Savannah River Remediation

We do the right thing.

Performance Assessment Community of Practice
Technical Exchange Meeting

SRS Liquid Waste PA Modeling

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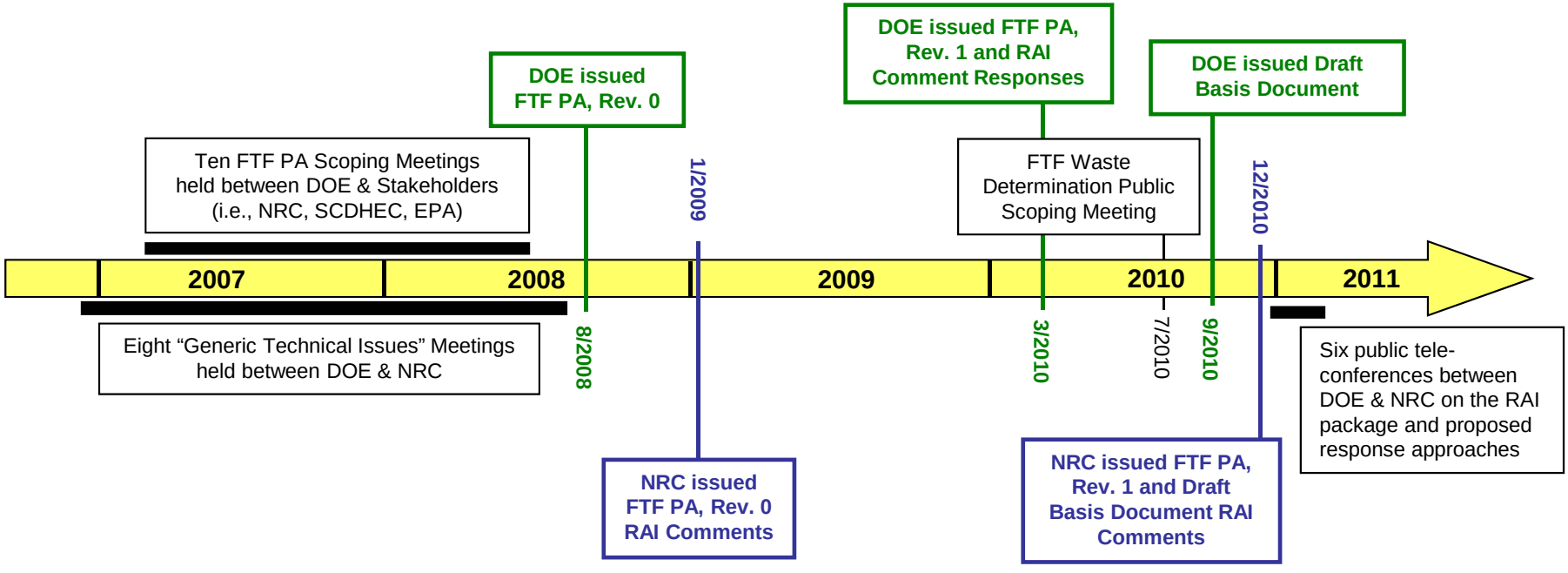
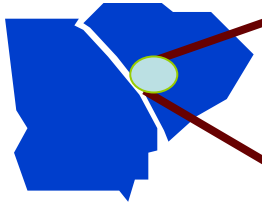
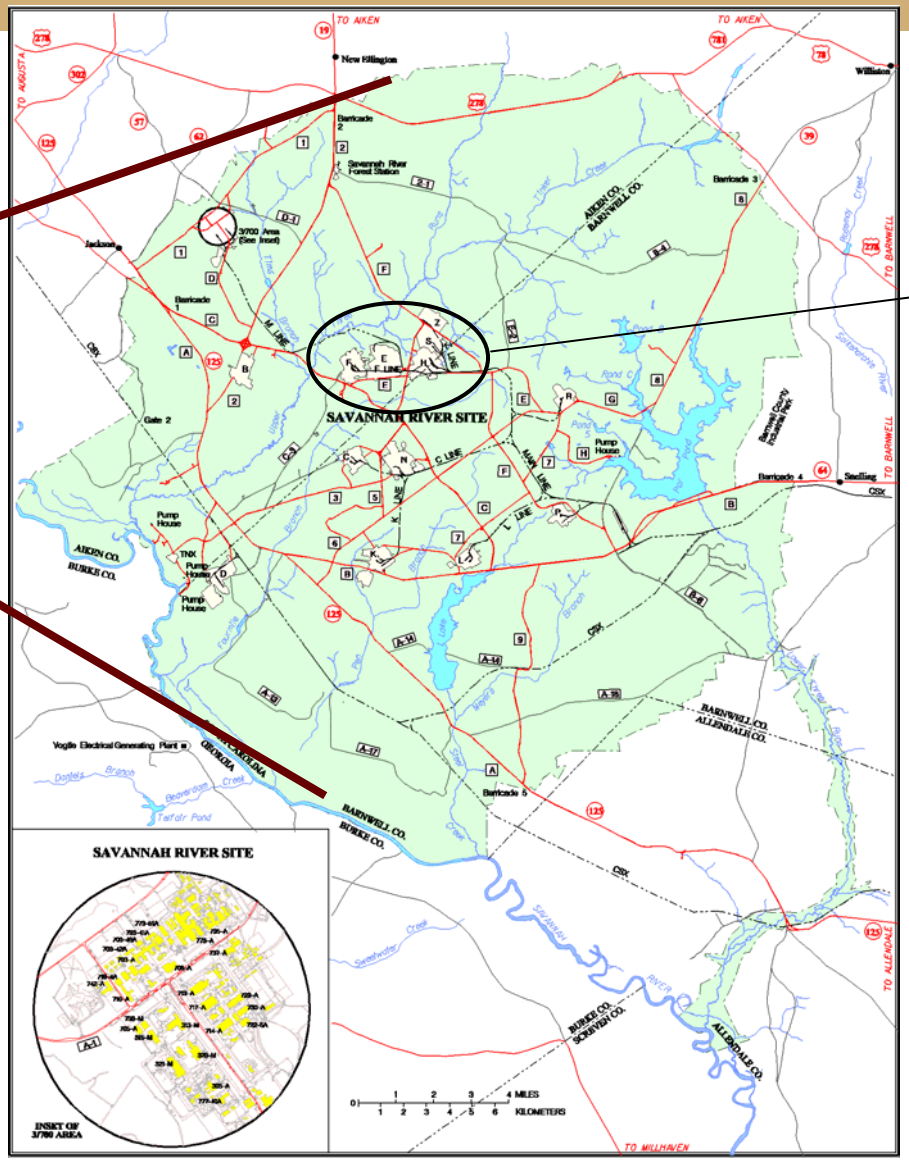
- **Current Status of SRS LW PAs**
  - Three SRS Liquid Waste (LW) PAs in various stages of approval (FTF, HTF, SDF)
  - Balancing various external inputs
    - New information
    - Modeling improvements
    - Reviewer comments
  - Goal is to ensure that individual PAs remain adequate risk information tools

FTF PA History



Savannah River Site





General Separations Area

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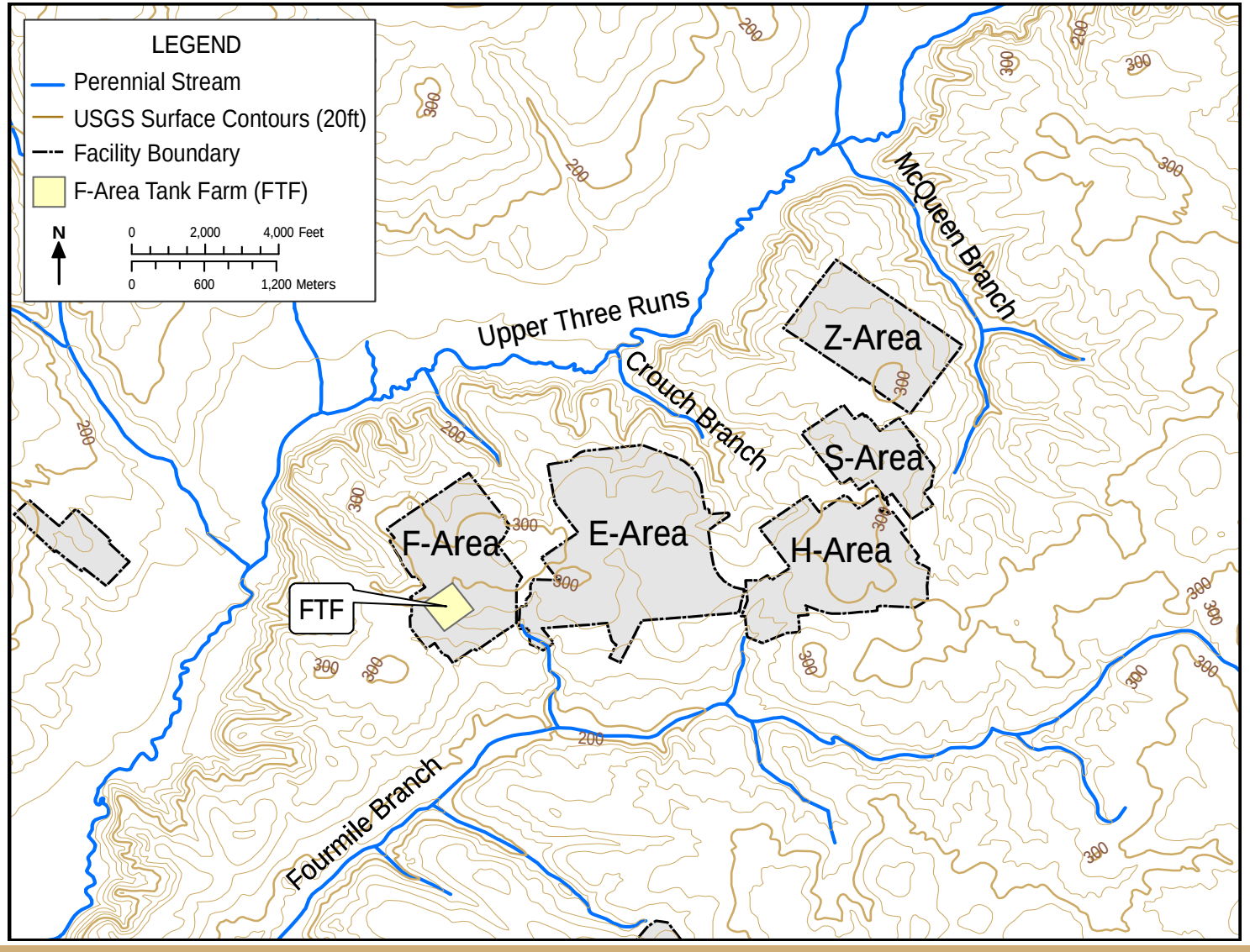
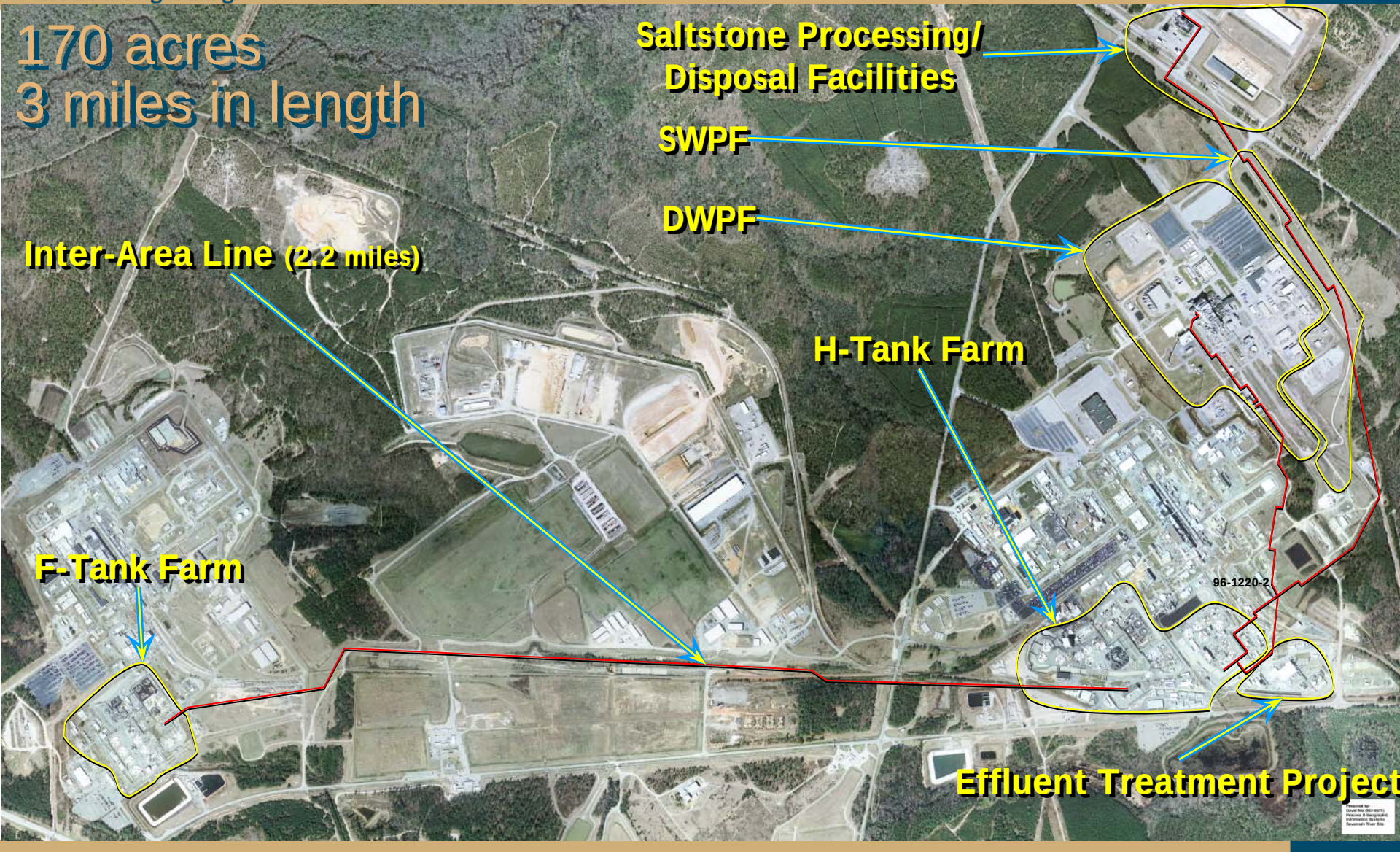


Liquid Waste Facilities



Hybrid Approach Lessons Learned

- **Liquid Waste Performance Assessments**
  - The PAs are risk assessment tools
  - PA attempts to model long-term waste release and contaminant transport in the environment
  - PA includes evaluation of groundwater concentrations and doses at points of assessment
  - PA is a multi-disciplined assessment – including geochemistry, hydrogeology, materials science, health physics, etc.

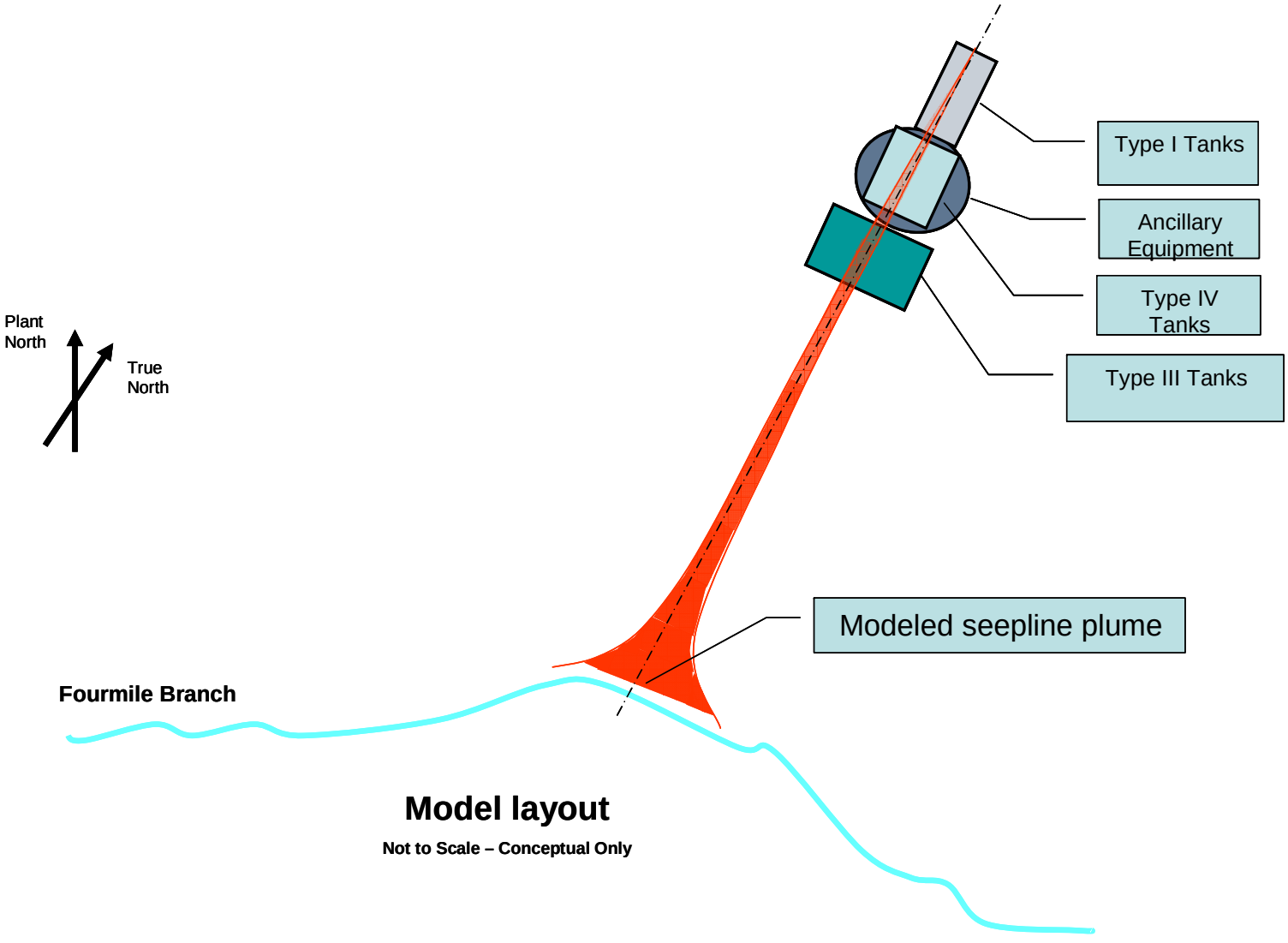
- **The SRS LW PAs are Multiple Purpose**
  - The LW PAs inform future decision-making
  - The PAs determine doses at various points of assessment (e.g.,100 meters, seepline)
  - The LW PAs include radiological and non-radiological evaluations for state closure documents
  - The LW PAs serve as technical reference documents for later 3116 and closure document decisions

- **Hybrid Approach Used for SRS LW PAs**
  - A deterministic Base Case is developed for each PA using best-estimate assumptions where possible
  - The deterministic Base Case model is accompanied by additional sensitivity analyses in the Hybrid Approach
    - Probabilistic modeling
    - Deterministic alternative configuration models

- **Hybrid Approach**
  - Allows for the less probable, but still possible, assumptions to be captured
  - Improves overall system understanding
  - Agreed to at onset of PA development for each LW PA

- **Role of the Base Case**
  - The Base Case is an integrated conceptual model of the individual system after closure, not a simulation of future reality
  - Application of modeling assumptions and/or specifications that do not reflect a one-to-one match to real-world physical conditions does not invalidate the model

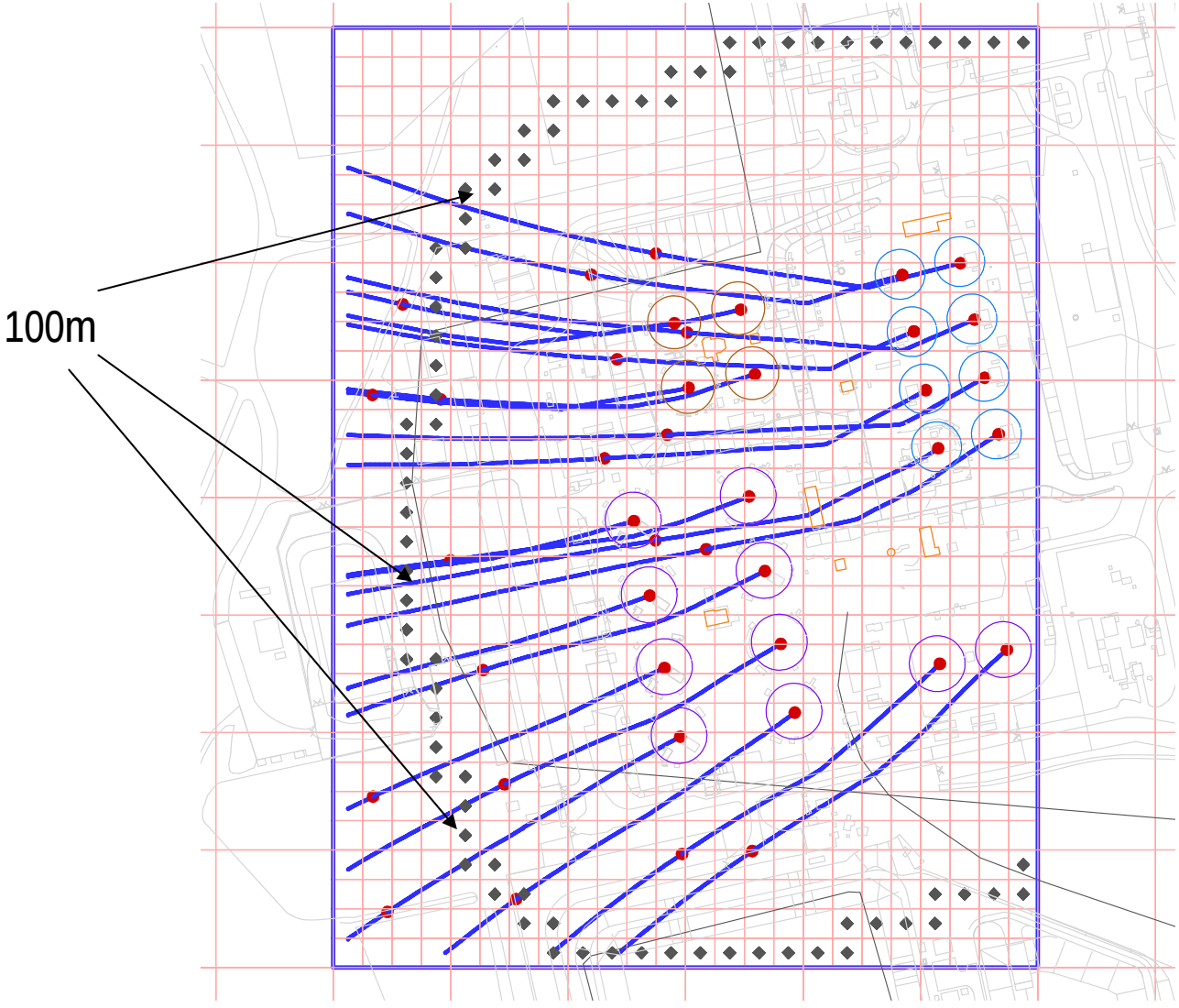
Simple FTF Modeling



Model layout

Not to Scale – Conceptual Only

Enhanced FTF Modeling



- **Base Case Analyses Development**
  - The fact that Base Case values have uncertainty associated with them does not a priori make them incorrect or any less probable
  - Base Case should be well defined to allow individual aspects of the Base Case to be understood
    - Allows for evaluation of input variability
    - Allows for evaluation of input uncertainty

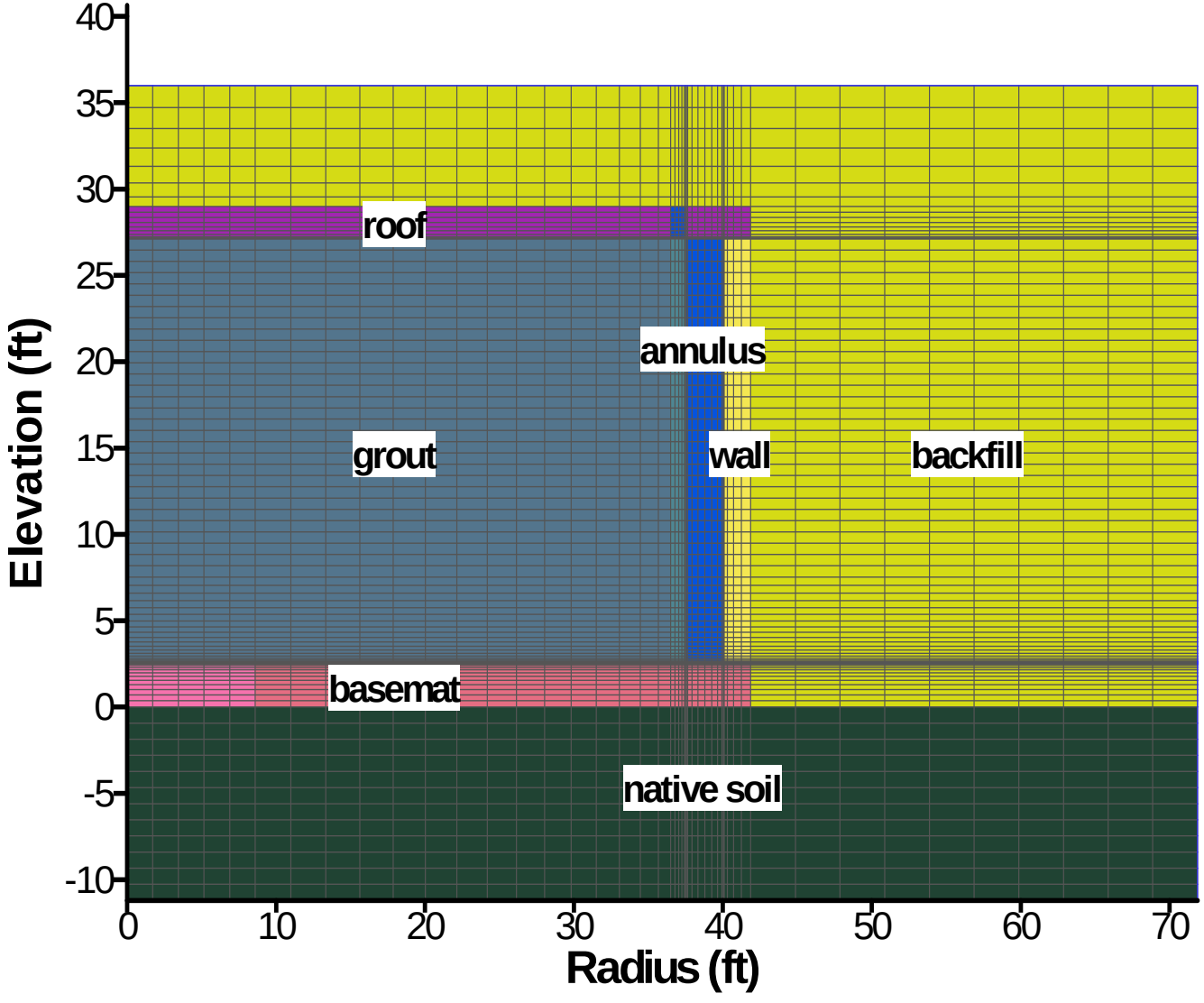
- **Base Case uses reasonable simplifications**
  - Assumptions can be restricted or limited by the model design conventions, or the simulation code or software
  - Approaches and/or parameters selected because they represented a reasonable modeling simplification for the highly complex systems, not because they explicitly reflected a perceived future outcome

- **Reasonable Simplification Example**
  - Different Approaches to liner failure considered
  - "Simultaneous" liner failure approach
    - The "simultaneous" liner failure approach assumes the entire liner fails in a given year
    - Assuming tank liners fail simultaneously and completely for a give tank type is recognized to be non-mechanistic

- **Reasonable Simplification Example (cont.)**
  - "Patch" liner failure approach
    - A "Patch" liner failure approach would assume some percentage of each waste tank liner fails each year
    - Application of the patch model would require the model to predict the location and timing of individual patch failures
  - Tank Farm Integrated Conceptual Models used the "Simultaneous" liner failure approach
  - Sensitivity of results to approach explored through varying failure year

Waste Tank Liner Construction

Waste Tank Modeling



- **Base Case Conservatism**
  - When given a set of possible risk-significant values there seems to be a predilection for the development of the Base Case to default to the perceived “conservative” values, regardless of the pedigree of such values

- **Base Case Conservatism (cont.)**
  - The fact that using a pessimistic modeling value can cause the Base Case peak dose results to increase does not make that modeling value more valid or more appropriate for use in the Base Case
  - The UA and SA are more appropriate mechanisms for assessing this type of risk

- **Impact of Pessimistic Base Case**
  - Substituting only pessimistic values for every assumption to account for uncertainty would:
    - Make it harder to evaluate impact of individual input variability through the “noise” of bounding assumptions
    - Likely result in needless expenditures, increased worker exposure, and delays in waste tank closure activities while resulting in little to no real risk reduction

- **"Conservative" Bias Impacts**
  - The PA conceptual models include numerous inputs with varying levels of uncertainty
  - It is unreasonable to impose a perceived "conservative" bias upon the individual inputs without considering how this bias can adversely impact a competing input or set of inputs

- **Dealing with "Conservative" Bias**
  - A "conservative" bias was not exclusively the default condition when developing the Base Case models for the LW PAs
  - Model input parameters were selected in an attempt to closely reflect best available information and real-world physical conditions wherever possible
  - Conservatisms were applied when uncertainty or modeling complexity precluded confidence in the selection of a nominal approach

- **"Conservative" Bias Example One**
  - The waste release model for the Tank Farm PAs uses a single solubility value for radionuclides at any given time
  - By assigning different solubility values to different percentages of the residual waste for a given radionuclide, the residual waste could be modeled as being released at different rates
  - This approach could result in a decrease in the overall peak doses by allowing a small percentage of very soluble waste to release early, reducing the amount available for release later when the overall peak release is occurring

- **"Conservative" Bias Example Two**
  - Assuming early transition from Oxidized Region II to Oxidized Region III can cause some radionuclides (e.g., uranium) to be released at a higher rate earlier, since they have lower solubility values in Oxidized Region II than in Oxidized Region III, while others such as Sr-90 would be released at a lower rate earlier

- **Complications of "Conservatism"**
  - The existence of decay chains provides additional complexity in trying to predict dose-based conservatism
  - Different radionuclides have very different fate and transport behaviors, making modeling decisions complicated

- **PA Improvement**
  - As required by DOE Manual 435.1-1, maintenance of PAs will include future updates to incorporate new information, update model codes, analysis of actual residual inventories, etc., as appropriate
  - Tools in place to evaluate new information

- **Updates to the Base Case**
  - Updates to the Base Case will be considered and applied in some circumstances as appropriate
    - New information regarding modeling assumptions show a different approach or value is more probable or appropriate
    - Instances where testing provides new information
  - Enhancements can have implications that are both conservative and non-conservative with respect to dose

Base Case Improvement

- New modeling approaches/assumptions
  - The following approaches have been applied in the more recent HTF model:
    - Technetium solubility in Oxidized Region III was not considered to be infinite
    - Neptunium has iron co-precipitation potential that slows waste release
    - Leachate effects on soil K*d* values increase adsorption for some radionuclides