

Restoration of the Salton Sea

Volume 2: Embankment Designs and Optimization Study

Appendix 2D: Risk Analysis

Attachment B: Event Trees

**Prepared for:
U.S. Department of the Interior
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada**

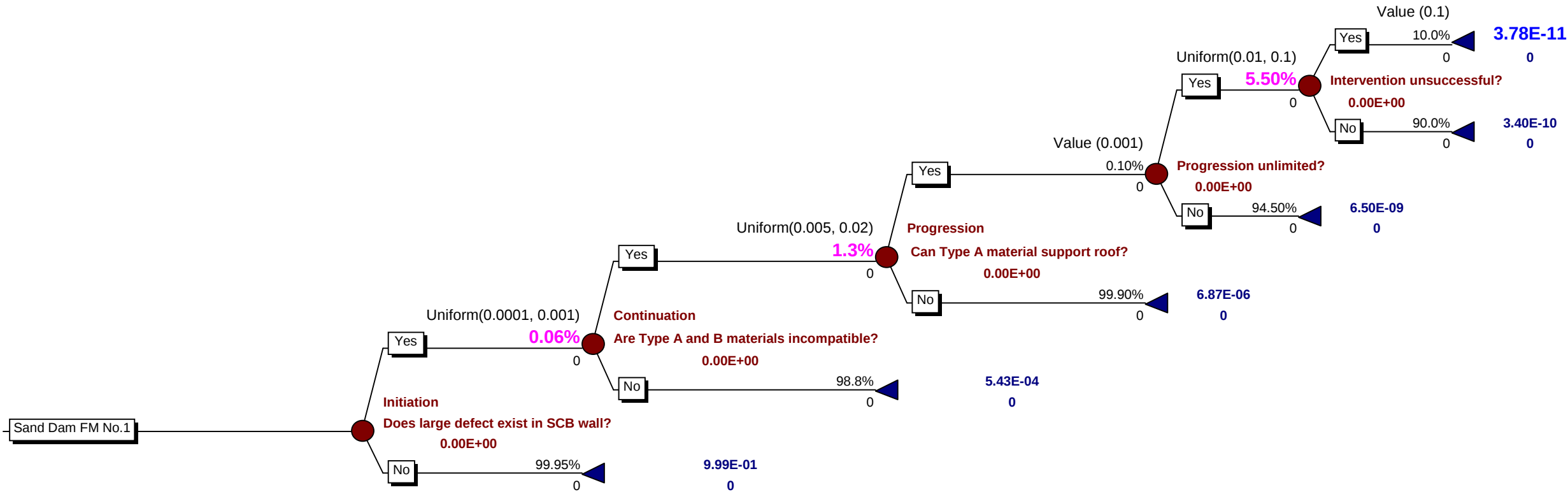
**Prepared by:
Kleinfelder, Inc.
Golden, CO 80401
Project No. 71100**

May 2007

Salton Sea Restoration Project
Embankment Alternatives Optimization Study

Sand Dam Embankment with Stone Columns
FM No. 1 Static - Internal Erosion (Piping) of Embankment

Annualized Loss of Life (ALL) 0.00E+00
Annualized Probability of Failure (APF) 3.78E-11

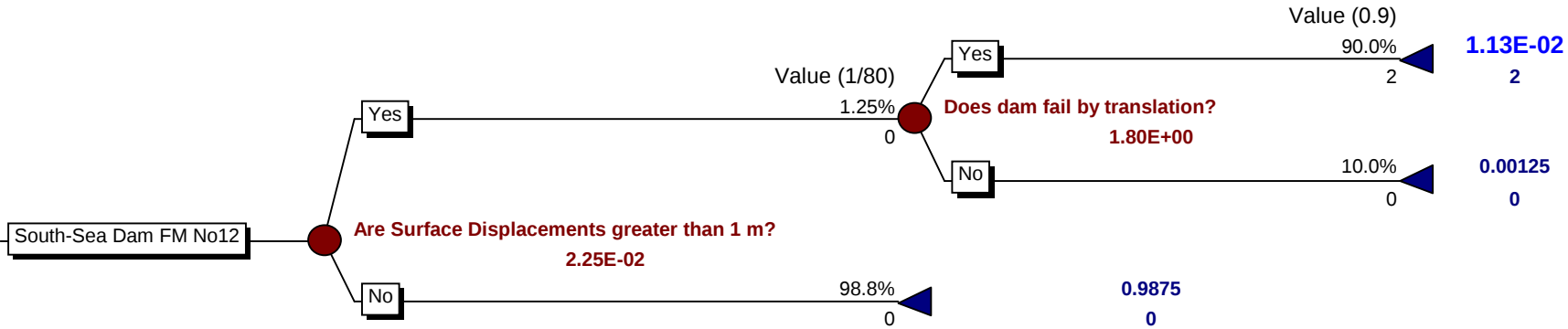


Annualized Probability of Failure	Annualized Loss of Life
3.78E-11	0.00E+00

Salton Sea Restoration Project
Embankment Alternatives Optimization Study

South-Sea Dam
FM No. 12 Seismic - Offset and Translation of Embankment

Annualized Loss of Life (ALL) 2.25E-02
Annualized Probability of Failure (APF) 1.13E-02



Annualized Probability of Failure	Annualized Loss of Life
1.13E-02	2.25E-02

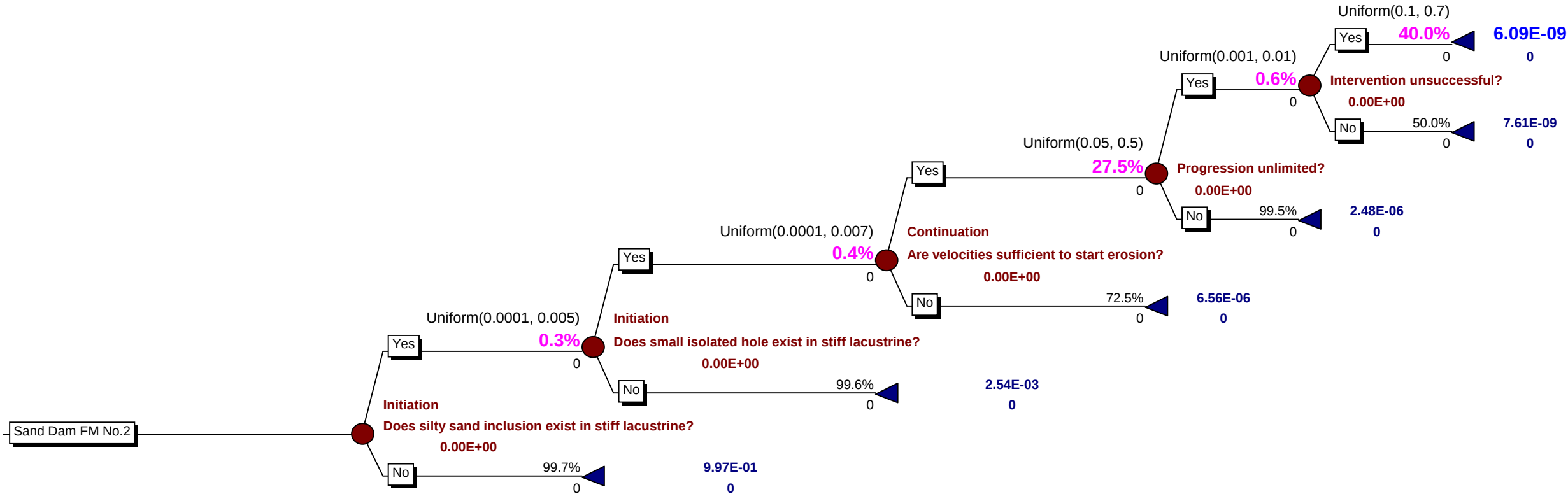
LOL Estimates (Pert Distribution)

Low Bound	Best Estimate	Upper Bound
0.28	1.5	3.5

Salton Sea Restoration Project
Embankment Alternatives Optimization Study

Sand Dam Embankment with Stone Columns
FM No. 2 Static - Internal Erosion of Foundation Materials

Annualized Loss of Life (ALL) 0.00E+00
Annualized Probability of Failure (APF) 6.09E-09

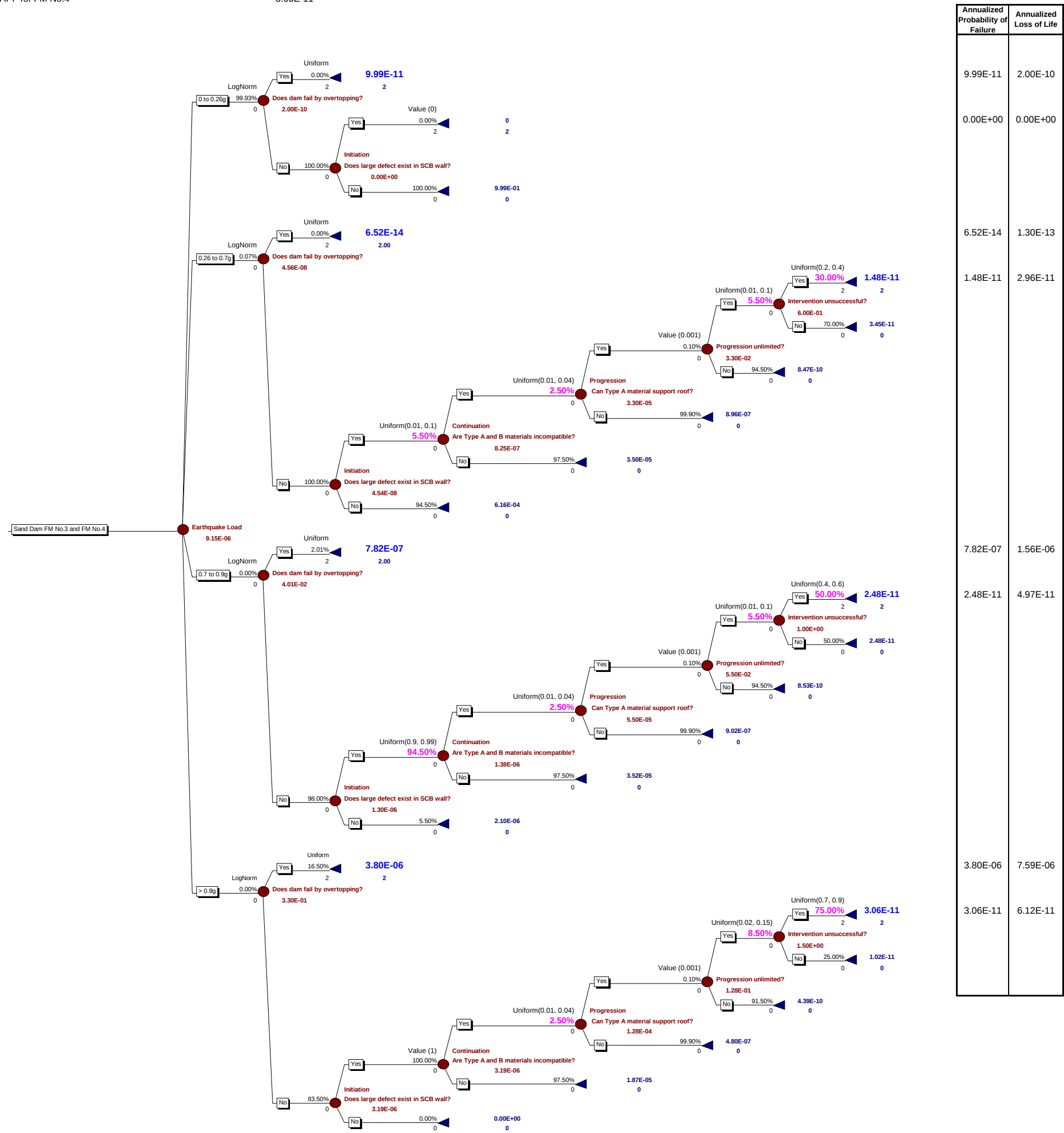


Annualized Probability of Failure	Annualized Loss of Life
6.09E-09	0.00E+00

Salton Sea Restoration Project
Embankment Alternatives Optimization Study

Sand Dam Embankment with Stone Columns
FM No. 3 Seismic - Deformation and Overtopping of Embankment
FM No.4 Seismic - Deformation and Internal Erosion of Embankment

Annualized Loss of Life (ALL)	7.59E-06	Failure mode FM No.3 is governing
Annualized Probability of Failure (APF)	3.80E-06	Failure mode FM No.3 is governing
ALL for FM No.4	6.12E-11	
APF for FM No.4	3.06E-11	



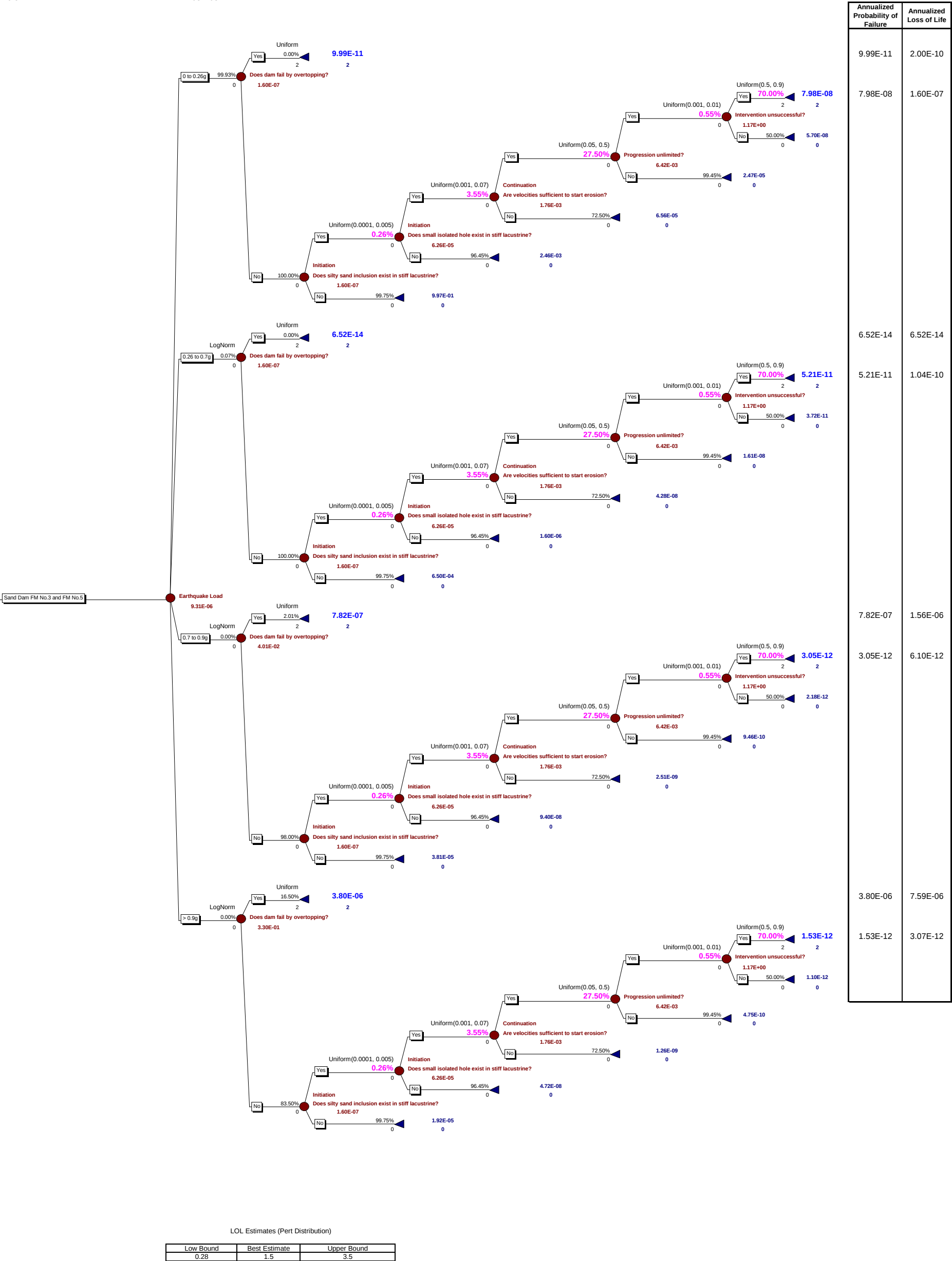
LOL Estimates (Pert Distribution)

Low Bound	Best Estimate	Upper Bound
0.28	1.5	3.5

Salton Sea Restoration Project
Embankment Alternatives Optimization Study

Sand Dam Embankment with Stone Columns
FM No. 3 Seismic - Deformation and Overtopping of Embankment
FM No.5 Seismic - Deformation and Internal Erosion of Foundation

Annualized Loss of Life (ALL)	7.59E-06	Failure mode FM No.3 is governing
Annualized Probability of Failure (APF)	3.80E-06	Failure mode FM No.3 is governing
ALL for FM No.5	1.60E-07	
APF for FM No.5	7.98E-08	

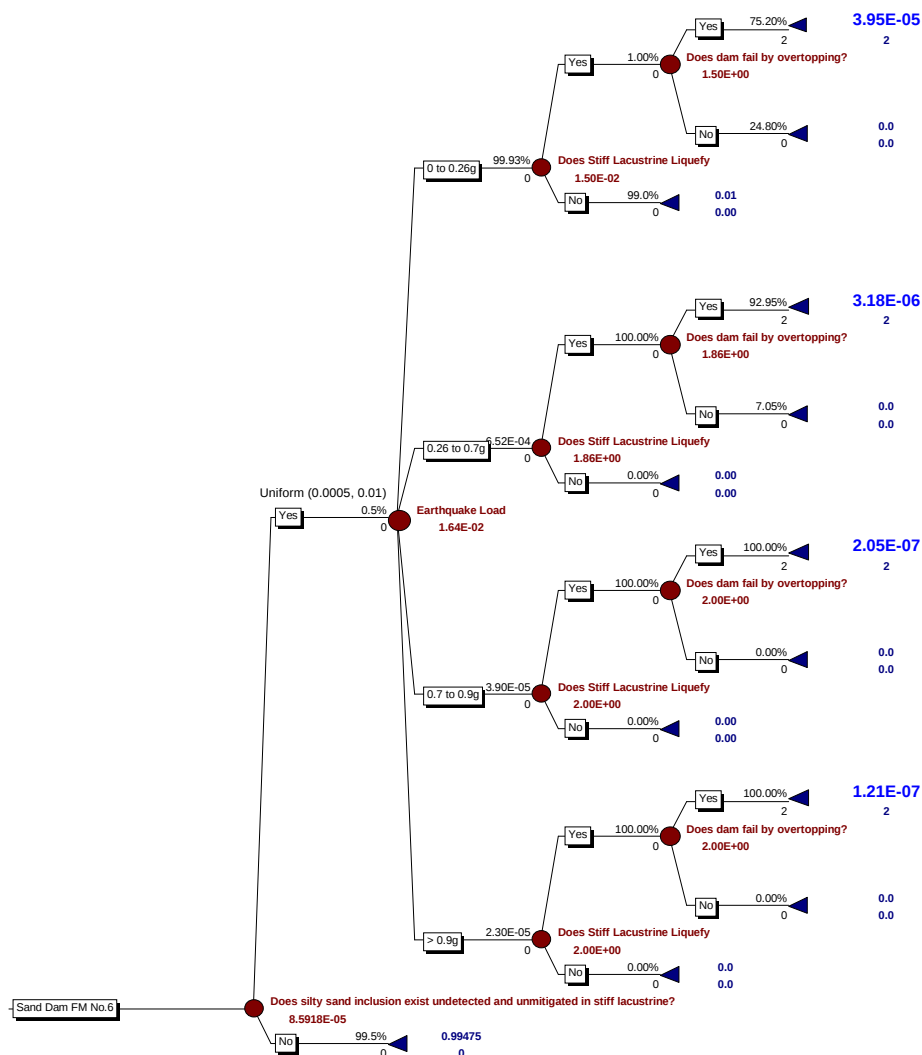


Salton Sea Restoration Project
Embankment Alternatives Optimization Study

Sand Dam Embankment with Stone Columns

FM No. 6 Seismic - Liquefaction of Stiff Lacustrine, Seismic Deformation and Overtopping of Embankment

Annualized Loss of Life (ALL) 7.89E-05
 Annualized Probability of Failure (APF) 3.95E-05



Annualized Probability of Failure	Annualized Loss of Life
3.95E-05	7.89E-05
3.18E-06	6.36E-06
2.05E-07	4.10E-07
1.21E-07	2.42E-07

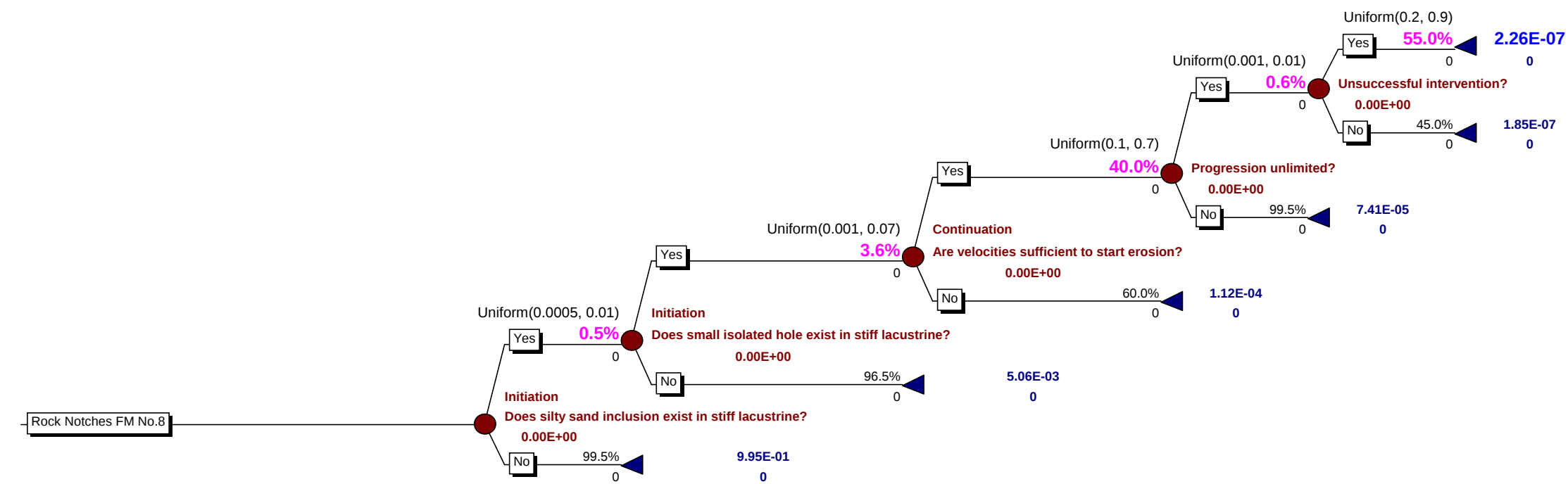
LOL Estimates (Pert Distribution)

Low Bound	Best Estimate	Upper Bound
0.28	1.5	3.5

Salton Sea Restoration Project
Embankment Alternatives Optimization Study

Rockfill Dam with Rock Notches
FM No. 8 Static - Internal Erosion of Foundation Materials

Annualized Loss of Life (ALL) 0.00E+00
Annualized Probability of Failure (APF) 2.26E-07



Annualized Probability of Failure	Annualized Loss of Life
2.26E-07	0.00E+00

Salton Sea Restoration Project
Embankment Alternatives Optimization Study

Rockfill Dam with Rock Notches
FM No. 9 Seismic - Deformation and Overtopping of Embankment
FM No.11 Seismic - Deformation and Internal Erosion of Foundation Materials

Annualized Loss of Life (ALL)
Annualized Probability of Failure (APF)
ALL for FM No.9
APF for FM No.9

6.09E-07
3.05E-07
2.00E-15
9.99E-16

Failure mode FM No.11 is governing
Failure mode FM No.11 is governing

