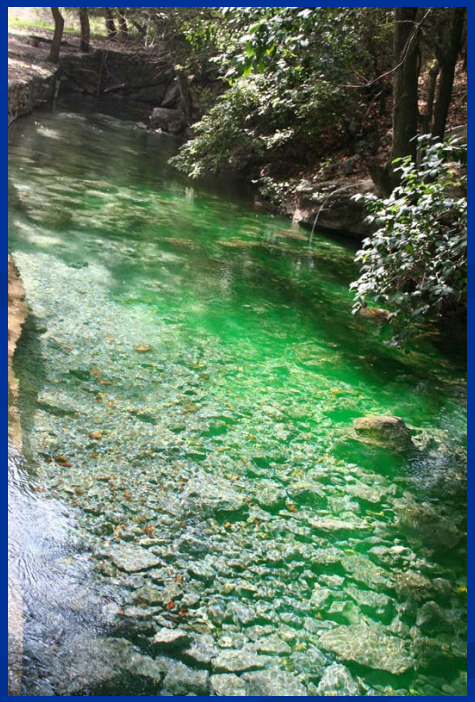
The Great Springs of the Edwards Aquifer

Presented by:
Geary Schindel, P.G.
Chief Technical Officer
Edwards Aquifer Authority
San Antonio, Texas



Spring Run 3, Comal Springs

Spring Factoids

- Occur where water table intersects the land surface
- Springs are characteristic of convergent flow
- May have rapid groundwater velocities
- Defined flow paths
- May be susceptible to water quality and quantity degradation
- Springs most commonly found in carbonates, basalts, some sandstones
- Discharge is proportional to size of recharge area

Spring Classification System by Discharge (Meinzer, 1927)

- 1st Magnitude > 100 cubic feet per second (cfs)
- 2nd Magnitude 10 -100 cfs
- 3rd Magnitude 1 - 10 cfs
- 4th Magnitude 100 gpm - 1 cfs (448 gpm)
- 5th Magnitude 10 to 100 gal/min
- 6th Magnitude 1 to 10 gal/min

Texas Springs Ranked by Discharge

Rank	Name	County	Discharge (cfs)
1	Comal	Comal County	300
2	San Marcos	Hays County	150
3	Goodenough	Val Verde	135
4	San Felipe	Val Verde	90
5	Barton	Travis	50
6	San Antonio	Bexar	50
7	Hueco	Comal	35

From G. Brune, 1981

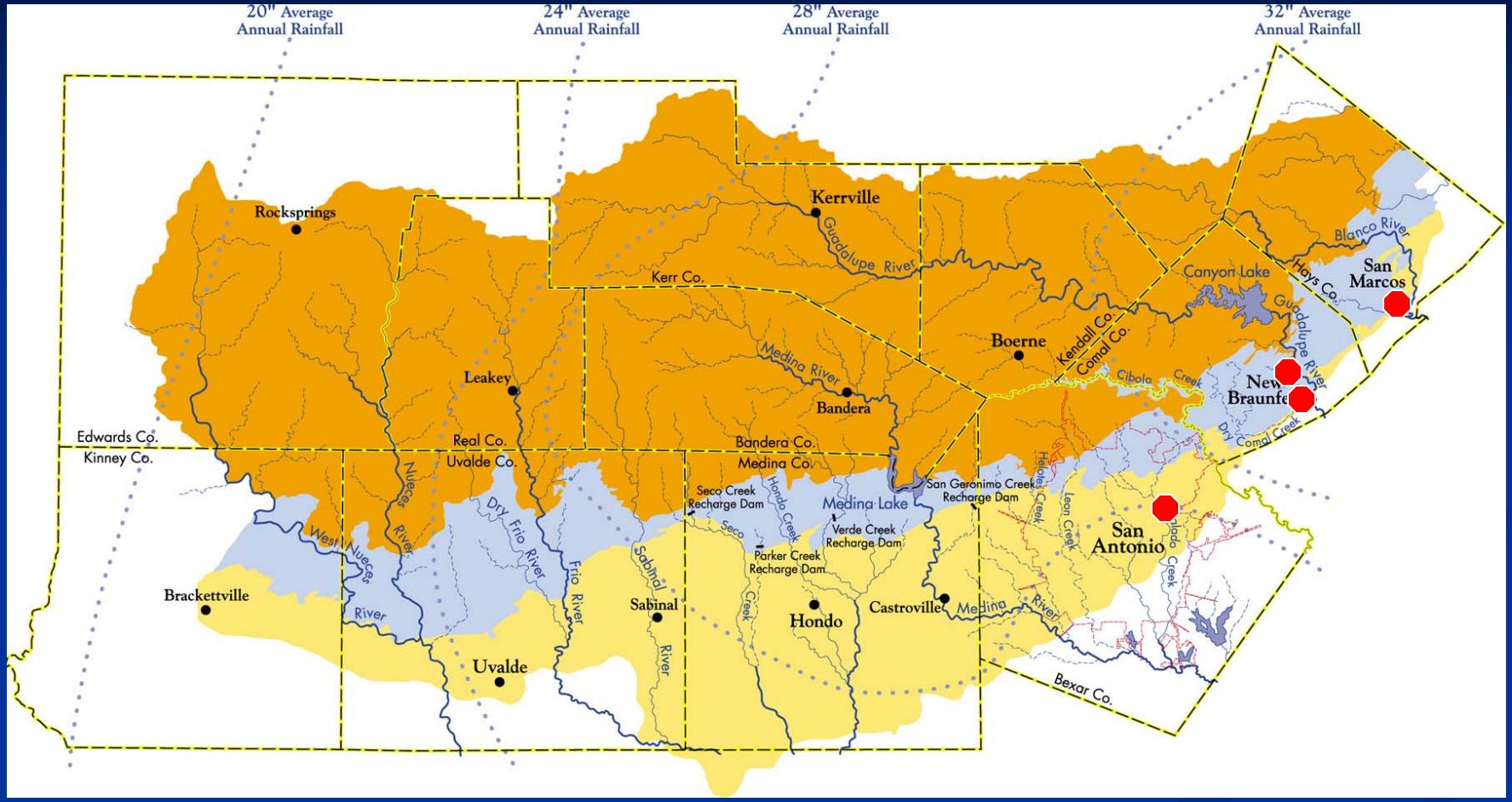
Spring Classification by Type

- Gravity (free draining springs)
- Alluviated (dammed)
- Artesian (vauclusian)
- Submarine (off shore)

Recharge Zone Delineation Methods

- Geologic Mapping
- Hydrologic Mapping
- Potentiometric Surface Mapping
- Normalize Baseflow Calculations
- Modeling (?)
- Tracer testing
- Water Quality Testing

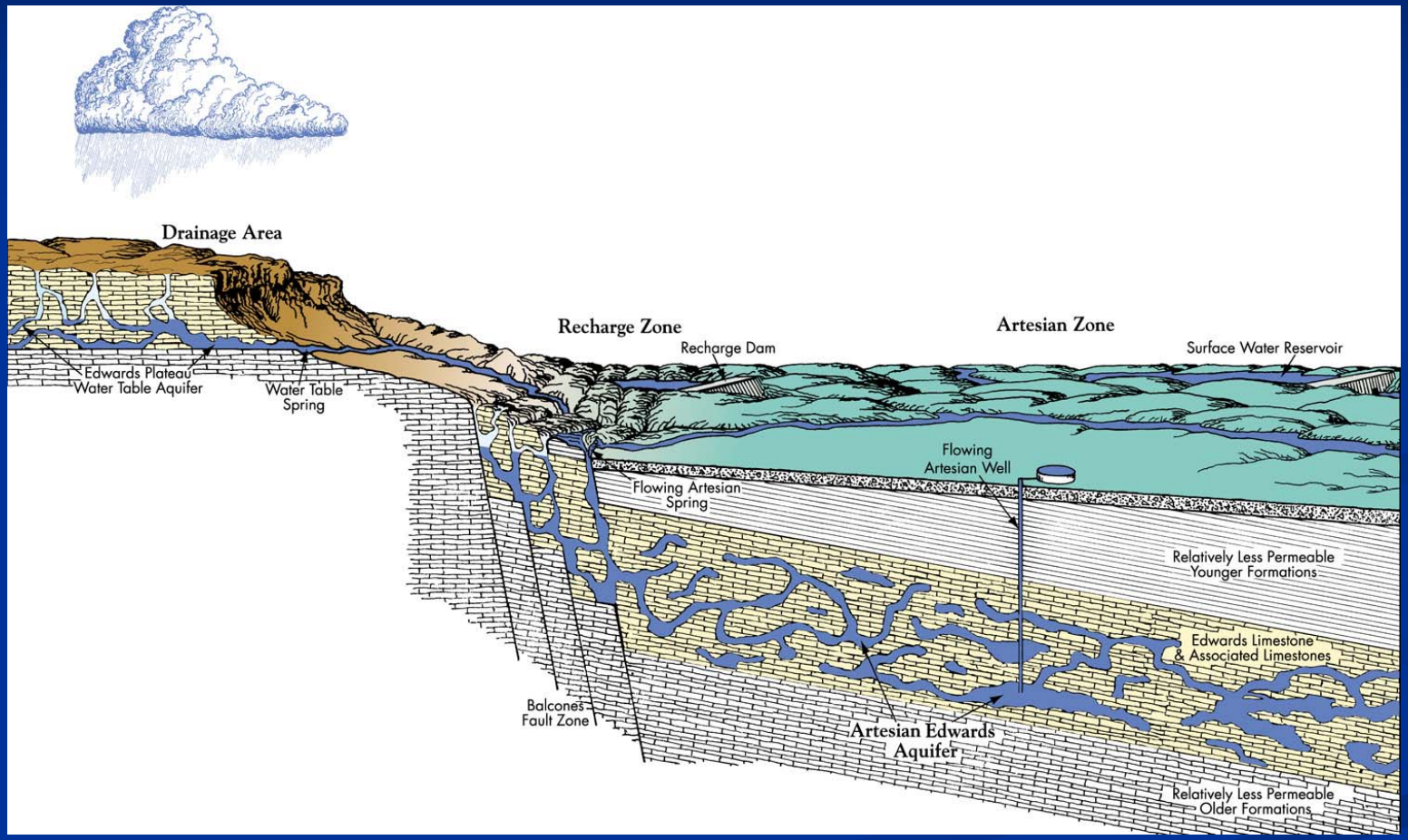
EDWARDS AQUIFER REGION



Source: Edwards Aquifer Authority 2002

Edwards Aquifer Authority

GEOLOGIC CROSS-SECTION OF THE EDWARDS AQUIFER



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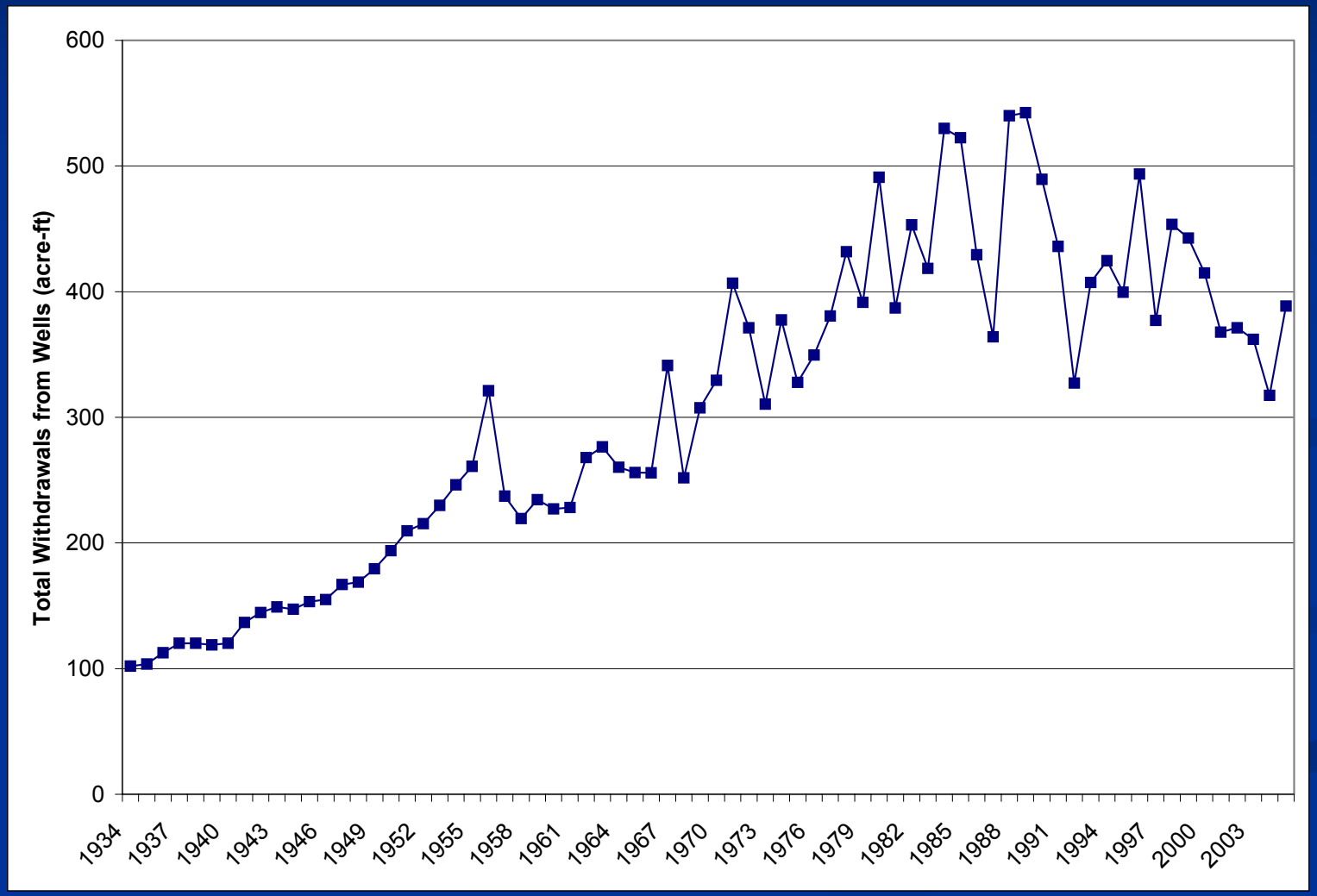
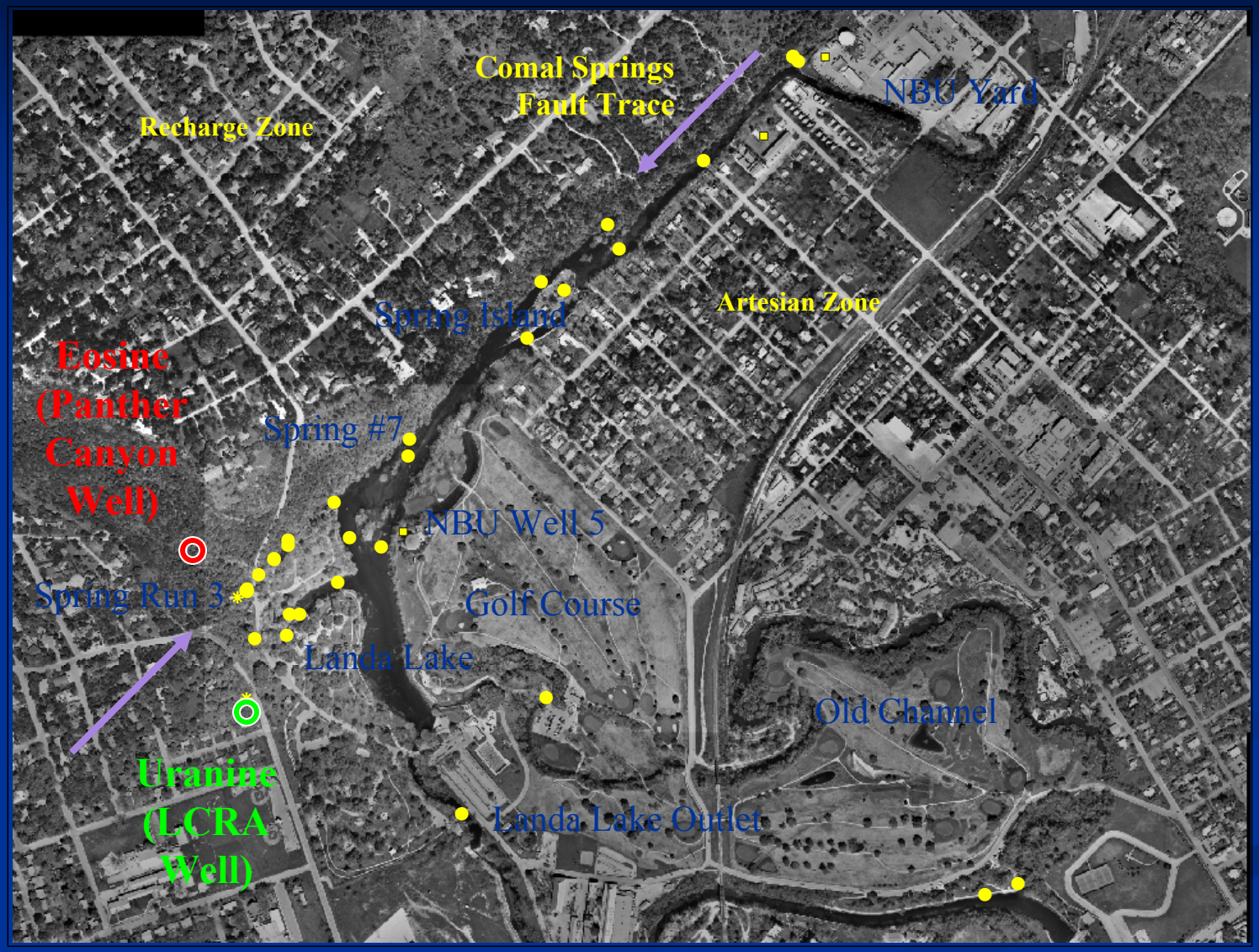
Hueco Springs, Comal County, Texas

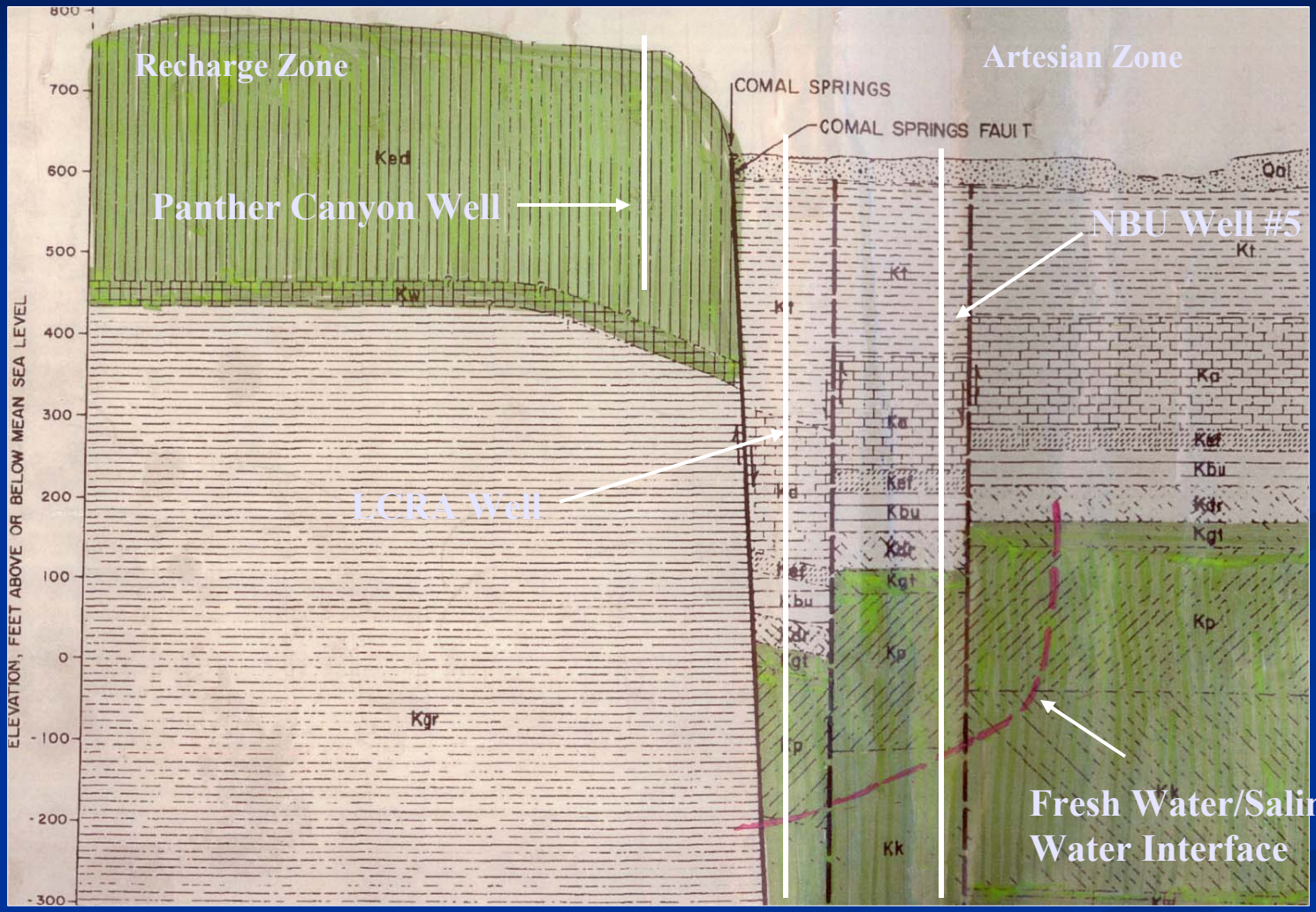
Actual Annual Edward Aquifer Withdrawal (from wells)



Tracer Test Sampling Points



Comal Springs Tracer Test

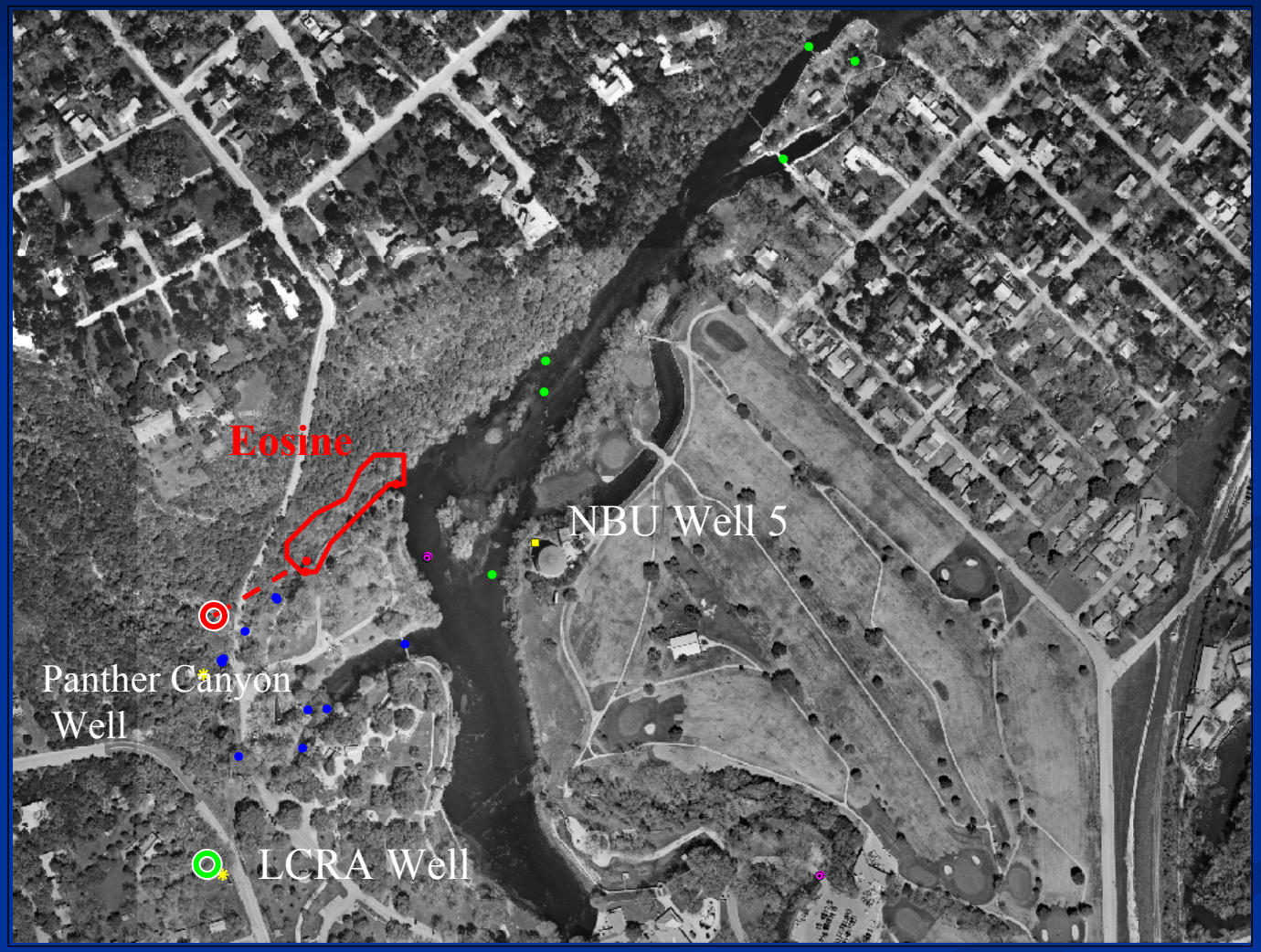


Comal Springs Tracer Test

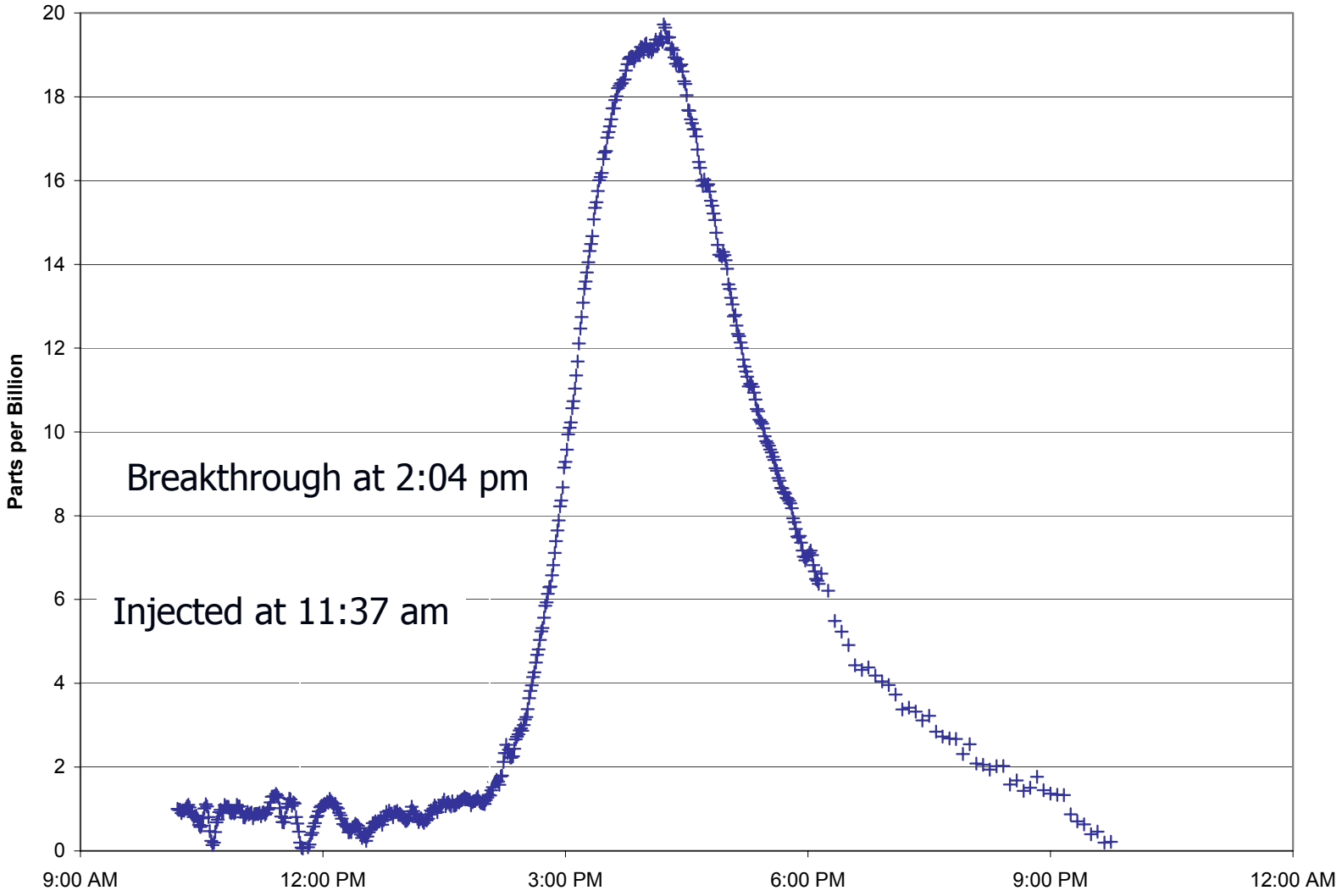
- Two Tracer Tests (Friday, March 22, 2002)
  - Injection of uranine into the LCRA Well located in the artesian zone (11:15 am)
  - Injection of eosine into the Panther Canyon Well located in the recharge zone (11:37 am)

Uranine Dye Injection at LCRA Well Located in the Artesian Zone

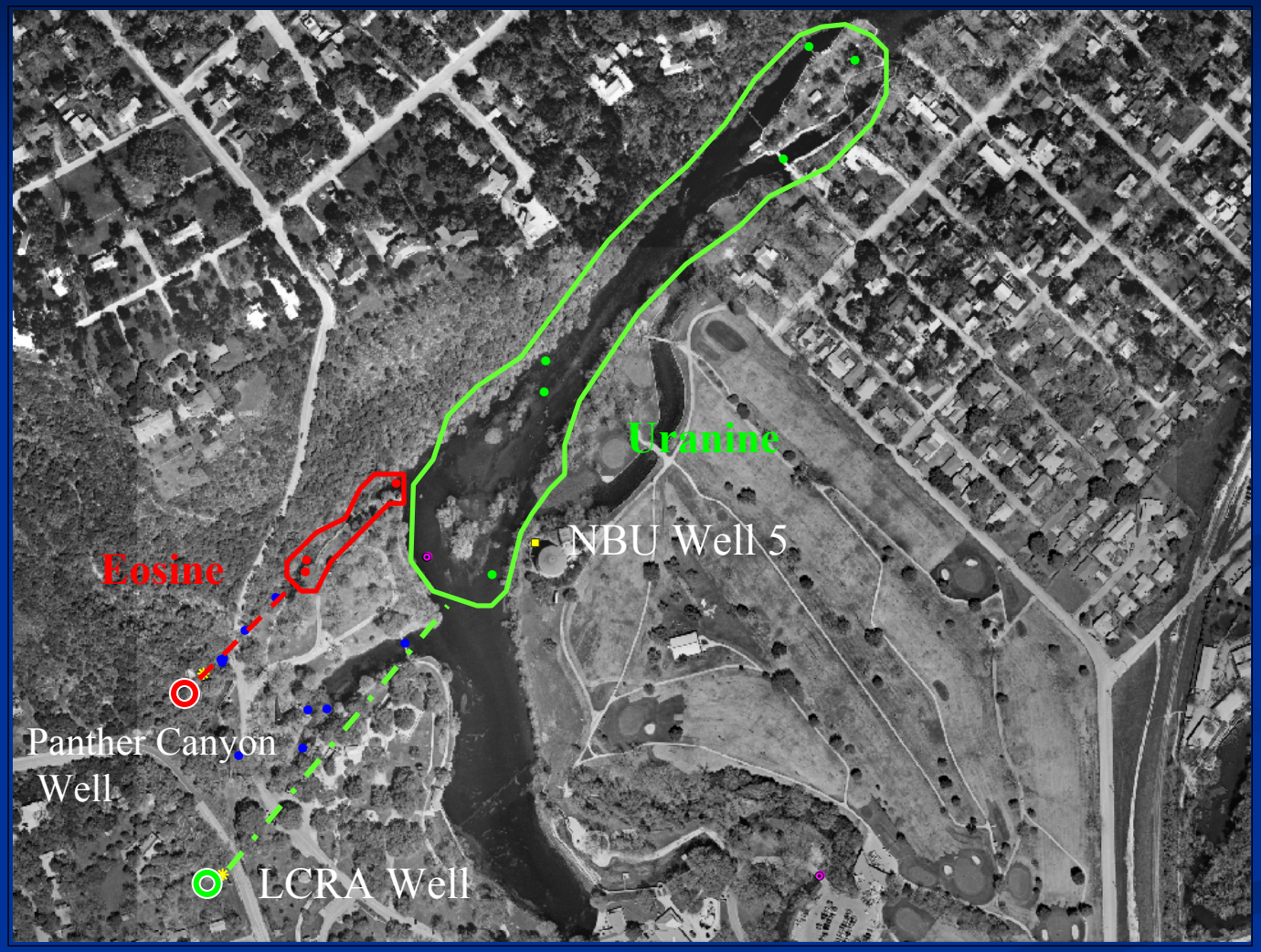
Eosine Tracer Test Results in the Landa Park Area



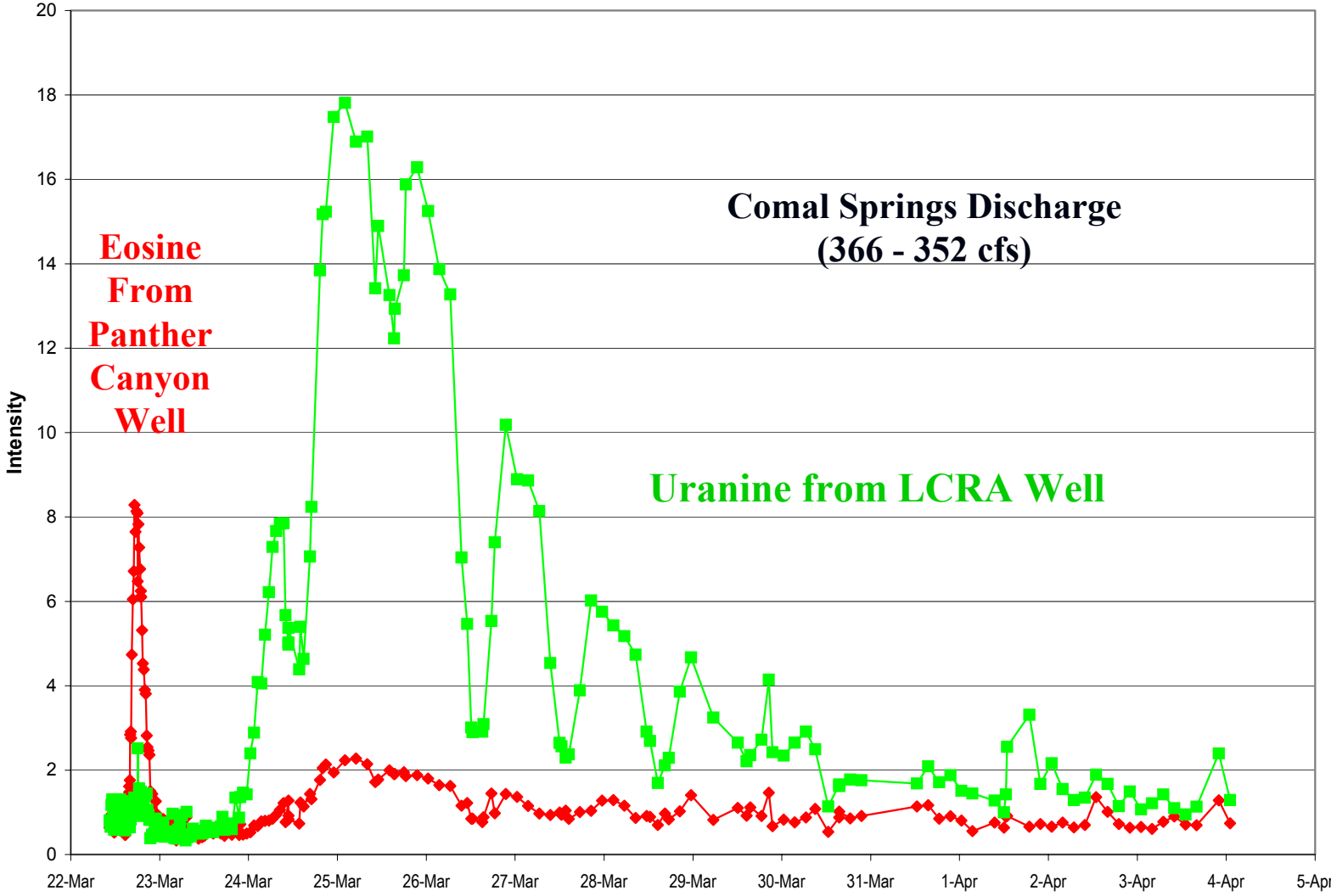
Eosine Breakthrough Curve on Filter Fluorometer at Spring Run #3
Sample collection interval - 15 seconds



Uranine Tracer Test Results in the Landa Park Area

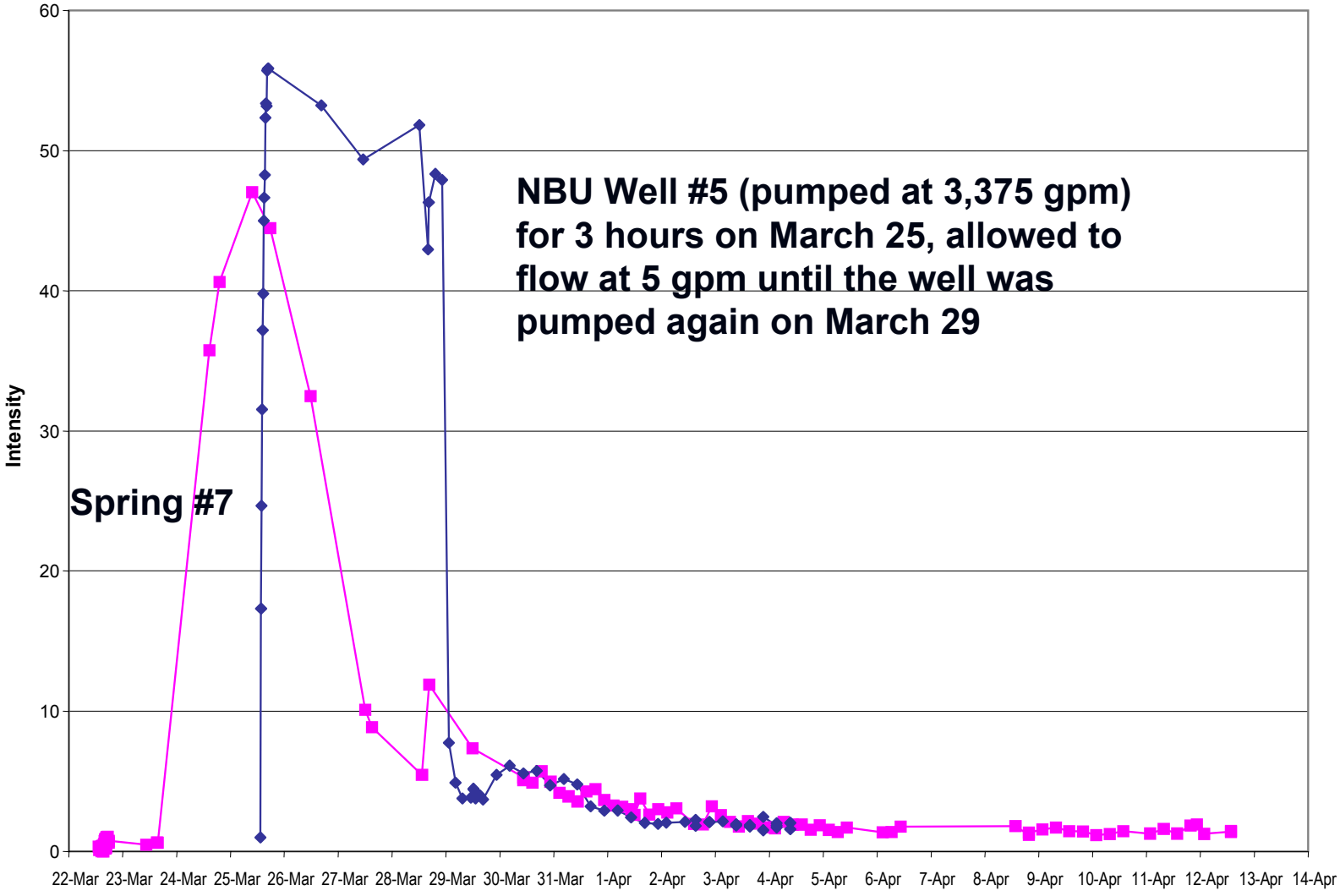


Breakthrough Curves at Landa Lake Outlet



Uranine results indicate photodegradation of dye as it crosses Landa Lake

Uranine Results from LCRA Well



Comal Springs Tracer Test

- Eosine was injected into the Panther Canyon Well at 11:37 am on March 22, recovered in Spring Run #3 starting at 2:00 pm, reached its peak around 4:00 pm, and was below detection limits after 9:00 pm.
- Eosine was visible in Spring Run #3 for about 2 hours
- Groundwater velocities in the recharge zone Comal Springs area are approximately 6,000 feet per day

Comal Springs Tracer Test

- Uranine was injected into the LCRA Well at 11:15 am, Friday, March 22,
- Recovered from the New Channel Outflow around 10:00 pm on Saturday, March 23.
- Dye was also detected in springs on fault plane in the middle of Landa Lake
- Uranine was also detected in NBU Well #5 during pumping test on Monday, March 25
- Groundwater time-of-travel from the LCRA well to Landa Lake was 36 hours. Distance ranges from 1,000 to 3,000 feet.
- Groundwater velocities are estimated at 2,000 feet per day in the deep artesian zone in the Comal Springs area.
- All uranine results were below visual range

Darcy's Law is the governing equation for groundwater flow in porous media equivalent aquifers

Is Darcy's Law valid for the Comal Springs area of the Edwards Aquifer?

Is the Edwards Aquifer a porous media equivalent aquifer?

This assumption can be tested using the velocity equation derived from Darcy's Law

$$v = Ki/n$$

Estimated Travel Time Using

Velocity Equation from Darcy's Law

$$v = Ki/n$$

T = 7,000 ft^2/day from kriging in UT BEG Report # 250

b = 500 feet (thickness of Edwards Limestone)

n = 0.3 porosity from UT BEG Report # 238

i = gradient = 0.01 ft/ft (21.7 feet of head over 2,000 feet)

v= Ki/n = 0.47 feet per day

or 11 year travel time from LCRA Well to Landa Lake

(Actual time of travel from tracer test data was 36 hours)

Darcy's Law is the governing equation for groundwater flow in porous media equivalent aquifers

Is Darcy's Law valid for the Comal Springs area of the Edwards Aquifer?

No

Is the Edwards Aquifer in the Comal Springs area a porous media equivalent aquifer?

No

Estimation of Conduit Size At Comal Springs Using Continuity Equation

$$A = Q/V$$

A = Cross-sectional area in square feet

Q = Discharge in cubic feet second (360 cfs)

(50% of discharge from artesian zone)

(50% of discharge from recharge zone)

V = Velocity, feet per second

(0.023 ft/sec for artesian zone)

(0.069 ft/sec for recharge zone)

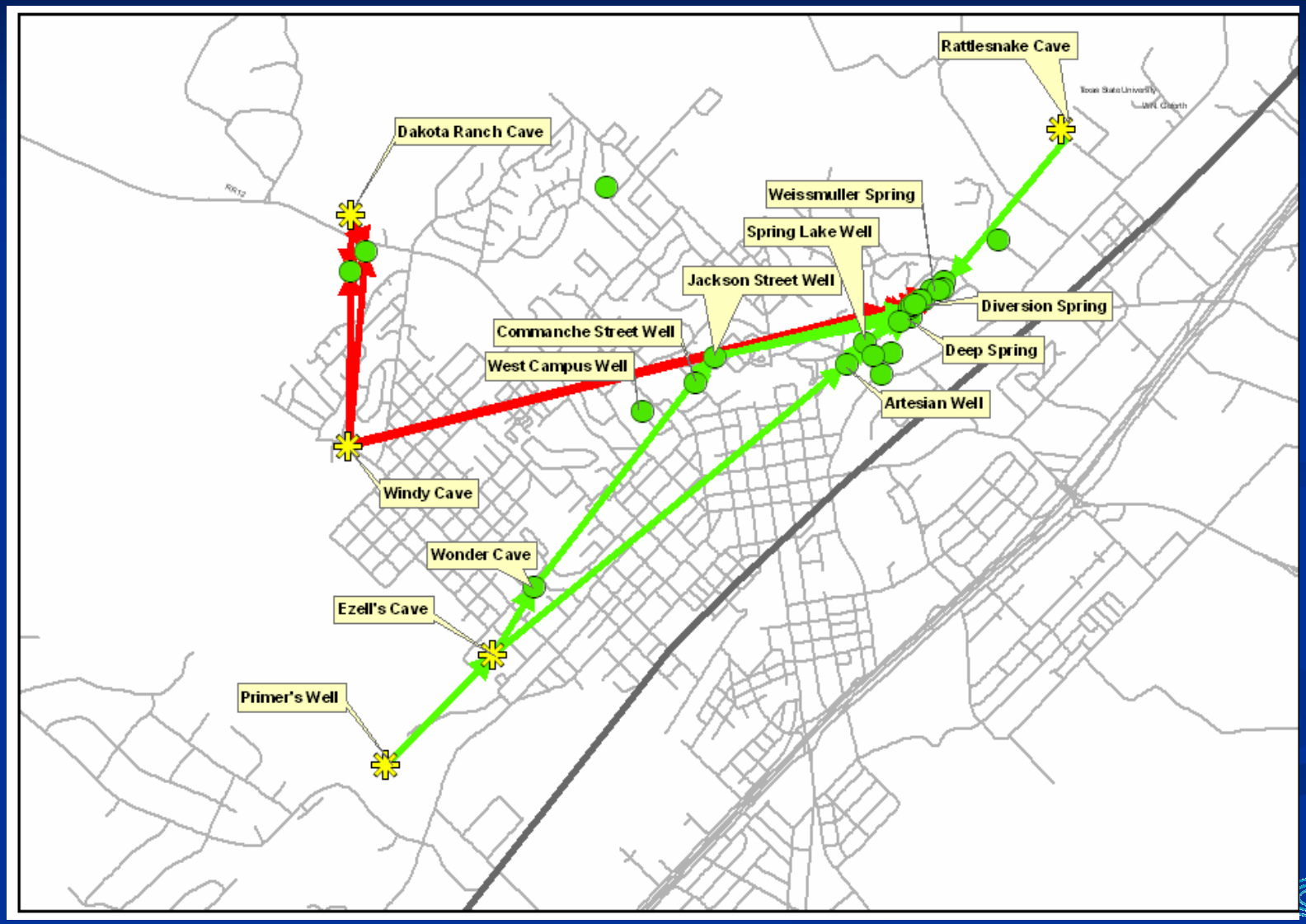
Comal Springs Tracer Test

	Artesian Zone	Recharge Zone
Area of Conduits	**7,826 ft^2**	**2,608 ft^2**
Number of Conduits	**Diameter**	**Diameter**
1	**100 feet***	**57 feet***
10	**30 feet**	**18 feet**
100	**10 feet**	**6 feet**

*** = Assumes conduit is circular**

Edwards Aquifer

San Marcos Springs Tracing



Questions