Evidence of Low-Altitude Recharge in Arid Environments

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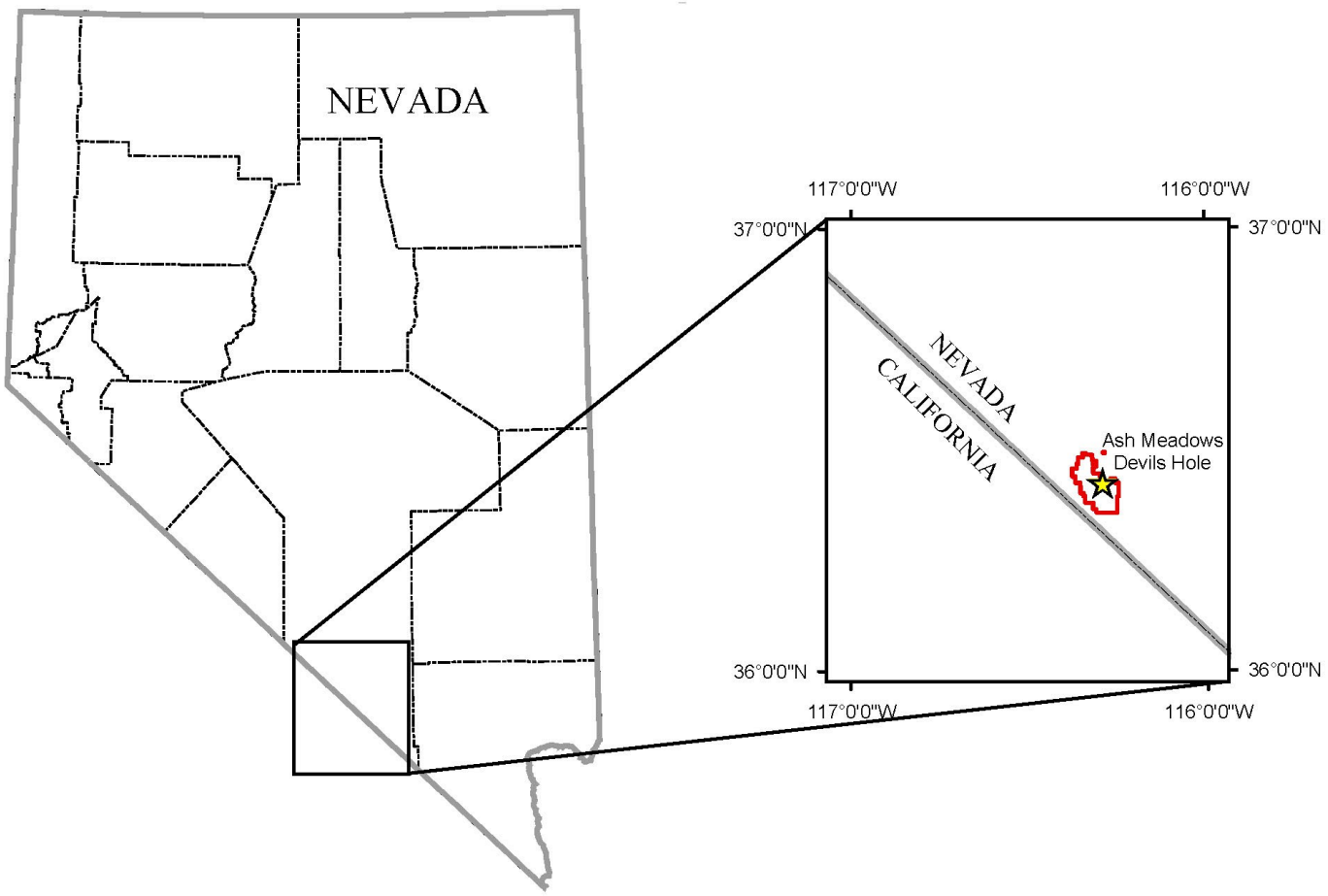
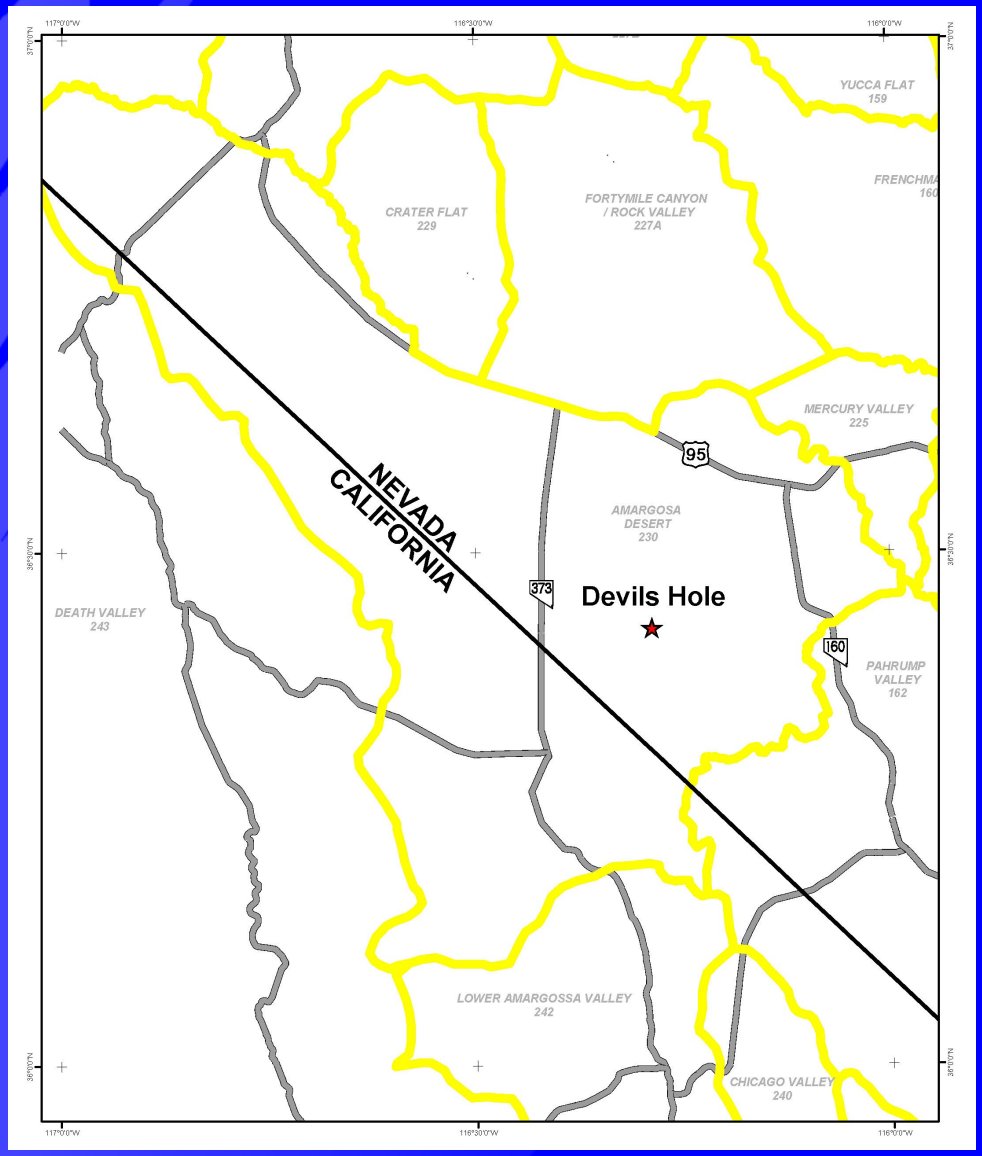
Location Map



Hydrographic Areas

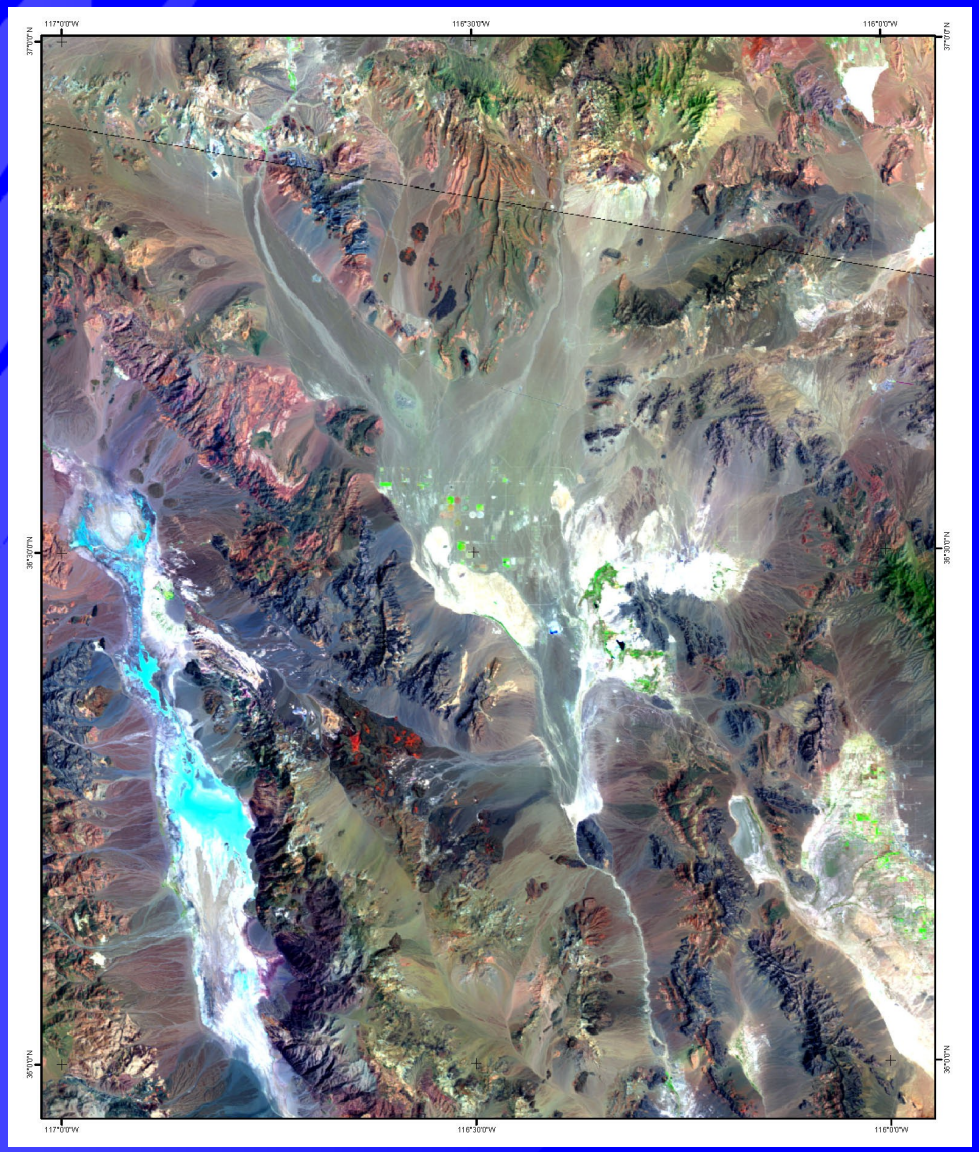


Hydrographic Areas delineated by yellow lines

Area dominated by Amargosa Desert (HA230)

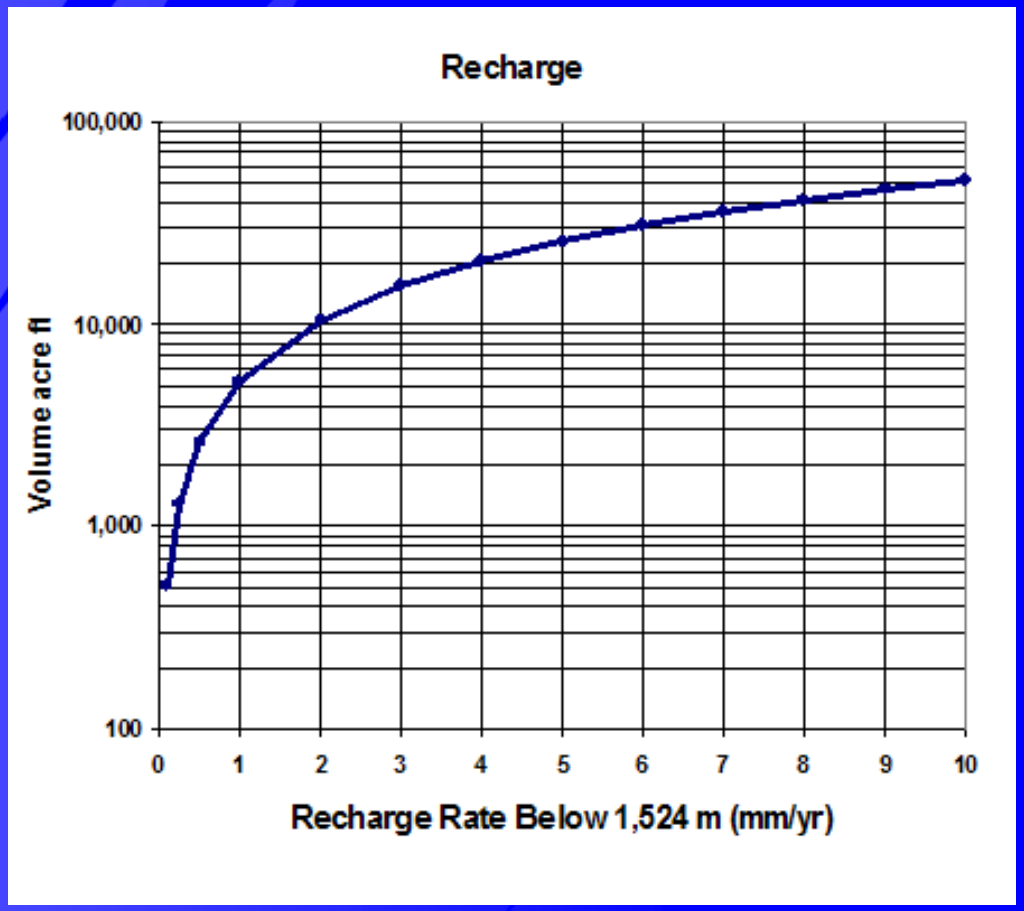
Roads in grey

1993 Landsat Image



- Amargosa Desert Area

SMALL RECHARGE RATES = LARGE RECHARGE VOLUMES



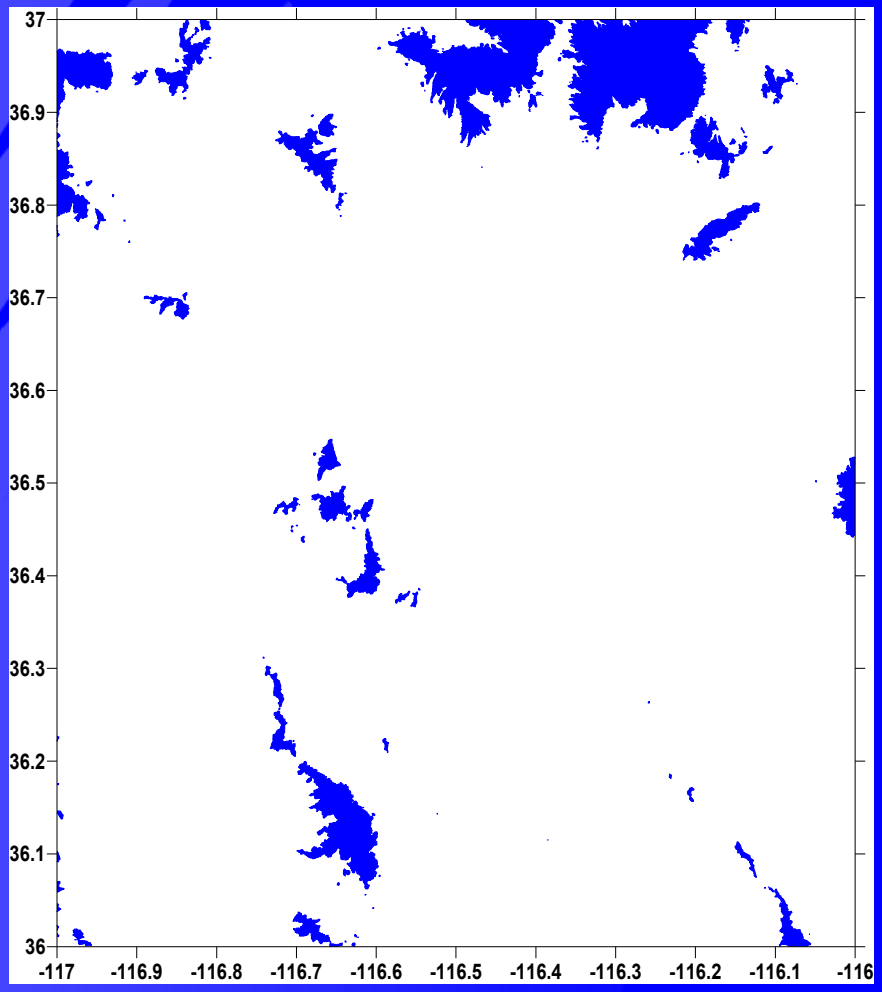
1,570,000 acres are below 5,000' in Amargosa Desert, Fortymile Canyon, and Oasis Valley (94% of total area in the 3 basins)

Walker and Eakin (1963)

Recharge from precipitation over Amargosa Desert and tributary basins estimated at 1,500 afy.

Every 0.1mm below 5,000' equates to 515 acre feet

MAXEY – EAKIN ESTIMATES



Precipitation Zone	Maxey-Eakin Coefficient	Recharge mm/year
>20”	0.25	127
15 - 20”	0.15	67
12 - 15”	0.07	8
8 - 12”	0.01	3
<8”	0.00	0

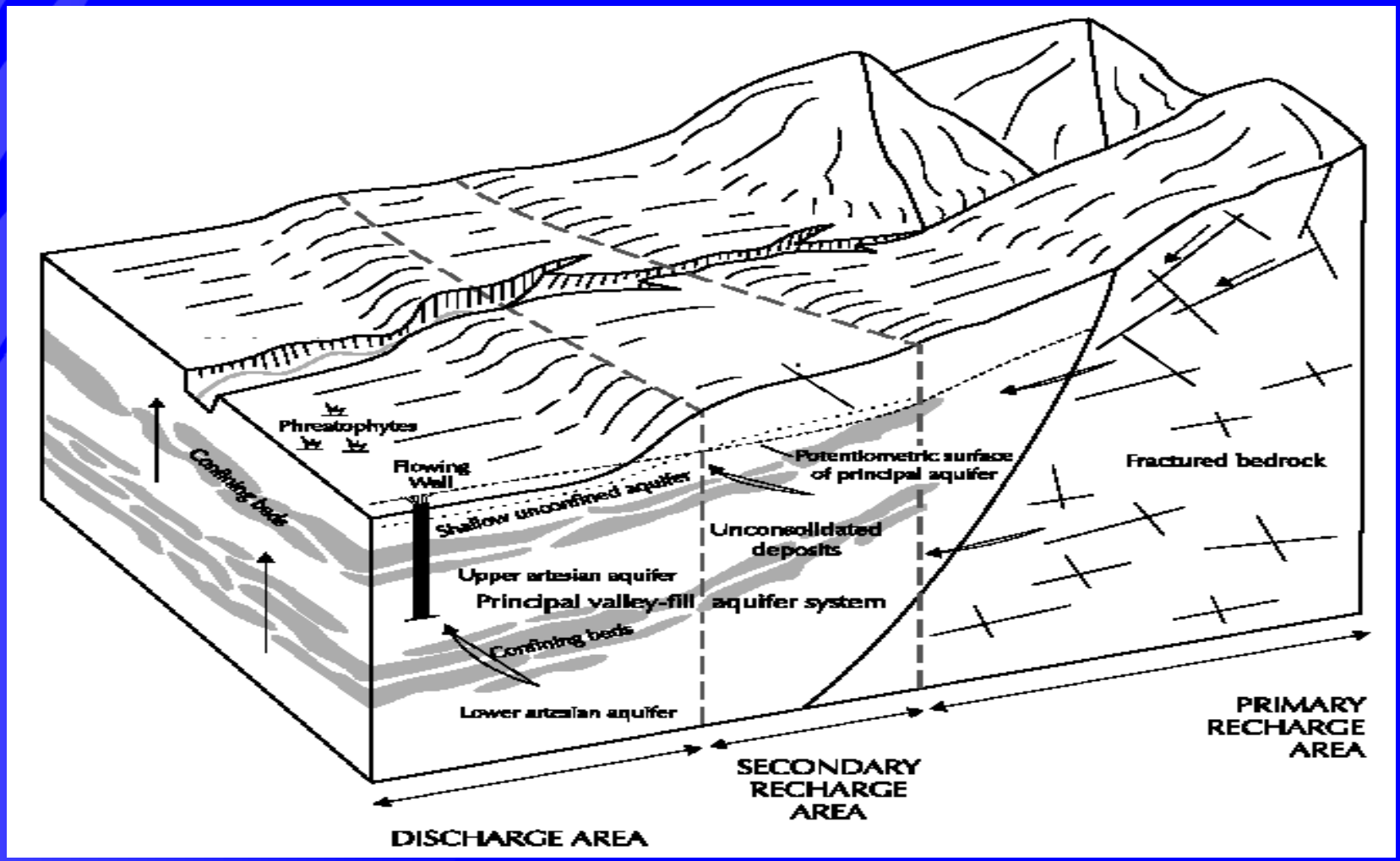
Note: Assumptions of and Walker and Eakin (1963)

For the 1° x 1° area at left:
(2,444,000 acres total – 11% > 5,000 ft)

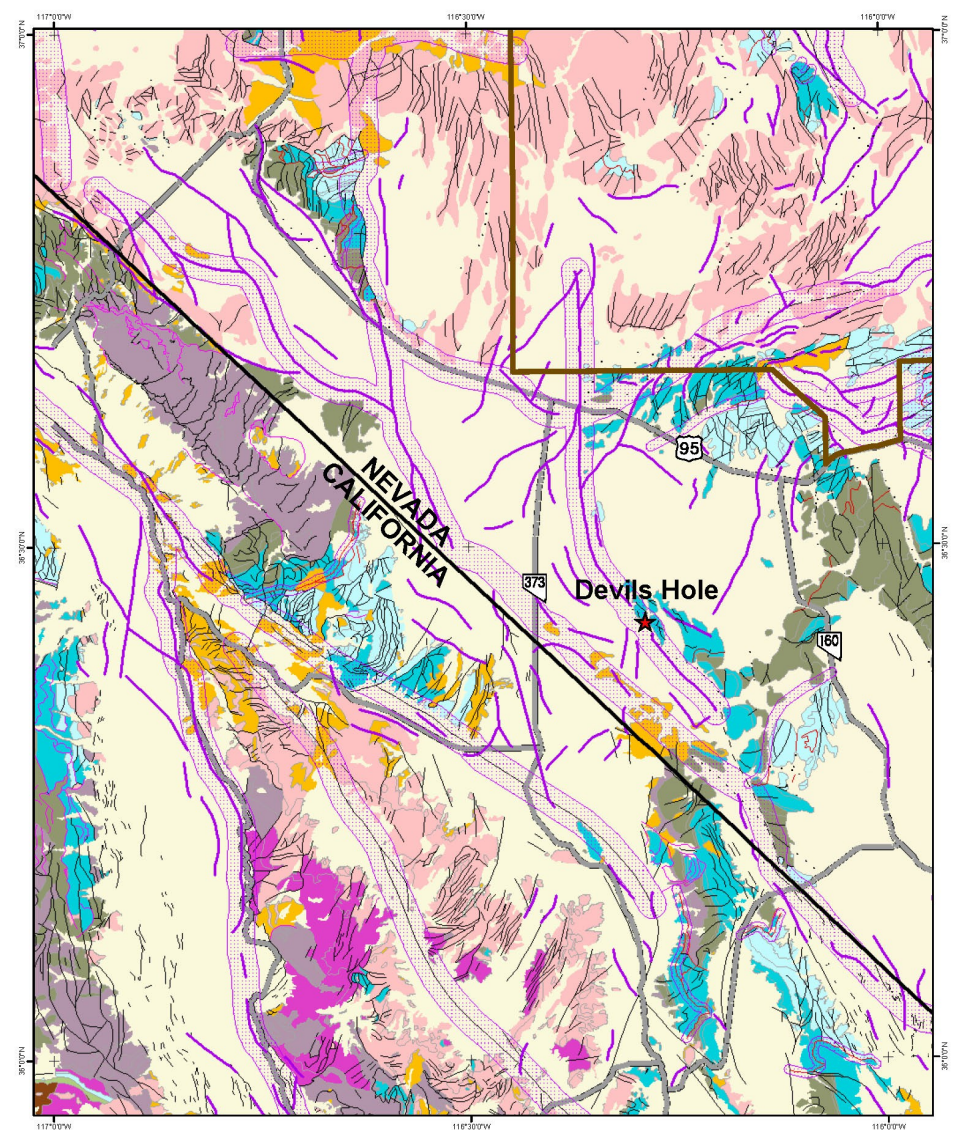
PPT in/yr	Acres	ME coef.	Recharge afy
15-20	114	.15	25
12-15	34,000	.07	2,670
8-12	228,000	.01	1,900
TOTAL			4,595

2% of precipitation above 5,000’
< 0.4% of total precipitation over basin

DISTRIBUTION OF RECHARGE IS NOT SIMPLE



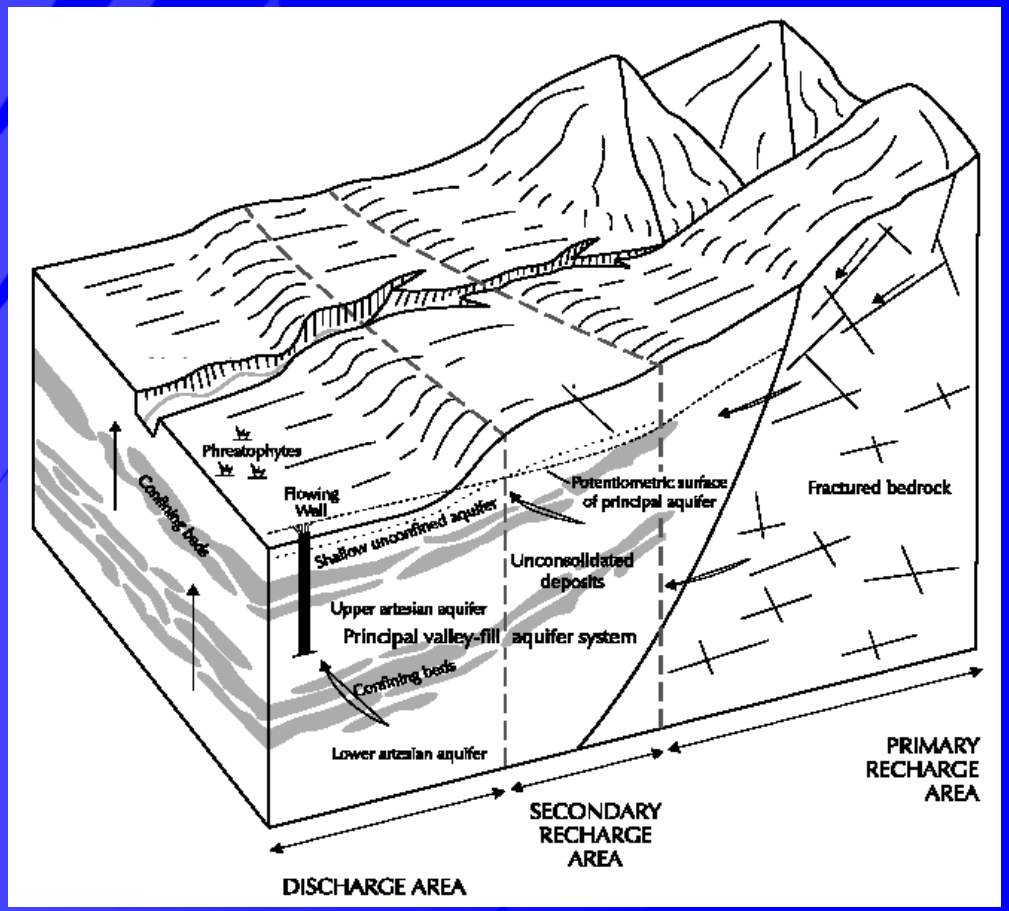
Hydrogeologic Map



Units

- Ivory – Qs
- Orange – Ts
- Pink – Tv
- Red - Ti
- Lt Blue – POc
- Dk Blue – Cc
- Olive – CpCs
- Purple - pCm

DISTRIBUTION OF RECHARGE IS NOT SIMPLE

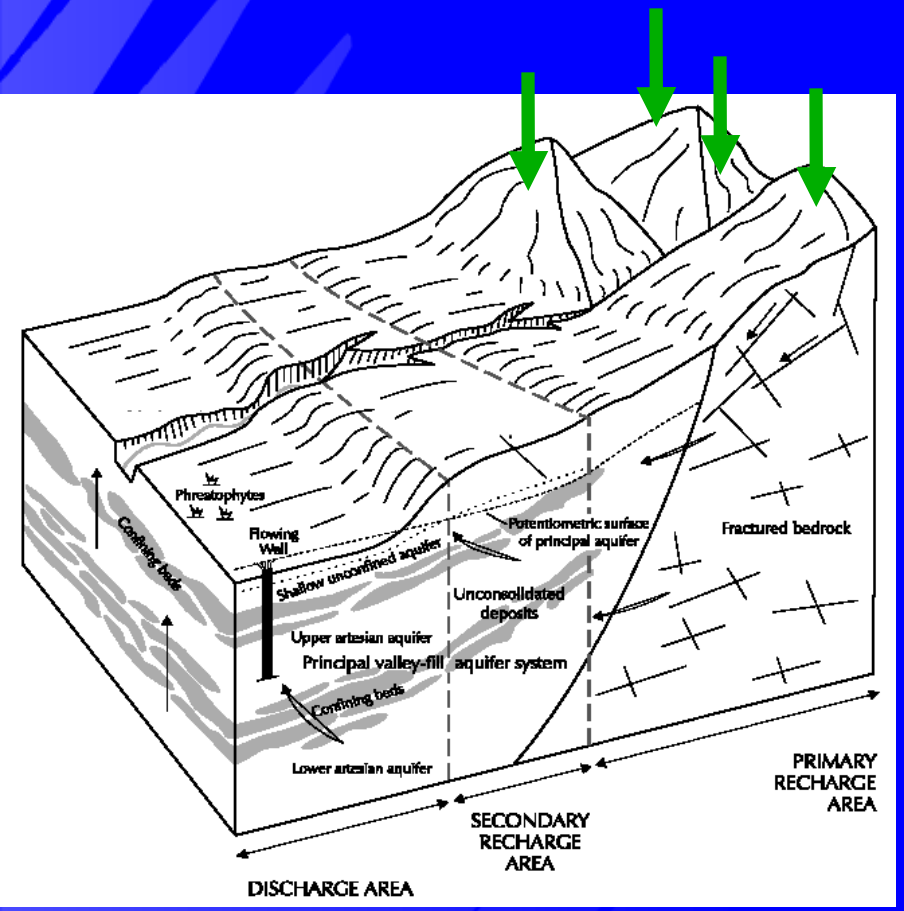


Areas below 5,000’ in Amargosa Desert include consolidated rock, alluvial fans, ephemeral channels, outwash plains, sand dunes, wetlands, and disturbed land.

Each environment has different recharge capacities depending on rock or soil type and degree of disturbance.

Recharge also occurs over discharge areas.

UPLAND AREAS > 5,000 FT



Only 11% of the area is above 5000'; PPT= 340 mm/yr; terrain is mostly consolidated rock with some vegetation limited woodland vegetation.

Published recharge rates in mm/yr:

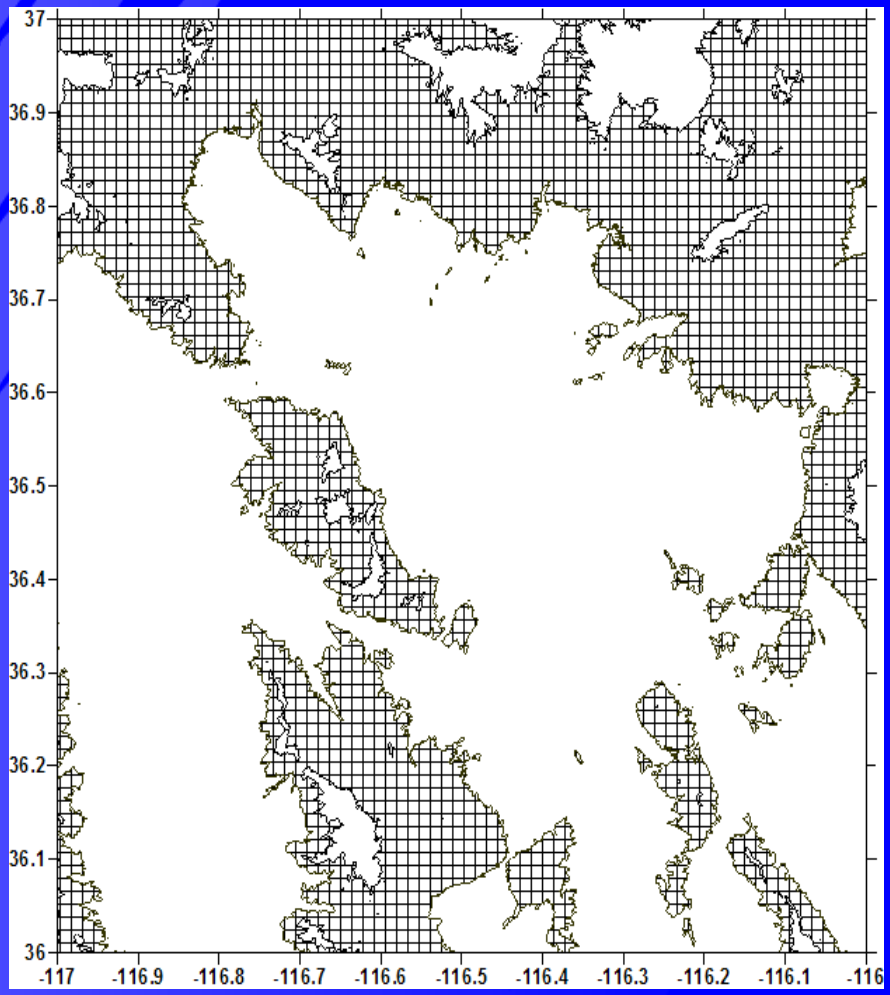
Rate	Locations	Method
11 – 33	NW Nye County	Cl^- balance*
310-330	Central Nye Co.	Cl^- balance**
3 – 127	NV	Maxey –Eakin

Maxey-Eakin coefficients within the range found for modeled chloride ion approach.

•Modeled based on Precipitation-Runoff Modeling Sysgtem and Reduced (Timed Averaged) Chloride Ion Model for a water shed altitude range of 7,000'to 9,500'

** As above but altitude = 9,675' to 10,000'

CONSOLIDATED ROCK BELOW 5000’



About 50% of the area below 5000’ comprises consolidated rock, approximated here by the area above 3,281 and 5,000 ft.

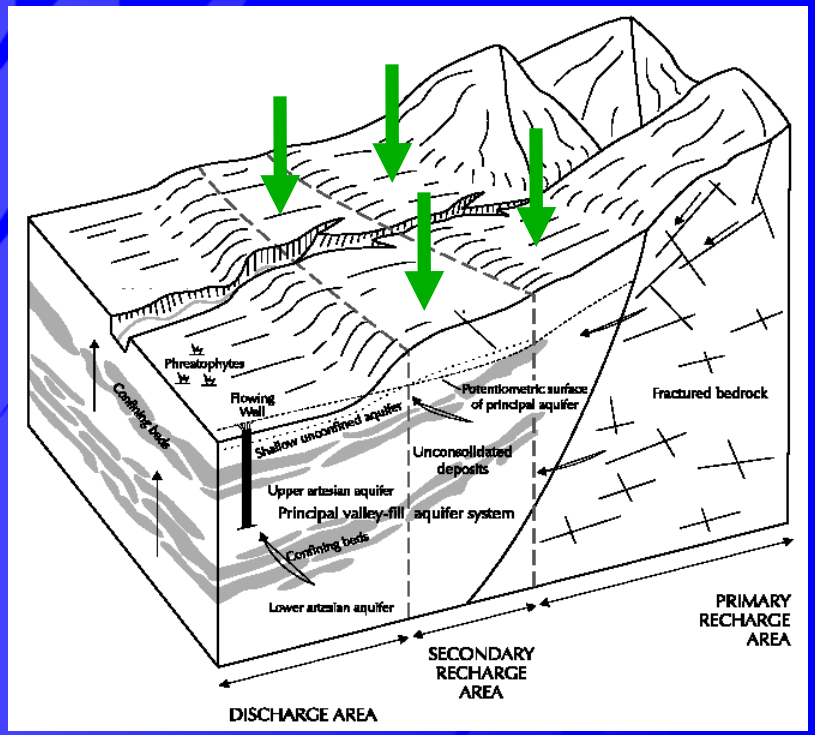
Published recharge rates in mm/yr:

Rate	Locations	Method
22	South Australia	Cl^- balance
16 to 66	Israel	Tritium
30 to 110	Israel	Bromide
100+	Namibia Karst	Cl^- balance
1-3	Yucca Mountain	various

Infiltration rates vary by orders of magnitude

4,000 acre feet per mm over consolidated rock over mapped area

ALLUVIAL FANS – OUTWASH PLAINS



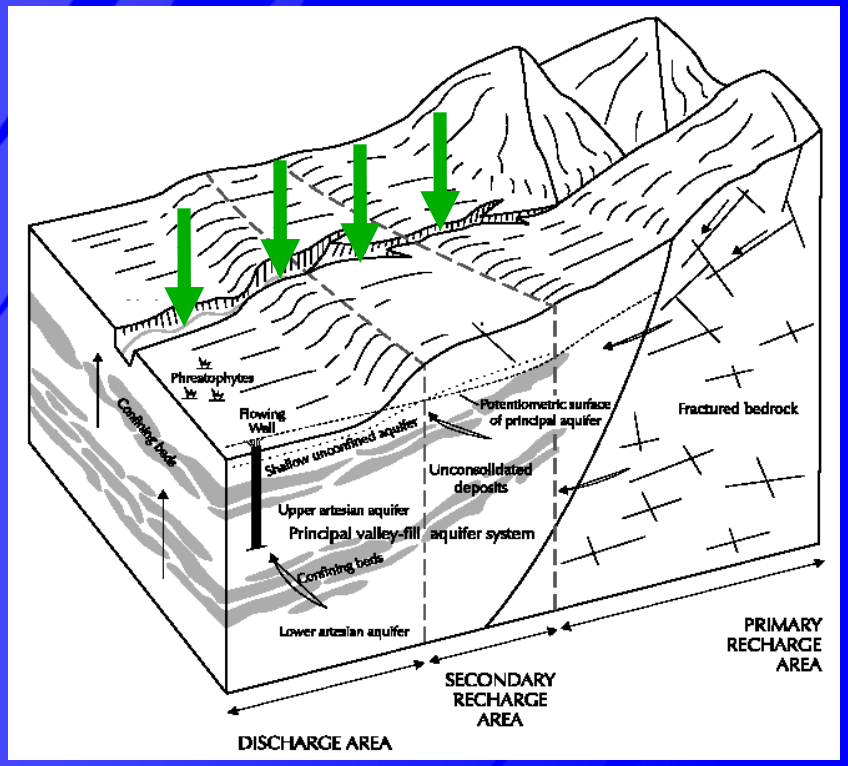
About 30% of the area is alluvium or outwash deposits.

Published recharge rates in mm\yr:

Rate	Locations	Method
<10	Kalahari Desert	Cl^- balance
.06 - .17	South Australia	Cl^- balance
.03 to .05	Ward Valley	Cl^- balance
0-2	Amargosa Valley	Isotopes

1 mm/yr over alluvium = 2400 afy over mapped area

EPHEMERAL CHANNELS



A small area of the alluvium and outwash deposits comprises ephemeral channels.

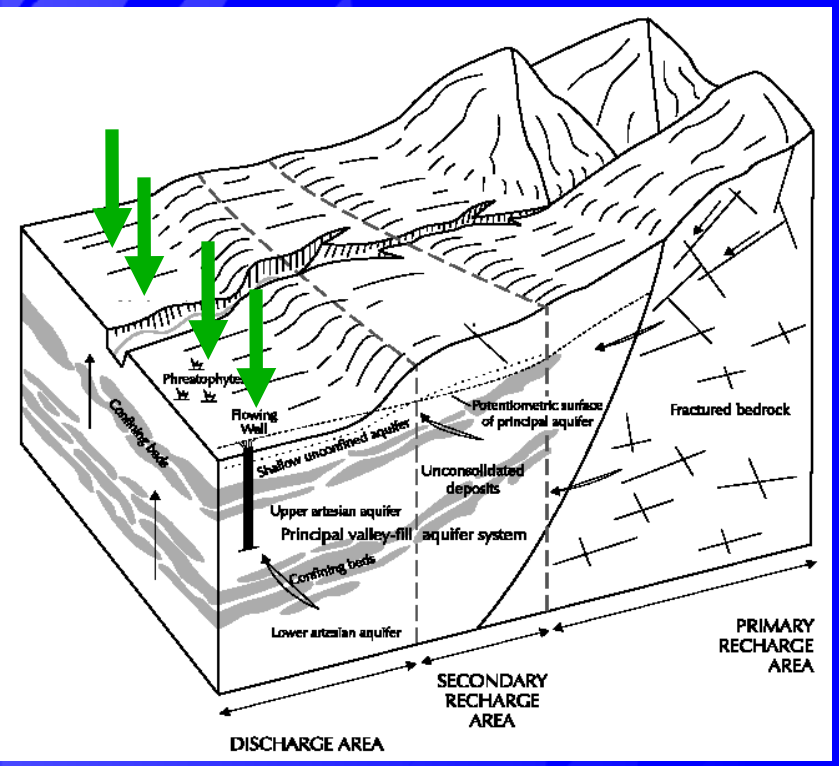
Published recharge rates in mm\yr:

Rate	Locations	Method
1.8	Yucca Wash	Chlorine 36
20 – 150	Amargosa Valley	Cl^- balance
.07 – 2.6	Nevada Test Site	Cl^- balance

Infiltration rate is in m/day but annualized rates are very small.

2 mm/yr - 500 mi of channels ~ 10 afy

RECHARGE OVER DISCHARGE AREAS



Areas of phreatophytes around spring complexes total about 20,000 acres.

Published recharge rates in mm\yr:

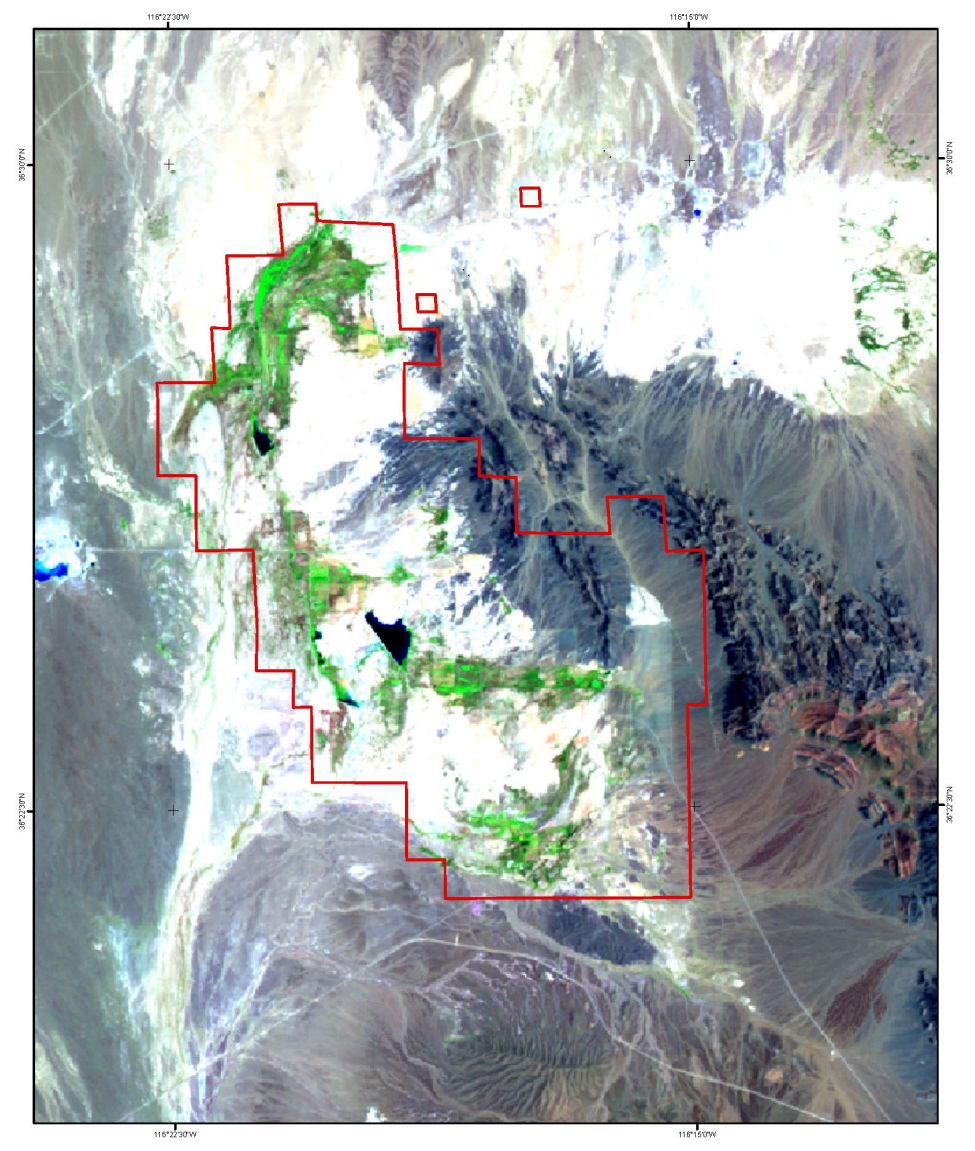
Rate	Locations	Method
77	Playa - TX	Tritium
≥12	Playa – NM	Cl^- balance

Or 0.5 to 1.5 percent of precipitation

1 mm/yr over 20,000 acres of Phreatophytes = 130 afy

UPLAND > 5,000’ reasonable	Maxey-Eakin coefficients
CONSOLIDATED ROCK < 5,000’ – Unknown	Potentially significant
FANS – OUTWASH – ALLUVIUM – moderate	Depth to groundwater a factor
CHANNELS – slight pulses	Episodic
RECHARGE OVER DISCHARGE AREAS– small shallow	Playas in areas of groundwater could contribute large pulses

1993 Landsat Image



- Detail of Ash Meadows