Texas Water Development Board

Marathon Aquifer Groundwater Availability Model

Stakeholder Advisory Forum #1

January 14, 2025

Marathon, Texas

DBS&A Daniel B. Stephens & Associates, Inc. a Geo-Logic Company

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Meeting Information

- A pdf file of the PowerPoint presentation and documentation of questions and answers will be made available on the project's TWDB webpage

- https://www.twdb.texas.gov/groundwater/models/gam/mrtn/mrtn.asp

Why Stakeholder Advisory Forums?

Keep stakeholders updated about progress of the modeling project

Inform how the groundwater model can, should, and should not be used

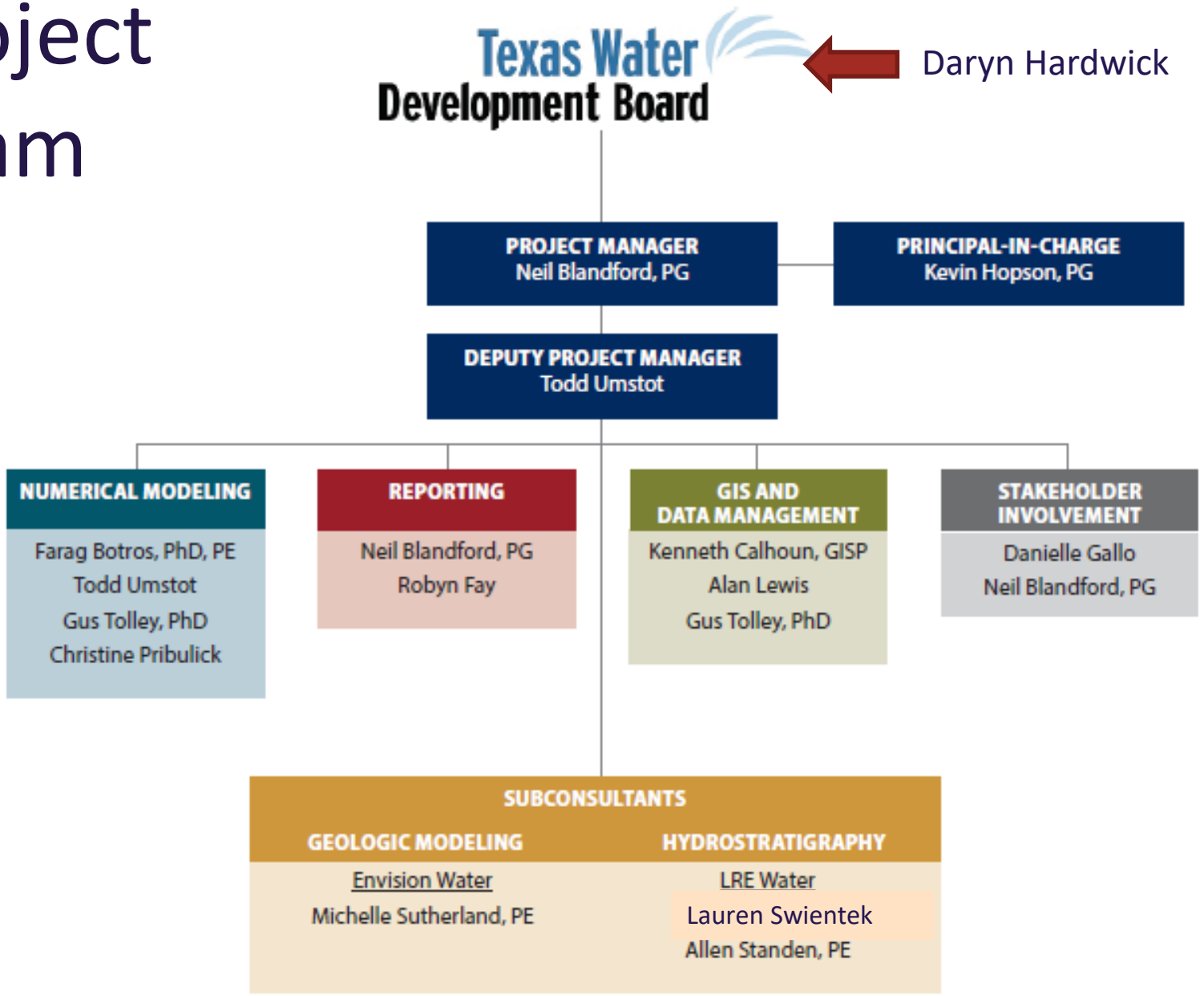
Provide stakeholders with the opportunity to provide input and data to assist with model development

Texas Water Development Board

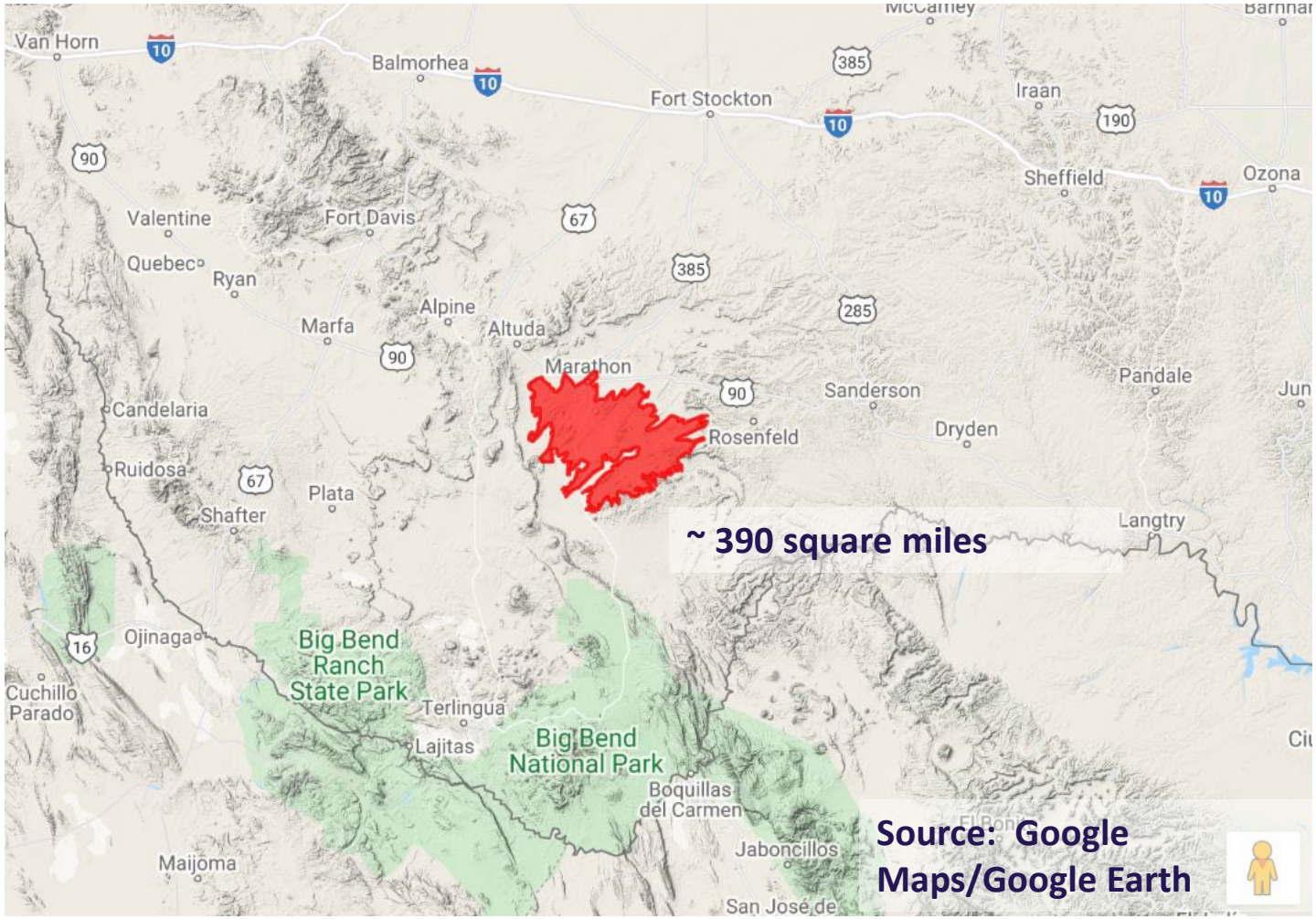
Agenda

1. Marathon Aquifer Conceptual Model review
2. Planned approach for developing the numerical groundwater availability model (GAM)
3. Project Schedule
4. Questions and Answers

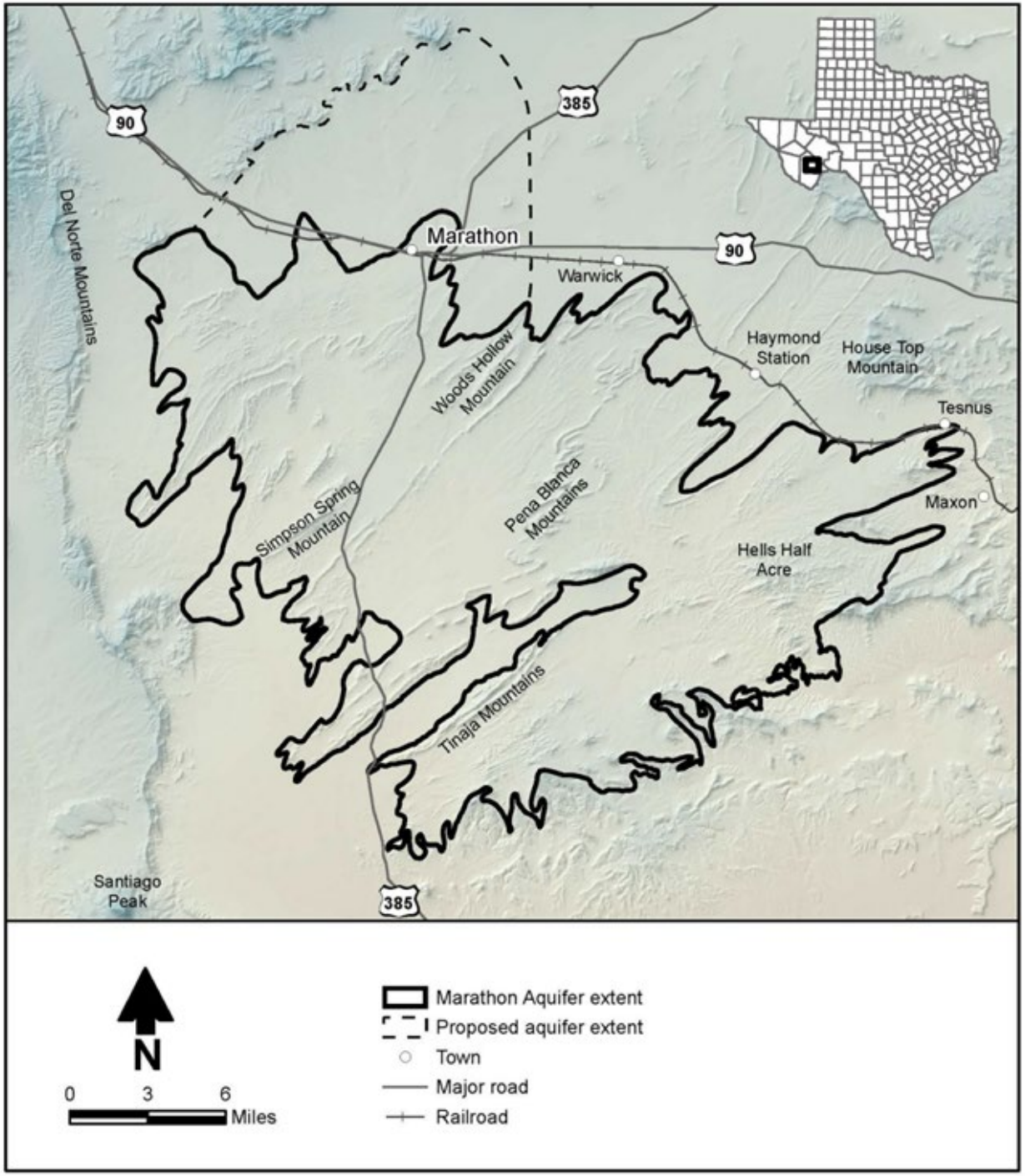
Project Team



Marathon Aquifer



Note: This slide was not included in the presentation, but was added for geographic context at Stakeholder request

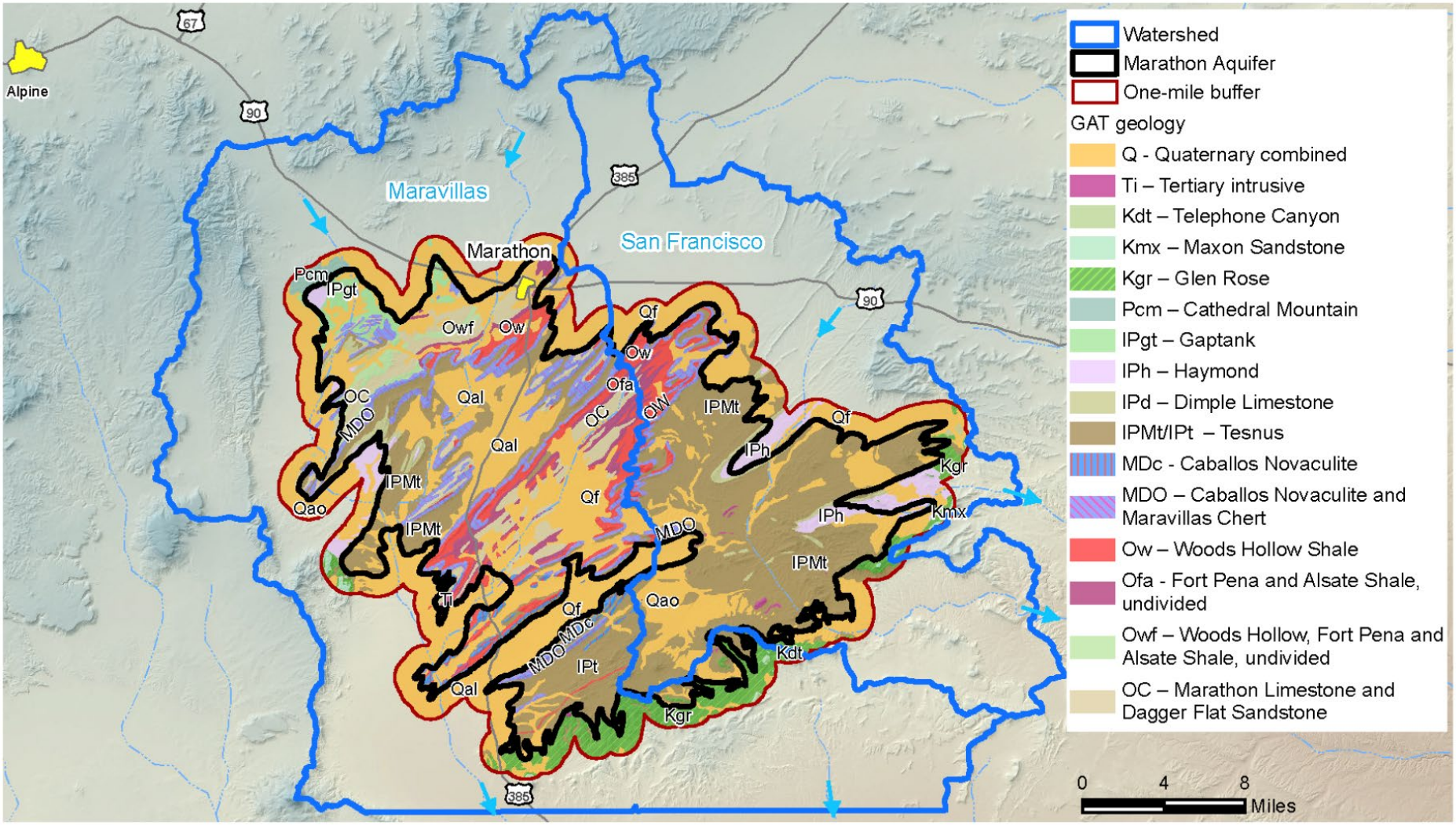


Project Objectives

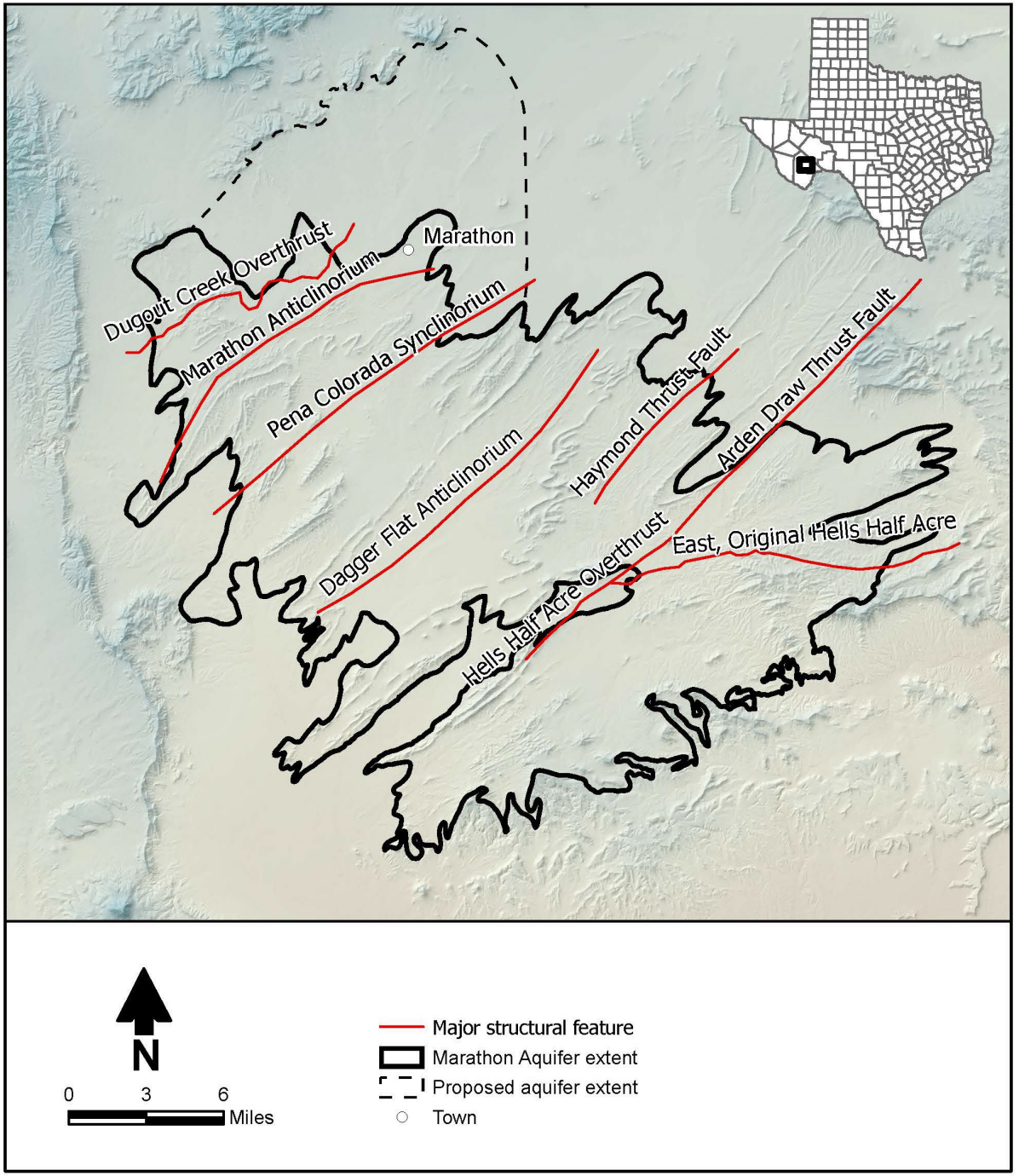
- Develop a numerical groundwater flow model of the Marathon Aquifer consistent with observed data
- Model can be used to:
  - Develop estimates of modeled available groundwater
  - Provide an aquifer water balance
  - Develop estimates of total estimated recoverable storage

Geology and Hydrostratigraphic Units

Study Area and Surface Geology



Main Structural Features in the Marathon Area



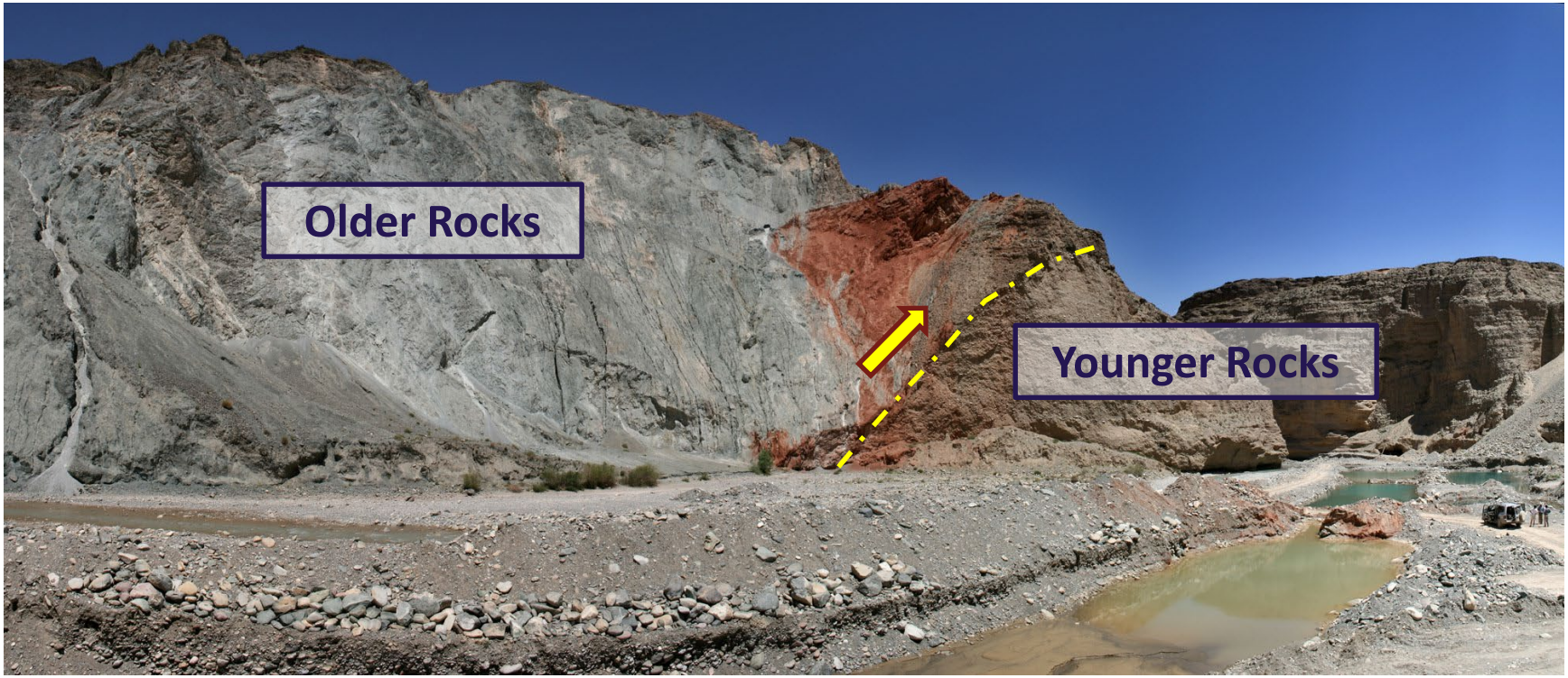
Anticline

photo by Neil Blandford

Syncline

photo by Neil Blandford

Overthrust Fault

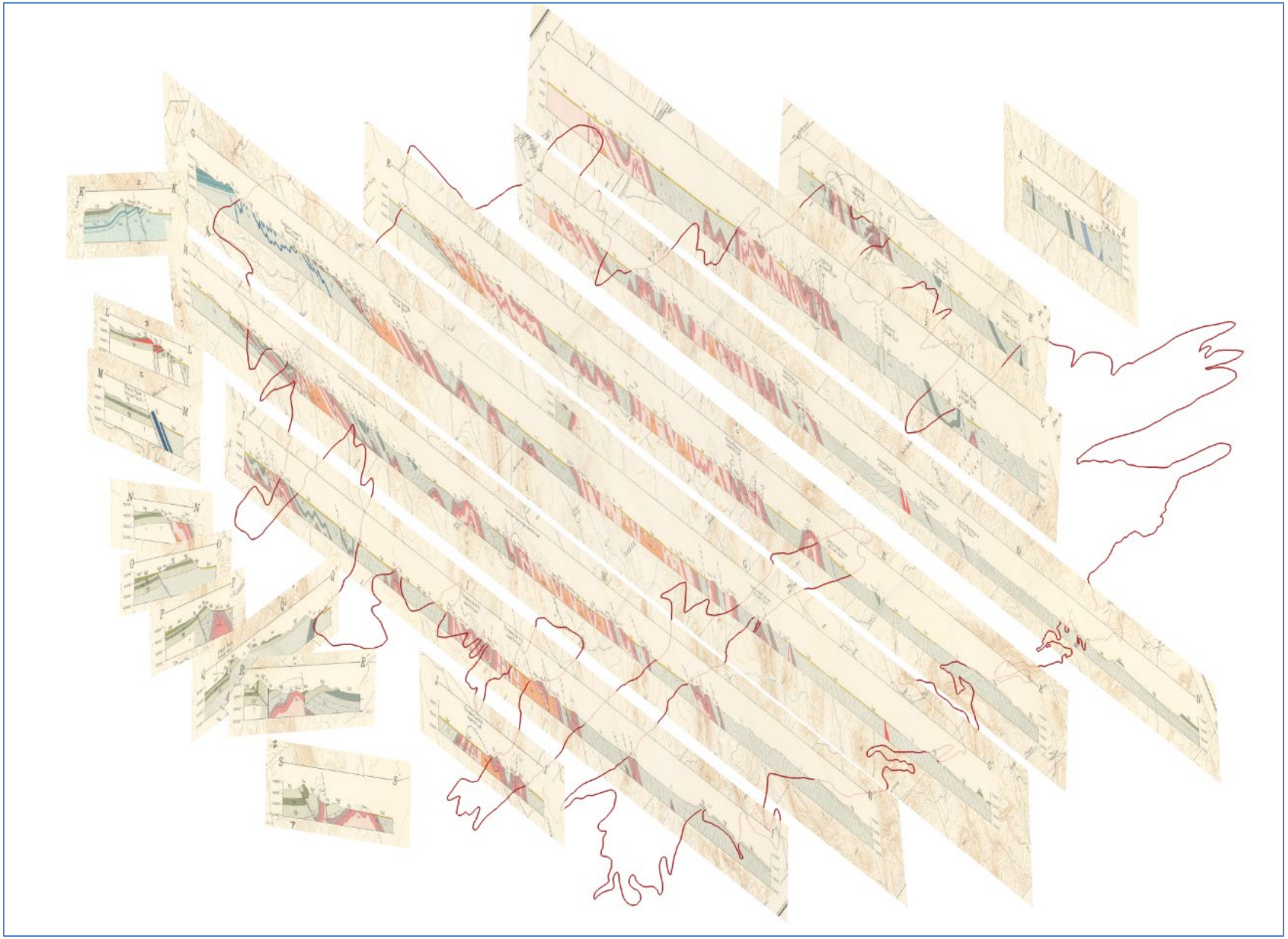


Source: https://en.wikipedia.org/wiki/Thrust_fault

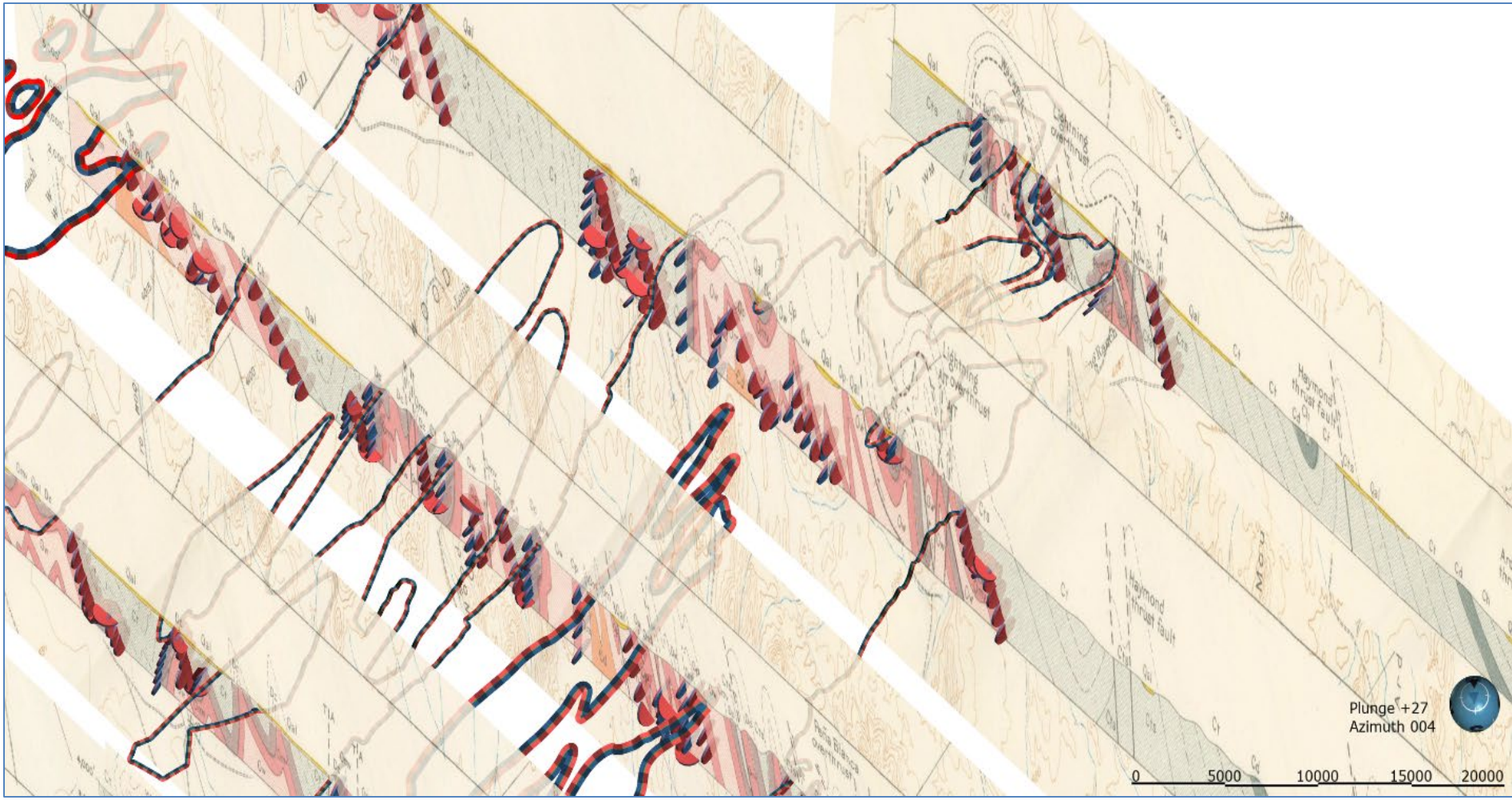
Geologic Column and Hydrostrati-graphic Designations

Period and Series	Model Layer	Predominant Hydrogeologic Character	Formation/ Geologic Unit	Primary Lithology
Quaternary	1	Aquifer	Alluvial types	Gravel, sand, silt, clay
Tertiary	2	Aquitard	Volcanic intrusives	Volcanic, intrusive rocks
Cretaceous, Lower Trinity	3a	Aquitard – not saturated in study area	Del Carmen and Telephone Canyon	Limestones, chert, and shales
			Maxon Sandstone	Sandstone and marl
			Glen Rose	Limestone, marl, chert, conglomerate
Permian, Leonard			Cathedral Mountain	Shale, limestone, and pebble conglomerate
			Skinner Ranch and Hess Limestone	Limestone and pebble conglomerate
Permian, Wolfcamp			Lenox Hills	Conglomerate, shale, and limestone
Upper to Lower, Pennsylvanian	3b	Aquitard	Gaptank	Limestone, sandstone conglomerate
			Haymond	Sandstone, shale, boulder beds
Lower Pennsylvanian to Upper Mississippian	4	Aquifer	Dimple Limestone	Limestone and shale
			Tesnus	Sandstone and shale
Devonian to Upper Ordovician	5	Aquitard	Caballos Novaculite	Novaculite and chert
			Maravillas Chert	Chert conglomerate
			Woods Hollow Shale	Shale
			Fort Pena	Limestone, chert, and shale
			Alsate Shale	Shale, limestone, and sandstone
Lower Ordovician to Upper Cambrian	6	Aquifer	Marathon Limestone	Limestone, sandstone, and conglomerate
			Dagger Flat Sandstone	Sandstone

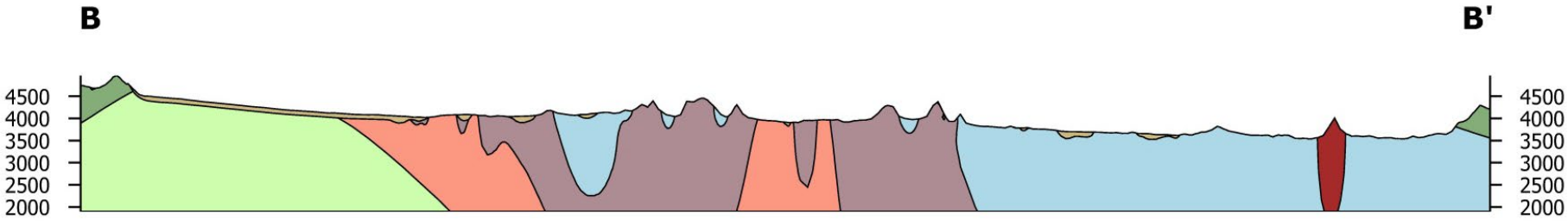
King (1937) Scanned/Georeferenced Cross Sections



King (1937) Cross Sections – Close Up



Leapfrog Section B-B’



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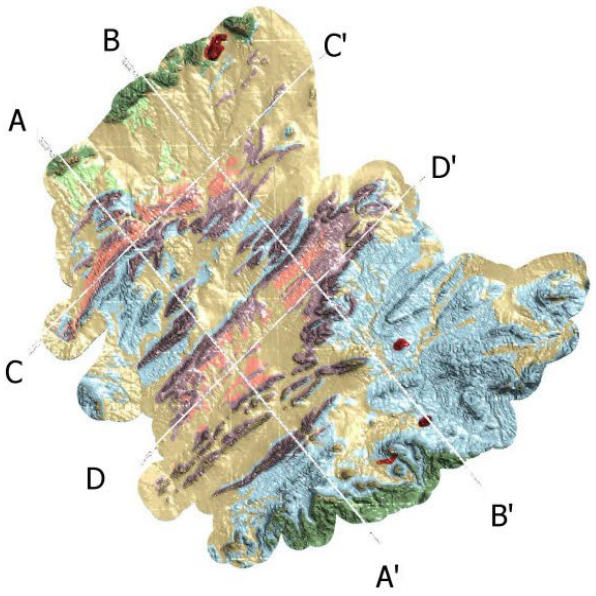
Vertical exaggeration: 5x

0ft 26400ft



Location

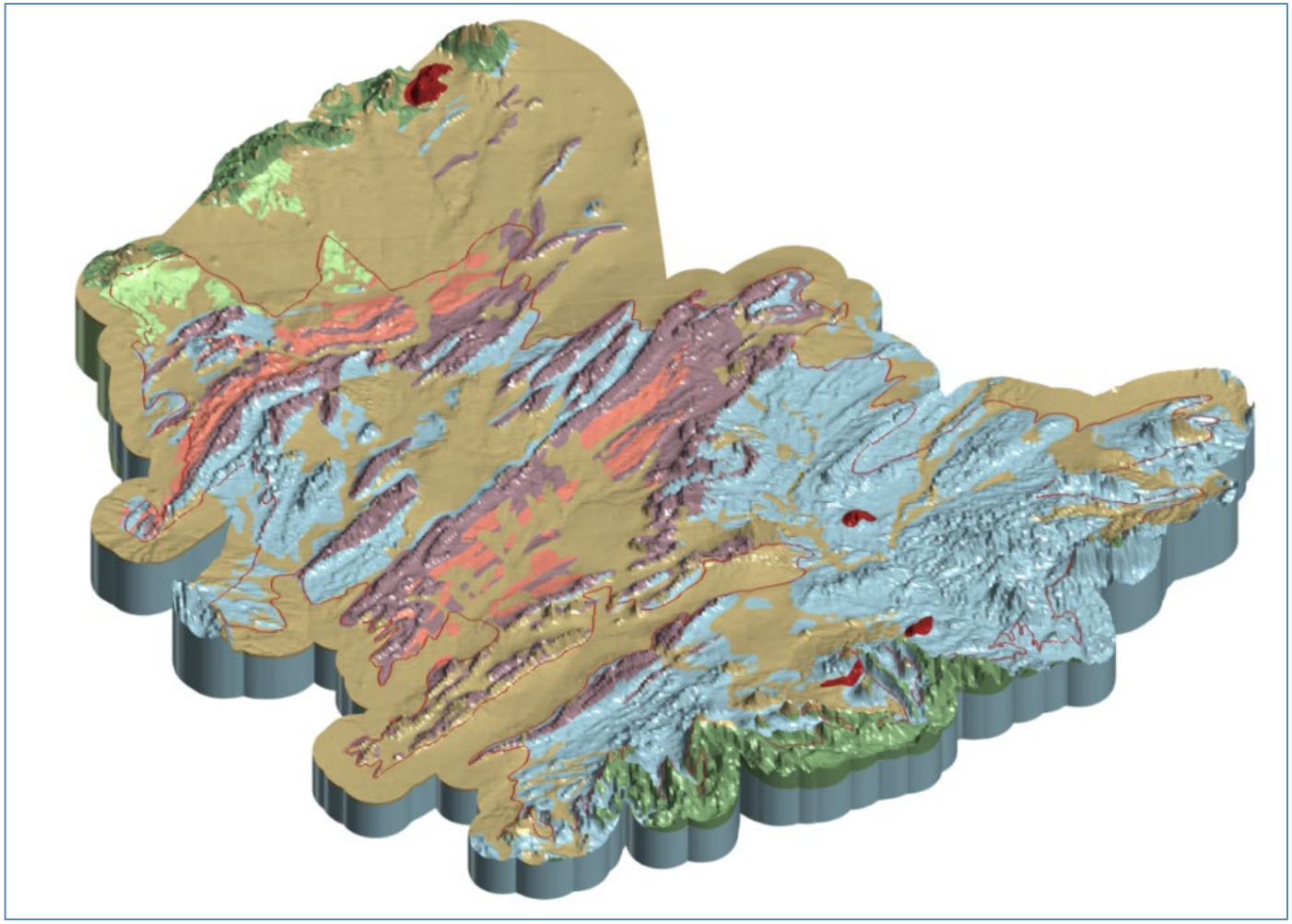
B: 3869802, 19348994

B': 3972983, 19222769

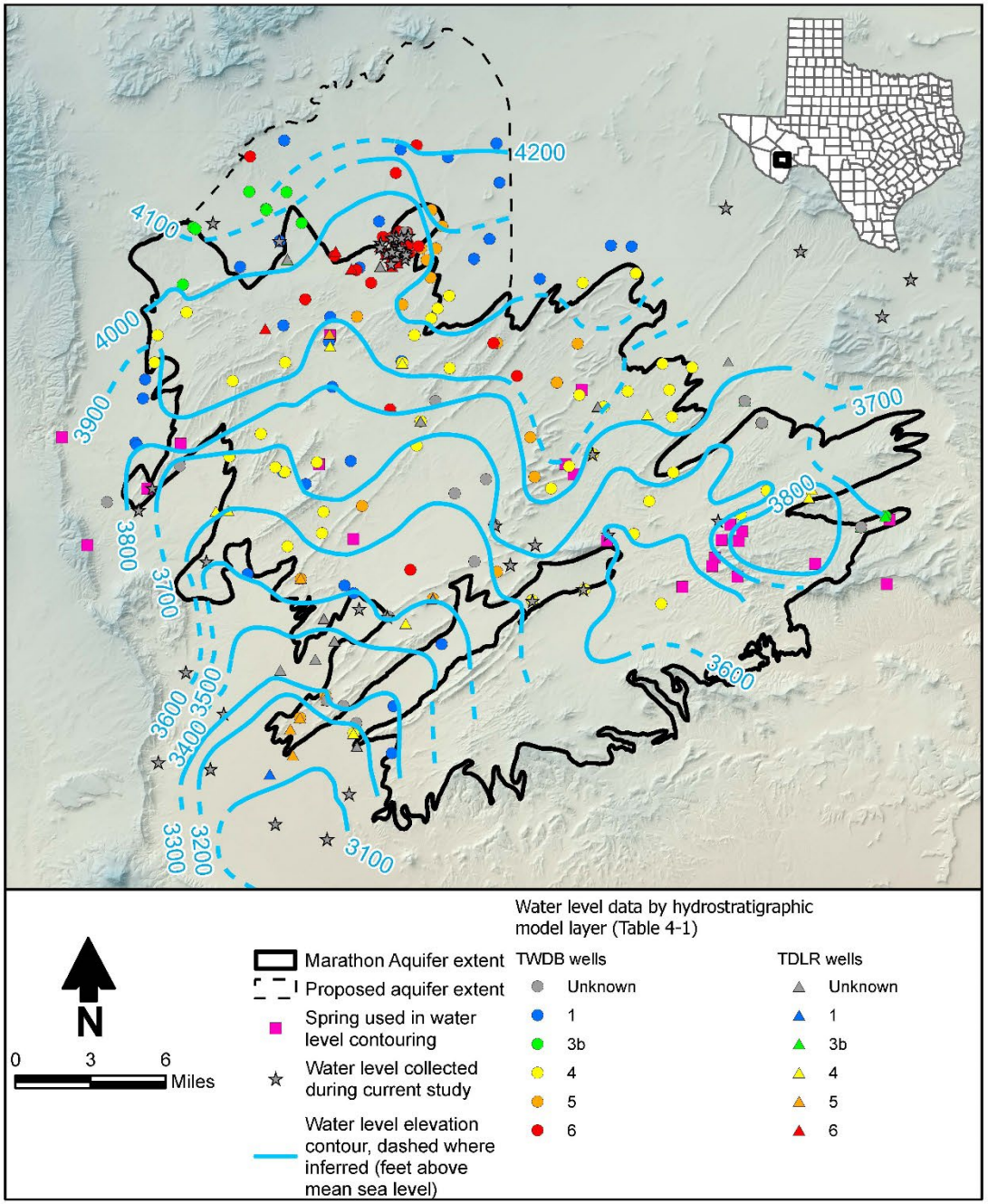
Legend

- 1_Alluvium (Qal)
- 2_Igneous (Ti)
- 3a_Telephone Canyon, Glen Rose, Skinner Ranch, Hess, Lenox Hills (Ke, Kgr, Cw)
- 3b_Gaptank, Haymond (Cg, Ch)
- 4_Dimple, Tensus (Cd, Ct)
- 5_Caballos, Maravillas, Fort Pena, Woods Hollow, Alsate Shale (Dc, Omv, Op, Ow, Oa)
- 6_Marathon and Dagger Flat (Om, -Cd)

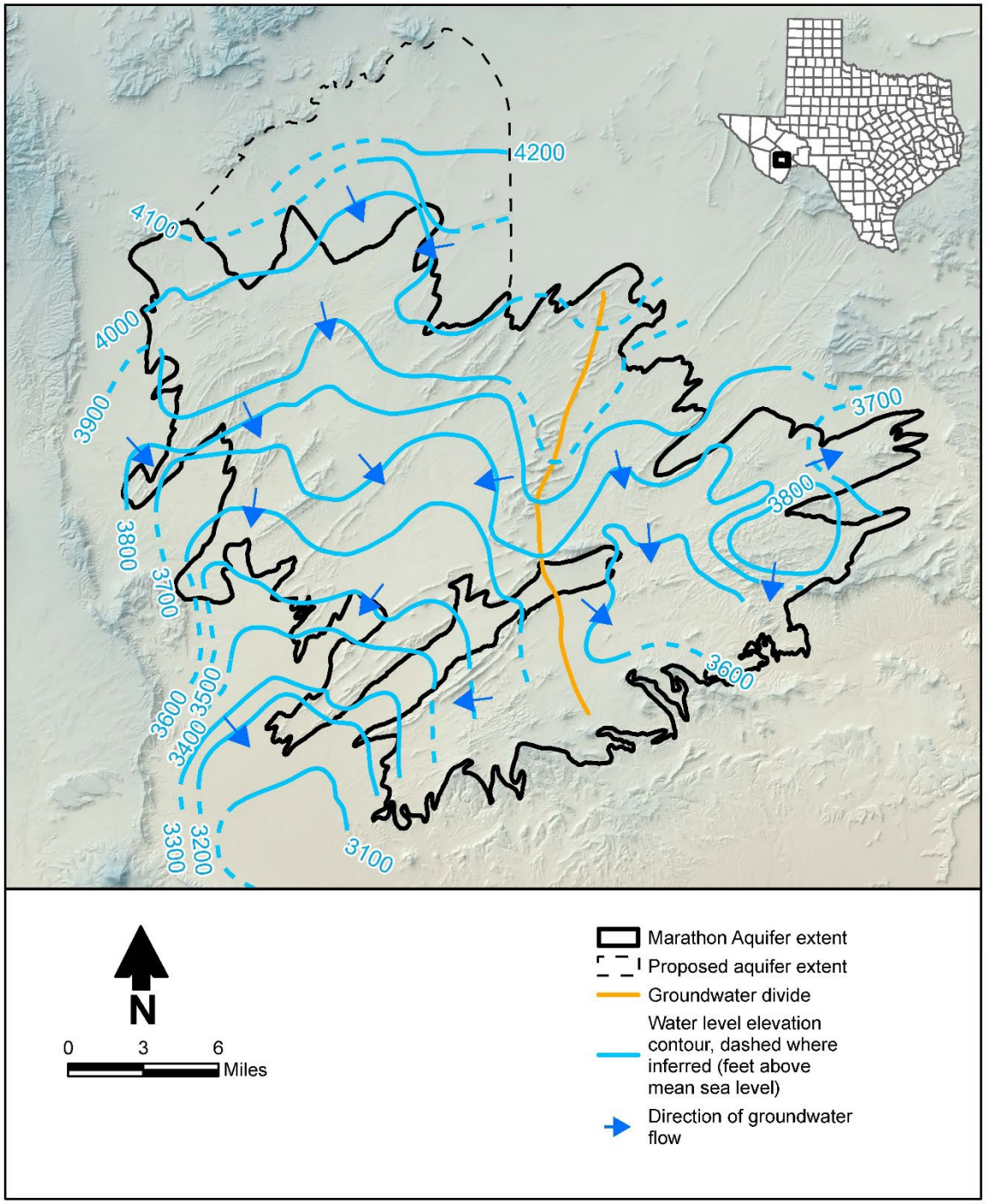
Completed 3-D Geology



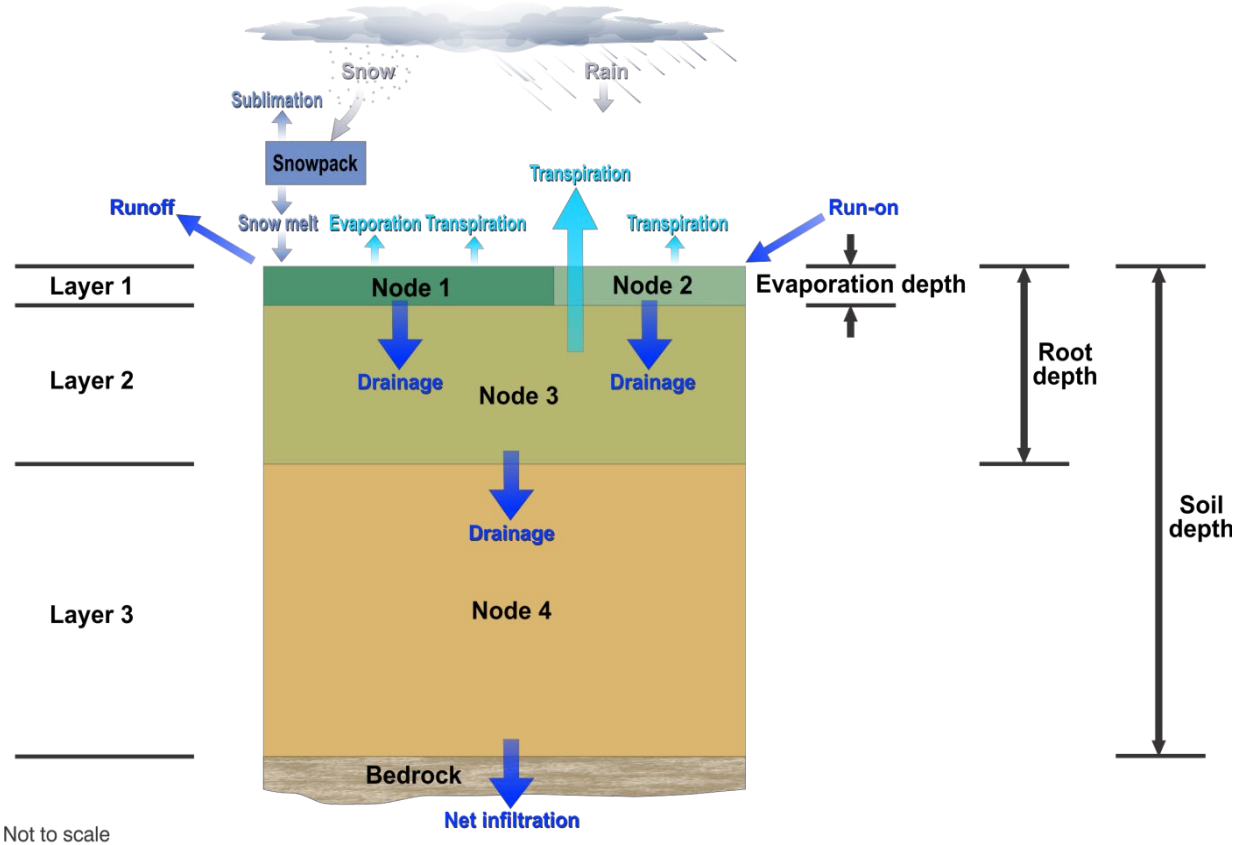
Water Levels



Groundwater Flow Direction



Groundwater Recharge - Distributed Parameter Watershed Model (DPWM)



Not to scale

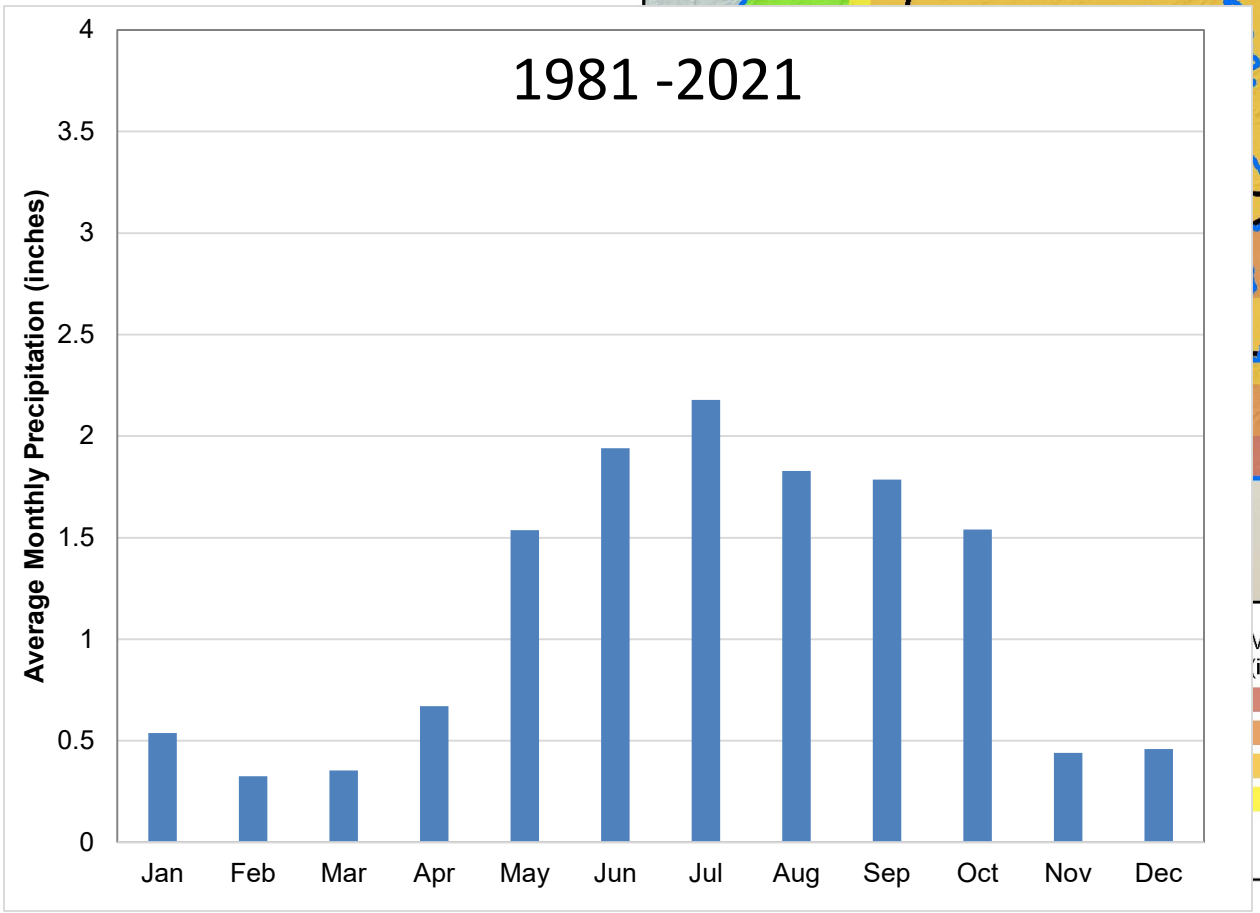
Notes:

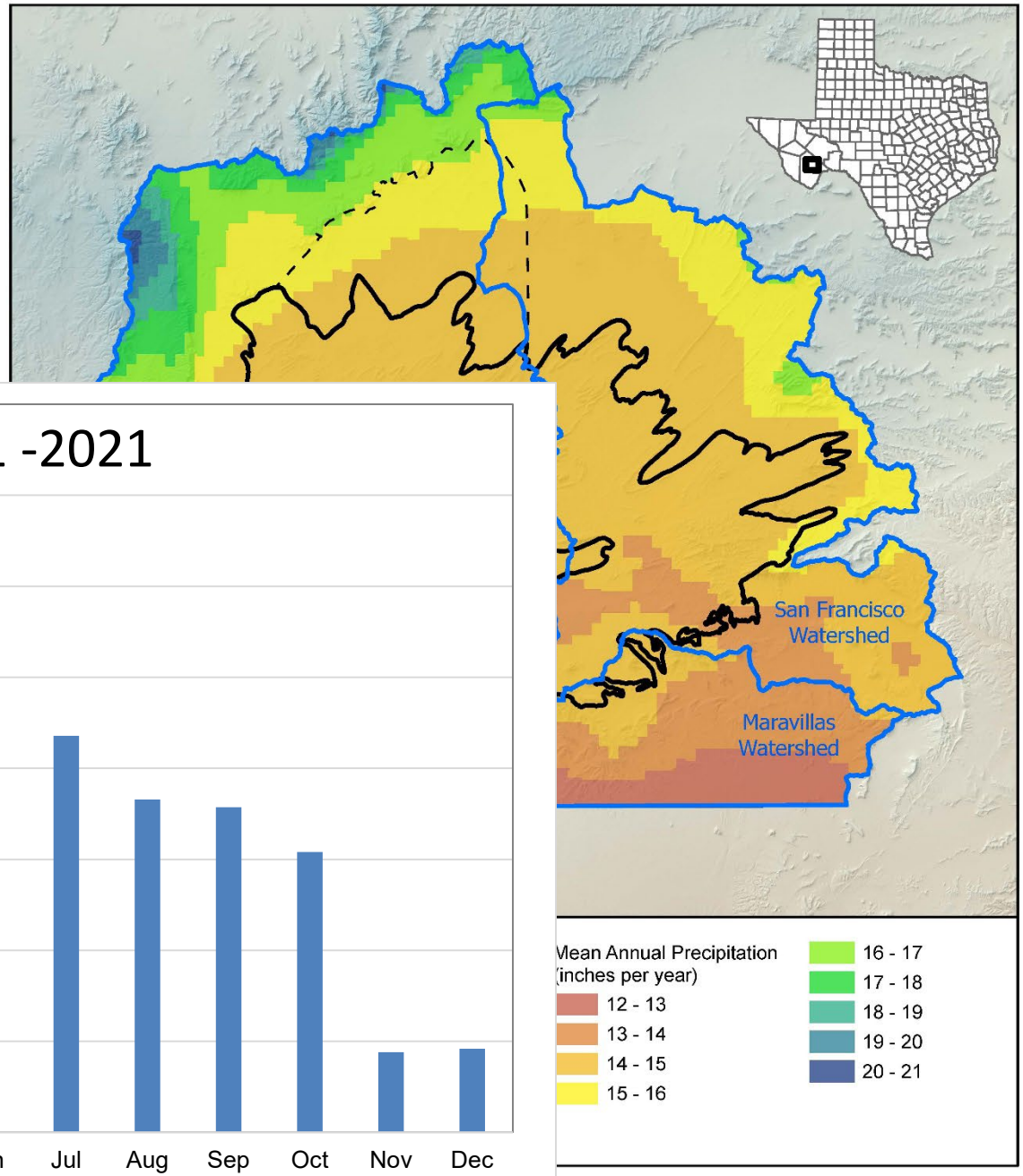
Node 1 = fraction exposed and wetted (f_{ew})

Node 2 = fraction covered by vegetation canopy (f_c)

- Soil water-balance
- Site-specific climate, topography, geology, soils and vegetation
- Daily time step

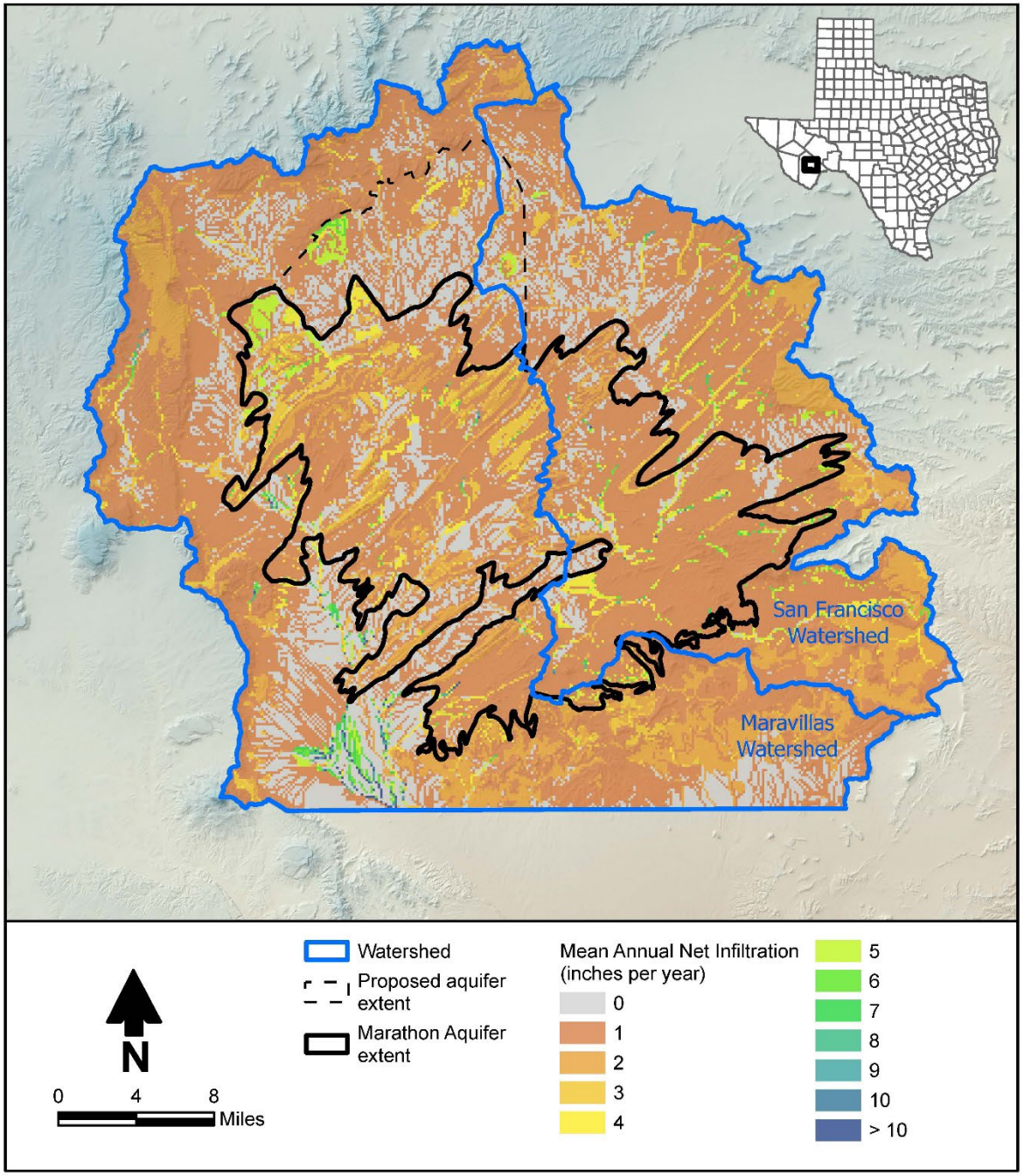
Mean Annual Precipitation



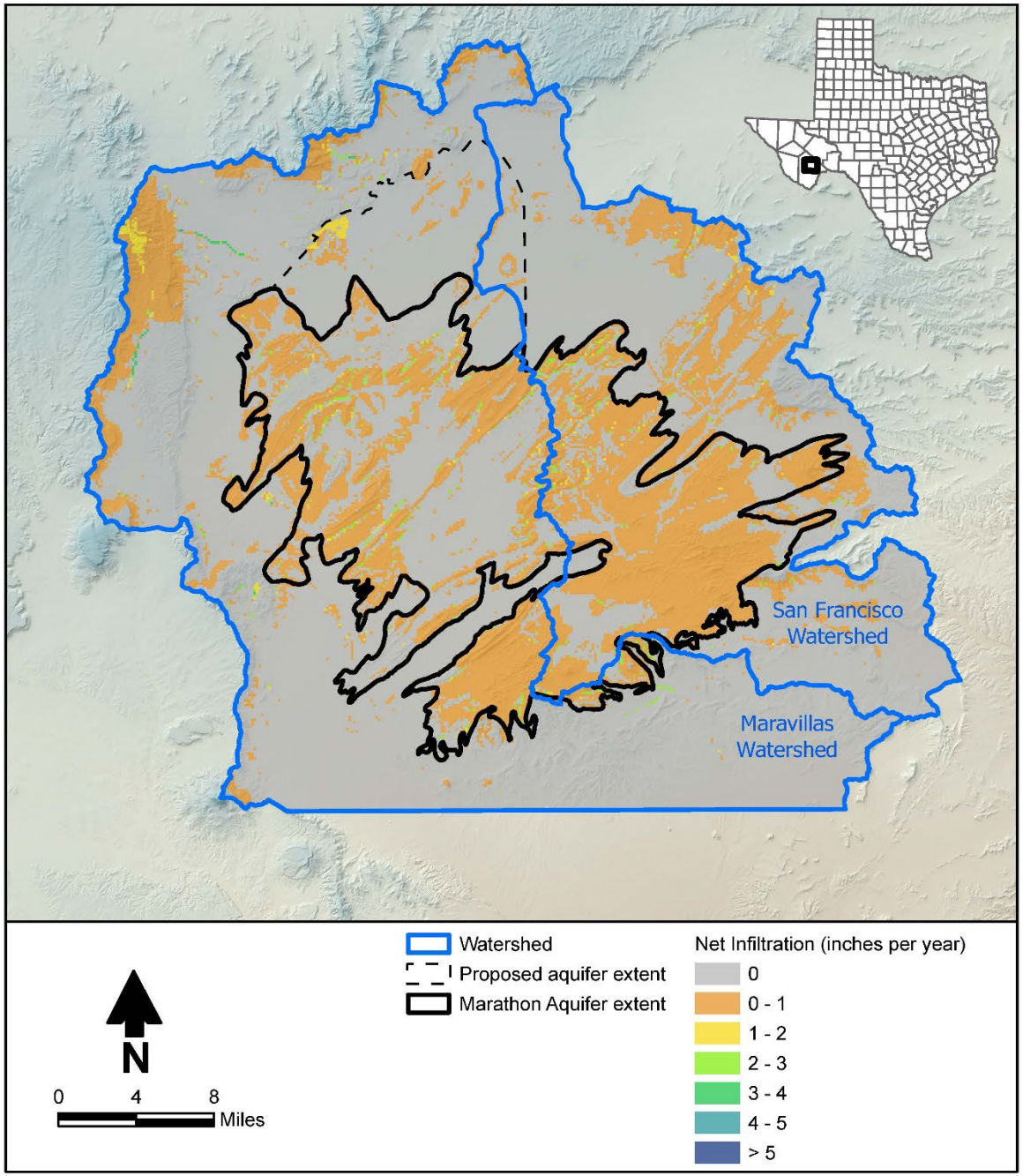


Mean Annual Groundwater Recharge

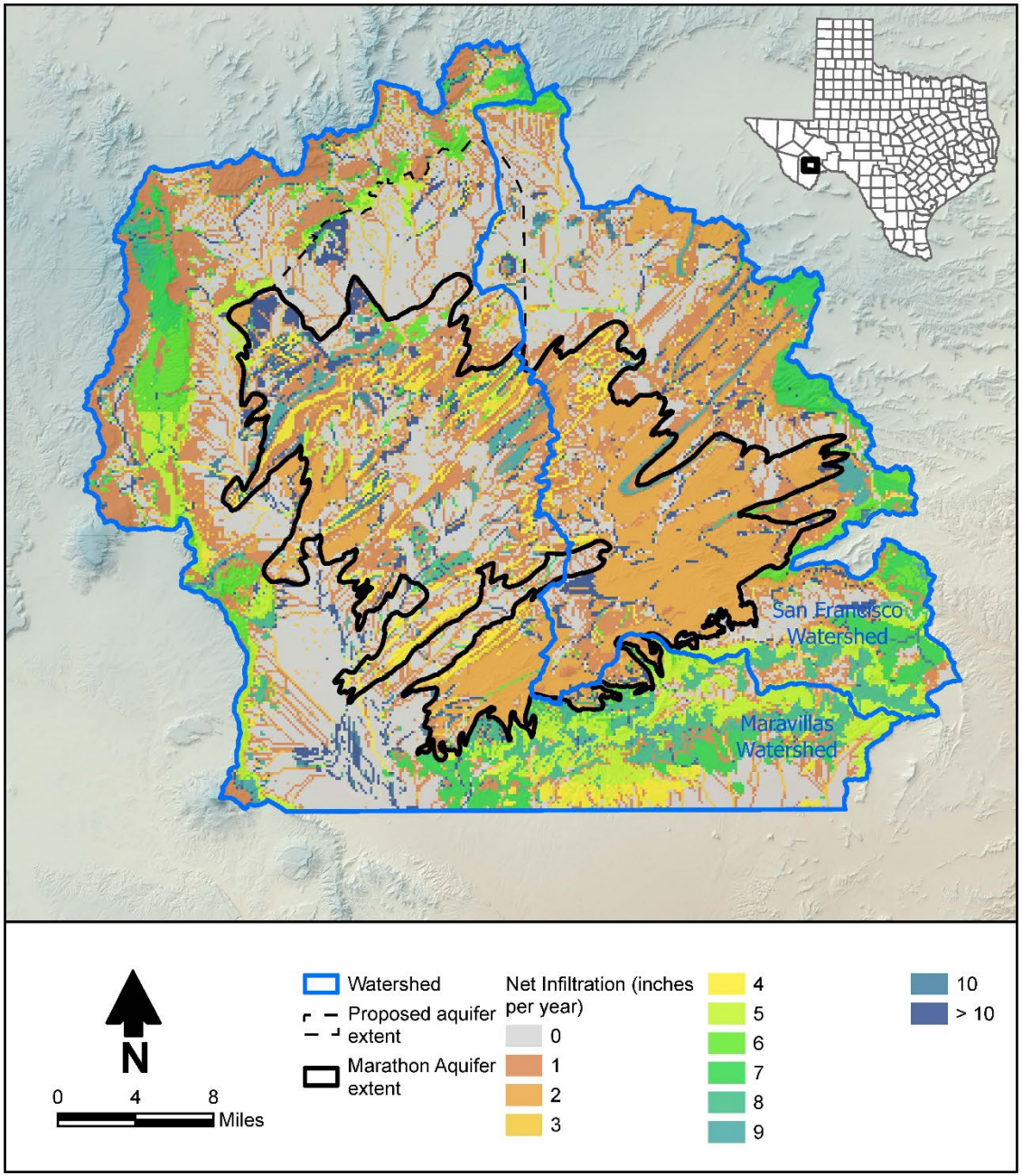
21,284 ac-ft/yr



Dry Year Groundwater Recharge - 2011



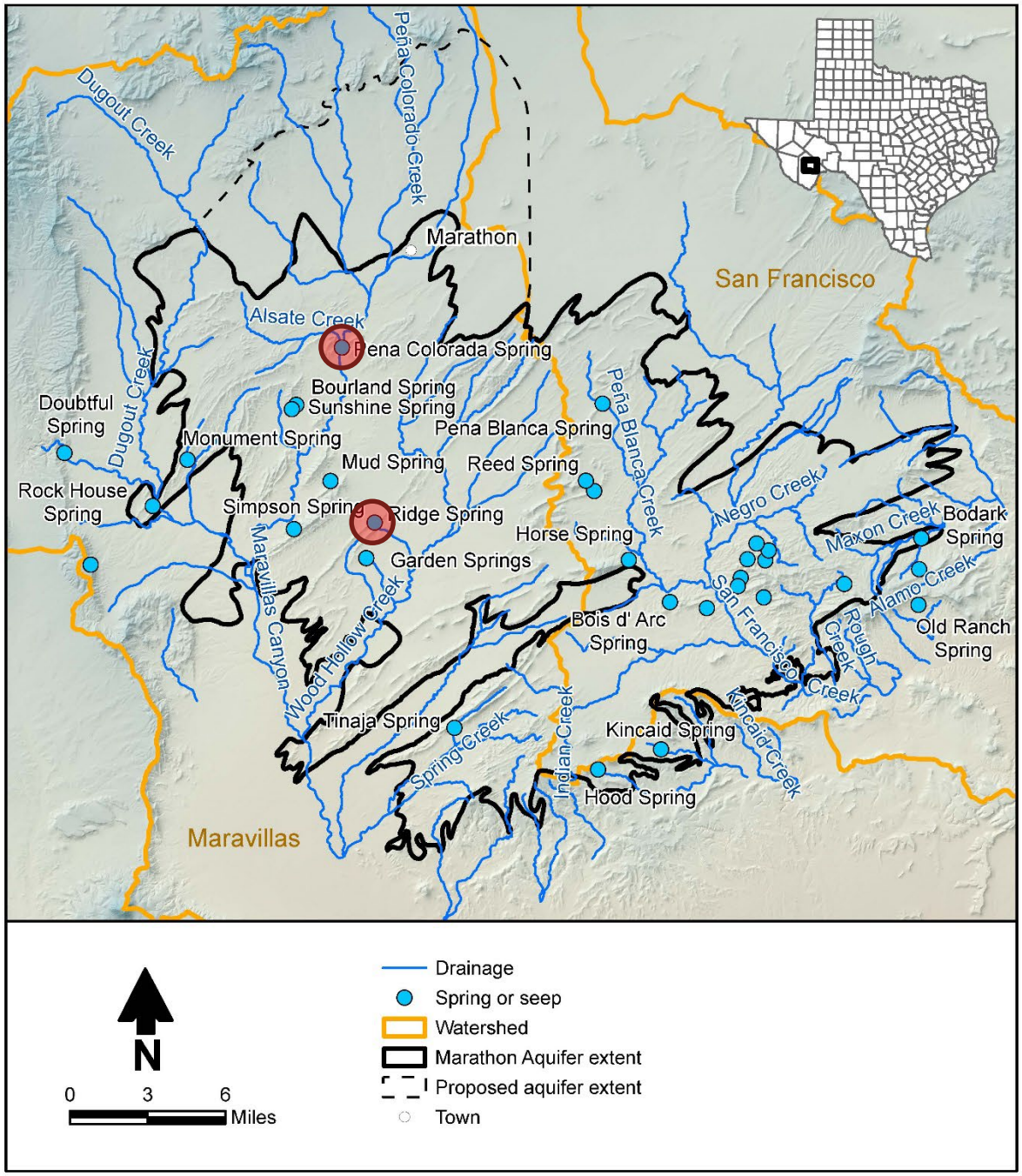
Wet Year Groundwater Recharge - 2004



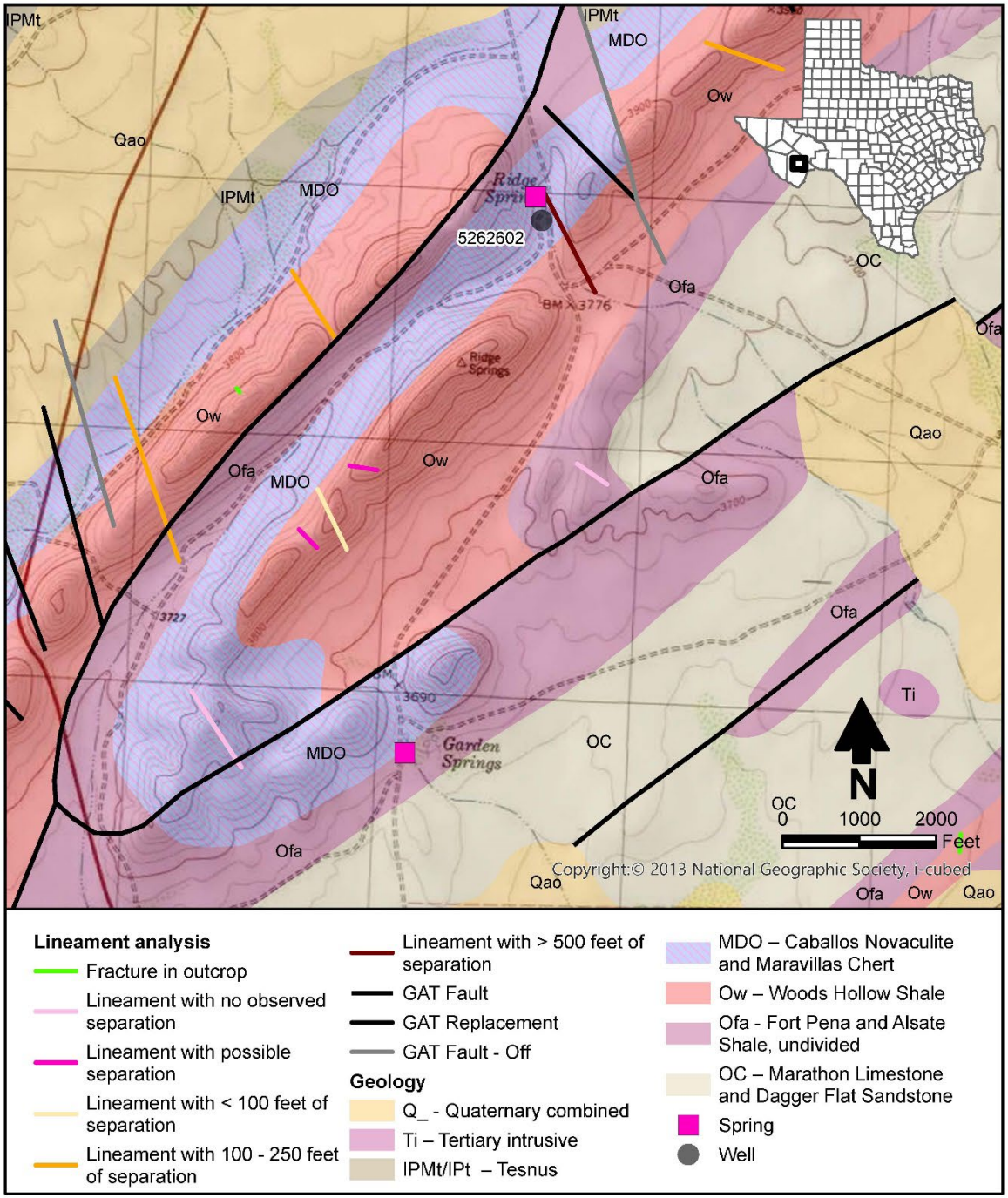

Springs

Drainages and Springs

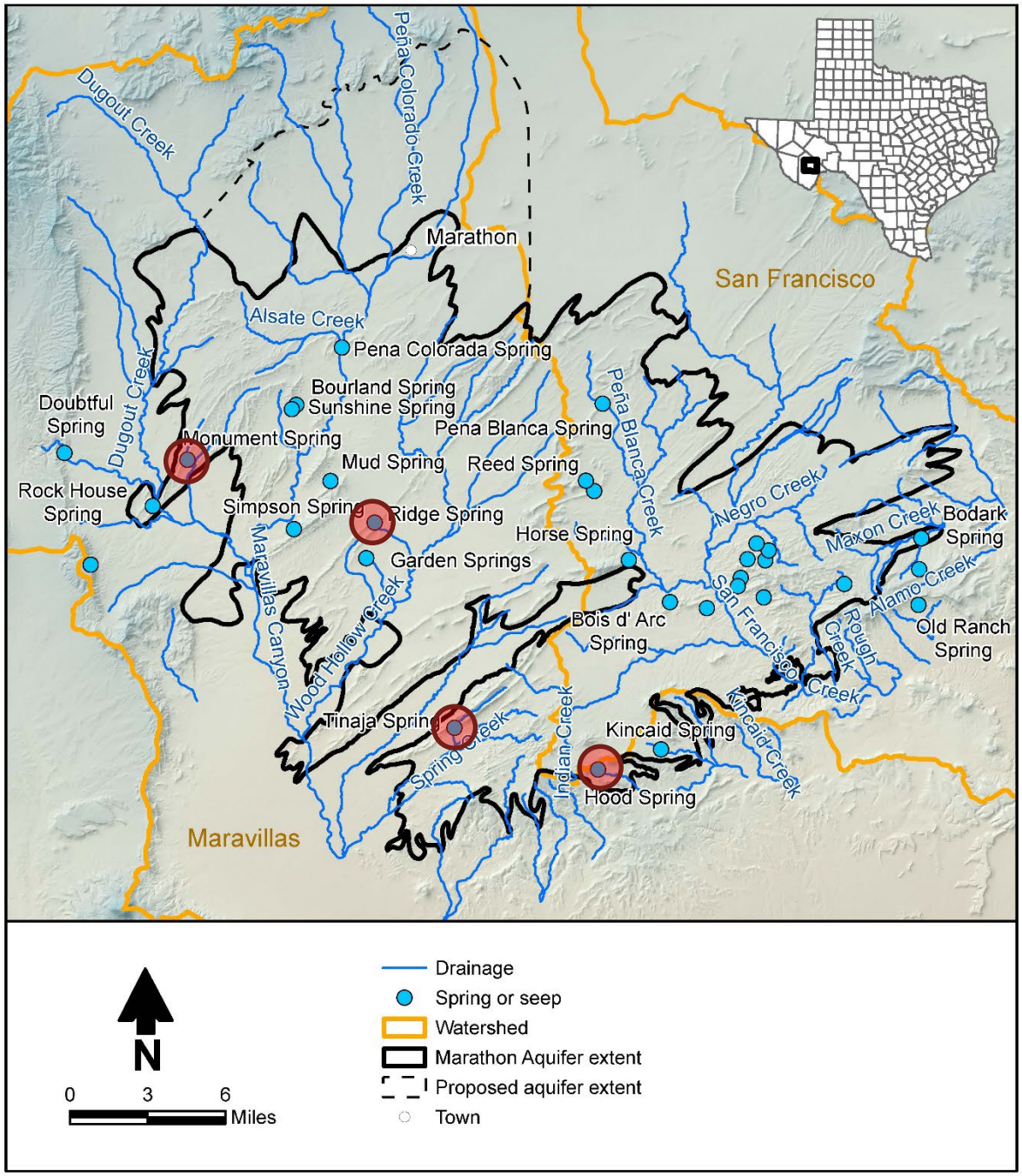
Spring	Flow range (gpm)
Pena Colorada	151-444
Ridge	95-320



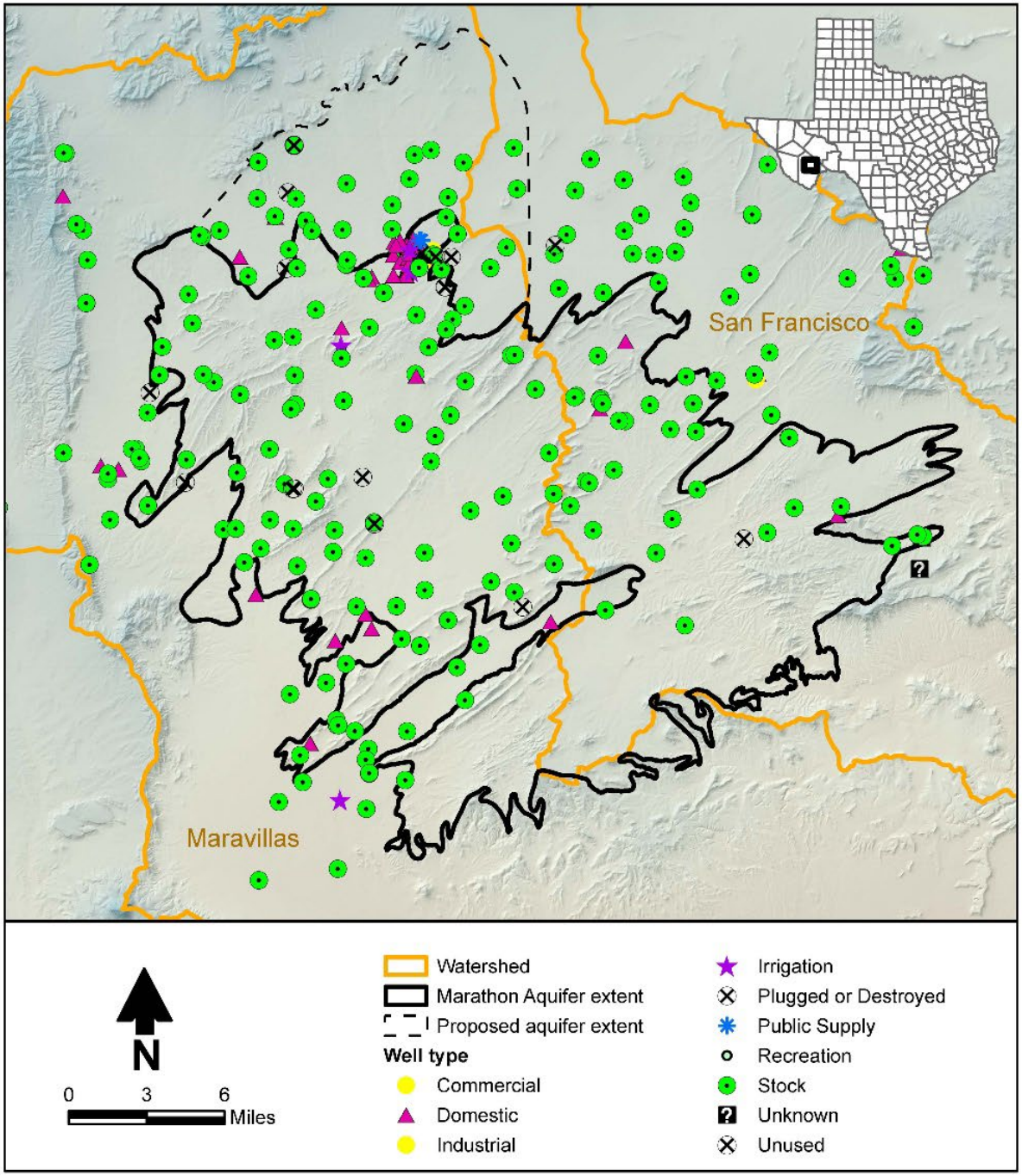
Ridge Spring



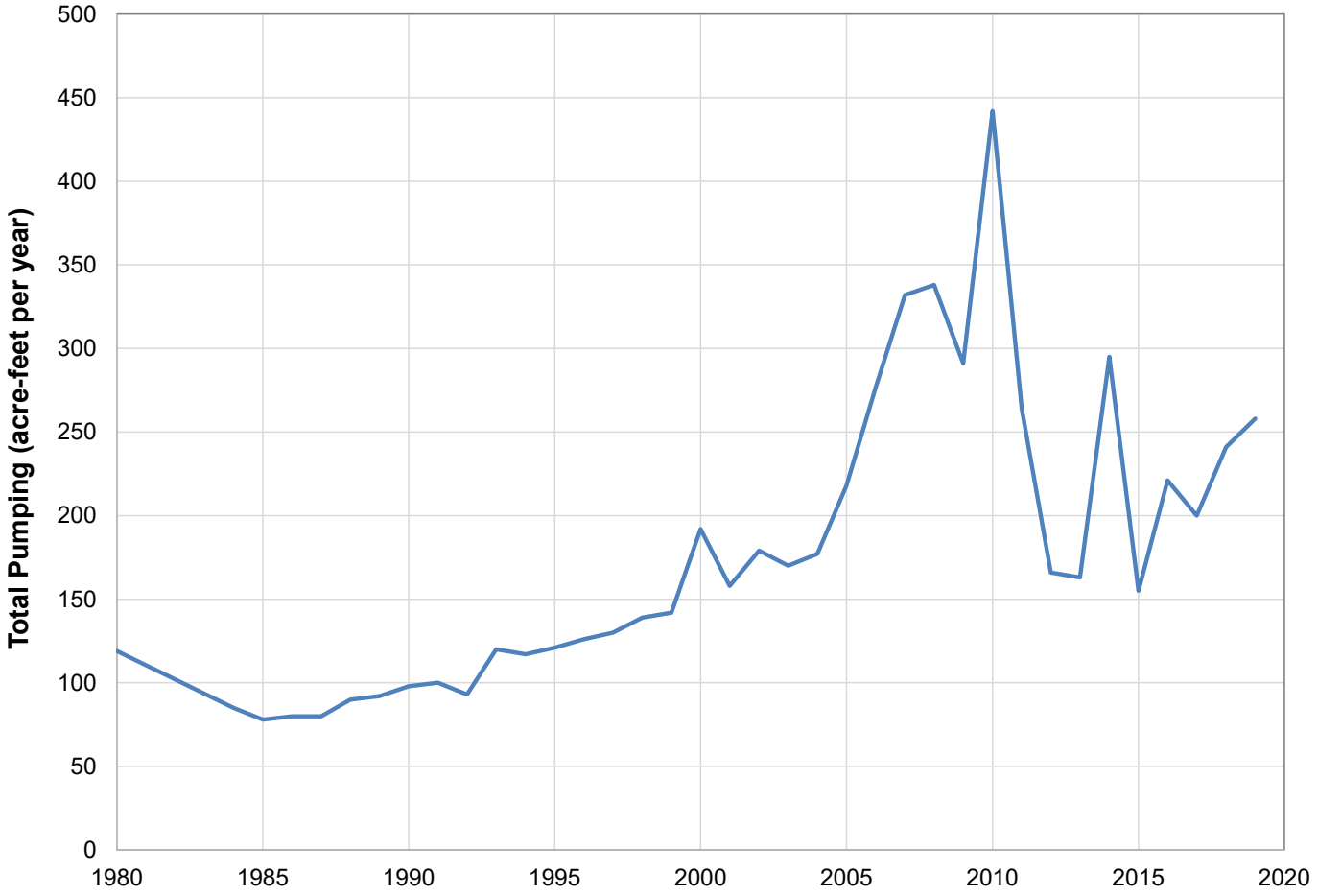
Perched Springs



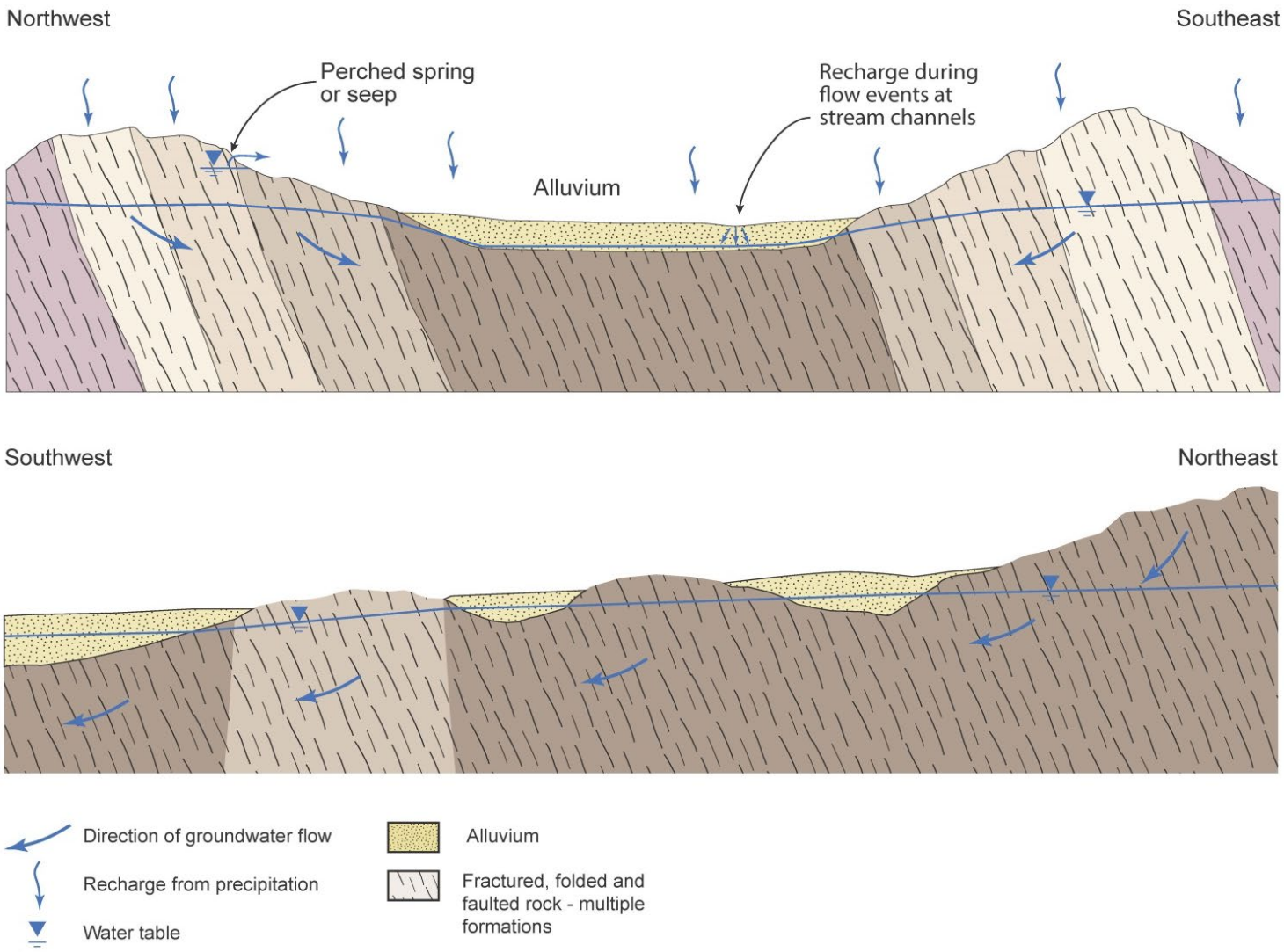
Groundwater Pumping



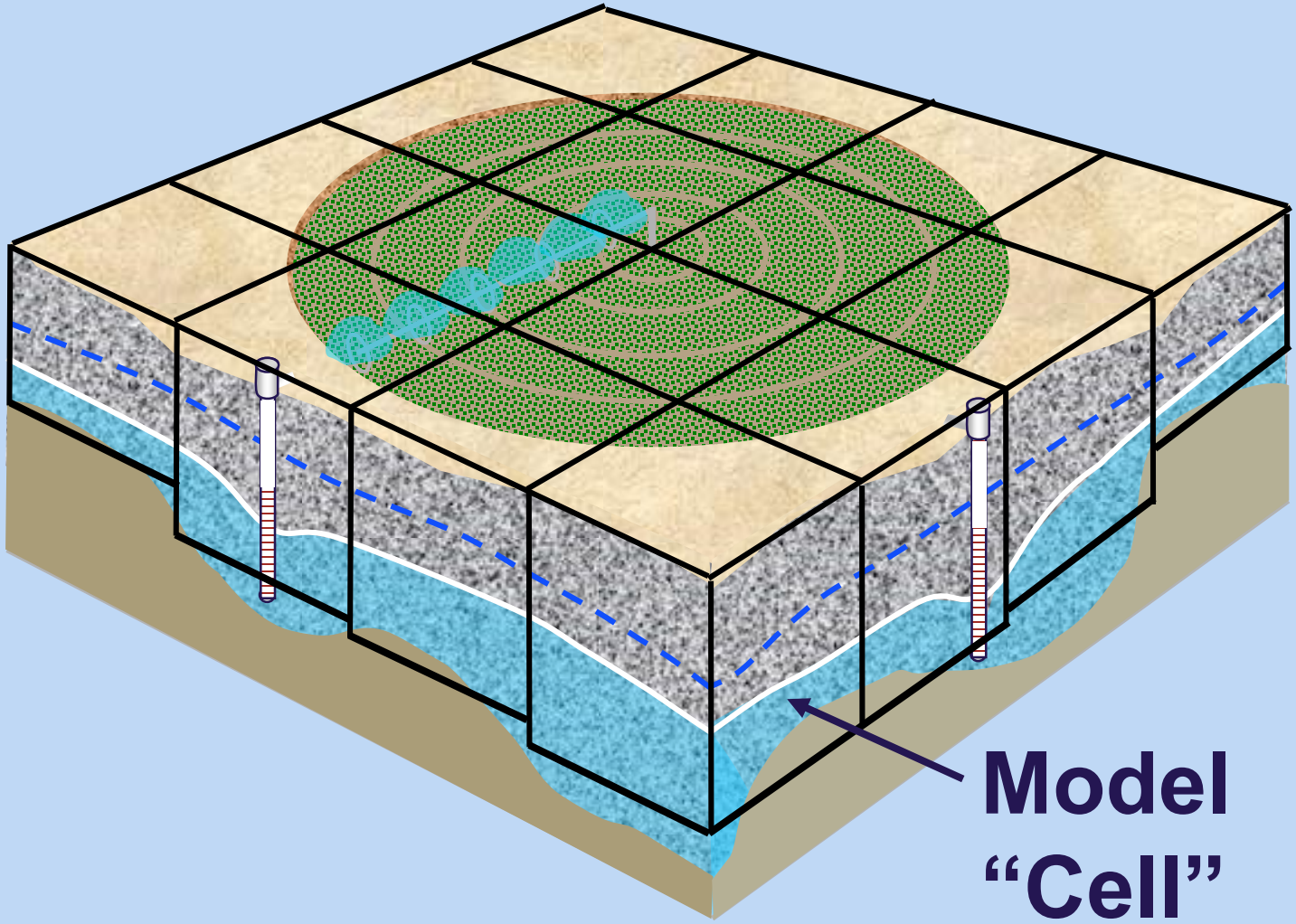
Total Groundwater Pumping from the Marathon Aquifer - 1980 to 2019



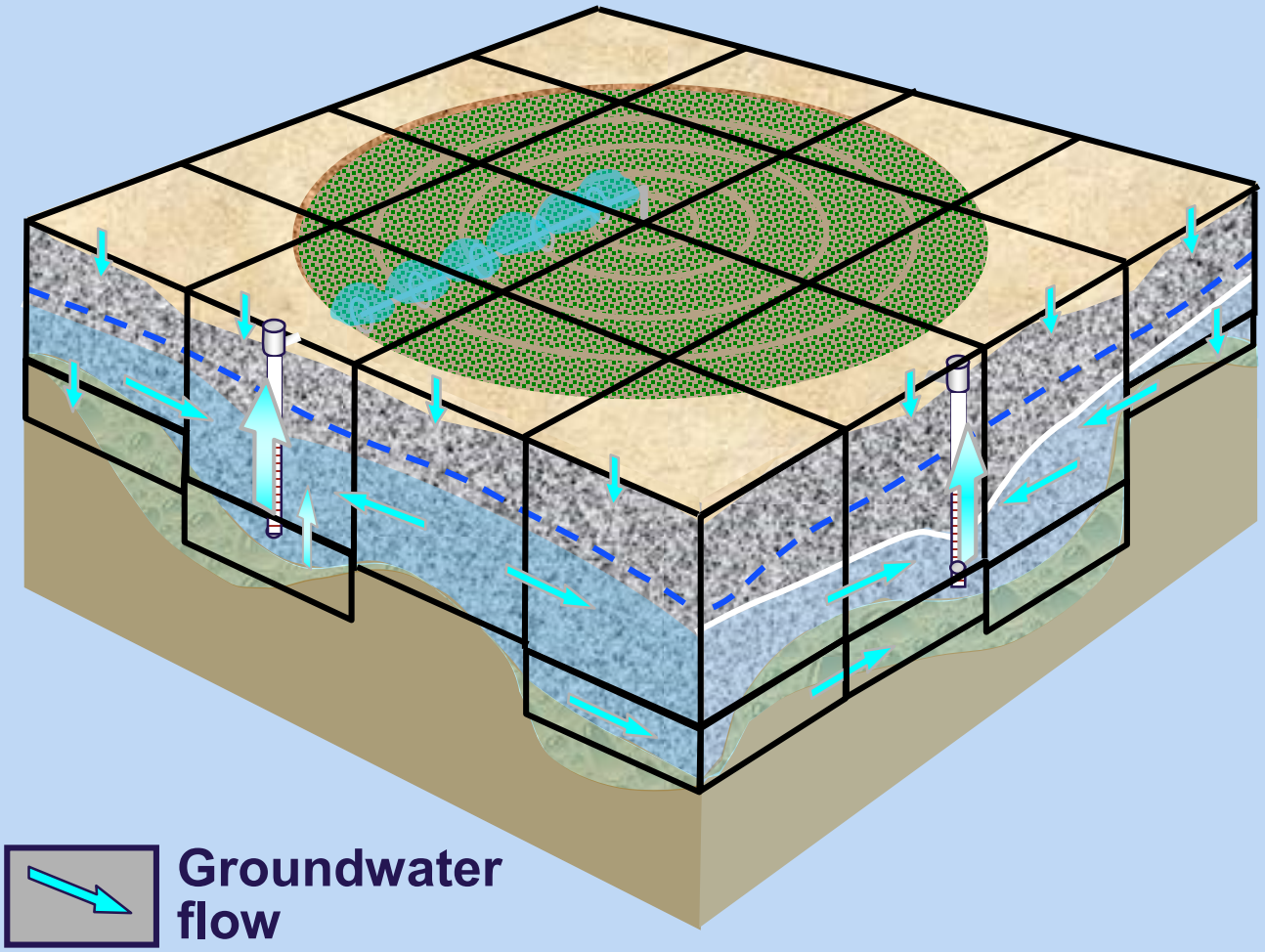
Conceptual Model



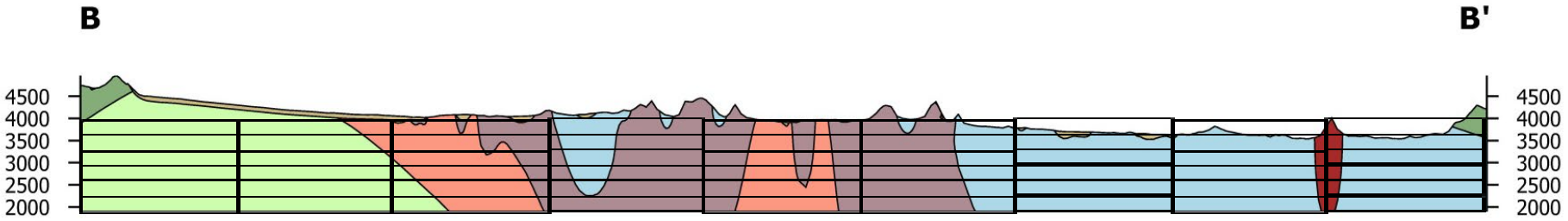
Overview of Groundwater Flow Modeling



Three-Dimensional Model



Model Grid



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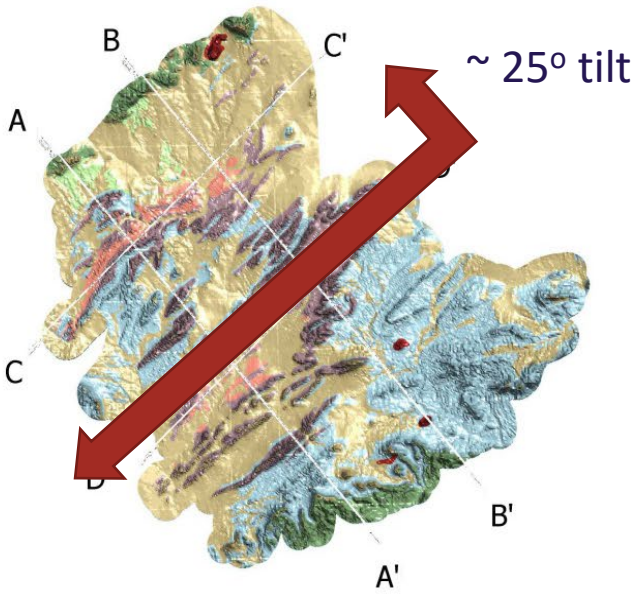

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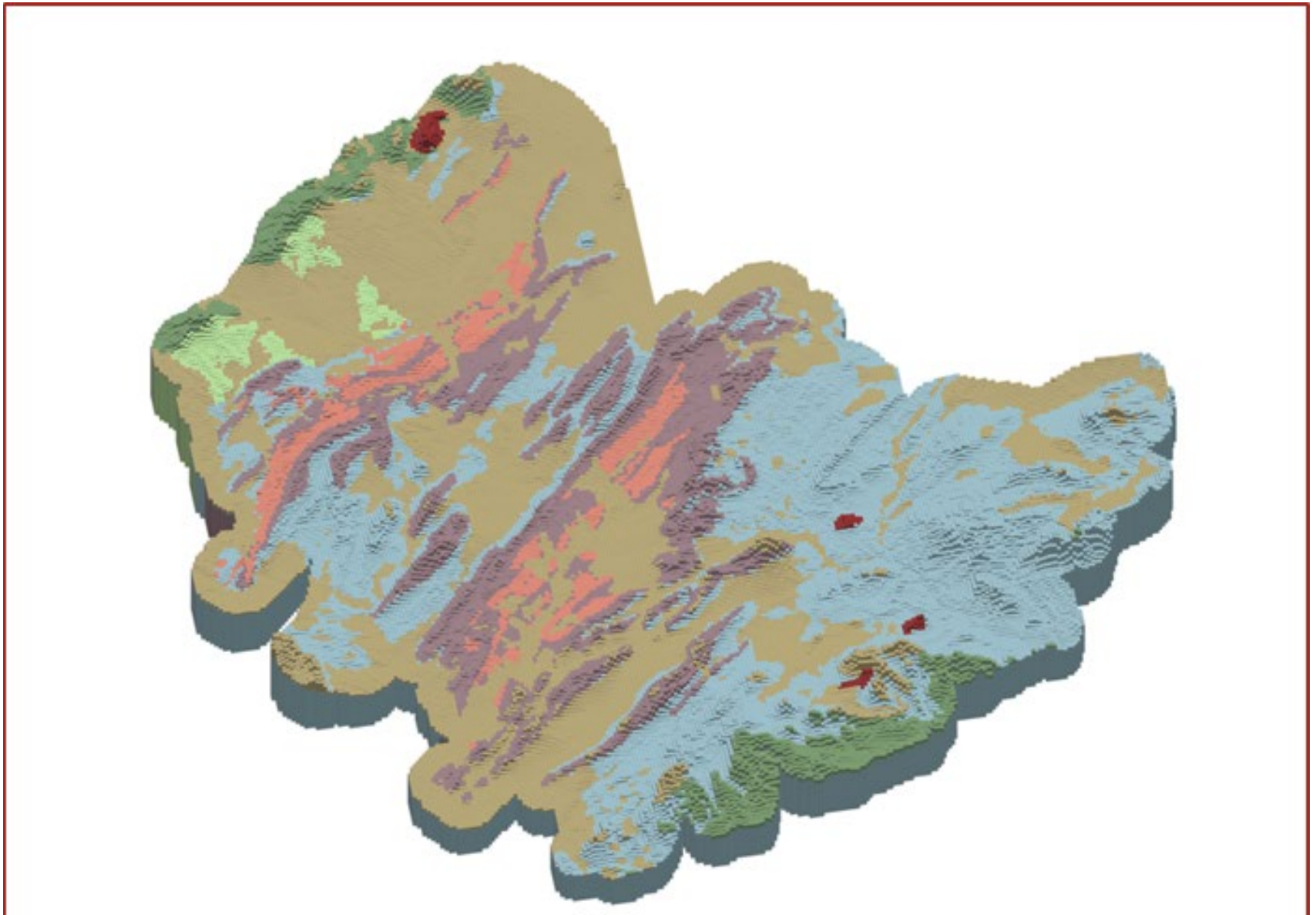
Hydrostratigraphic Unit Interpolation to Groundwater Model Grid

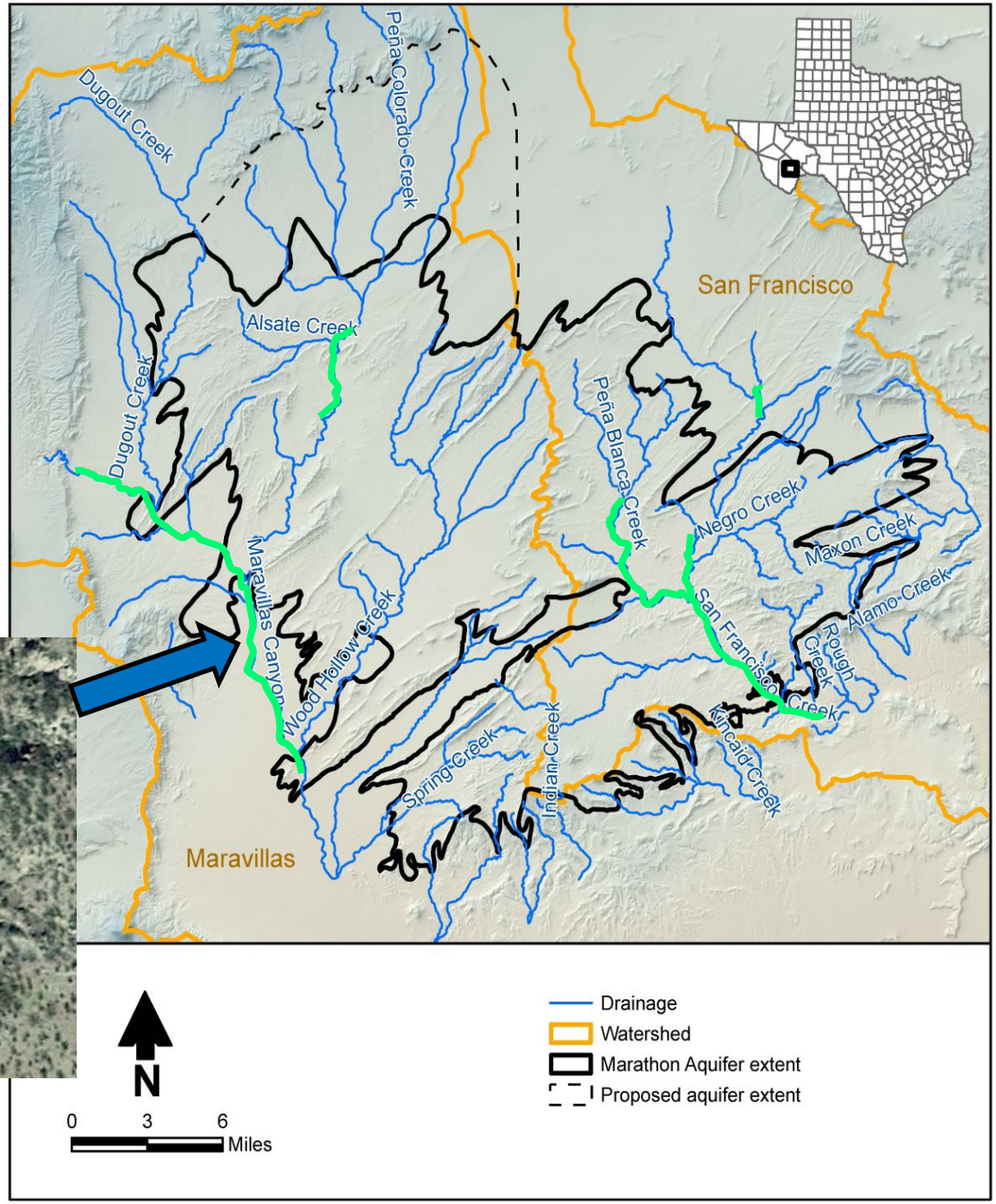


Aquifer Water Balance

- Marathon Aquifer Inflows
  - Recharge
  - Subsurface groundwater inflow, primarily from the north
- Marathon Aquifer Outflows
  - Groundwater pumping (small)
  - Discharge to springs/streams and related evapotranspiration
  - Subsurface groundwater outflow to the south

Perennial Streams

Perennial reach from USGS National Hydrologic Dataset

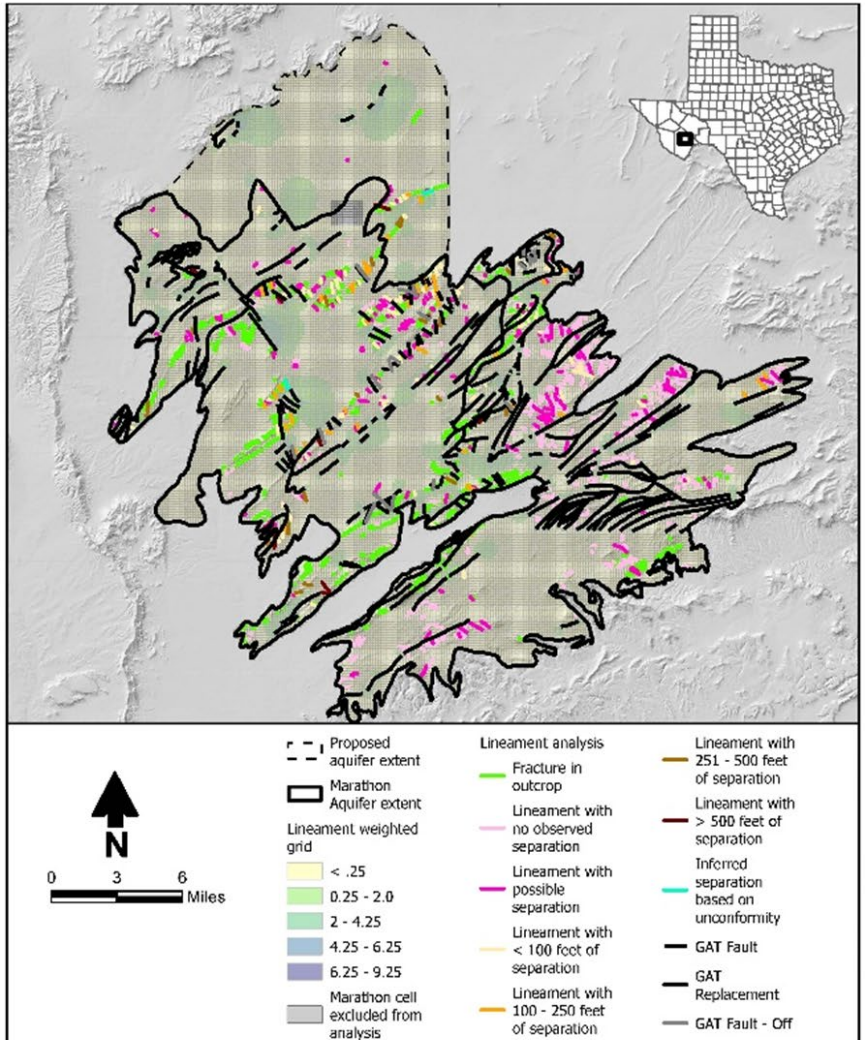


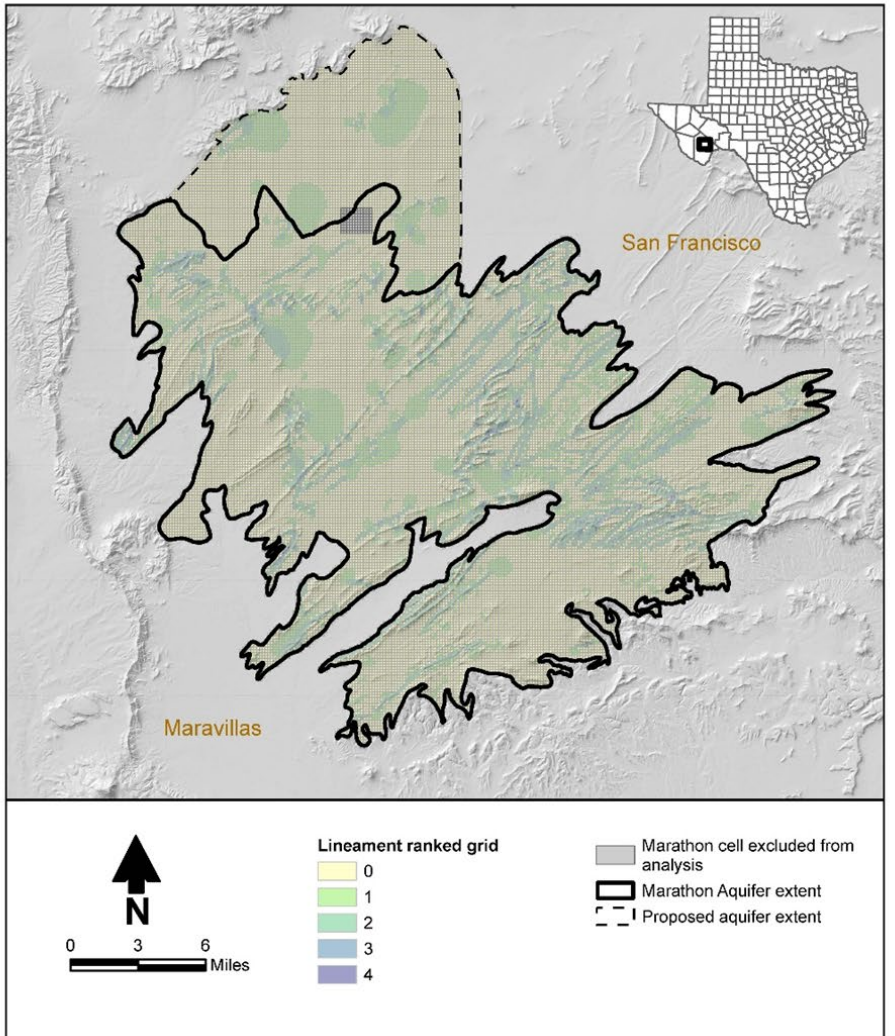
Aquifer Properties

- Seven known aquifer tests - all are Marathon Limestone aquifer at Marathon (1957-2009)
  - Hydraulic conductivity 5-92 feet per day
  - Storage coefficient 0.0007 - 0.017

Conductivity	Unit
HIGH	Marathon limestone
	Alluvium
	Gaptank, Haymond, Dimple and Tesnus formations and Caballos Novaculite and Maravillas Chert
LOW	Woods Hollow Shale, Fort Pena Formation, Alsate Shale

Aquifer Properties





Some Other Model Items

- Computer Code - MODFLOW 6
- Time Frame - 1980-2020
- Calibrate to
  - Observed water levels
  - Regions of baseflow
  - Interpreted groundwater flow directions

Project Schedule

Project Milestone	Due Date
Draft Model Design • Grid design/recharge model • Perennial flow reaches	March 20, 2025
Calibrated Transient Model and Interim report	November 20, 2025
Draft Predictive Model	February 20, 2026
Draft Model and Draft Final Report	April 20, 2026
Final Model and Report	July 20, 2026

Contact Information

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Web information:
https://www.twdb.texas.gov/groundwater/models/gam/mrtn/mrtn.asp

Texas Water Development Board

Thank you!

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