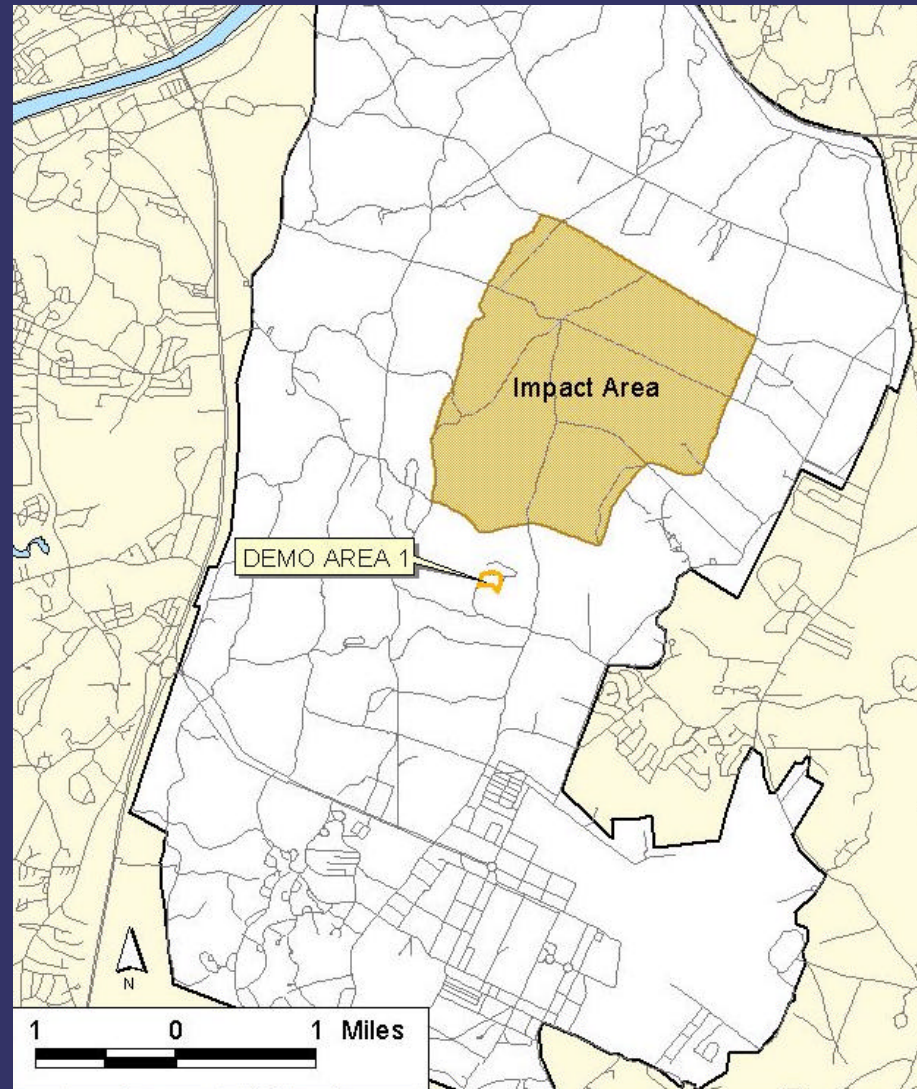


DISTRIBUTION AND FATE OF ENERGETICS AT DEMOLITION AREA 1



Jay Clausen, AMEC
Joseph Robb, AMEC

Location of Demolition Area 1



Demo 1 - Site Description and Land Use

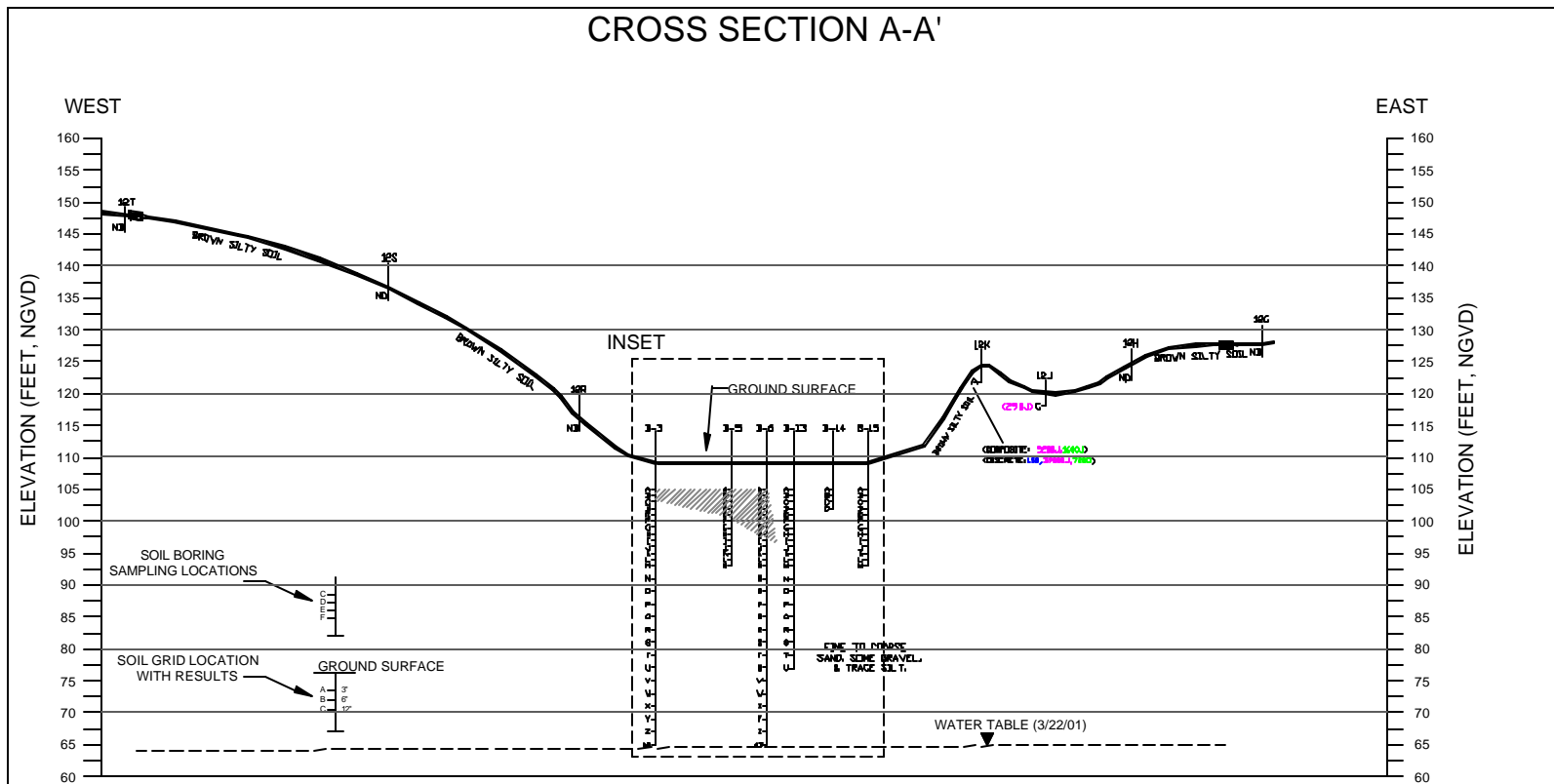
- Description
 - topographic depression or kettle hole 45 ft below surrounding grade
 - bottom of kettle hole is flat - approximately 1 acre
 - surrounded by perimeter road - total area within perimeter road is approximately 7.4 acres
- Use
 - From 1970 to mid 1970s - rifle squad attack course
 - From mid 1970s to late 1980s - OB/OD activities

Geology and Hydrogeology

- Top 10 ft = clay + sand; Below 10 ft = sand
- Bedrock = 285 to 365 ft below ground surface
- Depth to groundwater from bottom of kettle hole is approximately 45 ft
- Groundwater flow is westward
- Seasonal standing water in bottom of kettle hole

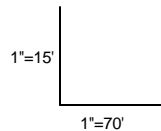


Cross Section



NOTES:

1. For orientation of cross section, see Figure 2-1.
2. Geologic condition between explorations are an interpretation of available data. Actual conditions may vary.
3. NGVD = National Geodetic Vertical Datum
4. Concentrations in ug/kg
5. J=Estimated Concentration
6. ND=Non-Detect



DRAFT

LEGEND

- RDX
- HMX
- 2-Nitrotoluene
- Demo 1 Access Road
- Clay

FIGURE 2-3

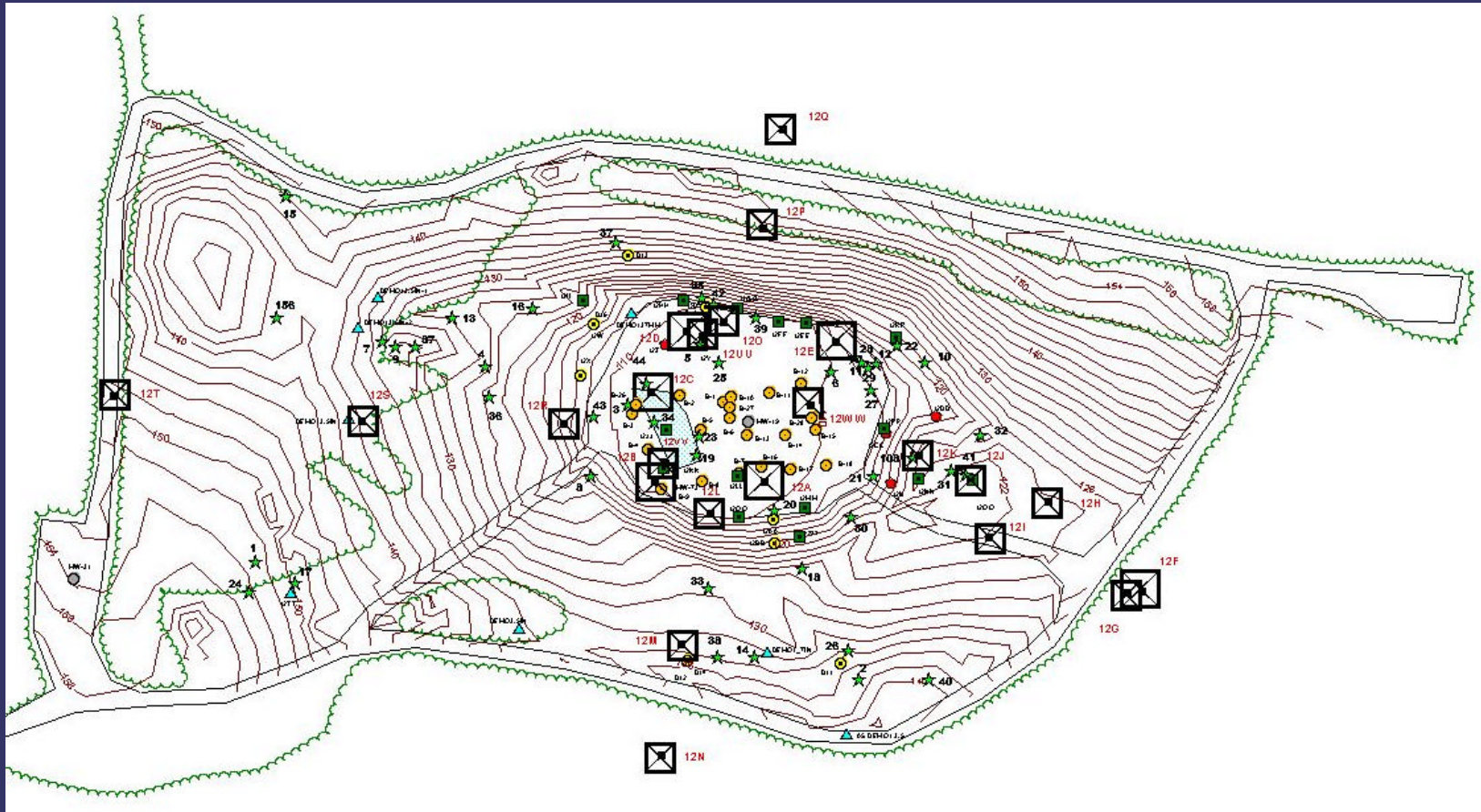
CROSS SECTION A-A'
DEMO 1 SOIL REPORT TM 01-10

Order Form No. 3-1300-03-00		
DATE BY	DATE	DRAWING NO.
DESIGN BY	REVISED	

Investigations - Demo 1 Soil

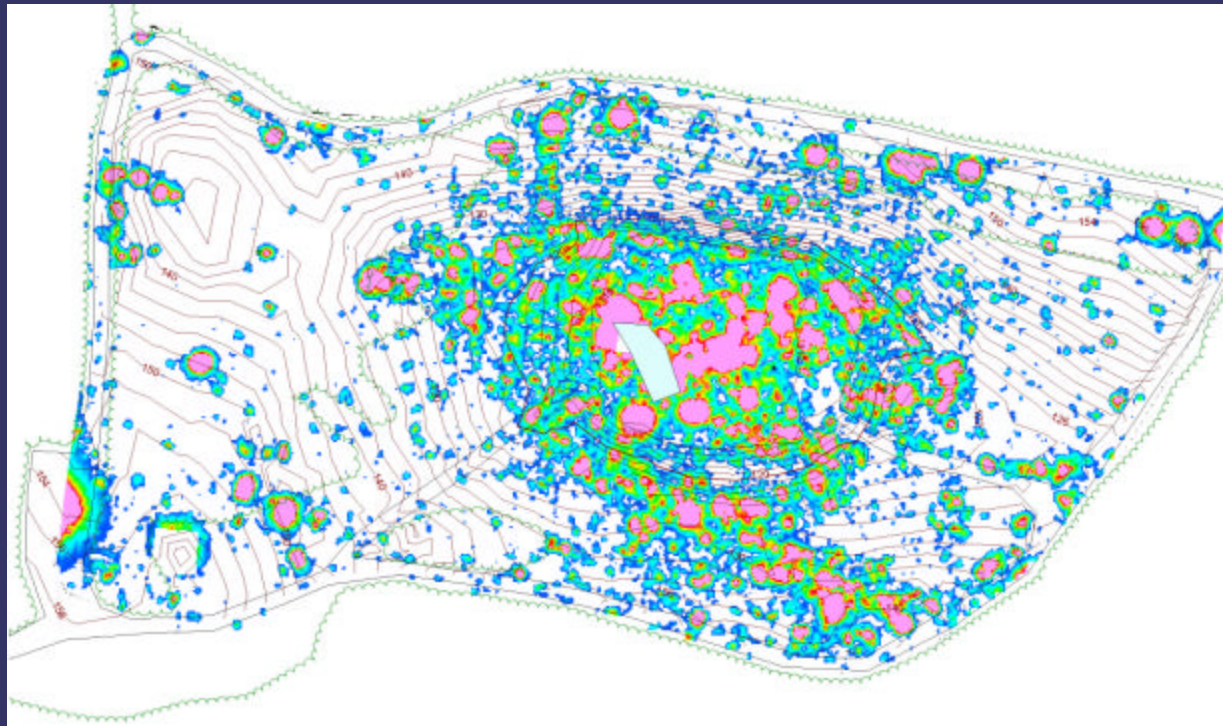
- 20 sampling grids (20 x 20 ft)
 - composite samples collected at 0-3, 3-6, and 6-12 inches
- 22 soil borings within base of depression
 - samples collected at 2 ft intervals
- 13 discrete samples collected beneath C4 or bulk explosives
 - samples collected at 0-3, 3-6, and 6-12 inches
- 15 discrete surface soil samples collected around depression to aid in nature and extent characterization
 - samples collected at 0-2 ft

Sample Locations



Munitions Survey Project (MSP)

- EM61 and CVM magnetometers used to survey area within perimeter road
- Over 1,700 anomalies detected
- 47 with highest signal ($>300\text{mV}$) investigated
- 6 locations identified containing ash - “burn pits”
- 31 soil samples collected beneath anomalies or of burned/stained material



Investigations - Demo 1 Groundwater

- 25 monitoring wells installed
 - delineate downgradient extent of explosive and perchlorate contamination in groundwater
 - monitoring wells sampled during installation and quarterly thereafter



Contaminant Distribution in Soil

- Explosives and Propellants
 - explosives RDX, HMX, 2A-DNT, 4A-DNT, TNT, 2-NT and nitroglycerin, and propellants 2,4-DNT and 2,6-DNT detected in soil
 - highest detections in surface soil (0-3 inches)
 - concentrations decreasing with depth
 - sporadic detections within pore water at depth



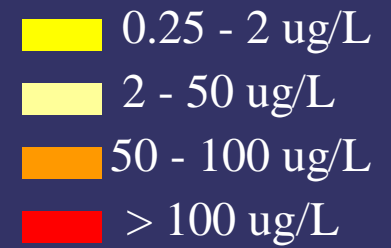
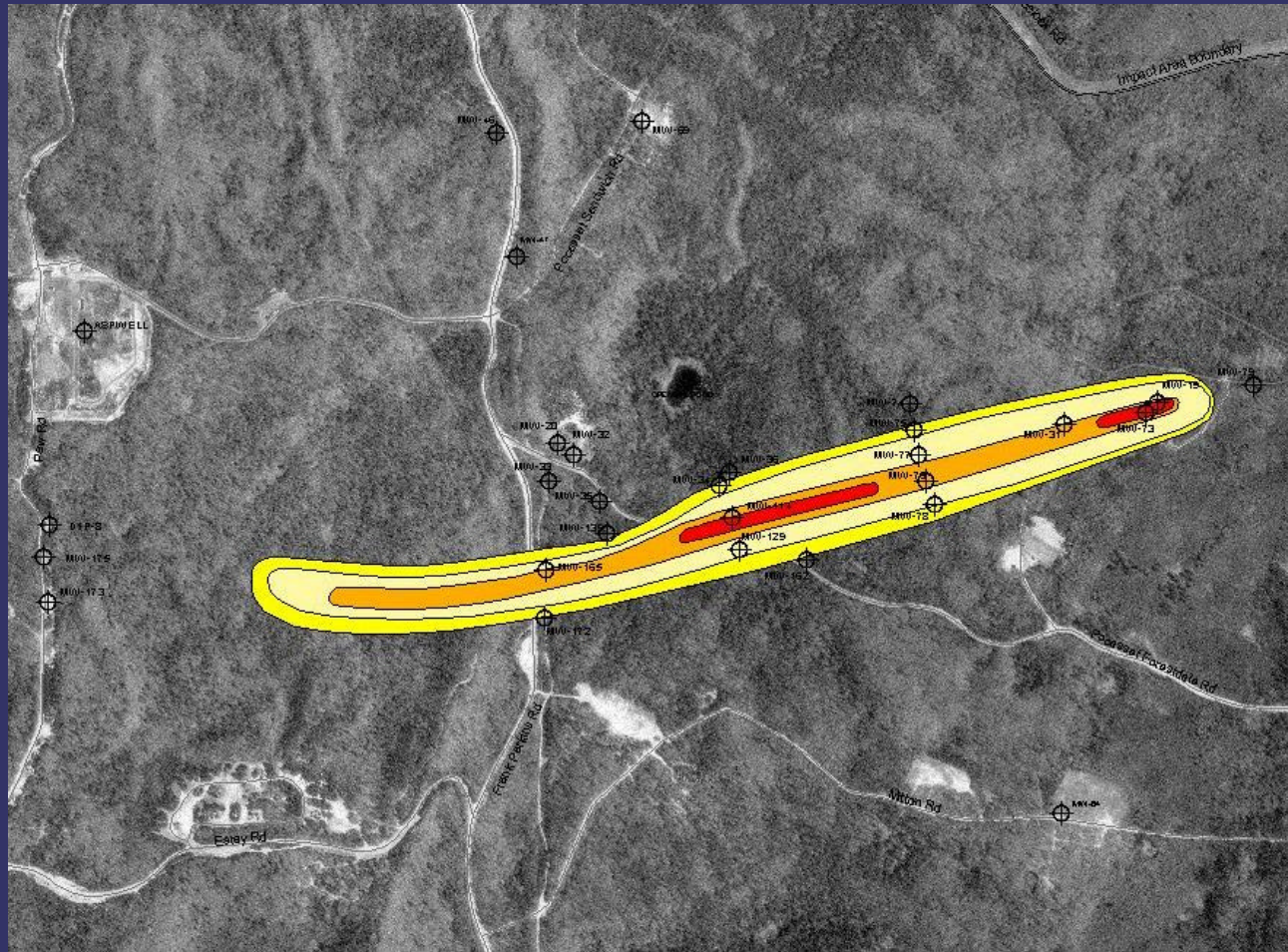
Contaminant Distribution in Soil (cont.)

- SVOC (PAHs and phthalates) were detected within “burn pits”
- VOCs, pesticides, and herbicides were sporadically detected but not considered a significant source of contamination
- PCBs were not detected at Demo 1
- Dioxins/Furans are ubiquitous in the environment and have been detected at Demo 1. Highest concentrations were detected in “burn pits”.
- PCNs, dyes, and perchlorate have recently been detected in soil. Additional investigations are ongoing.
- Concentrations of metals were an order of magnitude higher within “burn pits”

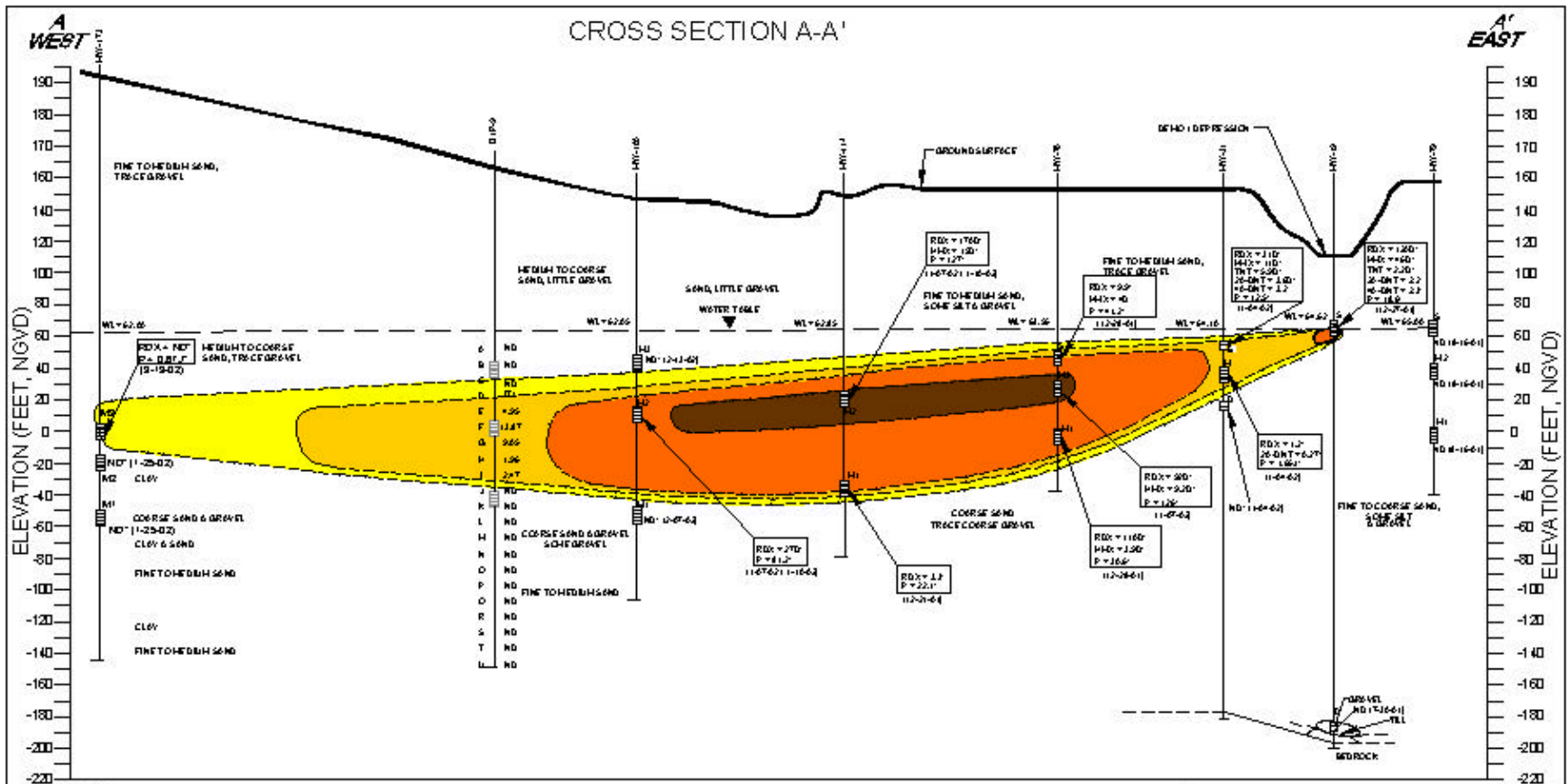
Contaminant Distribution in Groundwater

- Explosives and Propellants
 - 6 explosives and propellants detected in groundwater: RDX, HMX, 4A-DNT, 2A-DNT, TNT and 2,4-DNT.
 - RDX has been the most frequently detected explosive
 - Perchlorate detected within and downgradient of Demo 1.
- Some metals detected above background
- VOCs, SVOCs, pesticides, and herbicides were not detected at significant concentrations
- PCBs, PCNs and dyes have not been detected in groundwater.

DEMO 1 RDX PLUME MAP



Perchlorate in Groundwater



- NOTES:
1. For orientation of cross section, see Figure 4-1.
 2. Geologic conditions between explorations are an interpretation of available data. Actual conditions may vary.
 3. NGVD = National Geodetic Vertical Datum
 4. Sample collection dates for each Monitoring Well identified adjacent to or below each results for each well.
 5. Concentrations in ug/l
 6. * = Unavailable Data, D = Dilution, J = Estimated Concentration
 7. ND = Non-Detect, NA = Not Analyzed
 8. MWL = 63.55: Groundwater elevation (ft NGVD) as of 01-08-02.

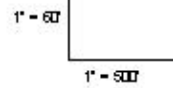
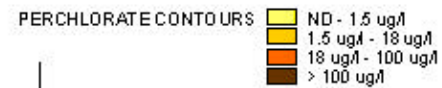


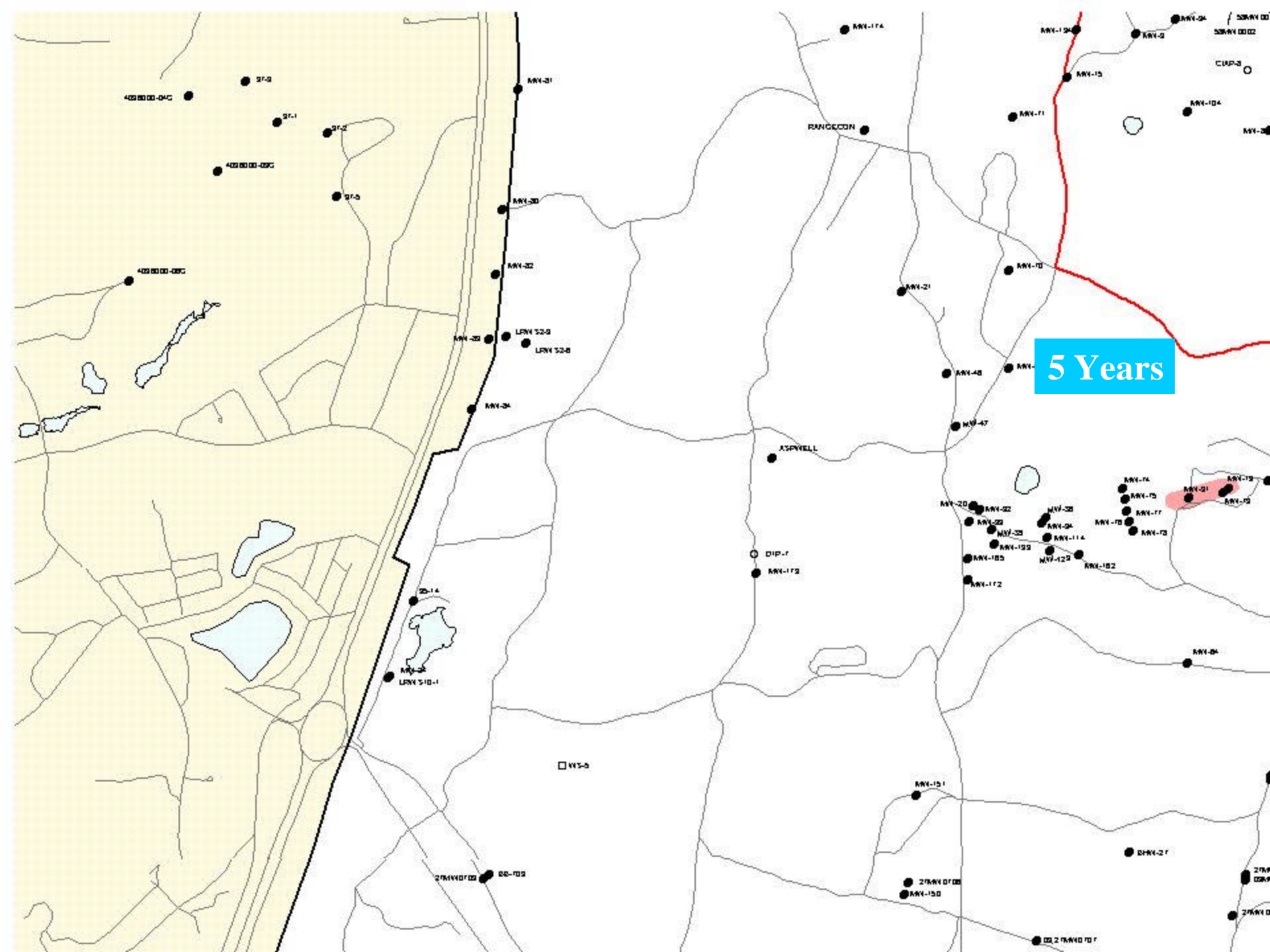
FIGURE 4-9 DRAFT

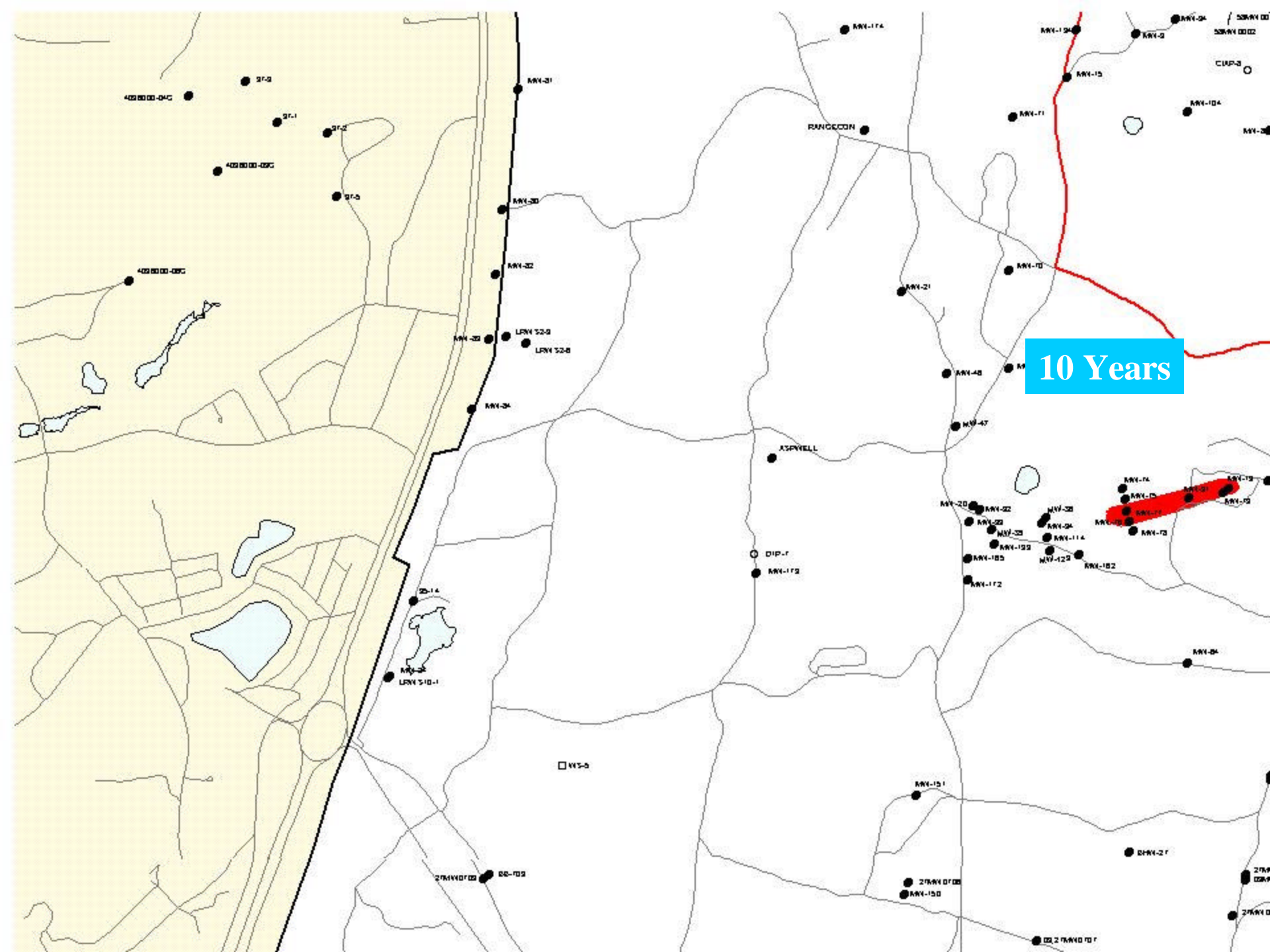
CROSS SECTION A-A'
PERCHLORATE DISTRIBUTION
IN GROUNDWATER

Feasibility Study Report
Demo 1 Groundwater Operable Unit

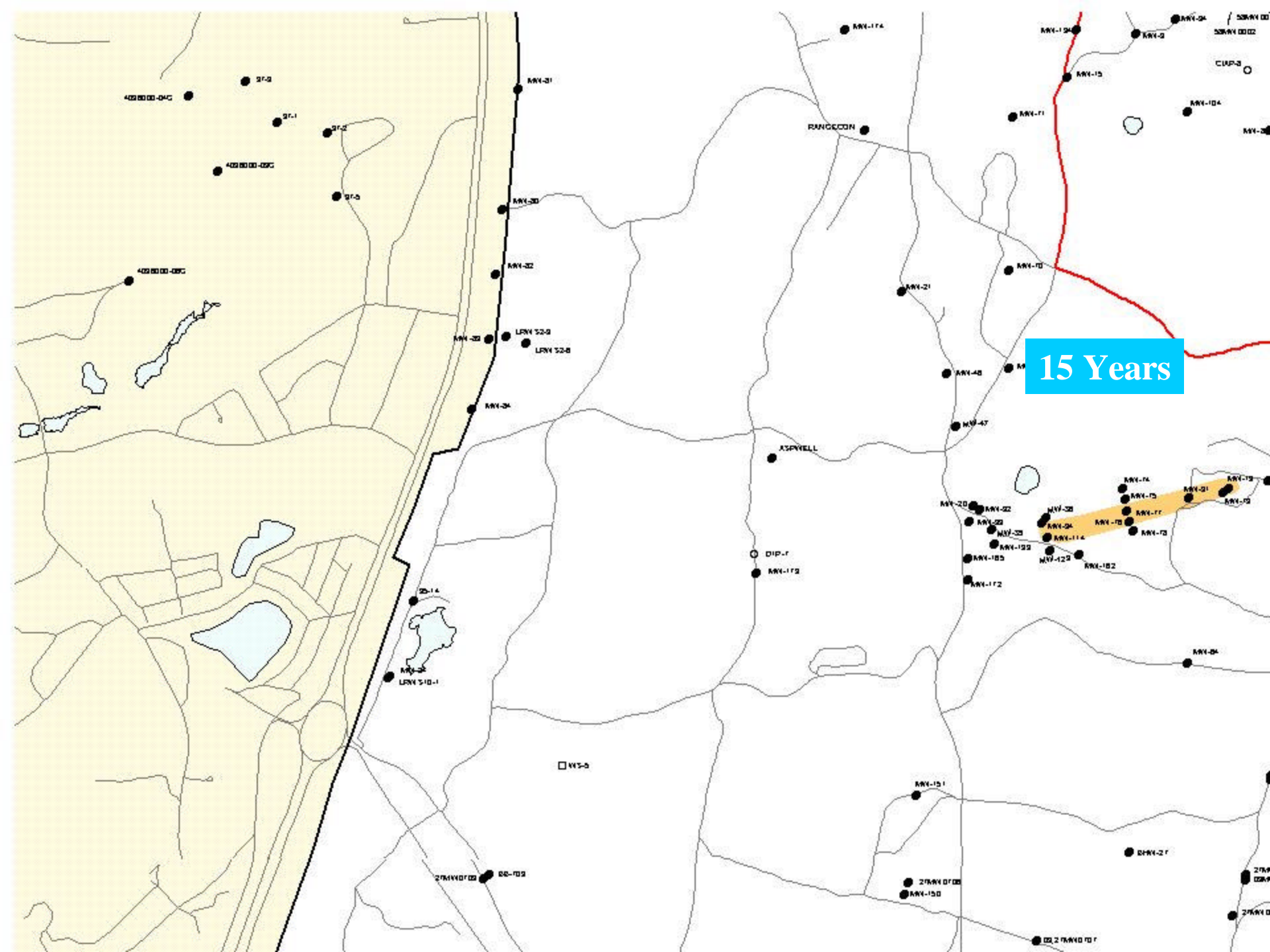
REVISIONS 4/18/00 01/17/01 04/18/01 08/22/01 04/01/02	AMEC Project No. 313000-500 DRAWN BY: DD CHECKED BY: JMM DATE: 4/18/00	DATE: 4/18/00 DRAWING NO.	
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5 Years

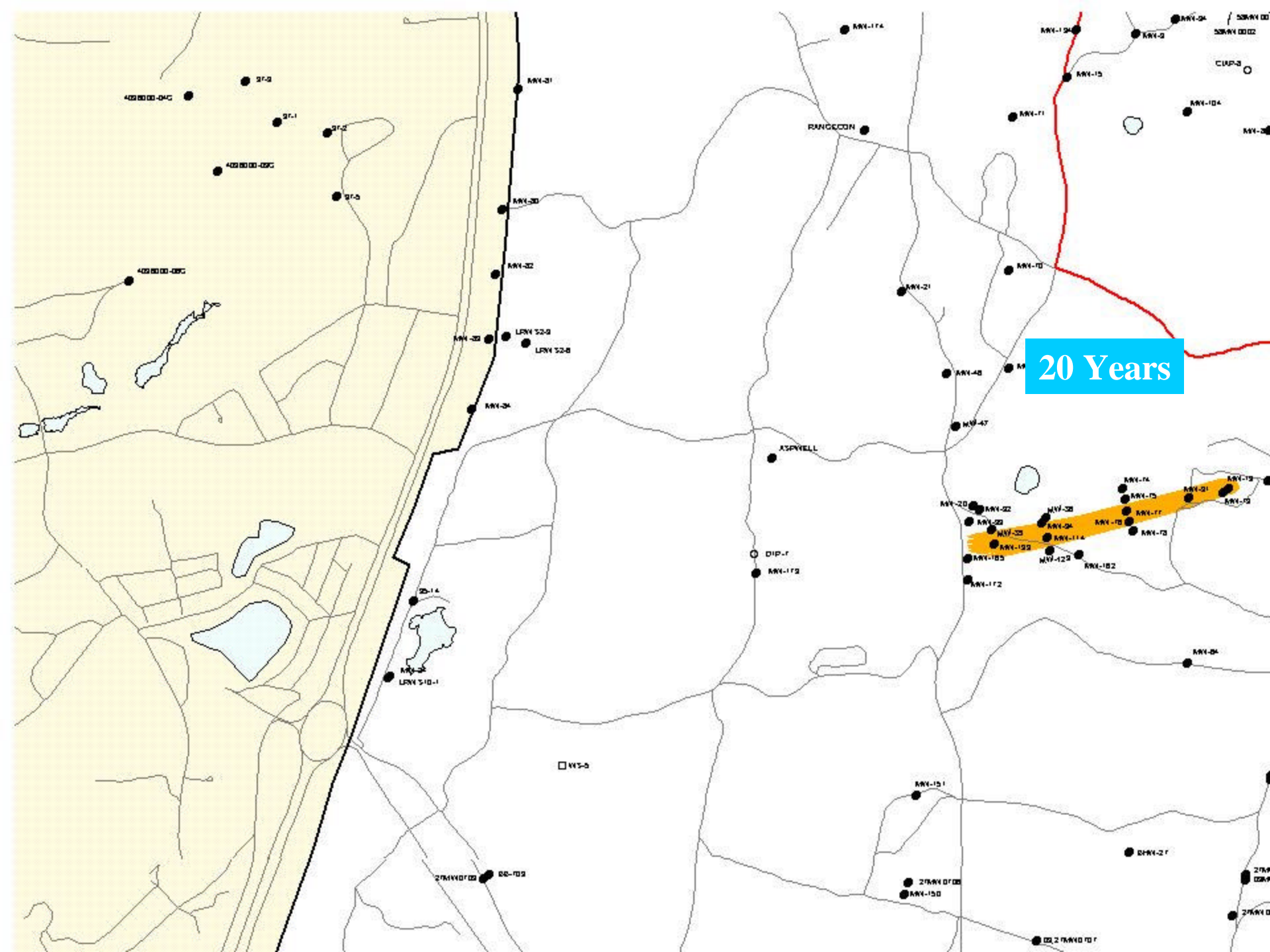




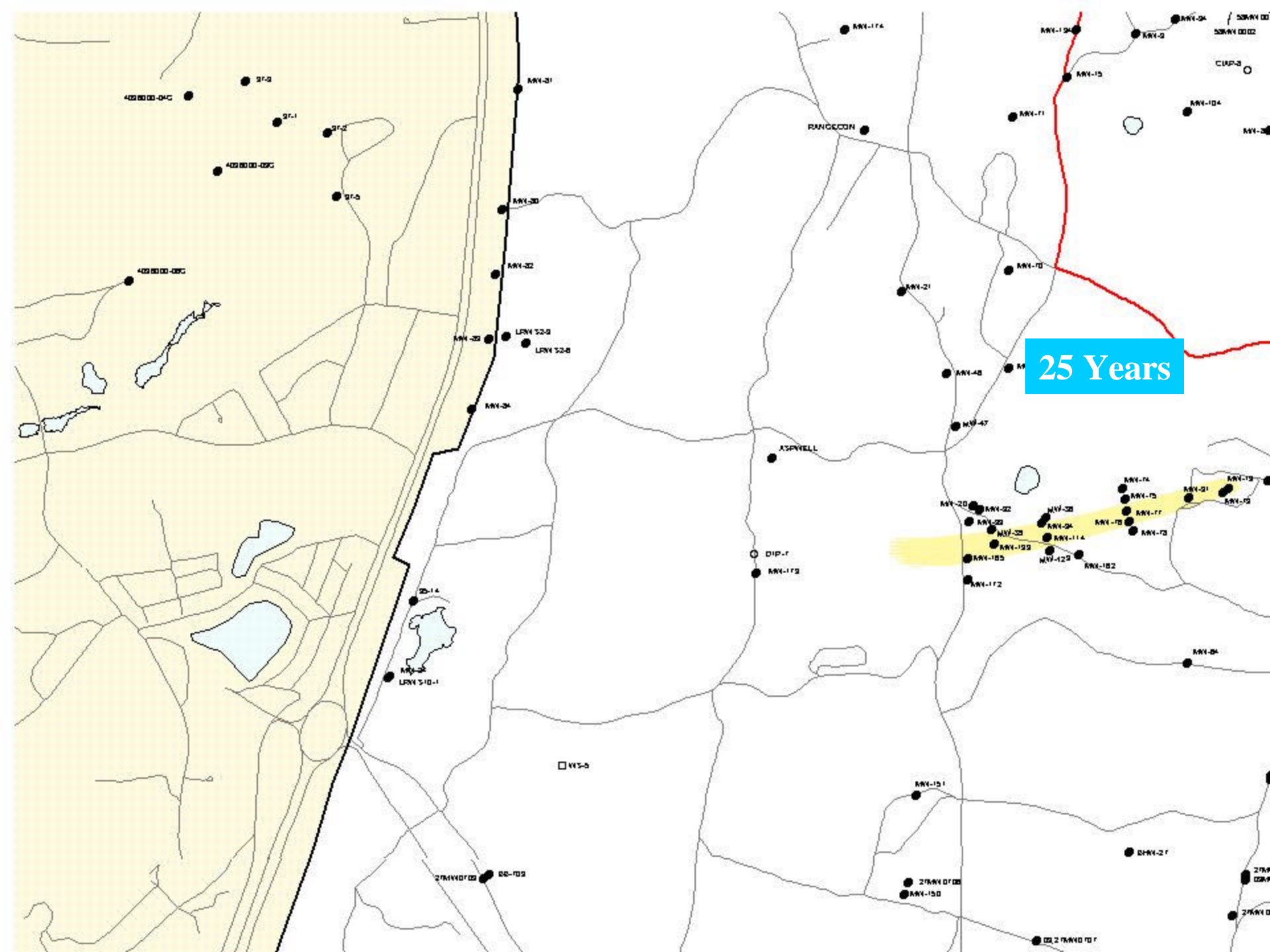
15 Years

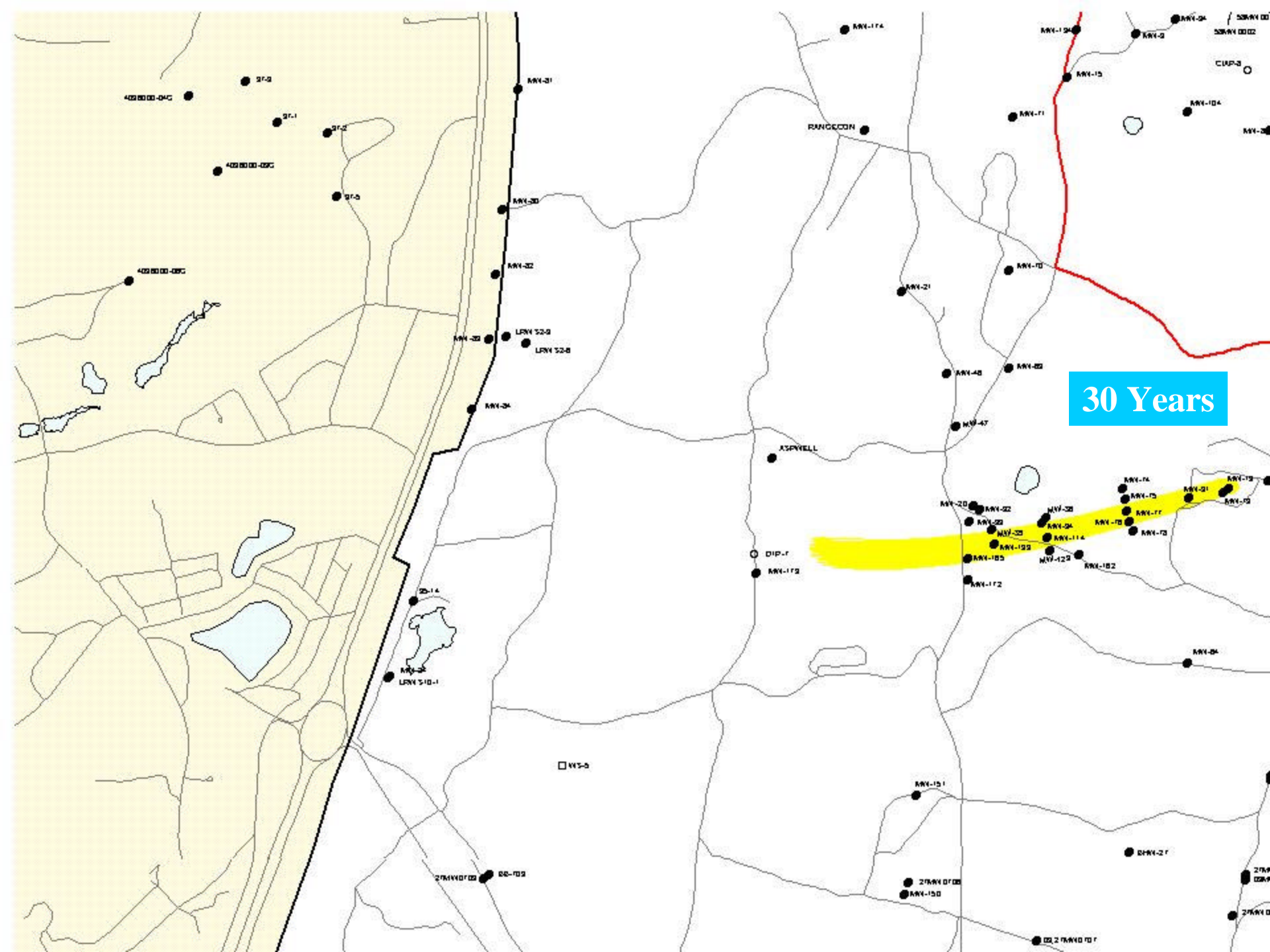


20 Years

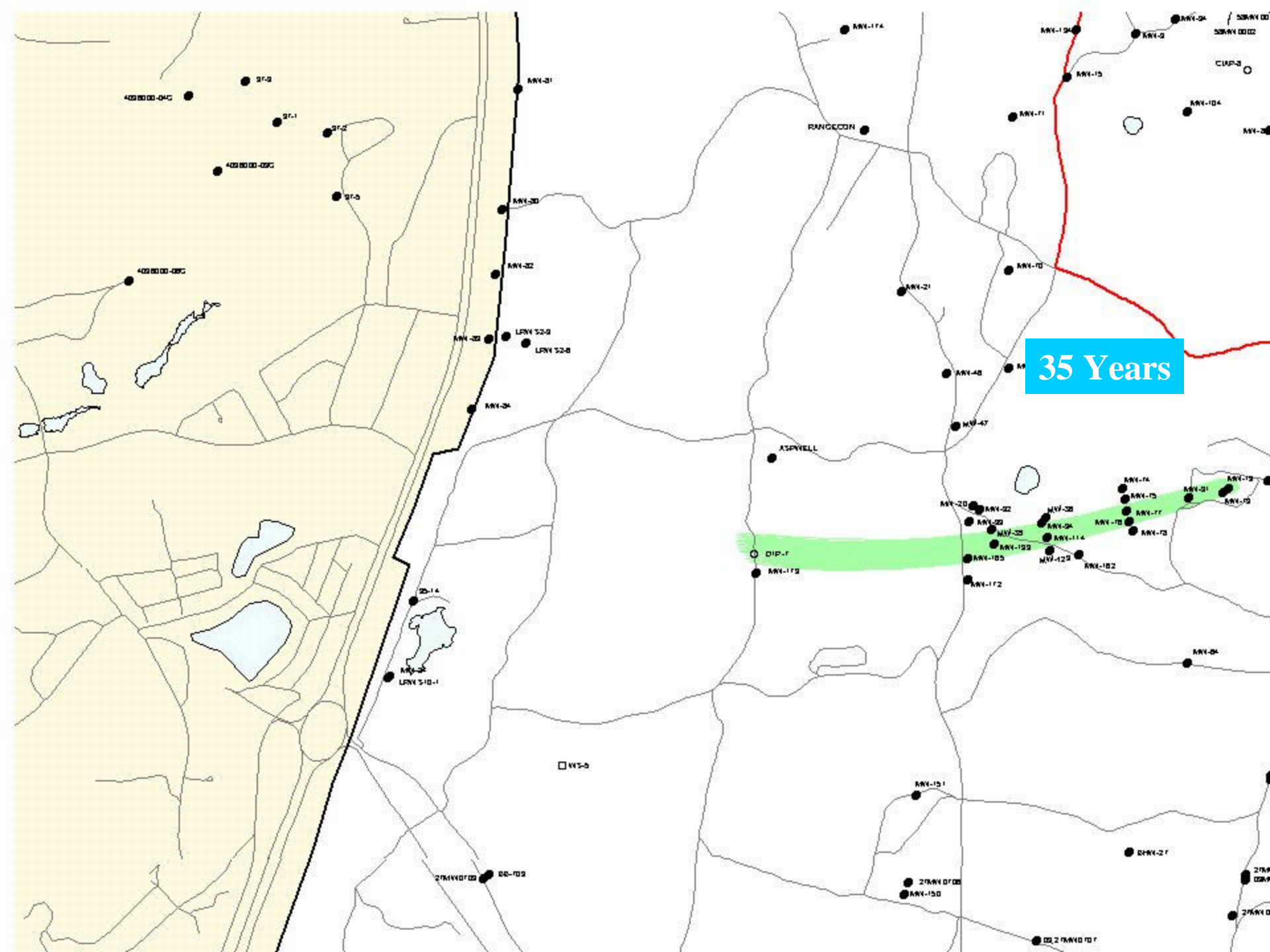


25 Years

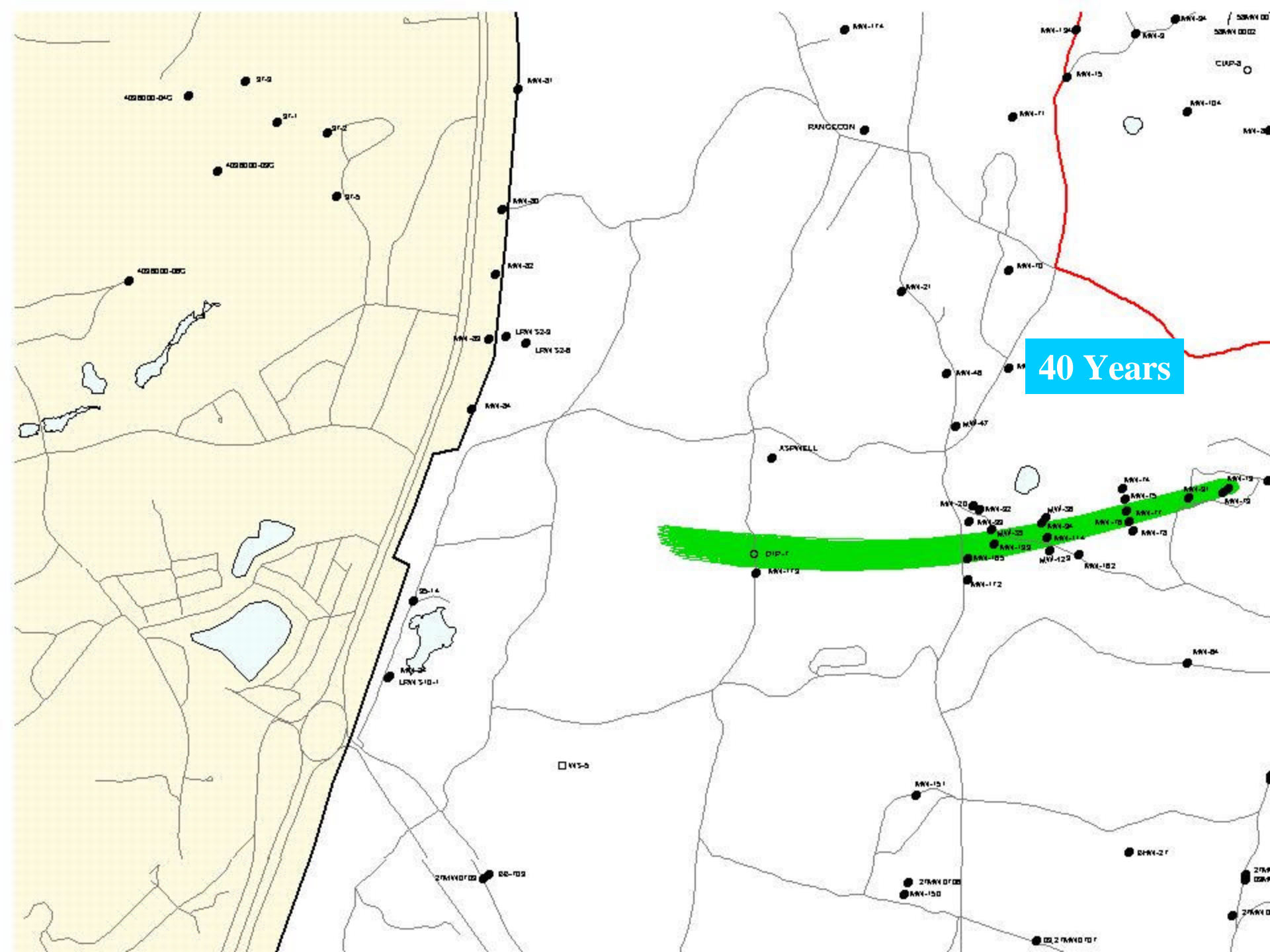




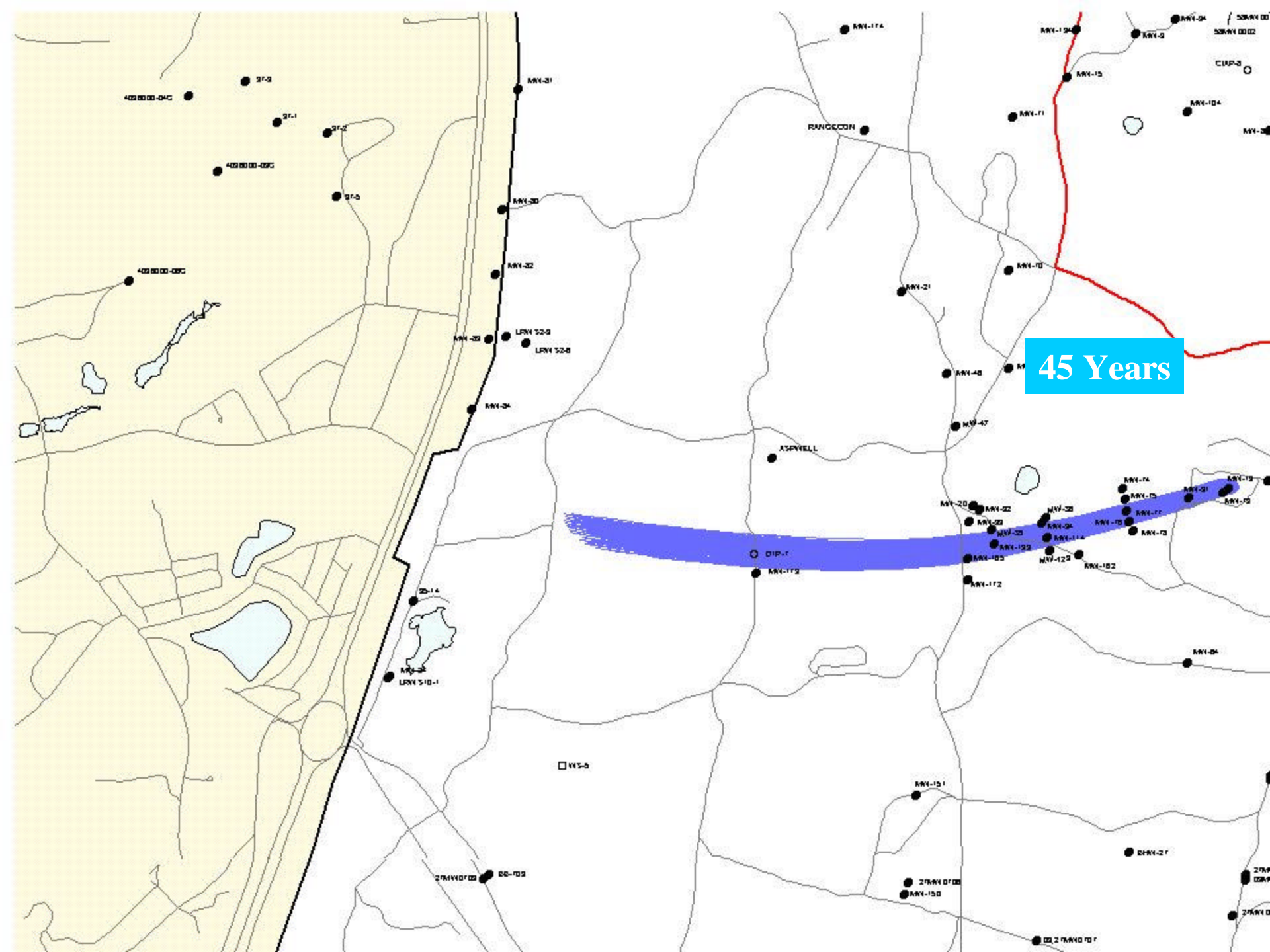
35 Years



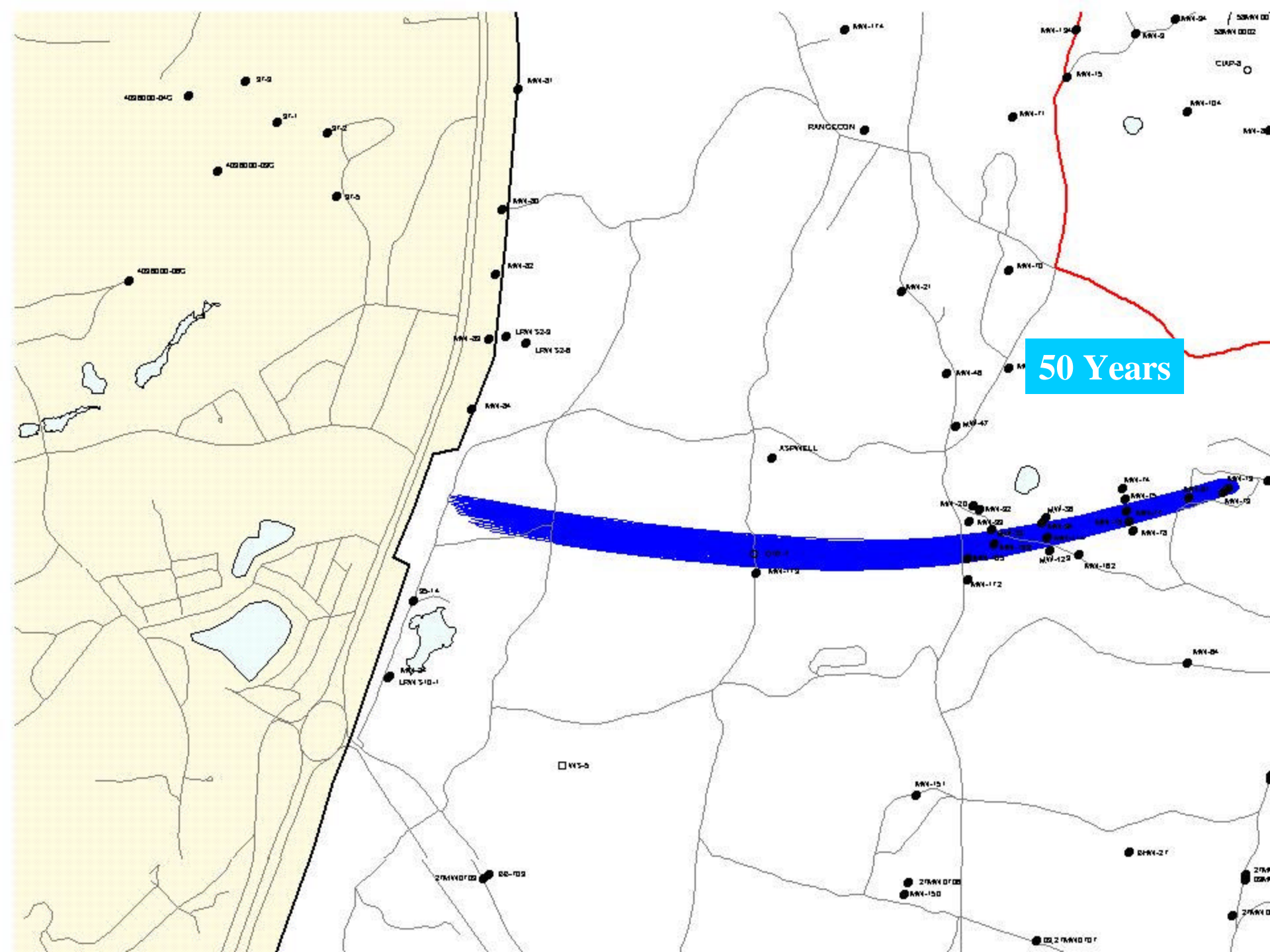
40 Years



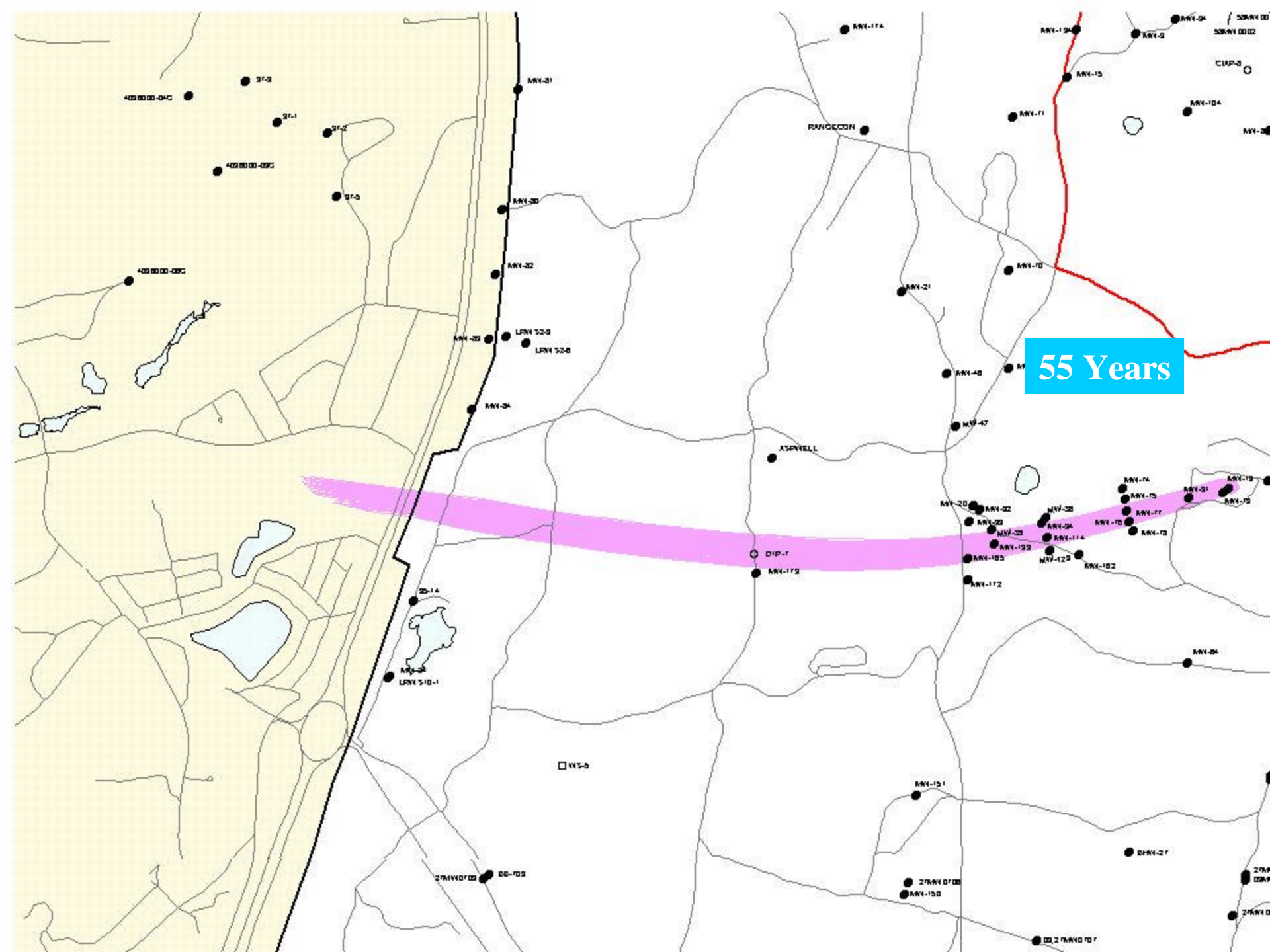
45 Years



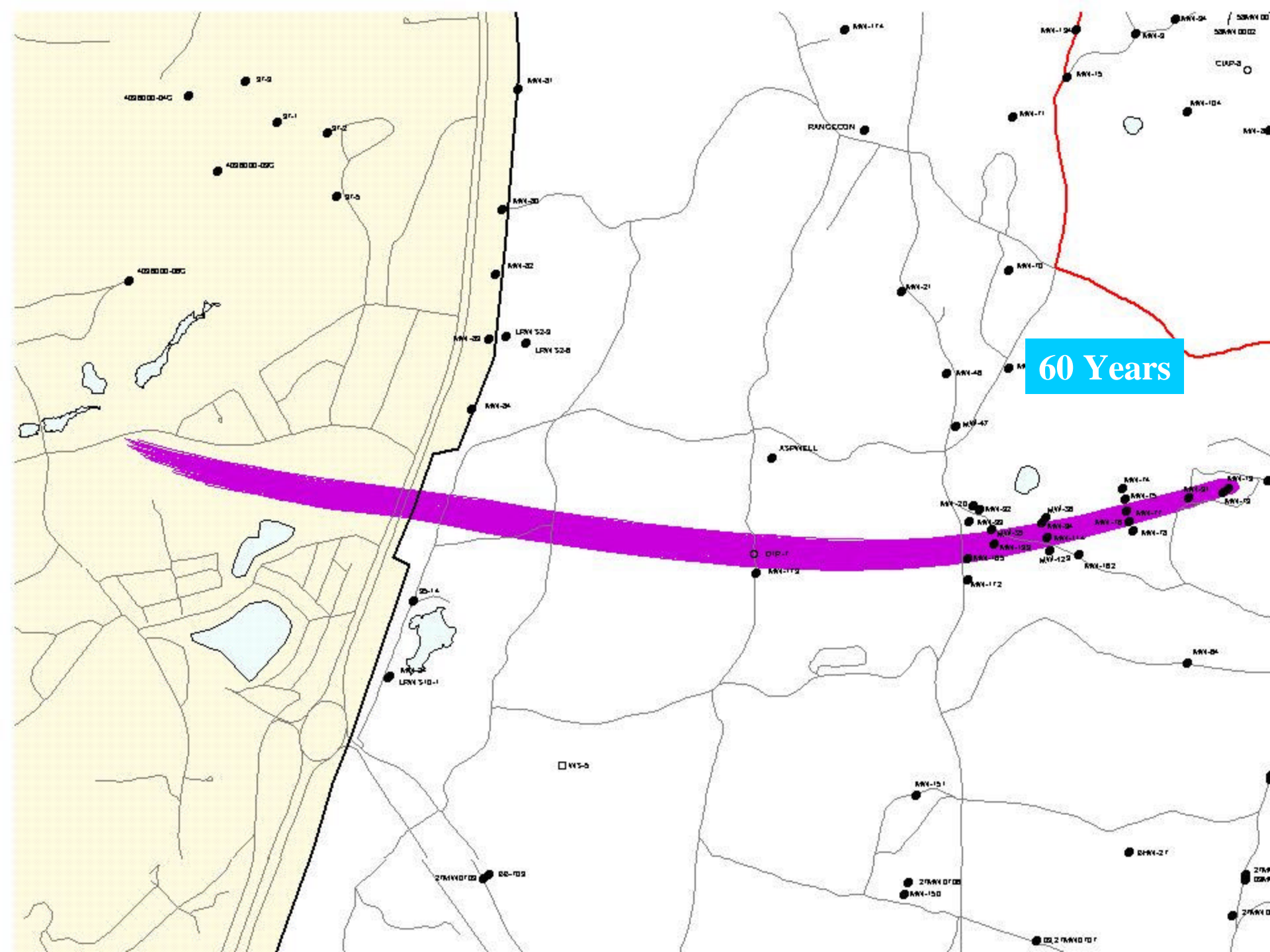
50 Years



55 Years



60 Years



Conceptual Site Model

- Propellants/explosives reside deposited on surface as particulates as a result of historic OB/OD activities.
- Regrading in and around the depression redistributed contaminants to depths of approximately 8 ft.
- The kettle hole tends to act as a funnel, focussing rainwater into the depression, dissolving contaminants.
- Explosives (TNT, RDX) dissolve slowly at MMR. Once in solution, RDX will leach through the vadose zone to groundwater, leaving little residual contamination. TNT will adsorb to soil leaving residual contamination, and allowing a small portion to reach groundwater.

Conceptual Site Model (continued)

- The presence of clay at Demo 1 may enhance the retention of RDX in the upper 7 to 10 feet.
- Once dissolved in groundwater, perchlorate moves at the velocity of groundwater and RDX moves slightly less rapidly. HMX, 4A-DNT, 2A-DNT and TNT are retarded, in order of decreasing movement.

COCs in Soil

- Antimony
- Arsenic
- Barium
- Lead
- Dioxins/Furans
- Hexachlorobenzene
- RDX
- 2,4-DNT
- 2,6-DNT
- 2A-DNT
- 4A-DNT
- HMX
- TNT
- PCE
- N-nitrosodiphenylamine
- Nitroglycerin
- 4-methylphenol
- Benzene
- 2-chlorobenzaldehyde
- 1,3-diethyl-1,3-diphenyl urea
- Bromomethane
- PCP
- MCPP
- Gamma BHC
- Naphthalene
- Carbazole

COCs in Groundwater

- RDX
- TNT
- HMX
- 4A-DNT
- 2A-DNT
- 2,4-DNT
- perchlorate

Conclusions

- Soil and groundwater contamination is a result of historic OB/OD activities
- Contiguous soil contamination limited to kettle hole
 - contaminants are mainly explosives and metals
- Contaminants outside of kettle hole related to “burn pits”
 - contaminants are explosives, metals, SVOCs, dioxins/furans

Ongoing Activities

- PCNs, dyes, and perchlorate are currently being evaluated as possible COCs in soil
- Explosives and perchlorate delineation in groundwater is continuing