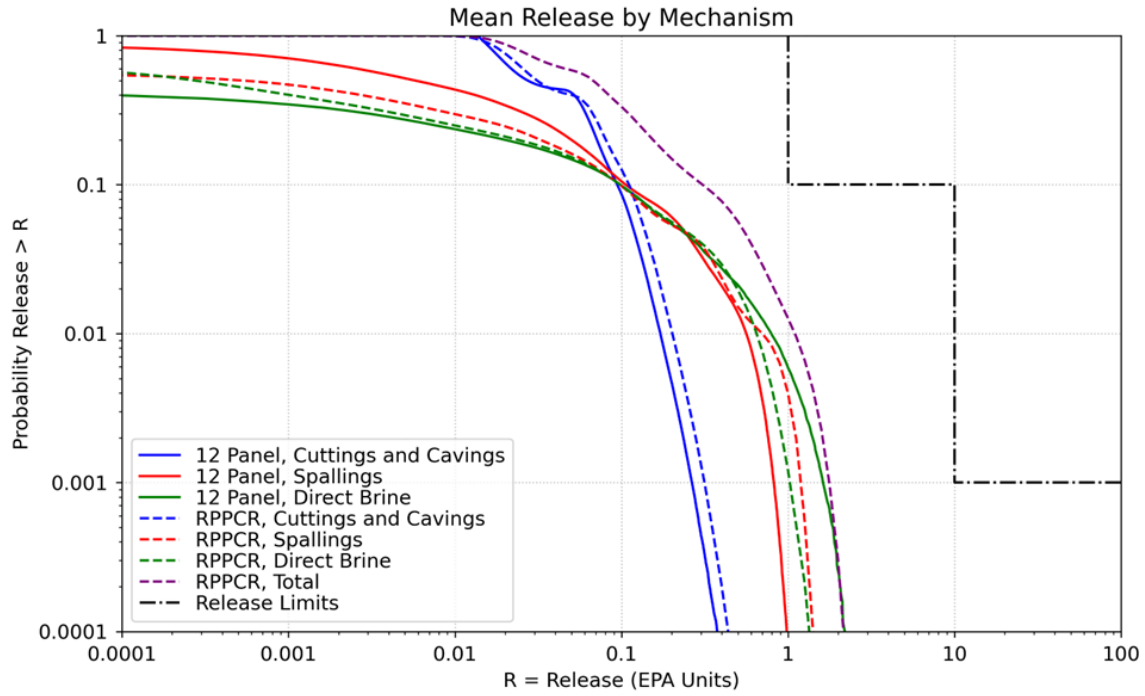
Each Release Component is Quantified by a Complementary Cumulative Distribution Function (CCDF)



Total
Cuttings & Cavings
Spallings
Direct Brine Releases
From Culebra Releases

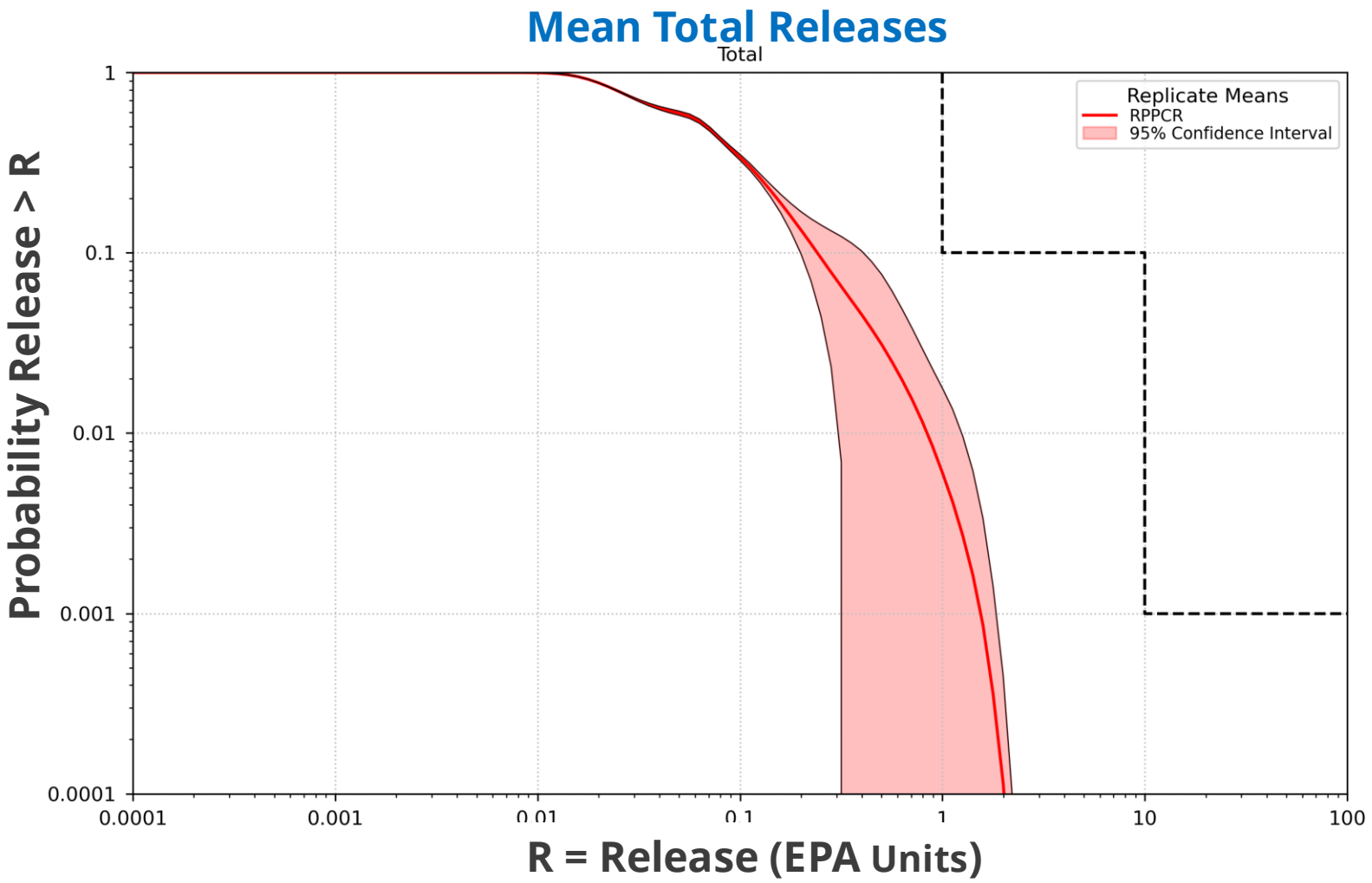
Approximation for a 12-Panel Repository





- 12-Panel results were estimated based on results from the full 19-Panel RPPCR PA analysis
- Per-panel releases extracted from RPPCR analysis and scaled to approximate releases from a 12-Panel repository
- Total releases are similar between individual panels.
- Containment assurance for a 12-Panel repository can be inferred from the results of the 19-Panel analysis.

Confidence in Overall Results – 19 Panel PA

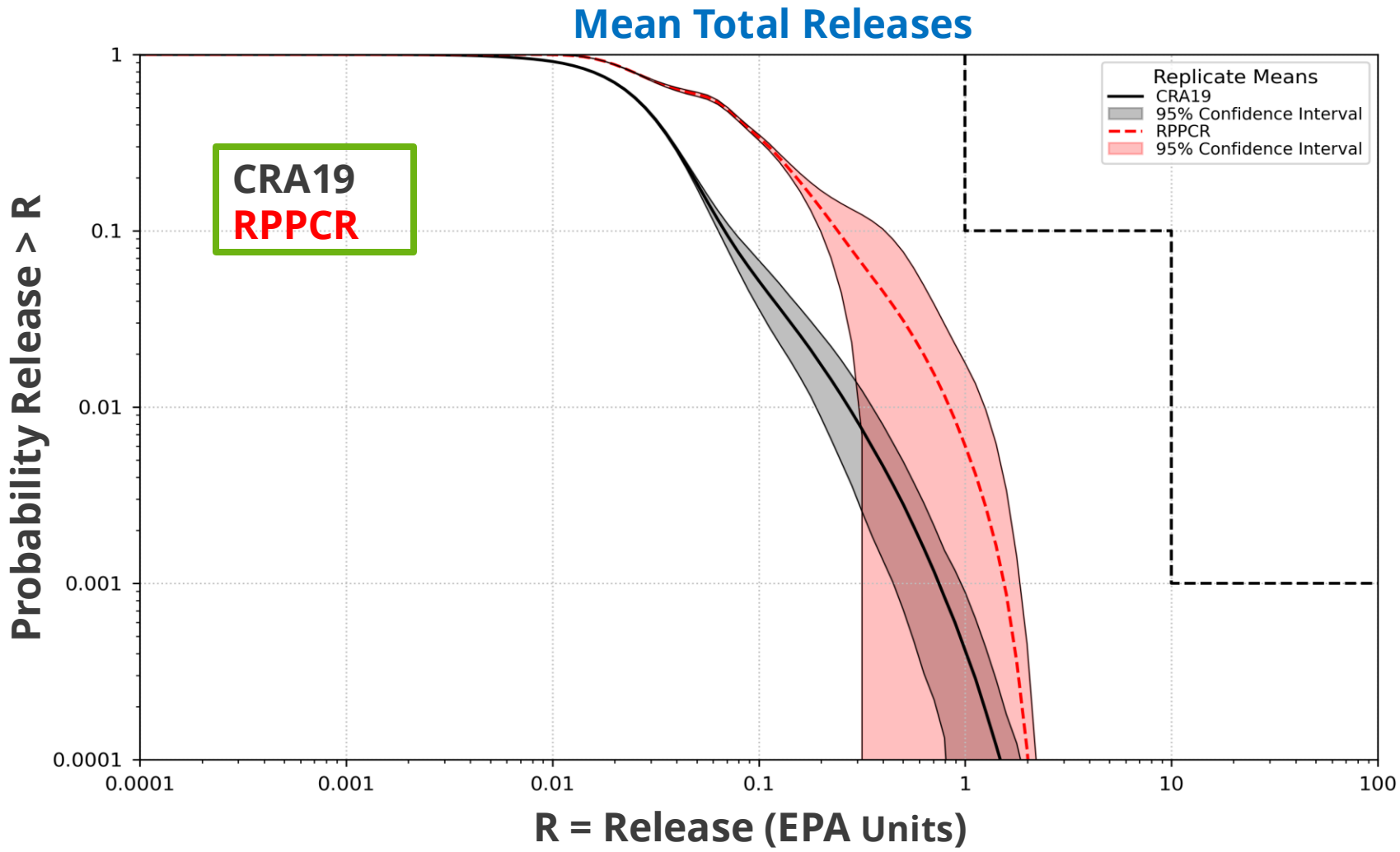


Changes in releases are mainly a result of:

- Increased drilling rate
- Updated inventory
- Updated model for salt creep closure onto the waste

The change to the repository footprint is not a major driver for the increase in releases.

Confidence in Overall Results – 19 Panel PA



The WIPP facility as modeled in the RPPCR PA remains in compliance with EPA containment requirements.