

Probability of Hitting Pressurized Brine in WIPP Performance Assessment

Ross Kirkes
November 14, 2014

Sandia National Laboratories
Piru Associates, Inc.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

This research is funded by WIPP programs administered by the Office of Environmental Management (EM) of the U.S Department of Energy.





History of Pbrine in PA

- 1992 Preliminary PA used 0.25 to 0.57; Median 0.4
 - Based on 1988 TDEM Survey (SAND87-7144)
 - TDEM Analysis not considered optimal (1D), but was conservatively bounding and provided a good test of preliminary models and associated sensitivities
- CCA (1996) used a fixed probability of 0.08 based on geostatistical analysis (Powers et al. 1996)
- EPA mandated a uniform distribution ranging from 0.01 to 0.60 for the 1997 PAVT
 - Supported/justified by EPA's "Technical Review of TDEM Analysis of WIPP Brine Pockets Document" (EPA Docket item V-B-30)
 - Results in an effective mean value of 0.305
 - Inconsistent with actual ratio of brine occurrences in vicinity of WIPP (biases towards high end) (currently near 0.05)



Why Change Pbrine?

PA endeavors to use the most accurate, defensible, and up-to-date information in compliance calculations.

- Current values not consistent with reservoir characteristics**
 - Does not adequately recognize near-vertical fracture orientation, which significantly reduces probability of intercept**
- Current values not consistent with monitoring data**
- Earlier probabilities largely based on simplistic 25-year old 1D survey that has known shortcomings**

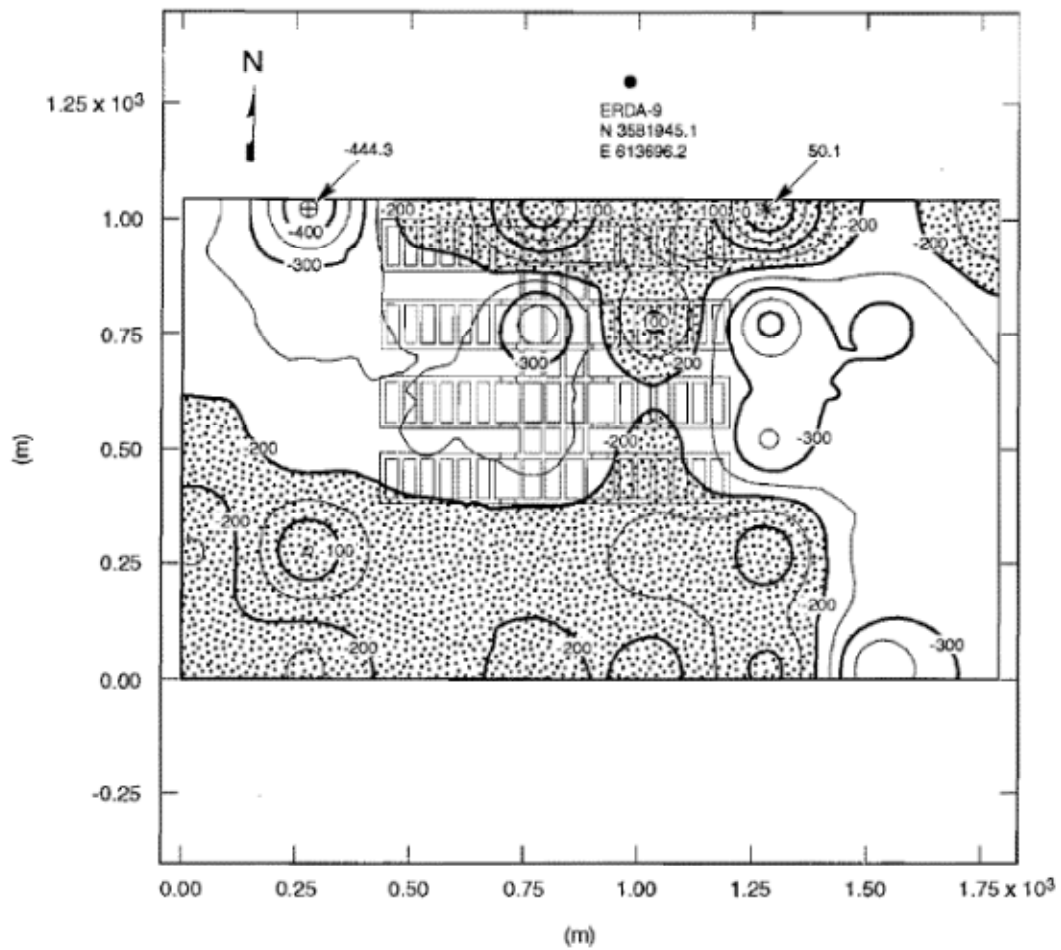


Figure 5.1-3. Conservative contour map of elevation above sea level of first major conductor below WIPP area.

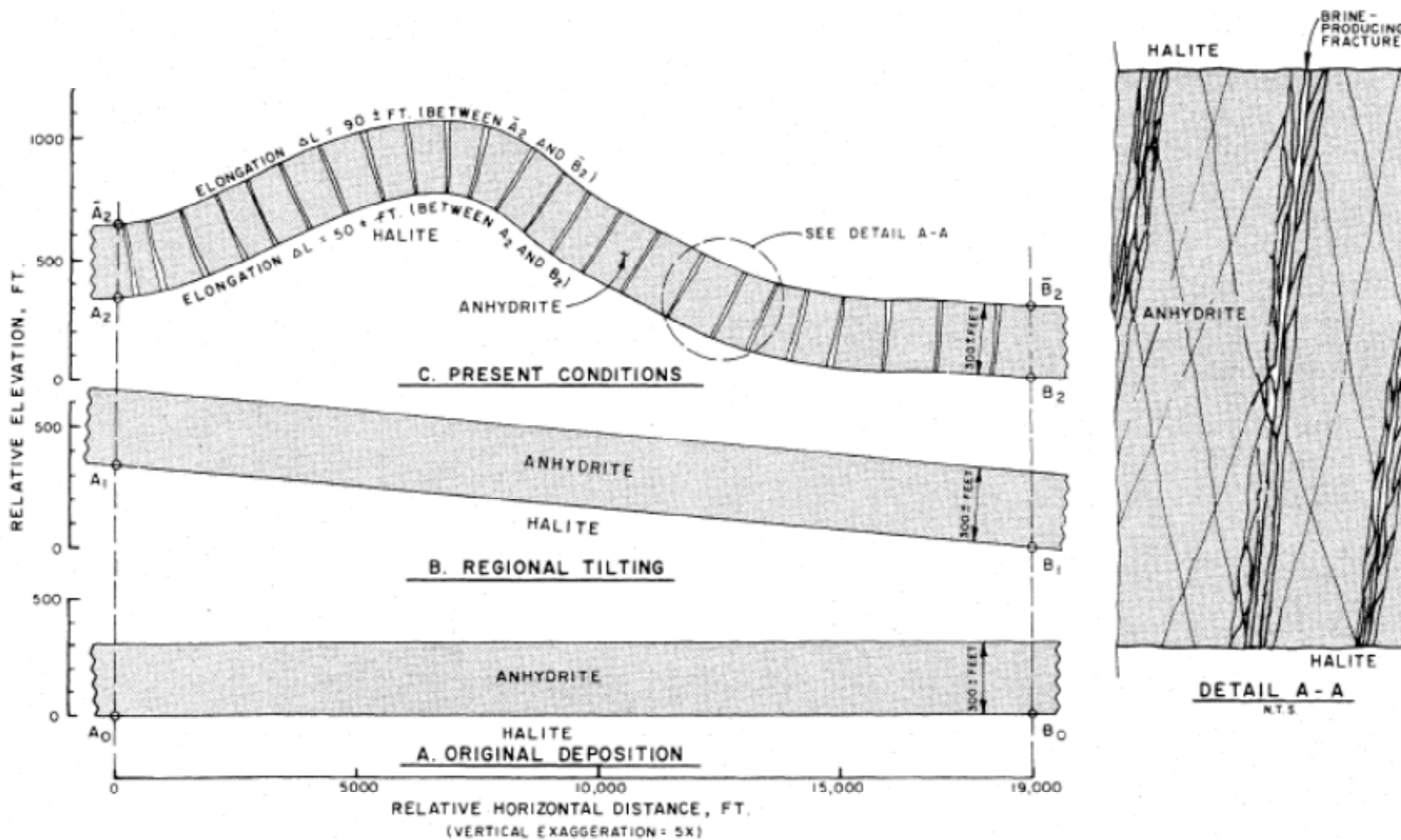
(Reproduced from SAND92-0700/3)



Reservoir Characteristics

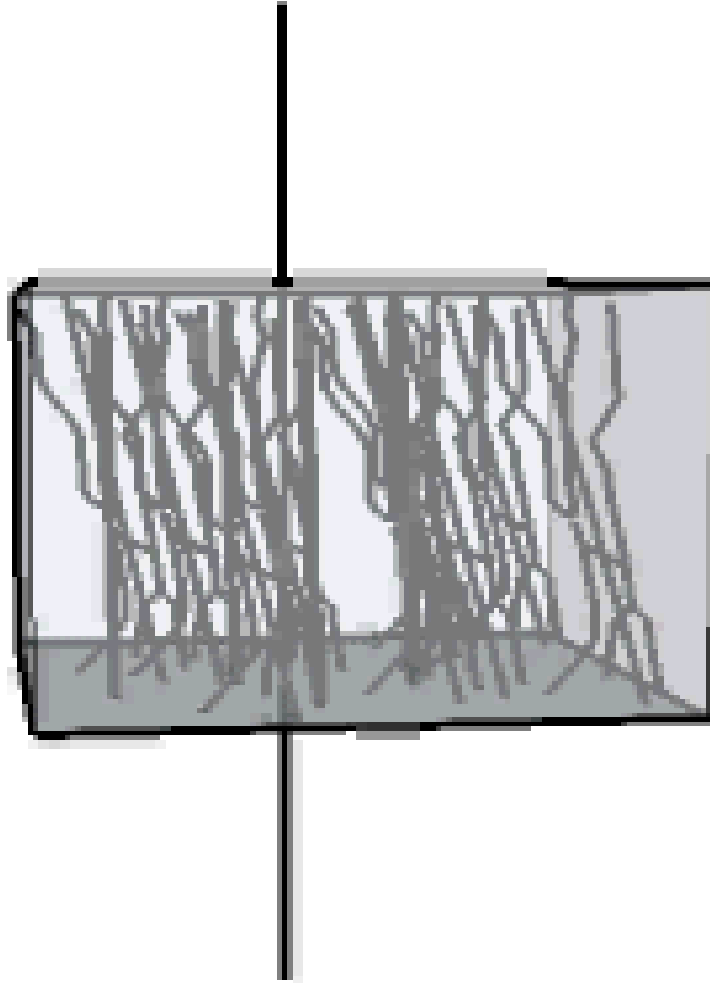
- Widely-held understanding that brine resides in near-vertical fractures in deformed areas of the Castile
 - Griswold (1977), Anderson and Powers (1978), Register (1981), Pepielak et al. (1983)
 - *“Where they exist, Castile brine reservoirs in the Northern Delaware Basin are believed to be fractured systems, with **high-angle fractures** spaced widely enough that a borehole can penetrate through a volume of rock containing a brine reservoir without intersecting any fractures and therefore not producing brine.”* -- CCA Chapter 2.1.3
 - *“Though the association of brine to structure appears to be strong, most drillholes in areas of structure do not report brine in the Castile”* – Powers et al., 1996

Structural Deformation and Sub-vertical Fracturing



(Reproduced from TME 3153 (1983))

3D Representation of High-Angle Fractures in Castile

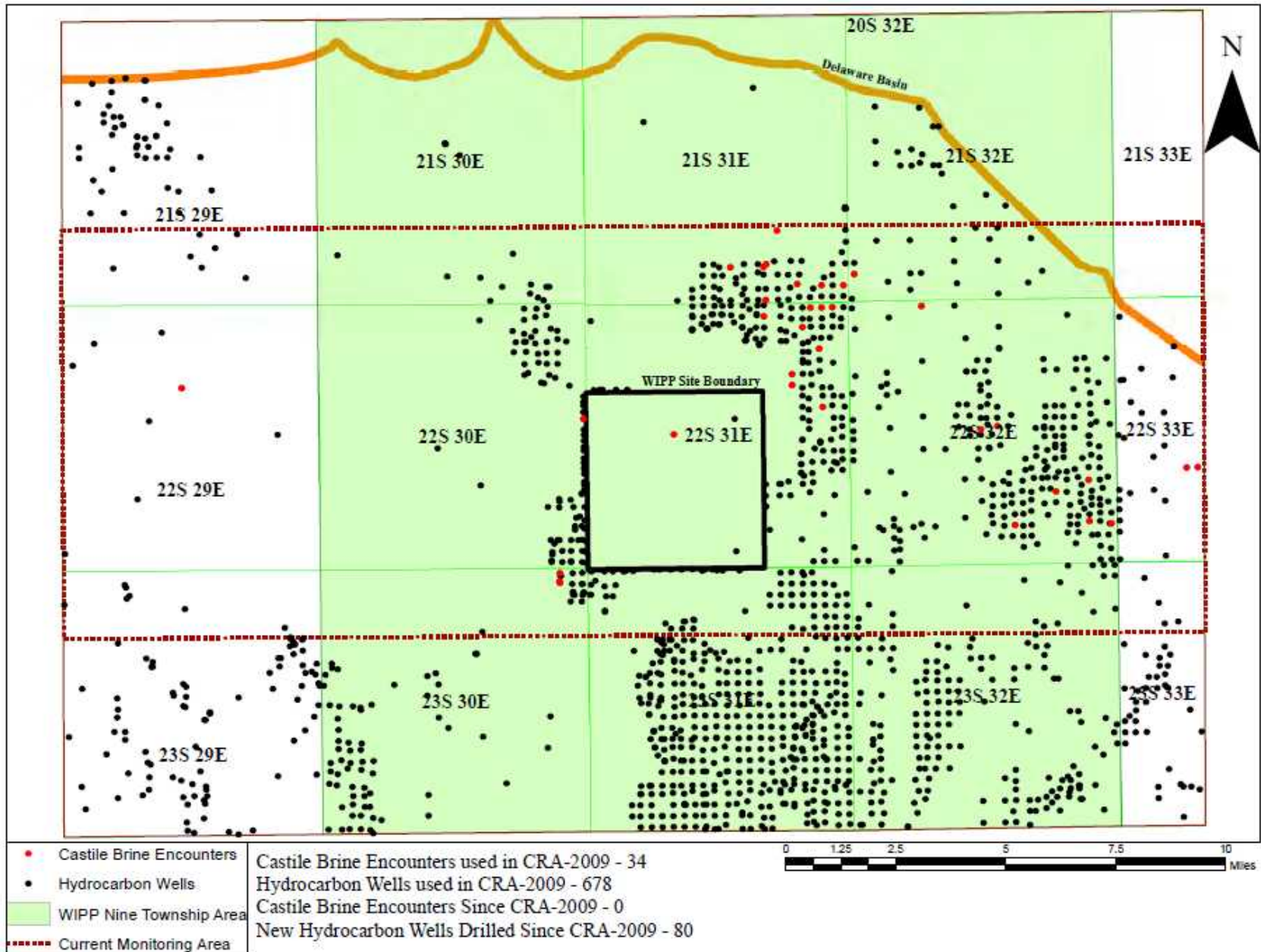




Monitoring Data

- **Pressurized brine intercepts are tracked and reported in the Annual Delaware Basin Monitoring Report (DOE/WIPP 12-23-08)**
- **Rate of occurrences of pressurized brine in the vicinity of WIPP is consistently very low**
 - **27 occurrences for CCA (1996)**
 - **34 for CRA-2004**
 - **34 for CRA-2009**
- **Last occurrence was April 2002**

Castile Brine Encounters





How to More Accurately Represent Pbrine in PA?

- **Develop a new distribution for Pbrine that:**
 - **Reflects actual brine occurrences in the area**
 - **Is consistent with reservoir characteristics (high-angle fractures)**
 - **Is statistically defensible and consistent with accepted theory**

- **Next presentation will discuss proposed statistical basis for new values of Pbrine**