4. Groundwater Extraction

This section presents the metered and estimated groundwater extractions from the Basin for WYs 2017 to 2025. The types of groundwater extraction include agricultural, municipal, rural domestic, and small PWSs. **Tables 1 through 5** summarize the groundwater extractions for each water year.

For WY 2025, total groundwater pumping was 16,100 AF. Municipal pumping was the largest component of total groundwater pumping and accounted for about 60 percent of total pumping during the current water budget period. Agricultural pumping accounts for 33 percent of groundwater pumping while PWS and rural domestic pumping account for 7 percent of total average pumping during the current water budget period.

4.1 Municipal Metered Well Production Data

The municipal groundwater extractions documented in this report are metered data. Metered groundwater pumping extraction data are from the city of Paso Robles, Templeton Community Services District (CSD), AMWC, and the county of San Luis Obispo for Community Service Area 23, providing service to the community of Santa Margarita. The data shown in **Table 1** reflect metered data reported by the respective agencies. The accuracy level rating of these metered data is high.

Table 1: Municipal Metered Well Production Data

Water Year	Metered Groundwater Extractions				Total (AF)
	City of Paso Robles[1] (AF)	Templeton CSD (AF)	Atascadero MWC (AF)	CSA 23 (AF)	
2017	2,609	1,207	4,807	137	8,760
2018	3,352	1,396	5,332	147	10,227
2019	3,075	1,308	4,917	142	9,442
2020	3,852	1,395	5,221	143	10,611
2021	3,612	1,531	5,575	143	10,860
2022	3,349	1,424	5,330	138	10,242
2023	3,130	1,295	5,189	127	9,741
2024	3,151	1,370	5,042	129	9,691
2025	**2,990**	**1,405**	**5,131**	**131**	**9,657**

Notes:

[1] – The city of Paso Robles produces groundwater from wells located in both the Atascadero Subbasin and the Paso Robles Subbasin. Only the portion produced from within the Atascadero Basin is included here.

AF = acre-feet

CSA 23 = county of San Luis Obispo Community Service Area

CSD = community services district

MWC = mutual water company

4.2 Estimate of Agricultural Extraction

To estimate agricultural groundwater extraction, WY 2025 specific land use data from Land IQ was used in conjunction with the OpenET ensemble model.[3] OpenET provides satellite-based estimates of the total amount of water that is transferred from the land surface to the atmosphere through the process of evapotranspiration (ET). The OpenET ensemble model uses Landsat satellite data to produce ET data at a spatial resolution of 30 by 30 meters (0.22 acre per pixel). Additional inputs include gridded weather variables such as solar radiation, air temperature, humidity, wind speed, and precipitation (OpenET 2025). OpenET provides estimates of ET for the entire land surface, or in other words, "wall to wall." To produce an estimate of ET specific to the irrigated crop acreage in the Basin the OpenET ensemble model results are screened by the Land IQ land use data set, thereby removing any potential estimated ET volumes associated with bare ground, non-irrigated crops, or native vegetation. A total of 10 irrigated crop types were identified in the WY 2023 Land IQ spatial dataset shown on **Figure 8**. Irrigated agricultural crop types were identified by inspection of monthly ET for each mapped crop type versus monthly ET for fallow ground. ET resulting from effective precipitation[4], rather than applied irrigation water, were removed from the analysis. Applied irrigation volumes are estimated by scaling up the estimated irrigated crop ET volumes using assumed crop specific irrigation efficiency factors.[5] The resulting volumes are summed by water year, which then represent estimated annual agricultural groundwater extraction. Deficit irrigation is captured in the satellite-based method through the measurement of actual ET. Groundwater extractions for frost protection are captured to the extent that the produced water results in increased ET. It is assumed that the remainder of the water produced for frost protection remains within the Basin and percolates back to groundwater. The estimated agricultural groundwater extraction volumes are summarized in **Table 2**. The accuracy level rating of these estimated volumes is medium.

[3] OpenET uses reference ET data calculated using the American Society of Civil Engineers (ASCE) Standardized Penman-Monteith equation for a grass reference surface and usually notated as 'ETo'. For California, OpenET uses Spatial California Irrigation Management Information System (commonly known as CIMIS) meteorological datasets generated by the California DWR to compute ASCE grass reference ET. OpenET provides ET data from multiple satellite-driven models and calculates a single "ensemble value" from those models. The models currently included are ALEXI/DisALEXI, eeMETRIC, geeSEBAL, PT-JPL, SIMS, and SSEBop. More information about these models can be found at: https://openetdata.org/methodologies/. All of the models included in the OpenET ensemble have been used by government agencies with responsibility for water use reporting and management in the western U.S., and some models are widely used internationally (OpenET 2025).

[4] Effective precipitation (the portion of rainfall that remains available to crops after runoff, evaporation, and deep percolation are removed) was calculated monthly for each field based on gridded precipitation values from gridMET using analytical formulas presented in FAO (1986). gridMET is a public domain dataset of daily high-spatial resolution (~4-km, 1/24th degree) surface meteorological data covering the contiguous United States from 1979-yesterday. The dataset is available through OpenET. The methodology behind gridMET is described in Abatzoglou (2013).

[5] Irrigation efficiencies were assigned based on FAO (1989) and Martin (2011). Vineyard, the dominant crop in the Basin was assigned an irrigation efficiency of 90%.

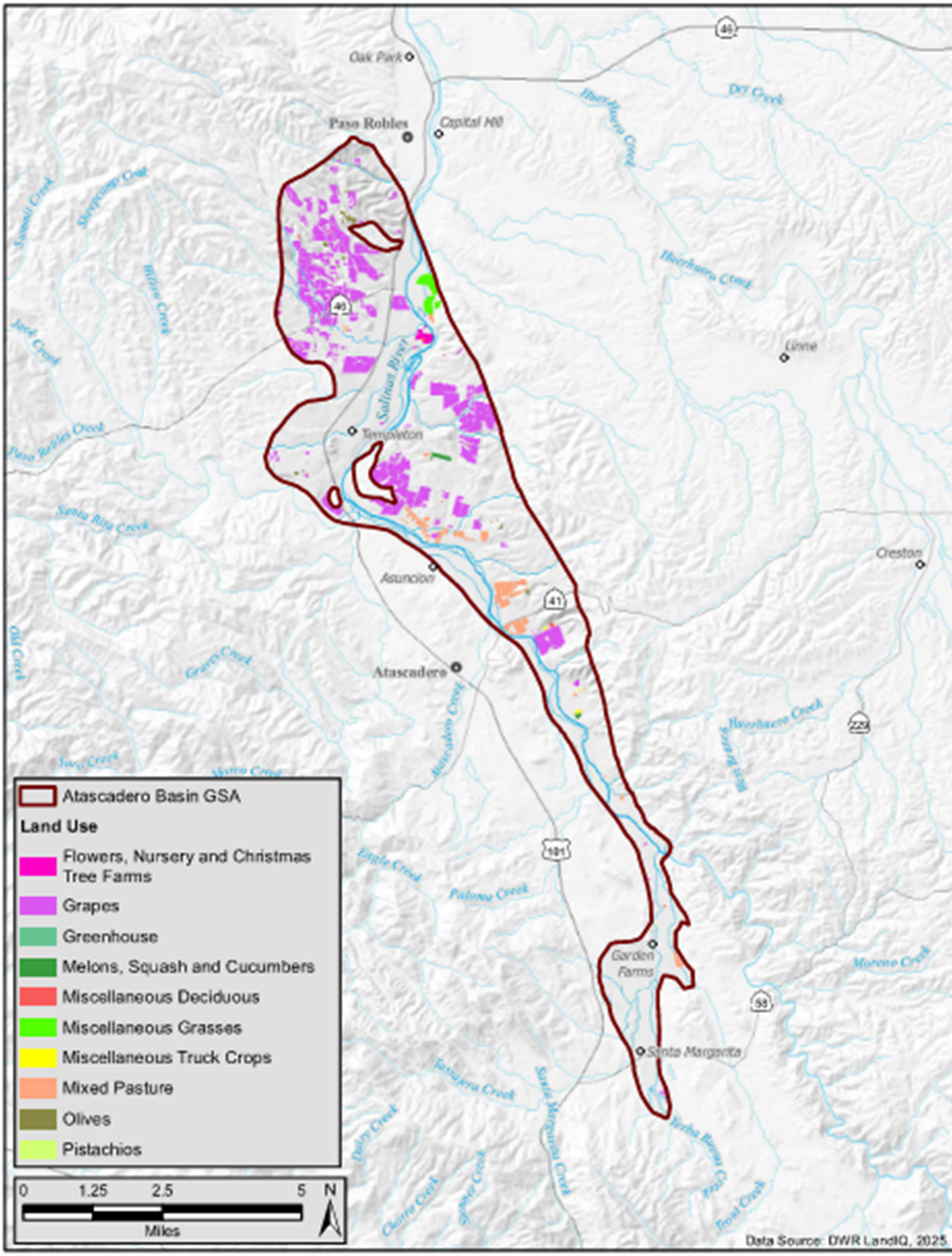

Figure 8: Existing Agricultural Land Use Designations

Table 2: Estimated Agricultural Irrigation Groundwater Extractions

Water Year	Agricultural Demand (AF)
2017	4,900
2018	4,300
2019	5,000
2020	4,700
2021	4,500
2022	4,500
2023	3,100
2024	**3,600**

Note: AF = acre-feet

4.3 Rural Domestic and Small Public Water System Extraction

Rural domestic and small PWS groundwater extractions in the Subbasin were estimated using the methods described here.

4.3.1 Rural Domestic Demand

As documented in the Paso Robles Groundwater Basin Model Update (GSSI 2014), the rural domestic water demand was originally estimated as the product of County estimates of rural domestic units (DUs) and a water demand factor of 1.7 acre-feet per year (AFY) per DU, which included small PWS water demand (Fugro and Cleath 2002). This factor was subsequently modified to 1.0 AFY/DU in the San Luis Obispo County Master Water Report, not including small PWS demand (Carollo 2012). Based on further investigation completed for the 2014 groundwater model update, the rural domestic water use factor was refined to 0.75 AFY/DU (GSSI 2014). To simulate rural water demand over time in the groundwater model, an annual growth rate of 2.25 percent for the rural population was assumed, based on recommendation from the San Luis Obispo County Planning Department (GSSI 2014). The groundwater model update completed for the GSP (GEI/GSI 2022) used a linear regression projection based on the 2014 model update to estimate rural domestic demand through WY 2016. The projected future water budget presented in the GSP (M&A 2020) assumes a 1 percent annual growth rate in rural domestic water demand from WY 2016 going forward. Therefore, the rural domestic demand volumes presented in this annual report are based on the same assumption. The groundwater extractions for rural domestic demands are summarized in **Table 3**. The accuracy level rating of these estimated volumes is low-medium.

Table 3: Estimated Rural Domestic Groundwater Extractions

Water Year	Rural Domestic (Acre Feet)
2017	493
2018	498
2019	503
2020	508
2021	514
2022	519
2023	524
2024	529
2025	534

4.3.2 Small Public Water System Extractions

The category of small PWSs includes a wide variety of establishments and facilities including small mutual water companies, golf courses, wineries, rural schools, and rural businesses. Various studies over the years used a mix of pumping data and estimates for type-specific water demand rates to estimate small PWS groundwater demand (Fugro, 2002; Todd Engineers, 2009). The 2012 San Luis Obispo County Master Water Report used the County of San Luis Obispo geographic information services mapping to define the distribution and number of commercial systems at the time and applied a single annual factor of 1.5 AFY per system (Carollo, 2012).

For the 2014 model update, actual pumping data were used as available to provide a monthly record over the study period (GSSI, 2014). Groundwater demand for golf courses was estimated using reference ET data measured in Paso Robles, the crop coefficient for turf grass, monthly rainfall data, and golf course acreage (GSSI, 2014). Water use for wineries was estimated by identifying each winery and its permitted capacity and applying a water use rate of 5 gallons of water per gallon of wine produced. Minor landscaping, wine tasting/restaurant functions, and return flows were also accounted for (GSSI, 2014). Water use for several small commercial/institutional water systems was estimated using water duty factors specific to the water system type (i.e., camp, school, restaurant, and other uses) (GSSI, 2014).

The groundwater model update completed for the GSP (GEI, 2022) used a linear regression projection for the 2014 model update to estimate small PWS demand through WY 2016. The projected future water budget presented in the GSP (GEI, 2022) assumes a 1 percent annual growth rate in small PWS water demand from WY 2016 going forward. Therefore, the small PWS demand volumes presented in this annual report are based on the same assumption. The groundwater extractions for small PWS demands are summarized in Table 4. The accuracy level rating of these estimated volumes is low-medium.

Table 4: Estimated Small Public Water System Groundwater Extractions

Water Year	Small PWS (AF)
2017	587
2018	592
2019	598
2020	604
2021	610
2022	616
2023	623
2024	630
2025	**636**

Note: AF = acre-feet

Used M&I future modeled values for 2020 and 2021 and then a 1% decrease each year for 2019, 2018, and 2017

Note: for WY24 report noticed that previously the formulas had been linked to the wrong (Dom) column in the M&A WB spreadsheet. Now fixed.

4.4 Total Groundwater Extraction Summary

Total groundwater extractions in the Basin for water year 2025 is 16,100 AF. **Table 5** summarizes the total water use by sector and indicates the method of measurement and associated level of accuracy. Approximate points of extraction were spatially distributed and colored according to a grid system to represent the relative pumping across the basin in terms of AFY (*see* **Figure 9**).

Table 5: Total Groundwater Extractions

Water Year	Groundwater Extractions by Water Use Sector			Total (AF)
	Municipal (AF)	PWS and Rural Domestic (AF)	Agriculture (AF)	
2017	8,760	1,080	4,900	14,700
2018	10,227	1,091	4,300	15,600
2019	9,442	1,102	5,000	15,500
2020	10,611	1,113	4,700	16,400
2021	10,860	1,123	4,500	16,500
2022	10,242	1,135	4,500	15,900
2023	9,739	1,146	3,100	14,000
2024	9,691	1,159	3,600	14,500
2025	**9,657**	**1,170**	**5,300**	**16,100**
Method of Measure	Metered	2016 Groundwater Model	OpenET	
Level of Accuracy	high	low-medium	medium	

Notes:

AF = acre-feet

PWS = public water systems

Groundwater Extraction Total has been rounded

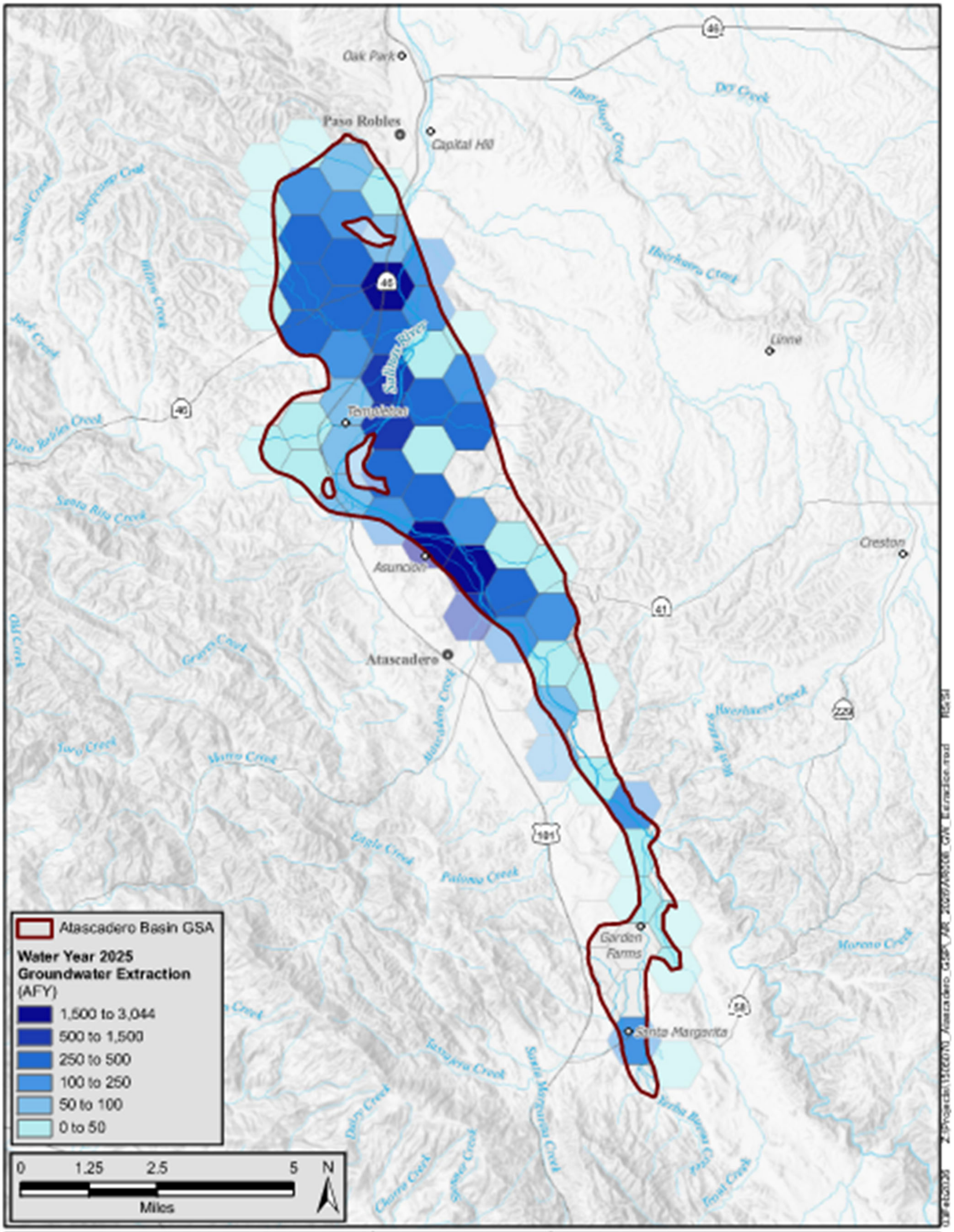

Figure 9: General Locations and Volumes of Groundwater Extraction

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