Safe Yield

The Political Issue Behind Cedar Valley Water Issues

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State Engineer Presentation 08 December 2016

Utah Code Section 73-5-15

- (1) As used in this section:
  - (a) "Critical management area" means a groundwater basin in which the groundwater withdrawals consistently exceed the safe yield.
  - (b) "Safe yield" means the amount of groundwater that can be withdrawn from a groundwater basin over a period of time without exceeding the long-term recharge of the basin or unreasonably affecting the basin's physical and chemical integrity.

- (2)(b) The objectives of a groundwater management plan are to:
  - (i) limit groundwater withdrawals to safe yield;
  - (ii) protect physical integrity of the aquifer; and
  - (iii) protect water quality

State Engineer Presentation 08 December 2016 continued …

Safe Yield

- Safe Yield: 21,000 AF/yr

- Current Well Depletion:
  28,000 AF/yr
- Potential (approved) Well Depletion:
  50,000 AF/yr

Sub Basins

- Should valley be split into smaller sub-basins for safe yield?
- What boundaries could be used?
- What would the safe yield amounts for those sub-basins be?

Plan Adopted 11 January 2021

State of Utah
DEPARTMENT OF NATURAL RESOURCES
BRIAN C. STEED
Executive Director
Division of Water Rights
TERESA WILHELMSEN
State Engineer/Division Director

SPENCER J. COX
Governor
DEIDRE M. HENDERSON
Lieutenant Governor

January 11, 2021

RE: Notice of Final Adoption

Dear Water Users:

The Cedar City Valley Groundwater Management Plan was adopted January 11, 2021. The objectives of this groundwater management plan are to ensure groundwater withdrawals do not exceed safe yield, to safeguard the physical integrity of the aquifer, and to protect water quality. A copy of the plan is available on the Division's website at www.waterrights.utah.gov.

The adoption of this plan is subject to Section 73-5-15 Utah Code, which allows an individual to challenge any aspect of the plan by filing a complaint in the appropriate district court within 60 days after the date of this notice.

We appreciate everyone who participated at public meetings and submitted comments during the development of this plan. We look forward to your continued support.

Sincerely,

Teresa Wilhelmsen, P.E.
State Engineer

1594 West North Temple, Suite 220, PO Box 146300, Salt Lake City, UT 84114-6300
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UTAH DNR WATER RIGHTS

Page 1 GWMP Estimated Safe Yield of 21,000 acre-feet per year contradicts USGS 42,000 acre-feet per year

CEDAR CITY VALLEY
GROUNDWATER MANAGEMENT PLAN
Adoption Date: January 11, 2021

Introduction

The objectives of this groundwater management plan are to ensure groundwater withdrawals do not exceed safe yield, to safeguard the physical integrity of the aquifer, and to protect water quality in the groundwater basin of Cedar City Valley in Iron County. The intent of this plan is to provide specific management guidelines for this area pursuant to Section 73-5-15 of the Utah Code.

Studies indicate average annual groundwater withdrawals in Cedar City Valley exceed safe yield, making this groundwater basin a critical management area as defined in Section 73-5-15.1 of the Utah Code. The safe yield for the groundwater basin is estimated to be 21,000 acre-feet per year, while the current average depletion from the groundwater basin is estimated to be 28,000 acre-feet per year. If all groundwater rights that are approved or perfected were to be used the total depletion from the groundwater basin would be approximately 50,000 acre-feet per year. It is estimated that average actual depletion must be reduced by 7,000 acre-feet per year in order to balance recharge and depletion amounts in this groundwater basin.

Affected Area

This groundwater management plan applies to the groundwater basin within the surface drainage area of Cedar City Valley in Iron County. The groundwater management plan area is more particularly described as Water Right Area 73 and is shown in Figure 1.

Priority Regulation

In order to reduce actual depletion to balance recharge, water rights will be regulated according to priority and regardless of a water right's nature of use. Regulation will follow the schedule described in Table 1. A regulated water right will no longer be authorized to divert water beginning on the target date corresponding to the phase wherein the water right is to be regulated. A list of groundwater rights and corresponding priority dates and depletion estimates are posted on the Division of Water Rights website.

The regulated priority date for a given phase in Table 1 may be adjusted by the State Engineer to a later priority date based on the average annual artificial recharge or reductions in depletions that occur within the groundwater basin during the 10 years prior to the target date. Each year in the annual groundwater distribution system report, the State Engineer will report on the status of the aquifer, the estimated annual depletion resulting from groundwater withdrawals, amount and disposition of artificial recharge, and any adjustments to the regulated priority date for a given phase. Recharged water under projects for which a recovery application has been approved and actively pursued will not be considered in adjusting the regulated priority date for a given phase.

USGS IN-FLOW

Summary 109

Hydrology and Simulation of Ground-Water Flow in Cedar Valley, Iron County, Utah

By Lynette E. Brooks and James L. Mason

Recharge to the unconsolidated basin fill is by seepage from unconsumed irrigation water, streams, and precipitation, and by subsurface inflow from consolidated rock and adjacent areas, and is estimated to be about 42,000 acre-ft/yr. The chloride mass-balance …

Prepared in cooperation with the

CENTRAL IRON COUNTY WATER CONSERVANCY DISTRICT; UTAH DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATER RESOURCES; UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY, DIVISION OF WATER QUALITY; CEDAR CITY; AND CITY OF ENOCH

Scientific Investigations Report 2005-5170

U.S. Department of the Interior U.S. Geological Survey

USGS Summary Expanded page 1

Summary

Cedar Valley, located in the eastern part of Iron County in southwestern Utah, is experiencing rapid population growth that needs a larger share of the available water resources. Water withdrawn from the unconsolidated basin fill is the source for public supply and also a major source for irrigation. Water managers are concerned about increasing demands on the water supply and need hydrologic information to develop a plan for efficiently using water resources and minimizing flow of water unsuitable for domestic use toward present and future public-supply sources.

Cedar Valley is a structural depositional basin located at the transition between the Basin and Range and Colorado Plateau physiographic provinces. Snowmelt runoff from the Markagunt Plateau to the east provides much of the water to the largest stream, Coal Creek. The 1939-2000 average annual flow in Coal Creek is 24,200 acre-ft of which most of the high flow occurs during April through June. Water in Coal Creek is diverted into a complex distribution system for irrigation. No surface water exits the basin because all of it is consumed by plant consumptive use, evaporation, or seepage to the ground-water system.

The thickness of permeable unconsolidated basin fill is estimated to be more than 3,500 ft in the Rush Lake area and more than 1,000 ft throughout most of the basin. Unconfined ground-water conditions exist along the basin margins and in the center of the basin above confining lenses. Confined conditions exist beneath discontinuous confining layers in the center of the basin. As water levels have declined as a result of continued ground-water withdrawals, the present extent of water under confined conditions may be less than previously defined. Ground water flows from the recharge areas near Coal Creek to three discharge areas at Rush Lake and Mud Springs Canyon, Iron Springs Gap, and Quichapa Lake.

Recharge to the unconsolidated basin fill is by seepage from unconsumed irrigation water, streams, and precipitation, and by subsurface inflow from consolidated rock and adjacent areas, and is estimated to be about 42,000 acre-ft/yr. The chloride mass-balance method indicates that recharge may be less than that, but is considered a rough approximation because of limited chloride concentration data for precipitation and Coal Creek. Stable-isotope data indicate that recharge sources are winter precipitation derived from snowmelt in upland areas or direct precipitation on unconsolidated basin fill. Continued declining water levels indicate that recharge is not sufficient to meet demand. Water levels in many areas are at or close to historic lows.

In 2000, ground-water withdrawal was estimated to be 36,000 acre-ft/yr. About 4,000 acre-ft/yr is estimated to discharge by evapotranspiration or as subsurface outflow. Prior to large-scale ground-water development, evapotranspiration is estimated to have been about 22,000 acre-ft/yr and is the largest component of discharge at that time. The large decline in evapotranspiration is a result of declining water levels, which are a result of increased withdrawals. As a result of declining water levels, most of the natural discharge has been intercepted by ground-water pumpage. Water quality in Cedar Valley is mostly suitable for domestic use except along the eastern margin where water from some wells has elevated dissolved-solids and NO_3 concentrations. Water with high dissolved-solids concentration generally has Ca and SO_4 as the predominant ions, which are likely derived by the dissolution of gypsum in some of the Mesozoic-age rocks of the Markagunt Plateau. Ground water with low dissolved-solids concentration is located west of Quichapa Lake where less soluble Tertiary-age volcanic rocks compose the Harmony Mountains.

Nitrogen-15 and oxygen-18 isotopes in the nitrate anion were measured to determine

possible NO_3 sources and whether or not denitrification is occurring. No single source can be identified as the cause for elevated NO_3 concentrations in ground water. Low $\delta^{15}N$ values north of Cedar City indicate a natural geologic source. Higher $\delta^{15}N$ values in water from wells that are located down-gradient from areas where waste-water effluent has been discharged indicate possible recharge from the effluent. Excess dissolved N_2 gas and low NO_3 concentrations in shallow ground water at two locations indicate that denitrification is occurring. These data indicate that NO_3 derived from near-surface sources might be reduced at these locations, but it is unknown whether this process is occurring in the shallow zones throughout the basin.

A computer ground-water flow model was developed to simulate flow in the unconsolidated basin fill in Cedar Valley to test the conceptual understanding of the ground-water system. This model was developed to simulate general ground-water flow through Cedar Valley and long-term water-level fluctuations; it was not developed to simulate local effects or cell-by-cell flow. In general, the model accurately simulates water levels and water-level fluctuations and can be considered an adequate tool to help determine the valley-wide effects on water levels of additional ground-water withdrawals and changes in water use.

The method of determining recharge from irrigation was changed during the calibration process to incorporate more areal and temporal variability. Simulated water levels respond more to location and amount of irrigation recharge than to any other model parameter. Measurements of distribution through canals, amount of water applied in city and residential areas, and amount of runoff in irrigated, city, and residential areas would refine the conceptual understanding of the ground-water system and may improve model fit. If recharge is substantially different from that used in the construction of this model, then simulated aquifer characteristics and other model parameters may not be realistic estimates of actual hydrologic properties. Water-level data collected at sites where data were not available during the calibration period may help refine the model and the conceptual understanding of the ground-water system. Long-term water-level fluctuations at those sites would be needed to refine estimates of specific yield, specific storage, and probably horizontal-to-vertical anisotropy.

The ground-water flow model was used to predict possible effects on water levels caused by increased withdrawal from wells, less-than-normal precipitation and streamflow, and changing water use from irrigation to municipal supply. In the projection simulations, water levels in the southern part of the valley declined 20 to 275 ft; the maximum projected drawdown of 275 ft occurred west of Quichapa Lake during projection 6 because of increased simulated ground-water withdrawal for municipal use. The continuous decline in water levels for most projections indicates that ground water is being removed from storage and that a new steady-state equilibrium has not been established after 30 years. The simulated amount of water in storage in the ground-water system during the 30 years of projection declined as much or more than from 1950 to 2000. Model projections should not be used to predict actual water levels at some future date, but can give general ideas about water-level declines likely to occur throughout the valley. The more the projected stresses vary from stresses used during the calibration period, the more likely simulated water-level declines may not accurately represent actual water-level declines.

References Cited

Averitt, Paul, 1962, Geology and coal resources of the Cedar Mountain quadrangle, Iron County, Utah: U.S. Geological Survey Professional Paper 389, 72 p.

Averitt, Paul, 1967, Geologic map of the Kanarraville quadrangle, Iron County, Utah: U.S. Geological Survey Geologic Quadrangle Map GQ-694, scale 1:24,000.

Page 2 GWMP

Table 1 Priority Regulation Schedule

Phase	Target Date	Priority Dates Regulated Through	Acre-Feet Reduction in Estimated Depletion	Cumulative Acre-Feet Reduction in Depletion	Remaining Depletion (acre-feet)
1	January 1, 2035	December 31, 1957	5,434	5,434	45,530
2	January 1, 2050	December 31, 1954	7,330	12,764	38,200
3	January 1, 2060	December 31, 1951	8,814	21,578	29,386
4	January 1, 2070	December 31, 1935	6,761	28,339	22,625
5	January 1, 2080	July 25, 1934	1,518	29,857	21,107

Depletion Calculations

For purposes of this groundwater management plan, annual depletion from irrigation will be calculated using an annual crop survey prepared by the distribution system commissioner. The crop survey will tabulate the irrigated acreage for every crop type in the management plan boundary. It will include acreage supplied by groundwater and acreage supplied by both surface and groundwater sources. The crop survey will be published every year in the annual groundwater distribution system report. For irrigated acreage supplied by both surface and groundwater sources, water users may be required to meter the amount of groundwater diverted to that acreage so that the groundwater depletion attributable to this acreage can be estimated.

Entities with municipal use will be required to report the following on an annual basis:

1. Amount of water diverted from all sources
2. Amount of water depleted from the municipal uses

Depletion due to municipal use will be the groundwater diversion minus any return flow resulting from the groundwater portion of wastewater effluent returning to the groundwater system and minus any return flow resulting from the groundwater portion of water used for lawn and garden irrigation and any other municipal purposes.

Depletion due to any other uses will be evaluated on an individual basis. Water users will be required to report diversions and depletions associated with these uses as directed by the State Engineer.

Artificial recharge due to recharge projects will be considered as an accretion of groundwater and will be a part of the depletion calculations. To be considered in the depletion calculations, the artificial recharge must be reported to the Division of Water Rights under a recharge permit approved by the State Engineer. The recharged water, if not diverted and left in its natural course, must not have previously recharged the groundwater aquifer.

Voluntary Arrangements

Pursuant to Subsection (4)(b) of Section 73-5-15 of the Utah Code, in consultation with the State Engineer, water users may agree to participate in a voluntary arrangement to manage withdrawals on a system other than by priority date. Any voluntary arrangement shall be consistent with existing statute and must not affect the rights of water users who do not agree with or do not participate in the voluntary arrangement.

The State Engineer has approved applications for the Central Iron County Water Conservancy District (CICWCD) to import water from Pine and Wah Wah Valleys to its service area in Cedar City Valley. Presuming the project is constructed and successfully imports water to this basin, a possible effect of this alternative water supply will be to increase recharge to the groundwater basin. The State Engineer will monitor development of this project which may be used in a voluntary arrangement between water users to offset future priority regulation.

Voluntary Arrangements associated with this Groundwater Management Plan will be posted on the State Engineer's website.

Adaptive Management

To determine the effectiveness of the plan, depletion calculations and groundwater level measurements will be used. As groundwater depletions approach safe yield it is anticipated that groundwater levels will stabilize with time. The phased reductions in depletions over long intervals as specified in Table 1 provide an opportunity for groundwater levels to respond to changes in groundwater depletions. A reduction in the rate of groundwater level decline over time will be used as an indicator of approaching equilibrium of depletion versus safe yield. If during any phase of the plan it is determined by the State Engineer that safe yield has been reached, future reductions in depletion will not be implemented. This plan may also be amended at any time in the same manner through which it was adopted.

Page 4, GWMP

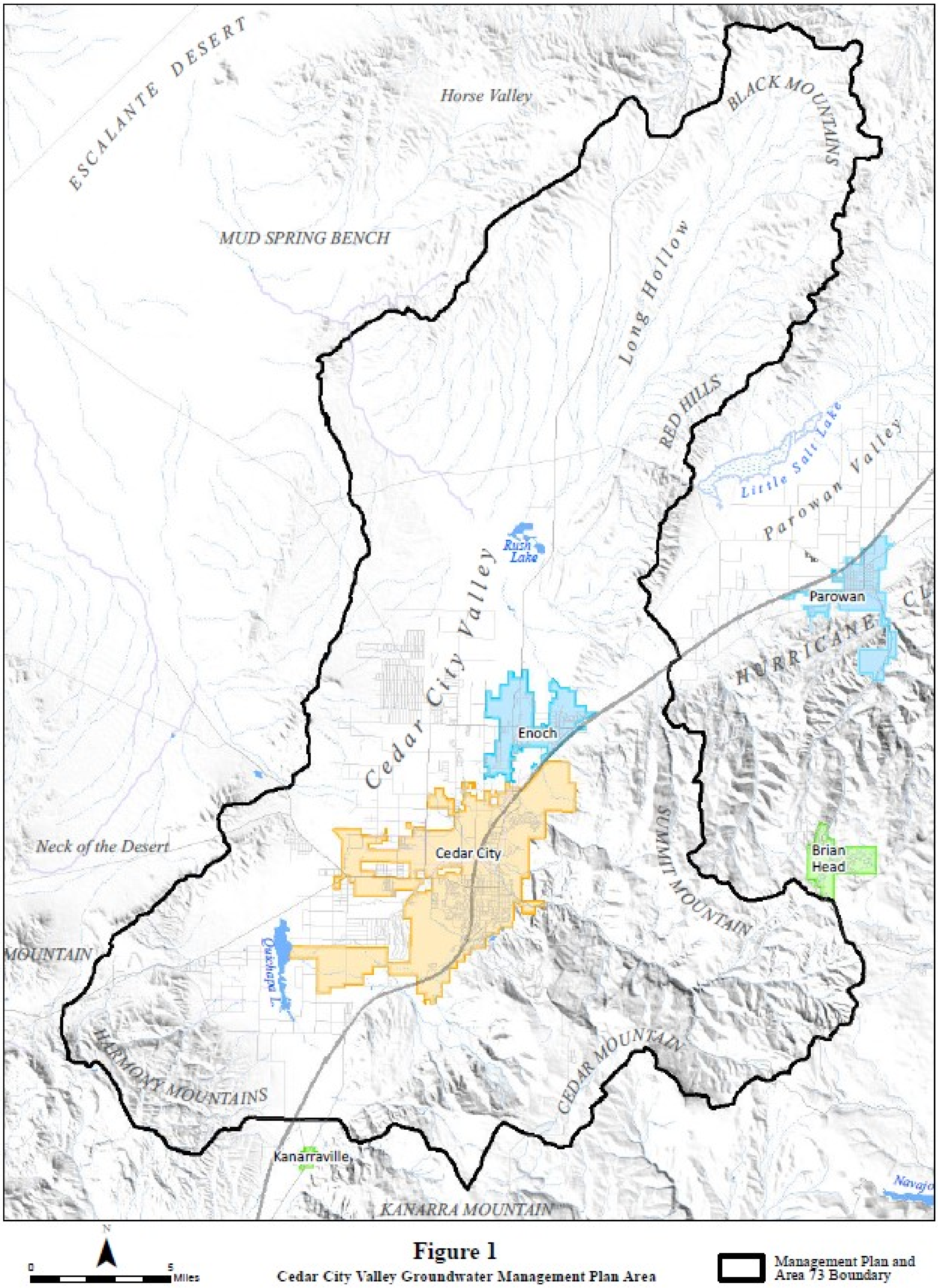
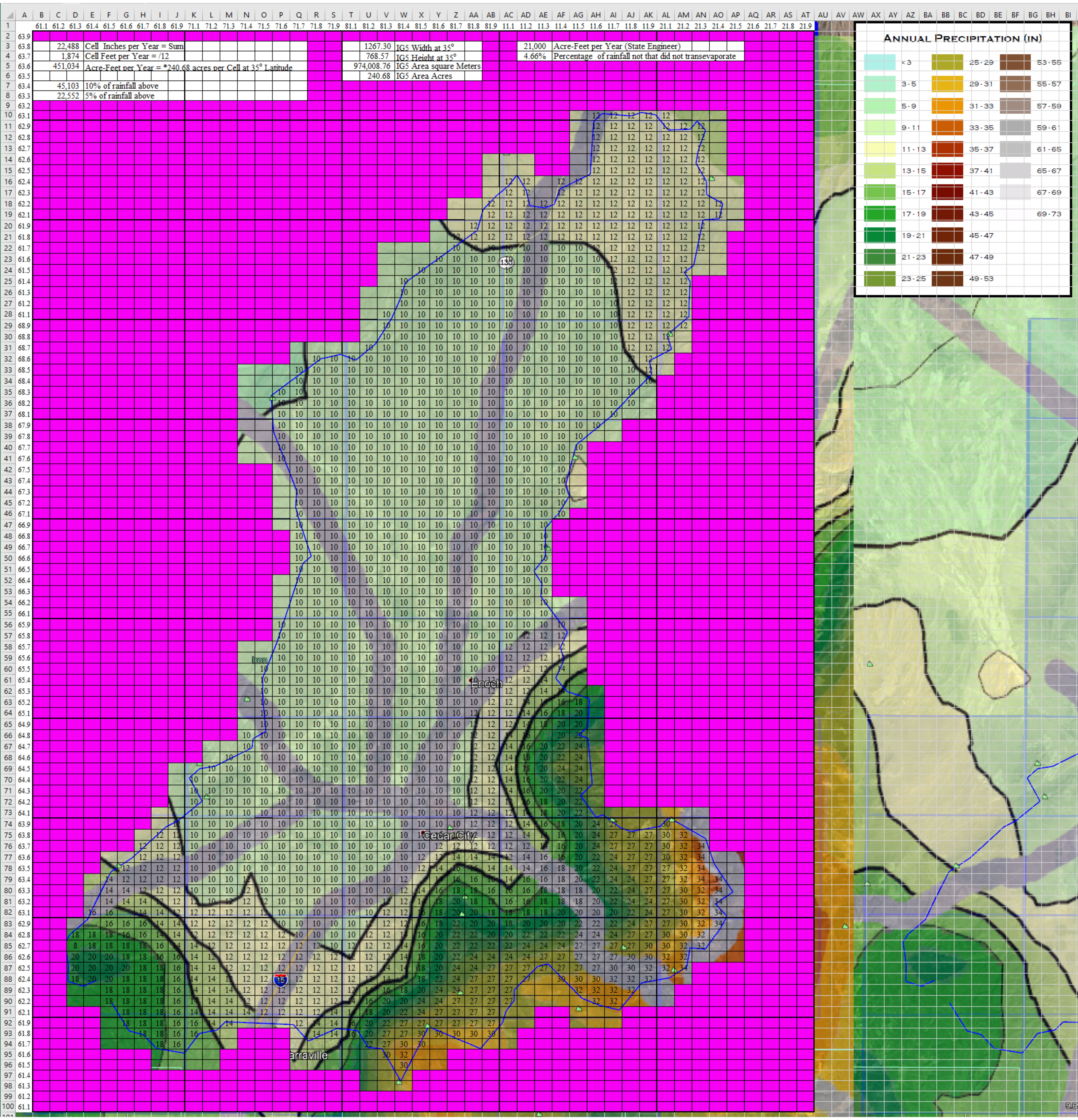


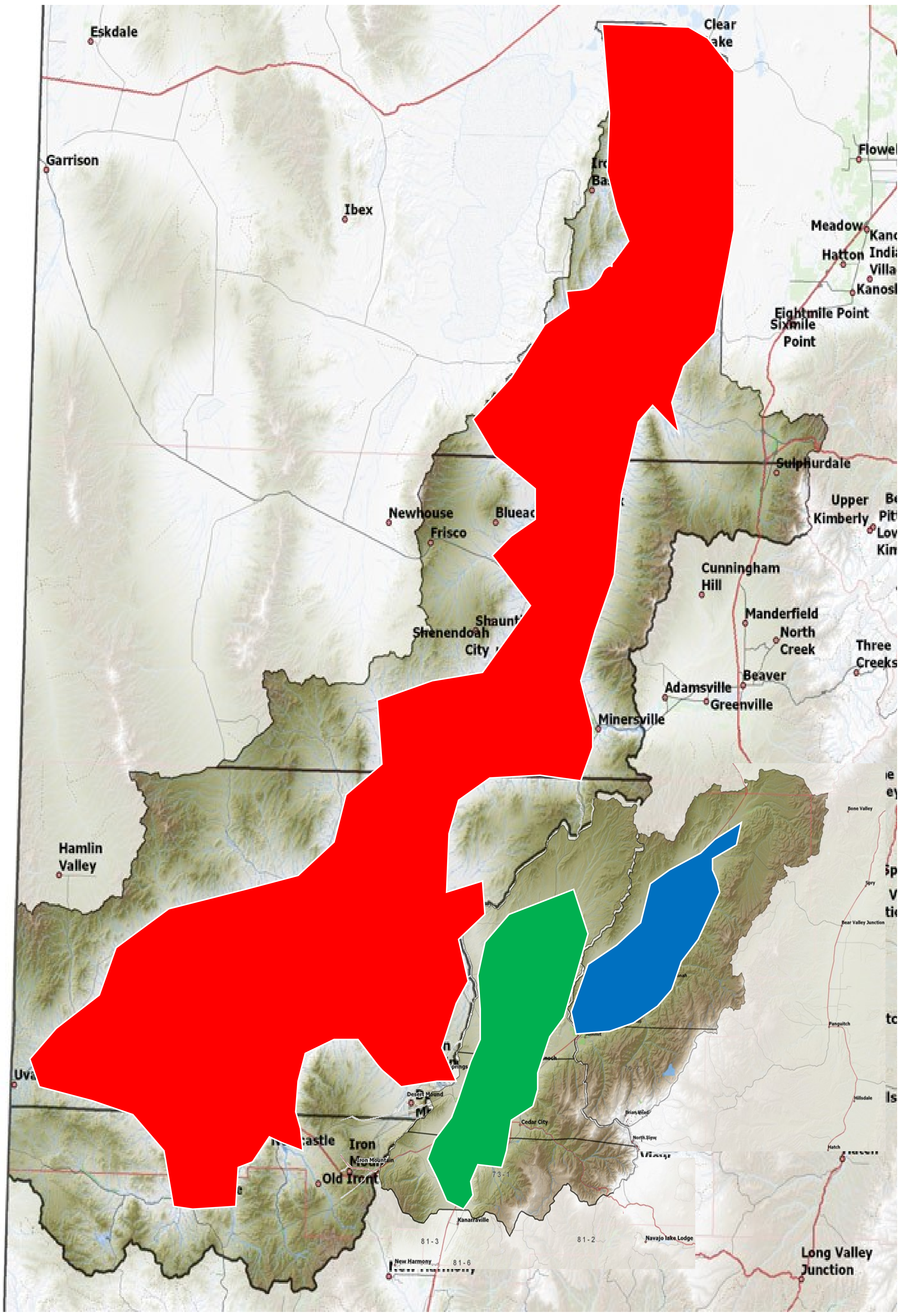
Figure 1
Cedar City Valley Groundwater Management Plan Area

4

Rainfall, Cedar Valley Drainage Basin

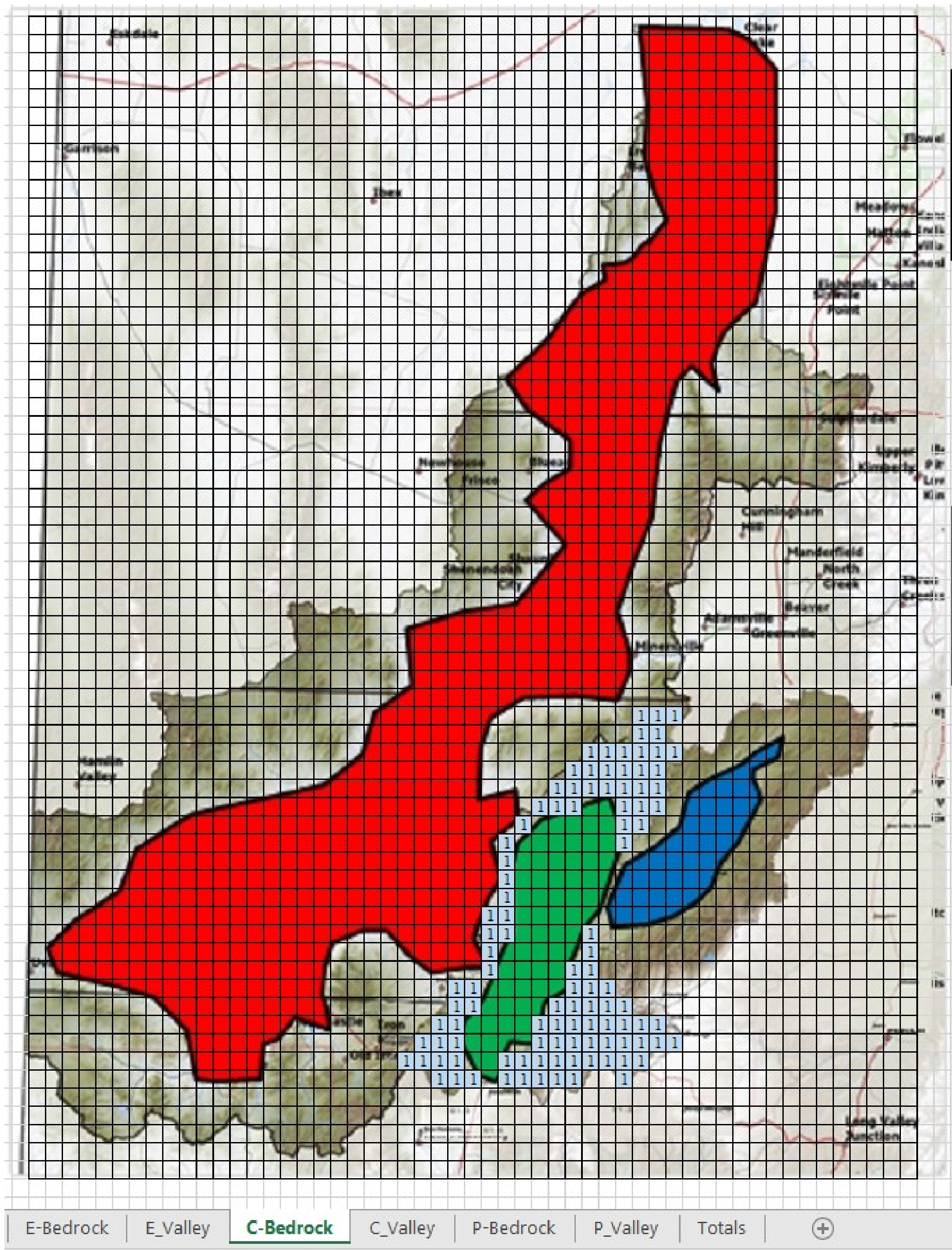


Valley Fill Aquifers vs. Surrounding Bedrock Aquifers



- There is a geologic difference between Valley Fill Aquifers and surrounding Bedrock Aquifers.
- Valley Fill Aquifers are composed of unconsolidated sediments, consisting of clay, silt, sand, cobbles, and boulders.
- When water is removed from these aquifers the aquifers collapse, and once they collapse, they cannot be refilled with water.
- Bedrock Aquifers do not collapse in the same way.
  - The rock forms the matrix, which is stable if water is extracted.
  - In addition, fractures support the aquifer, and in non-permeable rocks, like quartz monzonite, the fractures are the aquifer.

Iron County Aquifers & Specifically Cedar Valley Fill Aquifer vs. Surrounding Bedrock Aquifers



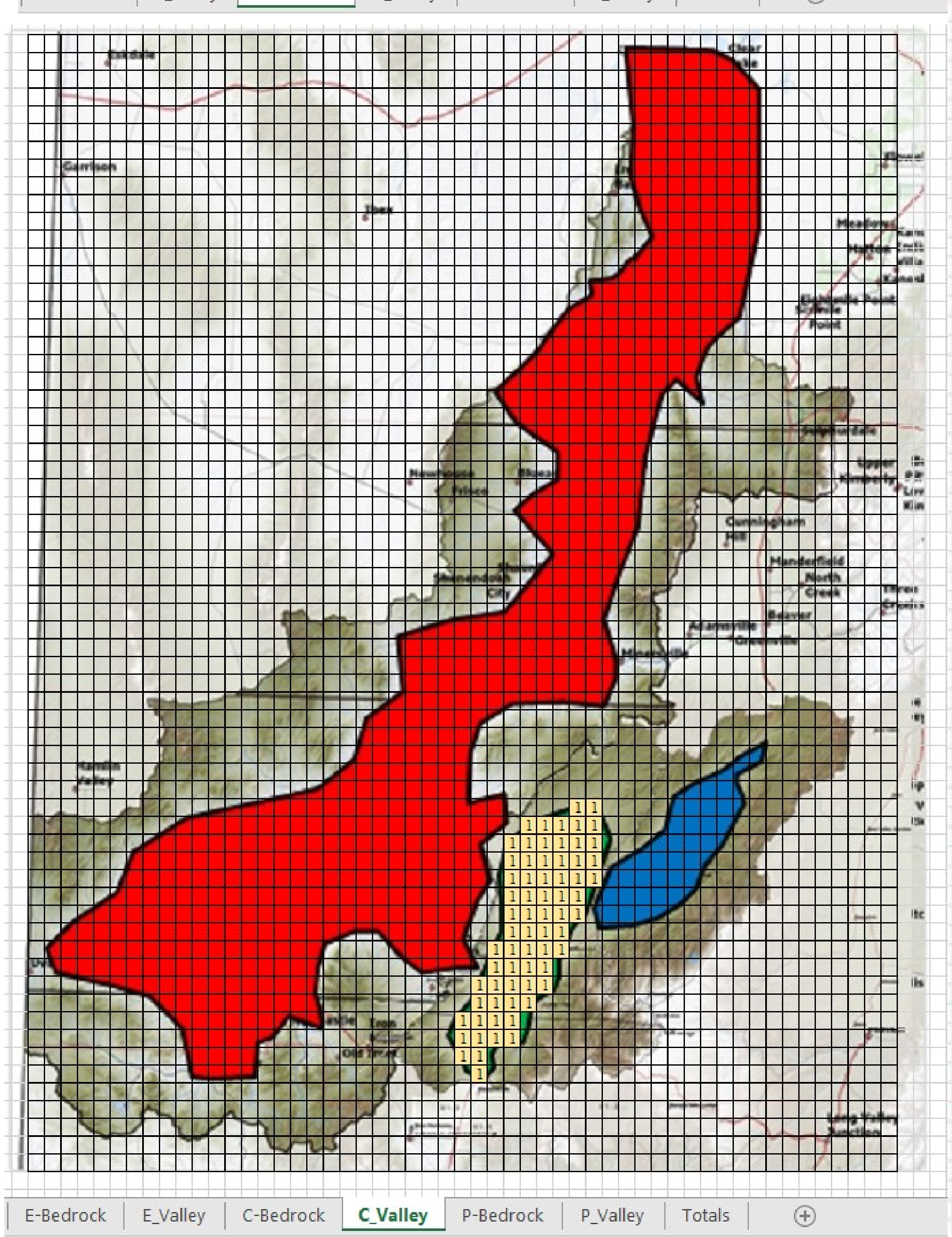
104	60.47%	Cedar Bedrock Aquifers
68	39.53%	Cedar Valley Fill Aquifers
172		

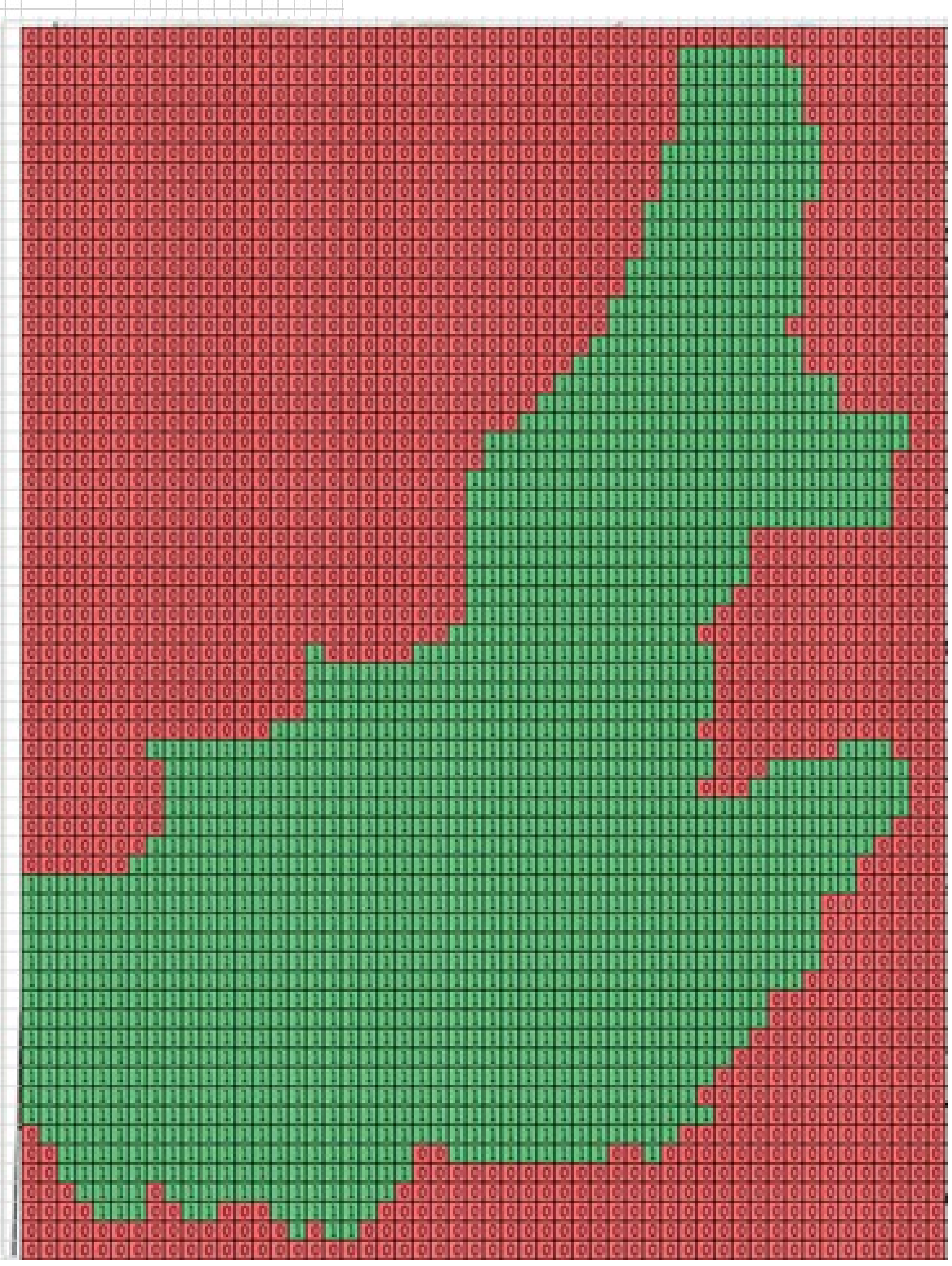
552	47.83%	Escalante Bedrock Aquifers
602	52.17%	Escalante Valley Fill Aquifers
1154		Total Area

113	74.34%	Parowan Bedrock Aquifers
39	25.66%	Parowan Valley Fill Aquifers
152		

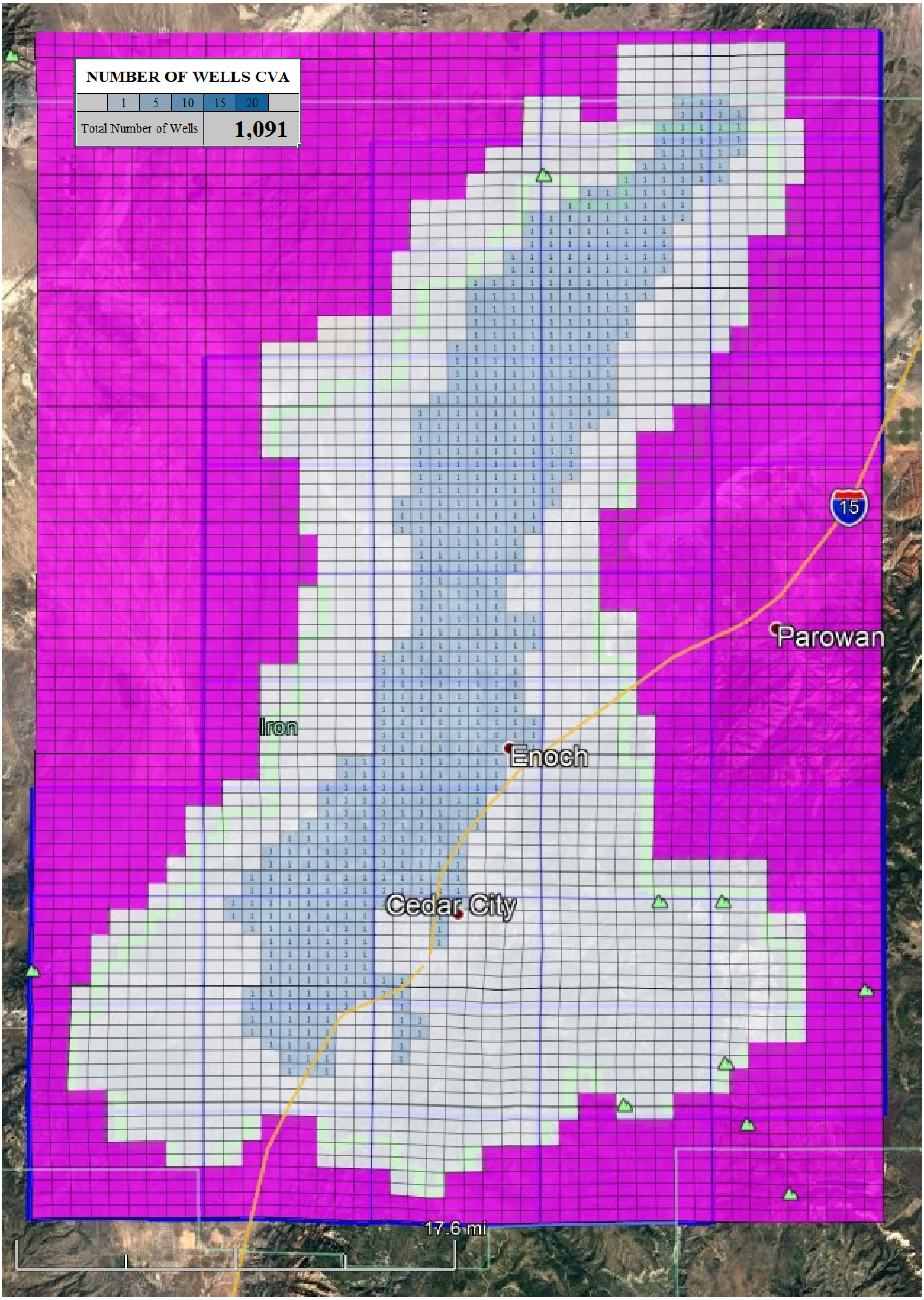
Iron County Aquifers.

1154	78.08%	Total Escalante
172	11.64%	Total Cedar
152	10.28%	Total Parowan
1478		Total Aquifers

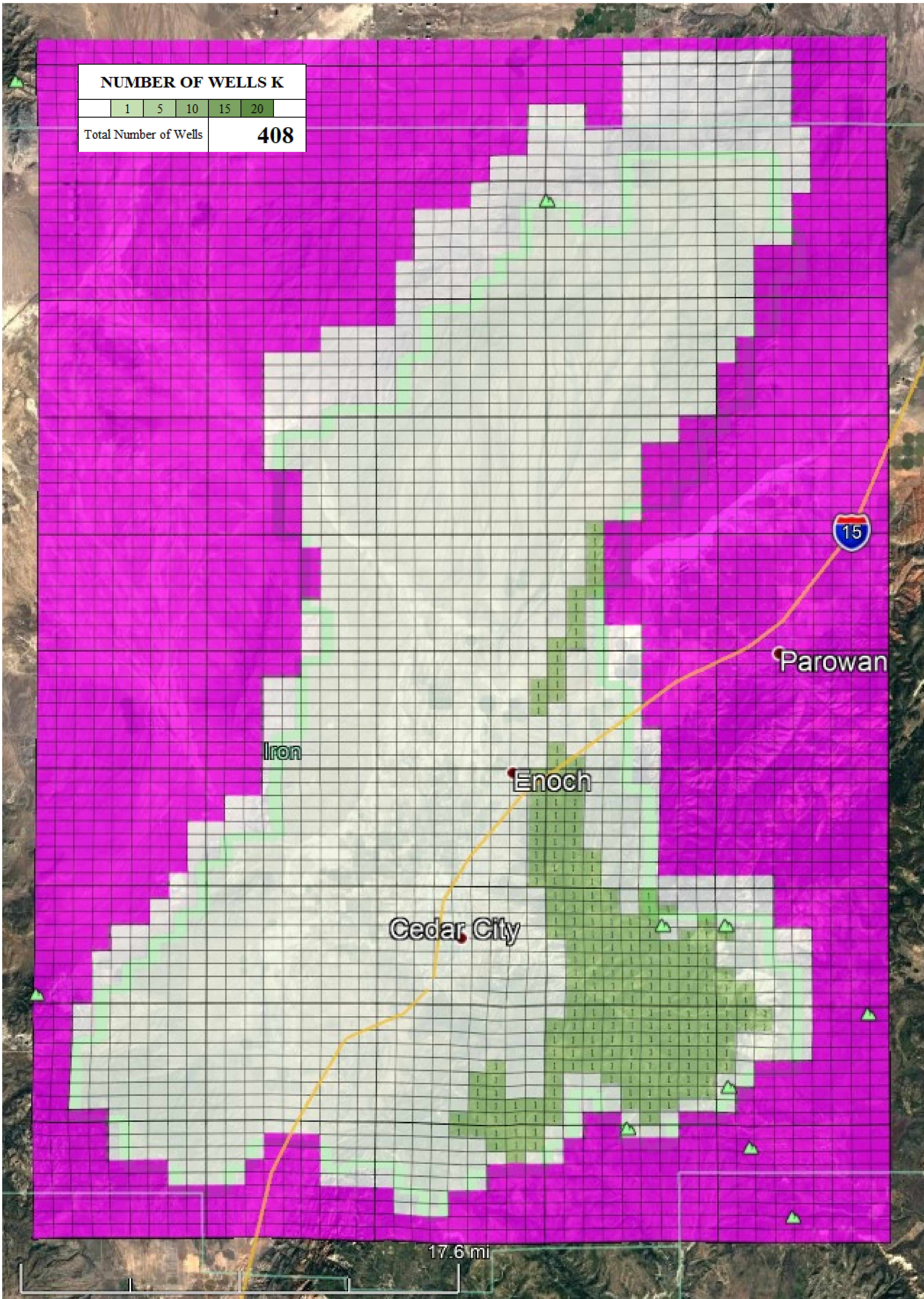




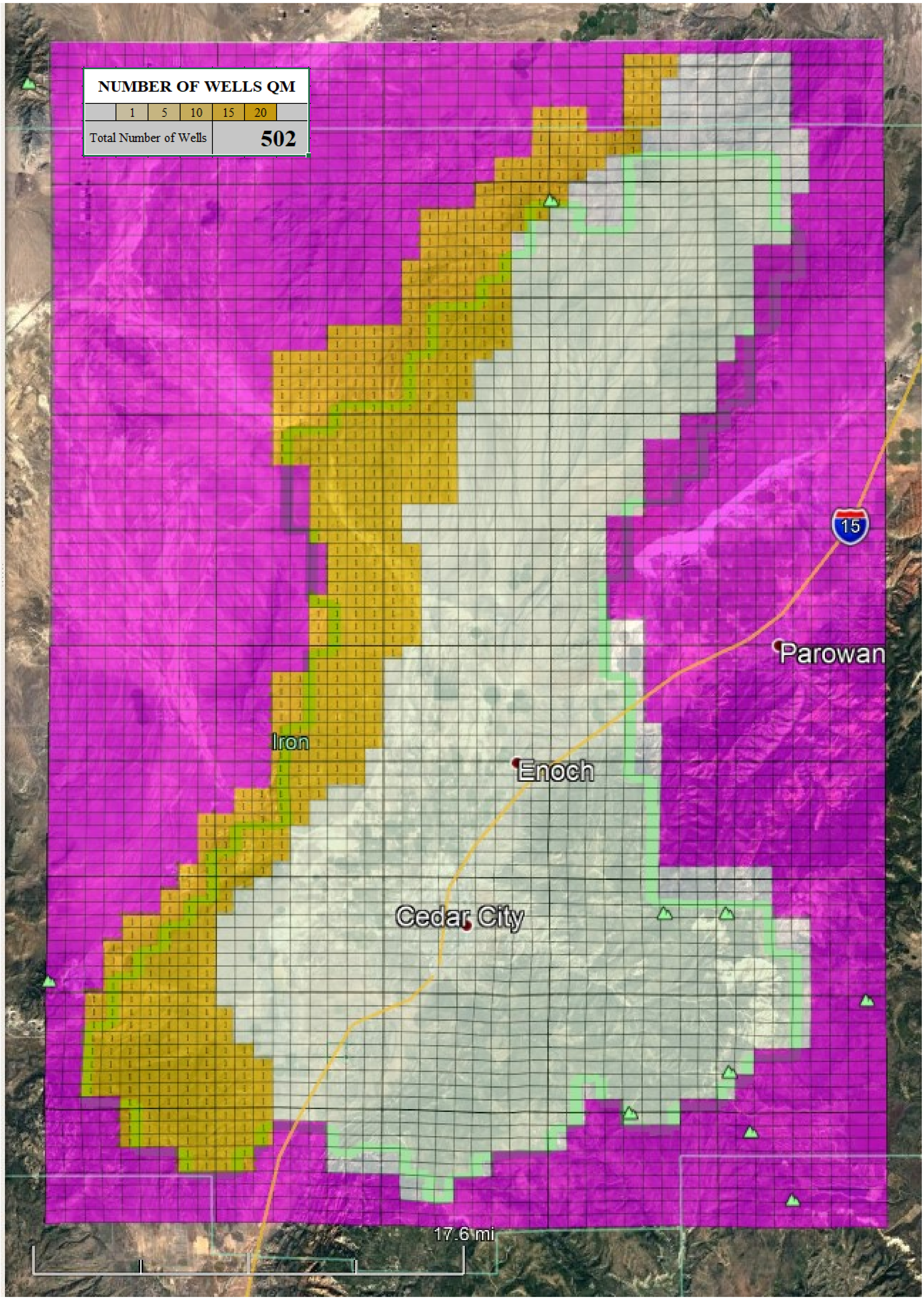
Cedar Valley Alluvial Fill Aquifer



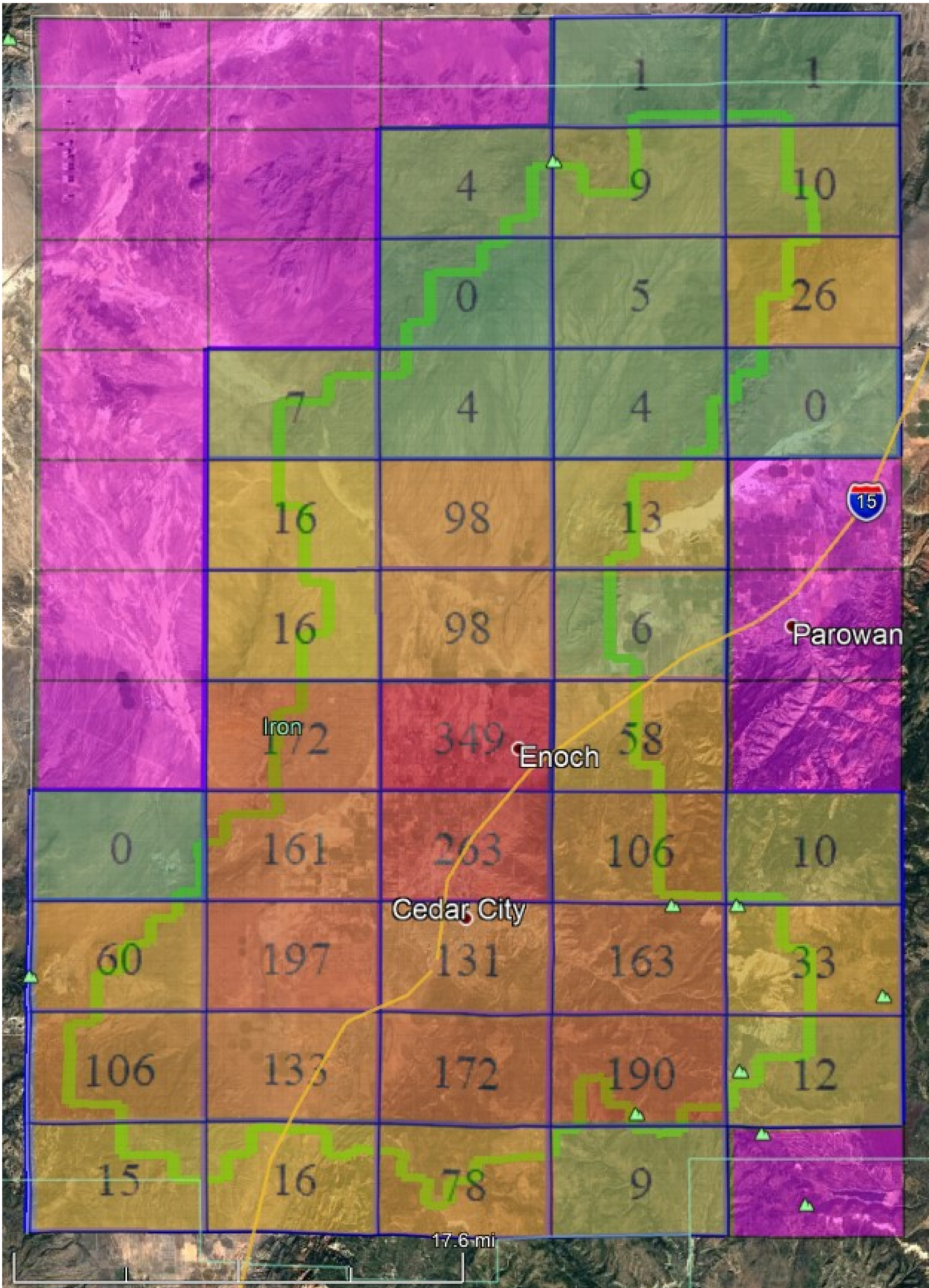
Cretaceous (K) Aquifer



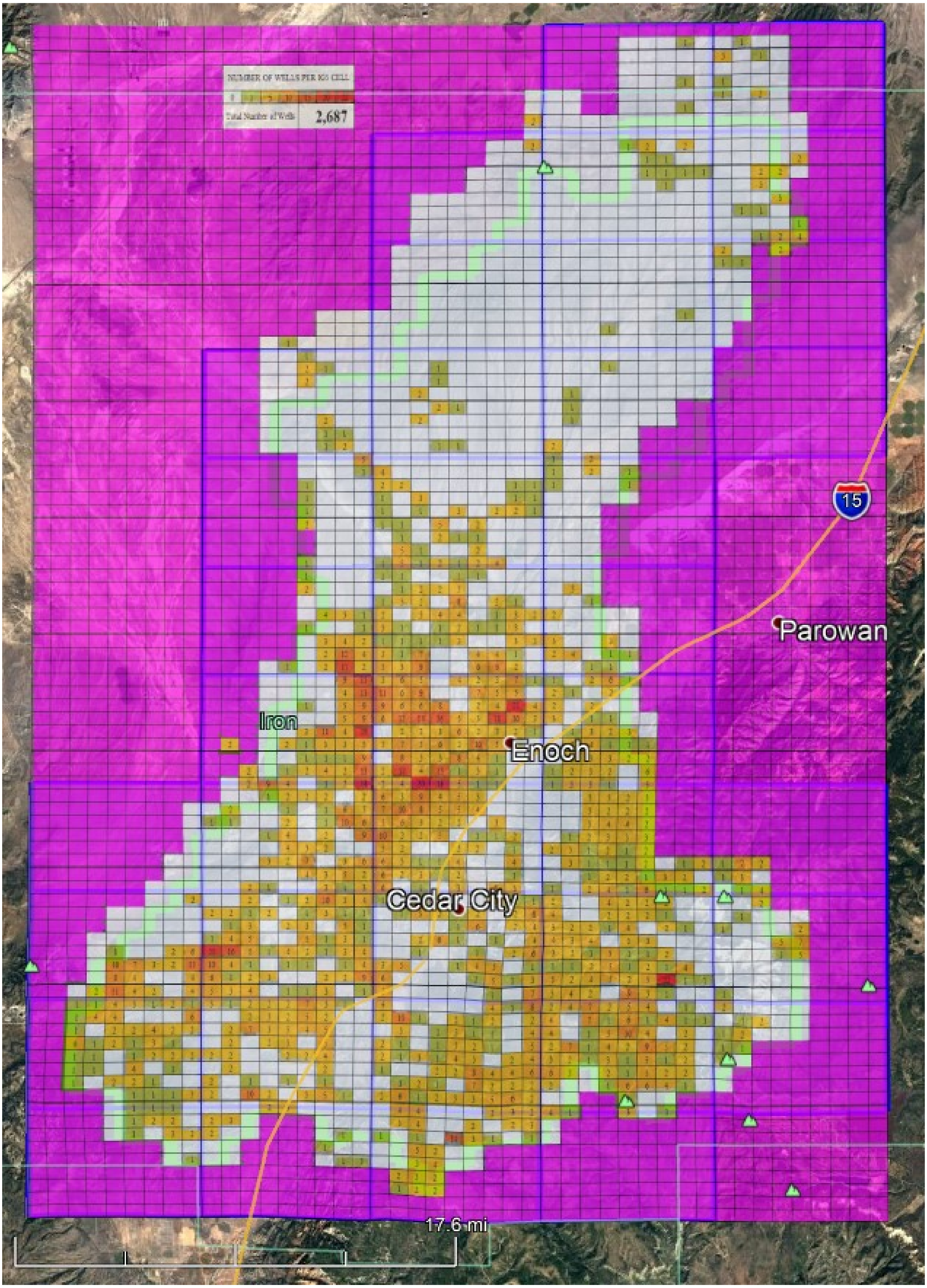
Quartz Monzonite Aquifer



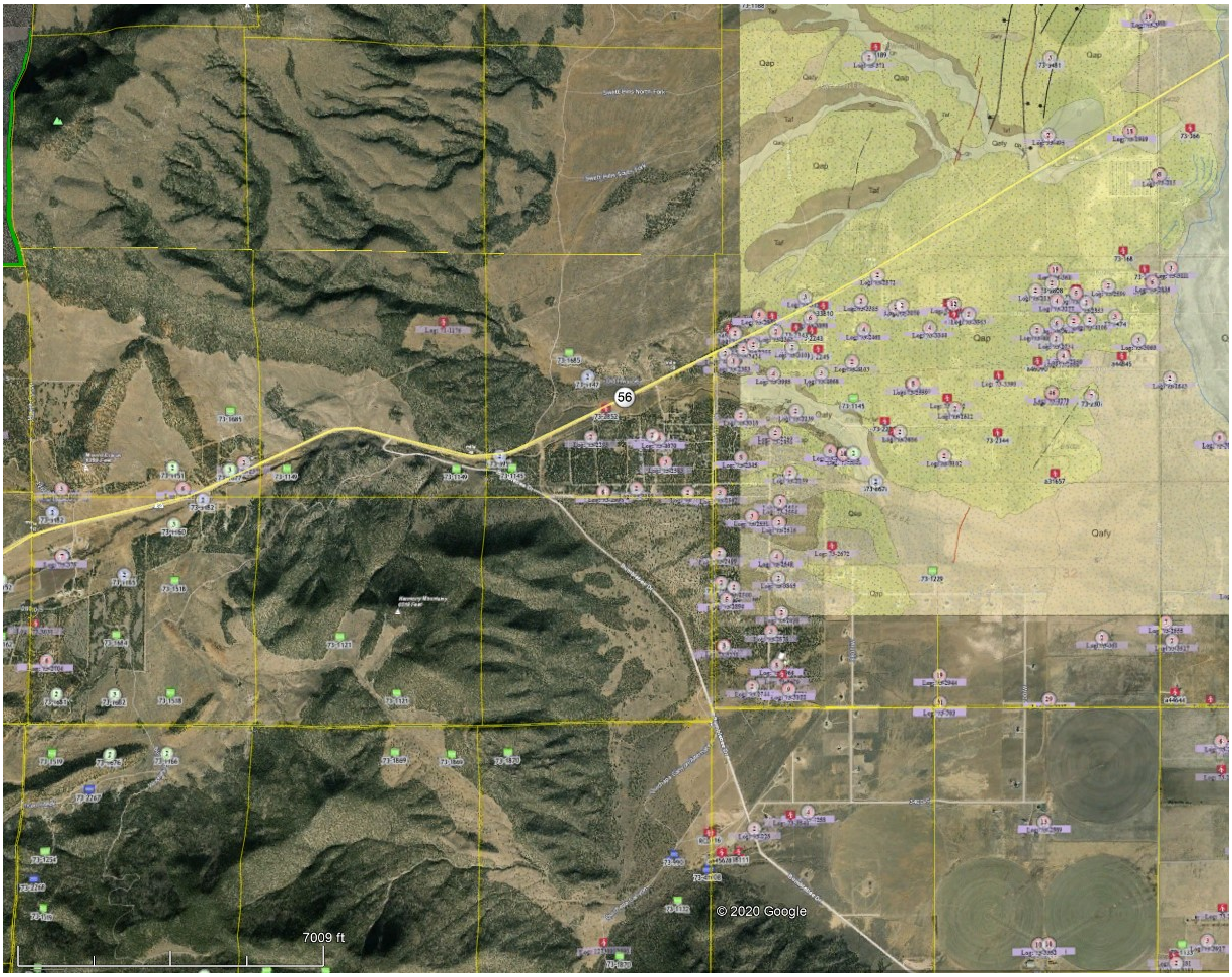
Number of Wells in IG4 Cells



Number of Wells in IG5 Cells

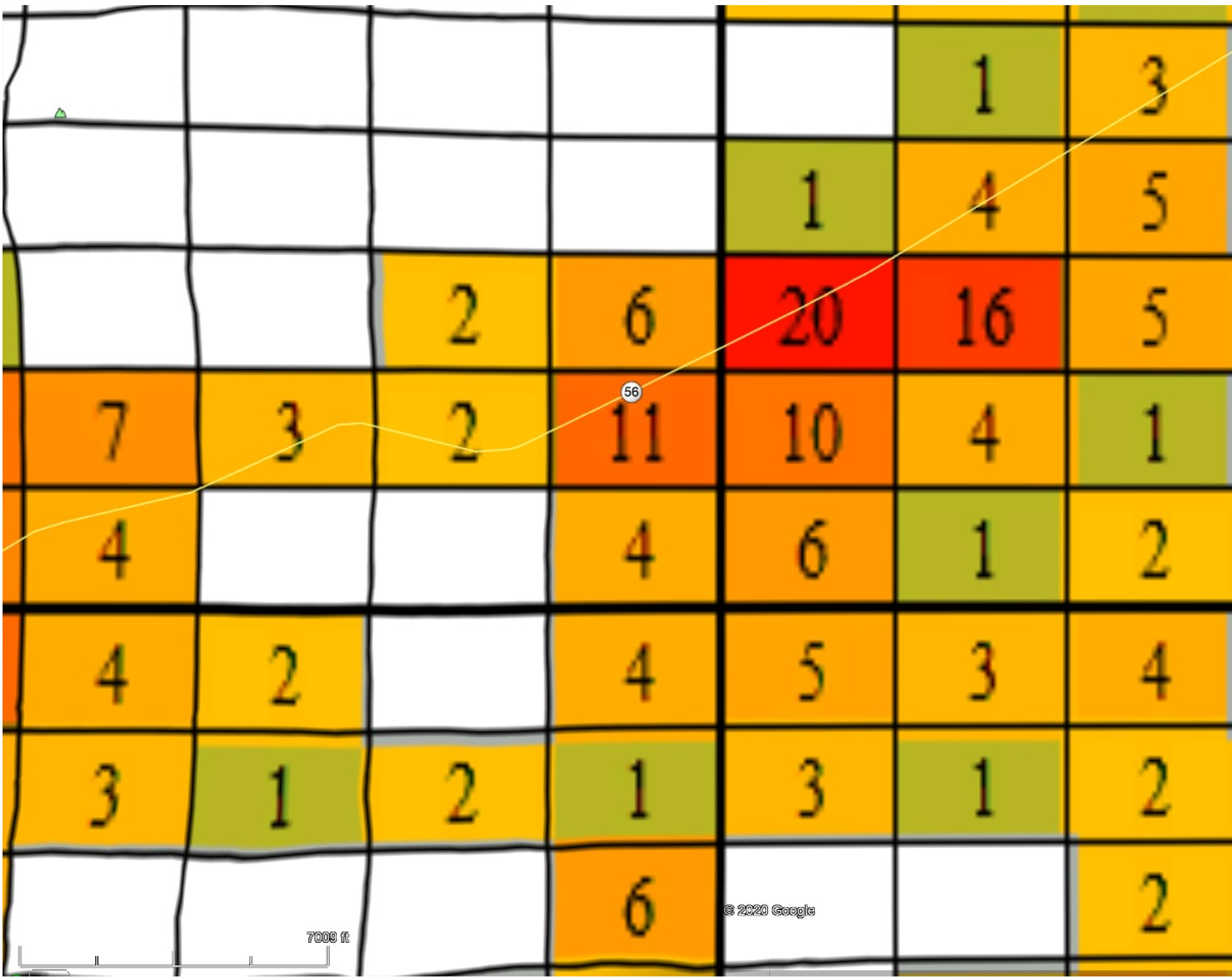


There are a lot of wells drilled in this part of the Valley

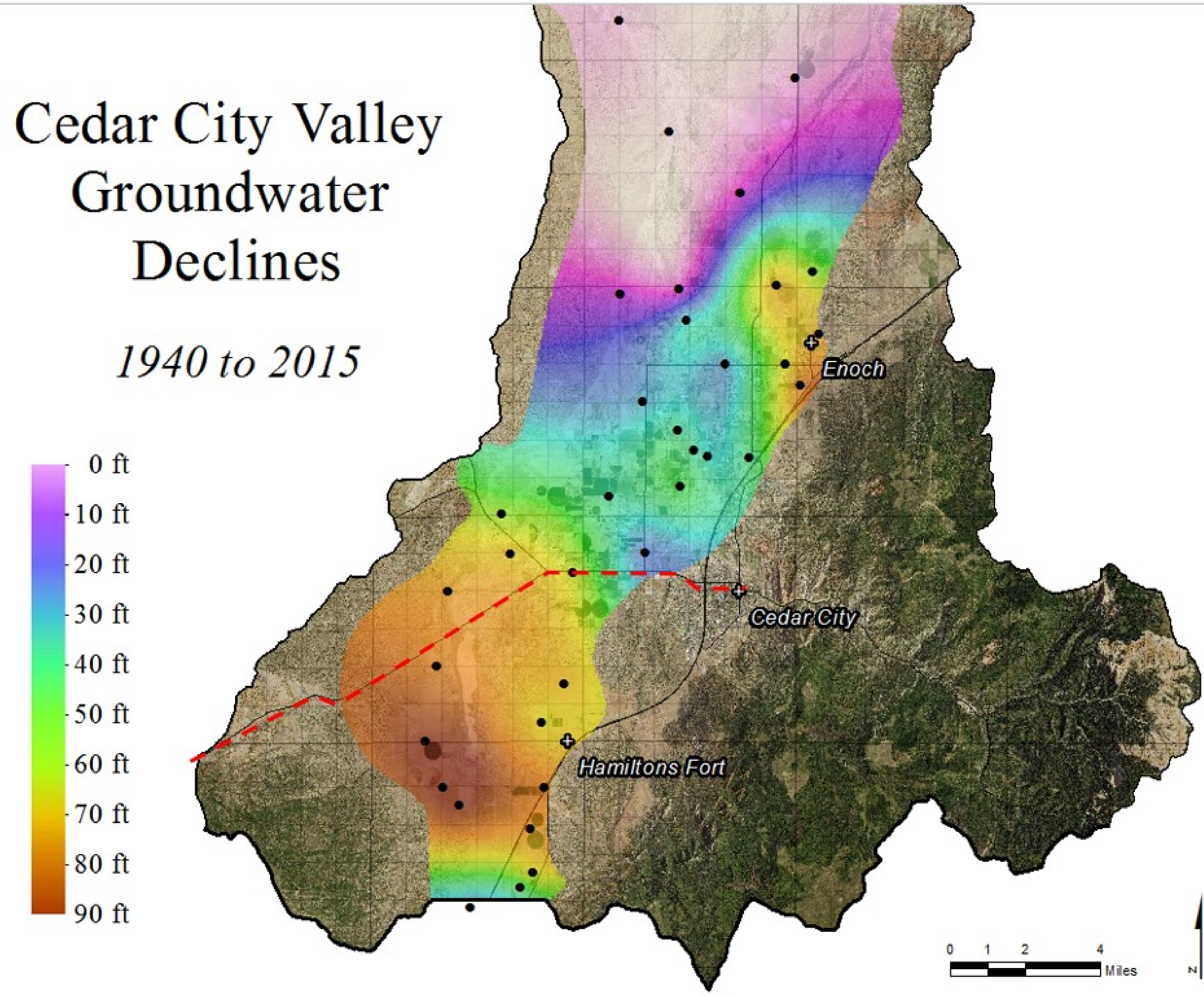


https://maps.waterrights.utah.gov/EsriMap/map.asp

Valley Fill Aquifers vs. Surrounding Bedrock Aquifers



State Engineer Presentation 08 December 2016 continued …



The Numbers The State Engineer Uses
Need to be Vetted

- Safe Yield: 21,000 Acre Feet per Year
  - Recharging the Aquifer
  - Condensation

- Current Well Depletion: 28,000 Acre Feet per Year
  - Measurement
  - Monitoring

- Approved Well Depletion: 50,000 Acre Feet per Year
  - Check All Records
  - Match with Owners Records

Facebook Conversation:

- The land that we are considering in Cedar City...
- A hot, very sunny day...bleached out the pictures a bit, but these photos show parts of the land that were not visible on the last set.





- What is the average annual rain fall?
- 9-12 Inches.
- Similar to San Pete County where I am looking. Gabions, 100% roof catchment and some shaded ponds. Its beautiful how all of this can be calculated to give us confidence of how much water can be stored and soaked during a single event. I love the desert! Interesting facts for dry lands... 80% of precipitation is from condensation... i.e., tree drip lines, rocks, etc. creating micro climates for condensation and letting the native vegetation take the lead. 🙂 So much fun to be had! Hope you are well!

https://www.facebook.com/groups/GracefulTransition/permalink/2788208401429944

Thank You

